

# REPORT ON THE POSSIBILITY OF TREATING “SURRA” BY INJECTIONS OF AN ANTI- PARASITIC SERUM.

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PROFESSOR M'WEENY,<sup>1</sup> under the heading “Recent Bacteriological Research,” reports that the tsetse fly disease is probably the same parasite that gives rise to the relapsing fever known as “surra” in India and Burma, which, especially in the latter country, every year carries off large numbers of mules and ponies.

That the organism is the same in both diseases there appears to be little doubt, though the diseases differ somewhat in their clinical history. I have indeed seen such very marked differences in different cases of surra itself, that I am quite prepared to find that, though the two diseases are identical, they may vary considerably in clinical history and character.

From an examination of specimens of surra blood stained with eosin-methylene-blue, I have now no doubt that the spirilloid forms develop spores, generally three in number, and that the spirilloids die in the blood stream, the spores being set free, and in turn becoming comma-shaped bodies (not often seen) or gradually elongating till they become spirilloids. The spirilloids are sometimes, but rarely, found in agglomerated masses.

## PARASITICIDAL POWER OF GOATS' BLOOD.

The spirilloids in surra blood, to which was added 1 per cent. of the serum, prepared as on pp. 286–288, the mixture being placed in a damp chamber at 100° F., along with a control surra blood, remained alive for the following periods:—

	Time first Spirilloid was seen to die.	Time last Spirilloid was seen to die.
Control, with surra blood only . .	5½ hours.	23 hours.
Surra blood and goats' serum .	½ minute.	2½ minutes.

<sup>1</sup> *Journ. State Med.*, February 1899.

The effect of the addition of this goat's serum was immediate, the movements of spirilloids at first becoming more vigorous, then gradually less active, and finally they ceased entirely.

#### SPIRILLOIDS FOUND IN THE HORSE FLY.

A small horse fly caught on a surra pony was examined, after I had kept it for some hours under a watch glass. In the blood and juices that could be squeezed out from its body a few spirilloids were found (dead). On further examination a few comma-shaped organisms were also found in the fly. I have since examined several other flies from surra ponies and mules, but have not again been successful in finding this organism.

#### FURTHER EXPERIMENTS WITH ANTIPARASITIC SERUM.

In a preliminary report, presented to the Government of India in August last, on some experiments I had been carrying out on ponies, with the object of obtaining an antiparasitic serum, I recorded some encouraging results, but a continuation of these experiments has completely altered my early opinions on the subject.

Having an opportunity of testing the action of serum on some cases of surra which appeared amongst the regimental foals of the 4th Burma Battalion, I availed myself of it, as I thought that the injection of the blood from a naturally immune animal (the goat) might act as an antiparasitic against the proteosoma. The following records of cases so treated may be of interest:—

CASE 1.—An iron-grey pony recently attacked by the disease, with numerous proteosomata in the blood, characteristic spots in the conjunctivæ, and a temperature below normal, was injected on the 19th July in the nape of the neck with 10 minims of blood, obtained under aseptic precautions (after shaving and washing the skin with antiseptics) by opening a vein in the ear of a goat (an animal very little susceptible to the attacks of the proteosoma). In the evening the temperature rose to 103°·5 F.; 20 minims of the same goat's blood was injected. On the 20th the temperature fell to 99°·5 F., and the proteosomata from 17 to 3 per field of the microscope; in the evening these figures rose to 100°·2 F. and 10 per field. On the 22nd, when they had fallen to 2 per field, and the temperature to 101° F., 10 minims goat's blood was again injected. On the 23rd the proteosomata had fallen to 1 per field, the temperature to 99°·50 F., and the eye spots had vanished. The pony improved up to the 29th, when the proteosoma and temperature again recurred.

CASE 2.—An old pony (æt. 13) in an advanced stage of surra was injected with 20 minims mule's blood; the temperature rose, and the proteosoma vanished from the blood, but later on reappeared in greater numbers. This pony died on the fifth day after injection.

I then tried to increase the natural immunity of a goat to the disease by injecting surra blood. I collected surra blood from Case 2, from the eye vein, and injected 5 minims into the nape of the neck of

the goat. The next day I examined its blood but found nothing, though the animal was ill and had a temperature of 105° F. The following day the goat was quite well again, and I used its blood in some fresh cases.

CASE 3.—An iron-grey pony (æ. 3) had numerous proteosomata in his blood, was very emaciated, and had a temperature of 103° F. He received 30 minims of the modified goat's blood on the 4th, the temperature and organisms fell the next day but rose in the evening. The pony was again injected on the evening of the twenty-third day, the proteosoma gradually dwindled, till on the twenty-seventh day there were none, but the temperature still continued to rise very high and to be very irregular.

The goat was during this time being injected with increasing doses of surra blood from Case 4, and usually had a high temperature on the evenings the injections were made; he remained ill for a few days and then recovered, after which another injection was made. No proteosoma could ever be found in the blood.

The proteosoma did not appear in the body till the twenty-eighth day. They were then very plentiful, and the temperature rose to nearly 105° F.; 20 minims of the goat's blood were injected; this was followed by a fall of the temperature, and the organisms entirely disappeared. The temperature recurred for a day and then kept down till the forty-first day, but the proteosomata never again made their appearance.

The after-history of this case is extremely interesting. When I wrote my first report the animal had been twenty-one days free from any abnormal temperature, had been very well, and had grown quite fat; in fact, the difference was most astonishing. On the twenty-third day from the last temperature, the temperature began to rise, and continued to be irregularly high till the animal could no longer stand, and he died on the fifty-fifth day. The later symptoms were absolutely unlike surra. Very bad kumrie affected the near hind-side first, and afterwards spread to the off-side; the pony suffered from staggers and giddiness; the stools were slimy and the urine pale. There was swelling of the head and neck, but no spots appeared in the eye and no parasites in the blood. On post-mortem examination an abscess was found in the left kidney, and tuberculous nodules (in which tubercle bacilli were demonstrated) in the spleen. The liver, stomach, intestines, and heart were all normal; the lungs were œdematous; the spinal cord showed the cause of the wasting of the hind parts; the anterior horns were degenerated. I failed to obtain a good microscopic section of the cord, but I prepared several slides showing the cells of the anterior cornua in an advanced stage of degeneration, fat globules and granules filling some of these cells, whilst others had the nuclei destroyed.

I had during this time been injecting the goat with surra blood from Case 4 till he was little affected by injection.

CASE 4.—On the day after injection parasites had fallen to nil and the temperature to normal, but these rose the following day. The animal was off its feed in a way not met with in surra ponies. On the sixth day he was in an extremely bad state; he lay down, the mouth was white and dry, and the conjunctivæ filled with spots. He rallied the next day. After two injections the number of parasites disappeared, and the temperature fell to normal on the twelfth day of the disease (six days after injection), and remained so till the nineteenth day, when the temperature rose and the parasites again became extremely plentiful. This condition lasted till the twenty-third day, an injection having been given on the twentieth. On the twenty-seventh the temperature became high and the parasites excessive, three injections of 20 c.c. each

brought the temperature down to 99° F. ; but the parasites increased, and on the 23rd the animal died full of parasites and with a high temperature.

CASE 5.—A Mounted Infantry pony having suffered from surra for thirteen days was injected, but the temperature and parasites did not fall till three days after injection. After remaining normal for eight days a four days' relapse followed. 40 c.c. of freshly prepared sterilised and filtered serum (from a goat injected from Case 4 till there was only a slight reaction) was then injected into the nape of the neck. After this date the parasites were never again found, but the temperature kept up ; abscesses formed in the sites of the old injections, the animal went off his feed, became extremely weak, and was shot, probably just before death would have otherwise occurred.

#### FURTHER EXPERIMENTS WITH ANTIPARASITIC SERUM.

In the beginning and up to the end of these experiments I had hopes that this injection method might offer a means of getting rid of the parasites through the formation of an antiparasitic substance in the blood of the animal.

From two goats resistant to, and little affected by, injections of 40 c.c. surra blood, blood was withdrawn, the serum of which after being passed through a Pasteur-Chamberland filter was sealed in tubes of 20 c.c. capacity, sterilised in a hot air steriliser at 57° C. for four hours a day for eight days, and kept ready for use, as opportunity should arise for further investigation.

By the kindness of the General commanding Mandalay District, and the Chief Commissariat Officer I was able to try the effect of the goat serum I had prepared on mules affected with surra in various stages. I injected ten cases on the first, second, third, thirteenth, seventeenth, twenty-second, thirty-first, and forty-fifth days of the disease. In only three cases was the parasite found before injection ; in two cases it was found after the first, and in three cases after further injections, although it had not been found previous to injection. In only three cases were no parasites seen, and two of those died suddenly. Thus five cases became bad after injection, three dying, one remaining about the same, and one apparently improving. Thus in eight cases out of ten the injections determined the diagnosis of the disease. Where parasites were not to be found in the first instance, they became visible, this being followed by the death of the animal.

Reference to the table in which are set out the results of inoculating these ten mules shows that one animal died one day after injection, one on the second day after a second injection, and one on the third day after a second injection. These three animals became extremely weak, could not stand up, the mouth became dry and white, the urine and fæces were not passed, the belly was not blown out, the conjunctivæ became full of spots, the pulse extremely weak and rapid, and the breathing laboured and rapid. The animals appeared to be unconscious, though they struggled occasionally with their fore-legs.

*Table showing the Results of Inoculation of a Serum into Surra Mules at various Stages of the Disease, with regard to the Appearance of the Parasite, the Temperature, and the Day of Disease.*

Case.	Mule No.	A. Day of Disease at First Serum Injection.	B. Temperature, + on, - after, Injection.	C. Day of Disease at Second Serum. Injection 1.	D. Temperature, + on, - after, Injection.	E. Day of Disease at Second Serum. Injection 2.	F. Temperature, + on, - after, Injection.	G. Day of Disease at Death.	H. Parasite found before Injection, + on, - after.	I. Parasite found after First Serum. Injec., + on, - after.	J. Parasite found after Second Serum. Injec. 1. + on, - after.	K. Parasite found after Second Serum. Injec. 2. + on, - after.
1	448	2 <sup>1</sup>	-	10	-	...	...	12 <sup>2</sup>	+	+	-	...
2	602	...	...	13	-	...	...	14	-	-	...	...
3	635	...	...	17	+	19	+	22	-	...	-	-
4	1635	17 <sup>1</sup>	=	21	-	26	-	...	-	-	-	+
5	637	...	...	3	=	5	+	...	-	...	-	-
6	908	...	...	45	=	47	=	...	-	...	-	+
7	22	...	...	3	+	5	+	...	-	...	+	+
8	454	1 <sup>1</sup>	=	9	-	10, 11	=	...	+	+	+	+
9	31	22 <sup>1</sup>	=	31	-	32, 33	+	...	+	+	-	+
10	649	31 <sup>1</sup>	+	38	-	39, 40	+	...	-	+	+	+

<sup>1</sup> Some of these figures are very doubtful, though approximate.      <sup>2</sup> Shot nearing death.

In the other cases parasites appeared in the blood, and spots were noted in the conjunctivæ—the two important diagnostic signs—became evident after injection. It is conceivable that this exacerbation was actually caused by the injection. As to why three mules died suddenly, and the others did not, although the serum used was taken from the same source and sterilised by the method above mentioned, and carefully preserved, and the syringe used was kept sterile and cleansed from animal to animal, I am unable to imagine. I do not think there could have been any accidental contamination.

#### CONCLUSIONS.

The following conclusions may be drawn from the above experiments:—

1. That by injecting goats with surra blood they get fever from which they speedily recover; that a second injection of a larger dose of surra blood is more easily overcome.

2. That as a result of such treatment a large amount of surra

blood may ultimately be given without much affecting the animal. In no case in the above experiments were parasites found in goats.

3. That the injection of sterilised serum from a goat thus prepared causes an exacerbation of the disease in mules, and renders its diagnosis more easy.

4. That horse flies can carry the parasite.

5. That the serum of goats prepared as above, when mixed with surra blood, causes surra parasites to die off speedily.

6. That the injection of this serum may cause sudden death of mules.

7. That in ponies, although the serum appears to inhibit the appearance of parasites, it does not modify the fever, and accelerates the bad symptoms. I have not had an opportunity of continuing these experiments since the 20th October, but as opportunity arises I shall try to determine in how far the forms of the *Trypanosoma* which exist in marshy pools, in fish, and in rats is related to the *Trypanosoma* which is found in surra animals.

8. The possibility of damp grass causing surra, of rats infecting grain, of flies inoculating fresh cases, must all be taken into account when discussing the causation of this very remarkable disease.