

BOVINE TRYPANOSOMIASIS IN PANAMA¹

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Trypanosomiasis of domestic stock has been recognized in Panama since 1909, when Darling (1) described a fatal disease of equines caused by *Trypanosoma hippicum*. Some years later Clark (2) demonstrated that cattle are also infected with this trypanosome, but that the disease is inapparent and the animals merely act as a reservoir for the virus. During the last six months a new pathogenic form, *Trypanosoma vivax* (*T. guyanense*, Leger and Vienne 1919), has been encountered in the central portion of Panama, and while it has been known for many years that it exists in the countries to the South of Panama, this is the first report of its occurrence in this republic.

Trypanosoma vivax was first reported from Africa in 1905 by Ziemann (3) and is usually considered an African form. Bruce et al. (4), Pecaud (5), Bouffard (6, 7), Roubaud (8) have demonstrated that the parasite is transmitted by species of *Glossina*, in which development of the trypanosomes takes place in the proboscis only. Leger and Vienne (9) described a trypanosome from cattle in French Guiana in 1919 which they called *Trypanosoma guyanense* and which subsequent workers, Roubaud and Provost (10), have shown to be identical with *Trypanosoma vivax*. This seems to be the first instance in which this or any other pathogenic trypanosome, normally undergoing a cycle in species of the genus *Glossina*, has been shown to be capable of establishing itself in regions devoid of *Glossina* spp. In more recent years *T. vivax* has been found in stock in Mauritius and Venezuela, also regions

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in which no members of the *Glossina* group are present. According to Adams (11), aside from *T. vivax*, *T. congolense* is the only other trypanosome which has been found in areas where its normal insect vector does not occur.

OCCURRENCE AND INCIDENCE OF *T. VIVAX* IN PANAMA

At the present time it is not definitely known when *Trypanosoma vivax* was introduced into this country nor the extent of its distribution. It is generally supposed that it was brought in during the comparatively recent importation of cattle from the South American countries where the parasite is known to exist. As mentioned before, Leger and Vienne (9) first noted *T. vivax* in this part of the world in 1919 in French Guiana and since then it has spread to Dutch Guiana, Venezuela and Colombia. As a natural consequence of cattle importation from these infected areas the parasite has reached Panama. Judging from the examinations of past records having to do with cattle and their blood parasites it would seem that the parasite was introduced during the last five years. In 1918 Teague and Clark (12), using concentration and culture methods as well as stained film technic, surveyed a large number of range and dairy animals from all parts of the Republic and were able to find only the large non-pathogenic trypanosome *T. theileri*. Much later, in 1935, further extensive surveys were carried out by Clark (2), who at that time was investigating the question of animal reservoirs of *T. hippicum*, and again *T. vivax* was not encountered. It seems reasonable to conclude, therefore, that this trypanosome was not present in the cattle here in Panama before 1935.

There has been no opportunity as yet to investigate the distribution of *T. vivax* in this country and our observations are limited to one relatively small area in the central portion of Panama near a small town by the name of Aguadulce and a small dairy some four miles North of Panama City. The parasite was discovered on a stock-breeding farm in the Aguadulce area, when it was called to our attention by the owner, who requested that we investigate a new disease which had appeared amongst his cattle. Two surveys of his animals disclosed the fact that 8.1

per cent were infected with this trypanosome. The survey figures are given in table 1 under Farm "A". Some time later a second owner, whose farm is situated next to farm "A", requested that we survey his animals also, and in these 51 per cent were found to be infected. In table 1 these figures are present under Farm "B".

The dairy herd which was examined belonged to the owner of Farm "A". According to the information obtained during the first survey on April 28, 1940, the animals comprising the herd at that time, although coming originally from Farm "A", had been at the dairy for a period of at least two years and no new animals had been added during that period. During the time

TABLE 1
Incidence of T. vivax in Panamanian cattle

LOCATION	NUMBER SURVEYED	NUMBER POSITIVE	PER CENT POSITIVE
Farm "A".....	580	47	8.1
Farm "B".....	143	75	51.0
Dairy, 1st survey.....	70	0	00.0
Dairy, 2nd survey.....	75	4	5.3

between the first survey and a second on October 12, 1940 a number of cows from the infected area was added to the old herd. A comparison of the results of the two surveys is striking: whereas on April 28th none of the herd were infected, on October 12th, after the addition of animals from Aguadulce, two of the old herd and two of the new animals were positive for *T. vivax* in thick blood smears. There can be no doubt that the appearance of *T. vivax* in the older animals at this dairy was a direct consequence of the addition of new animals from the infected region of Aguadulce. The distance between the dairy and Farm "A" precludes the possibility of the infection being carried in any other way.

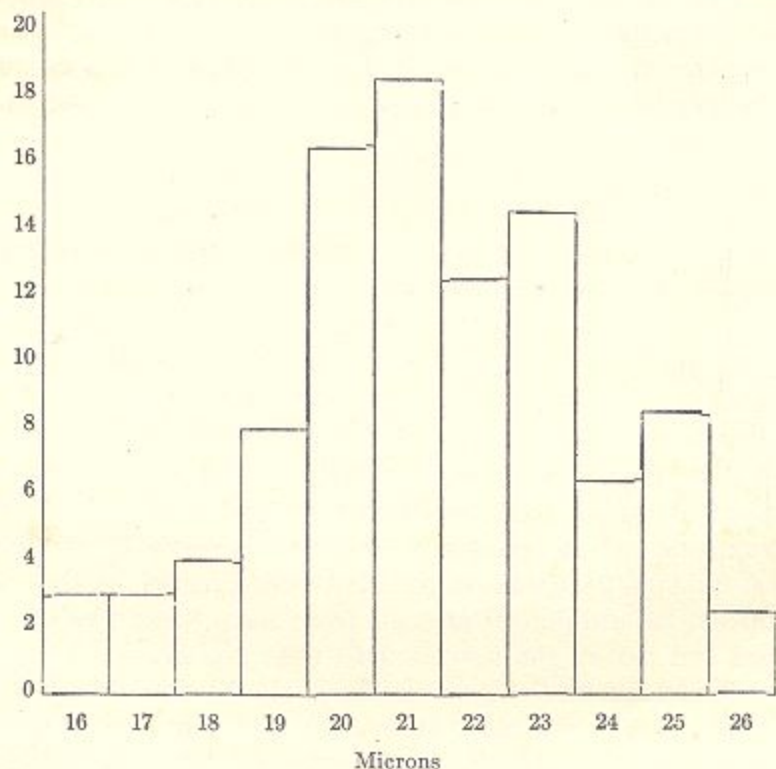
MORPHOLOGY OF *T. VIVAX*

The trypanosome which has been found in cattle here in Panama resembles *T. vivax*, as originally described by Ziemann in

1905, both in point of morphology and behavior in animals. It is a monomorphic form with a characteristic club shaped appearance. From the table and histogram in figure 1, it can be seen that the mean length of the 100 trypanosomes measured vary

FIG. 1. FREQUENCY DISTRIBUTION OF 100 TRYPANOSOMES IN REGARDS TO LENGTH

Length (μ).....	16	17	18	19	20	21	22	23	24	25	26
Frequencies.....	3	3	4	8	17	19	13	15	7	9	2



Histogram Illustrating Frequency Distribution of 100 *Trypanosoma vivax*

from 20μ to 24μ , while the complete range is from 16μ to 26μ . The body has a swollen, rounded posterior end and a narrow tapering anterior end. The undulating membrane is very feebly developed and in most instances cannot be seen. The flagellum extends beyond the anterior end for a distance of 4μ to 6μ . The

kinetoplast is large and placed usually at the extreme posterior end, but in some cases it is lateral and slightly sub-terminal. The lateral position of the kinetoplast is usually associated with the state of division or approaching division.

ANIMAL SUSCEPTIBILITY

Trypanosoma vivax is infective to the wild and domestic ungulates, but not to any of the common laboratory rodents with the exception of the rabbit, which is to some extent susceptible. Repeated attempts to infect rats, mice, and guinea pigs have resulted in failure. Occasionally a very slight transitory infection will occur in rats, but it lasts for a day or two only and then disappears. Blacklock and Yorke (13) were able to infect and maintain the infection in rabbits after the trypanosomes had gone through 38 goat passages. Roubaud and Provost (10) were able to repeat the work of the former investigators using the South American strain of *T. vivax*. In our own experiences we have established infections only in goats, calves and horses.

Goat experiments

A young native goat (no. 3, see table 2), three months of age and weighing 13 pounds was inoculated with 5 cc. of whole blood taken from the jugular vein of a naturally infected range cow, on May 8, 1940. Trypanosomes appeared in the blood on May 18, 1940, ten days after inoculation and the resulting infection has been of the chronic relapsing type. The occurrence of the trypanosomes in the peripheral circulation was marked during the first 18 days after which time the number decreased and finally disappeared, only to reappear again after a period of two days. At first the negative period was relatively short, usually from two to four days, but at the present time, some five months later, this interval is from 10 to 16 days with a corresponding shorter positive blood phase. The animal has exhibited no outward signs of the infection with the exception of fever and anemia. It has more than doubled its weight since the start of the experiment and its appetite is in no way affected. The temperature has been very irregular with many mild fever periods of short duration.

There is no indication at the present time that the infection will terminate fatally. The same results as given above apply to two other goats which were infected during the course of this study. The animals, goats 2 and 4, are listed in table 2.

TABLE 2
Summary of animal inoculations

ANIMAL	AGE	DATE OF INOCULATION	INCUBATION PERIOD	SOURCE OF INFECTIVE MATERIAL	REMARKS
			<i>days</i>		
Goat 2	3 mos.	5/ 8/40	10	Cow "Tachuela"*	Alive. Relapsing type of infection
Goat 3	3 mos.	5/ 8/40	7	Ox Trabajo*	Alive. Relapsing type of infection
Goat 4	6 mos.	6/28/40	8	Calf 8	Alive. Relapsing type of infection
Calf 8	6 mos.	6/ 7/40	7	Goat 3	Animal died 6/28/40
Calf 9	1 yr.	8/ 5/40	9	Goat 4	Alive. Relapsing type of infection
Mare 1	3 yrs.	6/ 7/40	13	Goat 3	Alive. Last positive 7/16/40
Colt 2	1 yr.	6/ 7/40	13	Goat 3	Alive. Last positive 9/13/40
Rat 211	Adult	3/27/40	2	Cow "Nube"*	Positive for two days only
Rat 212	Adult	3/27/40	0	Cow "Nube"*	Never positive
Rat 213	Adult	3/27/40	0	Brown bull*	Never positive
Rat 214	Adult	3/27/40	2	Brown bull*	Positive for two days only

* Naturally infected range animals.

Calf experiments

A young bull calf was inoculated on June 7, 1940 with 5 cc. of whole blood taken from goat 3. The blood of the calf was positive for trypanosomes on June 14, 1940 and remained positive until its death two weeks later. At the time of inoculation the blood of the animal showed a light infection of piroplasma, and on one or two occasions during the two weeks prior to its death these parasites were again seen in few numbers. During the three weeks before death the animal lost considerable weight and at times refused to eat. An intermittent fever was present, al-

though a great deal of importances could not be attached to this because of the concomitant piroplasma infection. During the last week copious lacrimation was present with pronounced swelling of the eye lids and surrounding areas of the face. The calf died on June 28, 1940 just three weeks after infection. At autopsy the gross findings were not remarkable. There was emaciation, severe anemia, edema of the eyelids, some pulmonary edema and several abscessed intestinal lymph nodes. Microscopic examination of the tissues showed petechial hemorrhages in the brain substance, pulmonary edema, round cell infiltration in the periportal spaces of the liver, sarcosporidial infection of the myocardium and necrosis of intestinal lymph nodes due to presence of unidentifiable worms.

A second bull calf (no. 9) one year of age was inoculated with 5 cc. of whole blood taken from the jugular vein of goat 4. The inoculation was done on August 5, 1940 and trypanosomes appeared in the peripheral circulation eight days later. In this animal the course of the infection has been similar to those in the goats. There has been an intermittent fever, never very high, with trypanosomes appearing in the circulation at varying intervals. Although it has been maintained on a good diet the animal does not gain weight and appears thin and under-nourished.

Horse experiments

On June 7, 1940 a mare (no. 1) three years old, was inoculated with 5 cc. of whole blood from goat 3 and thirteen days after trypanosomes appeared in the peripheral circulation. Trypanosomes could be found in the blood off and on until July 16, 1940 when they disappeared from the circulation and never reappeared.

A colt (no. 2) one year of age was injected with 5 cc. of whole blood from goat 3. Trypanosomes were first seen in the blood on June 20, 1940 and appeared in the circulation during various periods until September 13, 1940 when the blood was positive for the last time.

In neither of these animals were there any demonstrable reactions to the presence of the trypanosomes and it is probable that horses serve as animal reservoirs for *T. vivax*.

CLINICAL DIAGNOSIS AND PATHOLOGY

The clinical picture exhibited by the infected animals is in no way characteristic of the disease. The symptoms are those which might be shown by an animal suffering from any of the chronic protozoal diseases. There is intermittent fever, progressive emaciation, anemia, roughing of the coat and sometimes edema of the face. As the disease progresses there is evidence of posterior weakness and the animal is inclined to drag the hoof. Frequently there is a loss of appetite. When these symptoms are present it is presumptive evidence of a trypanosome infection and laboratory tests are indicated. The only reliable laboratory procedures for the diagnosis of this infection at the present time are thick film blood examinations and gland punctures. A combination of these two methods will usually suffice to bring to light most of the infections in a herd.

In our experience it is not possible to establish a diagnosis at autopsy as no gross lesions which have been seen are definitely characteristic.

SUMMARY AND CONCLUSIONS

1. *Trypanosoma vivax* has been found for the first time in cattle of the Republic of Panama.

2. It is concluded that the parasite has been introduced into Panama during the past five years as a consequence of the importation of cattle from the countries to the South where infected animals are known to occur.

3. A series of animals were inoculated with the parasite but infections were successfully established only in calves, goats and horses. The ordinary small laboratory animal was not susceptible.

4. The trypanosome is well established in the local animals, as surveys of a number of herds revealed that from 5 per cent to over 50 per cent of their members were infected.

5. The symptoms exhibited by the infected animals are not characteristic. Fever, anemia, and emaciation are the most common manifestations, while in some weakness of the posterior extremities, edema and loss of appetite are sometimes present.

6. Diagnosis is best accomplished by thick blood smear methods and by gland puncture.

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