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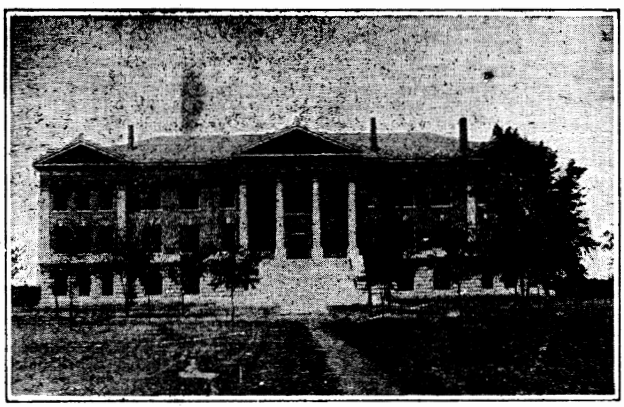
TEXAS FEVER

By
L. L. LEWIS



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Oklahoma Agricultural Experiment Station

BULLETIN NO. 81. JUNE, 1908

TEXAS FEVER

Commonly Known as the Tick Fever or Southern Cattle Fever

There is no live stock disease of any kind in Oklahoma that is costing the farmers and stockmen generally as much as is the cattle disease known as Texas fever. This disease is due to the presence of a certain tick, commonly known as the fever tick. Since the disease is of such importance in the state it is thought advisable at this time to present in bulletin form some of the essential facts relating to Texas fever that have been proven by experiments to be true. The more general the information concerning this disease, its cause, means by which it is spread, and manner of prevention, the more readily it can be controlled and finally eliminated.

It is no easy matter to convince the southern cattleman who has seen the fever tick on his cattle all of his life, and who may have actually lost but few if any cattle with this disease, that the tick is the cause of any trouble whatever. That the tick may be injurious to cattle in other ways than by actually killing them has not suggested itself to many southern cattlemen. While it is true that southern cattle infested with the cattle tick are immune to acute attacks of Texas fever, it is also true that this immunity has been obtained at a great cost in growth and development. In ridding the state of the fever tick it is necessary to have the co-operation of every farmer and stockman in the infested area, and this will be much easier obtained and more willingly given if the true situation is thoroughly understood.

Agricultural progress is dependent upon the development and maintenance of a healthy live stock industry. The maintenance of soil fertility, and the best development of any community or state in an agricultural way, is dependent upon the profitable production of live stock. The agricultural rating of any community or

state depends very largely on its live stock interests, and without live stock on the farm it is impossible in any practical way to increase the fertility of the soil or even to maintain it for any considerable length of time. Eliminate stock farming, and by this is meant profitable stock farming, and the most important factor in agriculture has been neglected.

In different sections of the United States there are prevalent certain stock diseases. In some cases these are entirely preventable, while in others the means of control or prevention is not so evident. In certain sections the farmer has found it necessary to vaccinate to prevent blackleg in his young cattle, while in other localities the disease is practically unknown. Over a large area of the south the fever tick is the greatest enemy the live stock farmer has to contend with. In fact stockmen have become so accustomed to the presence of the ticks that many regard them as a necessary evil and for this reason they have never, until quite recently, put forth any organized effort to get rid of them.

HISTORY OF THE DISEASE.

The earliest authentic account of Texas fever in the United States was in 1814 when Dr. Pease brought to the attention of an agricultural society in Philadelphia the fact that cattle from portions of South Carolina would give disease to cattle in certain sections of Pennsylvania, although the cattle from the south appeared to be without disease themselves. From this time on, reports were common that southern cattle would give a fatal form of fever to northern cattle. Finally these reports became connected with the northern movement of the large herds of cattle from Texas. As these herds moved north during the summer it was found that northern cattle in crossing the trail of the southern herds would in some way become infected and die of fever. It was in this manner that the name of Texas fever came to be attached to the disease, although the infested area included the entire southern portion of the United States from California to Virginia.

Texas fever is a widely distributed disease. Its place of origin is not definitely known but is probably in some of the European countries. The disease is found in southern France, Italy, and in

portions of Turkey. It is very prevalent in Central and South American countries, Africa, Philippine Islands, Mexico, and other tropical countries. The spread of the disease into northern countries is limited by cold weather. Wherever the winters are severe enough to kill the infection it is not difficult to eliminate the disease or to prevent by quarantine the introduction of infested cattle.

When attention was first directed to the danger arising from southern cattle being driven into the north there were many theories advanced as to how the disease was transmitted to northern cattle. Many believed that the southern cattle infected the pastures and trails with their saliva; others thought that driving the cattle long distances would make the feet sore and feverish and that infection of pastures and trails was by means of the feet; while others were just as positive that either the droppings or urine caused the disease in susceptible cattle. Very little was accomplished in determining the cause of the disease or the manner of its transmission until the Bureau of Animal Industry took up the work in 1889. At this time the government undertook its first systematic experiment to discover the cause and means of transmission of Texas fever. In these first experiments the small protozoan, or one-celled animal that lives in and destroys the blood corpuscles was discovered. It was also learned that the tick was in some way necessary for the transmission of the disease. These results were confirmed in more elaborate experiments in 1891 and 1892. Since that time practically every experiment station in the south, and a few of those in the north, have conducted experiments along similar lines until now it may be said that there is no fact more fully demonstrated than that the southern cattle tick or fever tick is the means of disseminating Texas fever. Other important points that have been fully demonstrated by experiments are that southern cattle free from ticks are not capable of transmitting the fever; that the cause of the disease operating in the body of the animal is a small one-celled animal parasite which lives in and destroys the red blood cells; that this blood parasite is in the blood of all infected cattle and probably remains there during the life of the individual even if they are kept free from ticks after the age of three or four years; and finally, that so far as is

known there is no other means of transmitting the fever under natural conditions except by means of the cattle tick.

LIFE HISTORY OF THE TICK.

The life history or development of the fever tick is not different in any essential point from that of other ticks. All of the ticks found on cattle are sexual forms, either male or female. The female is the large tick that when fully developed falls to the ground, deposits eggs, and then dies. The male tick is very small and can be found attached to the animal near where the female is found. The eggs hatch in varying lengths of time depending on such conditions as temperature and moisture. The young tick is known as the larvae or seed tick. After a few days the young tick moults or sheds its skin when it is in what is known as the nymph stage from which it soon develops into an adult.

In following the history of the development of the fever tick it will be necessary to go more into details, as advantage may be taken

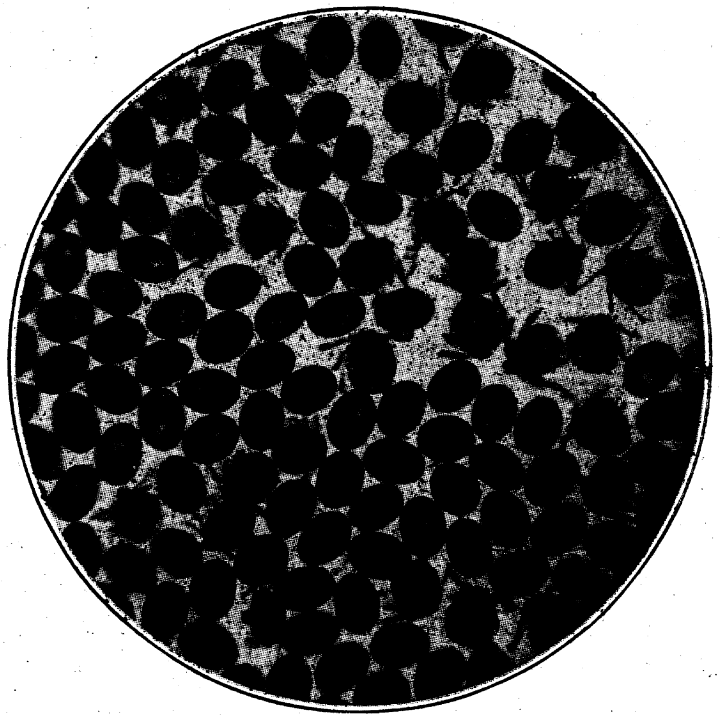

Fig. 1.—Photograph showing tick eggs and young ticks hatching out. (Larval stage.)

of certain stages of its development in eradicating it from pastures and ranges. In order to follow in a systematic manner the development of the tick we will begin with the egg. The eggs are oval in shape, of a light brownish color and are generally very regular in size, averaging about 1-32 of an inch in length. The time required to hatch varies from twenty days under moist and warm conditions, to several months under adverse conditions. In laboratory experiments we have hatched the eggs in eighteen days in the incubator, while at room temperature the time will vary from twenty-five days in summer to months during the winter season. Tick eggs have been kept in the laboratory from November until April and then hatched out by placing them in the incubator. Eggs exposed to a temperature of sixteen degrees below zero were afterwards hatched out by placing them in the incubator.

Figure one shows young ticks just hatched out. In this stage they have three pairs of legs and are commonly called seed ticks, a name that is applied in a general way to the young of all of the ticks. In the ordinary course of development the larval stage lasts about a week when the skin is cast and the fourth pair of legs is added. This is the stage (nymphal) in which the sexual organs are developed. This second or nymphal stage lasts about one week when the skin is cast a second time. Soon after the second molt the female becomes fertilized. After the second molt the female gradually increases in size for ten to fifteen days after which time she drops to the ground. The female enlarges very rapidly during the last two or three days she is attached to the animal. This sudden filling or growth is often confusing to the stockman. He looks his cattle over hurriedly and sees no ticks. After two or three days he examines them again and finds a number of fully developed ticks. Under such conditions he concludes that it requires only two or three days for a tick to develop, when in fact it requires from twenty to thirty days in summer and may require several weeks or even months during the fall and winter.

After the female is fully developed she falls to the ground and soon begins to deposit eggs. The tick does not crawl any great distance but stops under any bunch of rubbish or grass and remains there and deposits her eggs. The time elapsing after the tick is re-

moved from the animal before eggs are deposited, time occupied in depositing eggs, and time required for the female to die all depend largely on the stage of development of the tick and the temperature at the time the observations were made.

The following is taken from laboratory notes covering these points. Fever ticks were collected on August 24, 1905, and kept at room temperature.

Date collected	First eggs deposited	Tick dead
August 24 1905	August 26	September 9
" " "	" 27	" 4
" " "	" 27	" 9
" " "	" 27	" 11
" " "	" 28	" 20
" " "	" 26	" 18
" " "	" 27	" 9
" " "	" 27	" 12
" 29 "	September 2	" 12

A second lot of ticks obtained on December 15, 1905 were kept under observation, one portion of the lot being placed in the incubator at a temperature of 35 degrees C. and the remainder being kept at room temperature. Those placed in incubator were depositing eggs on Dec. 21; ticks dead on Dec. 26; eggs hatching on Jan. 10. A second lot placed in incubator Dec. 15, were depositing eggs on Dec. 18; ticks dead Dec. 26; eggs hatching Jan. 7. Ticks collected on Dec. 15 and kept at room temperature were depositing eggs on Jan. 2; ticks dead Feb. 2.

Some of the ticks collected on Dec. 15 were kept under water for 48 hours. They were then dried and placed in the incubator where they began to lay eggs on Jan. 2; ticks dead Jan. 8. Tick eggs may be kept wet for several days and afterwards hatched out, showing that they were not injured by the treatment. Eggs were submerged on Sep. 6, 1907, removed from the water on October 2 and placed in the incubator where about 40 per cent. of them hatched. Adult ticks were kept submerged for 22 hours, after which they deposited eggs that were hatched out.

Hunter reports experiments along these lines where eggs, seed ticks and adult ticks were used. His results indicated that when eggs were submerged for 25 days 33 per cent. of them hatched; that seed ticks would live after being submerged from ten to forty-seven days; and, that 50 per cent. of adult ticks would regain their full activity after being submerged from 50 to 90 hours. The practical use of such data is to show the possibility of ticks and eggs being washed from infested pastures into other pastures where the cattle may be susceptible to the fever. An adjoining pasture that is infested may in this way be a source of danger and annoyance to stockmen who are attempting to eradicate the tick from their pastures and farms.

IDENTIFICATION OF THE FEVER TICK.

There are not very many stockmen who have observed with sufficient care the slight differences between the fever ticks and other kinds that may be found on cattle to enable them to identify the fever tick when they see it. It is not as difficult to identify the

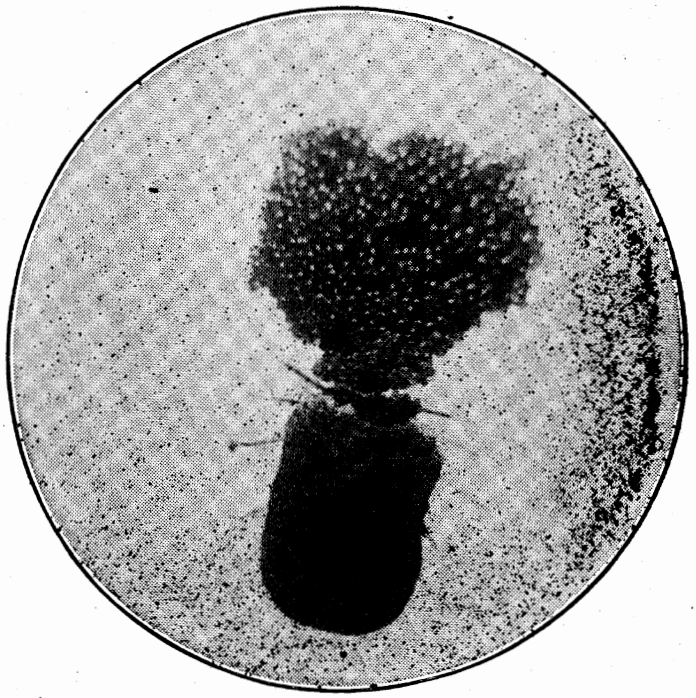

Fig. 2.—Enlarged photograph of adult female fever tick depositing eggs.

fever tick from other kinds found on cattle as it is to tell the difference between some of the harmless kinds, for example to tell the net tick and the dog tick apart. In order to aid the stock owner in determining whether a given tick is a fever tick or not the following figures are given showing dorsal and ventral views of different kinds also enlarged views of heads of some of the cattle ticks. By examining a mature female it is comparatively easy to determine whether the specimen is a fever tick or not.

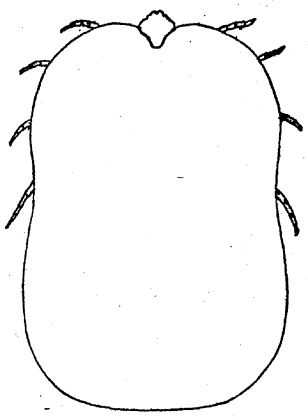

Fig. 3.—Dorsal view of fever tick.

Much confusion has existed in the mind of many stockmen as to the relation of the fever tick to Texas fever on account of their inability to recognize the difference between the fever ticks and other species that are found on cattle.

There is one characteristic of the fever tick that will enable any one to recognize it and especially if they have at hand any of the other kinds for comparison until the difference is fixed in mind. By referring to Figures three to eight it will be seen that they show the dorsal and ventral views of ticks most likely to be found on cattle in Oklahoma. Notice the position of the first pair of legs with reference to the head in all of the figures. In the fever tick the first pair of legs come out on the body well back from the head, while in all of the others the first pair of legs come out very close to the head. By noting this difference with reference to the relative position of the first pair of legs to the head one can soon become reasonably sure whether a given specimen is a fever tick or not.

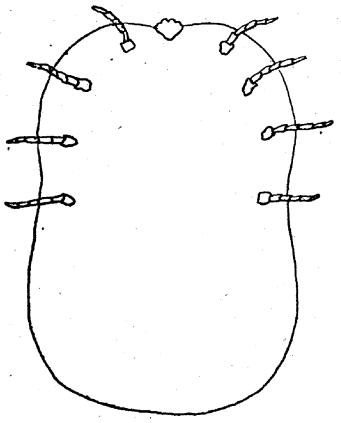

Fig. 4.—Ventral view of fever tick.

Another difference may be noted by examining the shield, which is the brown or mottled portion just back of the head. All of the ticks likely to be found on cattle with but two exceptions will show silver or white markings in the shield. The two exceptions noted

are the fever tick and the castor bean tick. In the castor bean tick the long mouth parts, shape of body and position of the first pair of legs will distinguish it, while the fever tick will be known by the absence of the white or silver markings and the position of the first pair of legs.

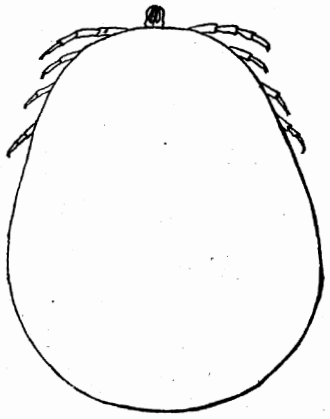

Fig. 5.—Dorsal view of castor bean tick.

Figures nine to thirteen shows the appearance of the mouth parts and shield as they appear under a low power microscope. A good hand magnifying glass will show these parts sufficiently clear to enable one to distinguish them with a considerable degree of certainty.

There are but few kinds of ticks commonly found on cattle in Oklahoma and of these the fever tick is by far the most common. This tick is found on horses, cattle and mules and is not, as many suppose, commonly found on dogs, rabbits and other small animals.

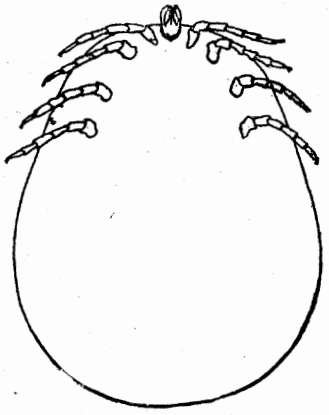

Fig. 6.—Ventral view of castor bean tick.

Following is a brief description of the common ticks found on cattle in Oklahoma.

FEVER TICK OR CATTLE TICK. (Margaropus annulatus) This tick maybe distinguished by the small size of the head, brown colored shield and the oblong oval shaped body which may be one-half inch in length in the adult female. The body has irregular mottling of yellow and brown and has two grooves running from front to back that become very noticeable when removed from their host for two or three days. This tick is commonly found on cattle, less frequently on horses and mules.

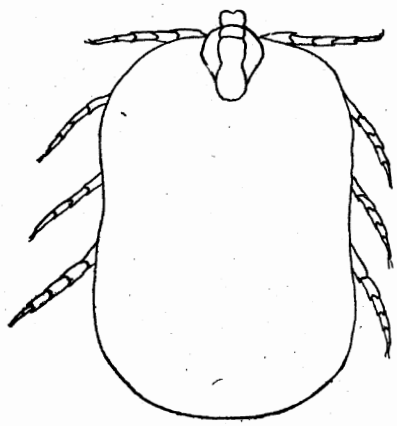

Fig. 7.—Dorsal view of net tick.

CASTOR BEAN TICK. (Ixodes ricinus) The shape of the body of this tick is something like the castor bean. The body is lead colored with mottlings of yellow. The head is a dark brown color and shows two well developed feelers that are easily seen (Figure 9). The castor bean tick may be found on any of the domestic animals and is widely distributed.

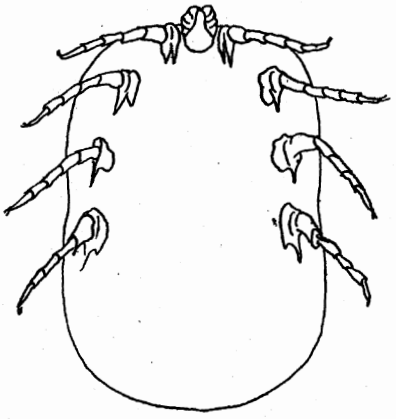

Fig. 8.—Ventral view of net tick.

NET TICK. (Dermacenter reticulatus). The body is oblong oval in shape and generally a slate color. The posterior margin of the body shows small indentations or festoons that are easily seen in the young female but almost entirely disappear in the fully developed female. The head or shield shows the silver or white markings. This tick is very common in the central and eastern portions of the United States and is common on horses, cattle and sheep.

DOG OR WOOD TICK. (Dermacenter electus). The dog tick and the net tick are not very easily distinguished apart but either may be easily distinguished from the fever tick by the presence of the silver or white markings in the shield, the shield of the fever tick not showing any white. The fully matured female may measure as much as half an inch in length, being the largest of our ticks. The posterior portion of the body shows the grooves as noted in the net tick. This tick may be found on cattle, horses and dogs.

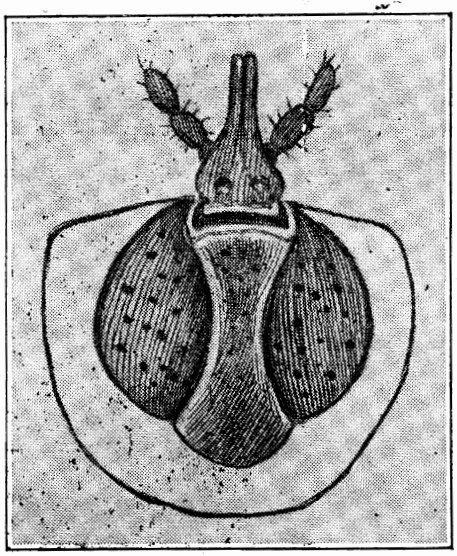

Fig. 9.—Head and shield of castor bean tick.

LONE STAR TICK. (Amblyomma americanum). This tick may be readily distinguished from any of the other kinds found on cattle by the presence of a distinct

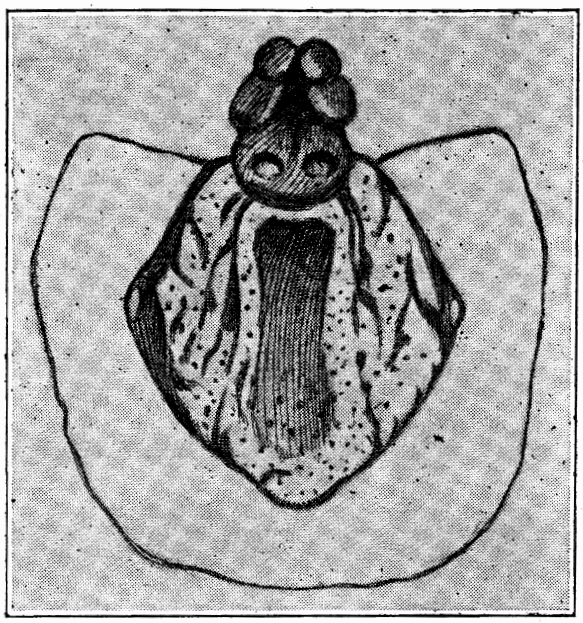

Fig. 11.—Head and shield of dog tick.

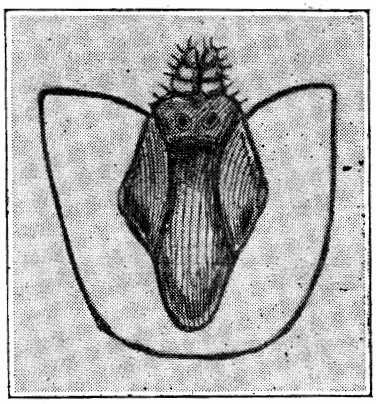

Fig. 10.—Head and shield of fever tick.

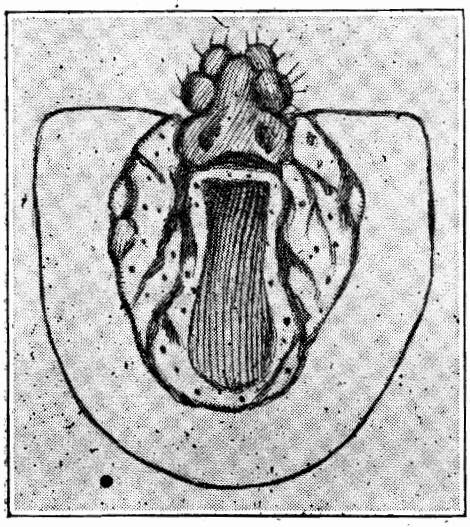

Fig. 12.—Head and shield of net tick.

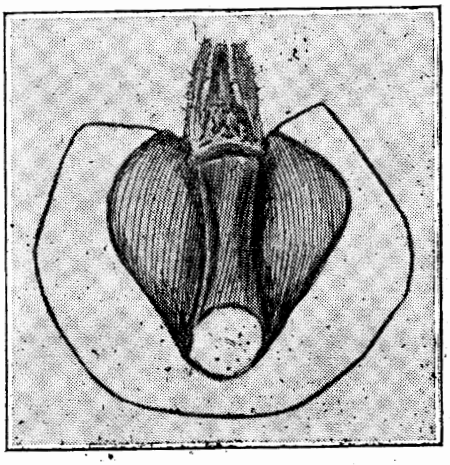

Fig. 13. Head and shield of lone star tick.

(Drawings for figures 9, 10, 11, 12, and 13 are taken from Bulletin 78 of the Bureau of Anima Industry.)

white spot in the back. In young specimens this spot is in the center of the back but as the body grows larger the spot appears to be nearer the head and is seen just back of the shield in the matured female. This tick has been found on practically all of the domestic animals and is widely distributed in the southern states.

EAR TICK. (Ornithodorus megnini). This tick is shown in Figure 15. It is easily distinguished from the other ticks on account of its peculiar shape, also by the relatively long legs and smaller size. It is commonly found in the ears of horses and cattle. Specimens have frequently been sent to the laboratory from western Oklahoma where they seem to cause considerable annoyance to the stock.

The descriptions given all apply to the fully developed female tick. The immature female and the males are not so readily recognized. One can generally obtain mature specimens for identification and this is all that is necessary so far as practical work is concerned.

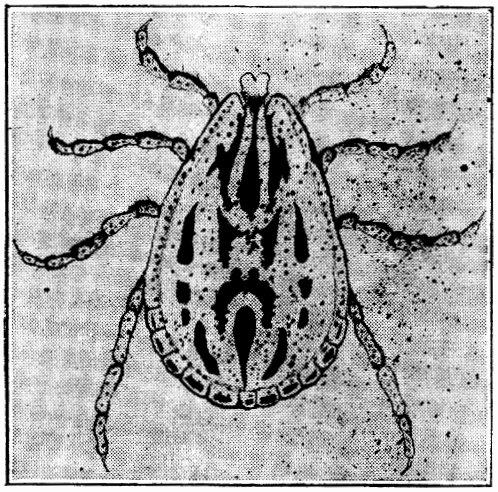

Fig. 14—Male net tick.

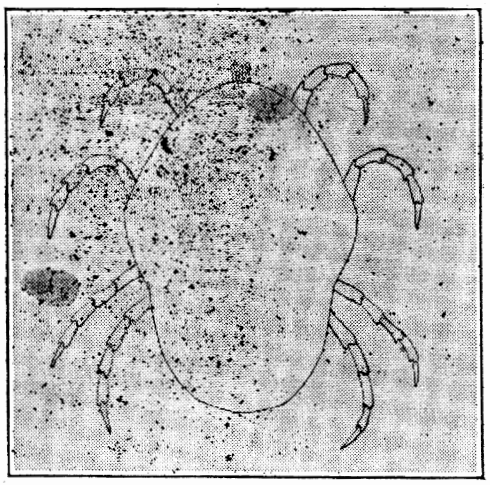

Fig. 15—Ear tick.

GENERAL CONSIDERATION OF TEXAS FEVER.

Cattle that are susceptible to Texas fever are those that have been raised in pastures or on ranges that are not infested with the fever tick. Such cattle may be from the north or they may be raised on farms in the midst of the infested area. Usually the term suscep-

tible or non-immune cattle is applied to cattle originating north of the quarantine line and immune cattle are referred to as those originating south of the quarantine line. However, there are great areas of territory south of the quarantine line that are not infested and cattle raised on these tick-free pastures, whether large or small, are susceptible to Texas fever and will contract the disease whenever they become infested with the fever tick.

So far as has been proven by experiments the tick is the only means by which, under natural conditions, the fever is transmitted from the immune or infested cattle to susceptible cattle. We have often noticed that certain fever ticks did not convey the Texas fever. Such ticks are known as non-infected ticks. These non-infected ticks are the progeny of ticks that have developed on horses, mules, etc., and consequently do not contain the Texas fever protozoan in their bodies. Cattle infested with such ticks do not contract the fever, but when put into pastures with cattle from a neighboring farm, they soon take the fever and die because the cattle from a different locality or farm may be carrying infected ticks. The non-infected tick becomes infected when developed on cattle containing the Texas fever protozoan in their blood. There is no difference whatever in the appearance of the infected and non-infected ticks.

The length of time elapsing from the time the animal is infested with ticks until the time the disease appears is known as the period of incubation. This period will vary from a few days to a few weeks depending on the season of the year, the period being short during the summer and growing longer as cool weather approaches. When susceptible cattle are placed in pastures immediately after the premises have become infested with the fever tick, the fever may appear in from thirty to ninety days. It will take the eggs at least twenty days to hatch in summer, and much longer as the weather grows cooler. After the young ticks are attached to the cattle it will take from eight to fifteen days for the fever to appear in summer, and much longer as cool weather approaches. If susceptible cattle should be placed on infested pastures after the eggs had hatched, then cattle might be lost from fever in ten days or even less time. In making the above estimate of time required for the disease to

appear, it is necessary to consider the time occupied by the tick in certain stages of its development.

According to the season of the year and the virulence of the infection, Texas fever may assume two forms, the acute and the chronic. The acute type is usually seen during the summer months and the chronic type becomes more common during the late fall and early winter months.

ACUTE FORM.

In this type of the disease the temperature will often register 106-108 degrees F. within forty-eight hours after the first symptoms are noticed. The sick animal will leave the herd, stand with back arched and ears drooping, the muzzle will be dry, appetite lost and rumination stopped, and all other symptoms and general appearance indicating a very sick animal. Constipation is present during the first stages of the disease, but may give way in the later stages to a diarrhea. In such cases the manure is frequently stained with bile and may be tinged with bloody mucus. There are certain very rapid changes going on in the blood of the sick animal caused by the small one-celled parasite that is introduced into the system by the tick. This small parasite lives in the red blood corpuscles and soon destroys a very large proportion of them. These changes in the blood are the most important in the system in Texas fever. Within forty-eight hours after the first symptoms are noticed these small blood parasites may destroy from one-third to one-half of the blood corpuscles. It is this rapid destruction of the blood cells that makes the animal so extremely weak after two or three days of fever. The blood soon becomes thin and watery, and this condition can be made use of in determining whether the disease is Texas fever or not. By making an incision into the skin or tip of the ear and allowing the blood to flow over the hand it will be noticed to be very thin and watery and does not stick to the hand as will blood from a healthy animal. The urine is often stained a very dark red or coffee color. This condition of the urine has given rise to the common use of the term red water in connection with Texas fever. The rapid destruction of so many red blood corpuscles liberates a large amount of coloring matter which is partially eliminated by the kidneys, giving the red color to the urine.

CHRONIC FORM.

This type of the disease is seen late in the season, as cool weather approaches, or may be seen during the summer in southern cattle that are only partially immune. The symptoms are not so severe as in the acute type, the fever rarely being higher than 105 degrees F. Rumination is stopped and a generally weakened condition of the animal follows. This is the type of fever usually seen among southern cattle. Death does not occur as a rule, but the loss in growth and general condition is such as to make this type of disease very important. It is this loss in growth and condition rather than an actual numerical loss by death that constitutes the great damage suffered by the stock industry of the south.

POSTMORTEM EXAMINATION.

The condition of the different organs as seen on postmortem examination is a very great help in determining whether the disease is Texas fever or not. Some of these conditions are just as readily recognized by the stockman as by the veterinarian and will be a valuable aid to the owner in determining just what the trouble may be. Animals contracting the acute form of the disease will die in from two to eight days as a rule. The organs showing the most marked changes are the liver, spleen or melt, the bladder and the heart.

The above organs will show certain changes that are practically characteristic of the disease. The liver is generally much larger than normal and if the animal has been sick for several days it will be tinged yellow on account of the bile collecting in the liver. The gall bladder is generally very large and filled with a thick granular bile. In the healthy animal the bile is thin and watery. The spleen is much enlarged, dark or almost black in color and very soft. The bladder may or may not be filled with red urine. In the acute cases the heart will show a number of red spots on both the inside and outside of the wall.

The condition of the liver, spleen and urinary organs is the result of these organs trying to carry off from the body the large amount of waste material caused by the rapid destruction of the tissues of the body and especially the rapid destruction of the red blood corpuscles. There are about six million of red blood cells in a cubic millimeter of blood in the healthy animal and this number may be

reduced after three or four days of cover to one-half of that number. This large amount of waste material in partially eliminated by the excretory organs and a part of it is carried to the spleen and liver hence the enlarged and congesteil condition of these organs.

TREATMENTT

It would seem that with as common a disease as Texas fever and the financial loss involved, that out of the great number of experiments conducted and the great amount and variety of medical treatment administered that some reliable remedy would have been discovered. However, this is not the case. Medical treatment may be considered a failure in the acute cases and only partially successful in the chronic form of the disease. In practically all forms of the disease a physic is indicated at the very outset. Either salts or oil may be given, from one to two pounds of the former or from one to three pints of the latter. If no results are obtained in from twelve to fourteen hours the dose should be repeated. Quinine in from thirty to ninety grain doses may be given every three or four hours. Ticks should be carefully removed from all sick and well animals. Ticks may have been on the cattle last season but the fact that you have sick animals is sufficient evidence that the ticks on them are infected and capable of causing trouble. Good care, such as shade and plenty of cool water should be supplied. We have seen good results follow pasturing the cattle on green corn or cane. The green feed is nourishing and at the same time will act as a laxative. When fever breaks out in a herd all of the cattle should receive attention. The well ones should have all of the ticks removed and be given laxative and nutritious feed in abundance. Such steps taken as precautionary measures will often stop the disease before the loss is very severe. In some cases stimulants are very beneficial such as aromatic spirits of ammonia in doses of one to two ounces, or whiskey in two to four ounce doses every three or four hours.

IMMUNITY TO TEXAS FEVER.

Immunity is a condition of the body which resists the attack of disease and may be obtained in several ways. Cattle are not naturally immune to Texas fever. Calves at birth are only slightly susceptible to the fever but as they grow older they become more

and more susceptible. When calves are born on pastures where ticks are plentiful they soon become infected and at an age when they can best resist the disease. As they grow older they become accustomed to the presence of the disease-producing organism in their blood, consequently they are said to become immune to the disease since they show no marked symptoms of the fever. The southern cattle then are not naturally immune to fever any more than are northern cattle but have become so on account of continued exposure to the tick. Southern cattle raised on non-infested pastures will contract the fever as readily the first time they come in contact with infection as will northern cattle under the same conditions. All cattle raised without ticks on them are susceptible to Texas fever.

There is a very marked difference in the activity or virulence of the infection carried by the fever ticks. Cattle may become immune to a certain degree of virulence of Texas fever infection but will contract the disease when ticks from cattle shipped from further south are allowed to get on them. This is a common experience in many portions of Oklahoma. A great many cattle are lost every summer on account of a more virulent form of infection brought into pastures and ranges by cattle from the extreme south. On the other hand the ticks of these pastures and ranges are capable of giving the fever when allowed to get on cattle raised in tick free pastures. It is necessary in considering the relation of the tick to Texas fever to have in mind all of these problems, to know that there are fever ticks incapable of conveying the fever because they are the progeny of ticks raised on horses or other naturally immune animals, and also that there are different degrees of virulence depending somewhat on the locality from which the infection comes, it seeming to be more virulent from the extreme south.

PRODUCING IMMUNITY TO TEXAS FEVER.

For the purpose of producing immunity in susceptible cattle brought from the north, blood inoculation has been practiced. The method consists in taking one or two cubic centimeters of defibrinated blood obtained from an immune animal and inoculating it into a susceptible animal. The process of inoculation is carried out very much as is the method of vaccination to prevent blackleg in cattle.

This process of blood inoculation is used very successfully to immunize northern calves when they are to be placed on infested pastures or ranges. Calves from six to eighteen months of age are most satisfactory for this work. They should be brought south during the late fall or early winter and immunized before being turned on infested pastures or ranges. The process is as follows: The animal from which the blood is taken must be immune to the fever, preferably one that is carrying ticks at the time or was known to have carried them the season previous. Cord the neck of the animal from which the blood is to be obtained until the jugular vein stands out prominently. Draw from one-half to a pint of blood by means of a a large hypodermic needle. Stir this blood rapidly with a bunch of clean wire or twigs to take out the fibrin, which will prevent clotting. The defibrinated blood is injected under the skin of the animal to be immunized by means of a hypodermic syringe. The blood cannot be kept for any length of time as the fever germ will soon lose its vitality. All of this work should be done in a cleanly and careful manner.

The result of this blood inoculation is to produce a typical though generally a mild case of Texas fever. The fever will appear in from eight to twelve days after the inoculation, and will continue for about ten days when the temperature will again be normal. The changes taking place in the animal during this period of fever are the same as in cases caused by tick infestation. The blood cells are destroyed and the animal becomes weak and thin. About thirty days after the inoculation a secondary fever appears. This secondary fever is very irregular in its course from day to day, but in other respects is about the same as the primary fever. It usually terminates in from forty to forty-five days after the inoculation. Cattle should be over the effects of the fever before they are allowed to become infested with ticks. This will require about sixty days from the time the inoculations are made.

During the entire time following the inoculations the cattle should be fed abundantly with good feed. It is necessary to maintain the animals in as good flesh and strength as possible with an abundant and nutritious diet. The bowels and kidneys should be kept active in order to fully eliminate the waste material from the

body. From all data connected with experiments of this character we are justified in concluding that immunizing by blood inoculation is a practical means for immunizing susceptible cattle, and it can be practiced with success where young cattle are brought south at the right season of the year and carefully handled during the periods of fever following the inoculation. Inoculation with blood from the adult fever ticks may be used in these experiments. A number of susceptible cattle were inoculated with eggs deposited by fever ticks without results. The small parasite that is transmitted by the tick seems to undergo a portion of its development in the egg and while in this condition is not capable of causing disease.

TICK ERADICATION.

It has been abundantly proved that the tick is the means of transmitting Texas fever and for the protection of northern cattle it is absolutely necessary to maintain a rigid quarantine against all sections of the United States where the fever tick exists. Under such circumstances it must appear to every one in the infested area that it would be an advantage to get rid of the tick. The eradication of the tick is comparatively easily accomplished, yet under actual field conditions it requires a great deal of work and patience on the part of those interested to secure this result. A few indifferent stockmen may retard the work of eradication in their locality for two or three years. In large portions of the infested area there is not more than ten to twenty per cent. of the pastures infested, yet this small per cent. of infested territory is sufficient to keep the other eighty or ninety per cent. quarantined.

The work of eradication naturally falls under two heads. First, the cleaning up of cattle, and second, the use of such means as may be adapted to killing ticks in pastures or on ranges. Where a large number of cattle are to be handled the only practical method of killing the ticks on cattle is to dip them in crude oil. Beaumont oil has proven most effective in this work and the dipping is followed by less injury to the stock than when other oils are used. Figure 16 shows the general plan of a dipping vat and Figure 18 shows the vat completed ready for use. Such a vat was constructed by the Oklahoma Experiment Station at Noble, Oklahoma, during

the summer of 1898. About three hundred head of cattle were dipped during the fall and with very satisfactory results. A number of vats are now located at various points in the state and large numbers of southern cattle are dipped every spring and summer. The results from dipping have proven very satisfactory and when the work is carefully done the cattle suffer very little injury. The greatest risk is in the uncertainty of the weather in the spring. If the dipping is followed by a cold wave the cattle have a tendency to crowd together and stand until they become chilled. Under such conditions a few of the weaker ones are generally lost.

On the average farm where only a few head of cattle are kept the dipping vat is too expensive, so the stockman must resort to other methods. Hand picking, applying oil by means of a mop or brush, or the application of an emulsion by means of a spray pump, are some of the means that may be adopted on any farm. In order to carry successfully into effect any system of eradication it is necessary to be familiar with the life history of the tick. The tick is a parasite and does not develop except when attached to some animal, hence it cannot live for any great length of time in any pasture from which stock is removed. The young tick when first hatched, crawls up on grass blades and weeds, and remains there until brushed off by some passing animal. If it does not reach an animal it will soon die. The young ticks live for a few weeks during the hot weather but may live the greater portion of the winter if hatched out during the cool weather of the late fall.

Greasing cattle with a mop or brush is perhaps the cheapest and easiest method of handling the tick question on the average farm. Spraying with a spray pump as show in Figure 17 is a very satisfactory method of dealing with the question in a small way. If the spraying method is used particular attention should be paid to the effect of the material on the ticks for there are some of the patent preparations recommended as dips and for spraying purposes that will give very poor results. So far as we know there is no remedy or preparation that is as reliable for destroying the ticks as crude oil. An emulsion of either the crude oil or of kerosene may be used in the spray pump with fairly satisfactory results, the crude oil being preferable. The following mixture when applied with a spray

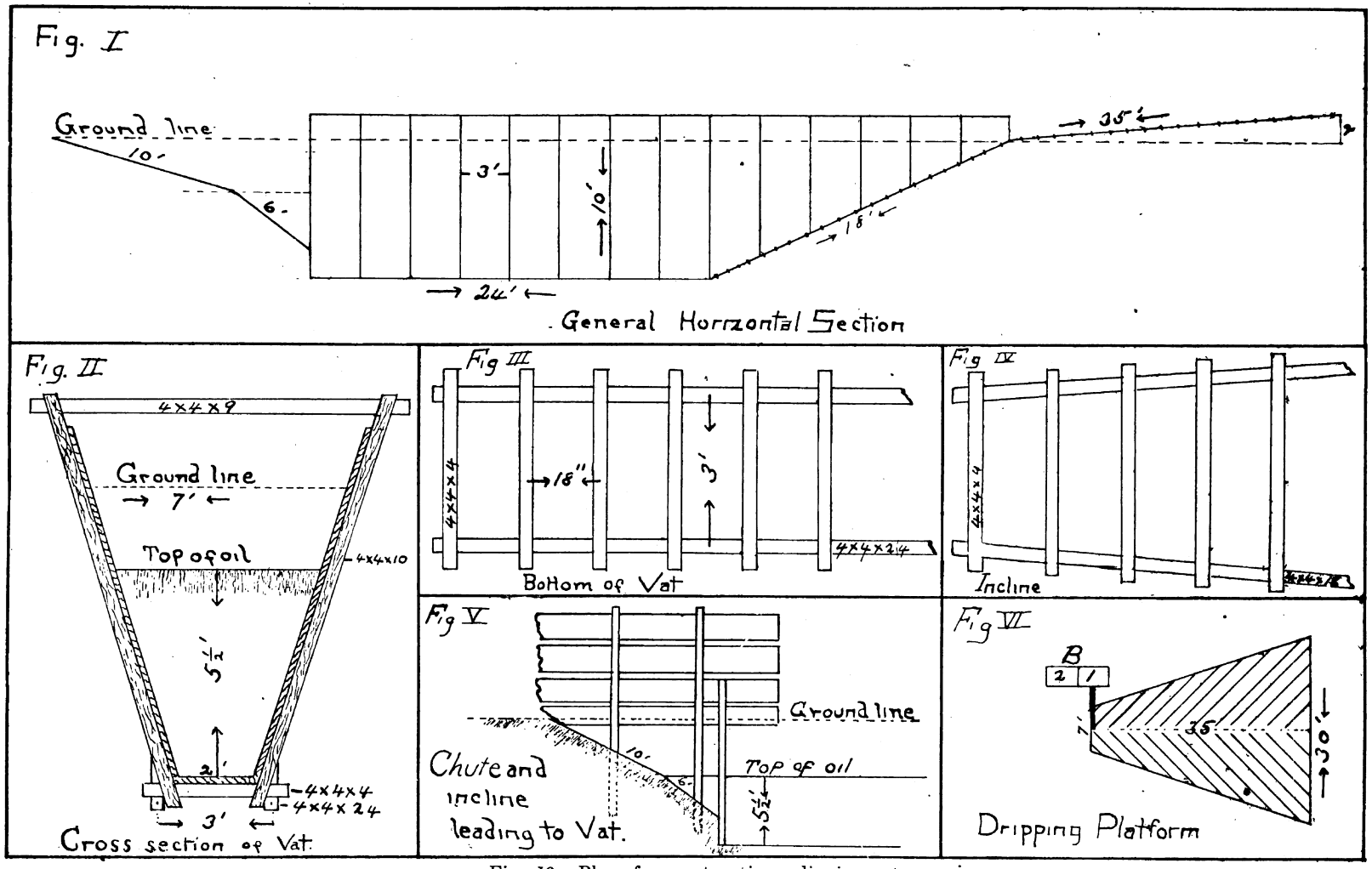

Fig. 16.—Plans for constructing a dipping vat.

pump will be very satisfactory and will have the advantage of being a very cleanly method of doing the work. Any good spray pump such as is used for spraying fruit trees may be used

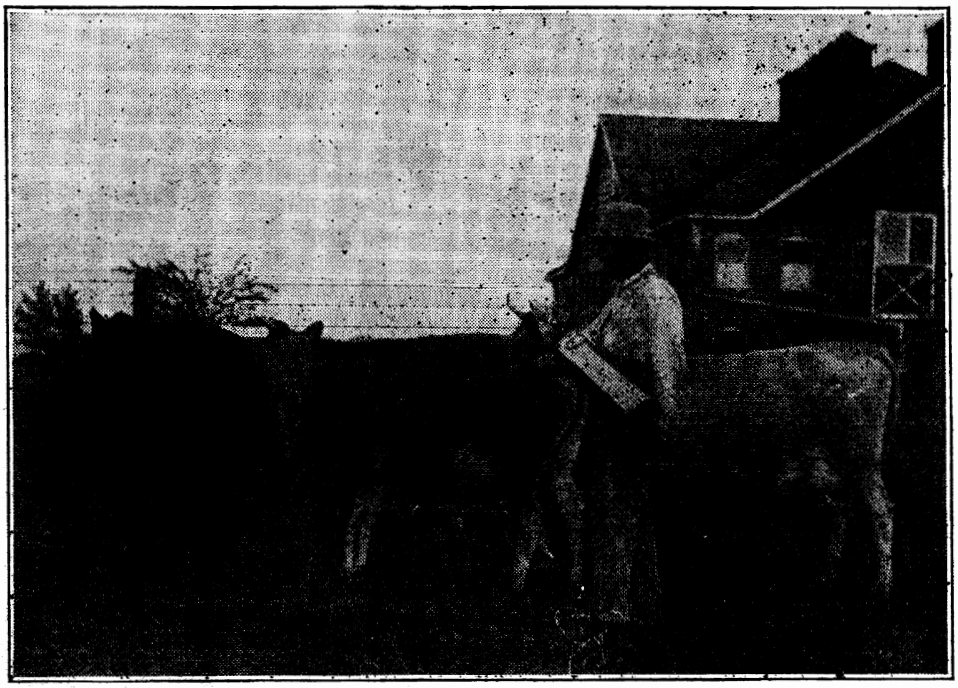

Fig. 17—Showing manner of using spray pump for killing ticks. The pump may also be used in applying preparations to relieve cows from the annoying flies.

where only a few head of cattle are to be handled. Various preparations may be used in the spray pump but the following will give very satisfactory results.

Laundry soap	one-half pound.
Water	one gallon.
Oil of tar	three ounces.
Sulphur	one pound.

Dissolve the soap in a gallon of soft water by heating or boiling the mixture. Remove from the fire and add the oil, either kerosene or crude oil, the oil of tar and the sulphur. Mix these throughly until a creamy mass is formed then add seven gallons of water which will give ten gallons of a twenty per cent emulsion and

will be sufficient to spray from fifteen to thirty head of cattle depending on age of cattle and the degree to which they are infested. The kerosene emulsion is made according to the above directions but has no oil of tar or sulphur in it.

An arsenic dip has been used in Cuba and to some extent in Texas and was first recommended by Dr. Mayo of Cuba. It is prepared as follows:

Commercial arsenic trioxide	eight pounds
Sodium carbonate, crystalized	twenty-four pounds.
Yellow soap	twenty-four pounds.
Pine tar	one gallon

Water sufficient to make 500 gallons.

Dissolve the arsenic in twenty-five gallons of water by boiling for several minutes, add water to make 100 gallons. Dissolve the soda in twenty-five gallons of water, dissolve the soap in the soda solution then add the tar slowly, stirring all the time. Mix the two solutions thoroughly and then add sufficient water to make 500 gallons. This can be used either as a dip or spray and may be made up in smaller quantities by observing the right proportions.

The coal-tar preparations may be used for spraying or dipping purposes but as a rule they will be found to have less value than the oils. These preparations are black syrupy fluids, having a strong odor of tar. They mix readily with water giving a white or milky colored emulsion. The coal-tar dips are known by a variety of trade names, such as Zenoleum, Chloro-naptholeum, Cretol, Creogen, etc. To prepare a spray or dip from any of the above or like preparations, use one gallon of dip to nineteen gallons of water. Use a brush or spray pump to apply this with and note carefully the effect it has on the ticks.

Any preparation applied by means of a brush or mop must be rubbed in against the hair so as to get the oil to the skin. Apply the dip thoroughly to all parts of the body, but especially to the under parts, shoulders and sides of the neck, where the ticks are most likely to be found. The cattle will get considerable benefit from the work even if it is carelessly done, but little will be accomplished so far as tick eradication is concerned unless the work is very thoroughly done. Where only a very few cows are to be hand-

led they may be curried or hand picked, being careful to see that all ticks removed are burned or otherwise destroyed.

Where it is practicable to divide a pasture so as to have a portion unused, this will be found a convenient method of getting rid of the ticks. The ticks will soon starve out if all stock are kept from the unused portion. If all stock are kept out of the pasture from July

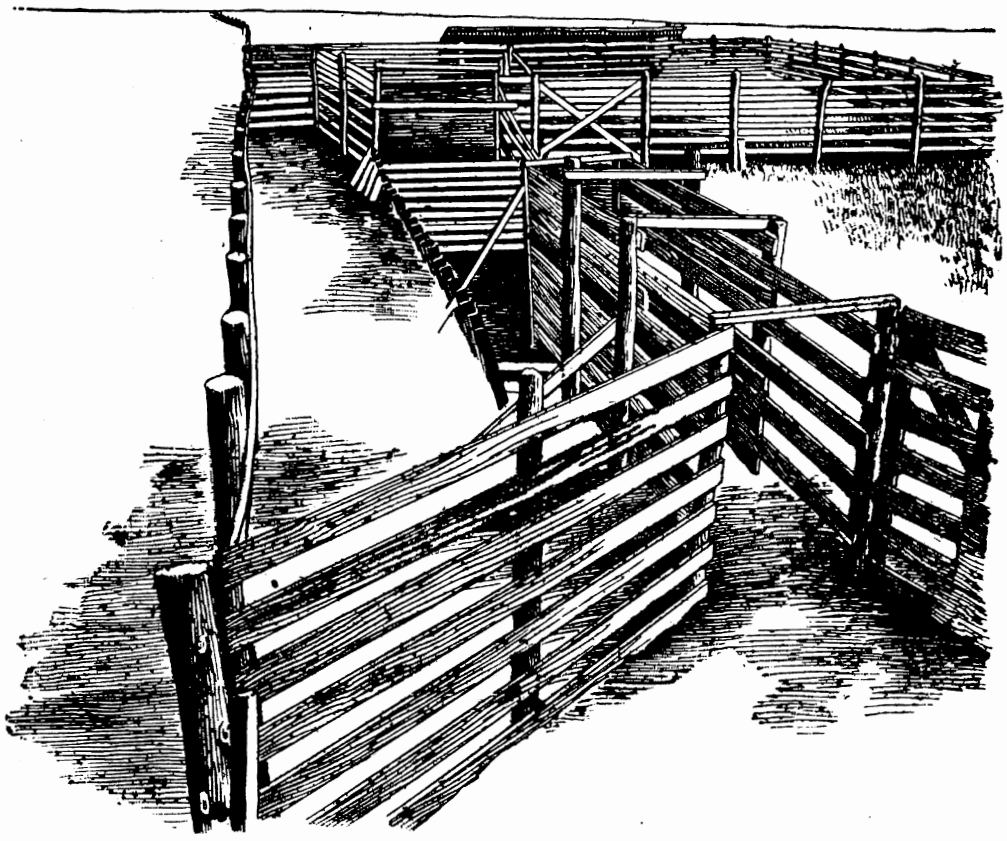

Fig 18—View of a completed dipping vat.

first until December first, or from September first until April first, all of the ticks will have been starved out. A shorter length of time might answer the purpose but the above length of time is considered safe. If a pasture is to be divided, two fences should be run across so as to leave a lane some eight or ten feet wide between the used and the unused portions.

Burning the pastures off in the spring will destroy a great amount of the infection. A time should be selected when every-

thing is dry so that as much of the trash will burn as possible, and isolated patches of grass in the thickets and brush should be looked after. Many stockmen seem to have the idea that feeding sulphur to cattle will cause the ticks to drop off and will in a measure keep the stock from becoming reinfested. We have advised farmers who could not be induced to try any of the reasonable methods of eradication to try feeding sulphur. The result has always been a failure to get rid of ticks. Rather extensive experiments conducted by the Bureau of Animal Industry and by Agricultural Commissions in South Africa have indicated that the method has no value whatever. There seems to be no arm chair method by which we can eliminate the tick, but they can be killed with oil or starved to death by a pasture rotation system.

QUARANTINE LINE.

Texas fever is an infectious disease and the infection (ticks) is carried by cattle from the infested area. To limit the spread of the disease it is absolutely necessary to maintain quarantine lines which will mark the northern boundary of the infested area. By referring to Figure 19 which shows the location of both the federal and state quarantine lines it will be seen that the federal line passes in a diagonal direction across the state from the northeast corner of Kay County to the northwest corner of Greer County. The state quarantine line (indicated by broken line) lies below considerable areas of infested territory. It is this territory between the two lines where special effort is being made to eradicate the tick. As counties or portions of counties are freed from ticks the federal line will be moved south so as to place the tick free area above the quarantine line, thus giving the stockmen the advantage of an open market and eliminating all danger of loss from Texas fever.

The first general quarantine order applying to Texas fever was issued February 26, 1892. The Department of Agriculture has since that time issued quarantine regulations defining from year to year the area infested by the fever tick. By enforcing the quarantine regulations the non-infested territory is protected from the disease. This shows what can be done by sanitary work of the right sort. Before the establishment of the quarantine line the loss from fever was very great in the northern states. When southern cattle

were driven or shipped north during the summer they usually carried on their bodies a large number of cattle ticks. These dropped to the ground, deposited their eggs, and in a short time the eggs hatched and the young ticks would attach themselves to northern cattle that were grazing over the same pastures. In this way the disease spreads readily to northern or susceptible cattle.

There are some who maintain that if the tick was completely eradicated from the United States that it would be impossible to prevent them from being brought into this country again. We do not think this is true. The United States is now quarantined against certain diseases that if once established in this country would be much more destructive than is Texas fever. The quarantine that is maintained against the foot and mouth disease, pleuro pneumonia, rinderpest, surra, etc., is effective and when the fever tick is eliminated from the south there will be an effective quarantine maintained against the introduction of infested cattle from any and all sources.

LOSS OCCASIONED BY THE FEVER TICK.

The tick problem is an important one from a financial stand point. It is not a matter of sentiment to get rid of the ticks but a matter of business. Very few stop to consider the monetary loss in Oklahoma due to the fever tick. If the same amount of money should be taken every year from the value of the corn, cotton or wheat crops by some preventable pest then every one would be instantly arrayed against that pest. There is an enormous sum taken every year from the cattle business, and by a preventable pest, yet many think the tick question a hobby and have no patience with the idea that they are doing damage of any kind.

The figures in the following table are taken from the Assessors report for 1907. They are for the counties of old Oklahoma that are located partially or entirely below the Federal quarantine line. No figures are available for the eastern portion of the state except the Osage Nation which was reported with Pawnee County.

County	No. of Cattle	Average Value	Total Value
Pawnee	84765	$ 6.03	$511,132.00
Payne	25549	7.00	178,843.00
Noble	13769	5.91	81,374.00

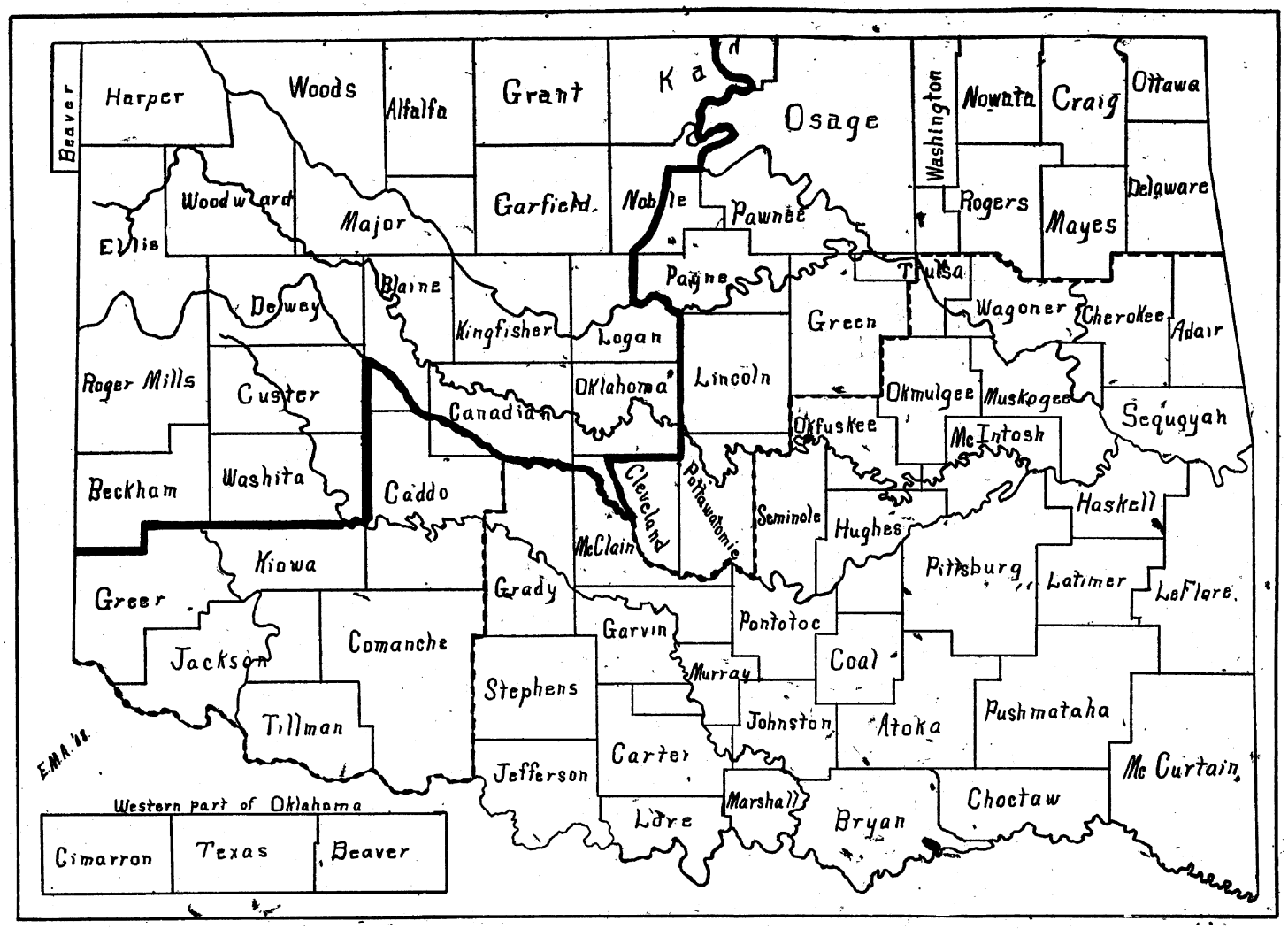

Fig. 19—Map of Oklahoma showing the location of the Federal and state quarantine lines. The Federal line is indicated by the solid heavy line, the state quarantine line by the broken line.

Lincoln	25624	8.00	204,992.00
Cleveland	9866	6 25	61,662.00
Pottawatomie	15928	5.87	93,497.00
Caddo	38031	5.17	196,620.00
Kiowa	17300	7.44	128,712.00
Comanche	40335	5.74	231,512.00
Greer	33308	7.18	239,151.00
Total	304475	6.45	1,927,495.00

The assessed valuation for 1907 was on a twenty-five per cent. valuation. Such being the case the cattle industry of the above counties amounts to an approximate valuation of seven and one-half million of dollars. The number of cattle reported may be accepted as correct. What is the annual loss in value on the three hundred thousand cattle in the above counties that can be attributed to loss by death from Texas fever, loss in condition and growth on account of the presence of the ticks, and loss in market value on account of restricted market? A very low estimate would be between one and two dollars per head or say $450,000. annually. While we have no figures at hand on which to base an estimate of the cattle industry in the east side of the state it is at least equal to that in the above counties and probably very much more. A low estimate at the present time of the annual loss in Oklahoma on account of the fever tick is between three-fourths and one million dollars. While the above may be only an approximate estimate it is sufficiently accurate to show the immense aggregate loss caused by a disease that is entirely preventable. This estimate does not even consider the loss in other directions but only on the actual number of cattle on hand. The breeding of pure bred cattle and dairying will be far more profitable in Oklahoma when the tick is exterminated.

GENERAL CONSIDERATION.

The winters in Oklahoma are such as to partially disinfect pastures but this disinfection is never complete. Oklahoma has experienced temperatures several degrees below zero with an abundance of snow and ice but the ticks would appear the next spring. In some localities ticks are found on cattle the entire winter and eggs that are in places exposed to the sun may hatch out in February.

So it happens that pastures that have ticks in them the latter part of a season will always be infested the following spring.

Any one who has handled cattle in Oklahoma knows that there are very few ticks to be found on cattle until the spring is well advanced. During March, April and May there are as a rule very few ticks to be found, and it is at this season of the year that the strongest effort should be put forth on every farm to get rid of the ticks. Since the season in Oklahoma will allow the development of three or four generations of ticks, it follows that every tick killed early in the season is worth more than the killing of thousands during the last part of the season so far as eradication is concerned. If stockmen would use the same effort in April and May that many of them use in August and September the results would be infinitely better. For every female tick allowed to mature in April or May there may safely be expected five hundred females in June and July, and for every mature female dropping off in these months there will be five hundred in August and September. A fully developed female will deposit from fifteen hundred to three thousand eggs. Of course many eggs are destroyed and young ticks may die from lack of an opportunity to attach themselves to cattle but the fact remains that the scattering ticks seen on cattle in the spring give rise to the countless numbers found during the last of the summer or fall. It would be no difficult matter to look after the ticks in the spring when there are so few of them and that is when the special effort should be made.

The losses from Texas fever may be placed under two heads. First is the loss in number from death due directly to Texas fever. There are probably a great many who think that this loss is practically the only one to be considered in connection with the disease, but in fact it represents the least loss. Under the second head we may place the loss of growth and the loss from exposure during the winter season due to a weakened condition of badly infested stock. No animal can support the large number of ticks usually found on southern cattle without losing flesh and becoming very much weakened as the winter season approaches. We have already seen that as the season advances the ticks become more numerous and this at a time or season of the year when grazing is generally poorest. So

it happens in many portions of the south that the cattle go into the winter season thin in flesh and not in condition to withstand exposure even to our mild winters. The loss in growth and the loss from death by exposure represents a much greater loss than can be charged against loss by death from the acute cases of fever.

Some statistics are of interest in this connection. States that are infested with the fever tick contain about 25 per cent. of the cattle of the United States, but the loss in the tick infested states from various causes is 50 per cent. of the loss in the United States. Estimates of the losses from exposure in some of the northern states runs from two to three per cent. while in most of the southern states the loss is estimated to be from eight to twelve per cent.

Climatic conditions in the south are not unfavorable to cattle raising. In fact so far as climatic conditions are concerned there is no section of the country more favored. However, any advantage that the south may have on account of favorable climate and an abundant forage crop production is now lost through the ravages of the cattle tick. Where the winters are the mildest the loss from exposure is the greatest. This loss by exposure is due to the weakened condition of the cattle brought about by the ticks sapping their vitality and poisoning their system with disease. It is often stated, and it is probably true, that the south suffers an annual loss of twenty million dollars due to the cattle or fever tick. The average value of southern cattle is given at about nine dollars per head less than that for northern cattle. It must not be inferred that cattle raised in the south will ever be superior to the well bred northern animal, but make the breeding of good cattle possible by eradicating the tick and there will be just as good cattle raised in the South as horses, mules, hogs and sheep.