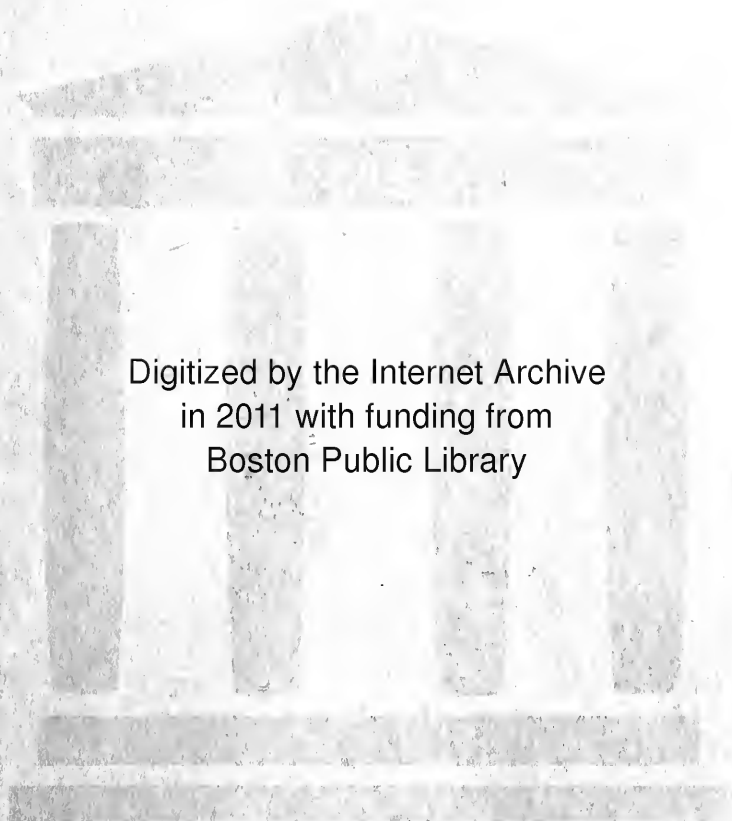


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1904.—No. 14.

DEPARTMENT OF THE INTERIOR.

BUREAU OF GOVERNMENT LABORATORIES.

SERUM LABORATORY.

TEXAS FEVER IN THE PHILIPPINE ISLANDS AND
THE FAR EAST.

By JAMES W. JOBLING, M. D., Director of the Serum Laboratory, and
PAUL G. WOOLLEY, M. D., Assistant Director Serum Laboratory.

BIOLOGICAL LABORATORY.

Bulletin No. 2 of the Entomological Division.

THE AUSTRALIAN TICK (*BOOPHILUS AUSTRALIS FULLER*) IN
THE PHILIPPINE ISLANDS.

BY CHARLES S. BANKS, ENTOMOLOGIST.

MANILA:

BUREAU OF PUBLIC PRINTING.
1904.

PREVIOUS PUBLICATIONS OF THE BUREAU OF GOVERNMENT LABORATORIES.

- No. 1, 1902, *Biological Laboratory*.—Preliminary Report of the Appearance in the Philippine Islands of a Disease Clinically Resembling Glanders. By R. P. Strong, M. D.
- No. 2, 1902, *Chemical Laboratory*.—The Preparation of Benzoyl-Acetyl Peroxide and Its Use as an Intestinal Antiseptic in Cholera and Dysentery. Preliminary Notes. By Paul C. Freer, M. D., Ph. D.
- No. 3, 1903, *Biological Laboratory*.—A Preliminary Report on Trypanosomiasis of Horses in the Philippine Islands. By W. E. Musgrave, M. D., Acting Director Biological Laboratory, and Norman E. Williamson, Assistant Bacteriologist Bureau of Government Laboratories.
- No. 4, 1903, *Serum Laboratory*.—Preliminary Report on the Study of Rinderpest of Cattle and Carabaos in the Philippine Islands. By James W. Jobling, M. D., Director of the Serum Laboratory.
- No. 5, 1903, *Biological Laboratory*.—Trypanosoma and Trypanosomiasis, with Special Reference to Surra in the Philippine Islands. By W. E. Musgrave, M. D., Acting Director Biological Laboratory, and Moses T. Clegg, Assistant Bacteriologist Biological Laboratory.
- No. 6, 1903.—I. New or Noteworthy Philippine Plants; II. The American Element in the Philippine Flora. By Elmer D. Merrill, Botanist. (Issued January 20, 1904.)
- No. 7, 1903, *Chemical Laboratory*.—The Gutta Percha and Rubber of the Philippine Islands. By Penoyer L. Sherman, jr., Ph. D., Chemist, Chemical Laboratory.
- No. 8, 1903.—A Dictionary of the Plant Names of the Philippine Islands. By Elmer D. Merrill, Botanist.
- No. 9, 1903, *Biological Laboratory*.—A Report on Hemorrhagic Septicæmia in Animals in the Philippine Islands. By Paul G. Woolley, M. D., and J. W. Jobling, M. D.
- No. 10, 1903, *Biological Laboratory*.—Two Cases of a Peculiar Form of Hand Infection (Due to an Organism Resembling the Koch-Weeks Bacillus). By John R. McDill, M. D., and Wm. B. Wherry, M. D.
- No. 11, 1903, *Biological Laboratory*.—Entomological Division, Bulletin No. 1, Preliminary Bulletin on Insects of the Cacao. (Prepared Especially for the Benefit of Farmers.) By Charles S. Banks, Entomologist Bureau Government Laboratories.
- No. 12, 1903, *Biological Laboratory*.—Report on Some Pulmonary Lesions Produced by the Bacillus of Hemorrhagic Septicæmia of Carabaos. By Paul G. Woolley, M. D.
- No. 13, 1904, *Biological Laboratory*.—A Fatal Infection by a Hitherto Undescribed Chromogenic Bacterium: *Bacillus aureus fetidus*. By Maximilian Herzog, M. D.

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2

1904.—No. 14.

DEPARTMENT OF THE INTERIOR.

BUREAU OF GOVERNMENT LABORATORIES.

SERUM LABORATORY.

TEXAS FEVER IN THE PHILIPPINE ISLANDS AND
THE FAR EAST.

By JAMES W. JOBLING, M. D., Director of the Serum Laboratory, and
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BIOLOGICAL LABORATORY.
Bulletin No. 2 of the Entomological Division.

THE AUSTRALIAN TICK (*BOOPHILUS AUSTRALIS FULLER*) IN
THE PHILIPPINE ISLANDS.

BY CHARLES S. BANKS, ENTOMOLOGIST.

MANILA:
BUREAU OF PUBLIC PRINTING.
1904.

Thinking of the
December 1992

LETTERS OF TRANSMITTAL.

OFFICE OF THE SUPERINTENDENT
OF GOVERNMENT LABORATORIES,

Manila, April 14, 1904.

SIR: I have the honor herewith to transmit for publication as a bulletin of the Bureau two papers, one on "Texas Fever in the Philippine Islands and the Far East," by Jas. W. Jobling, M. D., and Paul G. Woolley, M. D., and the other on the "Australian Tick (*Boophilus australis* Fuller) in the Philippine Islands." by Charles S. Banks.

I am, very respectfully,

PAUL C. FREER,

Superintendent Government Laboratories.

HON. DEAN C. WORCESTER,

Secretary of the Interior.

BIOLOGICAL LABORATORY,

Manila, P. I., April 14, 1904.

SIR: I have the honor to transmit herewith and to recommend for publication a report on "The Australian Tick (*Boophilus australis* Fuller) in the Philippine Islands," by Mr. Charles S. Banks, Entomologist, Biological Laboratory.

Very respectfully,

RICHARD P. STRONG,

Director Biological Laboratory.

DR. PAUL C. FREER,

Superintendent of Government Laboratories.

TEXAS FEVER IN THE PHILIPPINE ISLANDS AND THE FAR EAST.

By JAMES W. JOBLING, M. D., *Director of Serum Laboratory*, and PAUL G. WOOLLEY, M. D., *Assistant Director of Serum Laboratory*.

In the following report we shall not attempt to review the literature. The classic work of Smith and Kilbourne and the excellent reviews of Kossel, and Nocard and Laclainche render this unnecessary. We shall simply detail our own experiences.

Just before Texas fever appeared in Manila an attempt was being made to import American stock of medium size and good antecedents in order to improve the grade of native animals, which, through lack of care, had after many generations so degenerated that whether for slaughter, food, or dairy purposes, they were of little value.

In order not to introduce Texas fever into the Islands the cattle exported from the United States had been purchased at places 100 to 150 miles north of the Texas-fever line in California, all the animals having been raised at the places at which they were bought, with the exception of one heifer (No. 68), of which mention will be made. The herd was composed of two cows from San Bruno, a bull and three cows from Petaluma, a bull from Millbrae, and a bull and a heifer from San Jose.¹

On November 18, 1903, these cattle were landed in Manila. Prior to disembarkation they were examined and a few ticks were found, but these according to Veterinarian Meyers, were examples of a species other than that found in the Texas-fever belt of the United States. At this time, the animals appeared to be in good condition and not suffering from any acute or chronic disease.

Immediately upon landing they were sent to the Serum Laboratory for observation and for receiving anti-rinderpest treatment.

¹ The Laboratory numbers of the animals with relation to the place from which they came are as follows: Jersey bull No. 70 and Jersey heifer No. 68, from San Jose; Holstein bull No. 66, from Millbrae; Holstein cows Nos. 62 and 63, from San Bruno; Jersey cow No. 64, Ayershire cows Nos. 65 and 69, and Ayershire bull No. 67, from Petaluma.

At the time when "simultaneous inoculation" would have been practiced no virulent blood could be obtained and the cattle accordingly received prophylactic doses of immune serum only, so as to protect them until the necessary virulent material would be at hand.

The attached charts will show the temperature curves of these animals and will indicate their general condition better than words.

Twelve days after the second prophylactic dose of serum, virulent blood was obtained and "simultaneous inoculation" was given to all but one animal. The animal from which the virulent blood was taken was received from Shanghai on November 28. It developed rinderpest within a few days after arrival without having been inoculated, and was bled to death on December 3, 1903. The symptoms and post-mortem lesions were those always observed in rinderpest—that is, bloody diarrhea, redness of visible mucous membranes, and discharges from the eyes and nose. No pathologic change was found which could be attributed to Texas fever. The connective tissues were not yellow, the spleen was small and firm, the gall bladder enlarged and distended, and the mucous membrane of the fourth stomach inflamed and ulcerated. There were no symptoms which would lead us to think we had been using blood obtained from an animal suffering from Texas fever. This is the more certain since some of the blood was used not only to inoculate the American cattle but also eleven serum animals, the amounts varying from 1 to 1,000 c. c., and thirty calves received 5 to 50 c. c.

In all the cattle and calves other than the American cattle the reactions were those usually observed as following the inoculation of animals with virulent rinderpest blood. In no instance were there any symptoms which would lead us to think that we had been using blood from an animal suffering from Texas fever. This applies especially to some of the serum animals which received 1,000 c. c.

The results of this treatment in the cases of the American cattle were disastrous, for in a short time, varying in individual cases from four to eight days, the temperature rose abruptly to between 41° and 42° C., and five of the animals died.

The first one to succumb was No. 63. As this animal had developed a high temperature about the usual period following inoculation by the "simultaneous method," it was believed that death was caused by rinderpest, but the post-mortem showed none of the

lesions of this disease; instead, there was a marked yellowish discoloration of all the connective tissues and cloudy swelling of the liver, spleen, kidneys, and heart. The liver was the main organ affected. It showed chronic biliary cirrhosis following infection with liver flukes, suppurative and chronic obstructive cholangitis, and calciferous fluke cysts.

Nos. 63 and 69 died on the same day, but the disease was so unexpected that pyroplasmosis was not suspected until autopsy was made on No. 69, when the yellow color of the connective tissues and the size and consistence of the spleen, together with bloody urine, led Veterinarian Murray Meyers to make a diagnosis of Texas fever. The blood of the animal was not examined, but the following day another one (No. 66.) died, and in the blood corpuscles of the latter we were able to demonstrate the causative organisms in stained preparations.

Upon both of these animals and upon No. 70, ticks were found which were collected and sent to the entomologist of the Bureau who identified them as the Australian variety (*B. Australis*¹).

The clinical history taken from all the fatal cases was similar. No. 63 had been apparently well since landing and had been kept with the other cattle in a screened stable. Following the second injection of serum her temperature rose to 39.9° C., but fell during the next twenty-four hours to normal, where it remained until eight days later, when it again rose, this time to 40° C. This rise was but a transient one, and for the next week the curve was within normal limits. Twelve days after receiving the second dose of serum, the "simultaneous method" of immunization against rinderpest was practiced. On the fifth day following this the temperature was 40.5° C., on the sixth day it was 41.2° C., on the seventh day it was 41.6° C., and on the eighth day the animal died.

The autopsy showed all the connective tissues in a very yellow condition. The spleen was large and soft, and the mucous membrane of the gastro-intestinal tract in good condition. There were no ulcers in the abomasum. The liver was cloudy and honey-combed with abscesses containing flukes.

This history, save for some minor differences in the temperature

¹See the paper on this subject by Mr. C. S. Banks.

curves and the fact that no other animals showed the same hepatic condition, applies very well to the other cattle dying of the disease—that is, Nos. 65, 66, 67, and 69.¹ (See charts.)

One animal (No. 62) had the usual rise of temperature, and up to the time of death no pyroplasmas could be demonstrated, but trypanosomas were present. Whether this one died of one or the other of the suggested diseases can not be surely stated. In animal No. 70 the usual rise of temperature occurred and the parasites appeared in the blood. Later the fever decreased and the animal made a quick and satisfactory recovery. Animal No. 68 at no time showed a high fever, but following the “simultaneous inoculation” the temperature remained consistently between 39° and 40° C., and subsequently fell and remained regularly between 38° and 39° C. Parasites were never found in this animal in spite of careful and painstaking daily examinations covering a period of about three weeks. In this case we can not say whether or not we were dealing with a subacute attack of pyroplasmosis, but we do know that this heifer was bought at San Jose with No. 70, but was not a native of that place, having been brought into the herd from some other district. In the case of No. 64, in which no virulent blood was used, there was no sign of Texas fever.

Besides these cases two others have occurred in Australian cattle which were said to come from a district where neither the ticks

¹A somewhat similar experience has been told us by Dr. H. E. Keylock, of Shanghai, who has generously permitted us to use his story.

Dr. Keylock was preparing antirinderpest serum at Shanghai, using Chinese cattle exclusively, and upon the appearance of rinderpest among some dairy cattle in his district had been requested to treat the sick and immunize the other animals of the dairy. In this establishment there were ten animals which had been raised for the purpose for which they had been used and had never been outside the grounds where they were kept. The sick were given 50 c. c. of serum on alternate days until they had received in all 150 c. c. The others were immunized by the “simultaneous method,” which in this case meant 50 c. c. of serum and 10 c. c. of virulent blood. Following this, just as in our cases in Manila, three of the animals developed hemoglobinuria and subsequently died. The time intervening between inoculation and the onset of symptoms we do not know. Not suspecting Texas fever, neither autopsies nor blood examinations were made. A portion of the same blood given in the cases of these dairy animals was used to inoculate other animals used for serum purposes, and with no bad results.

nor the disease itself had ever been seen. The cattle were temporarily immunized with serum, and were then at once shipped to Baguio, in Benguet Province. Some time after arriving in the mountains both died with symptoms of Texas fever and the organisms were found in stained specimens of the blood. Three other cases in Australian cattle, two of which were fatal, have been observed at the farm of Mr. Angel, just across the river from Santa Ana. All these animals showed the parasites, but in comparatively small numbers. The cases were subacute. Previous to the occurrence of these cases no similar ones had been observed, nor had the care takers noticed any ticks until three or four weeks before the outbreak.¹

The above facts immediately brought up the question as to the origin of the disease, which had never before been observed in the Philippine Islands, but which had developed in animals imported from north of the Texas-fever line in the United States, and then only after these animals had been inoculated with fresh blood from native or Chinese cattle.²

¹ For obtaining a brilliant differential stain for these parasites and the blood corpuscles, we have had the best success with the following method, which has the advantage of fixing and staining the smears in a very short time and the further advantage of not overstaining.

Dried blood stains are covered with a solution of Wright's methylene blue and eosin in methyl alcohol. After a minute enough water is added to form a scum on the surface of the liquid. This is allowed to remain in contact with the smear for from two to fifteen minutes and is then poured off. Loeffler's methylene blue solution is added and the preparation stained during one to five minutes. The slide is then washed with water and quickly rinsed with a one-fourth per cent solution of acetic acid, washed, dried, and mounted. It will be seen that this is simply Wright's modification of the Romanowsky method, with Theobald Smith's method appended. It gives very satisfactory results.

² In this connection the report of Lingard for 1902-3 is most interesting. He says that the disease was first recognized in India in 1871, when it was discovered clinically by Colonel Hallen. Lingard's own cases occurred after inoculation with virulent rinderpest blood, and agree with those of investigators in Africa, and he concludes that the animals which he used were harboring the parasites at the time of inoculation and that the disease only became active when the resistance of the animal was reduced by an attack of rinderpest following inoculation. Comparable deductions were drawn by Koch in South Africa. The case of the bull No. 2, reported below, seems to be explained in a similar way.

In order to answer this question it was necessary to discover whether the native or Chinese animals were immune to the disease and whether or not American cattle presumably not immune could be infected by injecting into them the blood from the healthy native or Chinese cattle. We say native or Chinese cattle because the bloods of the two races have become so inseparably mixed in the processes of past immunizations that if one race is resistant to the disease the other must be. We may include animals from Singapore, Borneo, Java, Cochin China, and Australia, the bloods of all of which have been used for immunizing purposes and for serum work, and which have also been treated with native and Chinese blood. While such inoculations have been promiscuous, we can trace all blood which we have used and can state exactly how it has been used and what results have been obtained with it. If Texas fever were present in some animals in these Islands, and if the majority of the native animals were not immune, then we should have produced and reproduced the disease. Yet in a long series of blood examinations which numbered thousands, and in very large number of autopsies, we have been unable to see anything which suggested bovine malaria.

In order to settle beyond doubt just what the conditions here were in regard to Texas fever we attempted to reproduce the disease in Chinese animals by injecting subcutaneously blood containing large quantities of pyroplasmas. For this experiment two animals were used, one a calf imported from Hongkong (No. 325), the other a cow (No. 290), imported from Shanghai. Both of these were negative. At the time of the inoculation the calf (No. 325) showed large numbers of ticks on its hide. (See charts Nos. 325 and 290.)

We next attempted to produce the disease by injecting blood taken from a healthy American animal, which had not been immunized by the "simultaneous method" and which showed no parasites, into a healthy Chinese one (No. 333). The result was absolutely negative.

Following this we took blood from healthy animals used for serum purposes and injected it subcutaneously into American animals which had not received the "simultaneous method." This series of experiments was positive in two cases, negative in one. In the negative case (bull No. 1) we suspected an acquired immunity and

later injected a large amount of parasite-containing blood, an experiment that was also negative and which apparently supported our supposition. Some weeks later one of the positive animals (bull No. 2) contracted rinderpest and died suddenly. This animal was also suffering from actinomycosis. At autopsy, in addition to the actinomycosis, lesions of both Texas fever and rinderpest were found, and the pyroplasmas were found in the blood, but in a very small percentage of the blood cells. It seems reasonable to suspect that in this case the acquired rinderpest was the cause of the flaring up of the latent Texas fever and that the combination of the two diseases killed the animal.

The facts adduced as a result of the experiences detailed above were, first, that native or Chinese animals could not be infected with Texas fever by subcutaneous inoculation with relatively large quantities of blood containing the living parasites; second, that susceptible, non-immune American animals would acquire the disease following injections of blood taken from apparently healthy Chinese animals which had been immunized to rinderpest in the Philippine Islands; third, that we are dealing with true Texas fever and not the atypical South African or Rhodesian fever; and fourth, that a tick (*Boophilus australis*), the intermediate host of the parasite of Australian pyroplasmiasis, is present in these Islands.

Our conclusion, based upon these facts, is that Texas fever is endemic, not only in India but also in China, Java, Borneo, Cochin China, Singapore, and the Philippine Islands, and that the majority at least of all native and Chinese animals are immune to the disease.

SOME RECENT REVIEWS ON TEXAS FEVER.

- Kossel, Kolle und Wasserman's Handbuch, 1903. I, 841.
 Nocard et Lelainche—Maladies des Animaux. Paris, 1903.
 Lingard, Annual Report Imperial Bacteriologist for 1902-3. Calcutta, 1903.
 Schmidt, Arch. f. wiss. u. prakt. Tierhk., 1903. P. 65.
 Koch, Journal Comp. Path. and Ther., 1903. 16, 273.

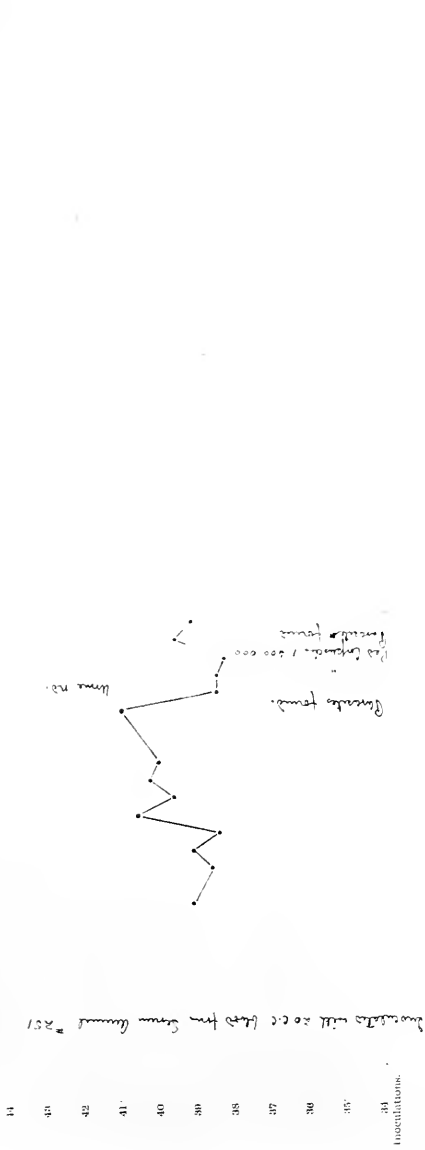
BUREAU OF GOVERNMENT LABORATORIES.

Invent. No. 1

Cacao Puro

Record of Variations of Temperature beginning January 20, 1904, at the Serum Laboratory, Manila, P. I.

Day of Month.	Time of Day.	KIND OF ANIMAL.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
Jan	3 0	cow							
	3 1	cow							
	3 2	cow							
	3 3	cow							
	3 4	cow							
	3 5	cow							
	3 6	cow							
	3 7	cow							
	3 8	cow							
	3 9	cow							
	3 10	cow							



34 inoculations.

10 inches

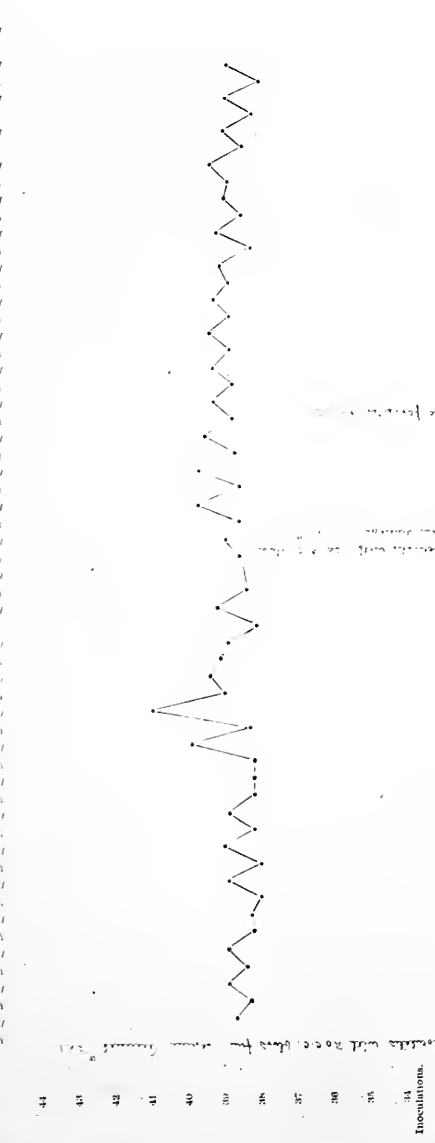
BUREAU OF GOVERNMENT LABORATORIES.

Animal No. *Bull 7*

Sex *Male*

Record of Variations of Temperature beginning January 4, 1904, at the Serum Laboratory, Manila, P. I.

Day of Month	KIND OF ANIMAL	HEIGHT	WEIGHT	AGE	COLOR	SEX	NATIVITY	PRICE
4		13	14	11			<i>Manila</i>	
5		12	14	11				
6		12	14	11				
7		12	14	11				
8		12	14	11				
9		12	14	11				
10		12	14	11				
11		12	14	11				
12		12	14	11				
13		12	14	11				
14		12	14	11				
15		12	14	11				
16		12	14	11				
17		12	14	11				
18		12	14	11				
19		12	14	11				
20		12	14	11				
21		12	14	11				
22		12	14	11				
23		12	14	11				
24		12	14	11				
25		12	14	11				
26		12	14	11				
27		12	14	11				
28		12	14	11				
29		12	14	11				
30		12	14	11				
31		12	14	11				
1		12	14	11				
2		12	14	11				
3		12	14	11				
4		12	14	11				
5		12	14	11				
6		12	14	11				
7		12	14	11				
8		12	14	11				



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BUREAU OF GOVERNMENT LABORATORIES.

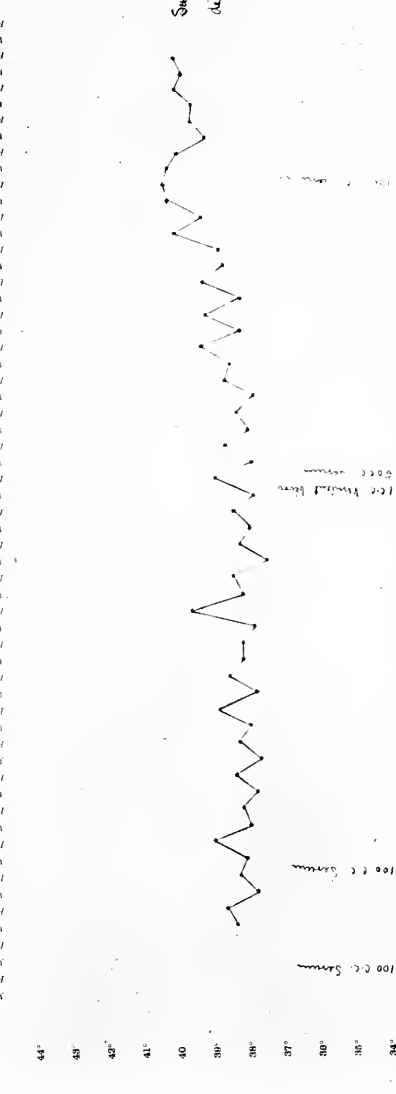
Animal No. 62

Takes Fever

Record of Variations of Temperature beginning November 14, 1903, at the Serum Laboratory, Manila, P. I.

KIND OF ANIMAL	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
Cow	1000	7 yrs	Black & white	F	Domestic	Silver Brown Ck

Day of Month.
 Day of Year.
 Time of Day.



Inoculations.
 Reaction.

BUREAU OF GOVERNMENT LABORATORIES,

Animal No. 03

Record of Variations of Temperature beginning *Texas Fever* *190 v. at the Serum Laboratory, Manila, P. I.*
 Kind of Animal: *Cow* Sex: *+* Nativity: *Illinois* Price:
 Weight: *1500* Color: *Black & White* Date: *10 11 13*
 Height: *50* Age: *6 yrs*

Day of Month.	Kind of Animal.	Height.	Weight.	Age.	Color.	Sex.	Nativity.	Price.																		
18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13
Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila	Manila



44°
 43°
 42°
 41°
 40°
 39°
 38°
 37°
 36°
 35°
 34°
 Inoculations.
 Reaction.

BUREAU OF GOVERNMENT LABORATORIES.

Animal No. 64-

Record of Variations of Temperature beginning *November* 1903, at the Serum Laboratory, Manila, P. I.

DAY OF MONTH.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.																	
Cow	48"	700	6 yrs	Brown	F	Amoyan	1.00																	
18	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13

Day of Month.
 Name of Animal.
 Time of Day.

44°

43

42

41

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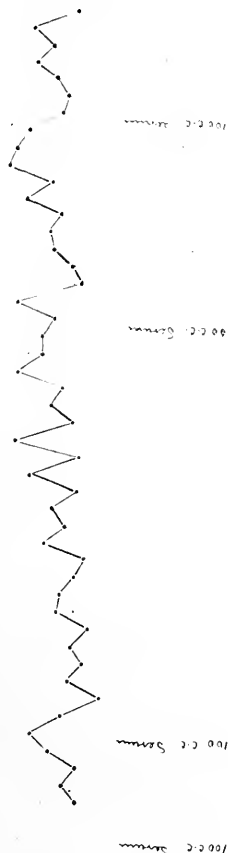
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Inoculations.

Reaction.



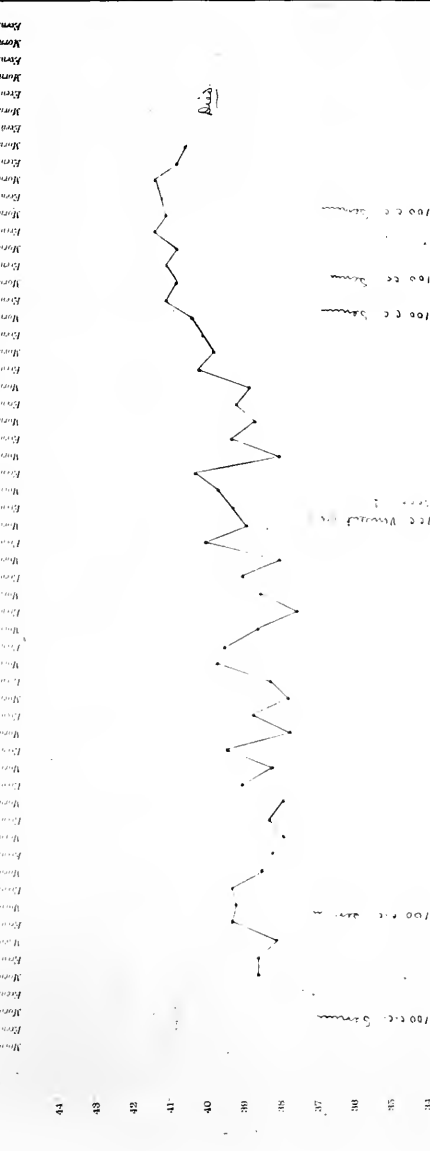
BUREAU OF GOVERNMENT LABORATORIES.

Animal No 68

Record of Variations of Temperature beginning *November 14* *1903* . at the Serum Laboratory, Manila, P. I.

KIND OF ANIMAL	HEIGHT	WEIGHT	AGE	COLOR	SEX	NATIVITY	PRICE
Cow	4' 8"	300	6 yrs	Brown and black	♀	Uniontown	Philippine Co.

Day of Month.	Time of Day.
14	00
15	03
16	04
17	07
18	06
19	05
20	04
21	03
22	02
23	01
24	00
25	01
26	02
27	03
28	04
29	05
30	06
31	07
1	08
2	09
3	10
4	11
5	12
6	13
7	14



Inoculations.
Reaction.

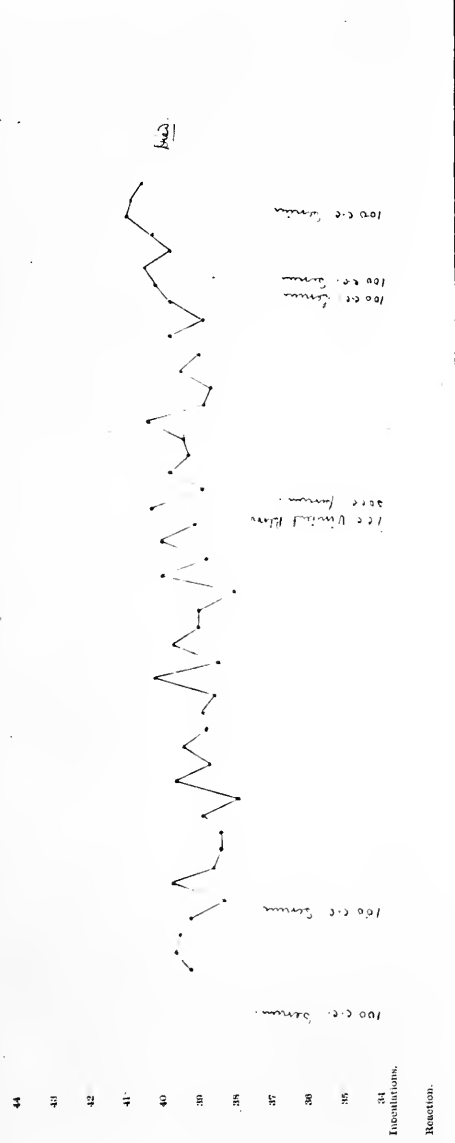
BUREAU OF GOVERNMENT LABORATORIES.

Animal No 66

Texas, Fries

Record of Variations of Temperature beginning November 1st 1903, at the Serum Laboratory, Manila, P. I.

KIND OF ANIMAL.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
Female	4 1/2"	700	3 yrs	Black and white	M	American	Private Use.



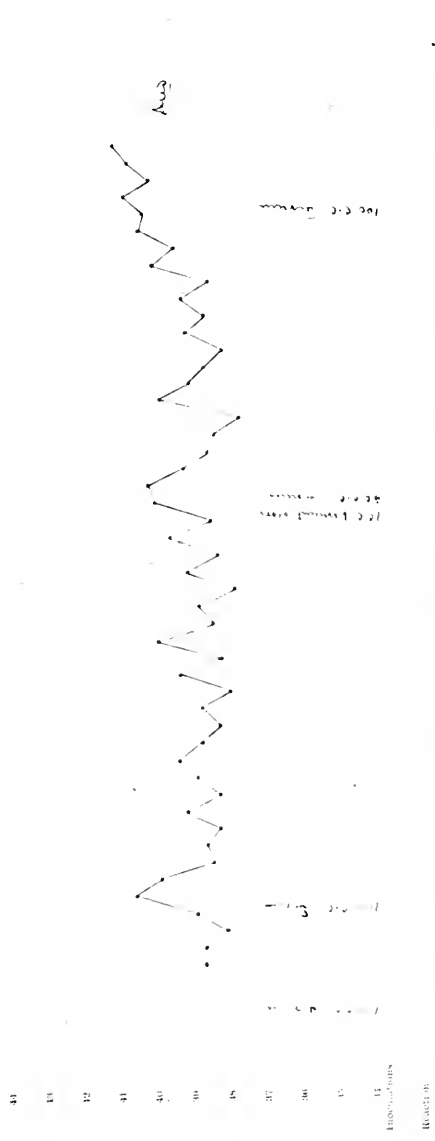
BUREAU OF GOVERNMENT LABORATORIES.

Animal No. 67

Record of Variations of Temperature beginning December 14, 1903, at the Serum Laboratory, Manila, P. I.

KIND OF ANIMAL	HEIGHT	WEIGHT	AGE	COLOR	SEX	NATIVITY	PRICE
Dog	14"	15.0	2 1/2 yrs	Black	M	Philippines	\$10.00

Day of Month
 Time of Day



RECORD

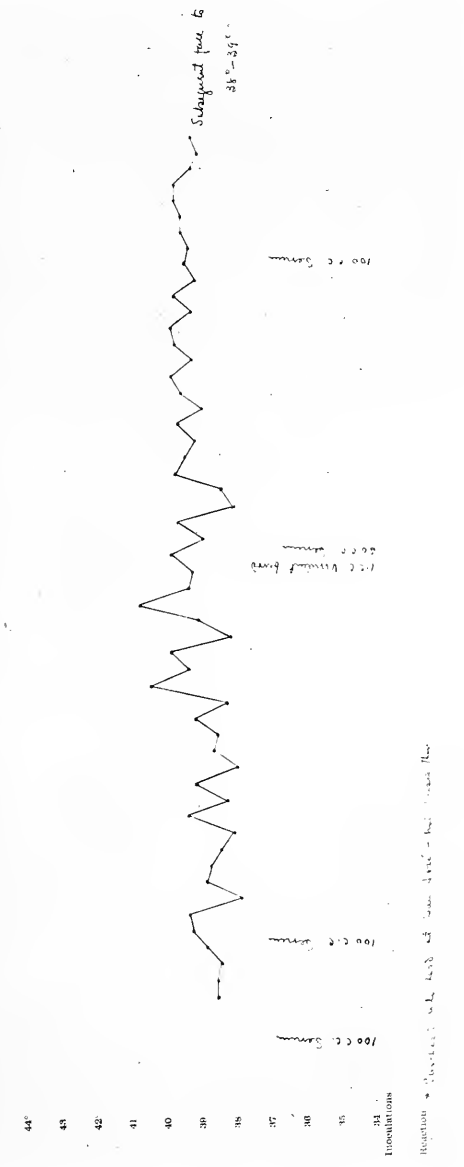
BUREAU OF GOVERNMENT LABORATORIES.

Animal No 68

Town Free

Record of Variations of Temperature beginning November 19, 1903, at the Serum Laboratory, Manila, P. I.

DAY OF MONTH.	KIND OF ANIMAL.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
Nov	Cow	44	600	3 yrs	Red (dark)	F	American	1000.00
19		41	25	24	25	26	27	28
20		41	25	24	25	26	27	28
21		41	25	24	25	26	27	28
22		41	25	24	25	26	27	28
23		41	25	24	25	26	27	28
24		41	25	24	25	26	27	28
25		41	25	24	25	26	27	28
26		41	25	24	25	26	27	28
27		41	25	24	25	26	27	28
28		41	25	24	25	26	27	28
29		41	25	24	25	26	27	28
30		41	25	24	25	26	27	28
1		41	25	24	25	26	27	28
2		41	25	24	25	26	27	28
3		41	25	24	25	26	27	28
4		41	25	24	25	26	27	28
5		41	25	24	25	26	27	28
6		41	25	24	25	26	27	28
7		41	25	24	25	26	27	28
8		41	25	24	25	26	27	28
9		41	25	24	25	26	27	28
10		41	25	24	25	26	27	28
11		41	25	24	25	26	27	28
12		41	25	24	25	26	27	28
13		41	25	24	25	26	27	28
14		41	25	24	25	26	27	28
15		41	25	24	25	26	27	28
16		41	25	24	25	26	27	28



Reaction + Clinical, etc. (handwritten notes)

BUREAU OF GOVERNMENT LABORATORIES.

Fever Chart

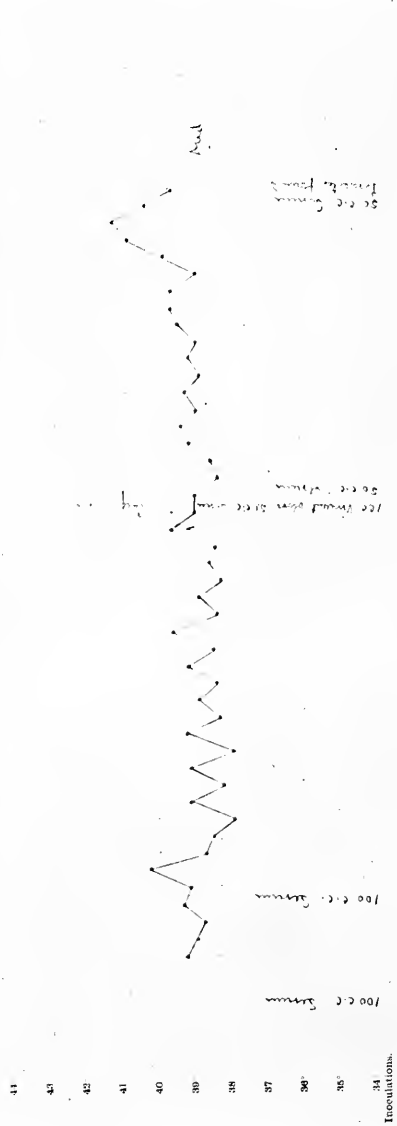
Animal No. 57

Record of Variations of Temperature beginning December 1, 190... at the Serum Laboratory, Manila, P. I.

Kind of Animal	Height	Weight	Age	Color	Sex	Nativity	Breed
Cow	4-4	740	2 yrs.	Black	♀	Philippine	Black

Day of Month

Time of Day



Inoculations.

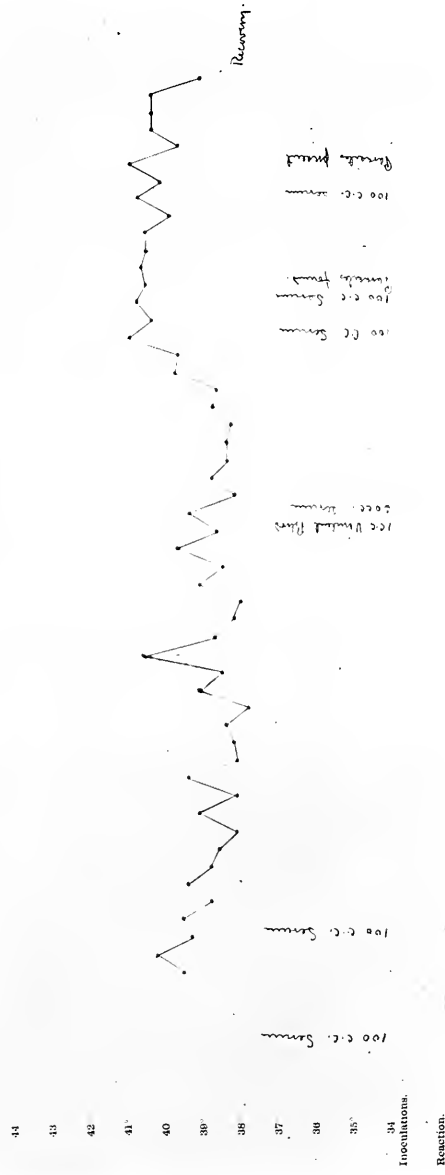
Reaction.

BUREAU OF GOVERNMENT LABORATORIES.

Animal No 70

Record of Variations of Temperature beginning November 19, 1903, at the Serum Laboratory, Manila, P. I.

DAY	KIND OF ANIMAL	HEIGHT	WEIGHT	AGE	COLOR	SEX	NATIVITY	PRICE																				
	Bull	4 1/2"	800	4 yrs	Light	M	Umanan	500.00 of Cal																				
Day of Month																												
November																												
Time of Day																												
	18	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



Inoculations.
Reaction.

BUREAU OF GOVERNMENT LABORATORIES.

Animal No 450

Taux fixe

Record of Variations of Temperature beginning 1903, at the Serum Laboratory, Manila, P. I.

Day of Month.	KIND OF ANIMAL.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
15	Goat	46	300	4 yrs	B	♂	Manila	1
16	Goat	46	300	4 yrs	B	♂	Manila	1
17	Goat	46	300	4 yrs	B	♂	Manila	1
18	Goat	46	300	4 yrs	B	♂	Manila	1
19	Goat	46	300	4 yrs	B	♂	Manila	1
20	Goat	46	300	4 yrs	B	♂	Manila	1
21	Goat	46	300	4 yrs	B	♂	Manila	1
22	Goat	46	300	4 yrs	B	♂	Manila	1
23	Goat	46	300	4 yrs	B	♂	Manila	1
24	Goat	46	300	4 yrs	B	♂	Manila	1
25	Goat	46	300	4 yrs	B	♂	Manila	1
26	Goat	46	300	4 yrs	B	♂	Manila	1
27	Goat	46	300	4 yrs	B	♂	Manila	1
28	Goat	46	300	4 yrs	B	♂	Manila	1
29	Goat	46	300	4 yrs	B	♂	Manila	1
30	Goat	46	300	4 yrs	B	♂	Manila	1
31	Goat	46	300	4 yrs	B	♂	Manila	1



Inoculations. Reaction.

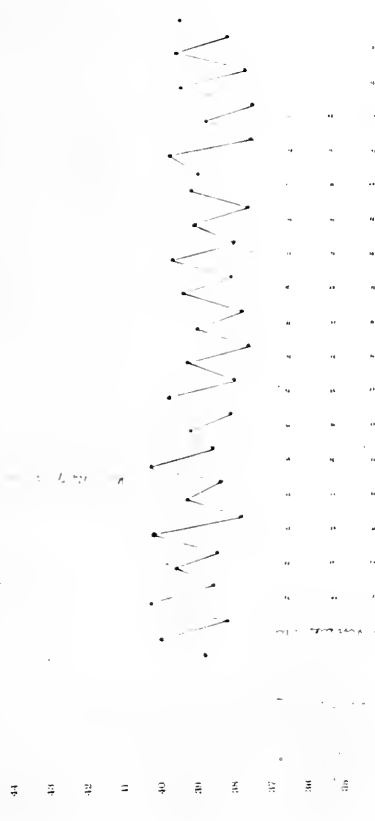
BUREAU OF GOVERNMENT LABORATORIES.

Live Fox

Animal No 324

Record of Variations of Temperature beginning December 14, 1903, at the Serum Laboratory, Manila, P. I.

KIND OF ANIMAL	HEIGHT	WEIGHT	AGE	COLOR	SEX	NATIVITY	PRICE									
664	37"	16.5	6 mos	Red	♂	Hong Kong										
Day of Month	14	16	11	11	14	17	19	21	23	25	27	29	31	1	2	3
Temperature																
Time of Day																



Temperature
Rectal

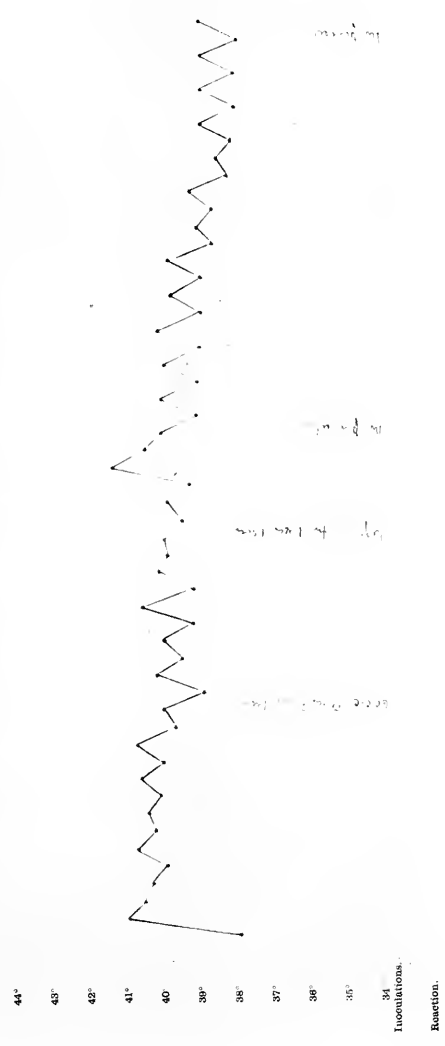
BUREAU OF GOVERNMENT LABORATORIES.

Animal No 333

1903

Record of Variations of Temperature beginning *January 15*, 1903, at the Serum Laboratory, Manila, P. I.

Day of Month.	KIND OF ANIMAL.	HEIGHT.	WEIGHT.	AGE.	COLOR.	SEX.	NATIVITY.	PRICE.
9	Man	44	150	6 yrs	Black	M	Manila	1
10	Man	44	150	6 yrs	Black	M	Manila	1
11	Man	44	150	6 yrs	Black	M	Manila	1
12	Man	44	150	6 yrs	Black	M	Manila	1
13	Man	44	150	6 yrs	Black	M	Manila	1
14	Man	44	150	6 yrs	Black	M	Manila	1
15	Man	44	150	6 yrs	Black	M	Manila	1
16	Man	44	150	6 yrs	Black	M	Manila	1
17	Man	44	150	6 yrs	Black	M	Manila	1
18	Man	44	150	6 yrs	Black	M	Manila	1
19	Man	44	150	6 yrs	Black	M	Manila	1
20	Man	44	150	6 yrs	Black	M	Manila	1
21	Man	44	150	6 yrs	Black	M	Manila	1
22	Man	44	150	6 yrs	Black	M	Manila	1
23	Man	44	150	6 yrs	Black	M	Manila	1
24	Man	44	150	6 yrs	Black	M	Manila	1
25	Man	44	150	6 yrs	Black	M	Manila	1
26	Man	44	150	6 yrs	Black	M	Manila	1
27	Man	44	150	6 yrs	Black	M	Manila	1
28	Man	44	150	6 yrs	Black	M	Manila	1
29	Man	44	150	6 yrs	Black	M	Manila	1
30	Man	44	150	6 yrs	Black	M	Manila	1
31	Man	44	150	6 yrs	Black	M	Manila	1



Inoculations.
Reaction.

THE AUSTRALIAN TICK (*BOOPHILUS AUSTRALIS* FULLER) IN THE PHILIPPINE ISLANDS.

By CHARLES S. BANKS, *Entomologist Biological Laboratory.*

On the 18th of November, 1903, a consignment of cattle from the United States was landed in Manila. About three weeks afterwards they exhibited symptoms which were diagnosed as those of Texas fever, and in a few days several of the animals died of this disease. Conclusive proofs of the identity of the malady with Texas fever were established at the post-mortem examinations of the first animals which succumbed. I was thereupon directed to look for, and, if possible, to identify, any ticks which might be upon the remaining ones. Several ticks were picked from the animals on shipboard at the time of their arrival in Manila by a veterinarian who, from a preliminary examination, took them to be *Boophilus annulatus*, but who, after a microscopical one, modified his original statement. He did not, however, retain the specimens, so that I had no chance to see them and to identify them positively. I first saw the cattle after they had been in Manila for twenty-six days. Since landing they had been kept in fly-proof stables at the Serum Laboratory, being taken out only once or twice to be washed. The ticks which I secured may not have been of the same kind as those brought over by the animals from the United States and which were picked off by the veterinarian. These cattle may have carried with them *Boophilus annulatus*, but the latter may all have been removed while on shipboard, as the herd was carefully scrutinized before being landed. The ones which I found and identified as *Boophilus australis* Fuller may possibly have been picked up by the animals while they were being driven into the yards and stables. Ticks have a wonderful sticking power. This is due to the admirable adaptation of their feet to

the purpose of clinging to their hosts. By reference to figs. 11 and 16 the structure of the feet may be seen.

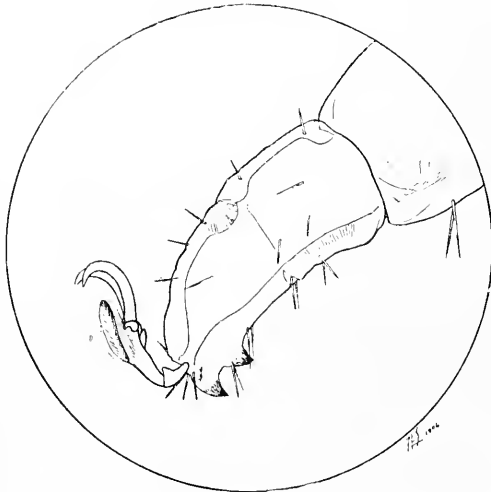


Fig. 16

Boophilus australis Fuller: Distal segment of tarsus of male, showing claws and pulvillum greatly enlarged. (Original.)

LIFE HISTORY AND DESCRIPTION.

Cattle ticks, one of the most annoying and serious of the parasites affecting domestic animals, because of their proven rôle in the transmission of disease, especially of Texas fever, belong to the family *Ixodidae*. This family of the order *Arachnida* is characterized as follows: They are hexapod in the larval and octopod in the nymph and adult stages. (See figs. 17 and 18, which represent the larvæ, and figs. 1 to 10, which show the adults.) In both the male (figs. 3-6) and the female (figs. 1, 2, 8-10) it is very difficult to distinguish the head from the rest of the body. That part of the female which appears as a brown, chitinous shield (figs. 9, 10, 14) at the fore part of the body is called the "capitulum" and corresponds to the head of true insects. It consists of a dorsal shield (fig. 9) terminating anteriorly in the rostrum (fig. 9*b*) or mouth parts which consist of the mandibles (fig. 10*a*), the maxillæ, and the palpi (fig. 10*b*). The maxillæ do not show in the drawing.

The palpi, as seen at *b* in fig. 10 and also in figs. 5*a*, 18, 19, and 20, are short, thick, and four-jointed, the segments being broader than they are long and having the folds thickened with chitin (see fig. 20, which represents the palpi of the young). They thus have a decidedly angular appearance. The mouth proper consists of a corrugated sheath (fig. 20*a*), in which the two lance-like, barbed, or hooked mandibles (figs. 12 and 13) move antero-posteriorly. This sheath bears upon its dorsal surface a series of very regular minute denticles and upon the ventral surface eight rows of the same of a larger size and pointing posteriorly (fig. 21). This number of ventral denticles is constant in *Boophilus annulatus* and *Boophilus australis*, but may be smaller or greater in other species. In the larval stage of *B. australis* the number is four (see fig. 20). The purpose of these denticles, judging from their structure and position, is evidently to give the animal a hold in the skin of its host. The mandibles are two bilaterally arranged, lancet-like organs, composed of chitin and having a barbed or hooked extremity (fig. 12*c*), with a moveable toothed appendage on the outer edge (fig. 12*e*). They also have a slight toothed growth near their point (fig. 12*d*).

The tick, when once fastened upon its host, does not relax its hold until replete with blood. This is true of the female. From observation of the male I am of the opinion that it does not attach itself in any one position for a great period, but wanders around upon the body of the host in search of the females. Its claws are so well adapted to clinging that it is removed only with considerable difficulty from the hairs among which it runs. Frequently the males are found adhering to the skin of the cattle.

The life history of cattle ticks is very interesting. The fecund female, after becoming engorged with blood, as shown in fig. 8, drops from the host and within twenty-four hours begins laying her eggs. These are tiny, brown, globular bodies, about 0.75 millimeters in diameter, a very small white patch developing upon one side just previous to hatching. In the Laboratory, eggs which were laid on December 22, 1903, hatched January 25, 1904; but this period was no doubt longer than normal, owing to the unfavorable conditions under which the eggs were placed. They were laid in a Petri dish which was not supplied with the requisite amount of moisture.

After the young ticks had hatched, they remained clustered together among the eggshells for three or four days, after which they began to disperse. One morning, four or five days after hatching, I found several of them crawling over my table, and upon examination of the dish in which they had been placed I found that they had escaped in large numbers from beneath the supposedly tight lid. (See figs. 17 and 18, which show the young ticks very much enlarged.)

Under natural conditions the females deposit their eggs, in numbers estimated to be from 1,000 to 2,000, in some sheltered spot. Ticks exposed to strong sunlight do not hatch. Within a few days or a week after the young emerge from the eggs they climb to some favorable position on weeds or fences, and from there are easily brushed off upon the passing cattle. During this time they molt twice, changing from the hexapod to the octopod stage. These insects have frequently been met with in Manila upon posts, weeds, and the walls of houses and upon stone walls in and around places where cattle are kept. From the readiness with which they grasp any passing object, it is very probable that attendants might easily carry them upon their clothing into even a supposedly insect-proof stable.

Upon attaching themselves to an animal, if they have reached the adult stage, they immediately begin sucking the blood. Copulation also at once commences, and it is not an uncommon thing to find a male and a female *in copula* upon the same spot on the animal's skin, both of the ticks having their beaks or rostra inserted into it.

In this latitude, under normal conditions, the time elapsing from the time of laying the eggs to the maturing of the ticks is probably not more than seven weeks. The exact time can not be stated because of lack of sufficient observation.

HISTORY AND CLASSIFICATION.

The Australian tick is also known as the South American, the Cuban, or the Porto Rican Texas-fever tick, it having been thoroughly established that this animal as well as the American form, to which it is so very closely related, is capable of transmitting Texas fever.

Salmon and Stiles in their excellent work on "Cattle Ticks," in

the Seventeenth Report of the Bureau of Animal Industry of the United States Department of Agriculture for 1900 (1902) say:

The Australian and South American fever ticks were originally considered as identical with *B. annulatus*. When the Australian Commission visited this Bureau the writers of the present paper examined the Australian forms and expressed the opinion that they were certainly a distinct variety and in all probability a distinct species. The same specimens were examined by Ashmead, Schwarz, and Coquille, who concurred in this view. This opinion was referred to by our Australian colleagues in one of their publications. (Hunt and Collins, 1896, pp. 31, 32.) Neumann, who examined the same specimens upon which we based our view, looked upon the Australian form as identical with the North American. Fuller (1899, pp. 389-394), however, restudied the question and recognized the North American, the Australian, and the South African forms as three distinct species. The following extracts from this paper bear upon the question involved:

"Together with this I am sending you some notes on the various cattle ticks, from which you will see that I have found the North American, the Australian, and that from Cape Colony distinct from one another. The Queensland form appears to be a new species, for which I have proposed the name *australis*; it is curious that it is the same as the one Mr. Pond sent me as coming from South America.

* * * * *

"As early as 1893 the Queensland cattle tick was identified as *Ixodes bovis* Riley, by the late A. S. Olliff, and was until recently regarded as specifically identical with that species by many later students. I believe that the first doubt as to the correctness of this assumption was thrown out by Dr. D. E. Salmon, Chief of the U. S. A. Bureau of Animal Industry, in a letter to Mr. P. R. Gordon, chief inspector of stock (Queensland). In this communication (dated December 9, 1897) Dr. Salmon says: 'You will possibly recall that we considered the Australian form as distinct from our American form. Professor Neumann, who had for his monograph a very large number of specimens, including our entire collection, and has studied the Australian ticks which Dr. Hunt gave us some time ago, does not, however, agree with us on this point, but considers that they are identical.

"As it has since become important to settle the identity of the supposed red-water tick in Cape Colony, also said to be *I. bovis*, I have made a careful study of all three forms and have come to the conclusion that they are three distinct species.'"

The technical description of *B. australis*, as made by Mr. Fuller in the report of Salmon and Stiles, is here given. He, however, placed this tick in the genus *Rhipicephalus*, proposed by Neumann

in 1897. But as the species *Boophilus* differs from *Rhipicephalus* in the essentials of form, palpal joints, and stigmata, together with other structural features, recent authors have rather agreed to cling to the name given by Curtice in 1891 and which "has become almost vernacular."

THE AUSTRALIAN, SOUTH AMERICAN, CUBAN, AND PORTO RICAN TEXAS-FEVER TICK.

Boophilus australis Fuller.

SPECIFIC DIAGNOSIS.

Boophilus, male.—Body oval, narrowed in front, broadest (about 1.3 mm.) in region of stigmata and Coxæ IV, 2.2 to 2.3 mm. long. Scutum reddish brown, extends from anterior to posterior margin of body, but leaves a narrow lateral margin uncovered, prolonged in front by two pairs of projections; one pair of more prominent dorso-lateral pointed projections, dorsal of anterior projections of Coxæ I, and one pair less prominent and more median, somewhat semilunar, with concavity median, surrounding the base of the neck. Two shallow cervical furrows, extending more or less distinctly to the posterior margin of the body, may be interrupted in the middle; a median furrow present in posterior half, may be indistinct; festoons of posterior margin very indistinct. Distinct circular pores with extruding short, stout, bristly hairs scattered over the entire surface. Eyes small, pale at I intercoxal space. Ventral surface lighter than dorsal, all portions provided with short, stout hairs. Genital pore broad, transverse between Coxæ II. Anus slightly posterior of stigmal plane; and plates (clypei) more chitinous than those of *B. annulatus*. Strong chitinous cervical median caudal appendage present, 85 microns long. Capitulum about 425 microns long, postero-lateral spines of base more marked than in *B. annulatus*; mandibles about 600 microns, digit about 90 microns; internal apophysis apparently with three teeth; external apophysis bidentate (only three specimens examined). Hypostome with four rows of teeth on each half, the inner row being less strongly developed than the others. Palpi about 200 microns long, in general similar to those of *annulatus*. Legs strong; Coxæ similar to those of *annulatus*; but bidentation of I pair much more marked. Tarsi similar to *R. annulatus*.

Female.—Very similar to female of *B. annulatus*, but the lateral constriction at the stigma is usually more marked. Body elliptical, as broad in front as in back; when replete, may attain 10 to 12 mm. long by 6 to 7 mm. broad. Color varies like *annulatus*. Dorsal shield smaller, somewhat lighter in color. Eyes small, near middle or anterior third of lateral margin of scutum. Capitulum very short, 560 to 612 microns from postero-dorsal margin to anterior end of hypostome, quite similar to that of *annulatus*, except lateral projection slightly more marked. Mandibles 765 microns long, digit 120 microns; internal apophysis "tricuspid," and

“presenting rounded process as well;” external apophysis tridentate as in *annulatus*. Hypostome spatulate, slightly longer than palpi, each half with four rows of 7 to 10 denticles which do not extend to the base. Palpi very short, about 320 microns long, articles at least as broad as long, in general similar to *annulatus*.

Hexapod larva: Similar to *R. annulatus*; in some cases a third pair of stigmata (between Coxæ I and II) appears to be present.

Rhipicephalus australis, species nova.

Female.—When replete, measuring 10 to 11 mm. in length and 6 to 7 mm. in breadth. Dorsal shield smaller than that of *annulatus* and greater than that of *decoloratus*, of the same form and with similar furrows. Eyes, pale. Labium with eight rows of teeth.¹ Mandibles with lesser process tricuspid, and presenting a rounded process as well.

Male, adult.—Approaching that of *annulatus*, but with adanal shields more chitinous and also exhibiting a caudal appendage. Neither the shields nor the “tail” are so pronounced as those of *decoloratus*.

Habitat.—On horses, cattle, etc.; northwest to northeast Australia.

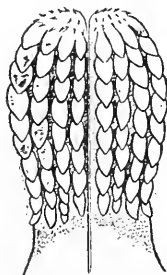


Fig. 21

Diagram of labium of *Boophilus australis* and *B. annulatus*. Greatly enlarged. (Redrawn from Fuller.)

In addition to the habitat above given we may now add the Philippine Islands, inasmuch as the ticks found upon cattle here have been identified as belonging to this species.

It is well to direct the attention of those who are likely to be called upon to make a diagnostic examination of the Australian tick to the essential points of difference between *B. annulatus* and *B. australis*.

Aside from the fact that *B. australis* has been found in the Philippine Islands and that *B. annulatus* has not, the differen-

¹See fig. 21.

tiation of the two species by those who study specimens may be facilitated by the following table, modified from Fuller's report: .

- A. Mandibles with lesser process biuspid..... *B. annulatus*.
 B. Mandibles with lesser process tricuspoid, or quadricuspoid;
 or having a fourth slight rounded projection..... *B. australis*.
- A. Male with anal (adanal) chitinous plates slightly toothed
 on the median posterior margin¹..... *B. australis*.
 B. Male with anal (adanal) chitinous plates more evenly
 rounded¹ *B. annulatus*.
- A. Male with a distinct horny tail..... *B. australis*.
 B. Male with no evidence of a tail..... *B. annulatus*.
- A. Larvæ having a curved line posterior to eyes and inclosing
 dorsally a semilunar space comprised by the posterior
 part of the body..... *B. australis*.
 B. Larvæ having no curved division line..... *B. annulatus*.

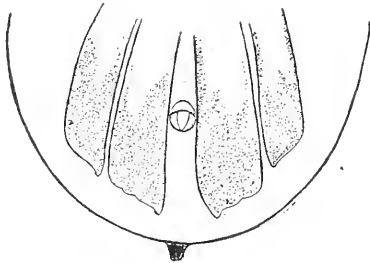


Fig. 22.

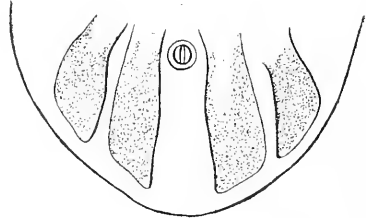


Fig. 23.

Diagrams of posterior margins of males of *Boophilus australis* and *B. annulatus*, showing caudal appendages in former and toothed appearance of adanal plates. Greatly enlarged. (Fig. 22 redrawn from nature, fig. 23 redrawn from Sahnou and Stiles.)

In the female there is unfortunately no mark of distinction for the two species, the surest evidence in this case being the finding of males, as above described, *in copula* with females on the same host.

¹ See figs. 22 and 23, which give a diagrammatic representation of the adanal plates of *B. australis* and *B. annulatus*.

THE AUSTRALIAN CATTLE TICKS.

Boophilus australis, Fuller.

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1899. *Rhipicephalus australis* Fuller (1899), pp. 389-394, figs. 1-3. Notes on the Queensland Cattle Tick and Its Relationship to the Texas Fever Tick and the Blue Tick of Cape Colony (South Africa). Queensland Agric. Jour., Brisbane, IV (pt. 5), May.
1900. *Boophilus bovis* (Riley), of Fuller, 1896, pp. 760-787 (in part).
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1901. *Boophilus australis* (Fuller), Stiles and Hassell, 1901, pp. 2, 3. Notes on Parasites, 56: *Boophilus australis* present in Cuba, Porto Rico, Venezuela, and India. Cir. No. 34, Bureau of Animal Industry, U. S. Dept. Agric., Washington, pp. 2-3.
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¹This date reference can not be found. It is evidently intended to be: Canastrini, G., and F. Fanzago, 1877. Intorno agli acari Italiani. Atti del reale Instituto Veneto descienze, lettere ed arti. ser. 5, IV (1877-1878) [for 1877], pp. 69-208, Tav. II-VII.





Fig. 1.



Fig. 2.

Boophilus australis Fuller: Adult female, dorsal and ventral aspects; specimens not yet replete. (Fig. 1, 8 X; fig. 2 slightly more.)

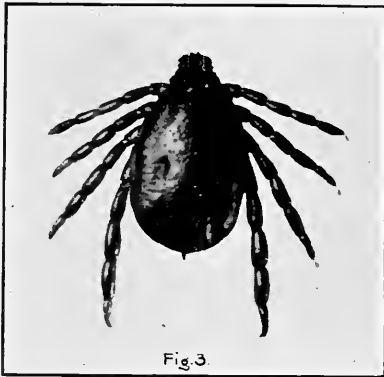


Fig. 3.



Fig. 4.

Boophilus australis Fuller: Adult male, dorsal and ventral aspects, showing caudal appendage or "tail." (13½ X.)

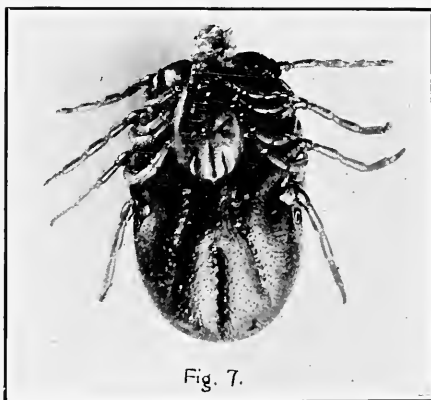


Fig. 7.

B. australis Fuller: Adult male and female in copulā. (8 X.)

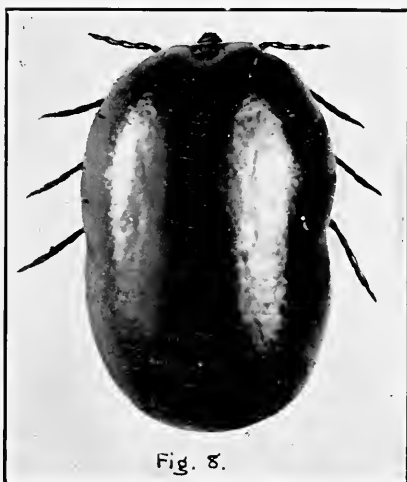


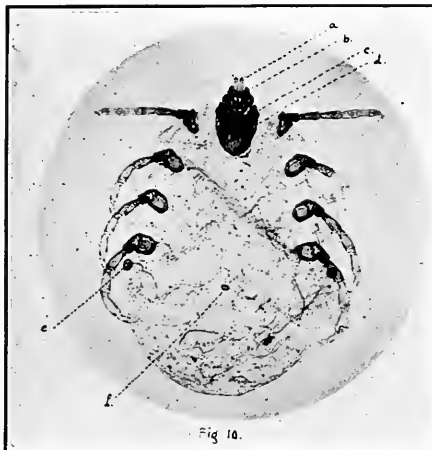
Fig. 8.

B. australis Fuller: Replete adult female, showing lateral constriction. (5½ X.)

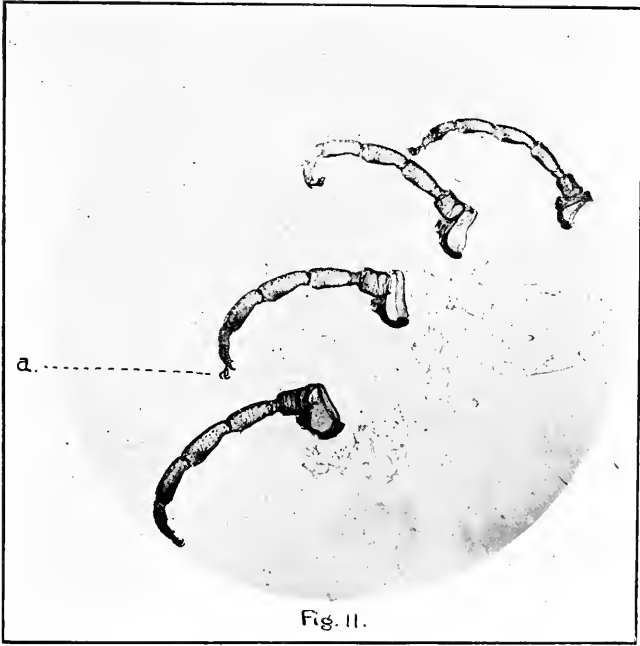




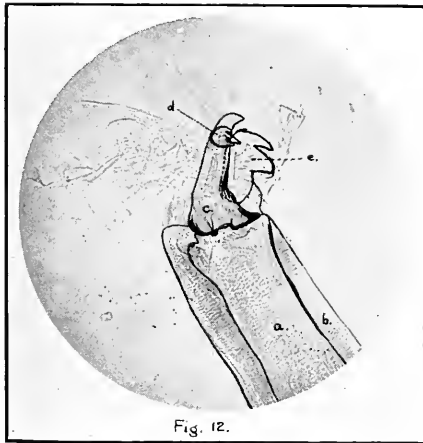
Boophilus australis Fuller: Half-grown female. (15 X.) *a*, Scutellum; *b*, Rostrum; *c*, Stigmata.



B. australis Fuller: Adult female previous to repletion. (6 X.) *a*, Mandibles; *b*, Palpi; *c*, Scutellum; *d*, Ocelli (eyes); *e*, Stigma; *f*, Anus.

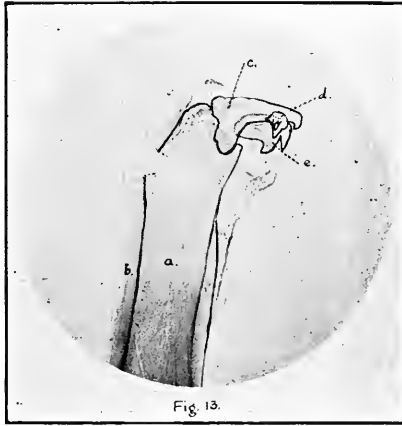


Boophilus australis Fuller: Left legs of female, showing claws. (12 X.)

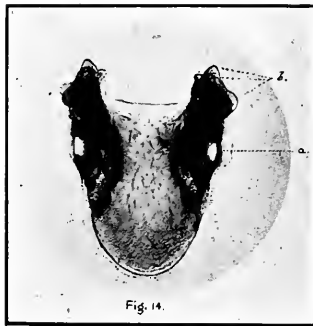


Boophilus australis Fuller: Mandible in sheath. (100 X.) *a*, Mandible; *b*, Sheath; *c*, Digit of mandible; *d*, Internal apophysis; *e*, External apophysis.





B. australis Fuller: Mandible in sheath, showing shagreen-like character of sheath near *a*. (1000 X.)



B. australis Fuller: Scutellum of female, showing antero-dorso-lateral projections at *b* and eyes at *a*. (19 X.)

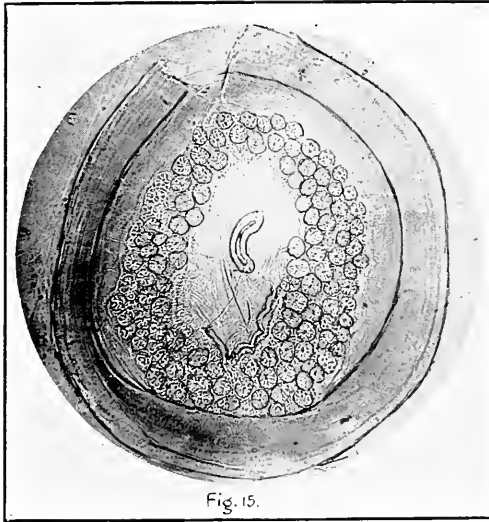


Fig. 15.

B. australis Fuller: Stigma of female, showing star-like structure. Slightly broken at upper left margin. (60 X.)

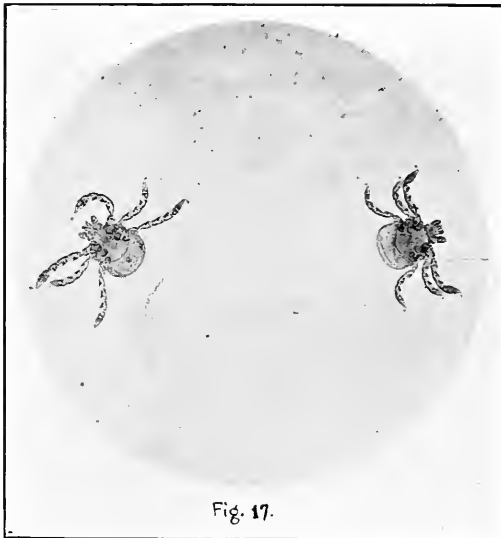


Fig. 17.

Boophilus australis Fuller: Young ticks, larvæ, first hatched from eggs. (20 X.)

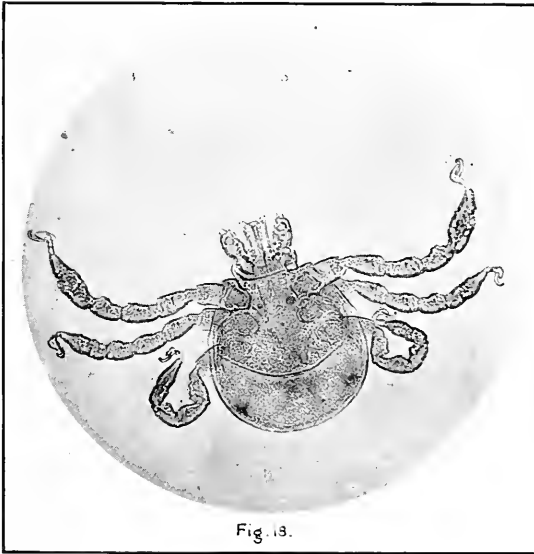


Fig. 18.

B. australis Fuller: Young tick, showing rostrum and claws of feet. (50 X.)



Fig. 19.

B. australis Fuller: Young tick, showing eyes and curved dorsal line. (50 X.)

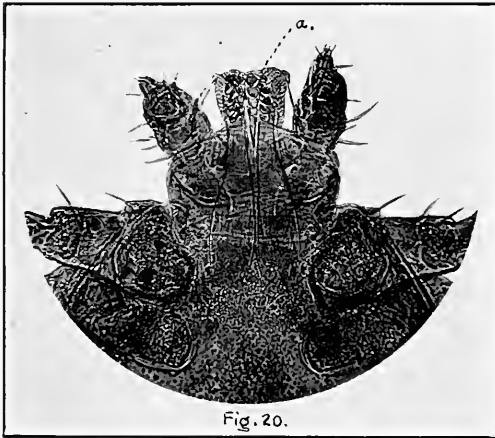


Fig. 20.

B. australis Fuller: Rostrum of young tick, showing only two rows of ventral-paired denticles. (130 X.)





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