Oklahoma Agricultural Experiment Station,

STILLWATER, OKLAHOMA.

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TEXAS FEVER.

SUMMARY.

Northern cattle may be brought south with safety if they are placed on pastures free from infection. Calves may be shipped south under any conditions with more safety than mature cattle; and stock breeders may get well bred animals from Southern herds without any danger of losing the cattle from Texas fever.

The Dynamo oil used in the dipping experiments is absolutely destructive to the Cattle tick and can be used under proper conditions with little danger to cattle. Dipping in this oil late in the fall or during the winter is not advisable. A sample of oil from the National Refining Company, of Cleveland, Ohio, was tried on ticks and animals. It has less irritating effect on the skin and is equally as effective in killing the tick as the Dynamo oil.

Keeping defibrinated blood of a Southern animal for a great length of time appears to lessen its virulence and causes a mild attack of the fever. This was only tried on two animals, and no positive conclusions can be drawn from this amount of work. Blood taken directly from a Southern animal is unsafe to use as the protozoa is introduced into a susceptible animal and will cause Texas fever. Since there is as yet no means of controlling the course of the disease in the animal, this method is useless.

TEXAS FEVER.

In July, 1897, Bulletin No. 27 was issued by this Experiment Station, and was partially devoted to a popular description of Texas fever. Since then some work has been done in an experimental way as well as observations made on cattle brought into this part of Oklahoma both from the north and south.

The old theory that Texas fever is communicated by sore, or feverish feet, or by the saliva, has outgrown its usefulness, and is never considered by those who have studied the disease experimentally, or by stockmen who have informed themselves in regard to the work done, and then observed the course of the

disease and the means of infection on stock ranches. The so-called tick theory is no longer a theory but a fact, and the National Quarantine Line is located with reference to the distribution of the Cattle tick, and this only. The only object in enforcing the Quarantine against Southern cattle during the time they are infected with the tick is to prevent losses among cattle susceptible to this disease. The old theories of infection by means of the feet, or by the saliva, have received at the hands of experimenters as careful attention as any theories could receive, but were completely disproved in every experiment, while infection by ticks has always produced the disease in a recognizable form. Any experiments conducted now with the idea of proving that ticks are the means by which Texas Fever is communicated from Southern to Northern cattle is a repetition of previous work.

In connection with the inoculation experiments reported in this Bulletin it was found convenient to infect some cattle with ticks. This was done on October 12th, using animals numbered 128, 129 and 130. Animals numbered 128 and 129 had been inoculated with blood from a Southern animal and had suffered a severe attack of fever (See tables of temperature records.) Animal numbered 130 had been inoculated with blood from a Southern animal which had been kept for so long a time that it failed to cause a very distinct rise in temperature and it is doubtful if the slight rise noticed could be attributed to the inoculation. In the case of animals numbered 128 and 129 the ticks had no effect as they were protected by the previous severe attacks of the disease, but in number 130 a mild form of the disease developed in twenty-eight days after being infected with the ticks.

Animal numbered 132 was neither inoculated with blood nor infected with ticks, but was turned into a pasture that was known to be free from infection. The dairy cows belonging to the College were kept in the same pasture. This animal showed no indication of fever, but remained in as good condition as any of the native cattle in the same pasture. If Northern cattle could be placed on pastures free from infection there would be no danger from the fever, but this would be very uncertain where there is infection near. In order to be sure of success the cattle should be closely examined every week, young ticks removed if found, and the limbs of the animal oiled. Success will depend upon the thoroughness with which the work is done.

CAUSE.—The actual cause operating in the body and which

produces the disease is a very minute parasite or one celled animal (*Pyrosoma bigeminm n. sp.*) which lives in and soon destroys the red blood corpuscles. In the acute form of the disease a large portion of the blood corpuscles will be destroyed within two or three days and the number of corpuscles per cu. m. m. will fall from 5,000,000 or more in the healthy animal, to 2,000,000 3,000,000 in the diseased animal. This rapid destruction of the corpuscles accounts for the condition of the liver and spleen and the thin watery condition of the blood so noticeable on post mortem examination.

If the activity or virulence of this organism could be diminished in any way the blood containing these organisms might be used safely for inoculating purposes. This is a well known principle used by bacteriologists in decreasing the activity of the germ by heat, then using the weakened germ for inoculations.

THE CATTLE TICK.—*(Boophilus bovis, Riley.)* There are several species of the tick in the south, but this is by far the most abundant and aside from its importance in conveying Texas fever it becomes so abundant as to prove a pest to Southern cattle. This species should not be confused with what is commonly known as the "Dog tick" or "Wood tick", *(Dermocenter Americanus Linn.)* which is common in the Northern States, and may be found in localities where the Cattle tick is common. A very common tick in the Southern States is the Lone Star tick, *(Amblyoma unipuncta, Pack.)* With the exception of the Cattle tick, this is of more importance than the other species which occur in this region.

The average of a number of measurements of the adult female cattle tick was 12 m. m., long and 7 m. m., broad. The male is very small and found attached near the female. When hatched from the egg the ticks are very small and have only three pair of legs, but after passing through two moults they are sexually mature and have developed another pair of limbs. The length of time necessary for the female to become mature depends on the season of the year. In summer development will take place in from 20 to 25 days, but in winter the ticks may remain attached to the animal for two months and in one case of artificial infection ticks were found on the animal 63 days after infection. The length of time necessary for the eggs to hatch will also depend on the conditions. In September they were hatched in 22 days, in October and November 37 days were necessary.

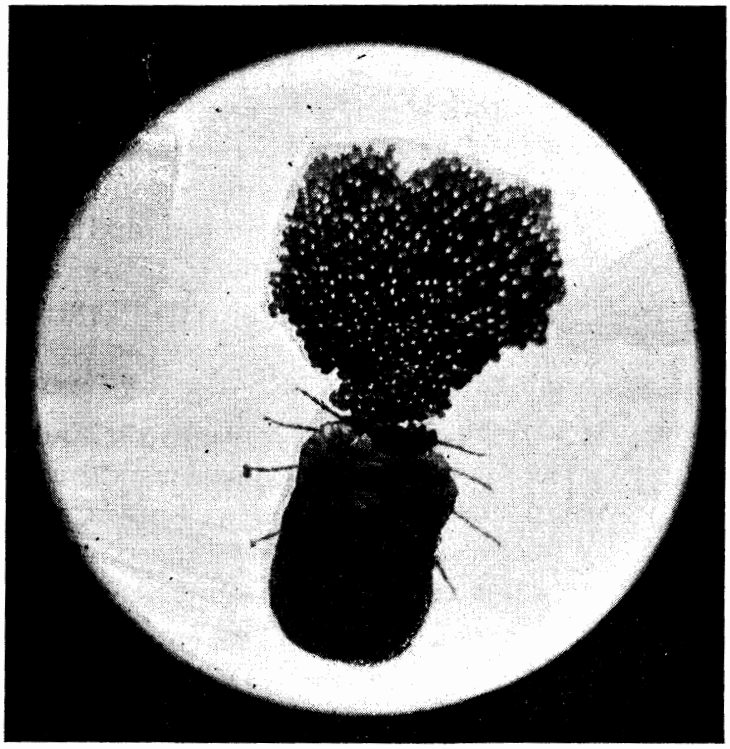

Fig I. Photo-micrograph of Tick Depositing Eggs.
(70 m. m,, objective with No. 4, ocular.)

The organism causing Texas fever, which is described in the previous paragraph is conveyed from Southern cattle to susceptible cattle by means of the cattle tick. It has not yet been definitely proven that the other species of ticks found in the Southern States are capable of communicating this disease.

The eggs of the cattle tick are small brownish colored masses .43 m. m., long and.3 m. m., broad. They are deposited from the oviduct which opens just above the mouth The tick dies as soon as the eggs are deposited.

It is certain that the cattle tick found here will convey the fever to susceptible animals, and from a number of opportunities for observing the effect of the infection brought here from Southern Texas and Louisiana, it is almost certain that ticks from these regions will kill the native cattle here. For the last three years the result of the infection brought from the extreme south has been watched and in most cases it has been followed by outbreaks of Texas fever among the native cattle. This being true it is important to prevent infected cattle from coming into the Territory.

Young cattle may be introduced into the infected area with much more safety than adult cattle. A number of breeders are taking advantage of this fact and shipping young calves south,

where they are put on infected pastures and fed all the m they can consume. When treated in this way 70 per cent. more will become immune. Other breeders, who are desir of improving their stock, instead of getting their anim from the north are purchasing breeding animals from the l heards in the south. In the latter case there is, of course, danger of losing animals from fever.

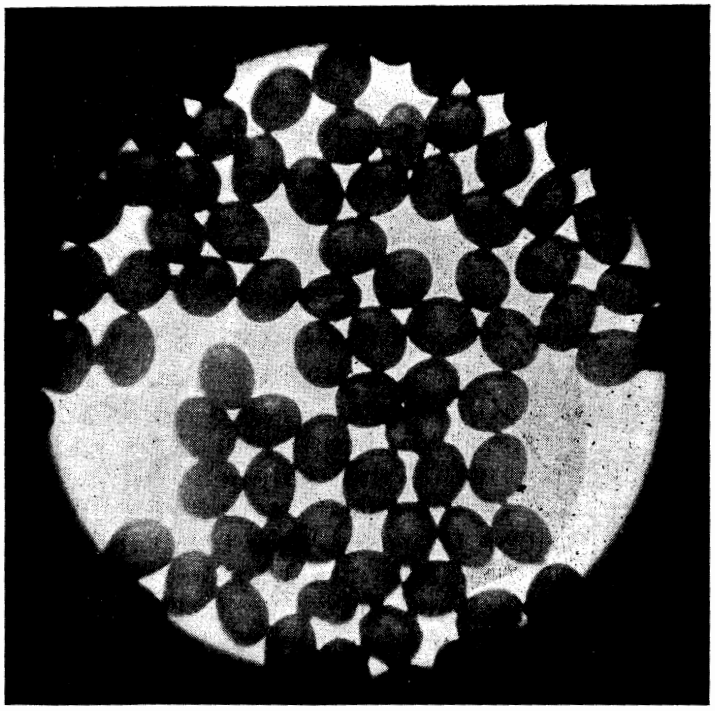

Fig II. Photo-micrograph of Tick Eggs.
(No. 2, objective (Leitz) with No. 4. ocular.)

POST MORTEM NOTES.—The following notes were ma the post mortem examination of animals which died fro inoculation of blood:

Animal No. 125.—Yearling steer, examined soon death. No lesion of any character at point of inocul Digestive tract normal. Spleen very large and dark, very soft and easily broken down, weight four pounds. did not appear to be affected. Gall bladder moderatel tended with thin bile which contained fine granular m Bladder filled with dark red water. The blood was not ly altered in color but was thin and watery. Made cover preparations from spleen and stained them finding the parasite.

Animal No. 124.—Red heifer, yearling. Condition spleen and blood same as in No. 125. There was slight

orrhage around the kidneys. Liver enlarged, mottled in appearance, soft and easily broken down. Gall bladder filled with a very thick black bile, granular in appearance. The post mortem notes from No's. 126-7 were the same in general character as those above.

The above notes, though brief, are descriptive of very characteristic conditions noticed on making post mortem examinations in cases of death from Texas fever. Generally the third stomach is found to be very dry and hard; this was not noticed in the cases above, principally on account of the character of food used.

QUARANTINE LINE.—The location of the Quarantine Line of Oklahoma for 1899 is the same as for several years past except that Canadian County is placed above the line.

According to the present regulations of the Department of Agriculture there is no "open season" in which any and all cattle may pass above the Quarantine Line. Sections five and six of these regulations are as follows:

"5.—Cattle originating in said area (infected area) may, after having been properly dipped, under the supervision of an inspector of this department, be shipped without further restrictions, excepting such as may be enforced by localities at the point of destination: *Provided*, that to establish the dipping stations, and that after being dipped the cattle are certified by an inspector of the U. S. Bureau of Animal Industry, and that the cattle when dipped are to be shipped in clean cars, and not be driven through the infected district or unloaded therein except at such point as may be duly designated by an order issued by this Department.

6.—From November 1, to December 31, inclusive, cattle from said area which are found free of infection upon inspection by officers of this Department may be moved north of the Quarantine Line without restriction other than may be enforced by local regulations at destination. If evidence of infection is found upon inspection, the cattle must be dipped in accordance with the provisions of section 5 before being moved north of the Quarantine Line."

CATTLE DIPPING EXPERIMENTS.

In the summer of 1898 this Station built a vat at Noble, on the south line of Oklahoma, in which 240 cattle were dipped under supervision of the Station. The vat was afterwards used for dipping several hundreds of cattle but this work was not under supervision of the Station.

PLAN FOR VAT.—Excavate trench nine feet wide at the top, five feet wide at the bottom, eight feet deep, and twenty-four feet long with an incline at one end eighteen feet long.

The short incline leading to the vat may be lengthened; t will allow the use of scrapers for excavating. Place in bottom of the trench two pieces 4 in. x 4 in. x 24 ft. Pl them three feet apart from center to center. (Figure III). Pl two more pieces 18 ft. long up the incline, three feet apart the bottom of the vat and 7 ft. apart at the top of the grou (Figure IV) Cut cross pieces from 4x4 material 4 feet lo beginning at the entrance of the vat place first one four inc from the end of sill, then place them 18 inches apart (Figure and Figure IV) from center to center, on the bottom and up incline. Those on the incline become longer as you go up.

Cut uprights 10 feet long from 4x4 material. Place the f one at the entrance to vat, then place uprights at every alt nate cross piece nailing them to cross pieces and sills. M the uprights 7 feet apart at top of ground. Cut braces to across the top of the vat 4x4x9 ft. (Figure 2). Before putt in the bottom of the vat fill around the sills and cross pie with dirt, tamping it firmly, making the top of the dirt le with the top of the cross pieces.

For siding and bottom use best 2x12x16 ft. lumber. F put in the bottom of the vat, running the plank lengthwise the vat, then put in the siding after which put in a second l tom of two inch material running the planks across the bot of the vat.

DRIPPING PLATFORM.—A portion of the dirt from the tre may be used to grade for the dripping platform making outer end of the platform two feet higher than the end nex the vat. The platform should have 4x4 sills every three and floored with two inch material, making the floor tigh prevent waste of oil. If large numbers of cattle are to be dip the platform should be thirty-five feet long and thirty feet w at the outer end and the end next to the vat of the same wi as the vat at the top of the ground. (7 ft.)

There should be a division fence in the dripping pen mak two pens side by side with a swinging gate at the entra when one is filled the gate is closed, opening the other While the first pen of cattle is dripping the second may be fil this will almost double the working capacity of the vat. close the dripping platform with a good fence with gates l ing from the platform to the holding pens. Cleat the inc from the vat and the dripping platform with 2x4 mate placing the cleats 16 inches apart.

The oil from the dripping platform should not be allo to run back into the vat as it will carry back a large amoun

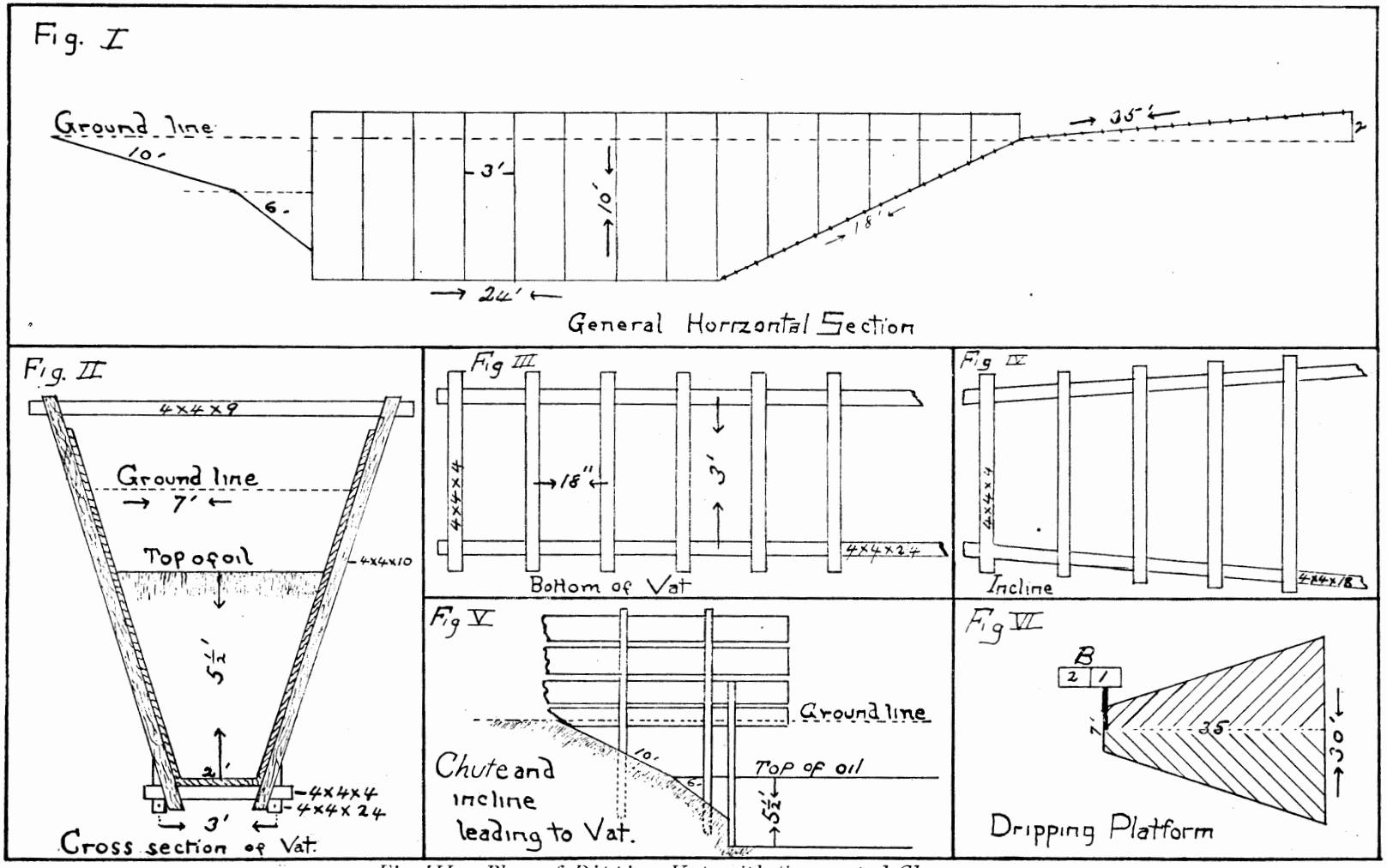

Fig III. Plan of Dipping Vat with Suggested Changes.

dirt and manure which will soon make the dip very dirty and foul. Have the oil drained to one side of the dripping platform as shown in figure IV and run into a settling tank B, which should be always large enough to hold ten barrels. This settling tank has a division extending to within six inches of the top, this prevents very much sediment reaching the second division from which the oil is either pumped or carried by tube back into the dipping vat.

CHUTE.—Make the chute of 2x6 material, making sides almost solid and seven feet high. The siding should be on inside of posts and the chute three feet wide inside measure. Extend the chute back ten feet beyond the point where the incline begins; extend the end next to the vat three feet which will prevent cattle from falling against the sides of the vat. The first vats were provided with a trap door, but this required considerable effort to get cattle on the trap. The incline will enable you to dip more cattle in a given length of time and with less danger of injuring them. The sudden drop of six feet (see Fig 5.) beginning at the top of the oil will cause the animal to be completely immersed.

A vat constructed according to these plans will have a capacity of about fifteen hundred cattle a day, but where a small vat is needed for ranch purposes the dimensions may be easily changed so that the vat would require less of the dip. The contract price for the vat constructed by the Experiment Station was $210. The plans given above are slightly modified, yet not sufficient to make any considerable change in the cost.

DIPPING CATTLE.

The principal object the Station had in view when these experiments were begun was to secure a dip which would free cattle from ticks and enable them to be moved north of the quarantine line at any season of the year, and secondarily the dip could be used on ranches to keep the cattle free from ticks, as it is very apparent that large numbers of ticks will prevent an animal from making the growth and gain during the summer season that it would otherwise make if kept free from these parasites.

The first dipping vat constructed in the south for the purpose of dipping was, so far as can be learned, constructed by R. J. Kleberg in 1888, at the Santa Gertrudis ranch in Nueces County, Texas. Mr. Kleberg states that the first use of the vat

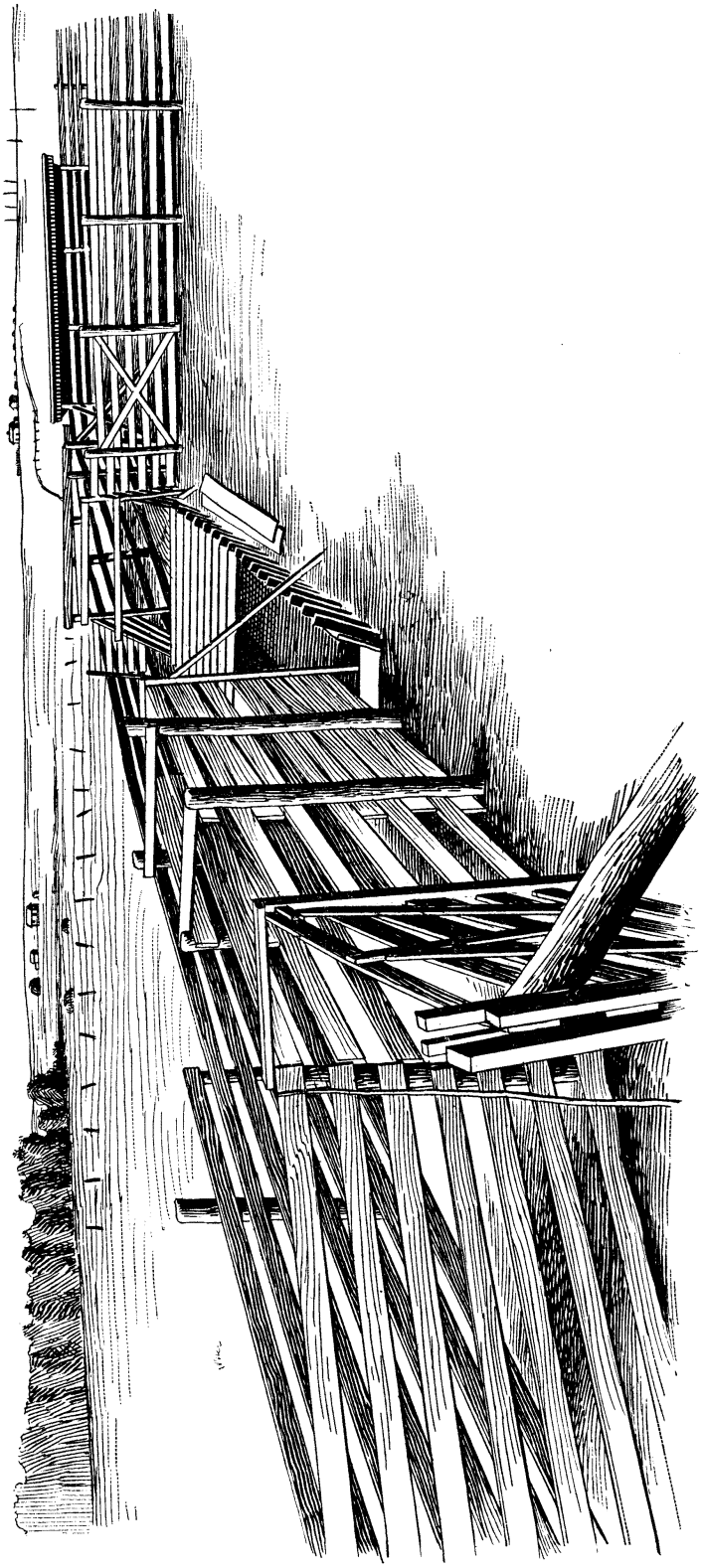

Fig. IV. General View of the Dipping Vats at Noble, Okla.

was to dip 3000 head of cattle to free them from ticks, itch and lice and that the dipping was successful so far as all practical results were concerned, although Mr. Kleberg states that he has never used any dip that he was sure killed all the ticks. This vat was afterwards used by the Bureau of Animal Industry in experimenting with Chloro-Naptholeum which is a non-poisonous disinfectant. Chloro-Naptholeum is not a perfectly reliable dip as occasionally some of the ticks escape in part the action of the disinfectant, but there are certain things to recommend this dip for ranch purposes. A 2 per cent. solution may be used with perfect safety and with the assurance that nearly all of the ticks will be removed from the animals. The dip would be cheaper and more cleanly than any of the oils and where cattle are dipped several times during the season this would be of considerable importance. If the cattle on ranches were dipped as necessity requires it would be of the greatest benefit, keeping them free from ticks, lice and mange. A small vat in which Chloro-Naptholeum was used in a 2 per cent. solution has been in use by Mr. Pomeroy of Pawnee, Oklahoma, since 1897 and has given perfect satisfaction.

In 1894 Dr. Francis, of the Texas Agricultural Experiment Station, put in a vat on the Station grounds and has since that time used various oils and other preparations for the purpose of freeing cattle from t cks.

Solutions of various preparations were first used and these were followed by dipping in thin layers of oil over a body of water. The persistent efforts of the Texas Experiment Station in this line of work has done much to bring it in to prominence.

A number of experiments have been conducted in which a thin layer of oil was used. While many of the ticks are killed by this method it is not so absolutely certain as any method must be when cattle are to be shipped out of the infected area and pastured with Northern or susceptible cattle. The failure to kill every tick would soon bring any means of freeing the cattle from ticks into disrepute, as cattle carrying any live ticks to Northern pastures would be a source of danger to the native stock.

While two or three inches of oil on the snrface of water in the vat is not sufficient to insure success, a solid body of oil is not necessary. The cattle dipped by this Experiment Station were dipped in oil forty to forty-two inches deep, and every tick was destroyed. Thinner layers of oil were used in other vats and complete success reported. Where cattle go into the

vat from an incline instead of a trap the oil has more time to act on the limbs and lower part of the body, and a layer of oil two feet deep would, I believe, give as good results as a solid body of oil. To determine the depth of the oil a glass tube of one-fourth inch in diameter and of sufficient length to reach a foot or more below the oil was used. Sink the tube slowly through the oil until almost covered by the oil, then close the end of the tube by means of a cork, then quickly withdraw the tube and invert it, the oil can then be accurately measured.

EFFECTS OF DIPPING.—The first cattle dipped by this Experiment Station was on October 22, 1898. Sixty head of cattle, principally two-year-olds, were dipped in the vat at Noble. At the time of dipping the vat contained forty-two inches of oil with sufficient water in the bottom to make the total depth about five feet. The cattle were very badly infested with the Southern Cattle Tick or Fever tick, and were in every way excellent cattle for the experiment. They were dropped from a trap door placed two feet above the surface of the oil. Every animal was completely immersed and swam through the oil without difficulty. After swimming through the vat the cattle were allowed to stand on the dripping platform from five to ten minutes, to allow the oil to drip from them. At the time of year when this work was done the hair is long and the cattle will carry out considerably more oil than they will earlier in the season when the hair is short, and ten minutes is not too long to allow them to drip.

Within two hours after dipping a number of cattle showed that the eyes were considerably irritated and from further observations this is found to be generally the case, but the irritation as a rule continues only a day or so unless the cattle are exposed to considerable wind and dust and insuch cases considerable trouble may be experienced.

As a rule the oil is more severe on the light colored animals than on dark colored ones, also on such as the Jersey where the skin is thin and pliant. After the hair becomes long and the weather cool so much oil remains on the animal and its effect is so prolonged that very injurious effects were noticed in cattle dipped late in the season. No serious results we noticed in any of the 240 dipped by the station except in the last lot of 177 head where the effect of the oil and dust combined to produce considerable irration to the eyes. Some loses have been reported among cattle dipped at other vats, and in one lot of stock cattle a considerable number died from the effect of dipping,

but in this case the effect of the very cold weather which followed close after the dipping combined with the dipping to give the bad results.

Wherever the skin wrinkles, as on the side of the neck, behind the ears, limbs etc., the effect of the oil is more marked and the outer skin, or epidermis, scales off in the form of dandruff and in a few cases the hair was shed in patches.

EFFECT ON TEMPERATURE.—The object of this test was to determine the effect on the skin, eyes and temperature, of a sample of oil furnished by the National Oil Company of Cleveland Ohio. The oil is of a light straw color, specific gravity of .854 and contains no sulphur. Sulphur was added in the proportion

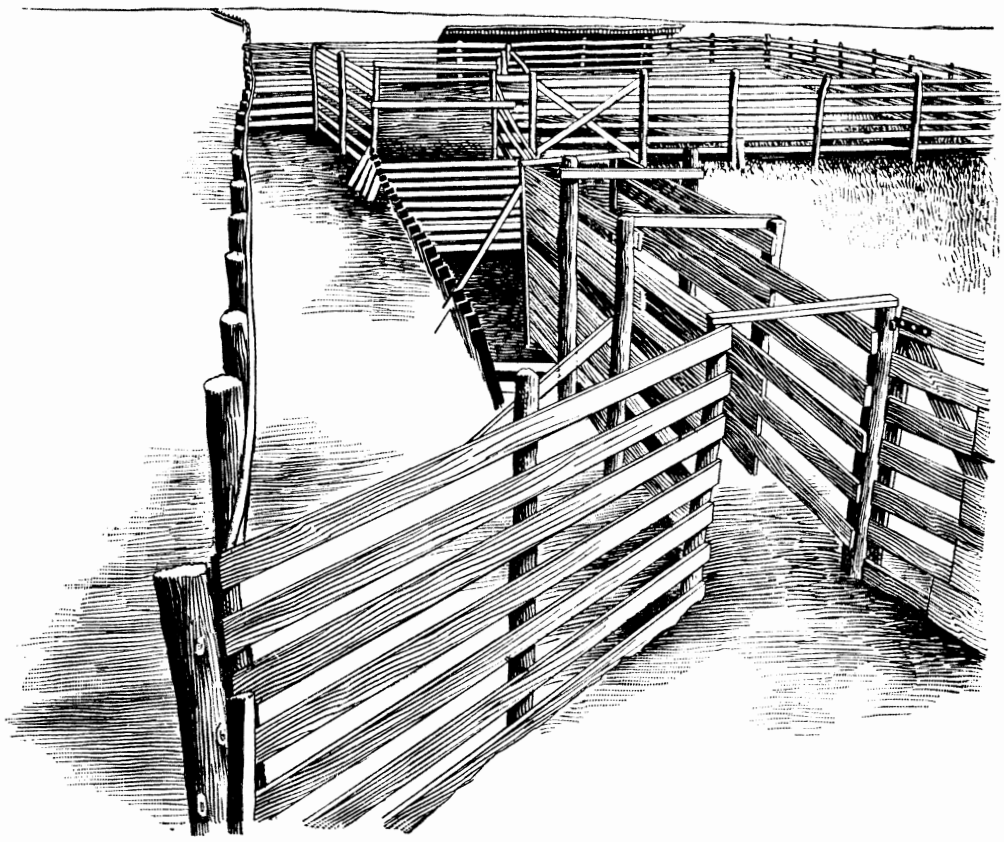

Fig V. View of dipping vat at Noble showing the entrance to the chute.

of .75 per cent., which is about the per cent. in the Dynamo oil furnished by Waters Pierce Oil Company for the dipping experiment.

Three two year old heifers were used for the test. There were no ticks on the cattle, but a number of laboratory tests were made with the oil and so far as conclusions can be drawn from laboratory work this oil is as effective as the Dynamo oil. Temperatures were taken daily and are given in the following

table. Some dandruff was noticeable on the skin after a few days. The skin was not irritated or burned in the least and no effect was noticiable on the eyes although considerable oil was forced into the eyes. Weather records for the same date accompany the temperature records of the cattle.

One gallon of oil was used on each animal and it was thoroughly applied by means of a sponge.

Temperatnre Records of Cattle.

NO. 128.			NO. 129.			NO. 130.			Max. Air	Min. Temp.
Nov. 30	2 p m	102	Nov. 30	2 p m	102	Nov. 30	2 p m	103.2	52	36
Dec. 1	2 "	101	Dec. 1	2 "	101	Dec. 1	2 "	103	53	30
Dec. 2	2 "	102.4	Dec. 2	2 "	102	Dec. 2	2 "	103	59	30
Dec. 3	2 "	103	Dec. 3	2 "	102	Dec. 3	2 "	103	54	26
Dec. 4	2 "	102.4	Dec. 4	2 "	102	Dec. 4	2 "	102.4	45	18
Dec. 5	2 "	102.4	Dec. 5	2 "	103.4	Dec. 5	2 "	102.4	56	23
Dec. 6	2 "	102	Dec. 6	2 "	103	Dec. 6	2 "	101.4	56	29
Dec. 7	2 "	102	Dec. 7	2 "	102.4	Bec. 7	2 "	102	42	19
Dec. 8	2 "	101	Dec. 8	2 "	102	Dec. 8	2 "	102	37	21
Dec. 9	2 "	102	Dec. 9	2 "	102	Dec. 9	2 "	102.4	24	12
Dec. 10	2 "	10	Dec. 10	2 "	102	Dec. 10	2 "	102.4	35	8

ACTION OF THE OIL ON THE TICK.—The first dips used to free cattle from ticks were of the same general character as are in use as sheep dips, but when they were of sufficient strength to kill the tick they were too poisonous and irritating to be used on cattle. After this such dips began to receive attention as would form a covering or coating over the tick and kill by excluding the air, since the tick breathes by means of pores over the body.

The mineral oils used at present in dipping have a chemical action in addition to the mechanical one of forming a coat over the body of the tick. In laboratory tests ticks dipped in the oil for a few seconds soon turn black and in two or three days are dry and hard. In laboratory tests it was noticed that some of the mature ticks would deposit a few eggs on the first or second day after being dipped in oil, but in no instance could the eggs be hatched. Where the tick is simply dipped in the oil, then placed on filter paper which absorbs the surplus oil, the conditions are quite different from the conditions when the animal is dipped in oil. The hair is filled with oil and the tick is practically bathed in oil for several hours, and under these conditions it is not probable that any eggs are deposited after the tick drops to the ground.

The first cattle dipped were badly infested with the cattle tick. On the second day after the dipping all of the large ticks had dropped off and those that were still attached to the

animal were dry and hard, looking like thin black scales. A close examination did not show any live ticks on the cattle.

A number of samples of oil were tried in the laboratory with the following results: The ticks were dipped in oil for varying lengths of time, then placed on filter paper for a few minutes, and afterwards placed in glass dishes.

Refined cotton seed is not effective. Many of the adult ticks deposited eggs and some of these were hatched.

Crude cotton seed oil is more effective and is about equal in value to Creolin or Chloro-Naptholeum. The Dynamo Oil and samples from the National Refining Company are of equal value. Some few ticks dipped in the oil deposited eggs but none of them were hatched.

CARE AFTER DIPPING.—From observation of cattle dipped by the Station and those dipped in the vat located at Wewoka, it is necessary to exercise care in handling or moving cattle immediately after dipping. If possible they should not be driven for a few days after being dipped. The oil irritates the skin to a certain extent, and when the animal becomes heated by driving the irritation is increased and the cattle are frequently hard to control.

Slight irritation of the eyes is noticable soon after dipping but this disappears within one to three days unless the cattle are driven or otherwise exposed to the dust, as the oil causes the dirt to adhere wherever it strikes, and in some cases where the dust was bad the inflammation was quite severe This severe inflammation was not seen except in cases where cattle were driven over dusty roads immediately after dipping.

The Dynamo oil which was used quite extensively in Arkansas, Texas and Oklahoma is too severe to be adopted as a perfect dip and brought into general use, although under favorable conditions it can be used with little or no danger. Any oil however non-irritating would cause dirt to collect around and in the eyes when cattle are driven on dusty roads.

INOCULATION EXPERIMENTS.

The object of this work was to give animals from the north a mild form of disease during the winter season that would protect them from acclimation fever when turned on infested pastures during the summer season. The need of some method by which Northern cattle can easily be made immune is evident Large numbers of breeding stock are purchased every

year in the north and shipped south to improve the Southern herds. This is at an expense disproportionate to the gains, when it is known that a large per cent. of the cattle brought south die from acclimation or Texas fever. This disease which is communicated to susceptible animals by the cattle tick is the great hindrance to improving southern stock. Probably from 50 to 75 per cent. of the cattle shipped south and placed on infected pastures die during the first two years from Texas fever. This makes the improving of herds so expensive that few undertake it as compared with the number who would if the disease could be controlled.

There are two ways by which this protection might be secured; either by giving the animal a mild attack of the disease, or by such treatment as would render the animal immune to the disease. Any means employed that will keep stock free from ticks will prevent the fever, but most stockmen will not take the care necessary to insure success by this method.

It is now conceded that Texas fever is communicated in only one way in nature and that is by the agency of the cattle tick. The tick introduces into the system a protozoa, or one celled animal, aud it is the action of this parasite or protozoa in the blood that produces all the symptoms noticeable in Texas fever. This protozoa exists at all times in the blood of Southern cattle, and is capable of producing the fever in susceptible cattle when introduced into their circulation either by means of the tick or artificial means.

Since the protozoa will not increase in sufficient numbers in the blood of Southern cattle to cause disease, it has been argued that the blood serum of Southern cattle, when inoculated into the susceptible animals, renders them immune to the disease or at least that it would afford some protection from the disease.

The Missouri Experiment Station, in Bulletin No. 37, reports an experiment testing the value of the serum inocculation. A native cow was injected with seven ounces of serum from a Southern animal. The injections were made from Sept. 2, to Sept. 15, and three ounces more were injected during the succeeding three weeks. On Sept. 16, the animal was infested with young ticks. The temperature record of the animal shows a rise of temperature on the 17th and 18th days after being injected. In this case it seems to have protected against infection with ticks.

This experiment encouraged the Louisiana Station to take up the work. This work was quite extensive both as to the life

history of the tick and its agency in communicating Texas fever, as well as, in attempting to render Northern animals immune by using blood serum from the native Louisiana cattle. The conclusions arrived at from using blood serum are given in Bulletin No. 51 second series, as follows:—

"The injection of two c. c. for each hundred pounds weight of the animal, given daily for ten days before the ticks are allowed to get on the animal, will not prevent the animal from taking Texas fever.

"The injection of a moderate amount of serum, beginning the treatment about the time the animal becomes infested with ticks does not prevent the development of Texas fever.

"The injection of a large quantity of the serum after the fever has developed does not influence the temperature of the animal."

It appeared in the work just referred to that there was little to encourage any further attempt along the same line, and it was decided to try and give the animals a mild form of the disease during the winter by inoculating them with defibrinated blood from a Southern animal. Observation has taught that the disease exists in a milder form during the fall and winter than during the summer, and this fact might be taken advantage of to confer immunity, or at least partial immunity during the summer season. Whenever ticks are placed on cattle or blood from a Southern animal injected, a certain number of the micro-parasites are injected into the system and may multiply to such an extent that the animal will show every symptom of Texas fever.

In this experiment the cattle were purchased by Dr. Peters of the Nebraska Experiment Station. They were to be inoculated with defibrinated blood sent from this station. The cattle were mostly two years old. Six were to be inoculated with one and one half drachms of defibrinated blood. The remaining three were kept for comparison. The temperature records began on March 8th but the cattle were not inoculated until March 15th. The cattle inoculated were numbered 124, 125, 126,127,129 and 131. The numbers of those not inoculated were 128, 130 and 132. These numbers also appear with the temperature records of the cattle. The temperature records up to April 7th were furnished by Dr. Peters. The record from April 7th to April 15th is wanting on account of shipping.

The blood for all inouculations in the experiment was from the same animal. which was selected from a number of cattle purchased in Northern Texas.

On the second inoculation 2.5 cubic centimeters of blood was used for each 100 lbs. weight of the animal. Animal number 129 received 13 cubic centimeters of the defibrinated blood which was the largest amount received by any of the cattle. Animal number 126 received 5 cubic centimeters. This was the smallest amount injected.

The blood used in the first inoculation was drawn on the evening of March 11th and was used on March 15th. That used for the second inoculation was secured on April 18th and used in four hours after being drawn. This gave an interval of 34 days between the dates of the first and second inoculation which was thought to be sufficient time for any effect of the first inoculation to take place. There was, after the second inoculation. a marked rise of temperature in from one to three days, but in the inoculations made afterwards on animals numbers 118 and 130 the rise of temperature did not appear until the 13th day after inoculation, in the first, and the 14th day in the second.

The length of time an animal has been free from infection will influence to some degree the time necessary for the fever to establish itself in cattle inoculated with the blood from such an animal. In the Special Report on Texas Fever made by the Bureau of Animal Industry, page 109, records are given of inoculations made by using the blood of Southern cattle. In each of the three cases 28 cubic centimeters of blood were used and the high temperature of Texas fever set in on the seventh day in two cases and on the eighth day in the third case.

The Southern steer from which the blood was taken in these experiments was free from ticks 170 days when the last blood was drawn and the blood then contained a sufficient number of the micro-parasites (protozoa) to cause disease in a susceptible animal.

The Report referred to above states that the Texas fever parasite was carried in the blood of a North Carolina animal three years after leaving the permanently infected territory.

It is now believed that Southern cattle will carry the micro-organism of Texas fever in their blood for an indefinite number of years, very likely their entire life.

Record of Animal No. 124.

DATE 1898	Time A. M.	Temp	Time P. M.	Temp.	DATE 1898	Time A. M.	Temp.	Time P. M.	Temp
March 8	9.30	101.6	6.00	102.4	April 1	8.00	102	5.30	100.6
March 9	8.00	102			Apr 1 2	8.30	102.2	5.00	102.4
March 10	10 00	100.8			April 3	9.00	101.4	5 30	101.6
March 15	11.00	103.8	5.30	106	April 4	8.30	101	5.30	101.4
March 16	10.00	107.4	6.00	107.4	April 5	8.30	101	5.30	101
March 17	8.30	105.2	5.30	105.8	April 6	8.30	100.8	5.30	101.4
March 18	8.30	103.2	5.30	102.2	April 7	8.30	101.2		
March 19	8.30	102	5.30	103.2	April 14	8.30	101.6	6.30	104
March 20	8.39	102	5.30	102.4	April 15	9.00	101 6	5.30	104.4
March 21	8.30	101.4	5.30	103.2	April 16	8.00	101	7.00	102
March 22	8 30	102.4	5.30	101.8	April 17	8.00	101.8	6 00	102.4
March 23	8.30	101.2	5.30	101.4	April 18	8.00	101.8	5.00	101.6
March 24	8.30	101.8	5.30	101 4	April 19	8.00	102.4	5.00	106.2
March 25	8.30	102.2	5.30	101.2	April 20	8.00	102	5.00	106.2
March 26	8.30	101.6	5.30	101 2	April 21	8.00	102.6	5.00	106.4
March 27	8.30	100.6	5.30	100.6	April 22	8.00	104.8	5.00	104.8
March 28	8.30	101.6	5 30	101	April 23	8.00	104.4	5.00	106.8
March 29	8.30	101.4	5.30	100.4	April 24	8.00	105.6	5.00	107.4
March 30	8.30	100.6	5.30	101.4	April 25	8.00	104.6	5.00	106.6
March 31	8.30	101.8			April 26	8.00	103.4	6.00	106.4
March 8			1.30	100.8	April 27	8.00	102.8	6.00	105 8
March 16			1.30	105.4	April 28	8.00	103.4	6.00	106.6
					April 29	8.00	101.8	5.00	105.8
					April 30	8.00	106	6.00	107
					May 1	8.00	102	DIED.	

March 15.—Received first inoculation of the defibrinated blood.

March 16.—Had just been watered.

April 7–14.—Time lost in shipping from Lincoln.

April 18.—Inoculated second time using 6.25 cc of defibrinated blood from Southern steer.

Record of Animal No. 125.

DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.	DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.
March 8	9.30	101.6	6.00	102	April 1	8.00	103	5.30	100.2
March 9	8.00	102.2	.....	.....	April 2	8.30	102.8	5.00	102.4
March 10	10.30	101	.....	.....	April 3	9.00	102	5.30	101.6
March 15	11.00	101.2	5.30	103.4	April 4	8.30	102	5.30	102.4
March 16	10.00	104.2	6.00	101.8	April 5	8.30	102.2	5.30	102.8
March 17	8.30	102.2	5.30	102.8	April 6	8.30	102.2	5.30	102.6
March 18	8.30	102.4	5.30	102.8	April 7	8.30	102.2	5.30	.....
March 19	8.30	102	5.30	102.4	April 14	8.30	102.4	6.30	103.8
March 20	8.30	102.4	5.30	102	April 15	9.00	101.2	5.30	103.4
March 21	8.30	102.2	5.30	102.8	April 16	8.00	102.2	7.00	102.4
March 22	8.30	103.4	5.30	100.6	April 17	8.00	102.6	6.00	103.6
March 23	8.30	102.2	5.30	101.8	April 18	8.00	101.2	5.00	102.2
March 24	8.30	102.2	5.30	102.4	April 19	8.00	101.6	5.00	105.8
March 25	8.30	101.4	5.30	101.2	April 20	8.00	104.2	5.00	105.2
March 26	8.30	102.2	5.30	103.8	April 21	8.00	105.2	5.00	106
March 27	8.30	101.6	5.30	101	April 22	8.00	104.6	5.00	105.2
March 28	8.30	102.6	5.30	102.6	April 23	8.00	104.6	5.00	106.4
arch 29	8.30	103.6	5.30	103.2	April 24	8.00	104.2	5.00	106
March 30	8.30	102.2	5.30	102	April 25	8.00	104.2	5.00	105.6
March 31	8.30	103	.....	.....	April 26	8.00	104.8	6.00	106
March 8	.....	.....	1.30	101.8	April 27	8.00	106.2	6.00	107.2
March 16	.....	.....	1.30	101	April 28	Died	.....	.....	.....

March 15.—Received first inoculation of defibrinated blood.

April 7-14.—Time lost in shipping from Lincoln.

April 18.—Inoculated with 10 c c defibrinated blood from Southern steer.

April 28.—Animal died.

Record of Animal No. 126.

DATE 1898	Time A. M.	Temp.	Time P. M.	Temp	DATE 1898	Time A. M.	Temp	Time P. M.	Temp
March 8	9.30	101.4	6.00	103.6	April 1	8.00	102.2	5.30	100.5
Ma8ch 9	8.00	102.2			April 2	8.30	102.2	5.00	102
March 10	10.30	100.4			April 3	9.00	101.8	5.30	101.4
March 15	11.00	102.2	5.00	103.6	April 4	8.30	100.6	5.30	100.6
March 16	10.00	103	6.00	102.8	April 5	8.30	100.2	5.30	100.4
March 17	8.30	101.8	5.30	102	April 6	8.30	100.6	5.30	100.4
March 18	8.30	101.4	5.30	102	April 7	8.30	101.2		
March 19	8.30	102	5.30	102.6	April 14	8.30	102.6	6.30	104.2
March 20	8.30	101.2	5.30	102.2	April 15	9.00	102.2	5.30	103.2
March 21	8.30	101.6	5.30	102.4	April 16	8.00	102.2	7.00	102.4
March 22	8.30	101.4	5.30	100.2	April 17	8.00	101 4	6.00	103
March 23	8.30	101.8	5.30	101.2	April 18	8.00	102.4	5.00	102 2
March 24	8.30	101.4	5.30	101.2	April 19	8.00	104	5.00	104.8
March 25	8.30	101.6	5.30	100.4	April 20	8.00	104.2	5.00	104.8
March 26	8.30	102 4	5.30	104	Apri 21	8.00	103.2	5.00	105.2
March 27	8.30	103.4	5.30	99.8	April 22	8.00	102.8	5.00	102.6
March 28	8.30	103	5.30	101.2	April 23	8.00	102.2	5.00	103.8
March 29	8.30	103.4	5.30	100.2	April 24	8.00	101.6	5.00	103.2
March 30	8.30	100.8	5.30	101.4	April 25	8.00	102	5.00	103.4
March 31	8.30	102.8			April 26	8.00	103.2	6.00	104.4
March 8			1.30	102.4	April 27	8.00	103.4	6.00	105.6
March 16			1.30	99.8	April 28	8.00	105.4	6.00	106.8
					April 29	8.00	99.2	5.00	99.2

March 15.—Inoculated with defibrinated blood.

April 7–14.—Time lost in shipping from Lincoln.

April 18.—Inoculated second time using 5 cc of defibrinated blood from Southern steer.

April 29 —Animal passed bloody urine at the time temperature was taken. Died during the night.

Record of Animal No. 127.

DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.	DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.
March 8	9.30	100.8	.00	102.2	April 1	8.00	102.2	5.30	101.4
March 9	8.00	101.4			April 2	8.30	102	5.00	100.6
March 10	10.30	102			April 3	9.0	102.4	5.30	102
March 15	11.00	104.6	5.30	106.4	April 4	8 30	100.8	5.30	102.2
Ma ch 16	10.00	102.6	6 00	102	April 5	8.30	101.2	5.30	101.2
March 17	8.30	100.8	5.30	101.8	April 6	8.30	102.4	5.30	102
March 18	8.30	100.4	5.30	101.2	April 7	8.30	101.4		
March 19	8.30	101.4	5.30	102.6	April 14	8.30	102.8	6.30	104.4
March 20	8.30	101.6	5.30	101.2	April 15	9.00	102.2	5.30	103.8
March 21	8.30	101.2	5.30	101.4	April 16	8 00	102.8	7.00	103
March 22	8.30	101	5.30	101.6	April 17	8.00	103	6.00	103.8
March 23	8.30	102	5.30	102.6	April 18	8.00	102	5.00	102.6
March 24	8.30	103	5.30	103.8	April 19	8·00	103.6	5.00	105
March 25	8.30	102.4	5.3	102 2	April 20	8.00	104.4	5.00	104.6
March 26	8.30	103	5.30	103	April 21	8.00	104.8	5.00	106.2
March 27	8.30	102.2	5.30	102	April 22	8.00	105	5.00	105.8
March 28	8.30	101.8	5 30	101	April 23	8.00	106.2	5.00	106.2
March 29	8.30	101.4	5.30	101	April 24	8.00	106.2	5.00	106.4
March 30	8.30	101.8	5.30	101.2	April 25	8.00	105.2	5.00	106.6
March 31	8.30	101.6	5.30	101 2	April 26	8.00	105.2	6.00	106.2
March 8			1.30	101 6	April 27	8.00	103.4	6.00	105.2
March 16			1.30	102 6	April 28	8.00	104	6.00	105.4
					April 29	8.00	104.2	5.00	106.2
					April 30	8.00	104.2	6.00	100

March 15.—Inoculated first time with defibrinated blood.

April 7-14.—Time lost in shipping from Lincoln.

April 18.—Inoculated with 10 cc defibrinated blood from Southern steer.

April 28.—Animal died.

Record of Animal No. 128

DATE 1898	Time A. M	Temp.	Time P. M	Temp	DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.
March 8	9.30	102.2	6.00	102.4	April 1	8.00	103	5.30	102.8
March 9	8.00	102			April 2	8.30	103.2	5.00	99.2
March 10	10.30	102.2			April 3	9.00	101.6	5.30	101.4
March 15	11.00	102.2			April 4	8.30	101.8	5.30	101.4
March 16	10.00	101.8	5.30	101.8	April 5	8.30	102	5.30	100
March 17	8.30	101.6	5.30	102	April 6	8.30	101.8	5.30	100.8
March 18	8.30	101	5.30	101.4	April 7	8.30	101.6		
March 19	8.30	102.2	5.30	102.6	April 14	8.30	102	6.30	102.8
March 20	8.30	102	5.30	100.4	April 15	9.00	101.6	5.30	102
March 21			5.30	101.8	April 16	8.00	102	7.00	102.8
March 22	8.30	102.2	5.30	102	April 17	8.00	101.6	6.00	103
March 23	8.30	101.2	5.30	101.8	April 18	8.00	101.60	5.00	102.4
March 24	8.30	102	5.30	101.6	April 19	8.00	102.6	5.00	102.8
March 25	8.30	102.2	5.30	101.4	April 20	8.00	101.6	5.00	102
March 26	8.30	102.4	5.30	103	April 21	8.00	101.6	5.00	102.8
March 27	8.3	102 2	5.30	100.4	April 22	8.00	102	5.00	102.6
March 28	8.30	101.8	5.30	102.2	April 23	8.00	101.4	5.00	102.6
March 29	8.30	103	5.30	101	April 24	8.00	101.8	5.00	102.6
arch 30	8.30	100.6	5.30	103.2	April 25	8.00	102	5.00	103
March 31	8.30	102	5.30	102	April 26	8.00	101.6	6.00	102
March 8	8.30		1.30	102.6	Abril 27	8.00	101.4	5.00	102.2
March 16			1.30	101.4	April 28	8.00	102.6	5.00	103
					April 29	8.00	102	5.00	102.4
					April 30	8.00	102.8	5.00	102.6

This animal was not inoculated during March or April but the record is given for comparison with the records of those that were inoculated. No. 128 was afterwards inocu ated on May 15th. The temperatures of the remaining two animals that were not inoculated at this time are omitted. No. 130 was not inoculated until June and No. 132 was never inoculated.

Record of Animal No 128. After Inoculation.

DATE 1898	Time A. M.	Temp.	Time P. M.	Temp	DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.
May 19	8.00		5.00	102.2	June 1	8.00	102.8	5.00	103.6
May 20	8.00	102.6	5.00	102.4	June 2	8.00	105.8	5.00	105.8
May 21	8.00	102.2	5.00	102.4	June 3	8.00	106.2	5.00	106.8
May 22	8.00	102.6	5.00	102.2	June 4	8.00	105.8	5.00	105.8
May 23	8.00	102.8			June 5	8.00	105.2	5.00	106.2
May 24	8.00	102.2	5.00	103.8	June 6	8.00	104.8	5.00	106.2
May 25	8.00	102.4	5.00	103 2	June 7	8.00	103.2	5.00	103
May 26	8.00	102.4	5.00		June 8	8.00	102	5.00	102.4
May 27	8.00	101.8	6.00	103.2	June 9	8.00		5.00	103.2
May 28	8.00	101.8	5.00	102.2	June 10	8.00	101.6	5.00	102.8
May 29	8.00		5.00	102.2	June 11	8.00	100.8	5.00	102.2
May 30	8.00	101.8	5.00	102.8	June 12	8.00	102.2	5.00	
May 31	8 00	102.6	5.00	103.8	June 13	8.00	102 2	4.00	102.4
					June 14	8.00	101.4	5.00	102.4

This animal received first inoculation of blood from Southern steer on May 19th. This animal was not turned on any pasture after arriving from Lincoln, Neb., until July 12th. Inoculated on May 19th using 0.5 cc defibrinated blood. Secured the blood May 16th, defibrinated, added .5 per cent. carbolic acid, and placed blood on ice. Blood had been drawn eighty hours. The temperature was taken continuously from March 8th, but was not inocculated until May 19th.

Temperature record continued until July 10th, but with no variation from normal after June 9th.

Counts of blood corpuscles beginning on June 11th as follows:

June 11.—Red blood corpuscles 4813000 per cu. m. m.

June 12.—Red blood corpuscles 4910000 per cu. m. m.

June 14.—Red blood corpuscles 4336000 per cu. m. m.

June 15.—Red blood corpuscles 5104000 per cu. m. m.

June 20.—Red blood corpuscles 4400000 per cu. m. m

June 24.—Red blood corpuscles 4944000 per cu. m m.

June 28.—Red blood corpuscles 6352000 per cu. m. m.

Record of Animal No. 129.

DATE 1898	Time A. M.	Temp	Time P. M.	Temp	DATE 1898	Time A M	Temp	Time P. M	Temp.
March 8	9.30	102.2	6.00	102.4	April 1	8.00	102.6	5.30	101
March 9	8.00	101.4			April 2	8.30	101.4	5.00	102.2
March 10	10.30	101.2			April 3	9.00	102.4	5.30	102
March 15	11.00	102.2			April 4	8.30	102.6	5.30	101.8
March 16	10.00	102.6	5.30	103	April 5	8.30	101.2	5.30	102.2
March 17	8.30	101.6	5.30	102.2	April 6	8.30	102.2	5.30	101.6
March 18	8.30	101.2	5.30	102	April 7	8.30	102.2		
March 19	8.30	102.2	5.30	102	April 14	8.30	101.8	6.30	103
March 20	8.30	102	5.30	102.2	April 15	9.00	102	5.30	103.6
March 21	8.30	102.2	5.30	102	April 16	8.00	101.8	7.00	103.2
March 22	8.30	102	5.30	102.2	April 17	8.00	102.6	6.00	101.4
March 23	8.30	100.8	5.30	101.2	April 18	8.00	103.6	5.00	102
March 24	8.30	102	5.30	101.4	April 19	8.00	103	5.00	103.8
March 25	8.30	102	5.30	101.4	April 20	8.00	105	5.00	105.8
March 26	8.30	102.6	5.30	102.2	April 21	8.00	104.8	5.00	105 6
March 27	8.30	101.6	5.30	100.8	April 22	8.00	104.8	5.00	105.2
March 28	8.30	102.2	5.30	101.6	April 23	8.00	105	5.00	106.2
March 29	8.30	102.8	5.30	102	April 24	8.00	104.2	5.00	105.8
March 30	8.30	101.4	5.30	102.2	April 25	8.00	104	5.00	105.4
March 31	8.30	102.4	5.30	101.6	April 26	8.00	103.6	6.00	105.4
March 8			1.30	102.4	April 27	8.00	103.4	6.00	105.4
March 16			1.30	102.2	April 28			6.00	105.6
					April 29	8.00	106	5.00	105.8
					April 30	8.00		6.00	103.8

March 15.—Inoculated the first time with defibrinated blood.

April 7-14. Time lost in shipping from Lincoln.

April 16.—Inoculated the second time with defibrinated blood from Southern steer, using 13 cc.

This animal recovered. The temperature record was continued until May 17th, but the temperature was normal after May 1st. On May the 18th the animal was placed in an infected pasture and remained there until Oct. 12, when it was removed for other work.

Record of Animal No. 130.

DATE 1898	Time A. M.	Temp	Time P. M.	Temp.	DATE 1398	Time A. M.	Temp	Time P. M.	Temp
June 21	10.00	103			July 1	8.00	101.6		
June 22	8.00	102.4			July 2	8.00	101.8		
June 23	8.00	102.4	5.00	103	July 3	8.00	102.2		
June 24	8.00	102.2	5.00	103	July 4	8.00	101.8		
June 25	8.00	101.8			July 5	8.00	101.4	4.00	102.4
June 26	8.00	101.8			July 6	8.00	101.8	4.00	103.6
June 27	8.00	101.6			July 7	8.00	102.2	4.00	103.2
June 28	8.00	102			July 8	8.00	103	4.00	103.8
June 29	8.00	162			July 9	8.00	102	4.00	102.6
June 30	8.00	102			July 10	8.00	101.8	4.00	102

After keeping the temperature of this animal until May 17th she was turned on pasture until June 21st. At this time the animal was brought from the pasture and carefully examined for ticks, but found none. Placed animal in stall and inoculated with four cubic centimeters of defibrinated blood. The blood was from a Southern steer, the same animal from which all the blood used in this experiment was taken. The blood used to inoculate No. 130 had been drawn 88 hours when used. After drawing from animal the blood was defibrinated, had 0.5 per cent. of carbolic acid added and was placed on ice until used.

Temperature record was continued until July 20th, but the only rise noticeable was on July 6, 7, 8.

Several counts of red corpuscles were made as follows:

June 22.—6788000 per cu. m. m.

June 24.—6891000 per cu. m. m.

June 29.—6900000 per cu. m. m.

July 2.—5904000 per cu. m. m.

July 6.—5140000 per cu. m. m.

July 10.—6125000 per cu. m. m.

Temperature Record of Animal No. 130. after being Infested with ticks.

DATE 1898	Time A. M.	Temp.	Time P. M.	Temp.	DATE 1898	Time A. M.	Temp	Time P. M.	Temp.
October 14			2.00	101	November 6			2.00	102
October 15			2.00	103	November 7			2.00	101
October 16			2.00	102	November 8			2.00	102
October 17			2.00	102	November 9			2.00	100
October 18			2.00	101	November 10			2 00	106
October 19			2.00	102	November 11	8.00	104.2	3.00	105
October 20			2.00	102	November 12	8.00	101.8	3.00	104
October 21			2.00	101	November 13	8.00	103	3.00	103
October 22			2.00	102.2	November 14	8.00	103	3.00	102.4
October 23			2.00	102	November 15	8.00	100	3.00	103
October 24			2.00	102	November 16	8.00	100	3.00	103
October 25			2.00	101	November 17	8.00	102	3.00	104
October 26			2.00	102	November 18	8.00	101.4	3.00	101.4
October 27			2.00	102	November 19	8.00	101.4	3.00	102
October 28			2.00	103	November 20	8.00	100	3.00	104
October 29			2.00	101.5	November 21	8.00	101	3.00	103
October 30			2.00	101	November 22	8.00	102	3.00	103
October 31			2.00	103	November 23	8.00	100	3.00	102.4
November 1			2.00	102.4	November 24	8.00	100	3.00	102
November 2			2.00	102.6	November 25	8.00	102	3.00	100.4
November 3			2.00	100.4	November 26	8.00	101	3.00	102.4
November 4			2.00	101.4	November 27	8.00	100	3.00	102.4
November 5			2 00	102.4	November 28	8.00	102		

The ticks were secured from native Oklahoma cattle in the neighborhood of the College and the eggs hatched in the laboratory. By referring to the temperature record of the animal when inoculated with blood there was a very slight rise of temperature on July 6–8. This rise in temperature was, it was thought, due to the inoculation with blood as it occurred in about the same length of time after inoculation as in the case of animal No. 128, where the temperature record and counting of red blood corpuscles indicated an attack of fever. In the case of animal No. 130, the rise of temperature was so slight and brief that it might have been from some other cause. At least the inoculation afforded no protection against infection with ticks.