caused by tick fever; and a Congo Free State official knew the disease well, stating that certain camps on the other side of Lake Albert were always avoided by his soldiers for that reason. In the Upper Congo the ticks are known as *kumputu*, on the Swahili coast as *kupe*, by the Bunyoro as *kibo*, by the Nubian soldier as the *Unyoro dudu* (Kiswahili insect). From inquiries amongst the Unyoro natives, it seemed that fever from the bites of ticks was very generally known, certain camps and localities being looked upon as hotbeds of the disease. In particular, the Nubian soldiers were unanimous in condemning Butiaba, the port on Lake Albert. This place contains two stations, one on the lake level, the other and main one on top of the escarpment—important, because the former is a veritable mosquito camp, the other almost entirely free. Each camp has the usual collection of grass and mud "bandas" or huts, most of them extremely dirty.

The ticks are of a greyish-yellow colour, the most noticeable feature about them being a loathsome greasy appearance. They vary in size up to the dimensions of a little finger nail. Through the courtesy of Mr. F. V. Theobald, of the British Museum, they have been identified as *Ornithodoros savignyi* (Audouin), var. *Caeca Neumann*, supposed by some to be the same as (?) *Argas moubata* (Murray). Their habitat is in the old and dirty thatch of native huts, and in

the cracks of the mud walls and mud floors, where they secrete themselves during the day, coming out at night to feed.

As regards the course of the fever, the incubation period seems to vary—natives themselves say one to five days after being bitten, but probably this period could be extended. From the individual cases the following histories were obtained:

No. 4. Nubian private, K. A. R., stayed fourteen days at Escarpment Camp, Butiaba. On his return, two days later, fell ill.

No. 60. Mayoro hut tax labourer, stayed eighteen days at Lake Camp, Butiaba. The day after his return fell ill.

No. 44. Mganda boy, belonging to Nubian soldier, stayed several days at Escarpment Camp, where he had actually picked the ticks off his body each night. On the third day after his return fell ill.

No. 23, wife of Nubian sergeant, returned from Escarpment Camp, Butiaba, six days previously, and had fallen ill two days after her return.

The ticks seem to leave no marks on black skins; in one case in a European known to have been bitten there were left big excoriated lumps the size of a bean.

Symptoms complained of by all patients were noticeably severe pains in the head, mostly in the occipital region and back of the head; sometimes cough, pains in the back and limbs, sometimes splenic tenderness; another marked symptom was vomiting; pulse varied from 90 to 120; half of the cases had diarrhoea. On examination skin was hot and dry, there was congestion of the conjunctivae, alae of the nose working, tongue mottled with slight yellow fur; no enlargement of liver or spleen.

The cases all made a good recovery, though treatment was practically nil, a placebo being given in all cases.

Annexed are such charts as were possible to obtain; from these it will be seen that the attacks did not last long; the natives give the duration of the disease from one to four weeks. I am unable to say whether relapses occurred, as none of the patients presented themselves again for treatment.

NOTE ON THE RÔLE OF THE HORSE FLY IN THE TRANSMISSION OF TRYPANOSOMA INFECTION,

WITH A REPLY TO COLONEL BRUCE'S CRITICISMS.

By LEONARD ROGERS, M.D., M.R.C.P., I.M.S.,
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THE discovery by Colonel Bruce in 1895 that the infection of nagana is conveyed from one animal to another by the bites of tsetse flies opened up the question as to whether surra of India might not be conveyed in a similar manner by some other fly; for up to the present no tsetse fly has been found in India or Burmah, although trypanosoma infection is very prevalent in certain tracts of these countries. Lingard found trypanosoma in the body fluids of certain horse flies which had fed on surra animals, but never in flies which had not so fed, but he had not published any experiments as to their powers of transmitting the disease at the time I took over charge of the Muktesar laboratory in 1898. During the summer of 1899 I carried out a series of experiments on the powers of horse flies to carry the disease, and succeeded in transmitting it through a series of dogs by making flies first bite an infected animal and subsequently transferring them to a healthy one, which was then bitten by one or more of them. No infection was, however, carried if the flies were kept for a day or more after biting the infected animal before being put on the healthy one, so that in this respect my results differed slightly from those of Colonel Bruce with the tsetse fly, for he states that they can carry the infection up to forty-eight hours after biting the infected animal. Still, my experiments demonstrated that the disease might easily be carried by the bites of horse flies from one animal to another in a stable, or under the conditions of traffic such as occur on the tonga lines in India, where surra so frequently occurs; yet it was open to question how far this method of transmission would account for the distribution of the disease in general.

Since the publication of my paper¹ early in 1901 ample confirmation of my results in various parts of the world has been made, which I desire briefly to allude to in this note, for most of the references in which I am indebted to the very complete epitome of the literature of the subject in the admirable report of Drs. W. E. Musgrave and M. T. Clegg on trypanosoma and trypanosomiasis, with special reference to surra in the Philippine Islands.² Thus, in 1902 Shilling,³ in

Togo, proved that at least two species of flies can transmit the infection in dogs, while Curry,⁴ in Manila, found *Stomoxys calcitrans* to be the principal agent in the transmission of the disease among horses, etc., active trypanosoma being found in the proboscis and stomach twenty-four hours after feeding them on infected blood. In the same year Sivori and Lecler,⁵ in South America, proved that the *Musca brava*, the *Stomoxys calcitrans*, and the *Taon* can transmit the disease from horse to horse. Musgrave and Clegg have carried on a large series of experiments on the same lines, with stringent precautions against every other possible mode of infection, and have succeeded in transmitting the disease by biting flies to the horse, monkey, cat, and guinea-pig. Further, they transmitted it by means of the common house fly from an infected dog having a wound to a healthy one in a similar condition, as well as from one dog to another by means of fleas, just as had been done previously by Plimmer and others in the case of *T. lewisii* of rats from one rat to another. They sum up their conclusions in the following words: "Trypanosomiasis is essentially a wound disease, and infection takes place when the materies morbi are brought into contact with an injured surface, and in no other way. The most common agents in bringing about this condition are biting and stinging insects, and of these certain flies, and to a less extent fleas, are the most important."

It is clear, then, that other flies besides the tsetse fly can carry the trypanosoma infection, of which horse flies are the most important in the case of surra, as, I believe, I was the first to prove. As the tsetse fly is absent from the extensive surra regions of Asia, where the rabidae largely take their place in carrying the infection, the confirmation of my work is of importance, while it suggests the possibility of the occurrence of human trypanosomiasis in other countries besides Africa, in spite of the absence of tsetse flies from them, for other biting insects may equally well convey the infection from man to man as from animals to animals.

REFERENCES.

¹ Proc. Roy. Soc., vol. lxviii. ² Reports of the Biological Laboratory, Manila, No. 5, 1903. ³ Deutsches Colonialblatt, No. 14, and Centraltbl. f. Bakt., 16, 1902. ⁴ Vet. Journ., vol. liv, p. 292. ⁵ Centraltbl. f. allg. Path., 1902, p. 963.

ADDENDUM.

The above note was sent to the Tropical Section of the Oxford meeting, but for some reason or other it was not read. This was unfortunate, for it would have supplied information as to the ample confirmation of my work on this subject, which the opener of the debate appears to have overlooked, if he has been correctly reported as having stated (in discussing his sixth proposition that only species of the genus *Glossina* can convey the trypanosome of sleeping sickness) that

It has been said by Rogers that *Tabanus* can carry the trypanosome of surra; this may be true, but I must say that I have not been quite convinced that this experiment was carried out under the best conditions. It seems evident that if you place two animals beside each other, one infected with surra and the other healthy, if you proceed to shave the skin of both these animals, thereby causing a great deal of exoriation of the epidermis and the infliction of small wounds, if you then take a cage containing *Tabanidae*, and allow them to bite the infected animal, and while so biting to suddenly have the cage transferred to the healthy one, is to my mind not a fair experiment, etc.

If this was a correct description of my experiments, it would be a serious criticism; but, unfortunately, Colonel Bruce appears to have trusted entirely to his memory for the details he gives, and has thus conveyed an extremely inaccurate picture of my methods, which I am sure he will be the first to regret.

In the paper to which he refers, I expressly stated that "infection was always readily produced in both rabbits and dogs, the fur of the latter having been carefully cut, without abrading the skin, at the site over which the flies were applied." As a matter of fact, in the case of the dogs a blunt-pointed scissors was used, and no attempt was made to cut the hair very close to the skin, but only to remove the greater part of its length. In the case of the rabbits the hair was not even cut at all, so Colonel Bruce's criticism has not even a shadow of a basis in their case; nor is there any warrant in my paper for the details he gives as to the method by which the flies were applied, for each was placed in a test tube separately and the mouth carefully inverted over the skin, no possibility of infection through abrasions being incurred. As, however, I have shown above that my experiments have received full confirmation in various parts of the world, it does not appear necessary to pursue the subject further.

TRYPANOSOMIASIS IN THE ANGLO-EGYPTIAN SOUDAN.

[PRELIMINARY NOTE.]

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On staining some films of the blood of a donkey which had been brought from the Bahr-el-Ghazal province in the summer of 1903 by Colonel Griffith, D.S.O., Principal Veterinary Officer in the Soudan, I found trypanosomes present. El Bimbashi Head, of the Veterinary Department, assisted by Dr. J. B. Christopherson, likewise found these parasites in the blood of mules from the same region. These finds were to be expected, as the tsetse fly has been known to exist in those districts since first reported by the Pethericks at Runbek in 1869. *Glossina morsitans* was found by Colonel Griffith last year on the Pongo River at the place where the road from Wau to Dem Zobeir crosses it, the most northerly point of occurrence yet recorded for the Soudan. Several specimens, all of the same species, have been sent me by Captain Brakenridge, E.M.C., at present stationed in the Bahr-el-Ghazal. The above mentioned trypanosomes appear to be trypanosoma brucei, but the whole subject has taken an additional interest by the discovery of trypanosomes in the blood of cattle from Kodok (late Fashoda).

The cattle in question were members of a herd purchased by a Greek trader in the Shilluk country and brought by him to a place some fifteen miles from Khartoum. There the animals were inspected by Bimbashi Head, Army Veterinary Department, who, suspecting that the disease amongst them might have been induced by tsetse bites, secured blood films. On submitting these to examination in the laboratory, trypanosomes were found. One of the diseased cattle, in whose blood many parasites were present, was slaughtered, and the trypanosomes were found in smears made from the liver and spleen, while in the cerebro-spinal fluid amoeboid forms were discovered closely resembling those mentioned by Castellani¹ as occurring in the cerebro spinal fluid in sleeping sickness, and by Plimmer and Bradford² in the bone marrow in cases of nagana. Further, long chains of streptococci were present in smears made from the spinal fluid. These were possibly the results of contamination, but are interesting in the light of Castellani's preliminary work in Uganda.

In an ox which died of the disease and in whose blood trypanosomes had been demonstrated, a most curious condition of pigmented ulceration was disclosed in the mucous membrane of the stomach. At present I am not inclined to regard this as having any association with the trypanosomiasis. Another ox suffering from bovine nagana is now under observation, and it is hoped that the condition may be fully investigated. On this ox I found large numbers of a tick, the male possessing a brilliantly-ornamented scutum and striped legs. I think it belongs to the genus *amblyomma*, or possibly is the species *variegatum*—an African variety of which I have no detailed description.

The question of human trypanosomiasis in the Soudan is important, owing to the geographical position of the country and, in the light of Rogers's work,⁴ the fact that the Leishman-Donovan bodies were found last year by Dr. Sheffield Neave⁵ in the spleen of a boy from Meshra-el-Rek, in the Bahr-el-Ghazal. So far trypanosomes have not been discovered in human blood, nor has *Glossina palpalis* been reported to exist. Dr. Neave, who, thanks to His Excellency the Governor-General and to Mr. Wellcome, has recently been appointed Travelling Pathologist and Naturalist to the Research Laboratories, is now on his way out from England, and will endeavour to investigate the whole subject on the upper reaches of the White Nile and in the Bahr-el-Ghazal province during the present winter. It is hoped that he may be able to localize the existing fly belts and determine what species of *Glossina* exist and how they are distributed. The question of the occurrence of trypanosomiasis in big game will also be considered.

In the Northern Soudan trypanosomiasis has not been proved to exist. I have examined the blood of bats, mud-fishes, and small birds and mammals, with negative results. This may be due to the paucity of observations or to the rarity of the larger biting diptera in the neighbourhood of Khartoum. At the same time the recent work of Schaudinn⁶ on the halteridium stage in birds, and Chatterjee's discovery