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The Sleeping Sickness of Central Africa  
AND THE  
Filaria Sanguinis Hominis Minor.

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BY

DR. PATRICK MANSON.

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## The *Filaria Sanguinis Hominis Minor*.



21, QUEEN ANNE STREET, CAVENDISH SQUARE,  
January 19th, 1891.

DEAR DR. GRATTAN GUINNESS,—

In view of the discovery of a hitherto unknown species of parasite in the blood of two cases of "sleeping sickness" from the Congo (Mandombi and Stephen N'Coyo), it is just possible that the clew to the causation of this deadly and mysterious disease has been found. At all events, a point has been reached in the study of the disease and of the parasite where an answer is urgently demanded to the question, "Has the *filaria sanguinis hominis minor* any causal relationship to the sleeping sickness of Africa?"

Should the answer be given, and should it turn out to be in the affirmative, it is more than probable that very little further study of the habits of the parasite will enable us to point out definitely in what way the disease may be kept from spreading when introduced into a community, and, possibly, even cured when already developed.

You have already told me of the ravages caused by sleeping sickness in that part of Africa where the missionaries of your society are principally engaged, and of the serious interference with the progress of their work it has entailed. On this account, and knowing your professional interest in all matters relating to disease, I have concluded that *you* are just the person to ask for assistance in investigating the relationship of the *filaria* to sleeping sickness and other associated points.

I shall endeavour to put in what follows, as briefly and clearly as I can, the present position of the question, the direction which, in my opinion, the investigation ought to take, and the assistance I would ask of you and your society's missionaries.

For all that is as yet known about the *filaria sanguinis hominis minor* I would refer you to a paper I contributed to the *Lancet* of January 3rd, 1891. The best clinical description, and one which embraces all that is really established about sleeping sickness, will be found in an article by Corre in the *Archives de Médecine Navale* of 1877, and, in a convenient *précis* of this article, in the same author's *Maladies des Pays Chauds*. Hirsch gives a very good picture of the disease, which is to be found among the Sydenham Society's translations. There are other

descriptions, but none of them, as far as I am aware, are so exhaustive and scientifically exact as those I mention.

In reading Corre's description of the sleeping sickness, and also that by certain other writers, there are several points with which I have been particularly struck. (1) The frequency with which at some time or other in the course of the disease the patients have suffered from an itching papulo-vesicular eruption, or some other allied skin affection. (2) The frequency with which the cervical glands are enlarged, and the importance as a diagnostic mark attached to this by the negroes themselves. (3) The length of time—up to seven years—that sometimes elapses before the disease shows itself after the endemic area has been quitted. (4) The wide distribution of the lesions in the nervous system, as indicated by the symptoms: languor, drowsiness, taciturnity, mania, indicating implication of the higher centres; tremor, convulsions, spasm, and paralysis, pointing to implication of motor centres and motor paths; paralysis of sphincters and bedsores, indicating trophic and perhaps spinal trouble. (5) The marked endemicity of the complaint.

These features of sleeping sickness are compatible with and are perhaps best explained by the supposition that a parasite of some sort is at the bottom of the whole matter; and, since finding the *filaria sanguinis hominis minor* in Mandombi and Stephen N'Coyo, I am tempted to speculate on the possibility of this being the parasite in question and the *vera causa* of the disease. At all events, this speculation—in the present state of the inquiry I do not pretend that it is anything more than a speculation—seems to me to offer a good working hypothesis by which to direct further investigation. Moreover, it is a hypothesis to which certain other facts I have gleaned seem to me to give strong support. One or two of these I shall mention.

In the *Lancet* of February, 1875, surgeon John O'Neil described a negro disease under the name "craw-craw," resembling in many respects common itch, but in other respects differing from this pandemic affection. In the first place, craw-craw is confined to particular districts of Africa; and in the second, it is associated with the presence in the contents of the characteristic vesicles of a nematoid parasite and not the acarus. Furthermore, O'Neil states that the disease is relieved when the subject of it gets into cooler latitudes, but returns again on the patient coming back to the hot, damp atmosphere of the endemic area. In the vesico-pustules of the six cases he examined, a filaria-like parasite was found in great abundance. His description of the parasite is rather too brief, but it is certainly not the *filaria sanguinis hominis* that he describes; for it is broader considerably than this now

well-known worm, and there are two very noticeable dark dots or streaks, unlike anything I have ever seen in the *filaria sanguinis*, on the abruptly rounded cephalic end of the crawl-crawl worm. Moreover, O'Neil's parasite lives but a very few minutes after it has been transferred to the microscope slide, so unlike, in this respect, the *filaria sanguinis*, which keeps alive on the slide for days on end.

Care must be taken not to confound this African disease with a condition of the skin described by certain Brazilian physicians under the name of crawl-crawl, and assumed by them to be the same as O'Neil's disease. The Brazilian affection was associated with the *filaria sanguinis*; and on reading the descriptions given of these cases, I have come to the conclusion that it was quite another complaint from true crawl-crawl, and that it was probably lymph scrotum, or some other form of *varix lymphaticus* produced by lymphatic obstruction induced by the *filaria*. O'Neil's disease is quite another affair.

In April, 1882, at the Academie de Medicine of Paris, and in the *Archives de Medicine Navale*, No. xxxvii., Professor Nielly described, under the name of "dermatose parasitaire," a case of skin disease exactly resembling the crawl-crawl of O'Neil in every symptom, objective and subjective. It occurred in a lad, a native of Brittany, who had never been out of France. In this case, likewise, a filaria-like parasite was found in the vesicles. The parasite was subjected to very careful scrutiny, and it was found to resemble O'Neil's parasite. The measurements were not quite the same, but two dark lines, or dots, at the cephalic end are described; and it had the same feeble hold on life after removal from the vesicles. Further, by immersing the animal in picric acid solution, an alimentary canal as well as traces of an imperfectly developed uterus were rendered visible; and by crushing the worm under the cover glass, the pharynx and œsophagus could be forced out as a prolapsus from the mouth, and their anatomical features clearly displayed. O'Neil, apparently, made no examination of his patients' blood; but Professor Nielly did, and he found on one occasion—but only on one occasion—in the blood of his young patient several living and active embryos. These a competent and experienced observer, well acquainted with the *filaria sanguinis*, pronounced not to be that parasite. Unfortunately, a careful description of these hæmatozoa is not given, and the investigation does not seem to have been carried any further in this direction; at all events, I can find no account of the state of the lad's blood, as regards parasitism, at any future subsequent date. But the *bonâ fides* of the observer and the accuracy of the solitary observation cannot be called in question. It was an important observation, and, considering all the circumstances, we are justified in concluding that the concurrence of the embryo parasites in the blood

and the more advanced parasites in the skin was not accidental, but that the latter was an advanced developmental form of the former.

Corre and others describe a papulo-vesicular eruption as being of very frequent occurrence in sleeping sickness. His description of this skin affection tallies, as far as it goes, with O'Neil's description of crawl-crawl, only he makes no reference to the contents of the vesicles, and says nothing about the presence or absence of parasites in them. It has occurred to me that the itching, vesicular eruption of sleeping sickness is of the same nature as the eruption of crawl-crawl—in fact, that it is crawl-crawl—and, therefore, parasitic; and, as there was found a nematoid embryo in the blood of Professor Nielly's case of crawl-crawl, we have reason to believe that a similar embryo will be found in the blood in African crawl-crawl; and, if in crawl-crawl, then in the sleeping sickness which is so frequently complicated with this skin disease. This blood-worm I suggest is the *filaria sanguinis hominis minor*, which, in fact, was found in the only two cases of sleeping sickness in which it has been sought for; viz. in Mandombi and N'Coyo.

I do not pretend to specify exactly the way in which such a parasite could give rise to such a disease as sleeping sickness; but I can imagine that in certain circumstances it may become itself diseased, and then be a source of danger to its host; or, that it may stray from the safe position it usually occupies—as so often happens in the case of other and better known parasites—and that in its wanderings it may find its way into the blood-vessels or lymphatics connected with the brain, and so get into position there to do mischief to that delicate structure, and give thus rise to sleeping sickness.

Should my speculations as to the causal relationship of the *filaria sanguinis hominis minor* to sleeping sickness prove to be well founded, I think we can indicate an easy and effective way of preventing the development and spread of this disease in a threatened community.

I assume that O'Neil's crawl-crawl, Professor Nielly's dermatose parasitaire, Corre's papulo-vesicular eruption of sleeping sickness, and sleeping sickness itself, are all very much the same disease, and are caused by the filaria, which is present in these cases, at one time or other, in the blood as a simple embryo, and in the skin eruption as an embryo somewhat advanced in development. Now, I take it that the presence of the worm in the skin is not a mere accident in the parasitism, but a normal step in the life history of the animal, and one it habitually follows in progressing in its life cycle. The first step in this cycle must be the discharge of the embryo into the blood stream; and the second, the penetration of the walls of the blood-vessels by the embryo and its lodgment

under the skin, where, advancing in development, it acquires an alimentary canal and a somewhat augmented size. I would remark here that there is a peculiarity about the behaviour of the *filaria sanguinis hominis minor* in the blood, as well as features in its anatomical construction which, in the light of the life history I would assign to the little animal, are not without significance. You are aware that the ordinary *filaria sanguinis hominis*, as well as the *filaria sanguinis hominis major*, though very active in wriggling about, show no disposition to materially alter their position on the slide; the *filaria sanguinis hominis minor* however, in addition to being just as active a wriggler, exhibits a very marked locomotor tendency, which is very inconvenient to the observer, as it often carries the parasite out of the field while under observation with the microscope. Further, the *filaria sanguinis hominis* and the *filaria sanguinis hominis major* are provided with a sheath, which must effectually prevent their boring through the walls of the vessels; the *filaria sanguinis hominis minor* has no such sheath, and is, moreover, provided with a retractile *rostellum* which must have a purpose. What more likely than that this purpose is the penetration of the tissues of its temporary host? Another curious and suggestive circumstance I have observed during the cold weather we have lately passed through: the *filaria sanguinis hominis major* was readily killed by the frost, or rather by the cold slides I had to use in my observations, whereas the cold had very little effect in restraining the movements of the *filaria sanguinis hominis minor*. This seems to suggest that the latter is suited for a cooler situation—such as the surface of the body. This locomotor habit, this active, naked, armed body, and this capacity for resisting cold seem to me to suggest such a habit as I conjecture, and that the surface of the body is a suitable locality for the parasite to lodge in after it has penetrated the vessels.

What the next step may be after the little animal has acquired its alimentary canal, I cannot with certainty say; but I would conjecture that it is made in one of the three following ways: (1) The irritation attending the eruption causes scratching, which ruptures the vesicles, and then the finger which has ruptured the vesicle may readily convey the parasites to the patient's mouth or to some other person's mouth. In this way the filaria may be conveyed to stomach and alimentary canal, whence it may bore its way to a suitable position in which to attain maturity and propagate its kind. Something similar we know occurs in the case of the common seat-worm, which, at night, emerging from the bowel, gives rise to an irritation which in turn leads to scratching and smearing of the fingers with ova, which are thus readily and surely conveyed to the mouth, and so the continuity of the species is assured. In such strange ways does Nature



accomplish her ends. (2) When the patient bathes, the scratching he is likely to indulge in may permit the parasite to escape into the water, in which it may seek and find its appropriate intermediary host. We know that it is in this way that the Guinea worm finds its intermediary host in a species of cyclops. (3) Some insect or other foul-feeding animal may ingest the immature parasite while eating or licking up the patient's discharges. Of the three I am inclined—for reasons which would take too much space to detail—to regard the second as the most likely step next to be taken in the progress of development. The possession of an alimentary canal seems to indicate a capacity for independent life, such as would be required until an intermediary host could be found; and the two black streaks at the cephalic end, as described by O'Neil and Nielly, suggest a boring apparatus similar to that in the embryo Guinea worm, and employed to penetrate the integument or other tissue of the hypothetical intermediary host.

If this is an approximation to the correct life history of the parasite, as I believe it is, then it is evident that it may be successfully attacked at two points in its career: either when it is in the vesico-pustules in the skin, or when it is in the water and intermediary host. Professor Nielly easily cured his patient by applications to the skin, and it is evident that the parasite could be readily destroyed in the water by boiling or filtration. Thus, should *craw-craw* or sleeping sickness appear in a community, it would only be necessary to keep the skin eruption in check, or to boil or filter the drinking water, to prevent the spread of the disease.

Some possible practical outcome of this sort I would hold out to you and your friends who would assist me to carry out this inquiry, as a substantial result for the trouble you and they may take.

To establish or confute this hypothesis, or, at all events, to learn more on the subject of this disease and these parasites, I propose to examine the blood of a large number of Congo negroes to ascertain: (1) What proportion of the inhabitants of the Congo district is filaria-infested. (2) What proportion of cases of sleeping sickness is filaria-infested. (3) What proportion of *craw-craw* patients is filaria-infested. (4) To examine the contents of the vesicles of *craw-craw* to find out the exact characters of the parasites it contains. (5) To examine the contents of the vesico-pustules of the eruption of sleeping sickness to ascertain if they contain the parasite of *craw-craw*.

With this object I propose to send to any one willing to assist me in this inquiry, a number of microscope slides, along with suitable instructions and material,

with a request to charge them with blood in the ordinary way for making dry preparations; and when they have accumulated a fair number of specimens, duly marked for subsequent reference, to forward them to me. I shall then stain and mount these slides, and examine them for the parasite we would study. If, in this way, we could get a couple of thousand slides, I think we would be in a position to draw sound conclusions, and conclusions which might prove to be of great practical utility.

The trouble I propose to ask you and your missionary friends to undertake is considerable; but I do so without much hesitation, as I have had much experience in China of the willingness of missionaries, as a rule, to assist in forwarding any investigation that seemed to offer a hope of advancing knowledge, more especially if it carried in its train some promise of benefit to the people among whom they labour.

So much for the *filaria sanguinis hominis minor*. I would like also to put in a word for the other negro blood-worm, which I have provisionally named *filaria sanguinis hominis major*, but which, I now think, might be more suitably designated *filaria sanguinis hominis diurnalis*, in allusion to its habit of appearing in the blood only during the day, and in contrast to its congener the *filaria sanguinis hominis* of Indo-China, and which, in allusion to its habit of appearing in the blood only during the night, I propose to rename *filaria sanguinis hominis nocturnalis*.

I cannot at present associate the *filaria sanguinis hominis diurnalis* with any pathological condition; but, just as *nocturnalis* has been found to be the most important factor in the causation of the elephantoid and other lymphatic diseases, so, doubtless, as our knowledge of the new parasite increases, the *filaria sanguinis hominis diurnalis* will be found to have pathological bearings of its own, perhaps of equal importance. At present, while commending the pathological bearings of the parasite to your attention, I would principally ask your assistance in working out its life history.

The diurnal habits of the parasite indicate distinctly corresponding diurnal habits in its intermediary host, just as the nocturnal habits of the *filaria sanguinis hominis nocturnalis* pointed to the mosquito, which I have shown to be the intermediary host of the Indo-Chinese blood-worm. And, as the *filaria sanguinis hominis diurnalis*, owing to its anatomical structure, is incapable of itself of escaping from the body of its host, the aid of some blood-sucker is necessary, and, conformably to the habits of the *filaria*, this must be a blood-sucker of diurnal habits as regards feeding as well. I asked the negro boy, Richard Henshaw, about the diurnal bloodsuckers of Old Calabar, and he mentioned two flies—a red and a

black—called respectively, in the Old Calabar tongue, *uyo* and *ukpom*, whose habits seemed to suit them for the rôle of intermediary host. Richard told me that these flies are very common in the plantations about Old Calabar; in fact, that they were often a great pest. They attack with great pertinacity the skin, and, if not disturbed, so gorge themselves with blood that they cannot fly, but drop off on to the ground quite helpless. Probably after thus feeding they crawl away to some place near water, where they mature the ova which they subsequently deposit in or near this, and then themselves die, possibly fall into it. Doubtless, with the blood they so greedily ingest, they swallow thousands of the parasites that may be floating in that fluid, and quite likely serve as nurses, or as it is called, intermediary hosts to the filaria. In this case the filaria will proceed on a developmental metamorphosis which will be completed about the usual time of the death of the insect, and then it will find its way out of the body of the dead insect into some medium—probably the water—by which it will more or less directly find its way again to a human host. The Rev. Frank Foster told me that the Europeans in Old Calabar called certain voracious blood-sucking insects, which are very common during the heat of the day on the creeks and rivers, mangrove flies. Probably this mangrove fly is one of those Richard Henshaw told me about.

Would it be possible for you to work out the natural history of these flies? and could you procure for me specimens which had fed on the blood of a filariated subject? I would suggest some such plan as the following: Ascertain, by microscopic examination of his blood, if some native, who was willing to earn a little money, and, at the same time, advance medical science, was infested with the filaria in question. A very short examination with an inch objective, any time between the hours of 10 a.m. and 8 p.m., will satisfy on this point. Having satisfied yourself of this, provide the man with a number of quarter ounce phials, having a gauze or perforated covering. Send him, thus equipped, to some place where these flies are numerous, with instructions to allow the flies to fill themselves at his expense, and when they drop off to transfer two or three to each phial. These he would then bring to you, and receive payment so much per head. You could then mark the phials so as to indicate the date and hour of capture or feeding of the insects. To two or three of them you would immediately add sufficient Muller's fluid to kill and preserve the contents. Twelve or twenty-four hours later you would add Muller's fluid to two or three more of the phials, indicating on the labels the length of time between the capture of the insect and its death. A day later, treat a third lot the same way, and so on, until you had a series of insects in which we could find the filaria at different stages of its

metamorphosis. When you had accumulated a complete series, you might send the bottles containing the insects to me, and I could, by dissection of the preserved insects, check any observations you had made on the fresh specimens. In a similar way to this I worked out the metamorphosis of the *filaria sanguinis hominis nocturnalis* in the mosquito in China, and I have little doubt that in this way, provided we hit on the right insect, we could work out the metamorphosis of the *filaria sanguinis hominis diurnalis*.

I propose to provide you with phials, labels, Muller's fluid, etc., and trust to your scientific enthusiasm, as well as to that of your friends, either to undertake yourself or to help me to work out an interesting and, what I am sure in the future will turn out to be, an important problem.

Apologising for this long letter, and for the trouble I propose to inflict on you and your friends, and with best wishes for your health and success on the Congo, I remain,

Yours very faithfully,  
PATRICK MANSON.

