

1899

Immunization against Texas fever by blood inoculation: results of experiments at State Experiment Station, Baton Rouge, La.

William Haddock Dalrymple

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SECOND SERIES, NO. 57.

BULLETIN

—OF THE—

AGRICULTURAL EXPERIMENT STATION

—OF THE—

Louisiana State University and A. & M. College,

WM. C. STUBBS, Ph D., Director and State Chemist.

**IMMUNIZATION AGAINST TEXAS FEVER BY
BLOOD INOCULATION.**

**RESULTS OF EXPERIMENTS AT STATE EXPERIMENT STATION,
BATON ROUGE, LA.**

BY

W. H. DALRYMPLE, M. R. C. V. S.

W. R. DODSON, A. B., S. B.

H. A. MORGAN, B. S. A.

**ISSUED BY THE BUREAU OF AGRICULTURE AND IMMIGRATION,
LEON JASTREMSKI, COMMISSIONER.**

BATON ROUGE, LA.

PRINTED AT THE TRUTH BOOK AND JOB OFFICE.

1899.

Louisiana State University

and A. & M. COLLEGE.

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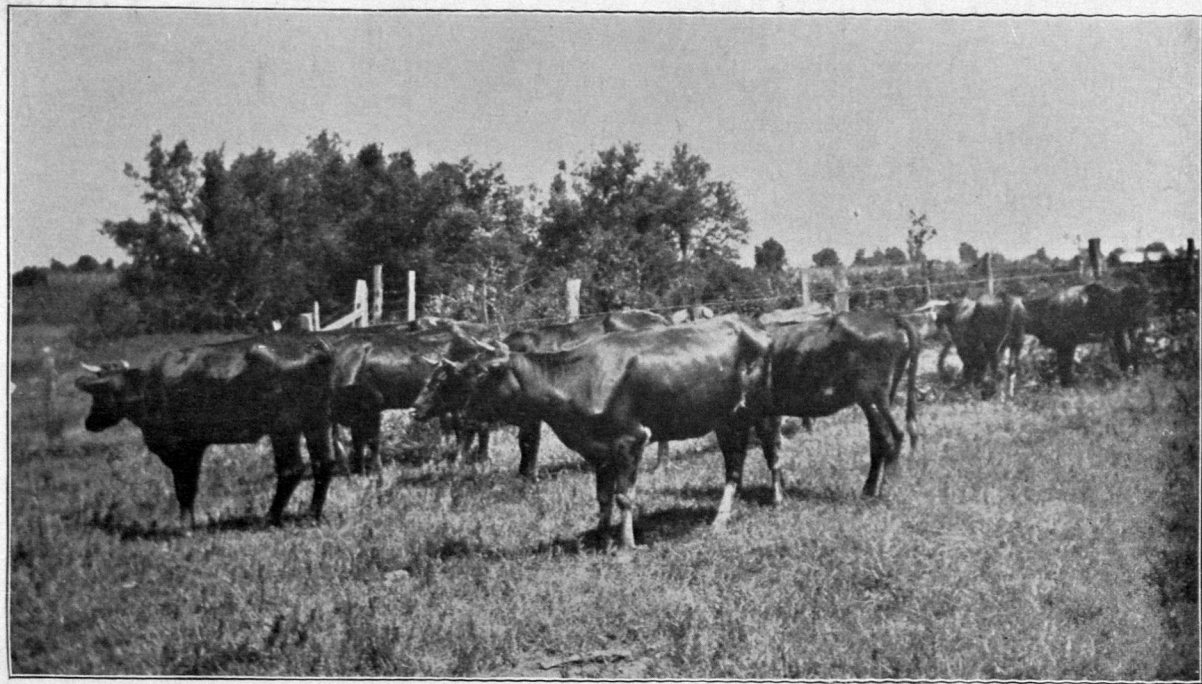
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GROUP OF ELEVEN CATTLE RECENTLY IMMUNIZED AT THE LOUISIANA
EXPERIMENT STATION, BATON ROUGE.

LOUISIANA STATE UNIVERSITY AND A. AND M. COLLEGE, }
Office of Experiment Stations,
Baton Rouge, Louisiana. }

Gen. Leon Jastremski, Commissioner of Agriculture and Immigration,
Baton Rouge, La.:

DEAR SIR:—I hereby transmit the results of experiments testing the different methods of immunizing imported cattle (from above the National fever line) and ask that it be published as Bulletin No. 57.

Respectfully submitted,

WM. C. STUBBS,

Director.

from a native Southern animal, or one which has recently been rendered immune.

When used in five cubic centimeter doses, blood from a recently immune animal gave a less virulent and less protracted form of the artificially produced fever than a similar amount from a native.

Two and one-half cubic centimeters of blood from a recently immunized animal acted satisfactorily on two imported Hereford (bull and heifer) calves, aged, respectively, eight months and five months.

Two cubic centimeters of the same blood injected into a one-month-old calf gave satisfactory results.

Animals that had been allowed sufficient time to perfectly recover from the inoculation fever before being exposed on a tick-infected pasture suffered no apparent ill effects from ticks.

Animals exposed to ticks before convalescence was complete, suffered a temporary relapse.

TICKS AS A SOURCE OF BLOOD FOR INOCULATING CATTLE TO PRODUCE IMMUNITY.

Summary.

The blood with which the adult cattle ticks are filled, after maturing on Southern cattle, carries with it the power to produce Texas fever when subcutaneously injected into a susceptible animal.

Experiments indicate that we may be able to take the ticks from recently immunized animals, ship them considerable distances, and utilize them as a substitute for the blood drawn from the vein where recently immunized animals are not available.

Experiments further indicate that this will give a milder form of the disease, and afterwards immunity just as effectual as where the blood is taken from the immune animal immediately before it is used.

We have not as yet found any way of preserving the blood drawn from the vein for any considerable length of time without its losing its power to produce immunity.

IMMUNIZATION AGAINST TEXAS FEVER BY BLOOD INOCULATION.

(BY W. H. DALRYMPLE.)

In order to test the difference in degree of virulence or attenuation, if any, in the blood of different animals for inoculation purposes, nine susceptible heifers, from above the Texas fever line, were formed into three groups, each group being inoculated with blood from three different animals; one, a steer, brought from above the Federal quarantine line, but which had been given the fever on the Station during 1898, and had passed successfully through it; another, a two-year-old native animal, whose blood was obtained from one of the local slaughter pens on the outskirts of Baton Rouge; and a third, a grade Jersey calf, born on the college grounds under tick-free conditions, but which was considered to have had the disease during the previous year. The quantity of blood inoculated into each animal of the three groups, and from each of the animals mentioned, was five cubic centimeters, all of the animals being kept under tick-free conditions during the course of the artificially produced fever.

BLOOD OF JERSEY CALF.

Group No. 1—Animals I., IV. and IX.

ANIMAL No. I.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
March 15....	100.5	102.1	Inoculated with 5 cc. blood of Jersey calf.
March 16....	101.0	102.6	.....
March 17....	100.8	101.8	.....
March 18....	101.8	.....	7,280,000
March 19....	100.5	102.5	.....
March 20....	100.1	102.3	.....
March 21....	101.1	102.7	.....
March 22....	101.1	101.6	.....
March 23....	101.2	103.2	.....
March 24....	101.2	102.4	.....
March 25....	101.0	102.9	7,200,000	
March 26....	104.1	105.7	.....
March 27....	105.3	105.5	.....
March 28....	103.2	104.8	.....
March 29....	102.4	103.1	6,480,000	
March 30....	101.9	103.1	.....
March 31....	103.0	103.1	.....
April 1....	102.5	103.6	5,760,000	

ANIMAL No. I.—TEMPERATURE.—Continued.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
April 2.....	103.0	105.0	.....
April 3.....	101.6	103.0	.....
April 4.....	101.7	103.3	.....
April 5.....	101.2	105.0	5,280,000	
April 6.....	101.0	104.9	.....
April 7.....	103.6	105.5	.....
April 8.....	101.0	104.0	4,960,000	
April 9.....	103.0	104.0	.....
April 10.....	102.4	104.6	.....
April 11.....	102.7	103.7	.....
April 12.....	103.0	104.2	6,400,000	
April 13.....	102.5	103.9	.....
April 14.....	103.4	103.1	.....
April 15.....	101.9	103.2	5,536,000	
April 16.....	.....	102.2	.....
April 17.....	.....	.....	.....	Sent to tick-infested pasture.
April 22.....	.....	.....	5,600,000	
April 26.....	.....	103.4	.....
April 29.....	.....	102.8	5,760,000	
May 3.....	.....	102.7	.....
May 6.....	.....	102.6	6,960,000	
May 9.....	.....	102.5	.....
May 11.....	.....	103.1	.....
May 13.....	.....	103.1	.....	Mature ticks on animal.
May 17.....	.....	103.1	.....
May 22.....	.....	104.3	.....
May 24.....	.....	105.8	.....
May 25.....	.....	106.5	3,200,000	
May 26.....	106.2	106.6	.....	Numerous at second molt and mature ticks.
May 27.....	105.2	105.5	4,096,000	
May 28.....	.....	103.8	.....
May 29.....	.....	103.5	.....
May 31.....	.....	102.1	.....
June 3.....	.....	104.0	.....
June 6.....	.....	101.4	.....
June 8.....	.....	103.2	.....
June 14.....	.....	102.8	.....
June 17.....	101.9	.....	5,200,000	

ANIMAL No. IV.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES	REMARKS.
1899.				
March 15.....	100.6	102.4	.....
March 16.....	100.4	102.2	.....
March 17.....	100.6	102.0	.....
March 18.....	101.5	.....	7,200,000	
March 19.....	101.4	102.3	.....	Inoculated with 4½ cc. blood from Jersey calf.
March 20.....	100.8	103.0	.....
March 21.....	100.5	102.6	.....
March 22.....	101.2	102.1	.....

ANIMAL No. IV.—TEMPERATURE.—Continued.

DATE.	A. M.	P. M.	CORPUSCLES	REMARKS.
1899.				
March 23.....	101.3	102.5	.....
March 24.....	101.6	106.5	.....
March 25.....	104.9	103.5	7,200,000	
March 26.....	103.9	105.3	.....
March 27.....	105.4	105.0	.....
March 28.....	105.2	105.2	.....
March 29.....	103.4	103.8	5,440,000	
March 30.....	101.2	105.7	.....
March 31.....	102.4	103.1	.....
April 1.....	102.0	102.6	6,640,000	
April 2.....	102.0	104.0	.....
April 3.....	102.3	102.6	.....
April 4.....	102.0	103.8	.....
April 5.....	101.4	103.8	5,120,000	
April 6.....	104.0	103.0	.....
April 7.....	100.2	103.6	.....
April 8.....	100.0	103.2	5,200,000	
April 9.....	100.1	103.6	.....
April 10.....	102.1	103.0	.....
April 11.....	104.1	104.0	.....
April 12.....	102.0	103.6	6,720,000	
April 13.....	101.8	102.1	.....
April 14.....	102.1	103.2	.....
April 15.....	102.2	103.1	5,216,000	
April 16.....	.....	102.5	.....
April 17.....	.....	102.7	.....
April 18.....	.....	102.6	.....
April 19.....	.....	102.8	.....
April 20.....	.....	102.8	.....
April 21.....	.....	102.5	.....
April 22.....	.....	101.9	6,208,000	
April 23.....	.....	102.7	.....
April 24.....	.....	.....	.....	Sent to tick-infested pasture.
April 26.....	.....	103.2	.....
April 29.....	.....	102.0	7,040,000	
May 6.....	.....	102.3	7,120,000	
May 9.....	.....	102.0	.....
May 11.....	.....	102.3	.....
May 13.....	.....	102.6	.....	Ticks at second molt.
May 17.....	.....	102.1	.....
May 22.....	.....	103.6	.....
May 24.....	.....	105.6	.....	Numerous at second molt.
May 25.....	.....	105.1	5,600,000	
May 26.....	104.6	105.0	.....
May 27.....	102.8	103.6	5,440,000	
May 28.....	.....	102.1	.....
May 29.....	.....	102.4	.....
May 31.....	.....	103.0	.....
June 8.....	.....	102.4	.....
June 6.....	.....	101.8	.....
June 8.....	.....	102.2	.....
June 14.....	.....	101.8	.....
June 17.....	.....	101.4	6,260,000	

Although the blood from the Jersey calf undoubtedly produced the fever in the three heifers into which it was inoculated, as can be seen by reference to both the temperature and blood-cell tables of Nos. 1, 4 and 9, the mildness of its own attack the previous year might be thought to have depreciated, to some extent, its value in a rigid test. Nevertheless, as will be seen from the tables, the temperatures and the decrease in the number of corpuscles both indicate that all three animals receiving its blood became victims of the fever, and after natural infestation with ticks on a "ticky" pasture, gradually resumed their normal healthy condition. In order, however, that there might be no question as to the test being both rigid and accurate, we have deemed it better to forego further comment on the result of the experiment with the blood of this animal, and confine ourselves to those obtained with the blood of the immune Northern animal and the native, about which no doubt could exist.

BLOOD OF NATIVE TWO-YEAR-OLD.

Group No. 2—Animals III., VII. and VIII.

ANIMAL No III.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
March 15....	101.0	102.2	.....
March 16....	101.2	103.2	.....
March 17....	100.8	103.2	.....
March 18....	101.3	.....	7,600,000	
March 19....	100.6	102.5	.....
March 20....	100.5	103.3	.....
March 21....	101.3	102.0	.....	Inoculated with 5 cc. native blood of 2-year-old.
March 22....	101.0	103.1	.....
March 23....	101.0	102.8	.....
March 24....	101.2	102.9	.....
March 25....	101.3	103.1	6,640,000	
March 26....	102.7	103.3	.....
March 27....	102.8	102.8	.....
March 28 ..	102.0	103.0	.....
March 29....	103.2	107.3	7,520,000	
March 30....	106.0	106.6	.....
March 31....	106.3	106.8	.....
April 1.....	105.8	106.7	6,240,000	
April 2.....	106.6	105.9	.....
April 3.....	105.0	106.0	.....
April 4.....	104.8	106.8	.....
April 5.....	107.0	107.3	2,880,000	
April 6.....	.....	.....	.....	Gored to death by two other animals while herd was being fed.

ANIMAL No. VII — TEMPERATURE.

DATE.	A. M	P. M	CORPUSCLES	REMARKS.
1899				
March 15....	100.6	101.6	.....
March 16....	99.6	101.8	.....
March 17....	100.0	102.0	.....
March 18....	100.0	.....	7,520,000	
March 19....	99.0	101.8	.....
March 20....	99.6	102.3	.....
March 21....	99.8	101.5	.....
March 22....	99.2	101.9	.....	Inoculated with 5 cc. blood from native 2-year-old.
March 23....	100.2	103.1	.....
March 24....	100.2	102.7	.....
March 25....	101.2	102.2	7,520,000	
March 26....	101.5	102.1	.....
March 27....	102.4	101.8	.....
March 28....	101.0	102.2	.....
March 29....	103.9	105.0	5,760,000	
March 30....	101.6	105.2	.....
March 31....	106.0	106.2	.....
April 1.....	103.8	105.3	5,200,000	
April 2.....	102.2	103.0	.....
April 3.....	102.0	104.0	.....
April 4.....	102.8	104.2	.....
April 5.....	103.2	105.8	4,640,000	
April 6.....	100.7	107.1	.....
April 7.....	106.2	107.5	.....
April 8.....	104.0	106.5	3,760,000	
April 9.....	103.0	105.3	.....
April 10.....	105.6	106.2	.....
April 11.....	104.1	104.9	.....
April 12.....	102.1	104.0	4,000,000	
April 13.....	102.2	101.4	.....
April 14.....	101.8	102.2	.....
April 15.....	100.4	102.2	4,160,000	
April 16.....	.....	101.5	.....
April 17.....	.....	102.5	.....
April 18.....	.....	103.4	.....
April 19.....	.....	103.2	.....
April 20.....	.....	103.5	.....
April 21.....	.....	105.2	.....
April 22.....	.....	105.1	3,424,000	
April 23.....	.....	106.5	.....
April 24.....	.....	106.2	.....
April 25.....	.....	106.2	.....
April 26.....	.....	104.9	.....
April 27.....	.....	105.4	.....
April 28.....	.....	105.2	.....
April 29.....	.....	105.3	1,840,000	
April 30.....	.....	104.6	.....
May 1.....	.....	104.6	.....
May 2.....	.....	104.2	.....
May 3.....	.....	104.2	.....
May 4.....	.....	103.5	.....
May 5.....	.....	102.5	2,080,000	
May 6.....	.....	102.4	.....
May 7.....	.....	102.4	.....

ANIMAL NO VII.—TEMPERATURE—*Continued.*

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
May 8.....	102.4	.....	Sent to tick-infested pasture.
May 9.....	103.4	.....
May 11.....	102.3	.....	Plenty of ticks on animal.
May 13.....	103.0	.....
May 17.....	103.3	.....	Ticks numerous at second molt.
May 22.....	102.8	.....
May 24.....	102.4	.....	Ticks numerous at second molt.
May 25.....	99.8	3,520,000	
May 26.....	100.3	102.5	.....	Ticks numerous at second molt.
May 27.....	101.7	103.6	3,940,000	
May 28.....	103.1	.....	Ticks numerous at second molt.
May 29.....	102.2	.....
May 31.....	102.0	.....	Ticks numerous at second molt.
June 3.....	103.0	.....
June 6.....	100.2	.....	Ticks numerous at second molt.
June 8.....	101.5	.....
June 14.....	102.7	.....	Ticks numerous at second molt.
June 17.....	101.6	4,800,000	

ANIMAL NO. VIII.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
March 15....	100.6	102.5	.....	Inoculated with 5 cc. blood from native two-year-old.
March 16....	100.6	102.6	.....
March 17....	101.0	102.3	.....	Inoculated with 5 cc. blood from native two-year-old.
March 18....	101.6	.....	8,000,000	
March 19....	100.5	102.2	.....	Inoculated with 5 cc. blood from native two-year-old.
March 20....	100.8	102.8	.....
March 21....	100.0	102.1	.....	Inoculated with 5 cc. blood from native two-year-old.
March 22....	101.2	103.2	.....
March 23....	100.6	103.0	.....	Inoculated with 5 cc. blood from native two-year-old.
March 24....	101.0	102.8	.....
March 25....	102.0	102.4	7,600,000	Inoculated with 5 cc. blood from native two-year-old.
March 26....	102.3	102.7	.....
March 27....	102.3	102.1	.....	Inoculated with 5 cc. blood from native two-year-old.
March 28....	104.4	105.2	.....
March 29....	105.2	107.0	6,240,000	Inoculated with 5 cc. blood from native two-year-old.
March 30....	108.1	108.0	.....
March 31....	105.2	105.4	.....	Inoculated with 5 cc. blood from native two-year-old.
April 1.....	101.0	101.6	2,320,000	
April 2.....	102.4	103.7	.....	Inoculated with 5 cc. blood from native two-year-old.
April 3.....	101.4	104.7	.....
April 4.....	101.5	105.1	.....	Inoculated with 5 cc. blood from native two-year-old.
April 5.....	103.0	106.0	2,400,000	
April 6.....	104.0	106.9	.....	Inoculated with 5 cc. blood from native two-year-old.
April 7.....	105.5	106.0	.....
April 8.....	104.0	105.8	2,304,000	Inoculated with 5 cc. blood from native two-year-old.
April 9.....	103.6	103.9	.....
April 10.....	102.2	104.5	.....	Inoculated with 5 cc. blood from native two-year-old.
April 11.....	103.1	104.6	.....
April 12.....	102.4	103.2	3,620,000	

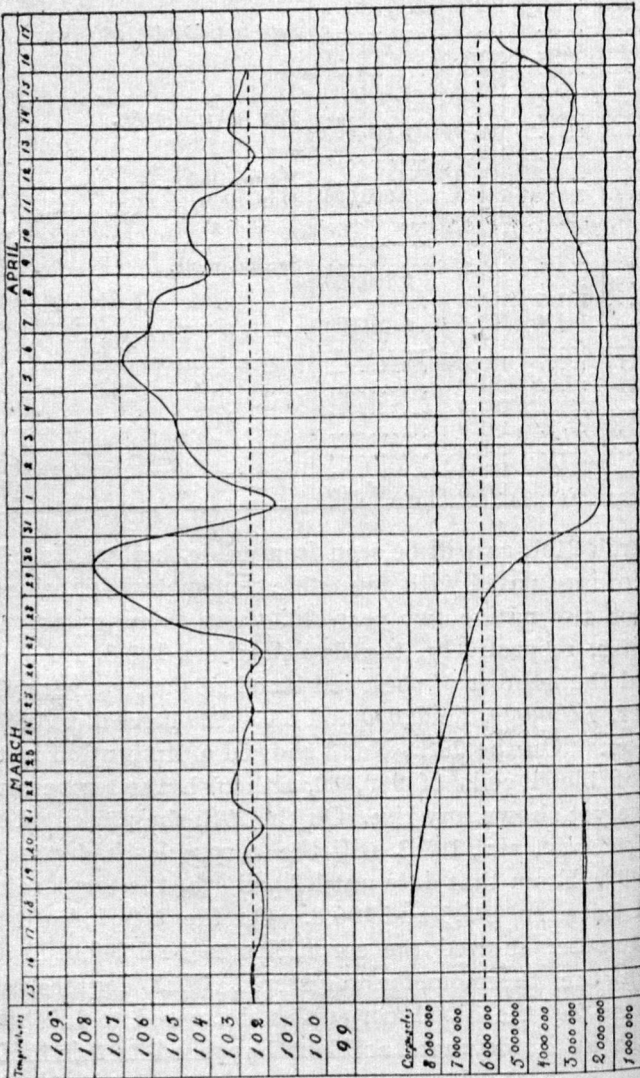
ANIMAL No VIII.—TEMPERATURE—*Continued.*

DATE	A. M.	P. M.	CORPUSCLES	REMARKS.
1899.				
April 13	101.2	102.3	.....
April 14	102.4	103.2	.....
April 15	101.4	102.9	3,104,000	
April 16		102.6	.....
April 17 .....		.....	.....	Sent to tick-infested pasture.
April 22			5,840,000	
April 26		104.4	.....
April 29		103.0	4,640,000	
May 3		103.6	.....	Few ticks in molt.
May 6		103.6	5,600,000	
May 9		106.0	.....
May 11		104.0	.....	Mature ticks. More ticks.
May 13		104.0	2,960,000	
May 17		104.0	.....
May 22		103.4	.....
May 24		103.0	.....	Second molt.
May 25		101.7	3,760,000	
May 26	101.5	101.8	.....
May 27	102.4	103.5	4,320,000	
May 28		103.4	.....
May 29		103.6	.....
May 31		104.6	.....
June 3		103.5	.....
June 6		101.8	.....
June 8		103.4	.....
June 14		103.4	.....
June 17		102.5	5,360,000	

On March 21st, as will be seen from table, heifers Nos. 3, 7 and 8 were inoculated with five cubic centimeters defibrinated blood from the native two-year-old, their evening temperatures being, respectively, the day previous, 103.3, 102.3 and 102.8, and the number of their red blood corpuscles, per cubic millimeter, 7,600,000, 7,520,000 and 8,000,000 three days before inoculation. On the 25th, No. 3 showed a diminution in the number of blood cells of 960,000, although the temperature had not as yet shown any rise. On the 29th she presented the first marked rise, viz., 107.3, still the corpuscles had gone up to 7,520,000. From that date until April 4th, the temperature remained between 105.9 and 106.8. On the 1st of April the haemacytometer showed the corpuscles to be 6,240,000. On April 5th the thermometer registered 107.3 degrees, and on the same day the blood corpuscles decreased to 2,880,000. On the 6th an unfortunate accident happened to this heifer,

She was in a debilitated condition and showed pathognomonic symptoms of the disease, but although inappetence was apparent, she was still inclined to eat a little. In this weakened physical state, she was attacked while feeding by two of the more robust animals, and died from exhaustion. An au-

ANIMAL NO. VIII.



Dotted line above represents normal temperature; dotted line below represents normal number of blood corpuscles; continuous lines represent fluctuations of temperature, and blood corpuscles, after inoculation.

topsy revealed no evidences of her having succumbed to the fever, but did indicate death from exhaustion.

On March 29th No. 7 also exhibited her first marked elevation of temperature, viz.: 105 degrees, with a decrease in the number of blood cells to 5,760,000. Between March 29th and April 5th the temperature showed a fluctuation of 3.2 degrees, the highest point reached in the interval being 106.2. On April 7th the temperature went up to 107.5, and on the following day the corpuscles went down to 3,760,000. From that date until the 20th there was a fluctuation of 5.1 degrees, the highest reached being 106.5, and the lowest 101.4. On April 22nd the blood cells were 3,424,000, and the temperature 105.1. The average temperature for the three following days was 106.3, and on the 29th, with the thermometer recording 105.3, the corpuscles had reduced in number to 1,840,000. From April 30th to May 9th the temperature remained between 104.6 and 102.5, at which date the corpuscles had increased to 2,080,000. On May 9th, with a temperature of 103.4, this animal was placed on a tick-infested pasture. On the 13th many ticks had become attached; temperature, 103.0. On the 24th numerous ticks on her were found to be at second moult. April 25th, temperature 99.8, corpuscles 3,520,000; 27th, temperature 103.6, corpuscles 3,940,000; June 17th, temperature 101.6, corpuscles 4,800,000. Last temperature taken (July 15th) showed 101.0 degrees.

No. 8 showed the first decided rise of temperature on March 28th, viz.: 105.2. On the 29th, the temperature was 107.0, and the corpuscles 6,240,000. On the 30th the morning temperature showed 108.1 degrees, and in the evening 108.0, and there was decided hæmoglobinuria. The evening temperature on the 31st was 105.4. April 1st the temperature dropped to 101.6, with the number of corpuscles reduced to 2,320,000. The temperature then gradually rose from 103.7, on the 2nd, to 106.9 on the 6th, with the number of blood cells remaining about the same. From this date until the 16th the temperature gradually decreased, with slight fluctuation, from 106.9 to 102.6. On April 17th this animal was placed on the ticky pasture. On the 22nd her blood cells numbered 5,840,000. On April 26th her temperature was 104.4;

on the 29th, 103.0, with corpuscles 4,640,000. The temperature on May 3rd was 103.6, and there was observed on her a few ticks in molt. On May 6th the blood cells had increased to 5,600,000. On the 9th the temperature was 106.0; on the 11th 104.0, and ticks were found to be matured. On the 13th, temperature 104.0, corpuscles reduced to 2,960,000; more ticks found on the animal. May 24th, temperature 103.0, ticks in the second molt; 25th, temperature 101.7, corpuscles, 3,760,000; 27th, temperature 103.5, corpuscles 4,320,000. From this date the temperature kept between 104.6, on May 29th, and 101.8, on June 6th. On June 17th, the temperature was 102.5, and the corpuscles 5,360,000. On July 15th (last temperature taken) the temperature stood at 102.2 degrees.

BLOOD OF IMMUNE NORTHERN STEER (*White-Faced Steer*).

Group No. 3—Animals V., X. and XI.

ANIMAL No. V.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1-93				
March 15....	100.4	101.8	.....	Inoculated with 5 c. blood from white-faced steer.
March 16....	101.0	102.3	.....
March 17....	100.8	102.1	.....
March 18....	101.0	.....	7,520,000	
March 19....	100.2	102.5	.....
March 20....	100.0	103.3	.....
March 21....	100.5	102.3	.....
March 22....	101.0	102.5	.....
March 23....	100.8	102.4	.....
March 24....	100.5	104.6	.....
March 25....	102.5	105.5	6,720,000	
March 26....	102.5	104.3	.....
March 27....	102.8	103.2	.....
March 28....	102.0	101.0	.....
March 29....	100.6	102.8	5,680,000	
March 30....	101.2	104.7	.....
March 31....	104.0	104.9	.....
April 1....	103.8	105.0	5,600,000	
April 2....	103.8	105.4	.....
April 3....	101.6	103.3	.....
April 4....	101.0	101.8	.....
April 5....	100.5	102.2	5,900,000	
April 6....	100.3	104.3	.....
April 7....	101.5	104.1	.....
April 8....	102.2	107.0	5,440,000	
April 9....	100.7	102.9	.....
April 10....	101.8	103.4	.....
April 11....	101.4	103.0	.....
April 12....	101.0	101.6	5,840,000	
April 13....	101.6	102.0	.....

ANIMAL No. V.—TEMPERATURE—Continued.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
April 14	101.3	103.0	.....
April 15	101.4	102.3	6,176,000	
April 16	101.8	.....
April 17	102.1	.....
April 18	102.3	.....
April 19	101.6	.....
April 20	101.8	.....
April 21	102.0	.....
April 22	102.0	5,184,000	
April 23	102.1	.....
April 24	
April 26	103.8	.....	Sent to tick-infested pasture.
April 29	102.1	6,080,000	
May 3	102.1	.....
May 6	102.4	6,800,000	
May 9	102.5	.....
May 11	102.0	.....
May 17	102.5	.....
May 22	102.2	.....	Ticks on animal.
May 24	104.0	.....
May 25	100.7	.....	11 a.m., matured ticks, and numerous at second molt.
May 26	101.3	102.8	.....
May 27	101.6	102.8	.....
May 28	102.7	.....
May 29	102.7	.....
May 31	102.2	.....
June 3	102.8	.....
June 6	102.0	6,500,000	
June 8	102.4	.....
June 14	101.9	.....
June 16	101.8	.....

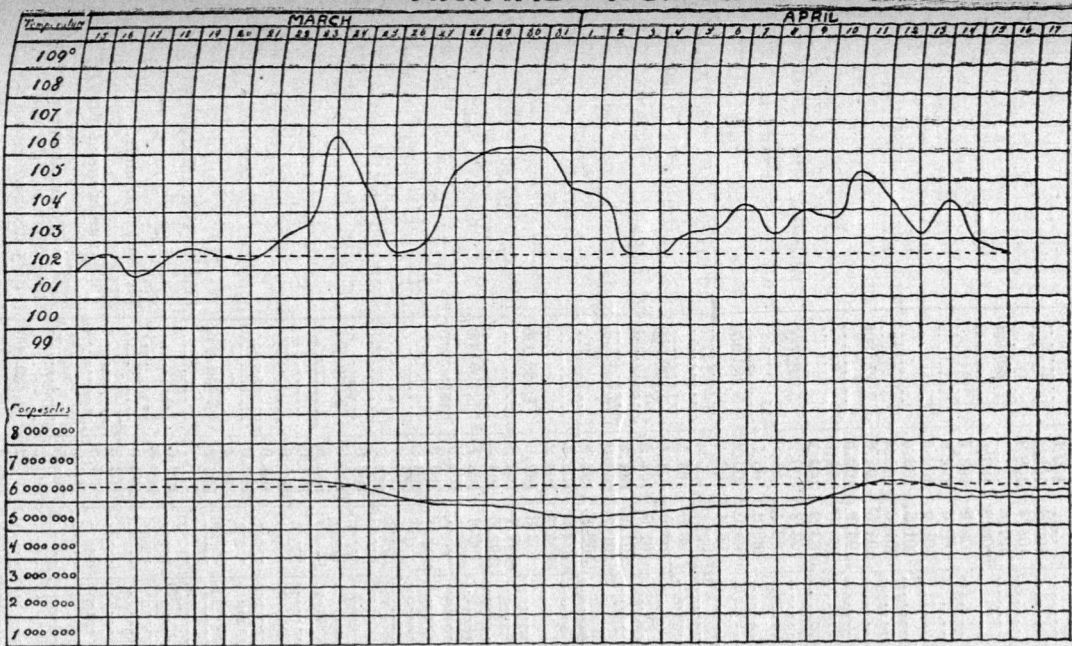
ANIMAL No. X.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
March 15	100.5	102.0	.....
March 16	100.0	102.6	.....
March 17	100.0	101.8	.....
March 18	101.0	.....	6,800,000	
March 19	99.0	102.8	.....	Inoculated with 5 cc. blood from white-faced steer.
March 20	99.5	102.5	.....
March 21	100.4	102.4	.....
March 22	100.0	103.0	.....
March 23	100.0	103.6	.....
March 24	100.6	105.6	.....
March 25	102.9	104.8	6,400,000	
March 26	102.6	102.6	.....
March 27	101.2	103.0	.....

ANIMAL No. X.—TEMPERATURE.— *Continued.*

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899				
March 23....	102.0	105.4	.....
March 29....	102.4	106.0	5,840,000	
March 30....	104.1	103.2	.....
March 31....	105.6	106.2	.....
April 1.....	104.2	104.8	5,360,000	
April 2.....	102.0	104.5	.....
April 3.....	100.9	102.5	.....
April 4.....	101.5	102.5	.....
April 5.....	101.6	103.2	5,680,000	
April 6.....	102.0	103.4	.....
April 7.....	101.8	104.2	.....
April 8.....	100.0	103.2	5,824,000	
April 9.....	100.0	104.0	.....
April 10.....	102.2	103.7	.....
April 11.....	102.4	105.3	.....
April 12.....	101.5	104.4	6,640,000	
April 13.....	102.0	103.2	.....
April 14.....	102.0	101.3	.....
April 15.....	101.4	102.9	6,176,000	
April 16.....	.....	102.5	.....
April 17.....	.....	.....	.....	Sent to tick-infested pasture.
April 22.....	.....	.....	6,240,000	
April 26.....	.....	103.2	.....
April 29.....	.....	102.9	6,240,000	
May 3.....	.....	102.5	.....
May 6.....	.....	103.6	6,800,000	
May 9.....	.....	101.6	.....
May 11.....	.....	102.4	.....
May 13.....	.....	103.1	.....	Matured ticks.
May 17.....	.....	103.2	.....
May 22.....	.....	101.8	.....
May 24.....	.....	103.2	.....	Mature ticks, and numerous at second molt.
May 25.....	.....	102.6	.....
May 26.....	104.8	104.9	.....
May 27.....	105.4	106.0	.....
May 28.....	.....	103.4	.....
May 29.....	.....	102.8	.....
May 31.....	.....	102.2	.....
June 3.....	.....	103.0	.....
June 6.....	.....	101.0	.....
June 8.....	.....	101.6	.....
June 14.....	.....	101.9	.....
June 17.....	.....	102.7	.....
July 1.....	.....	101.1	.....
July 15.....	.....	101.0	.....

ANIMAL NO. X.



Dotted line above represents normal temperature; dotted line below represents normal number of blood corpuscles; continuous lines represent fluctuations of temperature, and blood corpuscles, after inoculation.

ANIMAL No. XI.—TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES	REMARKS.
1899.				
March 15.....	.....	102.0	.....
March 16.....	100.8	102.4	.....
March 17.....	101.4	102.1	.....
March 18.....	101.6	.....	7,280,000	
March 19.....	100.2	102.0	.....
March 20.....	100.2	103.7	.....
March 21.....	100.6	102.9	.....
March 22.....	101.0	102.5	.....
March 23.....	101.5	103.6	.....
March 24.....	101.6	105.4	.....
March 25.....	104.5	105.6	7,520,000	
March 26.....	104.9	105.5	.....
March 27.....	103.8	104.6	.....
March 28.....	103.2	104.1	.....
March 29.....	103.8	105.2	5,632,000	
March 30.....	103.4	105.6	.....
March 31.....	105.2	105.7	.....
April 1.....	105.6	106.2	5,280,000	
April 2.....	105.4	106.1	.....
April 3.....	103.8	105.4	.....
April 4.....	103.0	104.5	.....
April 5.....	103.0	104.4	5,120,000	
April 6.....	101.0	104.2	.....
April 7.....	103.1	104.2	.....
April 8.....	101.7	104.0	4,720,000	
April 9.....	102.8	103.8	.....
April 10.....	102.9	105.4	.....
April 11.....	104.1	104.2	.....
April 12.....	103.3	102.6	4,880,000	
April 13.....	102.1	102.8	.....
April 14.....	102.6	104.3	.....
April 15.....	102.4	103.7	5,120,000	
April 16.....	.....	102.3	.....
April 17.....	.....	103.9	.....
April 18.....	.....	103.2	.....
April 19.....	.....	104.4	.....
April 20.....	.....	103.2	.....
April 21.....	.....	104.0	.....
April 22.....	.....	104.6	5,040,000	
April 23.....	.....	104.8	.....
April 24.....	.....	104.0	.....
April 25.....	.....	103.6	.....
April 26.....	.....	103.0	.....
April 27.....	.....	102.0	.....
April 28.....	.....	102.4	.....
April 29.....	.....	103.3	5,600,000	
May 1.....	.....	.....	.....	Sent to tick-infested pasture.
May 3.....	.....	102.6	.....
May 6.....	.....	103.8	.....
May 9.....	.....	103.0	.....	Ticks at first molt.
May 11.....	.....	103.5	.....
May 13.....	.....	103.5	.....	Ticks numerous at first molt!
May 17.....	.....	103.0	.....
May 22.....	.....	105.5	.....	Ticks very numerous at second molt.
May 24.....	.....	103.2	.....	Gave birth to calf, which was prob-
May 25.....	.....	101.2	4,480,000	ably dead when born.
May 26.....	104.0	106.5	.....
May 27.....	.....	105.0	5,120,000	
May 28.....	.....	103.6	.....
May 31.....	.....	102.8	.....

ANIMAL No. XI.—TEMPERATURE.—Continued.

DATE.	A. M.	P. M.	CORPUSCLES	REMARKS.
1899.				
June 1.....	101.8	.....
June 2.....	102.6	.....
June 3.....	102.8	.....
June 4.....	102.7	.....
June 5.....	103.5	.....
June 17.....	5,360,000	
June 21.....	103.4	.....
June 24.....	101.5	.....
June 30.....	101.8	.....
July 15.....	100.7	6,400,000	

On March 18th five cubic centimeters of defibrinated blood from the immune Northern steer were injected into Nos. 5, 10 and 11. Their respective temperatures (in the order of the numbers given) were, the day of inoculation, 101.0, 101.0 and 101.6. The number of corpuscles per cubic millimeter on the same day being, respectively, 7,520,000, 6,800,000 and 7,280,000. It may be stated that the temperatures just given were taken in the morning, which are usually lower than those obtained in the evening. The first marked rise shown was by No. 5, on the 24th, with 104.6 degrees. On March 25th the evening temperature was 105.5, blood corpuscles 6,720,000. From this date the fluctuations ranged between 101.8 on April 4th, to 107.0 on April 8th. This latter temperature may have been accidental, or due to some other cause than the disease, as the morning temperature of that day was only 102.2, the previous evening 104.1, and the following morning 100.7. On the 10th the thermometer recorded 103.4 degrees, which was the highest temperature during two weeks preceding the animal's exposure to the tick-infested pasture. On April 23rd the temperature stood at 102.1, and on the following day (24th) the heifer was sent to pasture. On March 29th the corpuscles numbered 5,680,000, and during the following eight countings, from April 1st to May 6th, varied only from 5,184,000 to 6,800,000 which was the last count made, and this was while the animal was at pasture. From April 24th to July 15th (last thermometer test) the temperature remained remarkably steady at an average of about 102.5, reaching only on one occasion 104.0, and

on another 103.8. The last temperature taken (July 15) showed 102.0. On May 17th ticks were observed on this heifer; on the 24th they had matured, and there were a number at second molt.

The records of Nos. 10 and 11 show great similarity when compared with that of number 5, which can be seen by reference to above tables. Only on one occasion did the temperature of No. 10 reach 106.6 degrees, and at no time did the number of corpuscles get below 5,000,000.

In the case of No. 11, this heifer's temperature only on three occasions exceeded 106.0 degrees, viz: 106.2 on April 1st, 106.1 on the 2nd, and 106.5 on May 26th (having given birth to a calf on the day previous), nor at any time did her corpuscles go below 4,700,000. On May 1st she was sent to pasture and became infested with ticks, but was removed for special care after parturition, and on July 22 was again returned to pasture.*

Those animals in which the increase of temperature indicated a relapse after being exposed to the tick-infested pasture were considered not to have sufficiently regained their physical strength before being exposed to ticks. Those which were in a more robust state previous to their being exposed to ticks suffered little, if any, apparent inconvenience after being tick-infested.

From the foregoing deductions, based upon the individual records of the two groups of animals, as well as on the general average of their temperature and blood-cell readings, we are justified, we think, in concluding that blood of the recently immune steer was less virulent than that of the native, and that the results, so far as its immunizing properties went, were more satisfactory, in that it accomplished the purpose in a shorter space of time without inflicting such a severe type of the artificially produced fever.

Further verification of this conclusion can be obtained by referring to the temperature and corpuscle-table of the two Hereford calves (imported from Maryland), the record of sus-

*It is not considered advisable to import cows that are expected to give birth to calves shortly after importation.

For temperature table of calf see page 184.

ceptible heifer No. 6, inoculated later (during the summer) and the temperature table of the one-month-old calf, with blood from the immune Northern steer.

HEREFORD BULL (Corla's Duke, 86565).

[See Illustration]

DATE.	A. M	P. M	CORPUSCLES	REMARKS.
1899				
April 13.....	102 3	Inoculated with 2½ cc blood from recently immunized animal.
April 14.....	103 0	.....
April 16.....	102.2	7,104,000	
April 17.....	102.3	.....
April 18.....	102 4	.....
April 19.....	102 5	.....
April 20.....	102.8	.....
April 21.....	103.5	.....
April 22.....	104.7	.....
April 23.....	103.1	.....
April 24.....	103 6	
April 25.....	104 6	.....
April 26.....	103.2	.....
April 27.....	102.8	.....
April 28.....	104.0	.....
April 29.....	103.7	3,200,000	
April 30.....	105.6	.....
May 1.....	104.4	.....
May 2.....	103.4	.....
May 3.....	103.3	.....
May 4.....	103 5	4 640,000
May 5.....	103.5	.....
May 6.....	103.6	.....
May 7.....	103 6	.....
May 8.....	103.0	.....
May 9.....	103.5	.....
May 10.....	103.7	.....
May 11.....	103.0	.....
May 12.....	104.3	.....
May 14.....	105.8	4,720,000
May 15.....	105.8	.....
May 16.....	104 9	.....
May 17.....	104.2	.....
May 18.....	104.2	.....
May 19.....	103.0	.....
May 20.....	103.2	.....
May 24.....	102 6	.....
May 25.....	104.4	.....
May 26.....	103.6	
*May 29.....	102.9	.....

*Continued slightly above normal after this date.

July 22d this animal was sent to tick-infested pasture and became infested with ticks, without the production of high fever, but the abnormally large number of ticks caused a reduction of flesh.

ceptible heifer No. 6, inoculated later (during the summer) and the temperature table of the one-month-old calf, with blood from the immune Northern steer.

HEREFORD BULL (Corla's Duke, 86565).

[See Illustration]

DATE.	A. M	P. M	CORPUSCLES	REMARKS.
1899				
April 13.....	102 3	.....	Inoculated with 2½ cc blood from recently immunized animal.
April 14.....	103 0	.....
April 16.....	102.2	7,104,000	
April 17.....	102.3	.....
April 18.....	102 4	.....
April 19.....	102 5	.....
April 20.....	102.8	.....
April 21.....	103.5	.....
April 22.....	104.7	.....
April 23.....	103.1	.....
April 24.....	103 6	.....
April 25.....	104 6	.....
April 26.....	103.2	.....
April 27.....	102.8	.....
April 28.....	104 0	.....
April 29.....	103.7	3,200,000	
April 30.....	105.6	.....
May 1.....	104 4	.....
May 2.....	103.4	.....
May 3.....	103 3	.....
May 4.....	103 5	.....
May 5.....	103.5	.....
May 6.....	103.6	4 640,000	
May 7.....	103 6	.....
May 8.....	103.0	.....
May 9.....	103.5	.....
May 10.....	103.7	.....
May 11.....	103.0	.....
May 12.....	104.3	.....
May 14.....	105.8	.....
May 15.....	105.8	.....
May 16.....	104 9	.....
May 17.....	104.2	.....
May 18.....	104.2	.....
May 19.....	103.0	.....
May 20.....	103.2	.....
May 24.....	102 6	.....
May 25.....	104 4	4,720,000	
May 26.....	103.6	.....
* May 29.....	102.9	.....

* Continued slightly above normal after this date.

July 22d this animal was sent to tick-infested pasture and became infested with ticks, without the production of high fever, but the abnormally large number of ticks caused a reduction of flesh.

HEREFORD HEIFFER (Gold Bell, 86567).

[See Illustration.]

DATE	A. M	P. M	CORPUSCLES	REMARKS.
1899.				
April 13	102.3	.....	Inoculated with 2½ cc. blood from recently immunized animal.
April 14	103.0	.....
April 15	10,656,000	
April 16	102.2	.....
April 17	102.3	.....
April 18	102.4	.....
April 19	102.5	.....
April 20	102.8	.....
April 21	103.5	.....
April 22	104.7	.....
April 23	103.1	.....
April 24	103.6	.....
April 25	104.6	.....
April 26	103.2	.....
April 27	102.8	.....
April 28	104.0	.....
April 29	103.7	7,200,000	
April 30	105.6	.....
May 1	104.4	.....
May 2	103.4	.....
May 3	103.3	.....
May 4	103.5	.....
May 5	103.5	.....
May 6	102.8	6,240,000	
May 7	102.5	.....
May 8	103.2	.....
May 9	103.2	.....
May 10	103.5	.....
May 11	102.8	.....
May 12	102.7	.....
May 14	103.0	.....
May 15	102.8	.....
May 16	102.6	.....
May 17	102.2	.....
May 18	101.8	.....
May 19	102.6	.....
May 20	103.0	.....
May 24	102.2	.....
May 25	102.5	8,320,000	
May 26	103.6	.....
May 29	101.8	.....	After this date temperature remained normal.

But, although the blood from a recently immune animal undoubtedly gave more gratifying results than that from the native when similar quantities were used, there is no reason why the native blood should not succeed admirably if used in smaller doses. In fact it would be impracticable, if not altogether impossible, when preventive inoculation against Texas

fever becomes generally adopted, to be able to procure blood from recently immune animals to meet the demand. The time is bound to come, and that at no distant period, when this preventive measure will be daily put into operation, and instead of having to depend upon Experiment Stations to supply the blood or undertake the operation it will be accomplished by the local veterinary practitioner, or, perhaps, the intelligent stockowner himself.

Consequently blood from native animals will be much more available, and with which success can be achieved, provided the dose to be inoculated is properly regulated.

That smaller doses of native blood will succeed satisfactorily in bringing about the desired end will be seen by reference to the appended table, submitted by Mr. J. T. Bryant, Calhoun, La., which shows the record of the temperatures of two Hereford yearlings (imported by him from Iowa) which were inoculated with two cubic centimeters of blood from a

J. T. BRYANT'S RECORD OF TEMPERATURE OF IMPORTED HEREFORD YEARLINGS.

Blood of Native Yearling Used. Inoculated May 26th, 1899. Dose, 2 cc.
First Temperature Taken May 29th, 4 P. M.

DATE.	MORNING	EVENING	DATE.	MORNING.	EVENING.
Bull—			Heifer—		
May 29.....	.....	104.0	May 29.....	.....	105.0
May 30.....	102.5	104.5	May 30.....	102.0	104.6
May 31.....	103.0	104.0	May 31.....	101.6	105.6
June 1.....	103.0	104.0	June 1.....	102.0	105.2
June 2.....	104.6	106.0	June 2.....	101.6	104.0
June 3.....	104.5	105.0	June 3.....	101.6	105.6
June 4.....	.....	105.5	June 4.....	.....	103.6
*June 5.....	104.5	106.6	June 5.....	102.0	103.6
June 6.....	103.2	102.0	June 6.....	102.6	102.2
June 7.....	102.0	103.0	June 7.....	101.2	103.2
June 8.....	102.2	102.6	June 8.....	103.2	105.2
June 9.....	102.0	102.3	June 9.....	103.6	103.5
June 10.....	102.8	102.0	June 10.....	103.6	104.4
June 11.....	102.0	105.0	June 11.....	105.1	107.0
June 12.....	104.0	.....	June 12.....	103.2	.....
June 13.....	103.0	103.0	June 13.....	103.0	104.0
June 14.....	102.2	102.4	June 14.....	103.2	103.5
June 14.....	102.0	102.0	June 14.....	102.0	102.1

*Red urine (almost blood); gave bismuriate quinine, 5 gr. doses, until fever lowered.

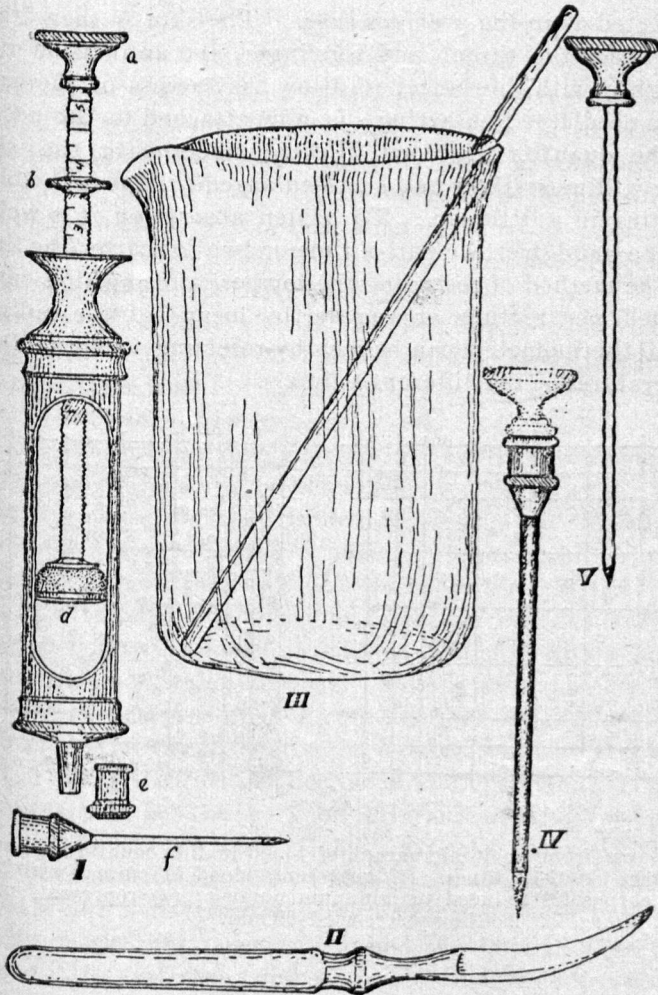
native yearling, and passed through the fever, although the bull had the fever in an acute form, having a temperature of 106.6, accompanied by bloody urine. It may be here stated that Mr. Bryant had made two previous inoculations which failed to give any reaction whatever. This was due either to the blood being inactive, it having been shipped from Texas, or to an insufficient quantity. It will be seen, however, by a glance at the table, that after the third inoculation (with 2 cc. of native blood) the animals showed typical febrile reaction, and recovered satisfactorily.

TECHNIQUE OF THE OPERATION.

The animal from which blood is to be drawn is secured either by casting and tying, or by placing in stocks or traxis. The hair is then clipped or shaved closely for three or four inches over the jugular vein, about half way up the neck. The part is then thoroughly disinfected by saturation with a 5 per cent. aqueous solution of pure carbolic acid or creolin. A piece of small rope (about one-quarter inch) is tied tightly around the base of the neck, so as to raise the vein by checking the flow of blood in it. The instruments and other requisites used are a small trocar and canula, a hypodermic syringe and needle, a small glass vessel, a small, sharp-pointed lancet or knife, a 5 per cent. aqueous solution of pure carbolic acid or creolin, and some cooled boiled water. Before being used all instruments, etc., should be thoroughly disinfected or rendered sterile with the antiseptic solution, and the vessel, trocar and canula, and syringe and needle should be rinsed out with the boiled water. When everything is in readiness a small incision is made through the disinfected skin, over the jugular vein, with the lancet. The trocar and canula is then inserted through the incision into the vein, and directed upwards toward the head. The trocar is now withdrawn and the blood allowed to escape through the canula into the glass vessel. When sufficient has been obtained the canula is withdrawn and the rope loosed from the neck, when the flow of blood will cease.

The blood in the vessel is then stirred slowly with a thin glass rod, which has also been sterilized, until all of the

fibrin collects on it and is withdrawn; it is then taken up into the syringe, and is ready for use.

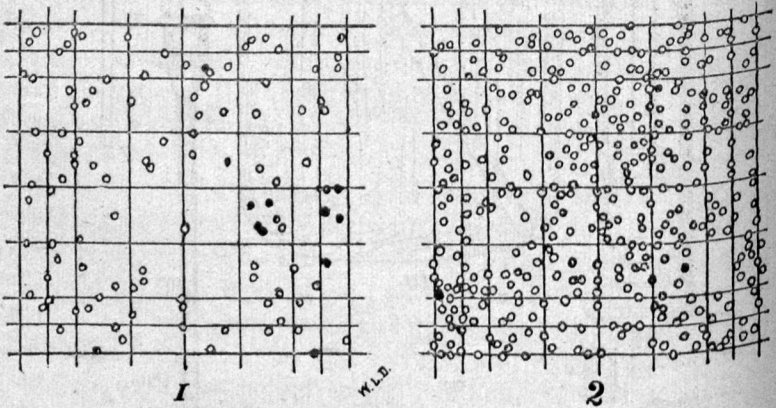


- I. Hypodermic Syringe.
 a. Piston.
 b. Screw regulator.
 d. Plunger.
 e. Cap.
 f. Needle.

- II. Lancet.
 III. Glass vessel and rod.
 IV. Trocar in position in cannula.
 V. Trocar separate.

The animal to be inoculated is prepared by clipping the hair from off a portion of skin about the size of the hand, behind the shoulder blade, about half way up the chest, and is disinfected as in the previous case. The skin is then drawn out between the thumb and forefinger, and an incision made through it with the lancet to allow easy access of the hypodermic needle. The syringe is now attached to the needle, and the quantity of blood injected underneath the skin. There will most likely be a small enlargement due to the blood collecting in a little sac. To hasten absorption it is well to pass the hand over the part a time or two to scatter the fluid.

The method of recording the temperatures (which can be obtained per rectum or vagina, by means of the ordinary clinical thermometer) can be seen by referring to the tables of temperatures of the different animals.



Drawn from photomicrograph of blood in the counting apparatus. Magnified about 145 times. (1) represents blood of animal with Texas fever, corpuscles reduced to minimum number; (2) represents normal blood. In actual size the squares are 1-20 mm.

TICKS AS A SOURCE OF BLOOD FOR INOCULATING CATTLE TO PRODUCE IMMUNITY.

(BY W. R. DODSON.)

Introductory.

Whatever may be said of the success of the method of inoculating animals with the blood of native cattle or of recently immunized animals for the purpose of establishing immunity from Texas fever, improvement in at least two features of the method is very desirable.

First—We want a better and easier method of securing and transporting inoculative material.

Second—We want a virus still less severe than that obtained from the recently immunized animal, if we can get it, and at the same time not lessen the degree of immunity established by the inoculation process.

It was with these two objects in view that we began the experiments presently to be described.

It may now be stated without any fear of successful contradiction, that the Southern bovine, which is annually infested with the cattle ticks (*Boophilus bovis*) carries in its blood at all times the microbic organism of Texas fever, which when introduced into the blood of a susceptible animal will produce the virulent disease. This is an anomalous fact, and one that we are slow to accept until an abundance of incontrovertible evidence is brought to its support. The work of Smith and Kilborne, of the National Department of Agriculture, verified by the work of this and other Experiment Stations in numerous cases, should leave no shadow of doubt of the truth of this matter. Probably no analogous case can be cited where a disease-producing organism normally lives in the body of the host species, leaving the host in a state of perfect health, but producing a virulent disease when passed into the body of the same species from another geographical section.

Most infectious diseases that are well understood have as their specific cause minute forms of vegetable life known as bacteria, but Texas fever of cattle is caused by one of the low forms of animal life belonging to the group Protozoa.

These little animals are extremely minute in size and can live within the red blood corpuscle.

When the tick extracts the blood from the animal to which it is attached, the organism of Texas fever accompanies the blood, and the ticks coming from the eggs of this tick are capable of transmitting the disease when they become attached to a susceptible animal. Since we have not been able to find a convenient way of preparing the immunizing blood for transportation purposes, we thought it worth while to try some inoculations with blood taken from ticks that had just become fully inflated from an animal that was immune from Texas fever. If they should prove to furnish satisfactory material for inoculation purposes, the tick itself would be a convenient capsule in which to transport the blood to points where immunized animals were not readily accessible. Since the adult ticks may be kept for several days before they begin to lay eggs, they could be shipped to distant points without having the blood lose its virulence.

INOCULATION OF TICK BLOOD, CASE NO. 1.

The following table gives the record of temperature and number of blood corpuscles per cube millimeter of an animal that was inoculated with the material obtained from three large cattle ticks, taken from native cattle just at the stage of maturity and full inflation. The ticks were washed externally with a solution of bichloride of mercury, one to one thousand, then washed in boiled water, mashed in a mortar that had been sterilized, a few cube centimeters of boiled water added, and the fluid portion then drawn off and inoculated subcutaneously into the animal. The object in washing the ticks was to prevent the possibility of blood poisoning from the introduction of bacteria adherent to the surface of the tick.

The animal had been previously used for an experiment reported in Bulletin No. 56 of this Station, in which it was shown that dog ticks, deer ticks, etc., other than cattle ticks, would not produce Texas fever. There is no reason to believe the previous experiments would vitiate the results obtained from the present experiment.

The animal was inoculated on September 17, but the tem-

peratures are given for several days previous to show the normal. During the month of August the temperature did not go above 102.4 degrees. The animal was a two-year-old steer; grade—Shorthorn.

TEMPERATURE.

DATE	A. M.	P. M.	DATE.	A. M.	P. M.
September 2....	101.5	101.3	October 16.....	.....	101.8
September 4....	100.0	101.3	October 18.....	.....	102.1
September 6....	100.0	101.9	October 19.....	.....	102.1
September 9....	101.5	102.5	October 21.....	.....	101.6
September 12....	101.1	102.3	October 22.....	.....	102.4
September 13....	101.8	101.2	October 23.....	.....	102.0
September 14....	101.8	102.4	October 25.....	.....	101.5
September 15....	101.3	.....	October 26.....	.....	102.1
September 16....	101.0	102.7	December 3.....	.....	102.2
September 17....	101.8	102.4	†December 4.....	.....	101.6
*September 18....	.....	102.5	December 5.....	.....	102.0
September 19....	101.0	.....	December 7.....	.....	101.9
September 20....	.....	103.0	December 9.....	.....	99.8
September 21....	101.8	102.0	December 11.....	.....	102.1
September 22....	101.6	102.1	December 12.....	.....	102.4
September 23....	101.4	102.0	December 16.....	.....	102.7
September 24....	101.9	104.0	December 19.....	.....	103.1
September 25....	.....	101.6	December 20.....	.....	100.1
September 26....	101.0	102.0	December 21.....	.....	103.5
September 27....	101.0	102.8	December 22.....	.....	103.6
September 28....	100.3	.....	December 23.....	.....	103.4
September 29....	100.2	100.8	December 25.....	.....	102.3
September 30....	.....	102.8	December 26.....	.....	106.0
October 1.....	102.6	.....	December 28.....	.....	101.8
October 2.....	.....	101.2	December 29.....	.....	102.0
October 4.....	.....	101.3	December 30.....	.....	102.4
October 5.....	100.6	104.6	December 31.....	.....	100.2
October 6.....	.....	103.7			
October 7.....	102.2	103.4			
October 8.....	101.6	.....	1899.		
October 10.....	100.9	102.7	January 1.....	.....	103.2
October 11.....	.....	103.4	January 2.....	.....	101.2
October 12.....	.....	102.2	January 3.....	.....	100.6
October 13.....	.....	102.0	January 7.....	.....	102.2
October 15.....	.....	101.7	January 11.....	.....	100.0

*Animal inoculated with tick pulp.

†Animal inoculated with 10-15cc. of blood from calf with fever.

The following is the record of the number of blood corpuscles per cube millimeter:

September 24th.....	6,176,000
October 3rd.....	5,664,000
October 5th.....	3,936,000

October 9th	5,444,000
January 3rd (1899)	5,184,000
April 1st	6,000,000

It will be noted that the temperature became considerably elevated one week after the injection, but again returned to normal, and again fifteen days after the injection the temperature came up and remained above normal for a week. 104.6 was the highest recorded. At the time of the highest temperature the number of blood corpuscles was diminished by about one-third. There was good evidence that the animal had had a mild form of the disease, but we were not sure of it beyond the possibility of a doubt. In order to settle the matter, and to test the immunity, on December 3rd, the animal received a hypodermic injection of about fifteen ccs. of defibrinated blood from an animal that was just recovering from a more decided case of Texas fever. By referring to the table it will be noted that there was very slight reaction from this inoculation, but not as much as from the first. This occurred about two weeks after the inoculation, whereas in all other cases, where we used the blood, there was a reaction in one week. On December 26th the temperature is recorded as 106, but this is probably a mistaken record, as the next day it was normal and remained so.

The subsequent use of this animal's blood for transmitting the fever proved beyond doubt that it had the disease.

In the early spring the animal was placed on pasture and became heavily infested with ticks, and has since matured several generations without any evidence of discomfort or unusual high temperature. The blood corpuscles have been counted quite a number of times during the summer, and there is every evidence that the animal is now immune from Texas fever.

Since the most decided reduction of blood corpuscles corresponded with the highest temperature about two weeks after inoculation, we think we are justified in concluding that the animal was given the mild disease by the injection of the blood obtained from the ticks.

☐ Of course we can not say whether the second inoculation would have given much stronger reaction without the first,

but we have no other record in which the blood inoculation gave such a feeble reaction. Whether the second inoculation increased the degree of immunity we can not say. At all events we could well afford to make both inoculations if the results would uniformly be as satisfactory. It must be remembered that only three ticks were used.

INOCULATION OF TICK BLOOD, CASE NO. 2.

This animal was a 2-year-old steer, grade Shorthorn. During the month of August, previous to inoculation, the temperature never registered above 102.5. On August 29th several ticks from native cattle were washed as described in the previous case, mashed, and the fluid content mixed with a little boiled water and injected under the skin just behind the shoulder. It will be seen from the tables that the temperature was quite high the two following days, but returned to normal on the fourth day. Very little fever is shown thereafter for quite a period, and on September 17th, the usual period of incubation having passed and the blood corpuscles and temperature not indicating the fever, we were of the opinion that enough bichloride had been left in the mortar and on the ticks to interfere with the development of the organism, and that the animal would not have the fever from this inoculation. As we had just inoculated the animal previously described, instead of repeating the same experiment here we decided to use tick blood from ticks that had been frozen for several hours. Several ticks were placed in water in a tube and kept the tube in ice and salt. The temperature registered by the thermometer, placed beside the ticks, was about 12 below freezing. The ticks were maintained at this temperature for seven hours. When they were taken out and thawed they were still alive. They were then washed, mashed as in previous cases, and injected under the skin of the animal. The object in freezing the ticks is described under the discussion of the next case.

The number of blood corpuscles soon began to diminish, but there was no decided elevation of temperature except for one day, just a week after the second inoculation, about the time you would expect an elevation if the second inoculation

TEMPERATURES.

DATE.	A. M	P. M	DATE.	A. M	P. M.
August 2 .....	.....	102.0	October 3.....	100.5	103.0
August 5 .....	.....	101.4	October 4.....	101.1	100.7
August 12.....	.....	102.5	October 5.....	101.3	103.2
August 15.....	.....	102.4	October 6.....	100.1	103.0
August 20.....	.....	101.8	October 7.....	100.5	103.4
August 23.....	.....	102.4	October 8.....	102.2	102.6
August 27.....	.....	101.6	October 9.....	100.8	103.0
August 30.....	102.0	105.8	October 10.....	101.1	102.7
August 31.....	104.8	105.0	October 11.....	.....	104.0
September 1.....	102.5	103.5	*October 12.....	.....	102.8
September 2.....	102.0	102.1	October 13.....	.....	103.2
September 3.....	101.7	102.6	October 15.....	.....	103.3
September 4.....	.....	103.7	October 17.....	.....	103.2
September 5.....	102.1	.....	October 18.....	.....	104.1
September 6.....	101.9	103.9	October 19.....	.....	103.0
September 7.....	101.8	102.0	October 21.....	.....	104.0
September 8.....	100.6	102.8	October 22.....	.....	105.6
September 9.....	100.8	103.0	October 23.....	.....	105.2
September 10.....	101.1	103.0	October 24.....	.....	104.0
September 11.....	101.5	.....	October 25.....	101.8	.....
September 12.....	101.5	102.5	October 26.....	103.2	103.8
September 13.....	101.5	101.5	†October 27.....	103.2	105.2
September 14.....	101.7	102.0	October 28.....	102.6	103.5
September 15.....	101.2	.....	October 29.....	101.8	101.6
September 16.....	101.0	102.6	October 30.....	101.0	102.3
September 17.....	101.1	102.3	October 31.....	101.3	101.6
September 18.....	.....	103.2	November 1.....	.....	102.6
September 19.....	101.0	.....	November 2.....	.....	102.0
September 20.....	.....	102.5	November 3.....	.....	102.4
September 21.....	101.4	103.0	November 4.....	.....	101.8
September 22.....	100.6	103.3	November 6.....	100.8	102.0
September 23.....	101.3	102.0	November 7.....	.....	102.7
September 24.....	100.3	103.0	November 8.....	.....	102.0
September 25.....	.....	104.0	November 9.....	.....	102.6
September 26.....	101.2	102.2	November 10.....	.....	102.0
September 27.....	100.4	102.0	November 11.....	.....	102.5
September 28.....	100.0	.....	November 14.....	.....	102.3
September 29.....	98.0	101.3	November 16.....	.....	102.4
September 30.....	.....	103.5	November 17.....	.....	101.5
October 1.....	101.3	103.5	November 18.....	.....	101.0
October 2.....	.....	101.5	November 20.....	.....	.....

*One tick was found on the animal.

† Tick above referred to, matured.

Number of Blood Corpuscles per c. m. m.

August 31.....	8,800,000
September 7.....	8,688,000
September 24.....	7,320,000
October 1.....	5,472,000
October 5.....	5,568,000
October 8.....	4,704,000
October 31.....	4,032,000

was to be effectual. On October 12th one tick was found on the animal, but there were probably no more, as we kept a close watch and examined the animal carefully. Our other experiments indicate that one or two or even several ticks will not give a pronounced case of the fever and thereby produce immunity, so we are probably safe in saying that the fever that follows later was due mostly to the inoculation of the tick blood, though it may have been intensified by the tick that became attached to the animal.

Since we found that in a second case of inoculating the tick blood from frozen ticks, at the same degree, for the same time, did not give the fever, it is probable that this animal contracted the fever from the first inoculation; that the period of incubation was very much prolonged. However, this matter must be pursued further in experiment before we can arrive at any positive conclusions. It would seem from these results that a large number of ticks gave a more severe form of the disease than did a few ticks, but even then the disease did not reach an acute stage. It is to be regretted that this case was not free from complications like the first.

INOCULATION OF TICK BLOOD—CASE NO. 3.

This animal was a 2-year-old steer, scrub stock. He was inoculated with the blood from several adult female ticks, obtained, as previously described, after the ticks had been frozen for seven hours at a temperature ranging from ten to twelve degrees centigrade, below zero. After the ticks thawed out they were still alive. The animal into which the blood of these ticks was inoculated showed no evidence of Texas fever eighteen days after the inoculation, and it was thought no fever would result. The animal was then inoculated with the blood from a native cow, and one week later developed a good case of Texas fever. While we were possibly a little hasty in concluding that there would be no fever from the first inoculation, we can say that the normal time elapsed after the second inoculation before the fever developed, and it is probable that the fever organism was killed by the freezing. If upon further investigation this is found to be true, it may have a double importance in that it may offer some

suggestions in regard to determining or modifying the quarantine line, and in the use of inoculative material in Northern districts preparatory to shipment to the South.

TEMPERATURE.

DATE.	A. M.	P. M.	DATE.	A. M.	P. M.
August 2.....	.....	102.3	September 27.....	102.8	104.0
August 5.....	.....	102.0	September 28.....	102.4	.....
August 9.....	.....	101.8	September 29.....	100.6	104.7
August 12.....	.....	103.0	September 30.....	102.5	104.5
August 13.....	101.6	.....	October 1.....	103.5	105.4
August 15.....	.....	102.4	October 2.....	103.0	103.8
August 20.....	.....	101.6	October 3.....	102.0	104.0
August 23.....	.....	102.0	October 4.....	104.2	102.2
August 27.....	.....	101.4	October 5.....	103.7	105.0
August 30.....	100.5	102.7	October 6.....	102.2	104.3
August 31.....	101.8	102.3	October 7.....	104.0	103.9
September 1.....	101.5	102.0	October 8.....	105.1	104.4
September 2.....	101.6	102.0	October 9.....	103.8	104.4
September 3.....	101.6	102.5	October 10.....	105.6	106.2
September 4.....	.....	102.8	October 11.....	102.2	104.5
September 5.....	101.6	.....	October 12.....	101.6	104.0
September 6.....	101.5	104.0	October 13.....	102.9	104.0
September 7.....	100.8	101.3	October 14.....	.....	102.7
September 8.....	100.5	102.3	October 16.....	.....	103.1
September 9.....	100.6	102.3	October 17.....	.....	103.3
September 10.....	100.8	102.6	October 18.....	102.1	103.5
September 11.....	100.8	.....	October 19.....	100.8	104.0
September 12.....	100.4	101.7	October 20.....	.....	98.6
September 13.....	101.7	100.0	October 21.....	100.1	102.8
September 14.....	100.7	101.7	October 22.....	101.6	102.5
September 15.....	100.0	.....	October 23.....	.....	102.2
September 16.....	100.8	102.6	October 24.....	.....	102.4
September 17.....	101.6	102.0	October 25.....	.....	104.4
September 18.....	.....	102.7	October 26.....	102.7	102.5
September 19.....	100.6	.....	October 27.....	103.2	104.0
September 20.....	99.0	102.9	October 28.....	103.8	104.8
September 21.....	102.4	102.0	October 29.....	103.7	104.5
September 22.....	101.4	103.2	October 30.....	101.2	102.7
September 23.....	101.2	103.0	October 31.....	103.0	103.0
September 24.....	101.2	104.2	November 1.....	.....	103.4
September 25.....	.....	104.0	November 2.....	.....	105.0
September 26.....	101.6	103.8			

Number of Blood Corpuscles per C. M. M.

September 1.....	7,920,000
September 23.....	6,640,000
October 1.....	4,460,000
October 3.....	5,064,000
October 5.....	4,480,000
October 8.....	3,488,000

October 13.....	4,192,000
October 15.....	4,608,000
November 1.....	4,448,000

Another object in testing the effect of cold upon the organism is suggested by the fact that tick infestation in the late fall or very early spring gives a less severe disease than that of midsummer. Our experiments indicate that when native blood is used for inoculation there is very little difference in severity whether the inoculation be made in summer, fall or spring. If this be true, then the difference must be due to some change toward attenuation of the organism while in the tick's body. It is important to know whether the exposure to frosts, or the protracted life of the organism within the tick tends to produce attenuation. On the other hand, if we may use the ticks from recently immunized animals, and ship them to distant points for inoculative material, it will be important to protect such material from exposure to severe frosts lest the organism should be killed.

INOCULATION OF TICK BLOOD—CASE NO. 4.

This animal was a heifer, probably 3 years old, that had been discarded from the other comparative experiments on account of continued fever. From the time of her landing in Baton Rouge the temperature was generally from two to four degrees above normal. The blood remained rich in blood corpuscles and of good color. Finally we decided to inoculate the animal with tick blood, but no unusually high temperature was recorded until the nineteenth day after the inoculation, when for two days she was 106. Before this the blood corpuscles were reduced by nearly 50 per cent. Soon afterwards she began to recover, and at no time did she show symptoms of being any sicker than she had been for months.

The ticks used were collected from animals that had recently acquired immunity. Twelve large ticks were used.

This animal was found dead on August 7th; having become deeply mired in a bayou. She was probably unable to extricate herself because of her enfeebled condition resulting from protracted fever previous to inoculation.

ANIMAL NO. VI.--TEMPERATURE.

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
1899.				
March 15....	103.0	105.0	.....
March 16....	104.4	103.8	.....
March 17....	100.6	102.0	.....
March 18....	101.8		7,280,000	
March 19....	100.0	102.6	.....
March 20....	100.2	102.5	.....
March 21....	101.2	102.7	.....
March 22....	101.5	102.7	.....
March 23....	101.5	102.9	.....
March 24....	101.0	101.8	.....
March 25....	102.5	102.6	7,200,000	
March 26....	102.7	102.7	.....
March 27....	102.3	102.4	.....
March 28....	102.0	102.2	.....
March 29....	101.6	102.7	.....
March 30....	102.4	102.9	.....
March 31....	102.6	103.0	.....
April 1.....	102.1	102.5	8,640,000	
April 2.....	102.0	102.5	.....
April 3.....	101.1	103.0	.....
April 4.....	101.4	102.4	.....
April 5.....	102.2	103.0	.....
April 6.....	102.1	103.7	.....
April 7.....	102.5	104.5	.....
April 8.....	102.5	103.4	8,000,000	
April 9.....	102.8	104.0	.....
April 10.....	101.8	102.4	.....
April 11.....	101.8	102.9	.....
April 12.....	102.0	102.6	8,320,000	
April 13.....	102.0	102.8	.....
April 14.....	101.8	102.2	.....
April 15.....	100.9	102.7	8,672,000	
April 16.....	.....	102.6	.....
April 17.....	.....	102.9	.....
April 18.....	.....	102.5	.....
April 19.....	.....	102.5	.....
April 20.....	.....	101.6	.....
April 21.....	.....	102.4	.....
April 22.....	.....	101.6	.....
April 23.....	.....	103.0	.....
April 24.....	.....	102.6	.....
April 25.....	.....	102.5	.....
April 26.....	.....	102.9	.....
April 27.....	.....	102.5	.....
April 28.....	.....	103.2	.....
April 29.....	.....	102.8	.....
May 7.....	.....	102.6	.....
May 8.....	.....	103.5	.....
May 10.....	.....	102.8	.....
May 11.....	.....	103.1	.....
May 12.....	.....	102.9	.....
May 14.....	.....	103.5	.....
May 15.....	.....	103.3	.....
May 16.....	.....	103.0	.....

6:30 p. m., inoculated with 8 cc.
of blood that had been drawn,
under aseptic conditions, from
No. VII., at 11 a. m., May 6, '99.
and preserved with 10 per cent.
potassium oxalate.

ANIMAL No. VI.—TEMPERATURE—*Continued.*

DATE.	A. M.	P. M.	CORPUSCLES.	REMARKS.
May 17.....	103.0	.....
May 18.....	104.9	.....
May 19.....	105.4	.....
May 20.....	104.3	.....
May 21.....	102.0	.....
May 22.....	101.8	.....
May 24.....	103.7	.....
May 25.....	103.0	.....
May 26.....	103.0	.....
May 29.....	101.6	.....
June 14.....	103.8	.....	Inoculated at 6:30 p. m., June 14,
June 15.....	103.9	.....	'99, 5 cc. of blood from immune
June 16.....	102.2	.....	'white-fæcæa" sterile.

AN EXPERIMENT IN PRESERVING BLOOD FOR INOCULATIVE
PURPOSES.

When the blood is to be kept, even for a few minutes before inoculation, it is necessary to add something to prevent coagulation or to remove the fibrin by gently stirring with a clean glass rod till it can be collected on the rod and removed. A portion of the blood will then remain fluid. If the fibrin is to be removed the blood can not always be kept under aseptic conditions, and may become unsafe before it could be transported to any considerable distance. Previous experiments have shown us that if we add the ordinary preservatives we destroy the fever organism and the blood becomes worthless. Potassium oxalate added to the extent of one tenth of one per cent. of the volume of blood will prevent coagulation, and will not be germicidal. It was therefore thought possible (from the suggestion of Dr. F. G. Novy, of Michigan University,) to draw the blood under aseptic precautions, adding the required amount of potassium oxalate sterilized, and in this way preserve the virulence of the blood, prevent it from coagulating and thereby secure it in a commercial form. Blood preserved in this way was shipped to Ann Arbor, and also tried after four days preservation here, but negative results were obtained in both instances. The blood kept well, there being no bacterial growth

after four days' incubation, but the Texas fever organism was destroyed.

Special Case—About the middle of June a prominent gentleman of Bayou Sara, La., imported from Missouri a cross Hereford and Shorthorn bull, 2 years old. The animal was inoculated the next day after arrival with blood drawn from one of our animals that had recently acquired immunity, from

TWO-MONTHS OLD CALF—TEMPERATURE (from Northern Susceptible Heifer.)

DATE.	P. M.	CORPUSCLES.	REMARKS.
June 14.....	102.9	.....	Inoculated with 2 cc. blood from "white-faced" steer.
June 15.....	103.2	.....
June 16.....	102.0	.....
June 17.....	102.2	.....
June 18.....	103.4	.....
June 19.....	103.1	10,000,000	
June 20.....	101.8	.....
June 21.....	101.2	.....
June 22.....	102.4	.....
June 23.....	103.7	.....
June 24.....	105.4	.....
June 25.....	104.8	.....
June 26.....	104.4	.....
July 1.....	103.2	.....
July 2.....	103.2	.....
July 3.....	103.2	.....
July 4.....	102.8	.....
July 5.....	104.2	.....
July 6.....	103.5	.....
July 7.....	103.0	.....
July 8.....	104.0	.....
July 9.....	104.6	.....
July 10.....	102.6	.....
July 11.....	102.6	.....
July 12.....	103.5	.....
July 13.....	102.3	.....
July 14.....	103.6	.....
July 15.....	103.6	.....
July 16.....	103.5	.....
July 17.....	104.1	.....
July 18.....	104.4	.....
July 19.....	103.8	.....
July 20.....	103.8	.....
July 21.....	103.9	.....	Taken to tick-infested pasture.

the same animal from which the blood was obtained for the experiments elsewhere described in this bulletin, and for the two Herefords imported from Maryland by this Station. The blood was drawn at 10 o'clock in the forenoon, shipped to Ba-

you Sara and the inoculation made about half past three that afternoon. Every reasonable precaution was taken to prevent blood poisoning, just as other cases where the results were uniformly successful. The inoculation was made on Saturday, and unfortunately the animal died the following Monday. The owner of the animal believes the bull died from blood poisoning. If this be the case it was due to accidental contamination of the blood, in spite of the most painstaking methods. In all cases inoculated during the past three years' experiments with Texas fever this is the only case where any bad results have followed the inoculation in this way. No case before even developed a swelling.

Acknowledgment.

The authors beg to acknowledge the excellent work of Mr. W. L. Denham, junior student in agriculture, who executed the drawings from which the various cuts were made.