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. lxxviii. 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 excoriation 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.]

By ANDREW BALFOUR, M.D., B.Sc., M.R.C.P. EDIN., D.P.H. CAMB.,

Director, Wellcome Research Laboratories, Gordon College, Khartoum.

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

in 1902, of a living trypanosome in the stomach of an *Anopheles* mosquito have to be borne in mind. Much of the wealth of native tribes in the Southern Soudan is represented by cattle, and it will be a very serious matter if bovine trypanosomiasis is found to exist to any extent, and in a severe form, amongst the Nuer, Dinka, and Shilluk herds. Portions of the spleen and liver referred to, and a few slides of blood smears have been forwarded to the London and Liverpool Schools of Tropical Medicine. The form of trypanosome present can thus be compared with the varieties already known from Uganda, East and South Africa, Nigeria, Senegambia, the Congo Free State, and other parts of Africa.

Had it not been for Bimbashi Head's knowledge of the subject, and his enthusiasm for the work, the disease would have been missed. As illustrating his interest in the subject, and the difficulties of research in such a country as the Soudan, I may mention that he had to ride thirty miles on several occasions, for the most part in blazing heat, and had to carry the portions of diseased organs, etc., fifteen miles on horseback for purposes of examination.

REFERENCES.

¹ BRITISH MEDICAL JOURNAL, June 20th, 1903. ² *Veterinarian*, vol. lxxii, p. 648. ³ BRITISH MEDICAL JOURNAL, March 14th, 1903. ⁴ BRITISH MEDICAL JOURNAL, July 2nd, 1904; and *Indian Medical Gazette*, October, 1904. ⁵ BRITISH MEDICAL JOURNAL, May 28th, 1904; and *Laboratories Report*, 1903. ⁶ *Jour. Trop. Med.*, June 1st, 1904, et seq. (translation).

SLEEPING SICKNESS (TRYPANOSOMIASIS):

THE PREVENTION OF ITS SPREAD, AND THE PROPHYLAXIS.

By CUTHBERT CHRISTY, M.B., C.M.EDIN.

Liverpool School of Tropical Medicine.

AN opportunity was recently afforded me of perusing a copy of some rules for the prevention of the spread of sleeping sickness, issued by His Majesty's Commissioner for East Africa. In brief, the rules direct that no native of Uganda or of Kavirondo shall be allowed to travel in an easterly direction from the infected area, which for the operation of the rules is declared to be all land within 25 miles of the shore of Lake Victoria; that no native of Africa other than personal servants of Europeans shall travel out of the infected area in an easterly direction unless furnished with a medical certificate. This is valid for two days only from date of issue, and must state that the traveller has no obvious signs of sleeping sickness; further, that an authorized medical officer at an advertised time and place shall examine intending travellers, and detain in hospital or observation camp any whom he suspects to be suffering from sleeping sickness.

These regulations would be all very well if the disease were plague; but it is not, and it is extremely doubtful if any rules based on the Bombay plague "measures" could possibly be successfully carried out in tropical Africa, either for plague or any other disease. In India the traveller goes by road, rail, or boat, and there are ample facilities for each method. During the "measures" régime observation stations were established at places on the roads and at certain stations on each system of railways, as well as at the Bombay landing stages. All other avenues were stopped. Now, bubonic plague has a very short incubation period, after which there may be high fever for a day or two, or perhaps only a few hours, before physical signs develop. The doctor at an observation station is able with practice to detect, by palpation of the body, any traveller with a temperature above normal. Such persons would be detained in an isolation camp for subsequent examination and observation. If the case were plague, within a few hours buboes or other obvious symptoms appeared, rendering the diagnosis clear. By the adoption of such means only an occasional case in the early incubation period, before the temperature had risen, was likely to pass the cordon.

With regard to restrictions against spreading African sleeping sickness the conditions widely differ. For example, the single railway in British East Africa is scarcely used as yet by the natives, while there are practically no roads. An observation station on the railway could of course be arranged, but the guarding of the numerous native pathways which branch out from the affected area would be next to impossible. Africa is a network of pathways. Apart from this there are technical difficulties with regard to diagnosis which make it quite hopeless to expect more than a minimum of benefit from any segregation measures based on the above lines.

Sleeping sickness has a very long incubation period—from a few months to several years probably—during which trypanosomes are to be found in the peripheral blood in the majority of cases either daily, occasionally, or periodically before the temperature becomes affected.¹ Consequently the individual all this time is a source of danger to his neighbours as long as he remains within the infective area, that is, where *Glossina palpalis*, the species of tsetse fly known to be the transmitter of the disease, is prevalent. Outside the fly area he is practically harmless so far as we know at present, unless his blood is used for inoculation. When the incubation period has ceased there is still a period of weeks or even months during which the temperature, normal during the morning, rises several degrees every afternoon, and this occurs before any other symptoms can be detected by others than the immediate associates of the patient.

During the long period of incubation before this fever stage commences there is at present no means of arriving at a diagnosis without microscopically examining the blood or cerebro-spinal or other fluids for trypanosomes, except indeed by the discovery of enlarged cervical glands, the presence of which may ultimately prove to be an early and sure sign, for in 1903, in Uganda, I showed that their area of distribution agreed very closely with that of sleeping sickness.²

After the fever stage has set in the detection of the case is less difficult, for if the examination is carried out during the afternoon a rise of temperature and quick pulse will draw attention to it. Even then the medical officer has no light task before him to establish a diagnosis, since the examination of each fresh bloodslide for trypanosomes by the ordinary coverslip method takes twenty minutes or more to complete, and the parasites are generally so scanty that daily examinations for a month or more may fail to reveal them.

If ordinary coverslip examinations yield negative results, then half a cubic centimetre of blood has to be drawn, centrifugized and examined, daily or oftener, till the parasites are discovered. When blood examinations are repeatedly negative the cerebro-spinal fluid should be examined, particularly if any excitement or other head symptoms are present, for, as I have pointed out elsewhere,³ trypanosomes may frequently be found in the cerebro-spinal fluid of these cases, and not in the blood. So also in the case of hydrocele, trypanosomes may be found in the fluid, and not in the blood or the cerebro-spinal fluid. Even if the parasites are never observed at all, the case may still be one of sleeping sickness.

Useful information pointing to the nature of the case may be gained by practice from the very first glance at the fresh blood preparation, even without using the microscope, by noting the condition of the red cells. Normally, these are evenly distributed if the slide is clean, or in rouleau, but in trypanosomiasis there is generally some agglutination: irregular clumps of cells are seen with large spaces between them, and in these trypanosomes, if present, may be detected. More or less agglutination is fairly constant, but how early in the case is doubtful.

Apart from the question of enlarged cervical glands, the early diagnosis of sleeping sickness is difficult; it requires considerable technical skill, and it entails much labour. Hence the difficulty of initiating measures for preventing its spread which are based on the examination and segregation of travellers.

What other preventive measures are there? It would, of course, be impossible to completely evacuate the whole of the affected area—namely, those districts in which sleeping sickness cases are to be met with, stretching may be for twenty-five miles from the lake shores. Judging from observations on the banks of the Congo and the Niger, I have good reason to believe that the distribution of *G. palpalis* along the shores of the Victoria Nyanza is much less extensive than that originally mapped out by me as the infective area of sleeping sickness in 1902-3, at a time when both the cause and mode of transmission of the disease were unknown.⁴ Probably the fly, and therefore the infective area, does not extend beyond a distance of one mile or so from the water, and in places possibly not more than a few hundred yards from it.

It would under these circumstances be quite unnecessary to evacuate the whole of the sleeping sickness affected regions, for where the tsetse is not found the transmission of the disease is not probable. On the other hand, the compulsory evacuation of the presumably narrow fly area on the mainland, as well as the complete evacuation of the islands in the lake, might not only prevent the spread of the