(2) Redwater or Texas Fever.

I may dismiss this disease in a few words. It is a most interesting disease, and of great importance to stock farmers. It only affects cattle.

**Geographical Distribution.**—It is found in almost every part of the world. It was first studied in North America; hence the name Texas fever. To Kilborne and Smith is due the honour of elucidating the causation of this disease, and their work forms one of the most interesting chapters in the history of pathological science. The following map, prepared by Professor Nuttall, F.R.S., Cambridge, represents the distribution of these piroplasma diseases over the whole world, as far as is at present known.

![Map of piroplasmosis distribution](image)

**Fig. 3.**

**Nature of the Disease.**—Kilborne and Smith discovered that it was caused by the presence in the red blood corpuscles of a protozoal parasite closely related to the parasite found in East Coast fever, and called by them *Piroplasma bigeminum*. They further discovered that this parasite was conveyed from sick to healthy cattle by means of a tick (*Boophilus bovis*). They also showed that

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1 Address delivered before the Physiological Section of the British Association for the Advancement of Science, at Johannesburg, August 29th, 1905.
the cattle born and bred in certain southern districts are immune to the disease, whereas cattle in the northern districts are susceptible. Hence, if southern cattle were driven into the northern district, they gave rise to a fatal disease among the northern cattle; and *vice versa*, if the susceptible northern cattle were driven into the southern district among the apparently healthy cattle of that district, they took Texas fever and died.

Texas fever was introduced about 1870, and is now endemic throughout most of South Africa. For many years the native cattle have been immune to the disease; that is to say, on account of being born and bred in a Texas fever locality they had inherited a degree of resistance to the disease which enabled them to pass through an attack when they were young, and so they became immune. But there is one peculiarity about Texas fever which does not occur in Rhodesian tick fever, and that is that the blood of an animal which has recovered from Texas fever remains infective—the germs remain latent—and so the native cattle of South Africa, although apparently healthy, are capable of infecting imported susceptible cattle with this very fatal malady. This is what makes it so difficult to import prize stock into this country.

When the Boers visited Mooi River, at the beginning of the war, they found a prize short-horn bull carefully stabled in Mr. P. D. Simmon’s farm. They killed most of his stock for food, but left this shorn-horn bull alive. When they left the farm they turned it into the nearest field, in order, of course, that it might procure food. They had much better have eaten it. It promptly took Texas fever and died.

This disease, then, has become of secondary importance to South Africa in these days. The native cattle have become naturally immune, and the disease is only fatal to susceptible imported cattle. This, of course, discourages the importation of prize stock; but with the knowledge we possess it ought to be possible, by good stabling and prevention of contact with tick-infected cattle, to keep the prize stock alive for a reasonable time. The question of the feasibility of immunising the prize stock while calves in England, might be considered.

In regard to methods of conferring immunity on susceptible cattle many have been tried, but none are absolutely free from risk.

We may sum up in regard to redwater or Texas fever by saying that our knowledge of its causation and methods of prevention are much the same as they were ten years ago. The work done by Smith and Kilborne on this disease was of such a brilliant nature,
and was done so thoroughly, that little has been left for later workers to do.

(3) **Biliary Fever of Horses, Mules and Donkeys.**

This is a disease of horses, mules and donkeys, very similar to redwater in cattle, and is caused by a closely allied parasite, the *P. equi*, discovered for the first time in South Africa by Bordet, Danysz and Theiler, and named by Laveran, of Paris.

It is similar to redwater, in that animals which have recovered from the disease remain a source of infection during the remainder of their lives to susceptible animals. The native South African horse is, like the cattle, immune to the disease. It is also conveyed by a tick, which has been shown by Theiler to be the “red tick” (*Rhipicephalus evertsi*), the infection being taken in the nymphal and transferred in the adult stage.

Theiler has also made the important observation that if a horse is injected with blood from a donkey which has recovered from the disease, as a rule a mild form of the disease is produced, so that this opens up a method of immunising susceptible horses which may prove of practical value.

Theiler has also made another curious discovery. This disease of horses was found to greatly complicate certain immunising experiments he was making against horse-sickness. He found he was introducing the *P. equi* at the same time he injected horse-sickness virus. But he found out that as the virus of horse-sickness keeps its virulence for years, whilst the *P. equi* dies out in a short time, this danger could be avoided by keeping the horse-sickness serum and virus for some time before using them.

(4) **Malignant Jaundice of Dogs.**

This disease is most important to sportsmen or importers of valuable dogs, as most of these animals are attacked sooner or later by this disease, and most of them succumb. It is also caused by
South African Stock Diseases

a species of Piroplasma (Piroplasma canis), and is spread by the dog-tick (Hemophysalis leachii).

Like redwater and biliary fever, the blood of dogs which have recovered remains infective.

The story of the tick infection is a curious one; and the credit of its discovery is due to Lounsbury. It is only in the adult stage that the tick is capable of producing the disease. It is therefore evident that the Piroplasma must remain latent in the egg, the larval and nymphal stages, and only attain activity in the adult stage.

According to Theiler there exists a peculiar phenomenon which may be made use of to confer immunity. The blood of a dog which has recovered from this disease and has been hyper-immunised is, as mentioned above, capable of giving rise to the disease in a susceptible dog. Now, if serum be obtained from this blood and a quantity added to a small amount of the blood, this infected blood loses its infectivity and no disease results.

II.—Diseases Caused by Parasites Belonging to the Genus Trypanosoma.

(1) Nagana or Tsetse-fly Disease.

We now come to the second group of diseases. These are also caused by blood parasites belonging to the same class of living things as the Piroplasma, but they are free organisms, swimming in the fluid part of the blood, and not contained in the red blood corpuscles, as are the others.

The first of this group I would draw your attention to is that disease called nagana, or the tsetse-fly disease. This fly renders thousands of square miles of Africa uninhabitable. No horses, cattle, or dogs can venture, even for a day, into the so-called “fly country.”

Now what was our knowledge of this disease ten years ago? At that time it was thought that the tsetse-fly killed animals by injecting a poison into them, in the same way as a snake kills its prey. Nothing was known as to the nature of this poison in 1894.

In 1895, on account of serious losses among the native cattle in Zululand from this plague, the then Governor of Natal and Zululand, Sir Walter Hely-Hutchinson, started the investigation of this disease. The result of this was the discovery that tsetse-fly disease was not caused by a simple poison elaborated by the fly, as formerly believed, but that the cause of the disease was a minute blood parasite which gained entrance to the blood of the
This parasite is known by the name Trypanosoma, which signifies a screw-like body.

Ten years ago two species only had attracted much attention—one living in the blood of healthy rats, discovered by Surgeon-Major Lewis in India; and the other, a trypanosome, found in the blood of horses and mules suffering from a disease known in India as "surra." As the result of this investigation in Zululand, which lasted two years, it was proved that a species of trypanosome was undoubtedly the cause of the death of the horses and cattle struck by the fly, and that the tsetse-fly merely acted as a carrier of this blood parasite.

Here is a representation of the trypanosome of nagana. These trypanosomes consist of a single cell; are sinuous, worm-like creatures, provided with a macronucleus and a micronucleus, a long terminal flagellum, and a narrow fin-like membrane continuous with the flagellum and running the whole length of the body. When alive they are extremely rapid in their movements, constantly dashing about, and lashing the red blood corpuscles into motion with their flagellum. They swim equally well with either extremity in front. These organisms multiply in the blood by simple longitudinal division, and often become so numerous as to number several millions in every drop of blood. They are sucked,
along with the blood, into the stomach of the fly, live in the alimentary tract for several days, and, when the fly has its next feed on an animal, take the opportunity of gaining access to the blood of the new host and so set up the disease.

Here is a representation, natural size, of the tsetse-fly (fig. 6). The wings have been separated in the second figure to show marking on back of abdomen.

Experiments were made which showed that the fly could convey the parasite from affected to healthy animals for at least forty-eight hours. It is a curious fact that among all the blood-sucking flies the tsetse-fly alone has this power, and up to the present the cause of this has not been thoroughly cleared up.

Not only was it found that the tsetse-flies could convey the disease from sick to healthy animals, but it was also proved that the wild tsetse-flies brought from the "fly country" and straightway placed on healthy animals, also gave rise to the disease. The question then arose as to where the tsetse-flies living in the "fly country" came by the trypanosomes. There were no sick horses or cattle in the "fly country." Investigation brought to light the curious fact that most of the wild animals—the buffalo, the koodoo, the wildebeeste—carried the trypanosomes in small numbers in their blood, and it was from them that the fly obtained the parasite. The wild animals act as a reservoir of the disease. The trypanosome seems to live in the blood of the wild animals without doing them any harm, but when introduced into the blood of such domestic animals as the horse, the dog, or ox, it gives rise to a rapidly fatal disease. The discovery that the wild animals act as a reservoir of the disease accounted for the curious fact that tsetse-fly disease disappears from a tract of country as soon as the wild animals are killed off or driven away.

In 1895, the living trypanosome which causes the tsetse-fly disease was sent to England in the blood of living dogs, in order that it might be studied in the English laboratories. These trypanosomes have been kept alive ever since by passage from animal to animal, and have been sent all over Europe and America, so that our knowledge of this kind of blood parasite has rapidly grown.

Koch, in a recent address, says that our knowledge of protozoal
diseases is based on three great discoveries—that of the malarial parasite, by Laveran; of the *P. bigeminum*, the cause of Texas fever or redwater in cattle, by Smith; and, lastly, this discovery of a trypanosome in tsetse-fly disease.

We may therefore, I think, congratulate ourselves on the growth of our knowledge of this great stock disease during the last ten years.

Since 1895 many other trypanosome diseases have been discovered in all parts of the world. The latest and most important of these is one which affects human beings, and is known as "Sleeping Sickness."

This sleeping sickness, which occurs on the West Coast of Africa, particularly in the basin of the Congo, has within the last few years spread eastward into Uganda, has already swept off some hundreds of thousands of victims, is spreading down the Nile, has spread all round the shores of Lake Victoria, and is still spreading southward round Lakes Albert and Albert Edward. The disease is in all respects similar to the nagana or tsetse-fly disease of South Africa, except that it is caused by another species of trypanosome, and carried from the sick to the healthy by means of another species of tsetse-fly—*Glossina palpalis*.

Austen, of the British Museum, has prepared a map (fig. 7) showing the distribution of tsetse-flies throughout Africa, on which it is shown that these flies extend from Lake Victoria down through Central Africa, past Lake Tanganyika to the Zambesi.

It is therefore not at all improbable that this human tsetse-fly disease may spread southward through the various fly districts to the Zambesi, and may even penetrate as far as the fly districts of the Transvaal and Zululand.

I am sorry to say that, in spite of innumerable experiments directed towards the discovery of some method of vaccination or inoculation against these trypanosome diseases, nothing definite, up to the present time, has been discovered. At present there does not seem to be any likelihood that a serum can be prepared which will render animals immune to the tsetse-fly disease. In the same way it has also been found impossible, up to the present, to so modify the virulence of the trypanosome as to give rise to a modified, non-fatal form of the disease. Again, all attempts at discovering a medicine or drug which will have the power of killing off the parasites within the animal organism, without at the same time killing the animal itself, have not as yet been successful, although some drugs, such as arsenic, have a marked effect in prolonging the
life of the animal. As nagana is fatal to almost every domestic animal it attacks, it seems very improbable that there is much chance of cultivating an immune race of horses, dogs, or cattle, which will be able to withstand the action of the parasite. It is quite evident that if an acquired immunity of this kind could be brought about, such a race of immune animals would now be found; but, as a matter of fact, there are no horses, dogs, or cattle in the "fly country." In other protozoal diseases, such as the Piroplas- mata, this acquired immunity seems to come about fairly readily.

To sum up, then, the increase in our knowledge of tsetse-fly disease during the last ten years, we may say that we have discovered the cause in the shape of the small blood parasite Trypanosoma; we have found that the reservoir of the disease exists in the wild animals, and that we can blot out this disease from any particular tract of country by the simple expedient of destroying or driving away the wild animals. We still have no means of preventive inoculation or successful medicinal treatment in this disease.

(2) Trypanosomiasis of Cattle.

This disease seems to be widespread over all South Africa. It cannot be said to be of much practical importance, as the infected cattle do not seem to be seriously affected by it. It is caused by a species of trypanosome remarkable for its large size, which was discovered by Dr. Theiler some years ago, and named T. theileri.

Dr. Theiler states that it is conveyed from animal to animal by the common horse-fly, Hippobosca rufipes.

This, then, is a short account of the trypanosome diseases which affect South Africa.

Of late years the tsetse-fly disease has become of less practical importance to the Transvaal, from which it has practically disappeared. This is due to the disappearance of the game, killed off by rinderpest; but with the preservation and restoration of the reserves with big game the disease is certain to reappear. Why the fly should disappear with the game is not known.

(To be continued.)