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Texas fever: being a general summary of our knowledge of the subject to date

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Agricultural Experiment Station
OF THE
Louisiana State University and A. & M. College.

Baton Rouge.

"Longing for the Sunny South."

TEXAS FEVER,
Being a General Summary of our Knowledge of the Subject to Date.

W. H. Dalrymple, M. R. C. V. S.
LOUISIANA STATE UNIVERSITY AND A. & M. COLLEGE.

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TEXAS FEVER.

By W. H. Dalrymple.

Owing to the previous literature of the Station, on Texas Fever, having become exhausted, it is the purpose of this bulletin to endeavor to supply, in succinct and practical form, the demand for information on the subject which is constantly being made.

Names Given the Disease.

The term, Texas fever, although in common use in our Southern States, may be considered a misnomer, as the disease is by no means confined to the State of Texas, but is prevalent in those sections of this country where the common cattle tick (Boophilus annulatus) exists, and in other countries, as well, although not, perhaps, transmitted by the same species of tick; the former, so far as we are aware, being peculiar to the United States of North America, or, at all events, the American continent.

Other names given to the disease in this country, are: Tick fever, bovine tick fever, Southern cattle fever, besides those of a more local or provincial character, as murrain, red water, black water, yellow water, acclimating fever, acclimatization fever, etc. It would be well, however, that these latter names should be dropped and become obsolete, because they are not uniformly applied, and are, therefore, misleading.

In parts of Great Britain and in many of her dependencies or colonies where the malady exists, the term, "red water," is in general use, except, perhaps, in New South Wales, where the name bovine tick fever has been suggested. In Italy it is known as bovine malaria, and so on.

It might be here stated, that although these names convey to the ordinary mind what the disease is, they are not what might be called specific terms. That is, they do not give a correct idea of its true cause, and, hence, it has lately been the tendency with biologists and scientific investigators to use the term, "Bovine
piroplasmosis," because the name of the organism (protozoan) producing it, is the "Piroplasma bigeminum," discovered by our National Bureau of Animal Industry.

It may be some time before the stockman becomes familiar with "new" names, such as the last one mentioned, but it would very much simplify matters were the disease known, everywhere, by only one name, and that one based upon a definite reason, such as its specific or definite cause.

THE CAUSE.

The one and only cause of Texas fever is a minute or micro-parasite belonging to the animal kingdom (bacteria proper belonging to the vegetable kingdom), and the name given to it by biologists; as before stated, is the *Piroplasma bigeminum*.

It is a "two-host" organism. That is, it lives during its life cycle in the bodies of two individual hosts, and does not seem to be able, naturally, to perpetuate itself in the absence of one or the other of them. These are, the bovine animal (ox, cow, etc.) and the common cattle tick, in this country. When transmitted into the circulation of a susceptible animal, it multiplies in the blood, causing destruction of the red cells; reduction in their number, and produces the different symptoms peculiar to the disease, including high fever. When an animal recovers, however, its power of resistance becomes so strengthened against the effect of the parasite as, thereafter, so long as it is exposed to ticks, to remain healthy (immune) although harboring the parasite in its blood.

The common cattle tick, after feeding upon the blood of such immune animal can, through the medium of the progeny of the female tick, transmit the micro-parasite into the circulation of a susceptible animal. And, in this way the germ is perpetuated and the disease spread.

But, if the two hosts—the bovine animal and the tick—are separated as for example by destroying the tick, the infection cannot be disseminated, because the parasite cannot exist outside of the bodies of these host animals. In short, it requires the tick to extract the parasite, along with the blood, from an immune animal which has been previously exposed to ticks, or one suffer-
ing from the disease, and inoculate it into the blood of one that is susceptible, before the disease can be transmitted, except through artificial means, which are resorted to in the process of artificial immunization.

THE COMMON CATTLE TICK THE TRANSMITTING AGENT OF THE GERM OF TEXAS FEVER.

Up to 1889, ticks were not suspected as having any connection with Texas fever, and nothing of a positive nature was done to elucidate their action in carrying it until the matter was taken up by the Experiment Station authorities of the Bureau of Animal Industry at Washington in that year, with Dr. Cooper Curtice in charge of the investigations, when a careful series of experiments were commenced and continued through several subsequent years. The results of these tests showed conclusively that the disease was conveyed through the agency of the tick, and that, without its presence and aid (except in the case of artificial inoculation), there could be no transmission. So far as is known, the tick, in this country, is the only agent responsible for conveying the parasite of the fever to susceptible cattle after having taken it, along with the blood, from a native immune animal, or from one suffering from the disease, or from a Northern immune after having had the fever and recovered.

Further, that among the different species of ticks experimented with at the Louisiana Experiment Station, the only one which transmitted the germ of the fever, was the common cattle tick of the country, *Boophilus annulatus*.

THE CATTLE TICK DANGEROUS, ONLY, AFTER FEEDING UPON THE BLOOD OF IMMUNE CATTLE, OR THOSE SUFFERING FROM TEXAS FEVER.

The cattle tick being purely the transmitter of the micro-parasite, it must, of necessity, first procure the organism with the blood from an animal either suffering, or one that has suffered from the disease. It is possible, therefore, for cattle and cattle ticks to live together without any ill-effect, so far as the fever is concerned, because the parasite must be present before
the tick can procure and transmit it. Such a condition rarely, if ever, exists, however, although we believe to have seen it recorded that in Porto Rico, Texas Fever did not exist, notwithstanding the prevalence of ticks. Should this record be authentic, the explanation would be, that the disease could not have been introduced into that country.

Then, again, ticks which have attached themselves, and fed upon the blood of horses or mules, will not, directly afterwards, transmit the disease to cattle. The reason for this seems to be, that the blood of these animals will not sustain the germ of Texas fever (it being purely a bovine malady), and, it either ceases to exist in the body of the tick nourished with this blood, or is not transmitted to its progeny, or if present, is in such a non-virile condition as to be innocuous to cattle. Cattle ticks will, however, develop on the blood of horses and mules, and for this reason these animals may be responsible for increasing their numbers, which afterwards may become dangerous, as transmitters, when their progeny find native cattle to attach to and extract their blood.

LIFE HISTORY OF THE CATTLE TICK IN BRIEF.

Briefly, the life-history of the cattle tick may be stated as follows: The fully engorged female (the large tick most frequently observed in cattle) drops to the ground, and in some secluded place, deposits between 1,500 and 3,000 eggs. During the summer months in our State these eggs hatch in from 20 to 30 days into a six-legged form, which, because of its resemblance to seeds of various kinds, or, because of its being the seed of the tick, is popularly known as a "seed-tick." In this condition the small seed-ticks bunch together in great numbers upon grass, weeds, etc., near the place where they are hatched. The passing animal coming in contact with a bunch of these ticks becomes thoroughly-infested with them, and they become attached by their mouth-parts to the skin of the host. In the course of from 6 to 10 days, the young six-legged form molts (sheds its skin) and then becomes possessed of four pairs of legs instead of three. In from 5 to 10 days after the first molt, another shedding of the skin takes place, up to which time no sexual characters are ap-
parent, except that the large size of the adult female seems to be foreshadowed. After the second molt, certain characters of the male tick are indicated. At this period mating takes place, and in a few days the life-cycle is complete—the females filled with blood drop to the ground, lay their eggs, and another generation begins. From the time the small six-legged seed ticks attach themselves to the animal, until maturity is reached, there is little disposition on their part to change location, except at the very beginning of their parasitic life, or, perhaps, immediately after each molt, or, in the case of males, to some extent, during their adult existence. Practically, it means the death of the cattle tick, if removed from its host after being once well attached.

The length of time taken by the eggs in hatching, will depend considerably upon the temperature and moisture conditions by which they are surrounded.

ALL SOUTHERN CATTLE NOT IMMUNE TO TEXAS FEVER.

Although the greater area of the Southern States has been placed by the Federal authorities in the "tick-belt," or below the Federal quarantine line, there are portions of, probably, all of these States in which the cattle are found to be non-immune, or, susceptible to Texas fever, when exposed to infestation by the cattle tick. It has been observed that portions of our own State, such as some of the alluvial districts, and those subject to overflow and inundation, are free from cattle ticks. And where no ticky cattle have been introduced, the native stock remain free from the disease, but are susceptible to infection when removed to tick-infected pastures. It is an impressive fact, also, that all cotton, corn, rice, sugar, and other cultivated lands, are every year free of ticks until infested cattle are again permitted to occupy them. This point is worthy of the greatest emphasis, in view of the campaign of extermination that is about to be waged against the cattle tick, as, by keeping such areas free of ticks, great assistance will be rendered this important work. It is not, therefore, a question of locality, as used to be supposed, but of an animal harboring the parasite in its blood, and cattle ticks to
transmit the parasite, through the medium of their seed-ticks, to one that is susceptible. These are the natural factors in perpetuating the life of the organism of Texas fever, and in the transmission of the disease. But, it is possible, artificially, to infect a susceptible animal by injecting into its system a small quantity of blood taken from one suffering from the disease, or from one that has had it during some part of its life and has recovered, or, in other words, an immune animal.

SYMPTOMS OF TEXAS FEVER.

The symptoms vary according to the actueness of the attack. After an animal has been infected, a certain amount of time elapses before signs of indisposition are observed. This is the period or stage of incubation, which is not always of uniform length, and, in the case of natural infection through the medium of ticks on pasture, cannot, in every case, be accurately ascertained. However, by placing infected seed ticks on a susceptible animal, or by injecting infected blood into its system, it can be obtained; and the records go to show that, in such cases, the period of incubation is about from 8 to 10 days. Then, if the temperature is taken by the ordinary physicians' thermometer at either of the posterior openings in the cow or heifer, it will be found to have risen above the normal height (100.5 to 102.5), and may reach, in the following 8 or 10 days, 105 to 108 degrees, Fahrenheit. Even with so many degrees of fever an animal may not present any very pronounced outward signs of sickness, other than slight dullness and inappetance, and, were it not for the thermometer record, would even pass suspicion. When, therefore, an animal exhibits unmistakable indications of the disease, such as dullness, loss of appetite, cessation of rumination (not chewing the cud), loss of flesh, staggering gait, hurried breathing, harshness of the coat, drooping of the ears, remaining apart from the rest of the herd, the passage of red-colored urine (haemoglobinuria), etc., it is more than probable the disease has existed for some time and was unobserved in the earlier stages. In susceptible cattle, as those imported from above the Federal quarantine line, on pasture, the presence of ticks would at once arouse suspicion as to the nature of the ailment, and especially
when accompanied by symptoms of an acute fever, such as those above enumerated.

**POST-MORTEM APPEARANCES.**

The changes taking place in the tissues of the body after death, do not, as a rule, mean much to the stockman who has not had the opportunity of studying pathology. Yet, we believe, there are a few of these changes more easily recognizable, which might be of some assistance in the way of diagnosis:

**The Fat (Adipose Tissue.)**

The fat in the interior of the body has usually a decidedly bilious or yellowish tinge.

**The Heart.**

A somewhat constant appearance is that of blood-staining underneath both the covering of the heart, outside, and the lining of the cavities, inside.

**The Spleen or Milt.**

In an animal, a steer for instance, weighing 1,000 pounds, the normal weight of this organ is about 1.72 pounds. In an acute case of Texas fever, however, it may be found to weigh two to four times that amount. When an incision, or cut, is made into the substance of the spleen, its structure appears as a dark brownish red mass, resembling "blackberry jam." The engorged condition and peculiar color is due to engorgement with the red cells of the blood.

**The Liver.**

The liver is the organ most seriously involved. It is very much enlarged and congested, and has a golden-yellowish mottled appearance, due to injection with bile, and fatty degeneration of the liver cells. It weighs from three to five pounds heavier than the healthy liver, and is paler in color.
THE BILE IN THE GALL-BLADDER.

The bile is found in considerable quantity, and is very much changed, having been likened unto the appearance of "chewed grass," and can be drawn out in long flat shreds.

THE BLADDER.

This receptacle may be found to contain from one to four quarts of high-colored urine, resembling, somewhat, the appearance of port wine, due to the coloring matter of the red blood cells mixed with the fluid.

It may be stated that the various changes which occur in the animal body in this disease take their origin, or are dependent upon, the destruction of the red corpuscles, or cells, of the blood.

ARE NATIVE SOUTHERN CALVES IMMUNE AT BIRTH?

An experiment was conducted at this Station to test the question of congenital immunity in calves. That is, to find out whether or not they were born immune. And we believe some of the other Southern Experiment Stations have done similar work. The results of these experiments show that resistance to the effect of Texas, or tick, fever, decreases with the age of the animal. Hence, calves up to five or six months old appear to suffer but slightly under blood-inoculation.

The impression at one time prevailed that the calf was born immune to the disease: but the explanation of this apparent immunity would seem to be that the high resisting power of the young animal enables it to pass over the stage of inoculation by the tick without much apparent effect, and it becomes immune before it reaches an age when that resistance is lessened.

CURATIVE TREATMENT.

Up to the present, so far as we are aware, there is no line of treatment that can be considered specific in Texas fever.

In treating animals during the acute stage of artificially produced, or immunization fever, although we have rarely had to resort to medicines, we have obtained satisfactory results from
the use of quinine. This medicinal agent was suggested by the fact that the Texas fever germ, and that of malaria, both belong to the protozoa, or one of the lowest forms of animal life.

Whatever medicinal treatment is employed should be commenced at the earliest possible moment after the disease has been recognized, and one of the first things to be done is to effectually rid the animal of ticks, both large and small, and place it in comfortable quarters which are absolutely tick-free.

If the bowels are torpid, the condition may be relieved by the administration of a dose of Epsom salts, combined with a moderate quantity of ground ginger, and made into a drench with about two quarts of tepid water. One to one and one-half pounds of the salts and a half to one ounce of the ginger, should be a sufficient dose for an adult animal. Free access to plenty of pure drinking water should always be permitted. Quinine may be given in from one to two drachm doses, three or four times daily if the temperature of the animal remains high—say, from 103 degrees upwards. With reduction of the fever, the dose of quinine may also be reduced. We have found beneficial effects in lowering the temperature, by combining phenacetin with quinine (30 grains of each, or 40 grains of quinine and 20 grains of phenacetin) for two or three administrations. The most convenient vehicle which we have found for either of the above, is syrup; making the dose into a paste and spreading it over the surface of the animal's tongue with a small, smooth, wooden paddle.

In extreme debility, or during convalescence, we have found a mixture of good whisky and the fluid extract of nux vomica a satisfactory tonic and stimulant. One or two drachms of the fluid extract of nux vomica, two to four ounces of whisky, with sufficient water to form a convenient drench, which should be given two or three times a day, as the symptoms indicate.

**Good Nursing.**

The administration of medicines, however, is by no means all that is necessary. Good nursing is "half the battle." The nourishment should be carefully looked to, and the patient's likes and dislikes, in this particular, closely observed, and, if pos-
sible, anticipated: easily digestible nutritious and tempting food being preferable. Owing to the immense destruction of the cell elements of the blood, and the consequent lowering of the vital forces which occurs in this disease, it stands to reason that the food should be nutritious, or, of what might be termed, the tissue-building class.

ARTIFICIAL IMMUNIZATION.

The discovery that the tick was capable of transmitting the germ of Texas fever from a Southern native animal to a susceptible one, was of enormous import, but without further investigation and experimentation the knowledge of this fact, alone, would have done but little toward the accomplishment of practical ends.

For some time it had been known to medical scientists that immunity, partial or complete, from certain infectious or contagious diseases could be conferred by producing, through inoculation or vaccination, a mild or non-fatal form of the same disease. This knowledge no doubt led to the experiment of endeavoring to produce Texas fever, artificially, in susceptible animals by the hypodermic (under the skin) injection of blood from a Southern native, knowing that in that blood there existed the germ which the tick was capable of transmitting. The results were satisfactory. For not only was it ascertained that the blood drawn directly from the native was virulent, but that the blood taken from the tick itself had the effect of producing the fever.

Although at first it was found that the mortality was somewhat excessive, a good many animals succumbing to Texas fever as the result of artificial inoculation, subsequent experiments and modifications tended to reduce the treatment to a more sound and practical basis.

Drs. Smith and Kilbourne, of the National Bureau of Animal Industry, in this country, discovered that this disease could be produced with infected blood, and in Queensland, Australia, Mr. C. J. Pond, Director of the Government Stock Institute, and Mr. J. Sydney Hunt, Government pathologist, showed that the disease known as "red water" in Australia, was identical in its nature with our Texas fever, and that if inoculations were made with the blood of cattle which had recently recovered from the dis-
TExAS FEVER

L.A. STATE UNIVERSITY

EXPERIMENT STATION

"Northern Male Trio, "East away to the sunny South and get immunized."

Immunionization.

I supply the blood.

I am being immunized.

I transmit the germ.

Red cells, in Texas fever blood.

Red cells in normal blood.

I transmit the germ of Texas fever.
ease, the degree of immunity resulting therefrom was sufficient to enable an animal to resist it in the future.

It should be stated, that in 1897, previous to the general adoption of the blood-inoculation method, other experiments were made. The first one tried was that based upon the use of sterilized blood-serum, as outlined by Dr. John W. Connaway, of the Missouri Experiment Station. This was to determine whether sterile blood-serum (the fluid part of the blood) of immune Southern cattle contained any chemical substance of the nature of an anti-toxin that could be utilized, practically, in bringing about, at least a passive immunity in susceptible animals. The results of this experiment showed, however, that this method gave little encouragement, if any.

A second experiment aimed at immunizing susceptible cattle by infecting them with the germ of the fever through the medium of infected seed-ticks. It was found that success could be attained by this method, but, on account of certain troublesome conditions, it was not considered so practical as could have been desired.

The third series of experiments was with the object of immunizing susceptible cattle by infection with the germ of the disease, through the agency of inoculation of infected blood drawn from a Southern native animal. This is now known as the blood-inoculation method of producing immunity, and which was confirmed by our own Station, as well as those of the other tick-infested Southern States (including Missouri), and has been practiced ever since the results proved so conclusive.

THE ENGOERGE D TICK AS A SOURCE OF BLOOD FOR INOCULATION PURPOSES.

Before proceeding further with the description of the inoculation treatment, it should be mentioned that this Station conducted a series of experiments (1) to ascertain whether the engorged tick could be used as a source of blood for inoculation purposes; (2) if the blood-engorged female tick might be utilized as a natural "capsule" in which to transport the blood for a distance, and (3) to test the possibility of preserving the in-
fected blood that it might be shipped to other points and still retain its virulence.

The results of these experiments were summarized at the time, and are as follows:

(1) "The blood with which the adult ticks are filled, after maturing on Southern cattle, carries with it the power to produce Texas fever when injected under the skin of a susceptible animal.

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

(3) Experiments further indicate that this will give a milder form of the disease, and, afterwards, immunity, just as effectual as when the blood is taken from an immune animal immediately before being used.

(4) We have not, as yet, found any way of preserving the blood drawn from the vein for any considerable time, without it losing its power to produce immunity."

BLOOD INOCULATION METHOD.

Previous to the discovery and adoption of the blood-inoculation method of immunizing susceptible Northern cattle against the ravages of Texas fever, the mortality in these animals ranged, anywhere, from 40 to 90 per cent. This, necessarily, discouraged Southern stockmen in the importation of pure-bred cattle for the purpose of improving their herds; and accounts, mainly, for the scarcity of pure and high-bred stock in the South, up to within recent years.

Consequent upon the use of this artificial method of immunization, however, the death rate from the fever has been enormously reduced. In a bulletin issued by the Texas Experiment Station within the past year or two, a record was compiled showing the percentage mortality of inoculated cattle that had been treated at the Texas, Louisiana, and other Southern (including Missouri) stations, which comprised several thousand head (4,562, up to January 1, 1904), to be only 7.7, and that, too, under various conditions of treatment after they had been placed in their owners' care. This fine record has given increased encouragement
to cattle men in the South, with the result, that the immunization work goes on, from year to year, at our own, and the other Southern stations as well.

The time will doubtless come when this treatment will be unnecessary, but not until the South has a sufficiency of pure-bred immune cattle to meet the demand, or, in the event of complete eradication of ticks from Southern pastures, which may, ultimately, be the case, and which we will allude to later.

The Louisiana Station was among the first to test the blood-inoculation treatment, having commenced to experiment with it in 1898, and the following is a synopsis of the

**Technique of the Operation**

as practiced by us, as well as of the symptoms in the patient during the inoculation fever.

A point we desire to make clear is, that by inoculation with virulent blood, the animal is given, artificially, a genuine attack of Texas fever; because the germs of the disease are in the infected blood. In other words, we produce, artificially, what ticks would do naturally, but we can control the dosage of the blood in this way, while it is difficult if not impossible, to regulate the number of ticks that might infest an animal on pasture.

**The Supply Animal.**

The supply animal is the one from which the infected blood is obtained, either a native or a Northern immune. It should be in good robust health and condition, in preference to one of a delicate constitution, poor in condition and of unthrifty appearance.

**Animal to be Inoculated.**

Although we have, at this Station, inoculated animals from the age of calfhood to that of mature cattle, experiments seem to indicate that the most suitable subjects are those from about eight to twelve months old, in good flesh, and weighing from about 500 to 800 pounds, in the case of the beef breeds.

Before inoculating, it is well to allow the animals to rest for a few days, especially those that may have come off a tedious rail-
road journey; and during this time they should be well and carefully fed and kept absolutely free from ticks. In short, the object is to have them in the best possible condition to pass through the inoculation fever satisfactorily.

**Obtaining the Blood.**

Should the animal be docile, it may only be necessary to secure it in a narrow stall, or even to a post. However, the operation seems more easily performed with the supply animal thrown down and tied.

The hair is now clipped from a portion of the skin of the neck just over the jugular vein. The denuded part is then bathed with an antiseptic solution (3 to 5 per cent. carbolic acid, creolin, zenoleum, or other effective germicidal agent) in order to destroy all septic germs on the skin which might gain entrance to the punctured wound (afterwards to be made) and produce an abscess, or septic inflammation of the vein. The neck of the animal is now straightened and tensed, and a piece of good strong cord or small rope (one-quarter inch) tied round its base sufficiently tight to check the flow of blood and raise the vein. A small trocar and canula, or hollow sharp-pointed needle, which has previously been sterilized, or disinfected, is then inserted into the distended vein and is directed up the vessel toward the head. As soon as the needle enters the vein, the blood passes through it into a sterilized glass, or other receptacle; and when sufficient blood has been extracted, the needle, or canula, is withdrawn, the rope around the neck loosed, and the wound bathed with antiseptic solution.

**Preparing the Blood.**

To prevent the blood clotting, after it has been withdrawn, it is immediately stirred, slowly, with a thin glass rod, which has been disinfected, until as much as possible of the clot has collected on it, and it is then withdrawn. The remaining defibrinated blood, or a part of it, is then drawn up into a clean hypodermic syringe, and the quantity to be injected gauged by a small screw-regulator on the piston.
Injecting the Blood.

The animal to be inoculated is prepared by clipping the hair from off a portion of the skin—about the size of the hand—behind or a little above the point of the elbow, on the side of the chest (any part where the skin is loose and thin, will answer). This is disinfected as in the case of the supply animal. The skin is then drawn out between the thumb and forefinger of the left hand, and an incision made through it with a narrow, sharp-pointed knife or lancet to allow of easy introduction of the hypodermic needle, care being taken not to injure the chest-wall. If the needle is a very strong one, it may not be necessary to use the lance. The syringe is now attached to the needle and the required amount of blood injected under the skin. After withdrawal of the needle, the part is again lightly bathed with the antiseptic solution, and the surgical part of the work is completed. Success here depends very largely upon the antiseptic precautions taken in the operation. Consequently, all instruments and utensils, the hands of the operator, and the operative area of skin, should be thoroughly disinfected.

Dose of Blood.

The standard amount of blood used at this Station for some time, has been one cubic centimeter (about 16 drops) for animals of any age. Latterly, however, it has been our custom to administer a second dose of two cubic centimeters, after recovery from the second fever period (referred to later on). The object here is to increase, if possible, the degree of immunity before the animal is exposed to ticks. After this second injection of blood, the patient is kept under observation for ten days, or so, longer, and the temperature taken to watch the course of the fever, should there be any.

We have previously stated that the blood before injection was stirred to remove the clot (defibrinated). This is usually done, when a number of animals are to be inoculated, to prevent clotting before the work is completed. In the case of a single animal, however, or even two or three, the blood may be drawn directly from the vein of the supply animal into the hypodermic
syringe and injected immediately into the other animal or animals, while it is still warm and fluid.

Fever Reaction.

For the first eight or ten days, with some exceptions, no rise of temperature takes place (period of incubation). About the tenth day, signs of fever are noticeable by the use of the thermometer. There may be two, three, or more degrees above the normal. The fever continues for about eight or nine days, but in some instances, may not exceed four days, while in others it may continue fifteen days. This is known as the primary reaction, or first stage of the fever. During this stage we have known the temperature to reach 108 degrees Fahrenheit, and over.

After this period there is a remission; and from about the twenty-fifth to the thirtieth day, after inoculation, there is another rise which lasts about seven to ten days. This is the secondary reaction, or second stage of the fever, which may differ somewhat from the primary in being more irregular in its course. The temperature should be taken morning and evening.

Should the blood of the animal be examined during these fever periods—by an instrument termed the haemocytometer—for the purpose of noting the number of cells in a given quantity of blood, it will be found that they will have been considerably reduced in number, owing to their destruction by the fever germ, which appears to be particularly active at these stages.

After perfect recovery from the second period of fever, which might be placed at from fifty to sixty days from date of inoculation, the animal may be exposed to mild tick infestation. But it seems much safer not to subject newly inoculated animals to extreme conditions for at least one year.

Although inoculation may be performed at any season of the year, the best time in our climate is during the late fall or early winter months. This prevents a too sudden gross infestation with ticks when the animal is turned on to pasture, as would, naturally, be the case during the summer months.
Care of the Animal During the Inoculation Fever.

The care of the animal during the course of the inoculation fever is of the utmost importance. The quarters should be absolutely free from ticks, and they should be comfortable in every way. Exposure to climatic severities, while the animal is the victim of the fever, is likely to be succeeded by untoward results. The food, as previously alluded to, should be nutritious, as it is desired to furnish the elements that will keep building up and restoring the blood and other tissues of the animal body that are being broken down as a result of the disease.

It has been the custom with our Station to feed the animals three times per day, with a moderate quantity at each feed, of concentrates such as crushed corn and oats mixed, with hay, when the animals were not able to be turned out to graze. Where a convenient oat patch can be made available, pasturing on it during the day will be found quite beneficial, in not only nourishing the cattle, but keeping the bowels in good condition. In this case, concentrated food may be given morning and night only.

There is no special ration that might be suggested. Any good sound concentrated feeding materials that are available, so long as they are nutritious, will be suitable. The animals should not be surfeited with too much food, but it should be rather allowed in moderate quantity. And, as before stated, pure drinking water should be accessible at all times; and a little salt will be found beneficial.

Complete Immunity Not Conferred by Artificial Inoculation.

Having successfully passed through two periods of fever before being exposed to ticks on pasture, the animal seems to have obtained a sufficient degree of immunity to withstand the ill-effects of further inoculation by the ticks, provided the latter are not so numerous as to transmit the germs in excessive numbers and cause a relapse. Hence the value of having the animal ready to place on pasture at a season of the year when seed ticks are few, but sufficient to keep up the inoculation until absolute im-
munity is reached. In other words, artificial inoculation gives the animal a start toward immunity, and the ticks keep it up until it is immune. But it should be arranged so as to have the tick inoculation gradual, and not sudden and excessive, as would be the case in summer, with gross tick infection of pastures.

RECENTLY ARTIFICIALLY IMMUNIZED ANIMALS SEEM TO SUFFER LESS ON PASTURE WHEN RUNNING WITH NATIVE, OR OTHER, PERFECTLY IMMUNE CATTLE.

It has been our experience at the Louisiana Station, that when a number of recently immunized cattle are placed upon a ticky pasture alone, they seem to suffer more severely from tick-inoculation than when allowed to run with native animals. The reason for this appears to be, that the germ of the fever becomes more virulent when perpetuated in ticks bred upon imperfectly immune, or partially susceptible, cattle. It would seem that when being passed, from time to time, through the blood of native or perfectly immune stock—which become highly resistant to its effect, the germ loses, to a considerable degree, its virulence. That is, it becomes attenuated or weakened, and afterwards, when inoculated into the circulation of the recently immunized animal by the tick, does not produce such an acute form of the fever. But, when there are no immune animals present, along with those recently inoculated, to modify the virulence of the germ, the latter may suffer considerably, on account of increased potency on the part of the organism. Hence, we would suggest that cattle, recently inoculated and turned out at the proper time, should be permitted to run along with native, or immune, animals for the reasons just advanced.

ERADICATION OF THE TICK.

Great as has been the boon of artificial immunization of susceptible cattle to the Southern stockman, the ideal situation will not have been reached until the cattle tick has been eradicated from the Texas fever belt of the Southern States.
By the aid of the inoculation process, alone, our stock owners have been enabled to import pure-bred cattle from Northern States to improve their herds, in spite of the presence of the tick. But the latter still remains with us, and so long as it does so, the Southern feeder of beef animals will never be placed upon the same footing with his Northern neighbor, so far as the advantages of the great markets of the North and West, at any and all seasons of the year, are concerned; and this, too, solely on account of the tick.

True, Southern cattle for immediate slaughter can now be shipped north of the Federal quarantine line, but only during a very short period of the winter season, and then have to be placed in special sections of the stock yards provided for Southern cattle, which tends to interfere with fair competition.

Again, the Southern raiser of show cattle is prohibited from competing with the Northern exhibitor in the great State, National and International expositions, which he ought, and would be able to do, were it not for the influence of the tick.

But, even in the case of our native cattle, and from a local economic standpoint, the tick is perhaps the greatest enemy of our cattlemen. Because, although our Southern animals may be, and the majority are, immune to Texas fever, the constant irritation produced by, and the blood-sucking proclivities of, the tick, enormously retards development in the animals, in the direction of growth, fattening and milk-giving qualities. Looked at from every point of view, therefore, it will be seen that the great incubus to a prosperous cattle industry in the South is the common cattle tick.

Appropos of our remarks with reference to shipping fat cattle to the Northern markets, it might be instructive to refer here, to a demonstration made by this Station two or three years ago.
DEMONSTRATION IN FATTENING CATTLE FOR THE NORTHERN MARKET.

To test the question as to whether Louisiana could fatten a carload of steers, on home products and by-products, for the Chicago market, and compete with those fed in the corn belt (which was not thought feasible by some feeders in that section), the Station purchased a lot of high-grade Aberdeen Angus calves in the neighborhood of Clinton, Ill. Seventeen steer calves, the remainder being heifers and one bull, were selected for the demonstration. Being susceptible, or non-immune, all of the animals (some thirty-four head) had to undergo the immunization process, which they did without loss, except in the case of a steer calf, which succumbed to an acute attack of congestion of the lungs during convalescence from the inoculation fever. On January 1, 1904, a carload of sixteen steers left the Experiment Station at Baton Rouge, averaging two and one-half years, and 1,325 pounds in weight. They were six days and nights on their journey, and when sold in Chicago, averaged 1,251 pounds. They brought $5.65 per hundredweight, topping the market on the day of sale by 40 cents. They were purchased for New York account, and when butchered, dressed within a fraction of 59 per cent.

Although this was an excellent showing, had it not been for the tick, which infested these animals from time to time during the convalescent and fattening periods, there is no reason to doubt that the gradual and ultimate gains made in weight would have been considerably greater.

THE ERADICATION OF TICKS FROM PASTURES IN THE SOUTH

Is a matter which has occupied the attention of several of the experiment stations for some time. Dr. Tait Butler, in North Carolina, has, already, by a system of tick starvation and rotation of pastures, freed several of the counties of that State of ticks, and brought them above the Federal quarantine line, so that the cattle now raised in them have free access to the Northern markets at any season of the year, much to the advantage and gratification of their owners.
In our own State, Prof. H. A. Morgan, late Station Entomologist, and now Director of the Tennessee Agricultural Experiment Station, has, based upon a careful study of the life-history and habits of the cattle tick, suggested a method of tick eradication, which we think will, so far as our latitude is concerned, prove of incalculable value in revolutionizing our cattle industry.

The results of Professor Morgan's investigations, while in Louisiana, have already been published as Louisiana Experiment Station Bulletin, Second Series, No. 82, and to which reference is commended for detailed information on the subject. We have, however, taken the liberty of reproducing that part of the work which deals with two methods suggested, in order to render this publication the more complete and comprehensive. These are as follows:

Data and Pasture Rotation. Remedy I.—(a).

"In the study of the development of the Texas fever cattle tick during the summer months it was found that the time required for seed ticks, after infesting animals, to mature into engorged females and drop to the ground for egg deposition was a little less than the time required for a female after dropping to lay eggs, and these eggs to hatch. Therefore infested animals might be cleaned of ticks by being placed in a tick-free field, upon which to drop all their ticks before eggs from females dropped the day the animals were placed in the pasture would hatch. The time between the dropping of the ticks and possible reinfestation was of too short duration for this plan to be practicable in the face of slight developmental variations due to changes in temperature or other conditions. Experiments were conducted in order to determine if a wider range of time between these important suggestive remedial periods did not exist and thus develop a remedy easily within the range of the average farm operations of the State. Continuing the breeding experiments through every month in the year, it was found that eggs deposited the latter part of November, and in December, January, and February, did not hatch until late March, April, or early May, and that the longest period of development of the tick (from seed tick to full engorgement and period of dropping) upon cattle during these months
was forty days, thirty-five being in most cases ample for the development and dropping of every tick. It thus became easily possible to place infested animals upon tick-free areas during late November, December, and January, have them drop every tick, and run no risk of reinfestation, as eggs did not hatch under the prevailing temperature of these months.

Data and Pasture Rotation. Remedy I.—(b).

"The next phase in the development of a practical remedy was the determining of the length of time necessary to starve ticks out of a pasture when all hosts (cattle, horses and mules) were excluded. Experiments during the summers from 1897 to 1904, inclusive, showed that about one month was necessary for the laying and hatching of eggs and that seed ticks could endure as long as two months in summer without food. For example, if all hosts of the cattle tick were removed from a pasture on June 1 this pasture would be tick free by early October.

"The fall and winter months, though a decidedly opportune period for ridding animals of ticks, were found least effective as a period for cleaning pastures by excluding cattle tick hosts. Eggs deposited in late fall may not hatch until the next March or April, and seed ticks may live without food from late September until the middle of the following April. It will thus be seen that more time is required during the late fall and winter months to deposit and hatch tick eggs or to starve out seed ticks than is necessary during midsummer to effect both operations.

"With this information a remedial application may be perfected to meet the conditions upon the farms or plantations of the South. Pastures may be divided so that from a portion of them all animals (cattle, horses and mules) upon which the Texas fever cattle tick develops may be excluded from June 1 until late fall in order that the animals when cleaned of ticks may have a tick-free field in which to be placed. To be cleaned the animals may be placed, not earlier than the middle of November, in a corn or cotton field from which the crop has been removed, and there kept until the ticks have dropped (thirty-five or forty days). In no case should they have access to the pasture from which they have just been taken, as animals may become infested during a
warm spell of the winter months with seed ticks which hatched in September or early October. (Seed ticks hatched September 29, 1903, remained alive without food until April 10, 1904). As soon as all ticks are dropped the animals may be removed to the tick-free field, or they may remain longer without danger of reinestation if the corn or cotton field provides sufficient pasture. Not later than February they should be placed in the tick-free field to be fed the hay crop gotten from this area the previous season. Upon this tick-free area they may be kept until sufficient time has elapsed to destroy the ticks by starvation in the pasture from which they were removed into the corn or cotton field the fall previous.

"FEED-LOT" METHOD OF RIDDING CATTLE AND OF CLEANING
PASTURES DURING SUMMER. REMEDY II.

"It should be remembered that not all farms nor all fields of individual farms lying below the National quarantine line are infested with the fever tick. Parishes of Louisiana devoted to sugar cane and rice culture are practically free from ticks. Many cotton plantations are also exempt, and those parts of all farms throughout the South upon which no cattle have been from June 1 until October 1, or later, are also tick-free. These areas may be advantageously used in eradicating the fever tick from contiguous ones.

"The 'feed-lot' method of cleaning cattle is based upon the fact that the parasitic period (from attachment as seed tick to dropping to ground as a fully engorged female) of the fever tick is not more than forty days; less in summer. In this method a portion of ground is set apart, half of which is of sufficient size to accommodate the number of cattle on hand. The area selected should be convenient to plenty of feed and water. Surround and divide the lot with a double fence (8 to 10-foot space). Feed the cattle for twenty days on one side, then remove them to the other for fifteen or twenty days longer. Every female tick will have dropped, and the cattle may then be placed upon such field or pasture as may be tick-free and available." (Male ticks may remain on cattle two or three weeks longer, but are harmless in
the absence of females.) “By this method entire farms may be cleaned during a summer period of not exceeding four months. In the early spring select a field with water and shade available to be devoted to broadcast sorghum, corn or millet, or all three. On June 1 fence off the feed-lot (within the forage field), in which place all the cattle of the farm, and feed and rotate as described above for forty days. At the end of this period the cattle may be turned into the field of sorghum, millet or corn, and there pastured until October 15 or November 1, by which time all fever ticks upon the entire property outside of the feed-lots will have perished.

“After the animals are removed the feed-lots should be immediately plowed and thoroughly cultivated, and their edges completely sprayed with crude petroleum, zenoleum solutions, or other substances destructive to tick life.

Summary.

“1. The North American cattle tick has been bred upon cattle, horses and mules. Horses and mules are not continuously infested when upon ticky pastures as are cattle.

“2. Sheep and goats run upon pastures, scatter bunches of seed ticks and reduce possible infestation of cattle upon the same pastures.

“3. The excessive tax of gross infestation of ticks is not only shown by the great loss of flesh of animals attacked, but in the slower development of ticks on animals intensely infested.

“4. In connection with the two pasture methods suggested for the eradication of the fever tick, the periods of greatest importance in the life of this tick are, (1) the combined egg laying and incubation, which takes place upon the ground of the pasture, and (2) the development of the tick upon cattle (from the time the seed ticks are collected from the pasture and attach, through the two molting periods, to the engorgement and dropping of the females). Eggs hatch readily in from twenty to thirty days from May until early October. Those deposited in the latter half of November, in December, January, February, and early March, hatch in April and May; earlier in exceptionally open winters. Ticks develop upon cattle in from about nineteen to thirty days
in summer, and the longest winter development upon cattle was found to be forty days.

"5. More eggs are deposited in summer than in winter. Many females succumb to the cold before depositing half as many eggs as females of the same size would deposit in summer.

"6. Seed ticks possess remarkable vitality, having been found to be able to exist without food as long as two months in summer and over six in late fall, winter, and early spring.

"7. From a study of the life and habits of the fever tick, two plans have been developed for its eradication: (1) a pasture rotation system, utilizing June, July, August, September, and October to starve out the tick from pastures by excluding cattle, horses, and mules; (2) the adoption of the feed-lot method within a sorghum, corn, millet or other forage field conveniently located for water and shade.

"8. Animals south of the quarantine line may, any time during the year, be absolutely cleaned of female ticks in forty days or less by the feed-lot method.

"9. Seed ticks hatched in late September and October, living as they can as long as six months, may infest cattle during any warm spell from late September until April.

"10. While a number of substances are of great value in reducing tick-infestation of animals, they are attended with some loss, considerable expense, and much worry, and can not be relied upon for complete eradication except when associated with the pasture rotation remedy. Many substances used to lessen tick infestation irritate the skins of animals and lengthen the period of development of ticks which survive the effect of the application.''

CAN THE CATTLE TICK BE EFFECTUALLY EX- TERMINATED FROM SOUTHERN PASTURES?

In answering the query we have made for ourselves, we would say, that with individual effort, only, No! With united action, Yes!

If the work of Morgan and Butler, and possibly some others, of totally eradicating ticks from restricted areas, which, in the
case of North Carolina, amounted to several counties, means anything, it is, that it is possible to extend the good work, along similar lines, to take in the entire tick-infected sections of the Southern States. But, there must, of course, be concert of action and uniformity of effort on the part of every one concerned. Fortunately, the ultimate success of the plans suggested has appealed to the United States Department of Agriculture, and Mr. Hunter, under the Bureau of Entomology, in co-operation with all of the States affected by the cattle quarantine, and who is in charge of the work, is now engaged in pushing the biologic investigation of the tick, which we hope is the beginning of great things for our Southern cattle industry.

Although the Government has already taken hold of the matter, it may not be out of place to quote a resolution passed by the American Veterinary Medical Association at its annual convention held in Cleveland Ohio, in August last, as it shows, in brief language, the importance of this great work:

"Whereas, the Southern cattle tick (Boophilus annulatus) and the resulting Federal quarantine restriction on the movement of Southern cattle, is the greatest obstacle to the growth of the cattle industry of the Southern States, and

"Whereas, the work of tick extermination in some of the Southern States demonstrates that it is perfectly feasible to eradicate the cattle tick pest, and

"Whereas, the Federal Bureau of Animal Industry has successfully conducted measures to eradicate other diseases when affecting or jeopardizing the cattle interests of other sections of the country; therefore be it

"Resolved, That it is the sense of this Association that the time has arrived for active and substantial Federal assistance to the Southern States in their efforts to exterminate the greatest present menace to the cattle interests of a large part of our country."

With the eradication of the tick, Texas fever, that bane of the Southern raiser of improved cattle, will be a thing of the past, and instead of embargoes, in the form of quarantine restrictions against the free movement of our cattle northward to the great markets, all barriers will be lowered, and our stock will be granted
a free entry at all times to whichever mart suits best the convenience of the owner.

What a future for the cattle industry of such a magnificent cattle-growing section of the country! What an object to be attained! It is possible of realization! Let us all work together as a unit for its accomplishment. For, apart from the fact that the tick is the conveyor of the germ of Texas fever, it should be strongly borne in mind that it is also a parasite on our cattle, and the most baneful in its effects that the Southern cattle raiser has to contend with.
EXPLANATION.—The Texas Fever section of the United States is south of a zigzag line, shown in the map, beginning at the extreme northwest corner of the illustration; passing along the southern boundary of Arizona, and down to a point on the southern boundary of Texas. It afterwards passes up to the northern line of the Indian Territory; across the southern boundary of Missouri; then through a portion of Tennessee and North Carolina and up in a northeasterly direction through Virginia.

The numbers shown on the map have no significance here.