SLEEPING SICKNESS

WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN UGANDA,

AND THE REMEDIAL MEASURES INSTITUTED,

being

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of the University of Edinburgh,

by

R. A. L. VAN SOMEREN,

M.B., Ch.B., D.P.H., Colonial Medical Service.

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S L E E P I N G S I C K N E S S,

WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN UGANDA,

AND THE REMEDIAL MEASURES INSTITUTED.

DEFINITION.

A haemo-parasitic disease with secondary changes in the lymphatic and central nervous systems, terminating in coma and death and due to the presence in the blood, gland juice and cerebrospinal fluid of the Trypanosoma Gambiense.

GEOGRAPHICAL DISTRIBUTION.

Senegambia, Congo, Uganda, British and German East Africa, British Central Africa, possibly also Northern Rhodesia, and certain of the Portuguese possessions in West Africa.

ETIOLOGY.

This disease, known for several years in the Congo as Sleeping Sickness, or Negro lethargy, was attributed to various causes, by some to a miasm arising from the infected locality, by others to contagion from eating from a common bowl, etc.

Natives of Uganda also firmly believe that it is conveyed by sexual coitus from an infected to a sound person, and this view has also been put forward as a contributory cause by Professor Robert Koch and receives colour from analogy to the "mal du dourine" of horses. This, however, is, I feel sure, an error, as on carefully investigating this point in my recent researches in Uganda, I failed entirely to find a single case in support, which could stand close examination. Invariably other possibilities of infection were admitted. As regards Prof. Koch's statements, did they not come from so eminent an authority one would brush them aside, but the possible fallacies were so many that the statement cannot be seriously taken. To indicate only two, Koch had to rely on native interpreters and entirely on native statements as to their movements. Anyone with the least experience of trying to get information through interpreters will be aware of the difficulties attending, especially when dealing with sexual matters, and native statements at best are notoriously unreliable, as a native almost invariably attempts to give a pleasing answer, and one which he thinks is expected.

Secondly, Prof. Koch states that the Baziba women he saw said they had never left their country

to accompany their husbands. While this may be true of those particular ones, which I doubt, I know as a fact that numbers of Baziba women were with their men folk who were rubber cutters in the Sesse group of islands, where, as I shall show later, the possibilities and probabilities of infection were enormous, owing to the peculiar distribution of the carrier, Glossina Palpalis. A subsidiary consideration is the fact that sexual impotence in both sexes is a very early symptom, as will be dealt with later.

In 1901 Forde and Dutton, of the Liverpool School of Tropical Medicine, came across a captain of a vessel trading on the Gambia river who suffered from an intermittent fever which resisted quinine treatment, and discovered in his blood a trypanosome which was styled Trypanosoma Gambiense. However, no connection between this discovery and sleeping sickness was thought of till the researches of the Royal Society's Commission in Uganda in 1903 demonstrated that this trypanosome was identical with those found by Castellani of this Commission, in the cerebro-spinal fluid of an advanced case of sleeping sickness. Subsequently Dr C. J. Baker of the Uganda Medical Service found this trypanosome in the blood of a native with this disease. Subsequent experiments

settled beyond dispute that this parasite was Dutton's Trypanosoma Gambiense, and that the condition described under Sleeping Sickness was merely the terminal stage of what had been previously described by Dutton as Human Trypanosomiasis.

This last discovery entirely abolished the view first stated by the Portuguese Commission and further elaborated by Castellani that the disease was due to a diplococcus.

HISTORY OF THE UGANDA EPIDEMIC.

In Uganda, as far as one can ascertain, the disease was unknown before 1900, when Dr A. Cook of the Church Missionary Society's hospital near Kampala, reported the occurrence of a new disease. At first unrecognised, it was soon identified as Sleeping Sickness, and at first confined to a few persons, the disease soon manifested itself with appalling rapidity.

Originally confined to the shores and islands of Victoria Nyanza, it steadily spread. In 1903 cases were reported from the Lake Albert district some 175 miles north of the Victoria Nyanza, then from the Nile and Mount Elgon districts till the present time when, as a glance at the map will show,

there does not exist in this Protectorate a single fly area (of Glossina Palpalis Rob. Deso.) which has not been infected.

Route of Introduction.

The method and route of introduction into Uganda is a matter of conjecture, but I think there is little doubt but that the surmise that the disease was introduced from the Congo, where it has existed for many years, is correct, and for the following reasons:

1. The fact that the Lake Albert epidemic occurred some years after the Victoria Nyanza one, though intercommunication was free and frequent, precludes I think, a Northern introduction from the Belgian Nile (Lado enclave) territory.

2. Its absence till last year (vide Prof. Koch's reports) from German East Africa, excludes a southern source.

3. The Eastern half of Victoria Nyanza was infected subsequently to the Western.

The remaining route therefore is from the West via the Congo.

Now we know that one of the greatest trade routes across Africa to and from the East coast to the Congo, especially since the completion of the Uganda Railway in 1900, lies through Uganda, through

A market Landing place. A reason for the rapid spread of Sleeping Sickness.

A much frequented Landing place. Victoria Nyanza

the Toro District and across the Belgian frontier, and numbers of Baganda were engaged in porterage daily.

Hence it is easily conceivable that a certain number were infected in the Congo, and returning home, set the torch, which was already to hand, blazing, with the most disastrous results, for, since between 1900-1908, more than 200,000 persons have succumbed to the disease.

The Uganda natives, not without excuse, considering their limited powers of logical deduction, attribute the disease to the white man, and in a way they are correct, for it is we who have opened up the trade routes to such an extent.

Histories of past and present epidemics prove beyond a doubt that the disease has invariably spread along the trade routes, and that its progress has been slow from post to post, but that once established at any given spot, its spread locally depended on the frequency of the flies' opportunity for biting the sick and the sound. In other words, given an infection of the glossinae at a populous market or much frequented landing place, the spread of the disease will be rapid. This explains the rapidity with which the disease spread in Uganda along the palpalis infected lake shore, as the soil

here being rich, the land was thickly populated and numerous markets established at frequent intervals along the shore for the purpose of trading with the numerous islands of the Victoria Nyanza; in fact here, par excellence, the disease had all the necessary conditions for an extensive and virulent epidemic most admirably present. The trade with the islands per canoes was considerable; the islanders were potters and not being able to grow sufficient food on the islands to supply their needs, owing to a poor soil, were forced to come to the mainland to barter pots, and, in times of great famine, even children, for food. Infected by the fly at these market landing places, they took the disease to their islands, which were and still are perfect haunts of G. palpalis: on some indeed, as will be mentioned further, the whole island is infected with palpalis, the distribution of the fly being somewhat anomalous. I have ascertained by personal investigations in the Buvuma group of islands and found that on some islands over 85% of the population were infected and doubtless the remainder had the disease in an early and less easily demonstrable form. Where in the former times (1900 and ante) the chiefs could count on 30,000 fighting men, at the time of my visit (1908) scarcely 1000 could be mustered. In contrast

to the Baganda the Buvuma islanders were practically free from venereal disease, and being prolific and polygamous had numbers of children, of whom, on one island, I found 90% infected from one year old upwards. They were also a very wealthy race, owning large herds of cattle and goats, as many islands are admirably suited to pasturage and are devoid of the numerous disease carrying ticks which have wrought such havoc amongst the Uganda herds. Holding aloof from the Baganda save on market days, and having little or no traffic with Europeans, these people differed considerably from the Baganda in language, customs and religion. Most of the children and women also are expert paddlers and fishers, hence the death rate amongst Buvuma women and children has been as heavy as amongst men, a contrast again to the Baganda whose women's occupation rarely took them into the palpalis areas, hence one often came across villages composed entirely of women, every man and boy over say 10-12 years having died of the disease. In some islands one found one or two inhabitants only remaining, and as it is a native custom when death approaches for him to kill off and eat all his live stock as soon as possible, the wealth of the islands diminished enormously. The different customs alluded to above had a practical bearing when measures

to eradicate the disease were put in force in Uganda, as I shall mention later in its proper place.

So alarming were the ravages of the disease that in 1903 a Commission under the auspices of the Royal Society and Colonial Office, was sent out to Uganda with Col. Sir D. Bruce, C.B., in charge. The work of this Commission was continued by various members till it was brought to a tragic ending in 1906 owing to one of the members (the late Lieut. Tulloch, R.A. M.C.) contracting the disease in March of that year and dying three months later.

Amongst the facts determined by the Commission, three were of outstanding importance:

1. That the disease was a trypanosomiasis due to Trypanosoma Gambiense and that "sleeping sickness" so called was merely a terminal phase of the disease.

2. That the disease was conveyed by the bite of a tsetse fly, identified as Glossina palpalis (Rob. Deso.)

3. That glandular enlargement occurred, conspicuously in the cervical region, and that trypanosomes could be easily demonstrated at almost any stage of the disease by puncturing a gland with a hypodermic needle and examining a drop of the juice so withdrawn, under a one sixth inch objective.

This last discovery at once put us in possession of a simple and rapid method of diagnosing the disease with certainty quite early in its course, in

fact, often months before the patient himself will be aware of his disease.

Here I may state that in my experience of over 2000 cases, gland puncture has given a positive result in nearly 99% of puncturable glands, which is higher than that given by Martin, Leboeuf and Roubond in their report which came to 88.25%, but they examined only 400 cases with a positive result in 353 instances. It is true that a gland which fails to yield a positive result to-day may do so to-morrow, a fact often overlooked. Further, though other causes contribute to cervical gland enlargement in the negro, yet the characteristic feel of a gland enlarged through trypanosomiasis is quite distinctive to one skilled and practised in palpating glands. Personally I can distinguish a sleeping sickness gland with great certainty, and a microscopic examination usually confirms the diagnosis.

A very few cases, however, do not show gland enlargement, and a patient blood or cerebrospinal fluid examination is necessary.

The trypanosome found, Col. Sir D. Bruce, C.B., A.M.S., from his previous researches into Nagana, the tsetse fly disease of animals, was led to suspect the tsetse fly, so common along the lake shores

of Victoria Nyanza, as the causal agent in the spread of this disease.

This fly was identified by Austen of the British Museum as Glossina palpalis, and experiments on animals speedily showed that the surmise was correct, rats, guinea-pigs, and especially monkeys, all developing trypanosomiasis after being bitten by infected flies caught at the lake shore.

Glossina palpalis being now definitely known as the carrier of the infection, it became necessary to ascertain as soon as possible the exact distribution of this fly, and also the extent of the sleeping sickness epidemic, and how far the distribution of one coincided with the extent of the other, so that any suggested measures might be intelligibly carried out.

Unfortunately, no concerted action was then possible by all the governments concerned, so researches were confined to Uganda, British East Africa, and Southern Soudan.

Preliminary observations were made in 1904, but in 1905 the Colonial Office appointed five medical officers under the able direction of Dr Hodges, now Principal Medical Officer of Uganda, to make detailed observations over the whole of the Uganda Protectorate.

To these investigations, which were continued during the whole of 1906, I had the honour of being appointed, and the distribution of the fly was definitely delimited, also the fact was clearly demonstrated that the epidemic area coincided with the fly area and confirmed the belief that Glossina palpalis was the main, if not the only, carrier of the infection. The fly areas are clearly indicated in the map attached as a frontispiece.

Various observations of importance regarding the habits and habitat of the fly were also made which materially aided the construction of a plan of campaign against the fly and the disease.

THE FLY.

The active agent in the dissemination of the disease is found in Glossina palpalis (Rob. Deso.). As its name indicates, it belongs to the genus Glossina, which, in its various species, is widely distributed over the whole of Africa.

In point of size it is the smallest of its genus, measuring, exclusive of the proboscis and palpi, 8 - 9.5 mm.

It is of a dark dusky brown colour, the thorax somewhat paler and the abdomen generally with at

least an indication of a pale longitudinal median stripe with pale lateral triangular markings, and usually the hind margins of the segments narrowly pale: legs, except the hind tarsi and last two joints of the front and middle pairs, sometimes entirely buff coloured, usually the femora, for the most part or entirely, dark brown and clothed with greyish dust, and the tibiae yellowish (Austen monograph of the tsetse flies).

At rest the fly stands alert and with its proboscis and palpi projecting straight forward and its wings folded scissors like across its back.

Male flies are easily distinguished from the females by the possession of a chitinous protuberance on the hinder part of the abdomen ventrally, furnished with two hooks. The appendage is hinged to the end of the abdomen and serves as a clasper when fertilising the female.

Characteristics and Habitat.

Its flight is rapid and characterised by a curious hum, which once heard is easily recognised. It alights suddenly and silently on the part of the victim selected (usually a shaded part, such as under the thighs when sitting, or on the neck under

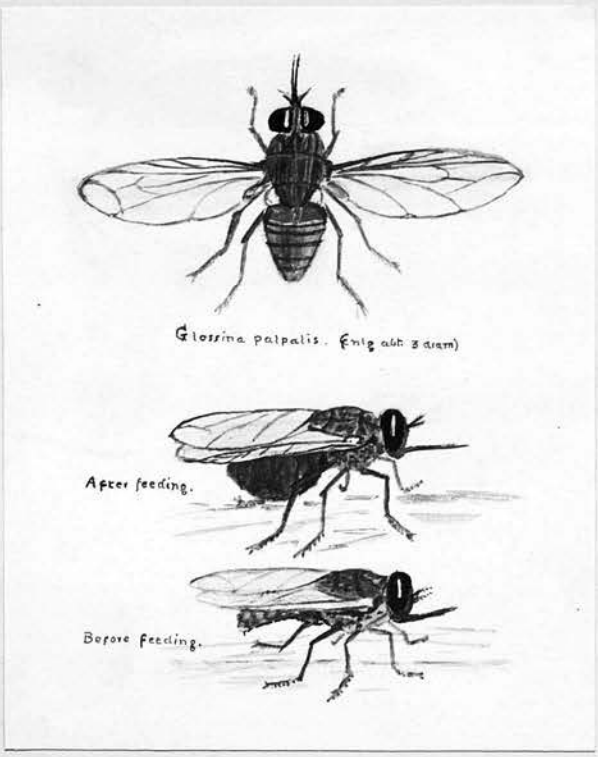

Glossina palpalis. Enlg abt 3 diam)
After feeding.
Before feeding.

Fig. I

the shade of a hat, under the chin and so forth. When once alighted it does not, like its congener Glossina Morsitans, wander around before selecting a spot to bite, but after an interval of alert watching as if to reassure itself, it rapidly buries its long keen proboscis into its victim and quickly swells itself with blood.

Its bite is often unnoticed and only very slightly painful, though subsequently, some redness, itchiness and swelling may be noticed.

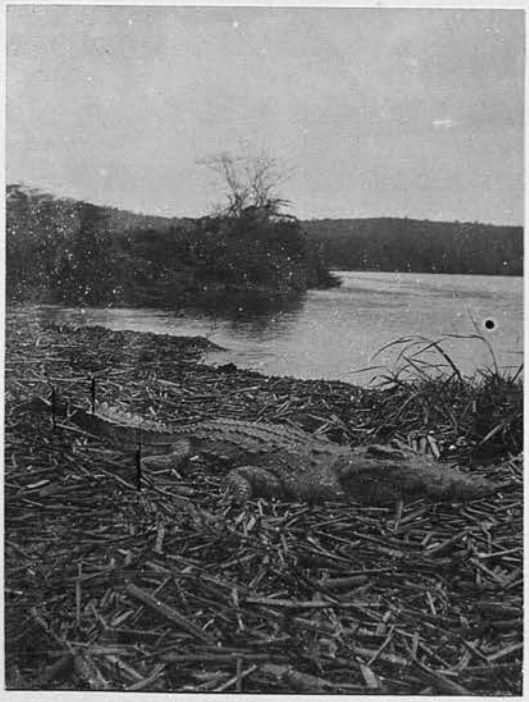
It is rapid and cautious in its flight, easily alarmed, and unlike the common house-fly or Glossina Morsitans, it does not annoy one by persistently returning when driven away.

Before feeding, the fly is extremely alert and difficult of capture. Its abdomen is thin and concave (see fig. I), but while feeding the abdomen rapidly swells into a crimson globule which is of great size relatively. The process of filling takes scarcely a minute, and the fly then flies heavily away to some shady spot to digest its meal. During its feed, and especially after, it keeps on extruding drops of clear fluid from its anus. In this gorged stage it is comparatively easily secured.

The meal is entirely digested within 24-48 hours

Typical lake Shore scenery. Shore infested with G. Palpalis.

A typical haunt of G. Palpalis. Victoria Nyanza.



A Crocodile "Lie" where G. Palpalis abounds.

and the fly is ready for another. This feeding is necessary, especially for the females, for the purposes of reproduction.

In habits, the fly is found almost invariably near water, if such water (lake or stream) has sufficient shade and also suitable breeding grounds consisting of dry places either of sand or earth, close to the water.

Sufficient shade is afforded by small shrubs and bushes growing on the shore.

Broad belts of papyrus, such as are found round parts of the Victoria Nyanza and in the sluggishly flowing parts of the Nile, apparently do not shelter the fly, especially if such belts be over 50-80 yards wide, though behind such belts suitable shade exists in the forest. This is doubtless due to papyrus swamps being moist and so unsuitable for a breeding ground. If the belt of papyrus is narrow and so the dry ground in the forest behind close to water, and along the lake shore free of papyrus, the flies are found in incredible numbers.

Places where hippopotami and crocodiles frequent to bask in the sunshine also hold many flies doubtless, since these animals serve as a food supply.

Range.

By this is inferred the extent inland or out on to the water which the fly normally traverses, and numerous observations made by myself and others seem to show that it is fortunately very limited. Unless the fly has followed anyone, none are found till one actually comes to the waterside. Also if a canoe keeps not less than 20-30 yards out from the shore, the fly does not cross out over the water to it. At less distances they come out freely and remain persistently on board for long distances, even up to a mile or more, when coasting. Thus flies are carried in canoes for long distances, though by going out shore for 200-300 yards, it is possible to rid the vessel of them, as they do not appear to care to go so far off shore.

Inland the fly may attach itself to a person and be carried for very long distances also, but for practical purposes, when considering measures against the fly, these may be neglected as they are easily dealt with as will be seen. If clear open spaces occur in the vegetation along the shore over 20-30 yards wide from water to forest edge, and from 80-100 yards long, no fly will be met with here, though on either edge of the clearing they may be numerous.

This again has a practical bearing when considering measures for extermination of the fly.

Exceptions, however, seem to exist in certain parts, as I found on the Sesse and Buvuma islands, also in Northern Unyoro. In Northern Unyoro the presence of open rivers, as distinct from the papyrus filled ones of Uganda, explains the presence of the fly far inland, but in Sesse the conditions are less explicable, as no water was found near their haunts.

The northern half of the largest island of the group (see map) which was carefully examined by me showed that in parts Palpalis existed quite one to three miles inland from the lake, and apparently far removed from water of any description. This part of Sesse is peculiar in consisting of a dense network of forest with clear, almost sandy, areas in between (see diagram 1) covered with short grass. All round the edges of these areas, in the forest fringe, in the forest itself, and even in some villages situated near by, I found Glossina palpalis in large numbers. I found them on children sitting by the huts in the village, and also demonstrated the fact that many of the village dogs carried trypanosomes.

The fact that these forests were held as rubber concessions by companies who imported labourers from the German province of Kiziba, a province so far free of the disease, though containing palpalis areas, rendered the problem of clearing more difficult, as compensation was not entertained, and it was obviously to the German government's advantage to hinder their men going thence. The Baganda refused to work on the islands, partly from a dislike to the lake, and partly because they recognised that for some reason or other unknown to them sickness and death followed in those who worked there. However, no steps were taken by the Germans, and the rubber collectors becoming bitten and infected in these forests took back the disease to their country, and this doubtless explains the recently reported epidemic there. Some of these porters also had women with them, as I saw for myself, hence I cannot accept Prof. Koch's statement unreservedly when he brings forward as proof of infection by sexual coitus the fact of Baziba women contracting the disease, without having left their homes in fly free areas. If anything, his evidence in my opinion, could be as reasonably adduced as proof that some other biting insects also convey the disease, as stated by the French Commission. At any rate, the presence of

these men emphasises the necessity for concerted international action in limiting the movements of natives in infected localities. (At the present time, 1909, by the action of the Uganda Government in depopulating all the islands, this danger has been minimised, though of course the previous infects remain to be dealt with by the German authorities.)

Again, in Unyoro, the distribution of the fly was unusual owing, as stated before, to the presence of clear flowing rivers. The caravan routes for some distance along each side of the points where they cross the river are infected with fly. I was through these districts in 1907, and again, on my return from leave, in 1908 and 1909, being sent up to arrange for the depopulation of the area between the Nile and Lake Albert. The contrast was painful, whereas in 1907 I had passed through populous villages, now the whole countryside was deserted. In one village I found some twenty women only left; in another five persons only; in fact, the whole of that district had been decimated. I was forced to recommend the closing of the trade routes and the removal of all the remaining persons, and the abandonment of the country to its usual inhabitants, the

vast herds of elephants which roam about there. This was immediately carried out by the Government and as a result a beautiful tract of country holding the wondrous Murchison Falls of the Nile is now a closed book to travellers, and, I expect, for all time, till at least we know how to exterminate the fly. Burning the country is useless, for this was done yearly by the natives, to secure grazing ground for their herds, but with the rains, the fly reappeared.

Time of Feeding.

Glossina palpalis rarely troubles one on a dull day, seeming to prefer bright sunshine, thus one seldom captures them much before 7.30 or 8 a.m. and never after 5 p.m., while Glossina morsitans, on the other hand, will attack one freely till sunset. I made several continuous counts during the day and noticed a distinct falling off in the activity of the fly between 12 and 2 p.m., the hottest part of our day, also, directly the sky clouded over or a strong wind sprang up. The following is a typical result on two days in a part where fly were numerous. I selected a shady spot by the lake and placing one or two semi-clothed natives before me caught

the flies which came to bite the natives.

6 - 7 a.m.	none		
7 - 8 a.m.	2 Flies		
8 - 9 a.m.	10 "		
9 - 10 a.m.	30 "		
10 - 11 a.m.	52 "		
11 - 12 noon	50 "		
12 - 1 p.m.	40 "	Bright sunshine all the time.	
1 - 2 p.m.	35 "		
2 - 3 p.m.	20 "		
3 - 4 p.m.	8 "		
4 - 5 p.m.	3 "		
5 - 5.30	nil		

6 - 8 a.m.	nil	Day very dull
8 - 10 a.m.	6 Flies	Fitful gleams of sunshine.
10 - 11 a.m.	10 "	
11 - 12 noon	1 "	Cloudy and gusty.
12 - 2 p.m.	none	Slight drizzle.
2 - 4 p.m.	1 Fly	Clearing.
4 - 5 p.m.	4 Flies	Bright.
5 - 6 p.m.	nil.	

The above, taken from my records, are very typical for the fly, and similar records were published in our 1st Annual Report. When captured, Glossina palpalis is very intolerant of sunlight and heat. Exposed to the strong sun they die quickly in two or three minutes. In a laboratory, cages of flies must be kept over bowls of water to preserve them for any time alive.

A feature which strikes anyone at once when dealing with Glossina palpalis is the extraordinary way in which males predominate in any batch of

Pupa. (x ten times)

captures, often forming 85% of the total. However, as would be expected, in parts where blood is easily obtainable for food, such as haunts of fishermen, and "lies" of hippopotami and crocodiles, females often predominate in one's captures, doubtless because they congregate where food is most easily found, so as to enable them to reproduce.

Reproduction.

Glossina palpalis produces at one time a single larva which is white when extruded, but rapidly darkens and assumes the characteristic pupa form (Diag H) which in from 10-14 days hatches out into the perfect imago. In captivity a fly appears to lay 10 larvae in all, one every two weeks or so, depending on the amount of blood it gets. Parthenogenesis has not been observed.

Breeding Grounds.

These were first discovered and described by Dr A. G. Bagshawe of our service (now director of the Sleeping Sickness Bureau in London). He found the pupae in great quantities on the sloping shore of Lake Albert amongst the roots of the banana trees, and subsequently they were found in various sandy

parts of the lake shore, either just on the surface of the sand or an inch or two below. Once the characteristics necessary for a breeding ground have been found, it is easy to find the pupae in thousands in the favoured locality. A Portuguese observer has recently reported finding them in the crevices of the bark of trees by the lake, but this is probably an exceptional locality, possibly owing to floods.

Vast numbers of pupae are now reared by us for the purposes of getting "clean" flies to study the effect of treatment on natives.

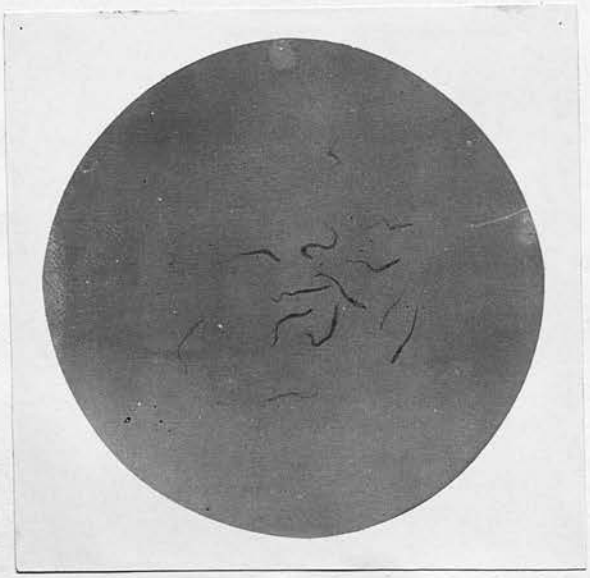
Infection of the Fly.

It seems certain from the work of Kleine in German East Africa, and Bruce, Hammerton and Bateman in Uganda, that the infection of the fly is not hereditary. Till lately it seemed certain that the trypanosome did not undergo a cycle in the fly, but Kleine's recent work, confirmed by Bruce for Trypanosoma Gambiense, shows that a period of about 18 days from the last feed of infected blood must elapse before the fly is capable of transmitting the disease; after that, the fly are infective at least up to two months. Bruce, however, still thinks

that the mere mechanical transference of the disease from the sick to the healthy is the more frequent method naturally. This favours, of course, the hypothesis that other biting insects can also convey the infection. Gray and Tulloch, of the Royal Society's Commission in 1904, showed that if Glossina palpalis were partially fed on an infected monkey and then immediately allowed to finish their meal on a second and third "clean" monkey, invariably only the first "clean" monkey was infected; the second never took the infection.

This point needs further elucidation. It is true of course that if Glossina Palpalis acted merely in a mechanical way it would help to explain to some extent why every person living in the infected areas was not infected.

Bruce, Hammerton and Bateman have also shown that in a batch of 100 flies often only one appears to have been infective, an extraordinary circumstance, for which, however, those of us who have been bitten time and again unavoidably in the course of our work are devoutly thankful, else the deaths amongst sleeping sickness medical officers would have been considerable. As it is, two medical men only have so far succumbed, one, Capt. Hardy, R.A.M.C. in Nyasaland, and Lieut. Tulloch, R.A.M.C. in Uganda.



All experiments so far have failed to show any of the wild or domestic animals to be natural reservoirs of Trypanosoma Gambiense, though, as I have shown under abnormal fly conditions, some native dogs carry the trypanosome.

Though Gray and Tulloch found that in a single instance they were able to infect monkeys with a stomoxys fed on an infected monkey, nc definite proof incriminating other biting insects, or even other species of glossinae, has been found. This is an important subject for investigation owing to the wide distribution of the genus Glossina; so far all experiments with them as carriers have proved negative.

Trypanosomes in the Fly.

If the gut of a Glossina palpalis caught at the lake shore is teased out in normal saline or preparations from these parts are suitably stained, it will be found that the gut contains two if not three distinct types of trypanosomes. These were first noticed by Gray and Tulloch and named by Professor Novy, Trypanosoma Grayii and Tullochi.

In Fig. (T. Grayii) the centrosome is seen posterior to the nucleus, and in Fig. (T. Tullochi) it is anterior.

As a rule any one fly has only the one type in its gut, and this in literal thousands often. Male and female forms are found, though one often predominates to the exclusion of the other. Males so called are fine and slender, while females are short and stumpy (Fig.).

After feeding, the numbers of these increase enormously, but what their significance in the fly is, we have not ascertained. It is extremely doubtful, however, if they have any direct relation to Trypanosoma Gambiense, as they appear entirely non-infective when injected into a monkey. Most authorities appear to regard them as a parasite of the fly. However, one would need to examine flies caught in non sleeping sickness areas, an impossibility in Uganda, as every fly area has been already infected.

PREVENTATIVE MEASURES DISCUSSED.

The disease has, as we have seen, a wide distribution at present, especially in Uganda, and demands, especially till all other species of Glossina and other blood suckers have been proved inocuous, special energetic and concerted action by the powers

concerned if we hope to check its spread and abolish it in districts already infected.

Of means which naturally suggest themselves to one's mind, segregation is the first, and this was mooted in Uganda during 1904, unfortunately before any precise knowledge of the disease had been gained, hence it was a move in the dark, which, fortunately I think, did not come off. The Uganda Government decided to remove all the cases to an island in the lake and there segregate them , and a proclamation was accordingly made. Curiously, however, it was given out that all the sick had to be taken to the island Bufu, a misspelling of the name for Buvu. The natives promptly took fright, as Bufu means in their tongue (Luganda) the "land of the dead", and they decidedly refused to be moved to such a place. The strenuous objections on their part caused the project to be dropped, and nothing was done till the urgent need for accurate knowledge, if any steps were to be taken, was forced on Home Authorities, and, though somewhat late, special men were selected to map out the areas where the fly and the disease occurred. When this was done, it was seen at once that the disease was less extensive than was feared, also that it was almost entirely confined to the

Fishermen at their nets:.... here they become infected.

Uncleared native Landing place .... infested by C. palpalis.

A cleared, so safe Landing place.

islands and lake shores, the inland cases being merely persons infected while at the lake, and that vast areas in the interior were entirely palpalis free and so suitable for segregation places. Precise measures were now possible on common sense lines.

Firstly, as no fly occurred in cleared areas devoid of bush, clearing of the shore and thus destroying the haunts and breeding places of palpalis in suitable places was considered. This measure is unfortunately, however, of only limited application and justifiable only in certain areas where the demands of traffic or the importance of the place (such as Entebbe peninsula) necessitated it, and this was for two reasons:

1. Because of the enormous extent of the lake shore needing to be cleared, an almost impossible task when the conditions of tropical growth are considered, the expense also being prohibitive.

2. Because in clearing, certain of the workmen were bound to be infected and thus life sacrificed needlessly. It is true that bearing in mind that so far only the mechanical immediate transference of the germ had been shown to hold good, it was possible to minimise this risk by a careful examination of all workmen and rejection of all who in any way exhibit glandular swellings or other symptoms of the disease. This had to be done recently for the workers required to cut a road leading from the Capital, Kampala, to the lake port of Luzira.

However, the expense involved in clearing was enormous, and was limited to Entebbe, Jinja and Luzira ports where the exigencies of the lake steamer traffic demanded it, if communication with the interior was to be kept up. The result, as far as driving away the fly, has been entirely satisfactory, but the expense is continuous as the growth needs constant checking to keep it down. For practical purposes clearing need be limited only to the bushes and undergrowth, all clean stemed trees over twenty feet high being left if not too thickly together.

Secondly, establishment of medical posts at the frontiers on all the trade routes for the examination of all travellers and the exclusion of all found infected and their segregation in prearranged places.

Thirdly and most important of all, the removal of the entire population in the infected localities and the segregation of infects in suitable localities.

In Uganda, this was a simple matter, as the natives are very progressive and highly amenable to rule, having lived under the most perfect feudal system probably that the world has ever seen. An order promulgated by the government ordered a line

of demarcation to be drawn round the lake shore and at a distance of two miles from the water. All natives within this two mile limit were told to leave and settle anywhere else in the interior. Within a short time this entire area (as I can personally testify, having been sent to examine it after the removal) was depopulated and the people settled elsewhere inland. The islands, the Nile province and Usoga ports comprised in the Uganda Protectorate and inhabited by a less civilised race, less amenable to rule, were for the time being left alone, it not being considered feasible to carry out a removal. However, the Uganda province removal having been successfully accomplished, these other parts have been since tackled with comparatively good success. Some of the warlike Bavuma being lake men resisted the order strongly, and some even withdrew into the forest where they barricaded themselves and gave battle to men sent to turn them out. As I had considerable influence with these islanders, knowing their language and habits intimately, I was told off to get in touch with them. This I did, and after explaining carefully the intentions of the Government, practically all were persuaded to leave.

All the islands are now uninhabited, a melancholy fate, as they comprise some of the most

beautiful country I have seen, and though, for some reason, the soil is not very fertile, yet rubber is found in a wild state in vast quantities, hence a commercial asset to the country has been lost.

What adds to our difficulties is the fact that no native really believes that the tsetse fly has any connection with the disease. I have often, after patiently setting forth to them the proofs and facts, which they admit readily enough, even met with the reply, "Yes, but all the same the disease "started only some seven or eight years ago, while "we and our fathers have known the fly all our lives. "Why should they have got suddenly poisonous?" In much the same way, every peasant is firmly of the belief that the chigger (pulex penetrans) was introduced and scattered in handfuls over the country by the white man, here again due doubtless to the fact that by opening up the trade routes with West Africa where the flea abounds, we have helped to introduce it. The result of all this, of course, is to render the native less willing to help protect himself, especially as he always seems to think a white man must have some ulterior motive for his actions, as our kindness to them is beyond their comprehension. "Why do these people trouble about us so much?" is their query, a suspicious attitude reminiscent

doubtless of the hard times they experienced when the Arab slave trade flourished.

However, so anxious were the Government not to use 'force majeure', no compulsion of any sort was put on the sick and infected to come to a segregation camp for treatment and isolation, hence early cases, in which hopes of effecting a cure are greatest, have not been obtained in any considerable numbers. This is a matter for keen regret.

Another regrettable fact to my mind is that when the natives were first removed from the lake shore they were not first examined by a medical officer and all "infects" at once segregated and treated. It mattered little really whether they settled in the camp precincts, or on ground elsewhere, as it was all new work, but in the former case we should thus have secured many early cases. Urgent representations were made by the medical officers of the camps at the time, but without avail, the idea held by the Government being that as long as they were away from contact with the fly, it mattered little where they died, death being considered inevitable as no cure, or even partial cure, was known, I being one of the few, indeed, who placed any reliance on organic arsenic as a remedy. My optimism was due to the privilege I had had in 1906 of seeing the

effects of atoxyl injections in patients treated by Prof. Koch, when I was at Sesse Island. I had already seen these cases prior to treatment, and was amazed at the improvement, though final results scarcely bore out one's hopes. However, atoxyl introduced a new factor into the segregation scheme, for the people had something definite offered them, though no mention was made of "cure". It was therefore decided to start a segregation camp in each of the five provinces bordering the lake, but for financial reasons these were reduced to three, treatment, however, being carried on at Sesse after Prof. Koch left, till the islands were depopulated.

Accordingly in December 1906 instructions were issued for the first camp and a site was chosen some twenty miles inland, with the idea of keeping the sick far from the fly, a foolish move, as it soon proved itself to be, for the distance proved a drawback as the sick found it almost impossible to get there, and their friends had no intentions of carrying them in, for the Baganda shun a person with sleeping sickness as a rule, and in the early days, indeed, used to drive out the sick to die in the forests. This camp was started in mid December by Dr C. Wiggins, and early in January 1907 I joined him and on the arrival of a supply of atoxyl on the

General view of Buanoka Camp.... "The hill of Thunder"

Medical Superintendents Quarters Buanoka.

Hospital Wards and Village Buanoka.

23rd January, we commenced treatment. The camp was also somewhat badly placed for food supplies, but fortunately we have always had the loyal assistance of the native chiefs, a matter for congratulation, else the camps would have failed. This will be seen at once when I say that at one time in my present camp I required 800-900 bunches of green bananas to feed the people, this being the staple native food. This meant at least 700 natives occupied in bringing food alone to the sick they detested, and but for the influence of the feudal chiefs, the work would have been a failure. Buildings for hospital wards, huts for natives were all erected by labour supplied free of cost by the chiefs. Unfortunately, Buanuka, the camp then started, had been selected by authorities on a high hill exposed to terrible lightning storms; in fact one night a ward was struck and burnt to the ground in a few minutes, luckily with the loss of only one life. The name Buanuka means the "hill of thunder", but this was not found out till too late.

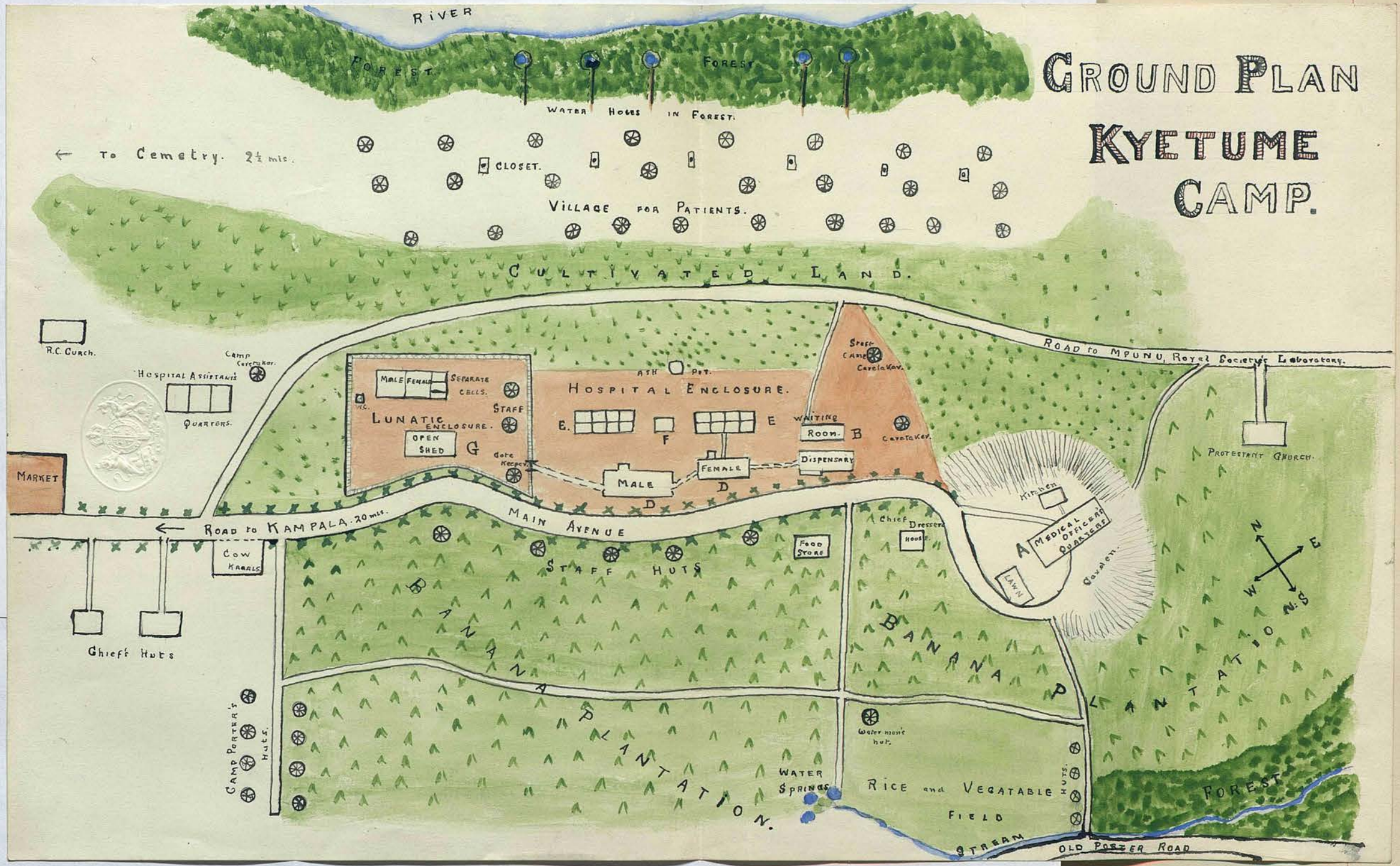
Financial considerations prevented the starting of other camps at that time, and in April 1907 I was deputed to carry on some extensive experiments with Glossina Palpalis on the Nile, some 200 miles to the north. These experiments had been started by Dr

Kyetume Camp.

Lunatic enclosure Hospital Wards M.O's house.

Bagshawe (now Director of the S. S. Bureau, London). But unfortunately, before much was done, the accidental death from a wild buffalo, of the medical officer in charge of Buanuka, caused my recall to take charge of that camp, which I did till August 1907, when, the entire scheme for segregation camps having received the assent of the Treasury in England, I was relieved and sent to start a second camp in the lake province of Chagwe, where sleeping sickness was rife. Profiting by past experience, a splendid site from every point of view was chosen at a spot called Kyetume, and in three months I had cleared the jungle and built a camp according to the attached sketch plan and photo. It was my endeavour to relieve the surrounding districts of the burden of our food supply, so some 200 acres were put under cultivation so that the camp could be in time entirely self supporting. A third camp was also started in Usoga at that time. I have therefore had considerable experience in the treatment of Sleeping Sickness, having had a greater number of patients under treatment than any other person, and shall now endeavour to detail the treatment used, especially the special method of giving simultaneous injections of organic arsenic and mercury, which I was the first to introduce.

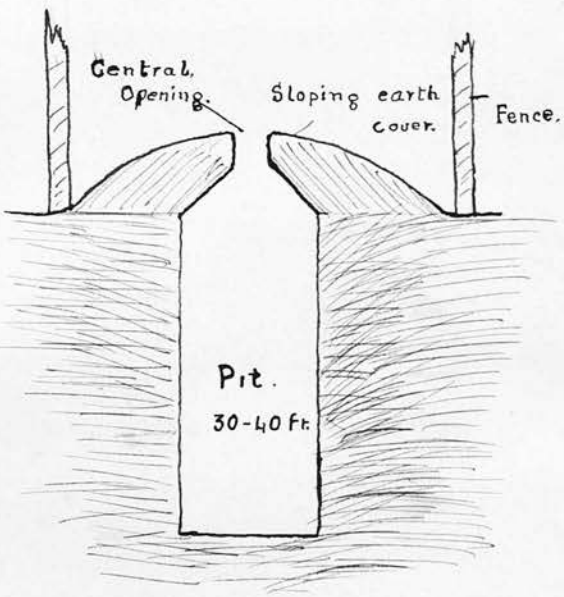
Before dealing with this subject, however, it will be convenient here to give a short description of Kyetume camp which was built according to a plan which past experience led me to consider the best. It must be kept in mind that these camps are primarily segregation centres, treatment according to the latest dictates of science being a secondary consideration; also that, unlike ordinary hospitals, with the exception possibly of lunatic asylums, patients in these camps are practically permanently settled here, as they have, for the most part, no homes elsewhere. All treatment is necessarily experimental and time alone can point out new methods and reveal errors. One has to attempt therefore to make the camp conform as far as possible to the usual surroundings of the native in his village, so as to render the camp homelike and attractive, while at the same time planning it so as to facilitate the proper administration and sanitation of the camp. Therefore as few rules and restrictions as are consistent with good administration are laid down, and in this, perhaps fortunately, we are aided by the fact that, with the exception of the islanders amongst whom familiarity and common misery has bred contempt or callousness to the disease, all natives suffering from sleeping sickness are shunned by all their


GROUND PLAN
KYETUME
CAMP.
RIVER
FOREST
FOREST
WATER HOLES IN FOREST.
← To Cemetry. 2½ mls.
CLOSET.
VILLAGE FOR PATIENTS.
CULTIVATED LAND.
R.C. Church.
Camp Caretaker.
Hospital Assistants
QUARTERS.
MALE FEMALE SEPARATE CELLS.
LUNATIC ENCLOSURE.
OPEN SHED
G
STAFF
Gate Keeper
ASH PIT.
HOSPITAL ENCLOSURE.
E.
F
E
MALE
D
FEMALE
D
WAITING ROOM.
B
DISPENSARY
Staff Cane
Caretaker.
Caretaker.
ROAD to MPUNU, Royal Society's Laboratory.
PROTESTANT CHURCH.
MARKET
ROAD to KAMPALA. 20 mls.
MAIN AVENUE
Cow KRAALS
Chiefs Huts
STAFF HUTS
FOOD STORE
BANANA PLANTATION.
Chief Dresser
HOUSE
Kitchen
MEDICAL OFFICERS' QUARTERS
Garden.
LAWN
BANANA PLANTATION.
CAMP PORTER'S Huts.
Water mans hut.
WATER SPRINGS
RICE and VEGATABLE FIELD
HUTS.
STREAM
OLD PORTER ROAD
FOREST
N
E
W
S

friends and relations, and formerly, indeed, were driven into the forest. Hence they found these camps a haven of refuge and no force was needed to persuade them to stay in the camp.

The buildings needed, therefore, are (a) quarters for one medical officer, quite an unpretentious house of wattle and daub, as little or no money was allotted for these (it was a struggle even to obtain mosquito gauze for the windows!): (b) a large dispensary and waiting room suitably fitted: (c) a store: (d) two long wards, holding about 30-40 patients each, one for males and one for females: (e) two wards divided up into separate rooms, say 6 x 10 feet floor space each, and used as isolation rooms for infectious diseases, or to which all very ill and moribund cases are removed, so as to obviate any deaths taking place in the main wards, which also serve as orphanages at times. A kitchen (f) is also needed, as well as a spacious enclosure in which are situated huts for warders, two wards for male and female lunatics, and separate cells for the more violent, also an open shed in which all lunatics sit during the day: and lastly, (g) the quarters for the numerous members of the staff required.

These buildings occupy the top of the long hill which we have built on, and on the slope behind, the



Section of Closet.

ground has been laid out in long parallel rows of huts, each with about 50 yards square of ground, which has been cultivated by the inmates so as to render the camp self supporting.

Each hut holds from 2-4 patients, and sanitary considerations have been satisfactorily met by means of pits some thirty feet deep, covered over, save for a small central opening (see diag.), one to every four or five huts. These serve admirably and are practically septic tanks and quite inoffensive; and being deep, are available for many months. According to preconceived English ideas, these might appear theoretically bad, but experience has convinced my once prejudiced mind that they are eminently satisfactory; in fact out here, I would make bold to say that no other system would be reasonably feasible, in a camp holding vast numbers of natives who are usually most insanitary in their habits. Indeed when these were first built, the stupid native defecated on the covered surface, till threats from a staff kept specially to see that these pits were kept sanitary, persuaded them that the central opening had a definite purpose.

Also a market place (h), store house for the produce grown, and quarters for the numerous chiefs (i), representatives of various districts and at-

Avenue of ficus trees. — to hospital block.

tached to the camp in order to be responsible for the regular supply of food and labour. All the hill slope in front has been devoted to banana cultivation, together with Rice, Maize, Millet and Simsim, of which we get large crops, the soil being so extraordinarily fertile. The water supply is very good from deep springs, and a small stream, and so situated that the medical officer has a private spring and all the staff and patients draw from numerous wells in the opposite direction.

Also, since I am interested in horticulture, the more pleasurable aspect of planting has not been neglected and the camp possesses admittedly the most lovely rock garden in Uganda, where roses and English flowers of all kinds grow in great profusion, while the long road leading to the camp has been planted with an avenue of ficus trees (indigenous), also syringa and rows of flowers, so that the amenities of life are kept up. The whole of the ground on which the hospital block is built has been laid down with a fine red gravelly sand on which weeds do not grow, so the whole place preserves its clean aspect with the minimum of labour and expenditure.

However, since only one medical officer has been allotted to each camp, with no trained assistants, the multifarious duties ranging from farming,

dairy keeping, administration book-keeping, to actual clinical and operative work, devolves on one person and practically no time remains for much scientific research, though naturally numerous interesting cases present themselves from time to time. Further, all post-mortems and even lumbar punctures have been absolutely forbidden, the alleged reason being that such procedure might render the camps unpopular by frightening the natives; thus a most valuable and necessary field of work has been closed. I am convinced, however, from my intimate knowledge of the native, that these restrictions have been laid down on quite insufficient evidence. Anyone who troubles to acquaint himself with the native language and customs goes far to gain their confidence, and personally I have not found the slightest difficulty in dealing with natives, though several races are comprised in my charge, including the uncivilised and formerly warlike Bavuma from the Buvuma Islands. Further, we have the fact that the Church missionary medical men in their magnificently fitted hospital in the heart of the most populous town in Uganda, almost daily carry out operations and post-mortems without the least difficulty or objection. A further proof I had lately when some experiments with laboratory bred fly were being

carried out on some patients I had sent to the Royal Society's Commission some seven miles away. Erroneous impressions were brought back by a foolish patient which so alarmed the patients in my camp that thirty decamped and others prepared to follow, but, hearing of it in time, I summoned the whole camp and gave them an address explaining our objects. Not only did no more go off, but some of the absentees returned on hearing the truth, and others even volunteered to go over and submit to the experiments. At the present time I can get patients to go over every time they are needed. After all the native is a child at heart, and treated as such is very tractable and amenable to rule. Doubtless in time a more enlightened spirit will render the authorities less obstructive to the advance of medical science, especially since true therapeutics depends largely on a clear conception of the pathological processes with which one is dealing. It is to be hoped, therefore, that now the scheme outlined has passed the purely tentative stage more adequate means and a sufficient staff will be forthcoming. Already there is talk of appointing a second medical officer to this camp for purposes of aiding investigations, but so far nothing has come of it. However, I have availed myself of the proximity of the

remaining members of the Royal Society's Commission and have persuaded them to take up a line of investigation with me so that we can ascertain more precisely the results of treatment and whether certain cases regarded as "cures" still harbour the trypanosome in a chemico-resistant form. But these results have not been completed so cannot be included here. But all results so far tend to show that even four grammes of organic arsenic seems to render the patient inocuous as regards spreading the infection, though unfortunately it does not cure the patient.

We will now consider the symptoms, diagnosis, prognosis and treatment.

SYMPTOMS.

It is convenient for purposes of statistics and description to divide the disease into three stages, but it must be borne in mind that this is entirely an artificial division, no hard and fast line delimiting one stage from another. For classification in the camp books I have divided the cases as follows under the classes A, B, C, D, though now C and D have been classed together.

A Cases are those who have absolutely no subjective symptoms whatever. They complain of nothing and are able to perform all the occupations and duties of an ordinary healthy man. Objectively they may or may not show cervical gland enlargement, but if glands are present trypanosomes are easily demonstrated. A man may be in the A stage for many months, if not years. Dr C. J. Baker noted a case of a native soldier in the King's African Rifles out here who had shown trypanosomes in his blood in 1905. With no treatment whatever he had served in the corps for three and a half years without having been off duty once. If patients complain of the least symptom subjectively, I class them under B.

B are those who have only recently complained of symptoms, such as headache and pains in various parts of the body.

C are those further advanced. They complain of being weak, unable for effort, intense headaches, vertigo, show transient oedema over tibiae, on face, etc. They are invariably impotent sexually, and in the case of females amenorrhoeic, and have marked tremors of tongue, lips, hands. They are often somnolent, falling asleep even during the act of eating and are altogether listless and obviously ill.

D cases were those who had all the above in a

marked form and were obviously moribund; totally unable to walk they had frightful bed sores, and were often in a state of coma.

However, for tabulating treatment results, C and D have been merged into each other.

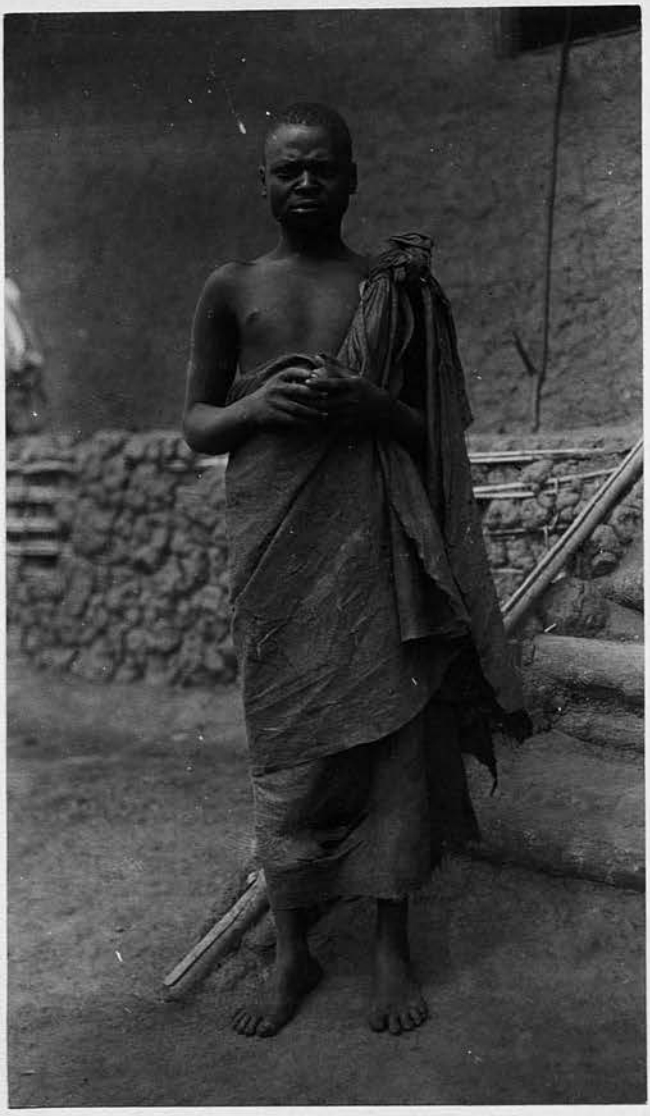
The French investigators very neatly class their patients as follows:

A	=	Cas du bon état.
B	=	Cas suspects.
C & D	=	Cas cliniques.

A more exact distinction, as mentioned by Bagshawe, could be made were lumbar puncture allowed, as all patients showing trypanosomes in their cerebrospinal fluid would be put outside A as an invasion of the subarachnoid space means an advanced state of the disease.

Broden and Rodhain (Rapport sur les Travaux du laboratoire medical de Leopolville) regard the absence or presence of trypanosomes in the cerebrospinal fluid as of quite secondary importance. Taking five lymphocytes per cubic millimetre as normal, any increase in these is taken as indicating an infection. Later cases also show muriform cells and later still myelocytes.

In my opinion lumbar puncture would greatly facilitate the division of cases, as at present the



Stout type of Patient.

Type showing great emaciation.

classification is largely a personal matter, or rather the personal equation is too great for any serious deductions to be made from the statistics. For instance, it is within my knowledge that cases have been classed as A in other camps which I would certainly regard as B. Hence A cases will show a higher death rate than they should.

It is noticeable too that patients suffering from Sleeping Sickness show two most distinct types, even in the early and late stages. The one appears very stout, extremely well nourished, but in these the prognosis is not nearly so good as would be expected. The other presents itself as emaciation, often of an extreme degree. Both these types are well shown in the annexed photographs.

It is probable that in every case, Trypanosomiasis is ushered in by a preliminary fever which the patient often overlooks, or considers as ordinary fever, and seeking no treatment escapes microscopical diagnosis.

The incubation period of this fever naturally is extremely difficult to ascertain, though it is unlikely to be long. In experimental infections of monkeys (circopthesus ruber or patas) trypanosomes are found usually in from 11-18 days: also Doctors Martin and Leboeuf quote seven cases in which try-

DISEASE.

Trypanosome Fever

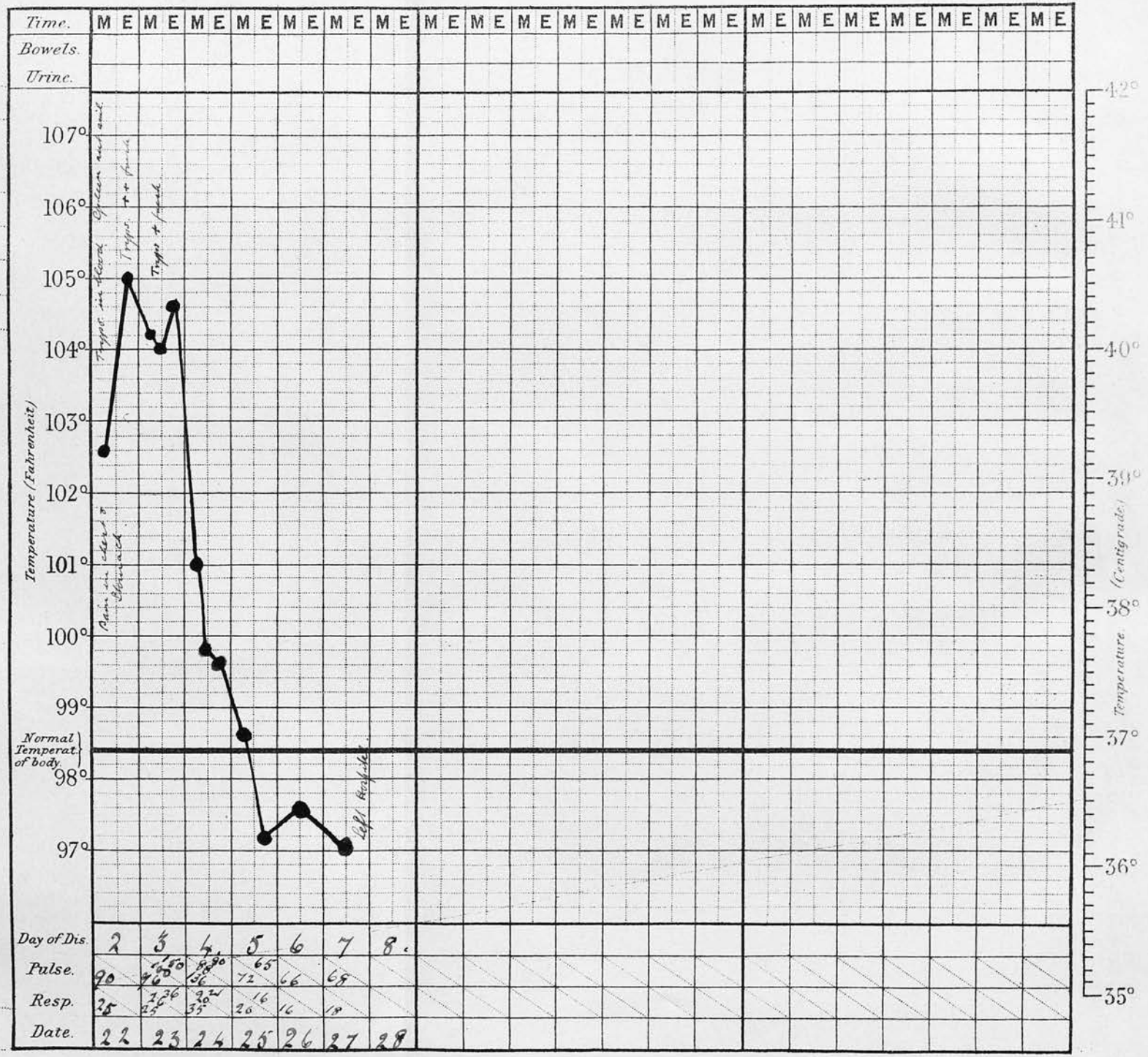
Notes of Case.

Name { Miranda - Fundi

Age

Diet

Case Book No.



Date of admission.

22 · 1 · 06 .

Result

Entered at Stationer's Hall. Printed and Published by Wodderspoon & Co. 6, Gate Street Lincoln's Inn. Gould's Clinical Chart.

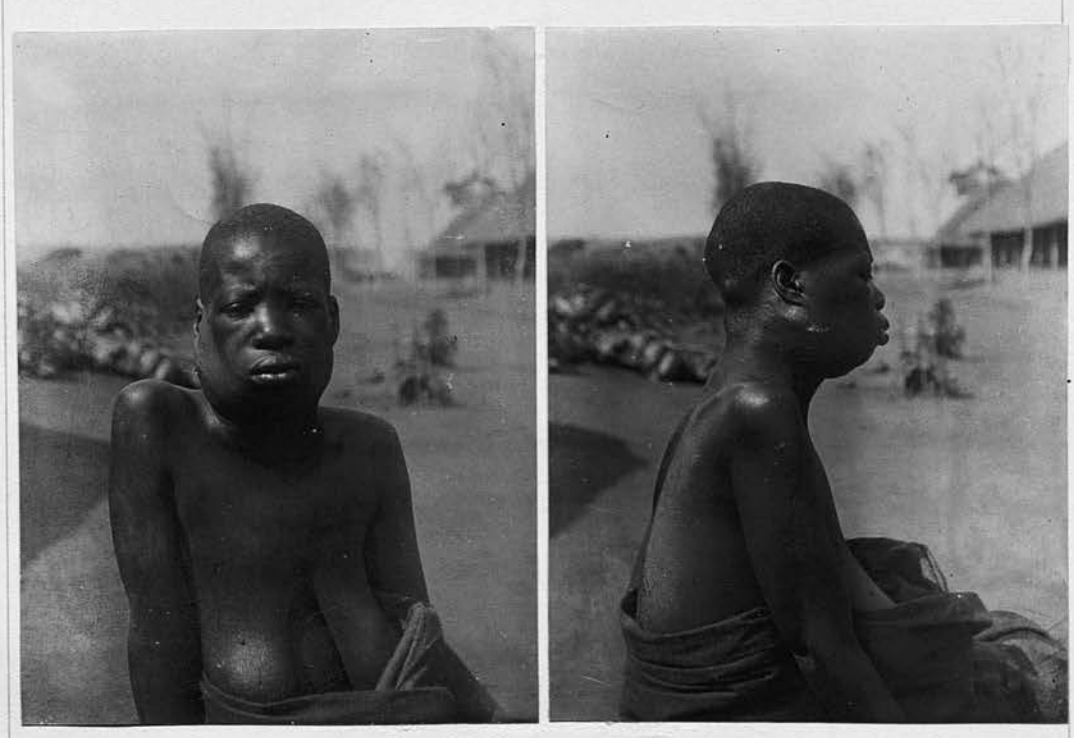
panosome fever followed in about 10-14 days after the bites of Glossina Palpalis. I have come across some cases of fever in which trypanosomes swarmed in the blood, and the patient was obviously in the very early stage only of the disease. This fever in my cases has been severe, accompanied by a temperature of often 104° F. to 105° F., great sweating, fleeting pains about the joints and intense headaches: no glandular enlargement whatever, and were it not for the microscope, in Uganda at least, one would at once suspect the patient of suffering from Spirillum fever. It emphasises the great importance of using the microscope as an aid to diagnosis in all cases of fever.

After lasting less than a week, all symptoms passed off and the patient appeared as well as ever.

If a blood film of such a case is examined, the trypanosomes will often be found to be very numerous.

The fever in my cases subsided by a kind of crisis. I attach a chart taken from such a case.

Judging from histories, these fever attacks are recurrent at long intervals, never last for any length of time, and leave the patient apparently well. However, glands soon enlarge, especially those of the submaxillary and posterior cervical group, and it may not be for months after these



Patient showing gland enlargement -(front & side view)

Canoe builders - Sesse Isls — note the visible cervical enlargement.

become palpable that a patient becomes aware of his disease. The negro appears not to be very observant of any gland enlargement in his neck, so it is difficult to estimate the length of this period, but from close enquiries I found that from the time glands were noticed to the time the patient felt definite symptoms, two to four months elapsed as a rule.

The degree of gland enlargement varies considerably, from pea-like swellings, even in late cases, to huge visible masses, the size of an ordinary egg (see photos), giving the patient an extraordinary appearance.

The feel of these glands is quite characteristic and to a skilled observer quite diagnostic. I can best describe it as the sensation felt when one palpates a piece of thick indiarubber covered say by a blanket or cloth - a curious semisolid, elastic feeling.

Subjective symptoms vary considerably and any one of those detailed below may be the first noticed or complained of, or all may come on about the same time.

The most constant are:

(a) Continuous headaches, usually of an intense character and almost approaching a migraine; with this is often

Scenes in a stricken village — Patients in last stage. Basking in the Sun.

"A Sleeper"

Child fell asleep while being spoken to.

(b) Intense vertigo, such that for the time being the patient is unable to move. If it comes on while he is walking, he may even fall down helpless and thus injure himself.

(c) Pains down the legs, similar apparently to the so-called lightning pains of locomotor ataxia.

(d) "Pains in chest." It is a difficult matter for an African to explain his symptoms properly, but these chest pains spoken of appear to me to be due to digestive troubles, and I am the more confirmed in this view, as they seem to yield rapidly to suitable treatment, as for dyspepsia due to an acute gastritis, and this opinion seems also borne out by the postmortem findings of Gray and Tulloch who describe a curious injected appearance of patches of the stomach mucous membrane.

(e) Gradual loss of strength; a state of lethargy and somnolence. Even while talking or eating the patient may fall off into a sleep and it is impossible to fix their attention. They do nothing save lie about in the sun, as they complain of feeling chilly.

(f) Gradual and then total loss of sexual powers, total loss of power of erection, amenorrhoea and sterility in women. This symptom is often the first which patients notice, and have come to my camp for. I think I was the first to point out the significance of this symptom as pointing to sleeping sickness, and having a close acquaintance with the native language I was able to make particular enquiries, for as a rule the negroes, and the Baganda especially, are extremely prudish in such matters, but it having got about that the Kyetume doctor had cured (six) persons with sexual impotence, numbers came complaining of this alone; for it

is a remarkable fact that under treatment I find patients recover their sexual powers. The most rapid was in a B case, who, recovering his powers after only three weeks' treatment, presented himself for discharge, as this having been the only symptom complained of, he considered himself now cured. It was noticeable that in Uganda many of the legal cases between man and wife arose from the fact that the man was sexually impotent. I have little doubt that had they been examined they would in a large number of cases have been found to be suffering from sleeping sickness.

(g) Intensely itchy skin. The areas where this is most intense are across the sacral and lumbar regions, down the legs, the front of the chest, then the back, in order of frequency. Patients often present a most grotesque appearance with the scratch marks. The skin is very dry and lustreless, and, as patients with sleeping sickness get very careless of themselves, extremely dirty. In a native it is practically impossible to make out the erythematous patches described as occurring in Europeans, and though a vesiculopapular eruption has been described by Manson, I have not found this and consider that it has been mistaken for a common itchy eruption of that type which natives call "bueri" and has been attributed by them to eating Indian salt and by medical men here as a form of scabies. It yields readily to sulphur treatment.

(h) Oedema over the tibiae is a late sign and of bad prognostic significance. It is present often to a marked degree, together with Kerandel's sign, deep hyperaesthesia of the tibiae.

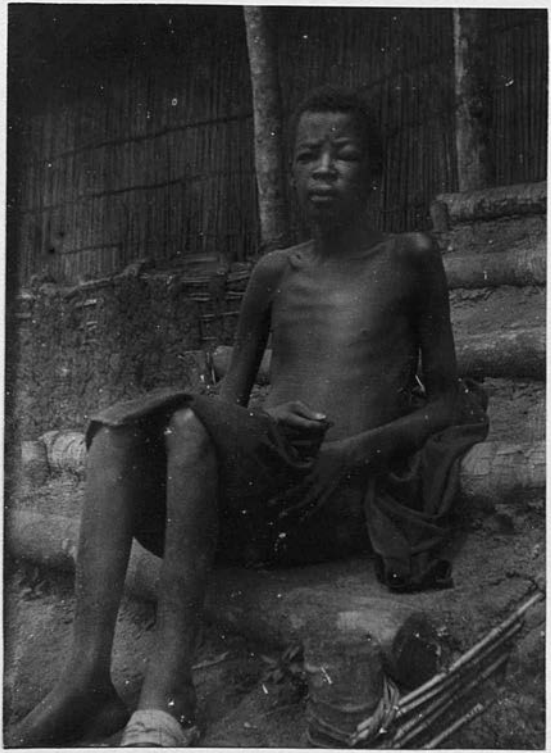
Pains in neck (probably the adenitis), vomiting, suppression of urine, faulty vision and fever are also found at times. The only one of interest is the faulty vision, which seems due to an optic neuritis or iritis, and ought to be carefully noted owing to visual troubles following atoxyl administration also; the two are apt to be confounded. I have found complete optic atrophy in two cases before treatment. As a high percentage of Baganda are infected with syphilis, it is difficult to say how much of the visual trouble is due to this poison, for it is a remarkable fact that visual trouble has been far less frequent before and after treatment amongst the Bavuma, a race who have little or no syphilis amongst themselves. The matter will be referred to more fully under Toxic symptoms during treatment.

Fever is usually present in a low form, the temperature swinging between normal 98.4° F. and 99° F. for a few days at a time, and then patient is free. A subnormal temperature is frequently met with. The fever, as a rule, troubles the native not at all, and in treated cases and cases undergoing treatment, one often finds a variation in the morning and evening temperature if readings are taken over long periods, though a careful examination

of the blood reveals no parasites whatever. It tends to lead one to the conclusion that the parasites acquire chemico-resistant properties against organic arsenic, as indeed Erlich found to be the case in animals inoculated with T. Brucei. This matter is still under investigation.

Anaemia, as is to be expected, is frequently present, though not to any marked extent, even in the worst cases. What renders it difficult to be certain that the anaemia is really due to the disease is because such a large number of patients here also have ankylostomiasis and various other intestinal parasites, and quite 60% show filaria perstans in their blood. Red blood corpuscles average 3,000,000 per c.m.

Autoagglutination. This phenomenon has been present in 100% of my cases examined so far, and to my mind a person showing this may well be suspected of sleeping sickness. I have found it in a few cases who showed no other signs of sleeping sickness and I am keeping a watch on these, for if subsequently they also develop Trypanosomiasis (except for cases who are not free from a suspicion of having come from infected localities) a valuable method of diagnosis is given us. Unfortunately, of 1,250



S.S. patient... showing oedema of eyelid and feet.

cases lately examined by me, and who had had full courses of treatment, not one showed an absence of the phenomenon, though some showed it in a less marked form. Therefore if its presence in a treated case is to be taken as evidence that the patient is not cured, as I think it must, then no cures have yet been made in this disease.

The technique is simple: a small drop of blood is taken from the patient's finger and placed between the cover slip and slide as a thin film and examined with a one sixth objective. If present, the field is quite characteristic; instead of rouleaux, the red cells are lumped in irregular masses. It is a subject I am at present still working on.

Local transient oedema is also marked in advanced patients. One morning a whole eyelid will be puffed out: in an hour or two this has subsided and the other eye, or a patch on the cheek, lips or chest is affected. It is an extremely bad sign for prognosis. Extensive oedema of the feet and ankles are also seen, recalling to one the oedema of Bright's and cardiac insufficiency or in hepatic disease. This local transient oedema is, I think, due to some local vasomotor change, possibly induced by an aggregation of the parasite or its toxins in that part.

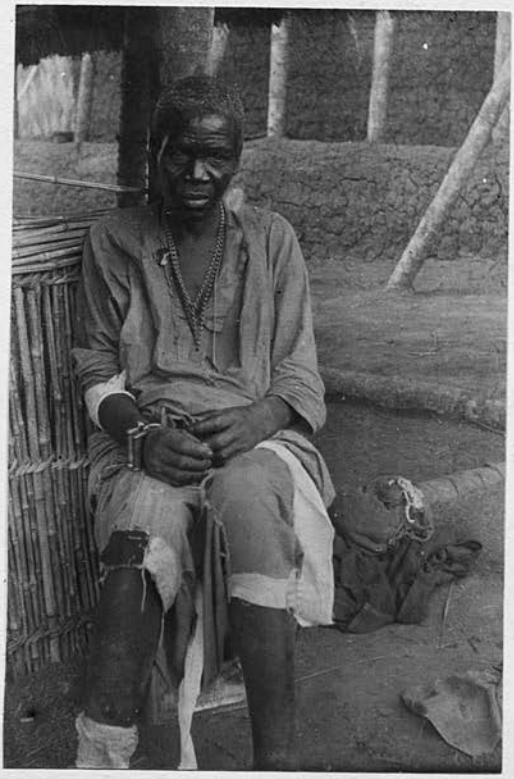
COMPLICATIONS.

1. Pneumonia. Patients with sleeping sickness are extremely liable to this disease, which in their low state of health is very fatal.

2. Epilepsy, of the Jacksonian type, is extremely common, due doubtless to the attendant meningeal changes which may be general or localised. The attack comes on quite suddenly, but undoubtedly exposure to the sun is a predisposing factor in bringing on the attack. A patient comes up to the dispensary and, according to their usual custom, sits sunning himself. Suddenly the attack comes on, with twitchings of fingers of one side, usually right, and marked clonic contractions, and then gradually general convulsions. There is usually marked deflection of the eyeballs upwards and to the affected side. The patient foams at the mouth and a period of rigid spasm may come on, but no opisthotonos. This attack may pass off in a few minutes and the patient walks away quite unconcerned, or, more usually, attack follows attack in rapid succession for two, three and even twenty-four hours on end, unless chloroform is administered. During the attack the teeth are tightly clenched and injury to

the tongue may occur; the breathing is hurried and shallow, sometimes Cheyne-Stokes is present, and altogether the patient has a most distressful appearance. Motions may be passed involuntarily. After a severe succession of attacks the patient may recover or sink into a profound state of coma, from which it is impossible to rouse him; this may often last up to eight days before death supervenes. The patient may be talking or walking when the attack comes on, with little or no warning, and he may seriously damage himself in falling. The stout type of patient is far more liable to these attacks, and in these the prognosis is extremely bad; almost 90% of the big stout patients under my charge who die, do so after these fits. The thin type seldom or never seem to suffer from them.

Hemiplegia frequently follows such fits, even quite early in the disease. In six cases, hemiplegia was complete and in four partial, but these seem to improve in a marvellous manner under treatment. Facial paralysis is rarely found. A kind of pseudobulbar paralysis is often met with, the patient being apparently quite unable to use his glossopharyngeal muscles for swallowing. Marked nystagmus occurred in a small child of six years. Of 1200 patients, I noted these fits in 62, 15 of whom were children.



A mental case.

Garments affected by a Lunatic.

3. Transient total Aphasia, due to a paralysis of the larynx, is a most extraordinary condition I have frequently met with; after about two or three days the patient gradually recovers his voice and attributes his complaint to the action of a devil.

Aphasia of central origin is also met with; also complete deafness of central origin. These conditions never improve.

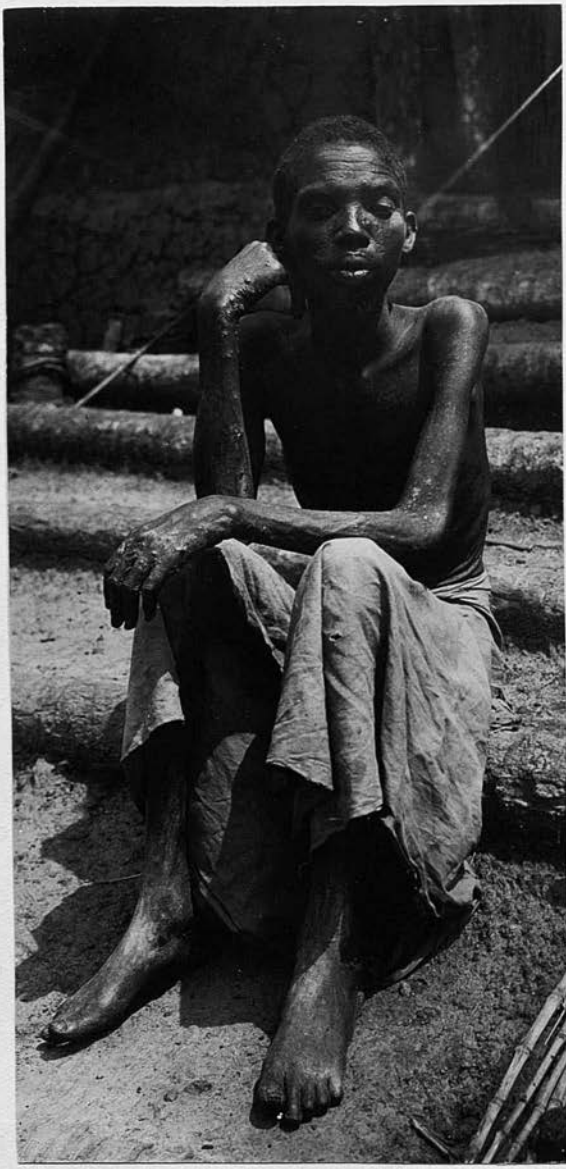
4. Mental symptoms are also quite frequently met with, curiously enough far more often amongst men than women, even taking into consideration the fact that men, from their occupations, fishing, canoeing, etc., have been infected to a greater extent than women. Out of an admission of 50 lunatics, only two were women, and in Buanuka Camp during my charge, and in this Camp, out of some 155 lunatics only five have been women; children, only four in all. In men it is almost invariably in the form of mania of grandeur, the patient believing himself to be a powerful chief and owning large herds of cattle, etc. Other delusions are also frequent; for instance one man I saw lately had a slight hemiplegia and he declared that he had been born twins with a python and that the python had curled himself round the paralysed leg. When the paralysis improved he

came to say with great glee that the snake had at last left him alone. Unfortunately they often take very violent turns and damage their fellow patients, and very frequently indeed they become incendiaries and do great destruction to property.

In habits they become extremely filthy and obscene: and have the greatest objection to wearing clothing of any description: they tear everything they have to shreds, and, as in the photo attached, feel proud in wearing a circle of palm leaves. However, under treatment, extraordinary improvement follows.

Out of all the 3000 odd cases of Sleeping Sickness I have had under charge, I have only four times met with insanity in the form of melancholia (three men and one girl). All save the girl committed suicide by hanging: the girl came up and asked me to give her a poison to kill her quickly. Suicide is practically unknown amongst the Baganda normally.

5. Bed Sores. As would be expected when in the last stages with somnolence or coma, extensive bed sores form, in spite of all care, and assume terrible dimensions. I have seen a patient brought into camp who had the whole of his sacrum, scapulae and trochanters on either side exposed. The marvel



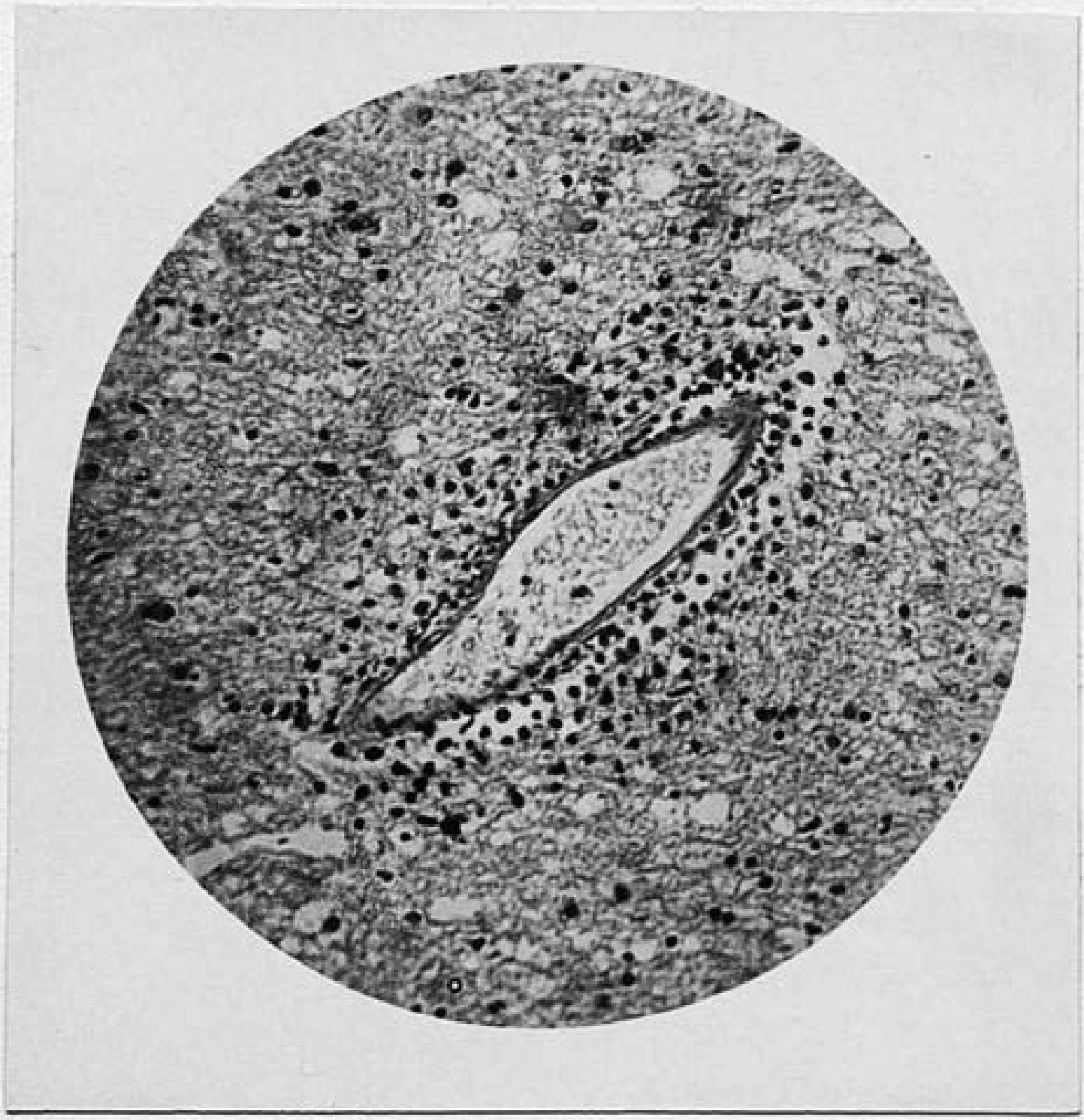
S.S. patient showing Legs and arms infected with - pulex penetrans.

was how he lasted as long as he did. It is noteworthy that with treatment, as used here, we no longer appear to get bed sores, even in the bedridden patients.

Chiggers.

Though hardly a part of the disease, being more or less an accident incidental to the fauna of the locality, these pests are a factor to be taken into consideration. The chigger so called, is the female of a flea (pulex penetrans), the female of which after fertilisation burrows into the skin of some host, man, dog or other animal, and there she rapidly swells up with eggs and after these are matured they burst out and are shed on to the ground like a fine white powder. The damage they do directly and indirectly is enormous. When this camp was first started one used to get most appalling cases with chiggers.

A patient with sleeping sickness, as I have said, soon gets neglectful of himself and becomes filthy, and when chiggers first burrow into his feet he no longer troubles to remove them, thus the eggs are sown in his hut and in a short time the place swarms with this pest, which of course at once attack him in hundreds till he presents a truly appalling



Section of brain in Sleeping Sickness.

Showing great small celled infiltration round the arterioles.

PATHOLOGY.

Very little work indeed has been done in this direction, nor indeed is more possible in Uganda under the existing rules.

That profound changes in the brain occur we know from the researches of Mott who showed that the condition was a meningo-encephalitis, and that brains (he had only marked cases of course) of patients with sleeping sickness show a great small celled infiltration round the arterioles, quite diagnostic in a section.

Gray and Tulloch described the curious appearance of the stomach in their cases which I have mentioned.

The cerebrospinal fluid shows a marked increase of lymphocytes and also muriform cells and myelocytes.

In the blood, very occasionally, we have poikilocytosis, but beyond a diminution in the red cells and haemoglobin index, I find little change. In some cases we have a leucopoenia; in others a leucocytosis (polymorpheal); most show eosinophilia, due I feel certain to intestinal parasites, chiefly ankylostomes.

Optic atrophy and neuritis I have stated is seen in some cases, but this is often a result of toxaemia

from the impure atoxyl.

DIAGNOSIS.

This is not by any means difficult in a vast majority of cases, as the presence of the parasite Trypanosome Gambiense in the blood, gland juice or cerebrospinal fluid is pathognomonic of the disease and admits of no argument.

While the microscope reduces diagnosis to an exact and precise science, to one familiar with the disease the various clinical symptoms already described are sufficient to establish a diagnosis, especially with the characteristic gland enlargement and the curious appearance of the patient's eyes.

The presence of the parasite in the blood is often very difficult to demonstrate in the great majority of patients, doubtless due to the scantiness of the trypanosomes in the peripheral circulation. Koch and his workers used thick films of blood, as used for demonstrating filariae; these films were suitably stained, but this method is not readily available for ordinary clinical routine, as it is difficult to stain the preparations easily, and, as Koch himself admitted, it took considerable experience before one could be certain that what

looked like a trypanosome was really such.

The method of centrifugalising the blood, used by Doctors Martin and Leboeuf, may be tried. They give it as follows:

Ten c.c. of blood are taken from a vein at the bend of the elbow by means of an iridium platinum needle 5 c.m. long and an internal diameter of 65.5 m.m., also a clean sedimentation tube and 20% solution of potas. citratis. The tube is moistened with the citrate and filled with blood, and thrice centrifugalised.

1. The first time is the most important and must be watched from 8-12 minutes. After seven minutes, verify condition of tube every 60 seconds and stop directly two layers are distinct. Best results are obtained if the plasma layer still has light clouds of red cells. (Using Krauss' two speed centrifuge, use 1500 revolutions per minute, i.e. 65 turns of handle on the urine axis.)

2. Carefully decant all the upper layer into a fresh tube and centrifuge for 10 minutes at same speed. The sediment has most of the white corpuscles, a few red cells, and most, if not all, of the filaria, some haematoblasts, and sometimes a few trypanosomes (always, if trypanosomes are numerous in the third sediment, they are found in this.)

3. Decant fluid of 2 and centrifuge for 20 minutes. The sediment has a few white cells and red cells, all the haematoblasts and trypanosomes, and if filariae have been numerous in No.2, a few will be found here.

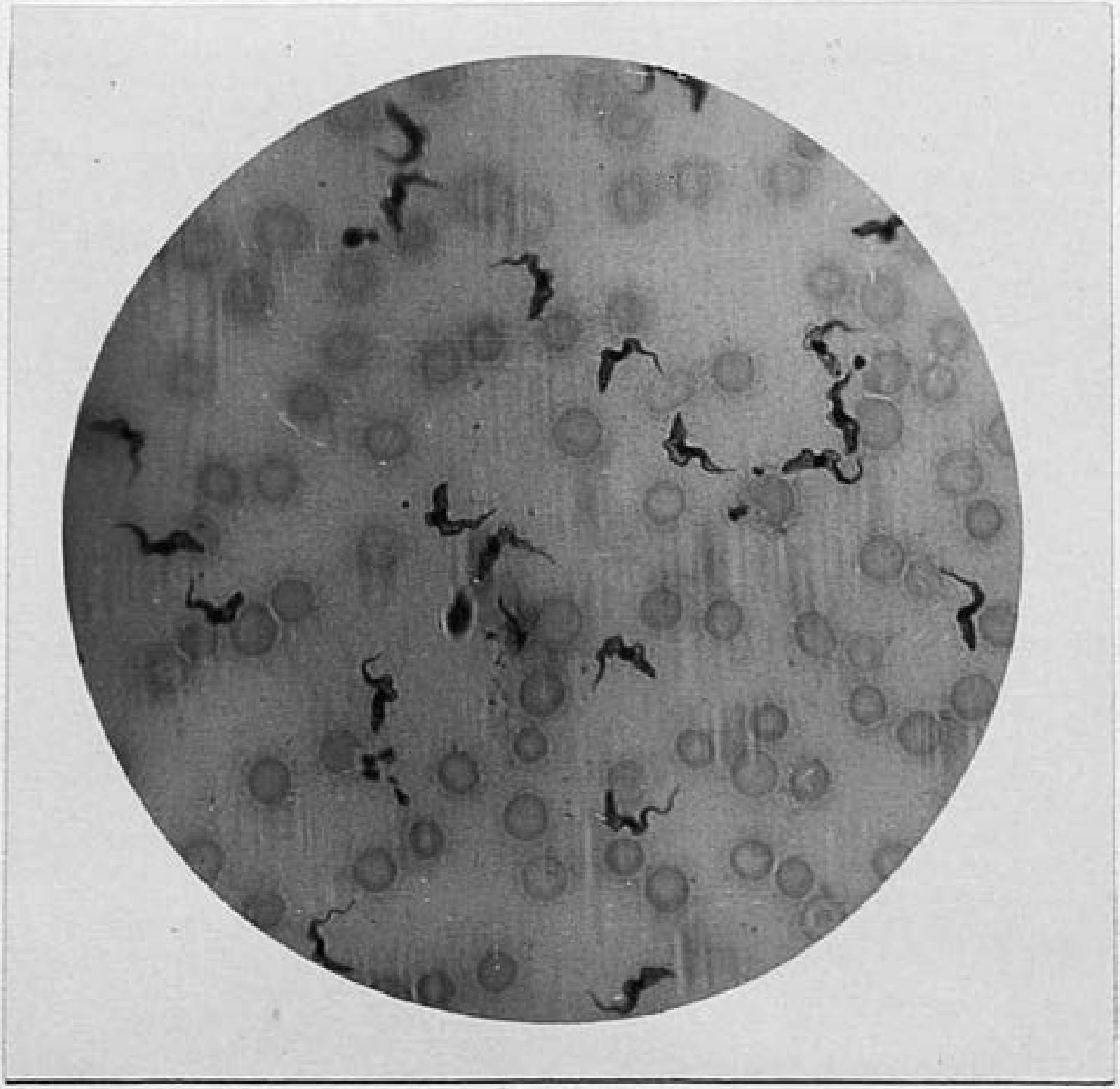
This method also is not practicable owing to the time it takes, unless one has assistants, when dealing with large numbers of patients.

If glands are present, it is extremely easy to find the parasite in nearly every case. The technique is as follows.

A hypodermic syringe (preferably of the all glass type) is taken, and the needle plunged into the gland fixed between the fingers: one can feel the needle pierce the gland capsule, and then to ensure getting fluid the point of the needle is gently moved about to break down part of the gland; the piston of the syringe is then partially drawn up to form a vacuum and the syringe is then disconnected from the needle; the needle is withdrawn and the syringe reaffixed to the needle, and the fluid in the needle is gently blown out on to a glass slide. If this procedure is followed, no fluid is drawn up beyond the needle and thus one avoids the necessity of sterilising the syringe for every patient.

The procedure is quite painless, save for the initial prick of the needle, and even quite small children submit to it without a murmur.

The fluid on the slide is then covered with a coverslip and examined under a one sixth objective. Personally I always use a one twelfth immersion lens



T. Gambiense · (under 1/12 oil im.)

as being more expeditious, for though the field is restricted, still in actual practice I find that if trypanosomes are present their agitation of the fluid is communicated to the corpuscles under the lens and it is easy to follow up the moving corpuscles to the parasite itself, which under the one-twelfth is quite unmistakable.

Trypanosoma Gambiense in a stained specimen shows a well marked full membrane and flagellum centrosome and nucleus. Its rate of progress in a fresh drawn fluid is remarkable, progress being accomplished by active lashings of its flagellum which is attached to the anterior of the parasite.

PROGNOSIS.

This, unfortunately, is still very grave, no treatment as yet having held out any bright prospects of ultimate permanent cure. I am still optimistic as regards early cases, but in Uganda at least, I fear I am the only one who is. It must be kept in mind in looking at all statistics of Uganda that we have nearly always had advanced cases to treat, as the Government have consistently refused to make notification and treatment compulsory in this disease, and, as I have said, the classification as

carried out too largely admits the fallacy of the personal equation in allotment. However, with treatment, life is considerably prolonged and under not at all bad conditions for the patient, though apparently ultimately death supervenes. Under treatment improvement is astonishingly rapid; all symptoms pass off. Even the lunatic becomes a rational being, and a person who was carried in and was, as one might think, moribund, in a month or so he is up and about and feeling so well, will himself tell you he is cured; but alas, this is not maintained, and after as long a time as a year, or even two more, he relapses and goes down hill completely.

Thus it is seen that the optimism of Koch, and all who believed with him that in organic arsenic we had a perfect remedy analogous to quinine in malaria, had a great deal of ground for justification, but was not based on long enough experience.

Untreated, on the other hand, the progress for the worse of a case is rapid, and from the time subjective symptoms manifest themselves rarely does a patient survive six months, from two to three being the average. Weakness increases rapidly, somnolence manifests itself in a marked degree, and if the patient is not driven out from his friends and rapidly dies from hunger, exposure, or wild beasts, he gets

so weak and lethargic that he ceases walking and so gradually falls into a semiconscious state, eating little, and having bed sores forming. This is the stage which gave rise to the term "sleeping sickness".

The comatose state may, as I have stated, last for a whole week before death mercifully intervenes.

Two striking symptoms which I have omitted to mention are, first, the extraordinary increase of appetite which sleeping sickness patients suffer from. They always complain of being hungry, though they eat enormous quantities of food, even for a Muganda. They also have a great craving for flesh foods. Ordinarily the Baganda are, at least by force of circumstances, largely vegetarians, living chiefly on the unripe banana pulp which is steamed for an hour or two, to a European a very tasteless and uninteresting food, but on which a healthy man can do 30 and 40 miles in a day with a 60 lb. load and only one meal at the end of the day. I was struck with their extraordinary powers of endurance when travelling here extensively.

TREATMENT.

This has been most disappointing, none of the drugs used so far having sustained the hopes derived

from the results of their action on experimentally inoculated animals.

Of all the drugs tried so far, viz. the various aniline dyes and trypanroth, the organic arsenics and antimony salts, the organic arsenics alone have proved of sufficient value to warrant their continuance. Of the organic arsenics "atoxyl", a compound manufactured in Germany, was the first to be tried on any extensive scale. It was the drug used by Professor Koch in Sesse, and induced by Professor Koch's results, it was given an extensive trial in the Uganda S.S. Camps. Its limitations were soon discovered, and moreover after a short period, for some reason or other, the supplies sent out proved most toxic. I had used the drug fairly extensively between January 1907 and October 1907 with good results, but during October of that year in this camp I suddenly noticed that patients were exhibiting the most extraordinary untoward symptoms after an injection. These were intense vertigo and vomiting, a form of metatarsalgia, cardiac pain, intense colic, diarrhoea, anuria, and in some, complete deafness and visual disturbances, amounting in some cases to total blindness. Alarmed by these symptoms, I at once stopped the drug and wired headquarters to ascertain whether other medical superintendents of

camps were experiencing similar trouble. They replied in the negative, as they were still using old supplies, but in a few days in using the new supplies they had such toxic symptoms also, showing often to a more marked degree.

Fortunately recognising my cases early, I lost none by death, and succeeded in allaying the condition rapidly by heavy doses of morphia injections along with copious draughts of magnesium sulphate. By these means one cured them easily of the toxaemia, and even in the visual cases, if patient complained early enough, we were able to assuage and prevent any further progress of the mischief, though unfortunately all cases who did not come up in time became totally blind. I shall discuss these visual cases more fully later.

Fortunately about this time Messrs Burroughs & Welcome sent me out for trial samples of a new arsenical preparation which they called sodium paraamino phenyl arsonate (Soamin). My experiences being favourable, further supplies were obtained which gave great satisfaction, and which were at least equal to atoxyl, being in fact, the same chemical in a purer form. I abandoned the use of atoxyl entirely, and in fact I am persuaded that as long as we can get 'Soamin' , I do not think we are justified in

using atoxyl, unless an absolute guarantee of its purity is given by the makers. It seems to me blindness is too heavy a risk to incur when one has sleeping sickness also. After nearly two years' use I have found no reason to alter my expressed opinion regarding atoxyl and Soamin in the least; for I have never yet found, nor has any one else, the least toxic troubles following the use of even gramme and a gramme and a half doses of Soamin, and visual troubles are things of the past.

In 1908 I took some of the impure atoxyl to the Sleeping Sickness Bureau in London, and they had it examined by Nerenstein of Liverpool School of Tropical Medicine, who stated that the sample contained free inorganic arsenic and aniline, which accounted for its dangerous properties. Macroscopically the bad samples had a dirty yellow tinge, doubtless due to the aniline oil, and the drug was in an amorphous powder instead of being finely crystalline, as were the safe and pure samples.

Later Messrs Burroughs & Wellcome produced other organic arsenics, namely, 'orsudan' and 'arsacetin' containing the meta and aceto group of radicals, also another designated as 'Kharsin'. None have equalled Soamin, and the latter proved highly toxic even in small doses, and was unfit for human use, so were

abandoned for Soamin alone.

Early, on noticing that certain syphilitic cases placed on mercury seemed to show a more marked improvement when being treated for their concurrent sleeping sickness by organic arsenic, I was led to try injections of a mercury salt, viz. the metallic mercury, calomel, perchloride salt, and also cyanide. Alone these have no visible effect on the trypanosomes, but with atoxyl the improvement shown seemed more marked. I abandoned all save the perchloride salt and found that a native could stand even one grain of mercuric perchloride as an intramuscular injection without trouble following. It is generally stated that soamin should not be given together with or in close approximation of time to any mercurial salt, but this is needless talk, as I, finding mercury useful, used to give an injection of each to a patient at one sitting, but this proved arduous, and for small children impracticable, so I tried mixing the two drugs and giving one injection and this is the method I still follow. If the perchloride solution is made with a slight excess of sodium chloride as a solvent, and then mixed with the Soamin, the slight cloudy precipitate which would form otherwise is prevented. I usually suck up the drugs successively into the one syringe and

so avoid them standing long as a mixture. The mixture so formed is a double sodium salt of mercury and arsenic.

Dosage. In view of the experience of the German Commission at Sesse, it was decided to follow their system of dosage at first, but every medical superintendent was given a free hand to alter if he thought it advisable. The German method was to inject subcutaneously 2 c.c. of a 20% solution of atoxyl on two successive days, and repeated every ninth and tenth days.

Dr van Campenout, of the Congo Medical Service, advised an initial dose of .02 grm. and increasing .05 grams every fifth day till a maximum of 0.7 grams was reached, this dose to be maintained for a month and gradually decreased at the same rate. This, however, was soon abandoned as being troublesome and of no particular advantage. The natives naturally objected to frequent injections and any method involving frequent injections is open to the same objections.

After testing various methods, I was firmly convinced that any good which resulted from these drugs was effected by the first two doses, and for these to be effective as large a dose as was compatible

with the life and well being of the patient was necessary, and that small doses, so far from doing any good, actually did harm by causing the parasite to become chemico-resistant. This view was not taken by the German investigators, but neither of us could produce proof of our respective views, though I was glad later to see some support of mine afforded by Erlich's similar conclusions when treating experimentally inoculated animals. Else I cannot explain the phenomenon of a patient continuously taking arsenic and yet showing daily elevations of temperature similar to an untreated case, and finally dying with every symptom of trypanosomiasis, and this though all traces of glandular enlargement have disappeared and no parasites could be found in the blood by ordinary means.

On this assumption, therefore, I gave atoxyl in full gramme doses, along with .01 grams of Mercury perchloride, and only in rare instances abating this dose for children, as I found they stood it well. Unfortunately about this time the atoxyl supplies became unreliable and treatment had to be suspended save by mercury alone. An accident showed me that mercury perchloride was tolerated by the native even in one grain doses, but I keep to .02 as effecting all one needs. This was a matter for surprise, as

all previous medical men in Uganda had laid it down as an axiom that the Muganda native had an idiosyncrasy for mercury, intense symptoms of toxaemia having been observed even after as small a dose as 1 gr. of Hyd. c̄ creta. While this is a fact with mercury given by the mouth or inunction, it is totally incorrect for mercury injections. My dosage therefore was

simultaneously on 1st day - Soamin 1 gram $HgCl_2$ .02
2nd day - Soamin 1 gram alone,
and repeated thus every 14th and 15th day following.

At present the arsenic courses have been limited to one month, only to be resumed on symptoms of relapse.

I have found no signs of an arsenic habit being formed.

Rapidly repeated injections are required, to my mind, as organic arsenic is quickly reduced and eliminated, being found in the urine only a few hours after injection.

Antimony has not been used much, as it is an awkward drug to give intravenously owing to syncope, etc. following unless caffeine is also given.

Intramuscularly no native will submit to it twice, owing to the subsequent pain and induration.

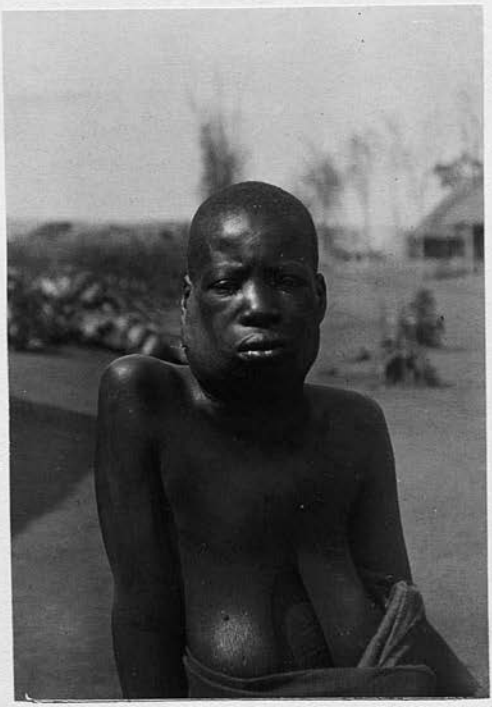
Intravenous injections are not feasible in

natives with the white staff allotted to each camp.

The suggestion of Balfour of Khartoum of injecting the patient's serum into the cerebrospinal canal has been tried with no result by me. For a time all patients who show a reaction temperature after the injection, seem to improve, but it rapidly disappears. As a routine all patients take daily doses of Liq. strychninae, and this seems of great benefit.

Other symptoms are met by the usual appropriate drugs. Vertigo rapidly gives way under large doses of caffeine citrate and phenacetin. Inorganic arsenic in the form of a trisulphide (Orpiment), as recommended by Thiroux and Danfreville, has been given an extensive trial with little result. Erlich stated that trypanosomes never became resistant to inorganic arsenic. We have tried it in daily increasing doses up to 1 gram, but have now abandoned it. It is given as a pill with Pulv. opii, but is open to two objections. Natives dislike coming daily, hence it is difficult to keep them regular in the increasing doses; secondly, it necessitates one carefully watching each native really swallowing his dose, or else he keeps it in his mouth and then spits it out when outside the dispensary.

As a routine also in this camp every patient once a fortnight takes doses of thymol and Beta-



Before treatment.

Same patient after treatment A.

naphtol for their ankylostomes with marked benefit.

Lunatic patients are kept in an enclosure, but only violent ones are kept under forcible restraint - usually a pair of light handcuffs round their ankles or on hands, but in a few days these are removed.

They improve rapidly and many take up occupations such as mat-making, pot making, gardening, and so forth, and prove most industrious and happy, a contrast to their condition in the villages where they used to be restrained by heavy slave-forks round their necks.

As a rule, after three months in the annexe, I allow them a hut in the village, and if they are kept longer it is on account of their liability to sudden outbreaks of incendiarism and rape, which is a common form of outburst, small girls being the usual victims.

Discussing results from returns we find that under atoxyl or Soamin and Mercury 40.5% of patients showed improvement as against 35% in one camp and 8% in another under atoxyl alone, and in these two camps under Atoxyl and Mercury, the results were 30% and 19% respectively.

Under treatment glandular enlargement usually entirely disappears (see Photo No.2 opposite), often

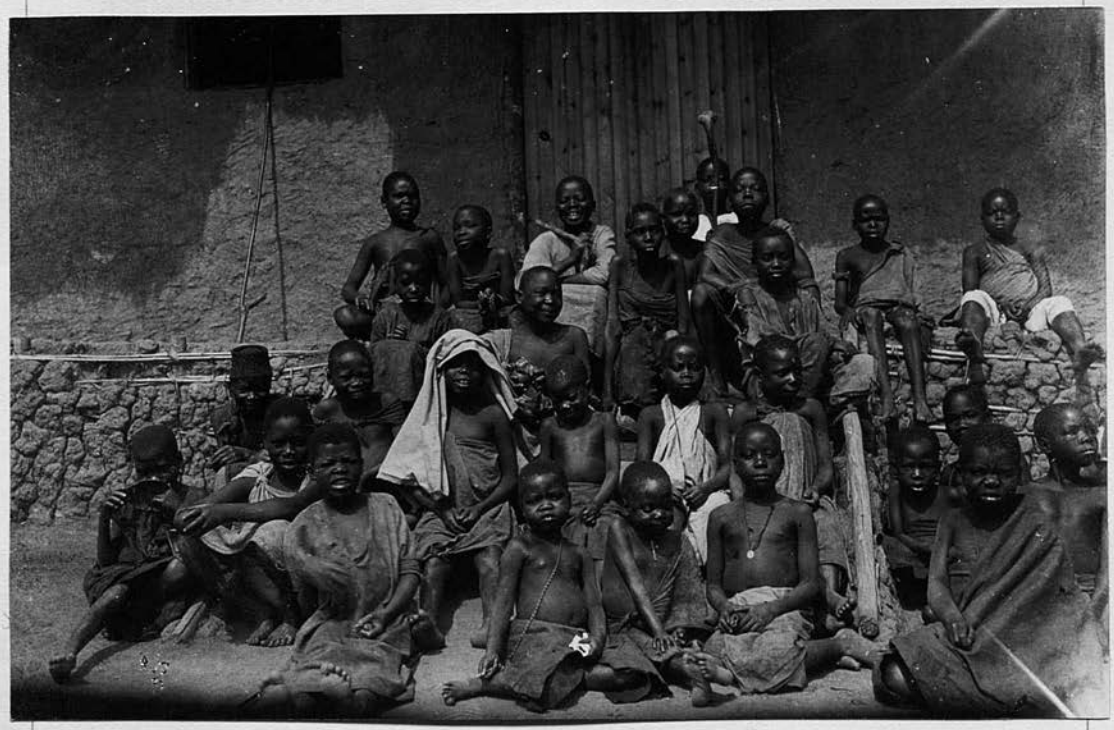
extraordinarily rapidly, and if any remain they feel like hard peas or shot, and on puncture no trypanosomes can be found. Out of all my hundreds of cases only once did I find trypanosomes in the glands after treatment, and this case had returned to his island and been without treatment for 19 months and had doubtless been reinfected. I know Dr J. H. Goodliffe in Sesse (Col. Reports) found trypanosomes in the glands of cases previously treated by Professor Koch, but here again these persons were living in palpalis areas and daily ran risks of infection. Otherwise no case of the trypanosome recurring in the glands has been found. In the blood, I have found recurrence in three cases, and in one only seven days after a full gramme injection of atoxyl.

From repeated observations I have found that after a gramme injection of organic arsenic, six hours is the shortest time before trypanosomes have completely disappeared from glands where they previously swarmed, six and ten to a one twelfth inch field. In the blood four hours after injection no trace could be found.

Unfortunately only in few cases is the extraordinarily marked improvement during the first three months maintained; later many go down, though I have still in my camp many patients who to all intents

Sleeping Sickness children

chiefly of Stout type.



and purposes look cured. They feel well and can do an ordinary person's work. They show no gland enlargement, nor any signs of trypanosomiasis, but experience tells me that though they have been thus for nearly two years without treatment, at any moment they may suddenly relapse and die with all the final symptoms of sleeping sickness, though neither blood nor cerebrospinal fluid shows the least evidence of the parasite. These cases are being further investigated by means of laboratory bred Glossinae palpales, as it is obvious that the parasites lurk somewhere, unless indeed it is that the parasites are killed but the brain changes which they have produced are progressive and eventually kill the patient, as curiously enough all so called "cured" cases die with every symptom of cerebral trouble.

Children, of whom I have at present nearly 200 in camp, do remarkably well, more so than adults, and I seldom have deaths amongst them, and I am inclined to accept Moore's view that experimental animals have been cured by the drugs which fail in the human subject simply because they are small and have a small body surface and doses are not to be calculated, as usually according to the weight of the animal but according to the body surface, and children can stand a heavier dose of organic arsenic

relatively to their body weight than can adults, who cannot stand a sufficiently large initial dose sufficient to sterilize his body of all the parasites without their acquiring chemico-resistant properties. However, that the measures taken in Uganda are proving effectual, is shown by the fact that according to the returns, the deaths before measures were instituted, numbered in 1906 some 6000, and in 1907-08, when the removal was carried out, 3,407, 1908-09 only 1408, and though 1909 figures are not to hand they will be much less, so there is good ground for the belief that though no cures are effected, still the disease will be stamped out shortly in Uganda as no fresh persons are being infected, for if what the French Commission state is true for the Congo, that mosquitoes of the genus Stegomyia are able to transmit the infection, and also other biting insects, it is certainly not the case in Uganda, for seeing the hundreds if not thousands of infected persons who have been removed inland, and living amongst sound people, it seems reasonable to expect that, since Stegomyia and other biting insects abound, if the hypothesis was true, we should have found some evidence in support. But close search has failed to find as yet one person who can be said to have been infected thus even as remotely

probable. Of course it may be that at this altitude - 4-500 feet above sea level and more - the conditions are unfavourable for such transmission of the disease, as compared with the low-lying Congo; that altitude has an influence is undoubted, but in any case either way Uganda escapes.

APPENDIX A.

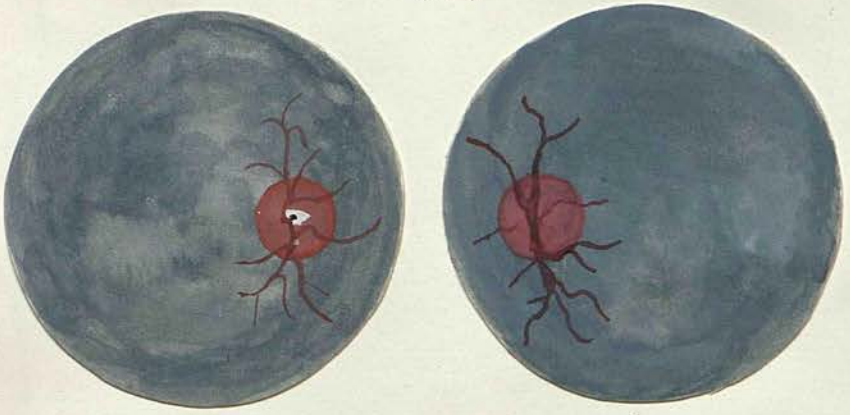
Note on the visual disturbances following the administration of the Impure Atoxyl.

The various symptoms noted have already been detailed (vid. ante) and I here add a few notes regarding the visual disturbances I have met with.

First it is important to note that toxic symptoms followed only with an atoxyl which was proved impure, and in my experience they followed even small doses, so dose had no connection with them as believed by the German Commission, who had a great number of cases with total blindness resulting. With Soamin, the same drug in a pure form, I have given up to 2 grammes at one injection with absolutely no trouble following.

The patient so affected complains first of dulled vision, and though outwardly nothing abnormal is made out in cornea or pupil reaction, it is found that there is a marked diminution in the field of vision, usually concentrically, sometimes laterally only. He complains of specks in his vision and often at a distance of over twenty (20) feet is unable to distinguish objects at all, or as in one case between certain distances I found there was

404.

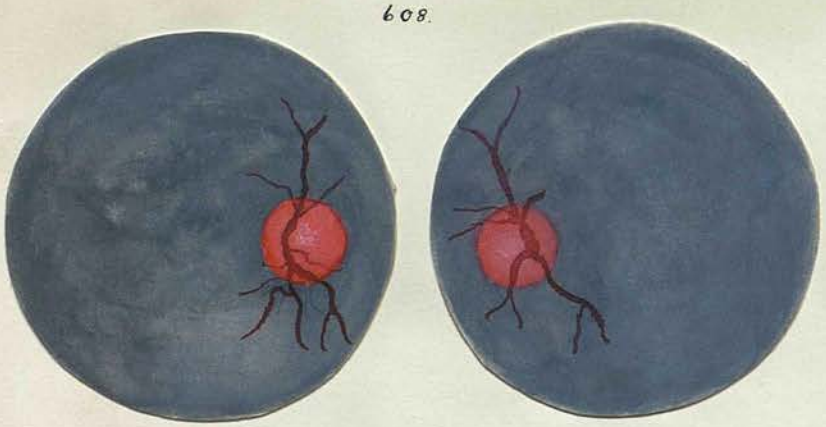


R. L.

Preyo 18-6-07.

Patient has been suffering from failing sight for two months. no pain.
OPTHAL. Left disc blurred, vessels indistinct, general swollen appearance Capill. enlarged, Choroid darker than on right side. Right disc pale, vessels distinct with white patch in centre of disc.
Red reaction against.

608.



R. Walabyeki L.

Complained of bad eyesight for last 3 weeks. no pain. Unable to distinguish objects at a distance over 30 yds. especially with Left eye.
Opthal. Rt. fundus normal in appearance. Lt. Left - edges swollen and heaped up. vessels enlarged - dimly outlined.
Red reaction - against.

diplopia.

Ophthalmoscopically, in the vast majority of cases, I could find nothing abnormal, nor has anything been published contrary to this. In a few I found symptoms of optic neuritis, a bulging and blurring of the optic disc, which I have endeavoured to portray in the accompanying diagrams. In one case there was partial atrophy, and in another total optic atrophy.

Untreated the progress is rapid to total blindness, and even in these cases frequently one can detect nothing abnormal in the fundus. I believe it to be a central condition which the following case seems to confirm.

A patient admitted under Class D. had been ill over one year and was bedridden: he was treated in the ordinary way with atoxyl, viz:

Jan. 16th, 1908 - Atoxyl 1 gram. $HgCl_2$ .01 gram.
Jan. 17th Atoxyl 1 gram.

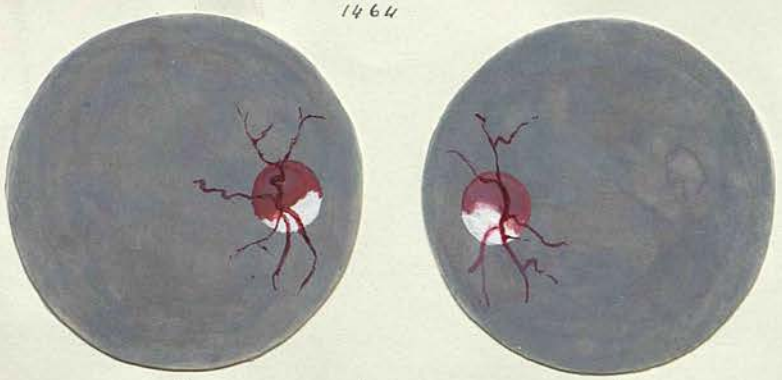
The subsequent history was as follows:-

On January 19th (two days after last injection) he was "stone deaf".

On January 21st, complained of bad vision, specially on right side.

On January 24th, was completely blind. An ophthalmoscopic examination made on both days revealed nothing, but pupils - especially of right side - were widely dilated as if paralysed.

1464

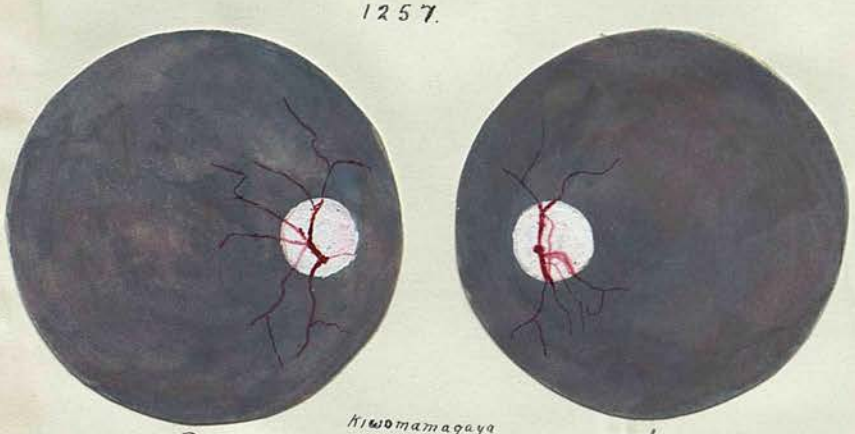


R

Gabriel
14/6/04

L

1257.



R.

Kiwomamagaya
20·6·07.

L.

On February 2nd, he died from no particular apparent cause.

A post-mortem was badly needed but not allowed. The auriscope revealed nothing abnormal, nor in five other cases which also became stone deaf, doubtless from a central lesion.

Since using Soamin, no trouble has been experienced at any time.

APPENDIX B.

BIBLIOGRAPHY.

1. Colonial Report. MS. 1909.

2. Manson's Tropical Diseases.

3. Rapport de la Mission d'Etudes de la Maladi du Sommeil au Congo Français, 1906-1908. Paris.

4. Rapport sur les Travaux du Laboratoir Médical de Léopoldville, 1907-1908. Brussels.

5. Bio-Chemical Journal, 1909, No.5-7.

6. Deut. Med. Woch. 1909, July 22.

7. S. S. Bureau Bulletin, No.6, 9, 12.

8. Lancet, 1900, March 6, p.716.

9. Erlich. Arch. f. Schiffs und Tropenh. 1909. No.16.

10. Half Yearly Reports on Progress of the Segregation Camps.

11. Native Lukiko Returns for Uganda.

12. Report of Royal Society Commission, 1903-1906. Nos.I.-IX.
