

TEXAS AGRICULTURAL EXPERIMENT STATION.

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INFECTIOUS ANAEMIA OF THE HORSE.



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INFECTIOUS ANAEMIA OF THE HORSE.

(A PRELIMINARY REPORT.)

M. FRANCIS AND R. P. MARSTELLER.

That part of the State of Texas which lies along the Gulf of Mexico is a flat costal prairie extending fifty miles or more into the interior. That portion of it which lies between the Sabine and Nueces rivers is covered with rank coarse grasses with only here and there trees of any size except along the water courses. This region having an elevation of only a foot or so per mile above the sea level, is too flat and wet for general farming, though of recent years rice culture has been developed with marked success. There are yet vast areas of it that are used only for stock raising on account of the deficient natural drainage. As this region has an abundant rainfall, much of the water must be carried away by evaporation, or slowly seep away through the ground, or accumulate in surface ponds which become actually dry only in dry seasons.

For many years this area has been used mainly for stock raising, but as time went on the industry has become less and less profitable on account of parasitic diseases, due to ticks, flukes in the liver, stomach and bowel worms, lung worms and others; until some people have abandoned stock raising or have moved their animals to higher altitudes.

Horses have been remarkably free from the troubles mentioned, but they, too, have been slowly dying of an obscure wasting disease, without apparent cause, which sooner or later results in death. This manifests itself by a gradual wasting away, with great loss of strength and spirit, and with partial loss of control of the hind quarters. A similar disease has been reported from Nebraska by Peters, from Minnesota by Cotton, from North Dakota by Van Es, from Manitoba by Torrence, and various other localities by Mohler. In Texas it has been studied by Knight, Langley and Parker. Some of these have described it as "*Malarial Fever of the Horse*," "*Swamp Fever*," "*River Bottom Disease*," "*Infectious Anaemia*," "*Loin Distemper*," etc.

SYMPTOMS.

The most conspicuous symptoms are those of progressive emaciation without apparent cause. Horses whose digestive organs are apparently normal, whose teeth are sound, whose appetite is good, and who have access to an abundance of nourishing food, gradually become thinner in flesh until the emaciation becomes extreme. There is frequent passing of urine, and difficulty in managing the hind quarters, with dragging of the toes and swaying from side to side. The animal finally gets down, can not get up without assistance, and dies. Hence the local name "*Loin Distemper*." If we observe them from day to day we de-

fect periodical attacks of fever, lasting several days to a week or more, in which the temperature will range from 103° to 107°. Then follows an interval in which the temperature may be subnormal, ranging from 95° to 98°. Then there is apparent recovery, with some improvement in condition, but it is only temporary, as sooner or later another attack occurs which leaves the animal weaker and more emaciated than before. The pulse is usually rapid and weak with regurgitation in the jugular veins.

The mucous membranes are very pale and often yellowish or rusty colored, or we may observe ptechiæ on the conjunctiva, and some dribbling of bloody serum from the nostril and anus.

The skin becomes dirty, with an unhealthy appearance of the hair, the eyes sunken and present a glassy stare, urine dribbles away frequently, the weakness becomes extreme, the tail hangs motionless, the anus becomes relaxed with frequent passage of gas and mucus, yet the animal will eat ravenously until it dies. We have observed no disturbance of the nervous system. If we examine the blood we find it deficient in red corpuscles, with some of them abnormally large, others small, and rarely a nucleated one. But out of hundreds of examinations of the blood in all stages of the fever, and during the intervals, we were unable to find trypanosoma, piroplasma, bacteria, or anything else to account for the fatal result. We made a large number of attempts to cultivate a germ from the blood, on horse serum, bouillon, gelatin, agar, etc., but all of these failed. Yet a virulent principle exists in the blood. If we inject a small quantity of it, say 1 to 2 c.c. under the skin of another horse or mule, we reproduce the disease in from ten to twenty days. If we filter the blood through a porcelain filter, which seems to be perfect, we have a similar result. If we inject this virulent blood into cattle, sheep, goats, pigs, or dogs, no sickness results to these animals. This would seem to show that the germ is exceedingly small and that it belongs to the group of ultra-microscopic organisms. How the infection spreads from one animal to another is unknown. We have kept healthy horses with diseased ones all summer and fall, allowed them to eat and drink together, and run together in the same pasture, where there were the same flies, ticks, and mosquitoes, yet no sickness has occurred among the healthy ones.

The blood of those that survive the first attack, and that regain much of their lost flesh and spirit, is as capable of producing the disease one year after the primary infection as it was during the first sickness. It would seem probable that the blood remains virulent for life.

The mortality is very high. Surely 80 per cent die within a few weeks. Some mules regain much of their flesh and strength if they be well fed and not worked, but almost every horse will die in spite of the best care and attention.

POST-MORTEM EXAMINATION.

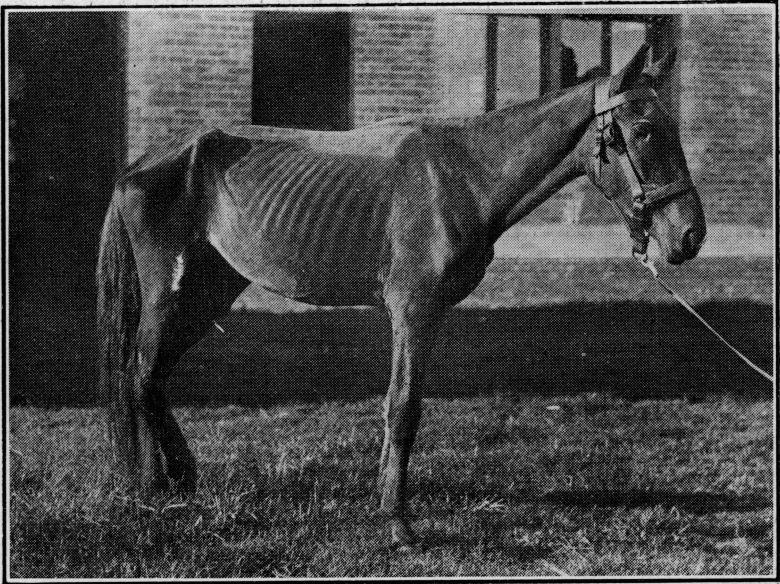
After death we notice extreme emaciation, some œdematous swellings along the lower part of the body and usually some bed sores.

The muscles are pale and the blood watery. The thorax appears nor-

mal except some patechiæ on the heart and pericardium, with also some enlargement of the heart. In the abdominal cavity we find marked spleen enlargement. The normal spleen weighs about two pounds. In the disease in question we find it weighing from four to eight pounds. The digestive organs appear normal and contain the usual parasites. The kidneys and liver show no conspicuous changes. In fact, aside from the blood, heart and spleen lesions, we are at a loss to account for the death of the animals.

HORSE NO. 1.

In October, 1907, Dr. W. G. Langley, of Dallas, was called to Harris county to investigate a disease of horses in that section. After making whatever examinations were possible in field work, and not arriving at



Horse No. 1.—Notice the extreme emaciation, though he had been well fed for a year. Died in a few days after this photograph was taken.

a satisfactory diagnosis, he forwarded some blood and smears to the Station Laboratory, and very kindly supplied us with all available information on the subject. A few days later we went to Katy, Texas, and, through the kindness of citizens there, were shown a large bay horse belonging to Mr. A. He seemed to be 10 or 12 years of age, very poor and weak, with œdematous swellings along the sternum and abdomen. The temperature was 102°. We suspected trypanosoma on account of the similarity of the symptoms with surra, but after repeated examinations of the fresh blood we could find none. Mr. A. offered to donate the animal to the Station for experimental purposes, but it was evident from his condition that he could not stand the journey on the cars. He died a few days later.

We then went to Mr. S.'s farm, a mile or more from town. In doing so we passed through a ravine and followed a creek some distance. As we were going along our horse was attacked with dozens of horse flies (*Chrysops flavidus* Wied), whose bites were sufficient to cause several drops of blood to escape. Arriving at the farm, we found his two-year-old among the bushes along the creek. He preferred to remain there the whole time, though it was a very pleasant day. The colt was very poor in flesh, though well fed on ear corn. His temperature was 104.4°, respiration 40, pulse 80, and his left eye was badly inflamed without apparent cause. He had an attack similar to this about a year ago, but partially recovered. He has been sick a month or so now.

Microscopical examinations of the fresh blood were made with great care, but no trypanosoma could be found. We then arranged to have him sent to the Station for further study, where he arrived October 22d.

We fed him generously on bran, corn chops, and prairie hay, which he ate ravenously, but he became poorer and weaker every day. Bowel discharges seem normal, but the urine is very dark in color and is passed frequently. If some of it be treated with fuming nitric acid, we observe the play of colors indicating bile. The colt stands for hours in a listless manner with the anus relaxed, the penis hanging out, the tail motionless, and he pays no attention to the dozens of flies that cover him. We filled a syringe with blood from his jugular vein and injected 5 c.c. of it intravenously and 5 c.c. subcutaneously into a horse we will call No. 2. His further history is as follows:

1907.	Temp.		Resp.	Pulse.	Remarks.
	A. M.	P. M.			
October 23.....	102.0	.....	50	66	
October 24.....	102.0	.....	30	64	Eats well.
October 25.....	100.2	.....		
October 26.....	99.0	.....			Anus and rectum relaxed.
October 27.....	100.4	.....	28	80	Down this evening. Blood tested 20 per cent on haematokrit.
October 28.....	100.0	.....		
October 29.....	99.0	.....			Down again this evening. Can't get up.
October 30.....	100.2	.....	28	64	
October 31.....	99.6	.....			Down again. Can't get up.
November 1.....	100.4	.....		
November 2.....	102.5	.....		
November 3.....	103.0	104.4		72	
November 4.....	102.4	103.8			
November 5.....	102.4	102.2			
November 6.....	101.6	101.6			
November 7.....	98.3	.....	60	100	Down again. Can't get up.
November 8.....	99.6	.....		
November 9.....	98.6	98.8			
November 10.....	97.4	98.4			Very weak today.
November 11.....	97.0	.....			Down. Killed at 4 p.m. and posted.

During this time, from October 22d to November 11th, we made smears of the blood daily, hoping to find trypanosoma or piroplasma, but all our efforts were fruitless.

POST-MORTEM.

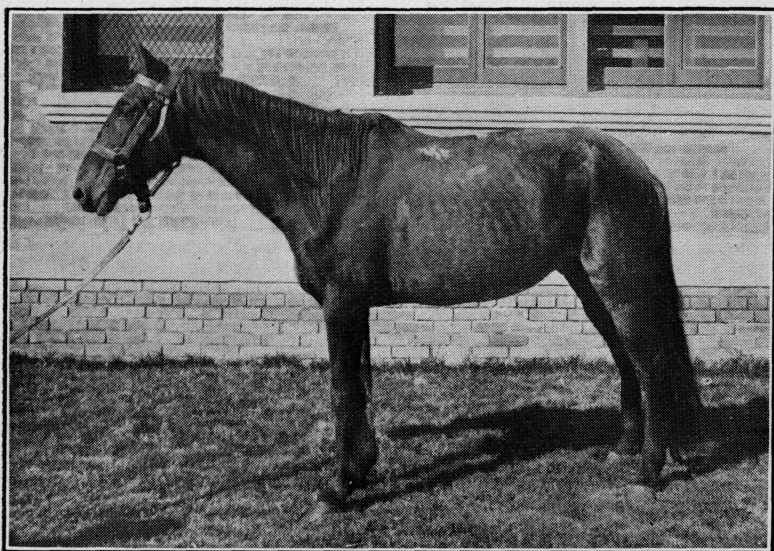
Subcutaneous tissues not yellow, blood thin and watery. Digestive tract normal. Some twenty-five or so *Tænia mamillama* in the duodenum, lungs normal except a tumor or abscess-like affair the size of a

hen's egg, liver appeared enlarged, but of normal color, gall duct open and normal, spleen normal in size and texture, no abscesses in it, kidneys apparently normal.

Made a large number of blood smears from the heart, kidney, spleen, and liver, which were fixed and stained with eosin and methylene blue, but on examination no trypanosoma or piroplasma were found.

HORSE NO. 2.

Horse No. 2 was raised in Brazos county and, with the exception of some eye trouble, seemed to be in good health. He was well fed on corn chops, bran, and prairie hay daily. October 25, 1907, he was given 5 c.c. of blood subcutaneously from Horse No. 1, and a similar



Horse No. 2.—Inoculated from Horse No. 1 more than a year ago. Had three acute attacks of fever, but survived them. (See Graphic Record.) His blood is yet virulent. He is losing flesh and strength rapidly, and will probably die within 30 days.

quantity intravenously from the same source. His fever record is as follows: October 23d, 100°; October 24th, 99.8°; respiration 32, pulse 36; October 25th, 99°; October 26th, 98.6°; October 27th, 98.9°; blood 40 per cent corpuscles; October 28th, 99°; October 29th, 99°; October 30th, 98.8°; October 31st, 99.2°; November 1st, 98.6°; November 2d, 98.9°; November 3d, 98.9°; November 4th, 99.2°; November 5th, 99.6°; November 6th, 99.2°; November 7th, 98.4°; November 8th, 99.3°; November 9th, 99°; November 10th, 99°; November 11th, 100°; November 12th, 100.7°; November 13th, 104.2° a. m., 104.9° p. m.; November 14th, 104.3° a. m., 105.2° p. m.; November 15th, 104.3° a. m., 103.4° p. m.; blood 30 per cent corpuscles; November 16th, 101.3°; November 17th, 99.8°; November 18th, 99.5°; Novem-

ber 19th, 98.6°; November 20th, 98.6°, losing flesh rapidly; November 21st, 98.6°; November 22d, 99.8°.

November 23d, 99.8°. Made plantings from the blood on agar and glycerin-agar, incubated them at 37° C. thirty-six hours, but no visible growth occurred. Planted also into broth which were plated out after thirty-six hours and a few colonies developed which were regarded as contaminations.

November 24th, 100.7°.

November 25th, 105.6° a. m.; 105.8° p. m.

November 26th, 105.6° a. m.; 106° p. m.

November 27th, 104° a. m.; 103.5° p. m.

On the 26th we inoculated three tubes of bouillon with several drops of blood from the jugular vein; put this in the incubator at 37° C. for forty-eight hours; then injected 2 c.c. of it intravenously and 1 c.c. subcutaneously into Horse No. 3, which caused his death on the fiftieth day following.

November 28th, 102°; November 29th, 98.1°; November 30th, 97.3°; December 1st, 97.4°; December 2d, 98.6°; anus relaxed. December 3d, 98.9°; December 4th, 98.2°; December 5th, 99°; December 6th, 99°; December 7th, 98.9°; December 8th, 98.6°; December 9th, 98.9°; December 10th, 105° a. m., 106.3° p. m.; no trypanosoma in blood. December 11th, 105.6° a. m., 106.3° p. m.; respiration 50, pulse, 88. December 12th, 105.2° a. m., 105.6° p. m.; won't eat grain; passes flatus. December 13th, 104.4° a. m., 105.2° p. m.; December 14th, 102.6°; December 15th, 100.3°, hemorrhage from nose and anus; December 16th, 99.2°, hemorrhage from nose and anus; December 17th, 99°; December 18th, 99.2°; December 19th, 99.2°; December 20th, 99.5°; December 21st, 99.8°; December 22d, 99.6°; December 23d, 100°; December 24th, 100.4°; December 25th, 100.6°; December 26th, 99.9°; December 27th, 99.7°; December 28th, 100°; December 30th, 99.5°; December 31st, 99.4°.

TEMPERATURE RECORD OF HORSE NO. 2.

1908.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1.....	101.2	99.6	100.2	100.0	99.2	99.8	101.6	100.8	100.8	100.2	100.4
2.....	101.7	98.6	100.2	100.2	99.8	100.6	101.0	101.0	100.4	99.8	99.2
3.....	100.9	100.4	100.0	99.6	100.1	100.2	101.2	101.4	100.0	99.8	99.2
4.....	101.0	100.4	99.8	99.0	100.2	99.8	101.2	101.0	100.6	100.2	100.0
5.....	100.7	100.4	99.6	99.4	102.2	100.4	101.4	100.6	101.2	100.2	101.0
6.....	100.3	100.6	100.2	99.6	100.0	100.6	101.0	100.8	104.8	101.8	99.0
7.....	99.6	100.0	100.2	100.0	99.0	100.0	101.4	100.4	103.8	101.8	100.0
8.....	100.3	99.8	100.6	100.0	99.2	99.8	101.4	101.2	104.4	101.8	99.4
9.....	99.3	99.8	99.8	100.4	99.0	99.6	100.8	100.0	103.8	100.8	99.8
10.....	100.5	99.2	101.3	100.5	99.2	100.2	100.6	100.6	104.2	101.4	100.6
11.....	100.5	99.2	101.0	100.6	99.4	100.0	101.0	100.8	102.6	101.8	99.4
12.....	100.5	.....	101.8	99.0	99.8	100.0	100.6	100.6	102.4	101.0	99.0
13.....	100.9	.....	100.4	99.0	99.6	99.6	101.4	100.6	101.8	100.2	101.2
14.....	100.4	.....	100.0	100.0	99.8	100.6	101.2	100.8	100.6	100.4	101.0
15.....	.....	.....	100.0	99.8	99.8	100.0	101.0	100.4	100.6	100.2	100.8
16.....	100.0	.....	98.8	100.0	99.0	100.2	101.0	100.6	101.0	100.6	99.8
17.....	.....	.....	99.2	100.6	100.0	100.8	101.2	100.2	100.6	100.8	99.2
18.....	100.4	.....	99.2	99.8	99.8	100.4	101.4	100.4	101.6	100.6	99.2
19.....	100.0	.....	99.0	100.0	99.8	101.0	100.6	100.4	101.2	100.6	99.6
20.....	.....	.....	99.0	99.0	100.0	101.4	101.8	100.8	101.8	100.6	100.0
21.....	.....	.....	99.2	100.0	99.6	101.2	101.8	100.6	100.8	101.0	99.5
22.....	.....	.....	100.0	99.4	99.8	101.4	101.5	101.0	100.8	101.0	98.0

TEMPERATURE RECORD OF HORSE NO. 2—continued.

1908.	Jan.	Feb.	Mar.	April.	May	June	July	Aug.	Sept.	Oct.	Nov.
23.....			99.4	99.6	99.6	101.0	101.0	100.4	100.4	100.4	99.0
24.....			100.0	99.4	99.6	101.0	101.2	100.4	102.0	100.0	99.4
25.....		99.6	100.0	99.8	99.6	101.0	101.6	101.0	101.4	100.2	100.6
26.....		99.8	99.0	99.6	99.4	100.6	101.4	100.8	102.2	100.2	99.8
27.....		99.5	100.6	99.2	99.2	100.4	101.4	100.0	100.8	101.0	99.6
28.....	100.2	99.0	100.2	99.6	100.2	101.4	101.4	100.6	99.6	100.8	99.6
29.....	100.2	99.6	100.0	99.4	99.6	101.6	101.0	100.8	100.2	100.8	99.2
30.....	100.2		99.4	99.6	99.6	101.6	101.2	100.8	99.8	100.4	99.4
31.....	99.7		99.4		100.0		101.2	100.8		100.2	

If we study the temperature record of this horse, we observe four severe fever reactions and several mild ones.

Reaction No. 1 began on the twenty-first day after infection and continued four days, with a maximum morning temperature of 104.3°.

Reaction No. 2 began on the thirty-third day after infection and continued five days, with a maximum morning temperature of 105.6°.

Reaction No. 3 began on the forty-ninth day after infection and continued five days, with a maximum morning temperature of 105.6°. (See Graphic Record.)

Reaction No. 4 began September 4th, 316 days after the primary infection and continued seven days, with a maximum morning temperature of 104.8°.

A mild reaction occurred in March, lasting three days; and another in July, lasting forty days. We must regard these as relapses, as there was no other source of infection known to us.

On November 4th, 1908, which was about twelve and one-half months after the primary infection, we inoculated Horse No. 11 with 1 c.c. of blood from Horse No. 2, which fevered it promptly on the tenth day, thus showing that the infection certainly persists over a year in the blood and probably continues for life. At the present time, November 18th, Horse No. 2 is very thin and would die in a few days—were it not for the very best care and attention given him daily.

That the disease under consideration does not affect other domestic animals seems to be proven by the following experiment: On March 24, 1908, we drew some blood from the jugular vein of Horse No. 2 and immediately injected 1 c.c. of it subcutaneously into a yearling heifer, a pig, a goat, and a sheep. No sickness was observed among these animals. (See diagram of Experiments.)

1908.	Heifer I.	Goat I.	Sheep I.	Pig I.	Heifer (check).	Goat (check).	Sheep (check).	Pig (check).
March 24.....	101.6	102.8	102.8	102.2	102.0	101.8	102.0	102.6
March 25.....	101.4	102.8	102.8	102.2	101.6	101.2	102.2	101.4
March 26.....	102.4	102.8	102.0	103.0	101.4	102.8	103.0	103.0
March 27.....	102.4	102.2	103.0	103.0	102.6	102.6	104.8	104.0
March 28.....	102.4	103.0	104.5	103.6	102.6	101.6	103.4	103.4
March 29.....	102.4	103.0	103.6	102.2	102.6	101.8	106.0	102.6
March 30.....	102.4	101.4	102.8	103.0	102.6	101.6	103.6	103.2
March 31.....	102.6	102.2	104.6	102.0	102.8	102.2	103.0	102.0
April 1.....	101.8	102.4	103.6	103.2	102.4	101.8	106.0	103.6
April 2.....	101.8	101.4	103.6	102.8	102.2	101.0	103.0	102.6
April 3.....	102.0	101.6	102.4	103.6	102.0	102.2	104.0	103.0
April 4.....	102.0	101.0	104.6	104.2	101.8	104.0	103.6	104.6
April 5.....	102.4	102.2	104.4	103.0	102.6	102.0	104.2	103.8

1908.	Heifer I.	Goat I.	Sheep I.	Pig I.	Heifer (check).	Goat (check).	Sheep (check).	Pig (check).
April 6.....	102.0	101.8	104.0	103.6	101.4	103.6	103.6	103.0
April 7.....	101.8	101.8	103.8	102.6	101.6	102.8	103.0	103.0
April 8.....	101.8	102.0	103.0	102.6	101.4	102.0	102.2	103.0
April 9.....	101.6	102.0	103.2	103.8	102.0	102.0	102.8	103.0
April 10.....	101.6	101.8	103.2	102.6	101.6	102.0	101.8	103.0
April 11.....	101.4	101.6	103.2	102.0				
April 12.....	102.0	101.2	102.0	101.0				
April 13.....	102.4	101.6	103.0	101.8				
April 14.....	102.4	101.6	104.0	102.0				
April 15.....	102.0	101.6	103.4	102.0				
April 16.....	101.2	102.0	103.6	102.0				
April 17.....	101.6	103.0	104.0	103.0				
April 18.....	102.6	103.0	103.0	103.4				
April 19.....	102.6	102.0	102.6	103.0				
April 20.....	102.2	102.2	103.0	102.8				
April 21.....	101.0	101.6	104.0	103.0				
April 22.....	102.8	101.0	104.0	102.2				
April 23.....	102.0	101.8	103.6	101.8				
April 24.....	101.8	102.0	103.8	102.0				
April 25.....	101.8	102.0	103.8	102.0				
April 26.....	102.0	101.0	104.0	102.0				
April 27.....	101.6	100.6	103.6	101.8				
April 28.....	101.0	102.6	103.2	101.0				
April 29.....	101.6	102.0	103.0	102.4				
April 30.....	101.6	101.6	103.0	102.6				
May 1.....	101.8	101.2	102.4	100.6				
May 2.....	101.4	101.0	102.6	101.2				
May 3.....	101.6	101.0	104.0	102.6				
May 4.....	101.8	102.6	103.4	101.6				
May 5.....	101.2	102.0	102.0	101.0				
May 6.....	102.4	101.0	102.4	101.0				
May 7.....	101.6	100.4	103.4	100.8				
May 8.....	102.0	101.8	102.0	100.4				
May 9.....	102.2	102.6	101.6	100.0				
May 10.....	102.4	103.6	102.0	102.0				
May 11.....	101.0	103.4	103.8	103.4				
May 12.....	102.0	103.0	103.4	103.0				
May 13.....	102.2	102.0	102.0	102.2				
May 14.....	101.8	102.2	102.0	102.0				
May 15.....	101.4	102.0	102.2	101.6				
May 16.....	101.4	101.6	102.6	103.2				
May 17.....	101.0	101.8	103.0					
May 18.....	101.8	102.0	102.4					
May 19.....	103.0	101.0	102.0					

Experiment discontinued, as the animals all seem to be in good health.

HORSE NO. 3.

Horse No. 3 was infected from Horse No. 2. On November 26, 1907, while No. 2 was having the second reaction, we drew some blood from his jugular vein, and mixed several drops of it with three tubes of bouillon. After keeping it in the incubator forty-eight hours at 37° C. we injected 2 c.c. of it intravenously and 1 c.c. subcutaneously into Horse No. 3, as before mentioned.

Horse No. 3 was probably 15 years of age, in fair flesh, and sound except for a mild case of heaves. He was well fed daily on chops, bran and prairie hay. As will be seen from the following data, he began to have the first reaction about the eighteenth day, which continued ten days, then an interval of subnormal or normal temperature, lasting ten days, when a violent secondary fever period began, lasting eight days, at the close of which he died. (See Graphic Record.)

The interesting feature of this experiment is that the infection lived forty-eight hours at 37° C. and at the expiration of that period was virulent enough to kill this horse in fifty-one days. Soon after death

we injected 10 c.c. of his blood into Horse No. 4, which caused his death in twenty days.

TEMPERATURE NOTES ON HORSE NO. 3.

November 27th, 99.6°; November 28th, 99.2°; November 29th, 99°; November 30th, 98.8°; December 1st, 98.2°; December 2d, 98.8°; December 3d, 99.6°; December 4th, 99.3°; December 5th, 98°; December 6th, 99.4°; December 7th, 99°; December 8th, 99°; December 9th, 98.8°; December 10th, 99.2°; December 11th, 100°; December 12th, 100.3°; December 13th, 100.6°; December 14th, 102°; December 15th, 102.5°; December 16th, 102.3°; December 17th, 102.5° a. m., 104.5° p. m., pulse 1110, 110, 11110, 10, 110, 1110; December 18th, 102.6° a. m., 104.6° p. m., pulse as yesterday; December 19th, 104.6° a. m., 105.3° p. m., pulse steady and regular; December 20th, 105° a. m., 105.3° p. m., anus relaxed, won't eat; December 21st, 105.1° a. m., 104.2° p. m., anus relaxed; December 22d, 103.3° a. m., 103° p. m.; December 23d, 102.2°; December 24th, 101.3°; December 25th, 99.7°; December 26th, 99.7°; December 27th, 99.5°; December 28th, 99.1°; December 29th, 98.4°; December 30th, 98.2°; December 31st, 99.4°; January 1st, 99.3°; January 2d, 99.4°; January 3d, 99°; January 4th, 99.7°; January 5th, 101.4°; January 6th, 104.5°; January 7th, 103.4°; January 9th, 104.7°; January 10th, 104.5°; January 11th, 102°; January 12th, 100°; January 13th, 98.6°; January 14th, 98.6; January 15th, 98°; January 16th, 97.3°; January 17th, dead.

During the last week this horse became very weak, with considerable hemorrhage from the nostrils and mucous discharge from the bowels. Notice the primary fever from eighteenth to twenty-eighth days, then a subnormal period of ten days, then a secondary fever period from the fortieth day to the forty-eighth day, which left him too weak to recover.

HORSE NO. 4.

Horse No. 4 was given 10 c.c. of blood serum from Horse No. 3 on January 18, 1908. His temperature was not recorded for the next ten days, but fever appeared on the 29th. January 28th, 101.4°; January 29th, 104°; January 30th, 102.4°; January 31st, 103°; February 1st, 102.4°; February 2d, 103°; February 3d, 105.4°; February 4th, 103°; February 5th, 102.2°; February 6th, 102.8°; February 7th, 101.2°; February 8th, 99.2°; February 9th, 98.4°; February 10th, 98.4°; February 11th, dead.

This horse became so weak and emaciated that he would not remain on his feet but a few moments after being gotten up. He could not walk, the swelling of the legs and along the belly were more marked than in other cases. Petechiæ were well shown in him. He was killed to end his misery.

The point of interest in this case is that he became infected from blood serum from Horse No. 3, taken six hours after death; therefore, the infection exists in the serum as well as in the whole blood.

HORSES NOS. 5 AND 6.

Horse No. 5 was inoculated subcutaneously with 2 c.c. of blood from Horse No. 2 on March 24, 1908. He was in splendid physical condition, having been used as a family horse in Bryan for a number of years. The case is of interest, as it shows the acute fatal type of the disease. Preliminary temperatures were taken for twenty-three days to eliminate any error. Notice this record:

March 24th, 100°; 25th, 99°; 26th, 99.2°; 27th, 100°; 28th, 99.8°; 29th, 99.4°; 30th, 99.2°; 31st, 99.6°.

April 1st, 99.6°; 2d, 99.6°; 3d, 99°; 4th, 103°; 5th, 106°; 6th, 104.2°; 7th, 102.6°; 8th, 103.2°; 9th, 103°; 10th, 105.8°; 11th, 106°; 12th, 105.4°; 13th, 105°; 14th, 105.4°; 15th, 105.4°; 16th, 105°; 17th, 103.8°; 18th, dead. (See Graphic Record.)

On April 11th, when the temperature stood at 106°, we drew some blood from his jugular vein and examined it for trypanosoma and piroplasma, but failed to find either of them.

We also injected 1 c.c. into Horse No. 6 and into a heifer, a goat, a sheep, and a pig. (See diagram of Experiments.)

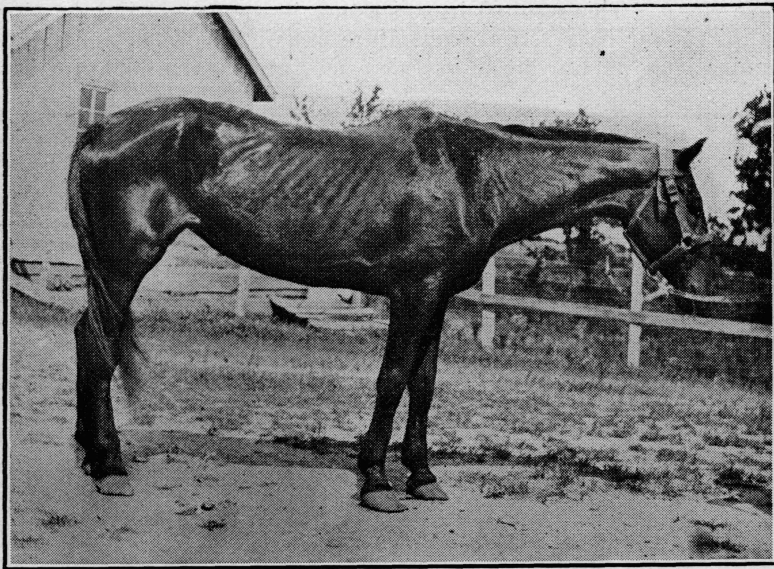
ANIMALS INOCULATED FROM HORSE No. 5.

1908.	Horse 6.	Calf 2.	Goat 2.	Sheep 2.	Pig 2.
April 11.....	100.2	102.8	101.8	102.0	102.6
April 12.....	100.6	101.6	101.4	102.6	102.0
April 13.....	100.0	101.4	101.0	102.6	102.0
April 14.....	100.0	101.8	103.0	103.0	102.6
April 15.....	99.6	101.8	102.2	102.0	103.8
April 16.....	100.0	101.4	102.0	102.4	103.0
April 17.....	99.8	101.6	102.6	102.8	104.0
April 18.....	99.8	102.4	102.2	103.0	103.6
April 19.....	100.0	102.4	101.8	102.0	103.0
April 20.....	99.0	104.4	102.0	102.4	102.6
April 21.....	100.0	101.6	101.6	102.6	103.8
April 22.....	99.6	102.0	103.0	102.8	103.2
April 23.....	99.8	102.0	102.0	102.0	102.4
April 24.....	102.0	102.0	101.8	103.0	102.6
April 25.....	101.6	101.6	101.6	102.6	102.6
April 26.....	101.4	102.2	100.4	102.6	102.0
April 27.....	102.0	101.6	100.4	102.6	101.6
April 28.....	103.6	101.6	102.0	102.4	102.0
April 29.....	102.4	102.0	103.4	103.6	102.4
April 30.....	102.0	102.0	101.2	101.4	102.0
May 1.....	103.4	101.0	101.2	102.2	101.0
May 2.....	102.8	102.0	102.8	102.0	101.0
May 3.....	102.6	101.8	101.6	103.0	102.0
May 4.....	103.0	101.6	103.2	104.0	101.8
May 5.....	101.6	101.8	101.6	101.6	101.8
May 6.....	101.6	101.6	101.4	102.0	101.0
May 7.....	101.0	101.0	100.0	102.2	100.8
May 8.....	102.0	101.2	101.0	101.8	100.2
May 9.....	101.0	101.4	102.0	102.0	103.0
May 10.....	101.0	101.8	101.6	102.0	103.2
May 11.....	102.6	101.8	102.4	103.4	103.2
May 12.....	101.6	101.0	102.6	103.0	103.0
May 13.....	101.6	101.6	102.6	102.6	102.2
May 14.....	101.6	102.0	102.4	102.0	102.2
May 15.....	101.8	101.6	102.2	102.4	101.8
May 16.....	102.2	101.2	102.4	101.8	102.0
May 17.....	104.2	100.8	102.6	101.8	.....
May 18.....	103.6	102.0	102.0	101.8	.....
May 19.....	104.0	102.0	101.0	101.0	.....
May 20.....	100.0	.....	.....	.....	.....

Observations on the calf, goat, sheep and pig were discontinued, as they have shown no apparent sickness. Notice that the results are similar to those previously reported with the blood from Horse No. 2.

Horse No. 6 began to have fever on the thirteenth day, which ran a mild course until the fortieth day. This was followed by a second fever period which began on the fifty-eighth day and continued twenty days. The case is of interest, as it illustrates the slow chronic type of the disease.

Relapses of mild fever occurred in June and July and a severe one in August, which reduced the animal's vitality so much that it declined rapidly and died October 12th, 153 days after infection.



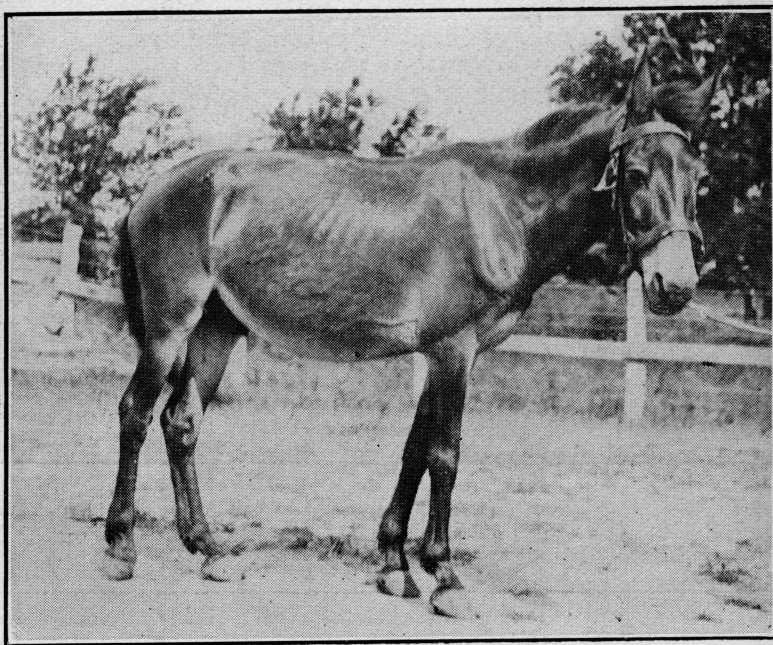
Horse No. 6.—Showing chronic type of the disease. Died on 153d day after inoculation.

Notice the fluctuations in its temperature.

	May.	June.	July.	Aug.	Sept.	Oct.
1.....	103.4	99.0	101.2	100.8	100.6	102.0
2.....	102.8	98.6	100.8	101.4	100.8	101.4
3.....	102.6	100.2	100.6	100.4	101.0	101.4
4.....	103.0	100.6	101.0	101.8	100.6	98.2
5.....	101.6	99.2	101.4	101.4	101.0	100.4
6.....	101.6	100.4	101.0	101.6	100.8	99.4
7.....	101.0	100.2	100.2	101.8	100.6	99.6
8.....	102.0	100.0	100.0	100.4	100.6	95.0
9.....	101.0	100.0	100.8	99.8	100.8	99.6
10.....	101.0	100.0	101.2	99.6	100.6	97.2
11.....	102.6	100.0	101.0	100.2	100.4	98.4
12.....	101.6	100.6	100.4	100.8	100.4	dead.
13.....	101.6	100.6	100.6	100.6	100.0	.....
14.....	101.6	101.4	101.2	101.0	100.2	.....
15.....	101.8	100.8	101.2	100.4	100.4	.....
16.....	102.2	102.0	101.0	101.2	100.0	.....
17.....	104.2	102.6	100.8	100.8	99.4	.....
18.....	103.6	102.7	100.4	100.2	100.4	.....
19.....	104.0	103.0	100.8	104.4	101.4	.....

	May.	June.	July.	Aug.	Sept.	Oct.
20.....	100.0	102.6	101.5	102.4	101.0	.....
21.....	102.0	102.8	100.4	102.8	99.6	.....
22.....	101.8	102.8	100.8	102.2	100.6	.....
23.....	101.0	103.0	101.0	102.0	100.8	.....
24.....	100.6	102.6	101.4	101.4	100.4	.....
25.....	100.2	101.8	101.4	101.6	100.4	.....
26.....	100.0	101.4	101.0	101.2	100.8	.....
27.....	99.6	100.6	101.0	101.4	100.8	.....
28.....	99.6	100.4	101.0	101.2	99.4	.....
29.....	99.6	101.4	101.0	100.4	101.4	.....
30.....	99.6	101.2	101.0	101.2	99.8	.....
31.....	99.0	.....	101.6	101.6	.....	.....

On April 28, 1908, we inoculated Mule No. 7 and Dog No. 1 from Horse No. 6. This resulted in no sickness in the dog during the following thirty-four days. His temperature remained normal, and frequent examinations of his blood revealed no trypanosoma or piroplasma.



Mule No. 7.—Chronic type. This mule appears in good health, though its blood is yet virulent, and killed Mule No. 9. One would hardly suspect this animal as a source of danger.

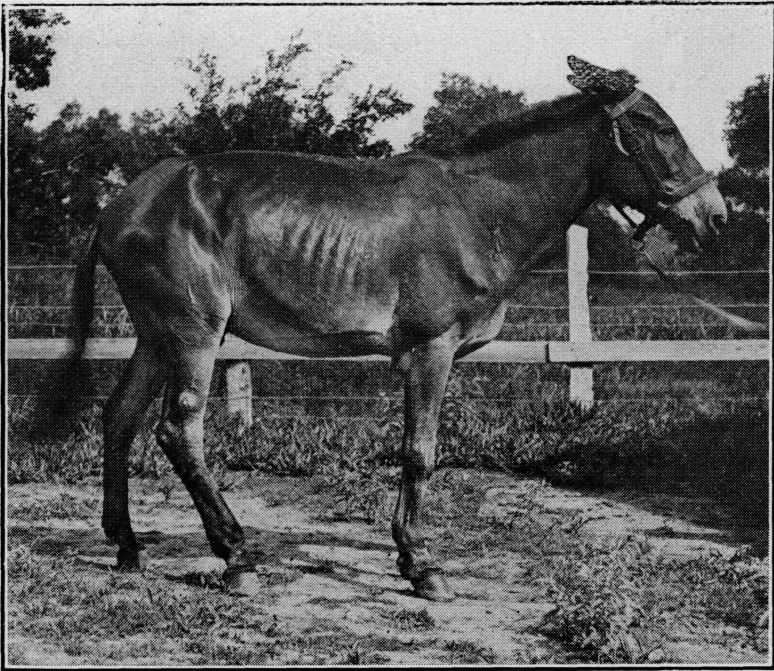
Mule No. 7 became infected, which shows that the blood used was virulent, and that the dog is probably not susceptible to the disease in question.

MULE NO. 7.

Mule No. 7 was infected April 28th from Horse No. 6, during the primary reaction, by subcutaneous inoculation of 1 c.c. of blood. A mild reaction occurred from the twentieth to twenty-fourth days, reach-

ing 101° only. A second one from the twenty-fourth to the fortieth days; a third one from the forty-ninth to the fifty-third days; a fourth one from the seventy-sixth to seventy-ninth days, and to be followed with a slow, mild fever period lasting ten days or more, in which the temperature was but one degree or so above normal. This is a typical case of chronic fever in which the animal resists the infection quite well and remains in good physical condition. (See photograph of No. 7.)

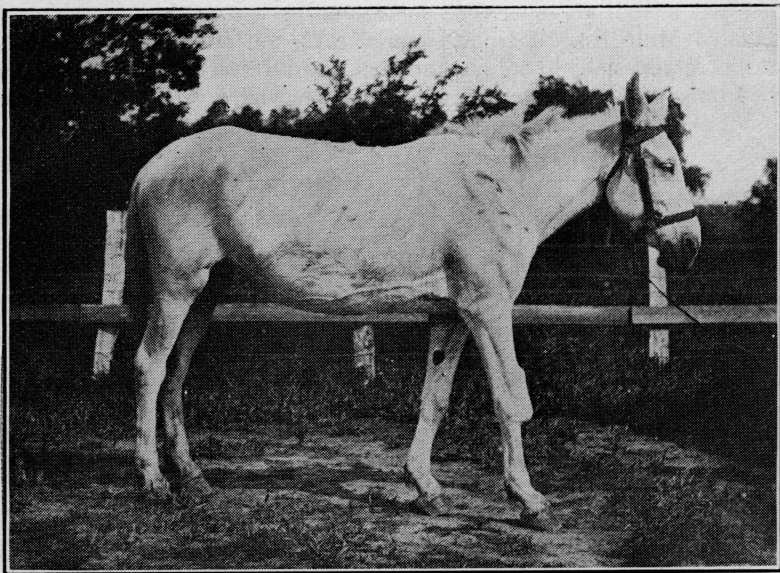
We had a similar experience some months before this, in which we inoculated Mule No. 10 from Horse No. 2, but as the mule was kept under observation eighty days and had a mild reaction, which reached 102.6° only, for two days, we concluded somewhat hastily that the mule was not susceptible, and he was used for other purposes.



Mule No. 8.—Chronic type. Had seven fever periods within 160 days after inoculation. (See Graphic Record.)

Mule No. 7 shows, however, that the mule is susceptible, but that it may resist the infection to such a degree as to appear in good health. This may make the detection and eradication of the disease a very difficult matter, as Mule No. 7 would today pass almost every one as sound, while its blood is still infectious. That its blood is virulent seems abundantly proven by the following experiment: On June 17th, forty-nine days after infection, and during the third fever period, we drew several ounces of its blood from the jugular vein into a clean sterile vessel. We then injected 4 c.c. of the whole blood subcutaneously into Mule No. 8.

The other portion of it was put into a sterile porcelain filtering apparatus and 4 c.c. of the filtrate injected subcutaneously into Mule No. 9. Both Mules Nos. 8 and 9 fevered at the usual time, and No. 9 died. This apparently proves that the infection is so small that it may pass through the finest filters we have, and that it probably belongs to the group of so-called ultra-microscopic organisms.



Mule No. 9.—Died on the 45th day after being inoculated with blood (from Mule No. 7) which had been passed through a fine porcelain filter. (See Graphic Record.)

Notice the following data:

MULE NO. 9.

Inoculated with 4 c. c. filtered blood serum
from Mule No. 7.

MULE NO. 8.

Inoculated with 4 c. c. whole blood from
Mule No. 7.

	June.	July.	Aug.	June	July.	Aug.	Sept.	Oct.	Nov.
1.....		100.0	104.2		104.4	100.2	103.4	102.0	98.0
2.....		100.2	dead		104.6	100.2	105.8	100.0	98.4
3.....		100.4			102.6	100.2	106.5	99.2	98.0
4.....		99.8			101.8	100.4	105.0	99.4	99.0
5.....		100.0			100.0	100.6	102.8	99.4	98.4
6.....		99.8			100.6	100.8	101.4	99.8	98.2
7.....		100.2			99.8	101.8	99.8	99.6	98.6
8.....		100.0			99.6	104.0	99.6	100.0	98.4
9.....		100.0			99.8	105.2	99.2	99.8	98.4
10.....		100.0			100.6	105.4	100.0	99.8	99.0
11.....		99.8			100.0	102.4	99.4	100.2	99.6
12.....		99.8			101.4	101.8	99.4	99.8	98.0
13.....		100.2			104.0	101.6	99.8	101.8	99.4
14.....		103.6			104.6	100.2	99.2	103.2	99.8
15.....		104.6			103.8	100.0	99.6	103.2	98.0
16.....		100.4			103.2	99.4	99.8	103.4	99.8
17.....		101.2			103.0	100.8	99.8	103.6	101.6
18.....	99.8	99.8		99.4	104.2	99.4	99.6	101.2	103.0
19.....	100.0	100.4		99.6	103.6	100.0	99.6	100.2	104.2
20.....	100.0	102.2		99.8	105.2	100.2	100.2	99.0	103.8
21.....	99.8	101.4		99.8	104.6	99.2	99.8	99.8	101.0
22.....	100.0	101.8		100.0	104.4	99.4	100.6	99.2	98.0

MULE NO. 9—continued.

Inoculated with 4 c. c. filtered blood serum
from Mule No. 7.

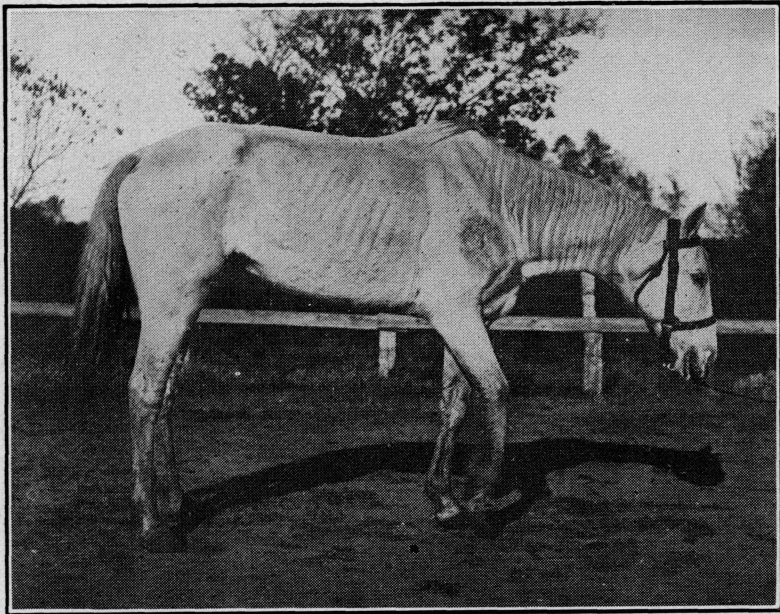
MULE NO. 8—continued

Inoculated with 4 c. c. whole blood from
Mule No. 7.

	June.	July.	Aug.	June.	July.	Aug.	Sept.	Oct.	Nov.
23.....	100.8	102.0	.....	99.8	103.4	100.2	100.0	99.8	99.0
24.....	100.0	102.8	.....	99.6	102.6	100.2	101.0	99.0	98.0
25.....	100.6	105.2	.....	100.2	101.4	100.8	102.4	99.0	98.8
26.....	100.0	106.4	.....	99.8	101.0	99.8	103.4	99.0	99.6
27.....	100.4	106.4	.....	100.0	100.2	100.2	102.4	98.6	97.0
28.....	100.0	106.6	.....	101.0	100.2	99.6	103.2	98.0	98.8
29.....	100.0	105.8	.....	101.4	100.4	100.6	102.2	99.0	99.6
30.....	100.2	105.8	.....	104.0	99.8	100.8	102.0	98.6	97.0
31.....	.....	106.2	.....	.....	100.0	100.8	.....	98.6	.....

HORSE NO. 11.

Horse No. 11 was a 10-year-old gray mare that had some difficulty in breathing, apparently due to melanotic deposits behind the jaw, and



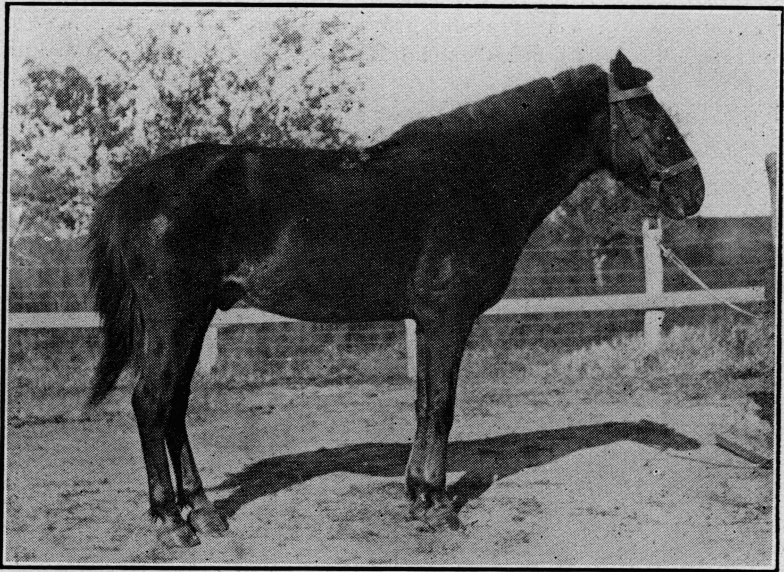
Horse No. 11.—Died on the 23d day following inoculation with blood from Horse No. 2. This occurred over a year after Horse No. 2 was inoculated and indicates strongly that the blood from an infected animal remains virulent for life.

a lameness due to an old wire injury above the fetlock. On November 3, 1908, she was given 2 c.c. of blood subcutaneously from Horse No. 2. The point in the experiment was to ascertain whether or not the blood of Horse No. 2 was still infectious, as it was twelve and one-half months since he had been inoculated.

Horse No. 11 developed fever on the ninth day, which became very acute and severe and caused her death on the twenty-second day.

Notice this record:

November 4th	100.6°
November 5th	100.3°
November 6th	100.2°
November 7th	100.8°
November 8th	100.2°
November 9th	100.2°
November 10th	100.8°
November 11th	101°
November 12th	103.8°
November 13th	105.4°
November 14th	103.4°
November 15th	102.6°



Check Horse.—This horse has been kept with sick ones from May until December, but has shown no signs of sickness.

November 16th	101.8°
November 17th	102.6°
November 18th	104.2°
November 19th	104.2°
November 20th	104.8°
November 21st	105°
November 22d	103.8°
November 18th	104.2°
November 19th	104.2°
November 23d	104.8°
November 24th	104.2°
November 25th	105.6°
November 26th	104.4°
November 27th	Dead.

This horse declined very rapidly. Several days before death the discharge of bloody water from the nostrils was more abundant than usual. Petechiæ in the eyes very well marked, and when it became evident that she would not live much longer we drew 4 ounces of her blood from the jugular vein and gave it to Horse No. 12 by way of mouth, and fed No. 12 in the same manger where No. 11 had eaten for three weeks. The point in the experiment is to ascertain if the infection can be contracted through the digestive tract.

After several hours Horse No. 11 died.

POST-MORTEM EXAMINATION OF HORSE NO. 11.

From the natural openings we note (1) blood, bloody serum and mucus from both nostrils, (2) mucus and soft mucous-coated bowel discharges from the anus, (3) coffee-colored urine dribbling from the vulva.

The mucous membranes of the mouth, anus and vulva are very pale or yellowish. Those of the eye and nose show petechiæ.

The pleuræ, peritoneum and pericardium show petechiæ and fibrinous exudates. The heart muscle on the left side is hemorrhagic. The liver is enlarged, weighing 20 pounds, and very dark in color.

Kidneys contain a greyish, pus-like substance, the right one weighs 1270 grams, the left 1130 grams. The spleen is enlarged, dark colored and weighs about 4 pounds. Bladder contains 1 ounce of coffee-colored urine. No other macroscopic lesions.

SUMMARY.

Infectious Anaemia is a very fatal disease of horses and mules characterized by intermittent fevers and progressive emaciation without apparent cause.

The infection occurs in the blood, and can be conveyed to other horses and mules by subcutaneous or intravenous injection. We have not been able to convey it to cattle, sheep, goats, pigs, or dogs.

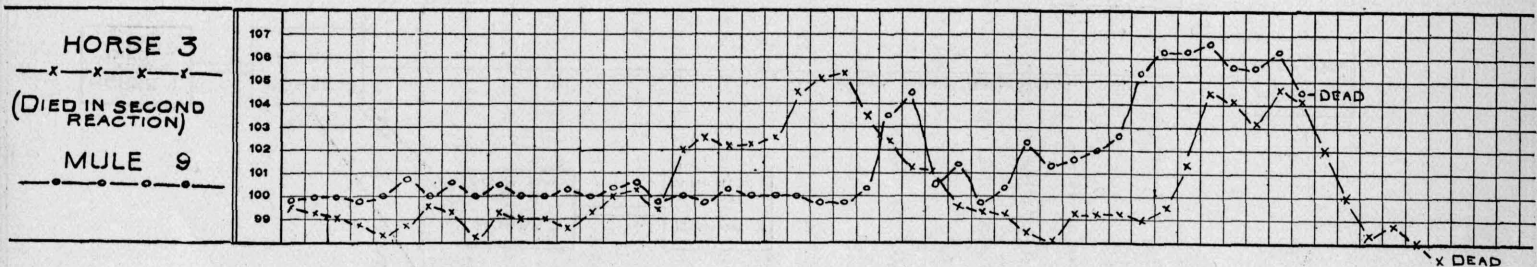
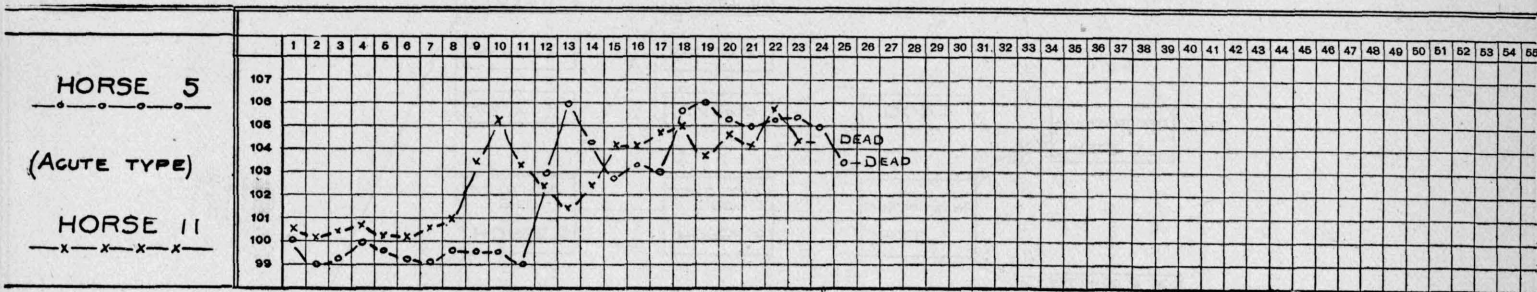
The clinical symptoms greatly resemble those due to trypanosoma and piroplasma, but we have not yet found organisms of this character in the blood.

Virulent blood which has been filtered through porcelain will reproduce the disease, therefore, we think the specific germ belongs to the group of so-called ultra-microscopic organisms.

The blood of infected horses retains its virulence more than a year after the primary infection.

Healthy horses have mingled freely with sick ones for months without contracting the disease.

December 3, 1908.



GRAPHIC RECORD OF ACUTE FATAL TYPE OF INFECTIOUS ANAEMIA OF THE HORSE.

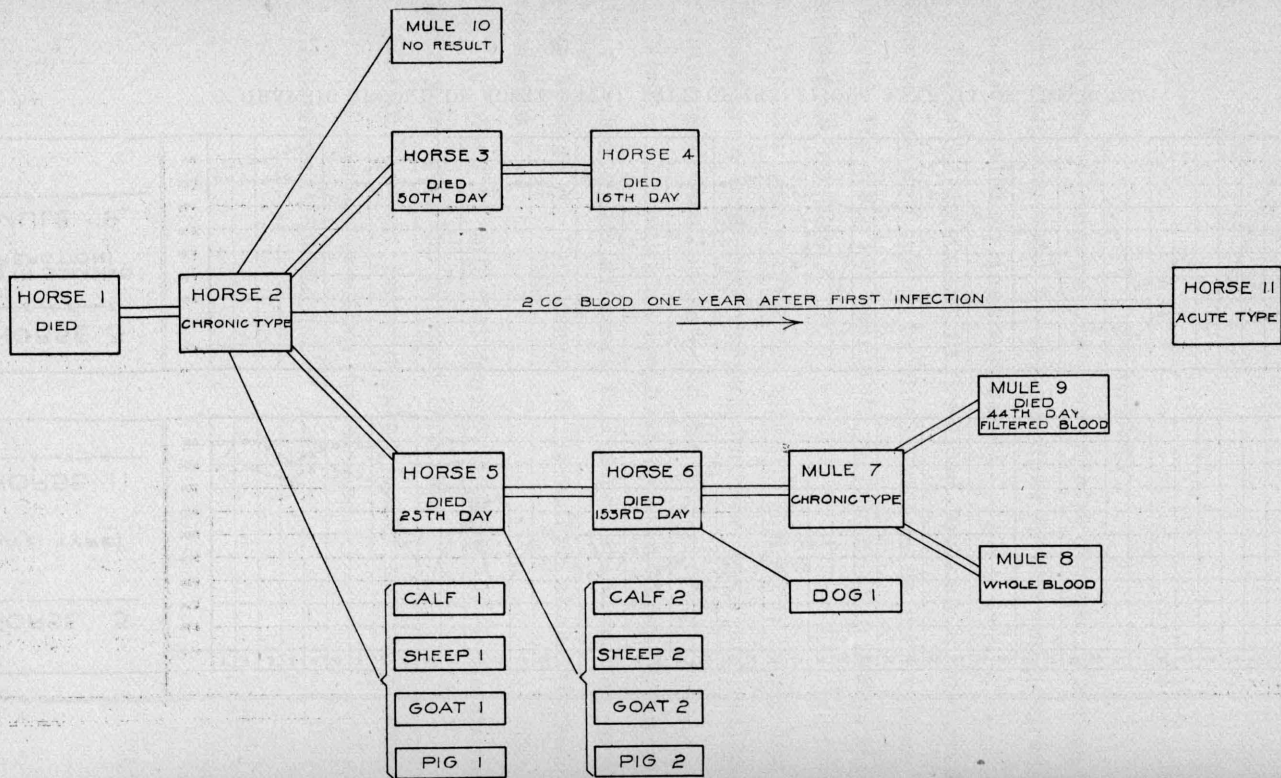
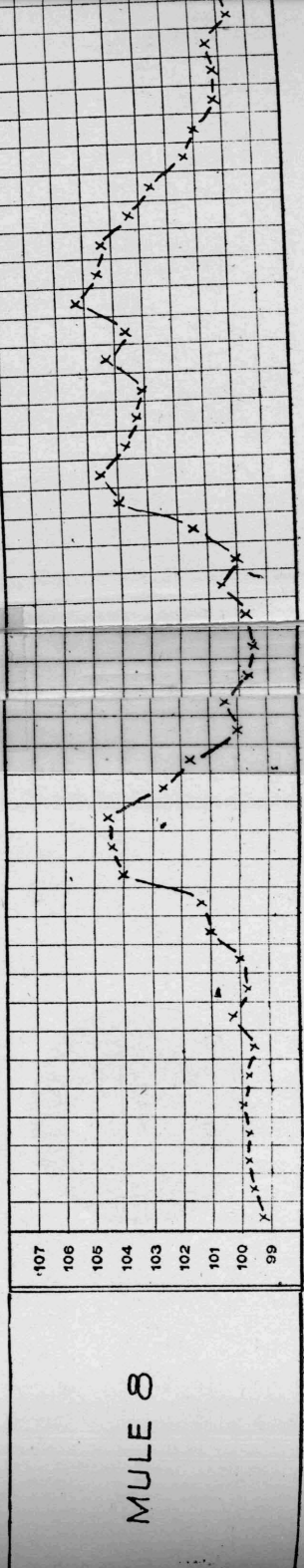
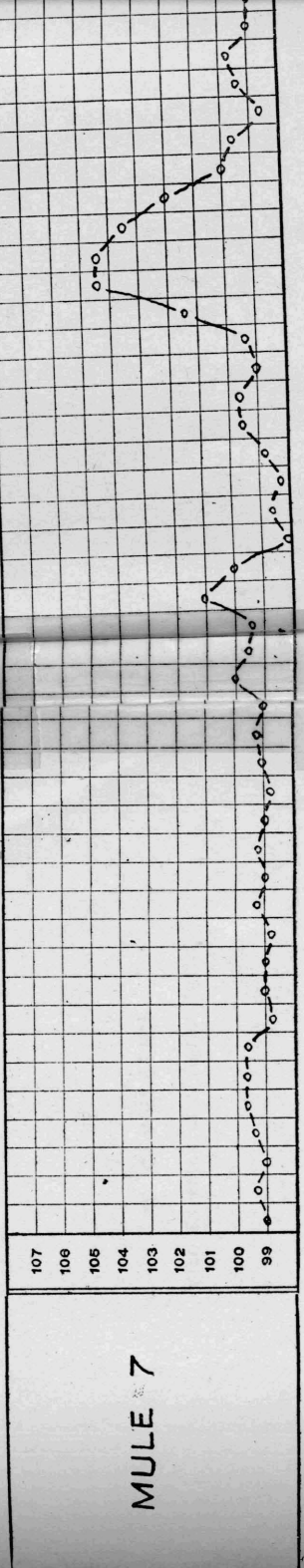
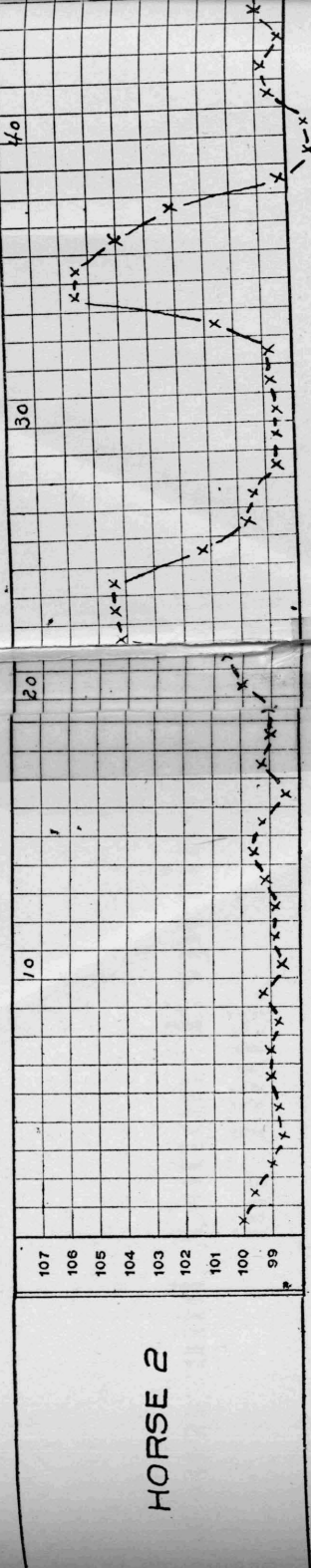
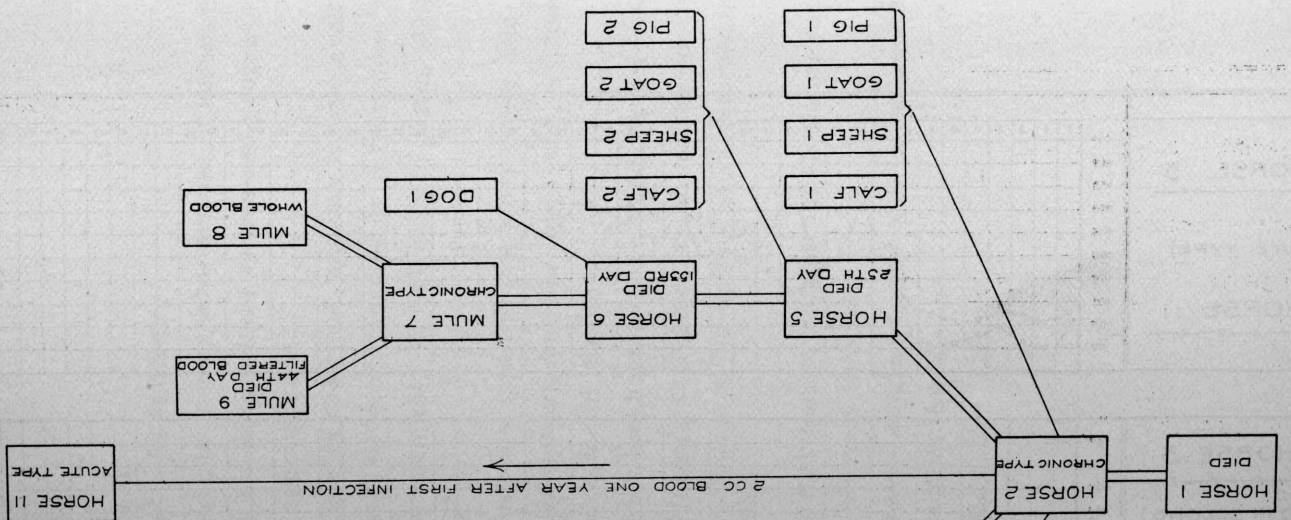
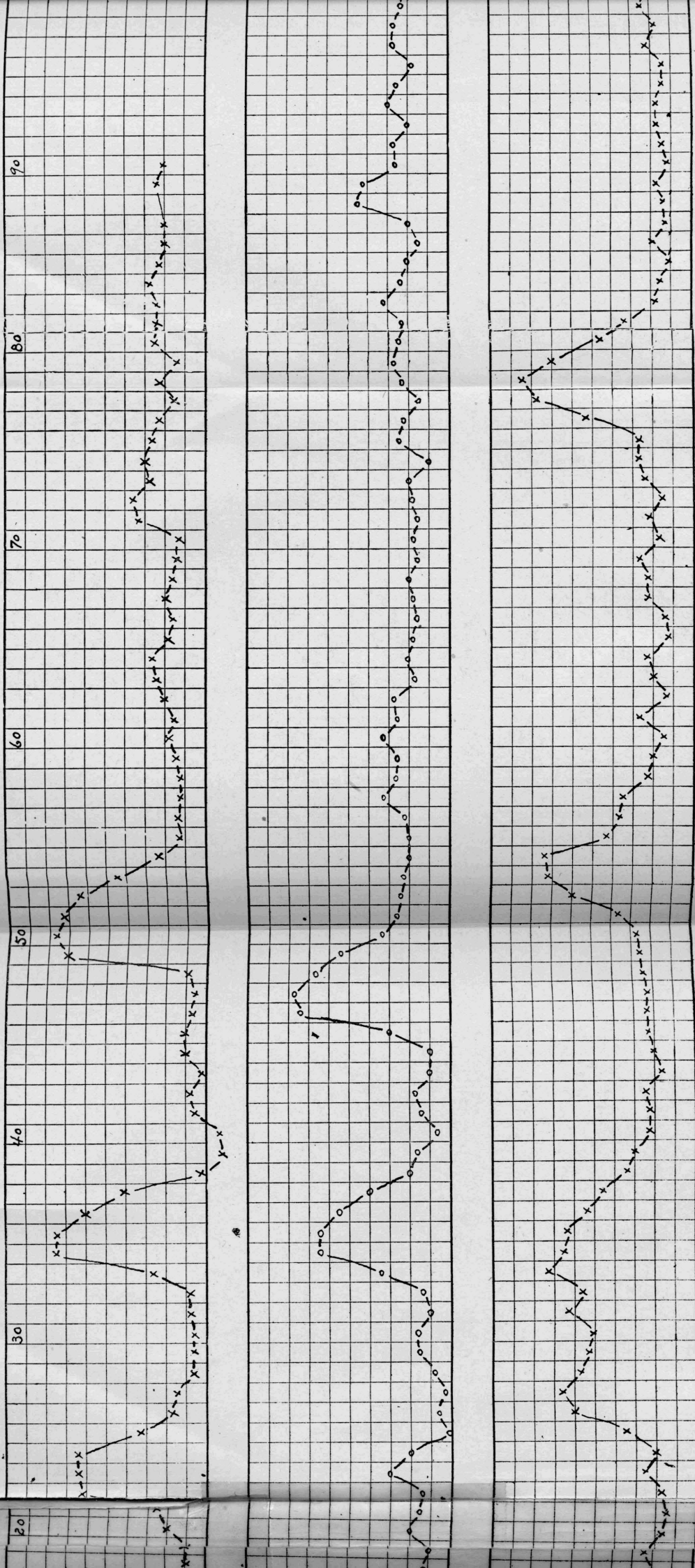


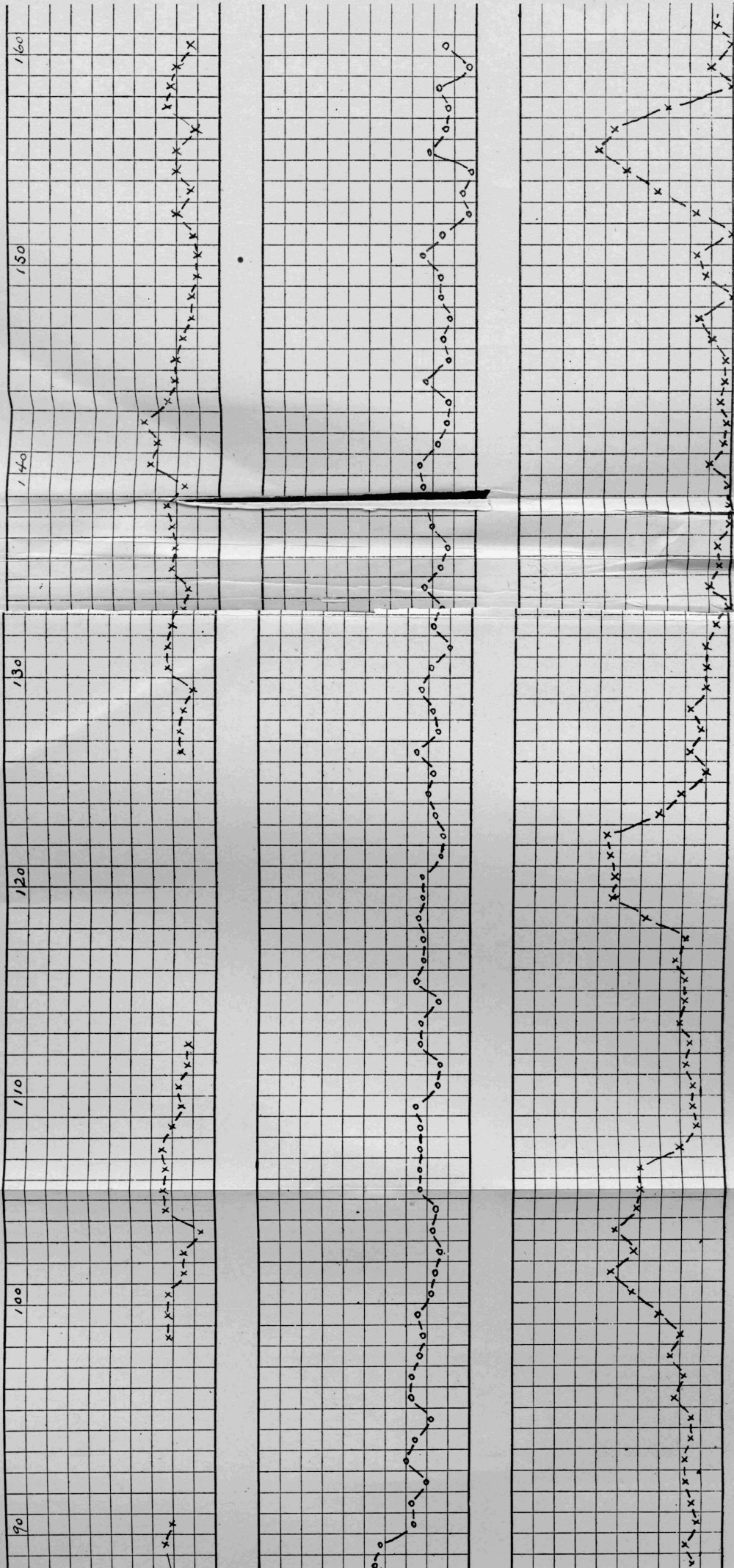
DIAGRAM SHOWING THE ORDER IN WHICH THE EXPERIMENTS WERE MADE

DIAGRAM SHOWING THE ORDER IN WHICH THE EXPERIMENTS WERE MADE





INFECTIOUS ANAEMIA OF THE HORSE—GRAPHIC RECORD SHOWING DURATION AND SEVERITY OF THE FEVER PERIODS.



OF THE FEVER PERIODS.