EXPERIMENT STATION
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VETERINARY DEPARTMENT.

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Blackleg and Vaccination.

EXPERIMENTAL investigation of blackleg was begun by this department in 1891, and a brief report upon the disease was published in Bulletin No. 69, in 1897. In 1897 the preparation of a blackleg vaccine was begun by the writer, and was carried on later by Doctor Fischer and Doctor Butler, the results being published in Bulletin No. 105, November, 1901. The present bulletin is based upon observations made since 1891. The statistics are based upon reports covering the period from January 1, 1901, to January 1, 1903.

Blackleg, also called black-quarter and quarter-ill, and sometimes described in text-books under the name of symptomatic anthrax, is a disease of young cattle caused by a germ, *Bacillus chauvmi,* and in Kansas causes a greater loss than any other disease of young cattle. The name symptomatic anthrax implies a relationship to the much more serious disease known as anthrax. As there is no relation between them, except some similarity of symptoms, the name symptomatic anthrax should be dropped, to avoid confusion, and the common, well-understood name of blackleg used.

Foreign veterinary writers state that blackleg occurs among sheep and goats, but if it ever occurs naturally among other animals than young cattle in this state it is extremely rare, although many thousand head of sheep and lambs are fattened for market in this state under conditions extremely favorable for the development of blackleg. But a single case of blackleg among sheep has ever been re-

ported to this department, that one being reported by a stockman, and was considered a doubtful case. If blackleg ever occurs among sheep and goats in this state, the loss is certainly insignificant.

CONDITIONS FAVORING BLACKLEG. It is the universal experience of stockmen that blackleg, as a rule, attacks young cattle that are in the best physical condition, particularly if they are gaining rapidly in flesh and are on excellent pasture, or are being fattened for the market on dry feed. Blackleg has been one of the most serious drawbacks to the successful production of baby beef. By some stockmen it is thought that if young cattle are losing flesh rapidly they are also more likely to contract blackleg. A thrifty or fat condition of young cattle is favorable to the development of blackleg and the only well-recognized condition that favors the disease Sex or breed does not seem to make any difference in the susceptibility to blackleg. In response to the question as to whether bull calves were more susceptible than heifers, 547 stockmen reported. One hundred and seventy-one reported that bulls seemed more susceptible and 381 reported that they were not. It is probable that the loss from blackleg among pure-bred beef cattle is a little greater than among common native stock, but this may be accounted for by the better physical condition in which the pure-bred young cattle are usually kept.

AGE. Many cases of blackleg have been reported in suckling calves from two to three weeks old. And several cases have been observed by the writer in suckling calves. This is important, because veterinary writers generally state that it does not occur in calves while on a milk diet, but blackleg frequently occurs in this state among calves that are suckling the dams or are being fed milk, although the disease is not so frequent as later on. The disease is most likely to attack calves between six and eighteen months of age. After two years of age there is little danger, although a few cases are reported. Above three years of age blackleg is extremely rare, but does occasionally occur in aged cattle.

SYMPTOMS. One of the first symptoms usually noticed is that the sick animal remains apart from the herd, usually lying down and not ruminating (chewing the cud). If the animal moves around it appears lame and stiff in one leg and moves the affected leg in a stiff and awkward manner. Exercise frequently causes some of the stiffness to disappear. Sometimes the disease affects more than one leg, and in some cases the neck is stiff or the animal is stiff all over, or in one-half the body only.

When examined closely the muscles of the affected part or quarter are found to be swollen and tense. At first the swelling is small and

painful, but as it rapidly increases in size the tenderness disappears, and in a few hours the circulation is arrested and the part becomes cold and painless. This swelling is found to contain gas, which is shown by a drum-like feeling and a peculiar crackling or spongy sound when firmly pressed or rubbed with the hand. The presence of a large muscular swelling, which emits a crackling sound on pressure, is a characteristic symptom of blackleg. Blackleg swellings occur most frequently on the shoulders, hips, along the sides of the back, on the brisket and neck. They do not occur on the legs below the knees or hock joints. Blackleg swellings are extremely rare on the belly. If the swelling is lanced a dark red, frothy, bloody fluid bubbles out. This fluid swarms with blackleg germs.

In the early stages the calf has a fever, the temperature often running to 105 degrees F., but as the disease progresses toward death the temperature falls below normal (101 to 102 degrees F.) At first the mucous membranes, particularly of the eye and nostril, are congested and red, but later they have a dull leaden color.

Animals suffering from blackleg are often easily excited in the early stages, and if driven and disturbed will sometimes fight viciously. After an animal affected with blackleg gets down and unable to rise there is often some bloating noticed, particularly on the left side, but bloating is only incidental and is due to indigestion, which may be induced by lying in one position. The bowels are usually constipated, a small quantity of dark-colored and rather hard dung being passed. Death usually occurs in from six to forty-eight hours after sickness is observed.

POST-MORTEM APPEARANCES. Practically the only abnormal condition noted in an animal that has died from blackleg is the altered appearance of the affected muscles. The muscles look as if badly bruised and filled with thick, dark blood and gases. The gas is noticed particularly in the connective tissue and blood, and occurs in bubbles. The connective tissue of the affected region often has a gelatinous appearance. Decomposition of the affected tissues, and the contents of the digestive organs occurs rapidly after death and the body is soon badly bloated. Bodies of animals dying from blackleg should be burned, or buried deeply, and not left on the surface of the ground to spread the infection.

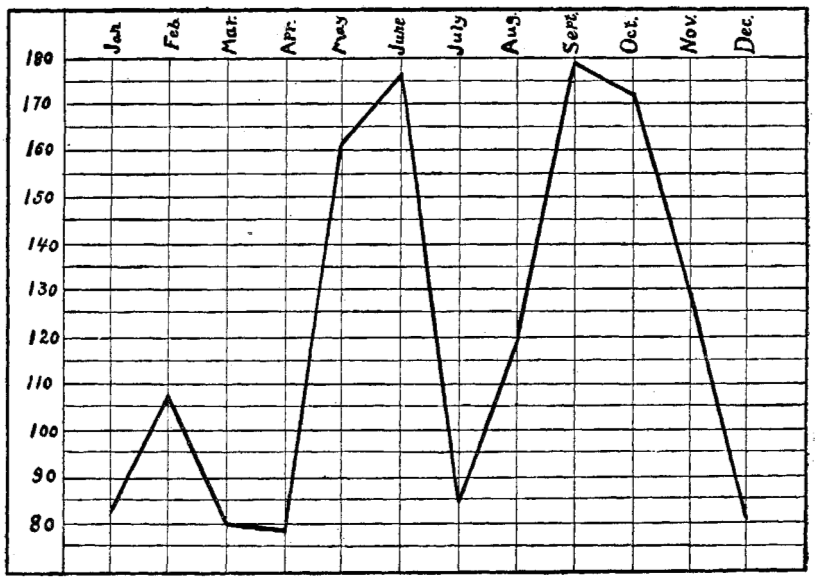
INFLUENCE OF THE SEASON OF THE YEAR. Blackleg occurs at all seasons of the year. Reports received from 1656 stockmen of Kansas, giving the months when their greatest losses occurred, show that in May and June and in September and October are the seasons when their greatest losses occurred. These reports were collected in six

different lots, each lot representing the state generally. The six lots of reports are summarized in the following table, the total results being shown at the bottom of the table.

TABLE showing losses from blackleg, by months. Figures represent the number of persons reporting the months in which their greatest losses from blackleg occurred.

No. of stockmen reporting.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
271	20	22	18	15	27	37	11	19	34	28	26	14
685	38	43	40	31	52	59	30	44	69	69	49	35
351	10	23	6	18	42	38	24	29	38	39	26	9
167	3	13	3	10	22	20	14	17	21	22	11	12
50	6	3	5	1	7	7	2	1	6	9	7	3
132	6	4	8	4	11	15	3	9	11	14	10	8
1,656	83	108	80	79	161	176	84	119	179	172	129	81

PLATE I. Chart compiled from these tables graphically illustrates the prevalence of blackleg during the different seasons of the year.



From these statistics, it will be seen that, as a rule, the loss from blackleg is much greater in May and June and in September and October than at any other season of the year. It is interesting to note that the line representing the mortality from blackleg shows the heaviest losses in those seasons when the young animals as a rule are making the most rapid gains in flesh. In May and June young cattle are usually making excellent gains on the fresh pastures; in July and August there is generally a slight falling off in flesh, due to the hot, dry weather. Later, as the grass matures and cooler weather comes on,

young cattle are usually in the best flesh of the year, and it is during this period of the year that the greatest losses from blackleg occur. The better physical condition seems to offer the most plausible explanation of the increased prevalence of blackleg at these seasons. It will also be noted that there is a slight increase of blackleg during the month of February, This increase I am unable to account for satisfactorily, unless it may be that young range cattle may be gaining in flesh from forage which is fed at this season or earlier.

INFLUENCE OF SEASON. In response to an inquiry as to whether losses from blackleg were greater in wet or dry seasons, 411 stockmen reported as follows: 191 reported that their greatest loss occurred in wet seasons, 140 reported their greatest loss in dry seasons, and 80 reported that no difference was noticed. These reports would indicate that blackleg losses were slightly greater during wet seasons, but this may possibly be accounted for by a better growth of forage crops and a correspondingly better condition of the animals.

DISTRIBUTION. Blackleg occurs in all parts of Kansas, the largest amounts of vaccine being sent to the central and western parts of the state; but this is probably the result of the greater number of young cattle raised in these portions of the state. In European countries blackleg causes greater losses in moist, fertile lowlands. The increased prevalence may be due to the thriftier condition of animals kept on such lands. Three hundred stockmen in all sections of Kansas, owning or controlling 107,874 head of cattle upon which to base their opinion, reported as follows: 151 reported blackleg more serious on bottom-land pasture, 62 as being more prevalent on upland pasture, and 97 could detect no difference. Blackleg seems to be as prevalent in western Kansas and eastern Colorado as elsewhere in the state, and this region is noted for its high altitude and clear, dry climate. From our own observations, made in the vicinity of Manhattan, no particular difference in prevalence of blackleg is noted on the high lands or river bottoms.

MANNER OF INFECTION. Blackleg is generally considered by veterinary authorities to be a wound-infection disease, but among a large number of cases observed by the writer there has never been a visible wound through which infection might have taken place except in cases experimentally inoculated. It is possible, if not probable, if infection with the germs of blackleg takes place through a wound, that sores in the mouth, which are frequent in young cattle while they are cutting and shedding their teeth, may offer favorable places for infection. Experiments made by this department by drenching susceptible calves with infectious material have not been successful

in producing the disease. Another circumstance which is rather against the theory of wound infection is that it is quite a frequent practice among stockmen to dehorn a bunch of calves as soon as blackleg appears, as there is a common opinion that this operation tends to stop the spread of the disease. If wound infection is a common method of contracting the disease, dehorning an infected bunch ought to offer favorable conditions for the spread of blackleg,

PERIOD OF INCUBATION. This is the length of time that elapses after the germs are introduced before signs of the disease appear. This will vary according to circumstances, from five hours to four or five days.

IMMUNITY. This is the power which an animal possesses to resist disease. Immunity may be natural or acquired; that is, an animal may possess immunity when born or they may acquire immunity afterwards. Swine possess a natural immunity towards blackleg; calves do not; but as they get older — from two to three years — they acquire immunity. Immunity against blackleg may be acquired by having a mild form of the disease or by vaccination. Calves are vaccinated to give immunity against blackleg.

Calves seem to possess some natural immunity against blackleg. This natural immunity varies with different individuals, with different herds of cattle, with the physical condition of the animal, and apparently with the season of the year. There is no way of detecting the degree of immunity, except that they do not acquire blackleg when infected by germs of the disease. This varying individual immunity is also shown by the fact that, when a dangerously strong blackleg virus is injected into susceptible calves under the same conditions, a few will resist infection and will not contract the disease. The physical condition of the animal also affects the natural immunity. Calves that are gaining rapidly in flesh are unusually susceptible. This is well established by the fact that when blackleg occurs in a bunch of calves the fattest and best are among the first to contract the disease. For this reason blackleg has been one of the most serious drawbacks to the successful feeding of baby beef.

Immunity also seems to vary with different bunches of cattle. Experiments in vaccination indicate that a vaccine that has been carefully prepared and tested, when sent out and used by different individuals upon more than 10,000 head of cattle, will occasionally cause the loss of cattle as a direct result of vaccination. This would indicate that the natural immunity in these cattle was very weak. These results, however, are always complicated by the possibility that the vaccine was not properly prepared or used.

VACCINATION IMMUNITY. When calves are properly vaccinated with a good vaccine the immunity conferred is considerable. Where calves have been vaccinated for experimental purposes by this department attempts to infect the calves by injecting virulent material were unsuccessful, and it was necessary to get unvaccinated calves in order to infect them with blackleg,

BLACKLEG VACCINE. Blackleg vaccine is made by taking the bruised-looking diseased flesh from an animal affected with blackleg. This meat is cut into thin strips, dried, and ground into a fine powder. The power is wet with distilled water and weakened or attenuated by heating for from six to seven hours. The higher the temperature and the longer the vaccine is heated the weaker it becomes. After being weakened by heat the vaccine is again ground into a very fine brownish powder, and is sent out in this form. Two kinds of vaccine are made and distributed by this department. Each vaccine is put up in ten- and twenty-five-dose packets only. These are doses for yearlings or over. A single vaccine that requires but one vaccination is put up in red-paper packets, and a double vaccine that requires two vaccinations about ten days apart is put up in white- and yellow-paper packets. Both single- and double-vaccine packets are plainly labeled, and on the back of the packet is stamped the date by which time the vaccine should be used, as it loses strength after a few months.

Single vaccine is made by heating the pulverized blackleg meat for six and one-half hours at a temperature of 92º to 93º C. It is wrapped in red paper, in ten- and twenty-five dose packets. The single vaccine requires vaccinating but once.

The double vaccine consists really of two vaccines. The first, a very weak vaccine, is made by heating the pulverized blackleg meat at a temperature of 99° to 100° C. for six and one-half hours. This first vaccine is put up in white papers, and, being a very weak vaccine, is intended to prepare the animal's system for the second, which is a strong vaccine.

The second of the double vaccine is made by heating the pulverized blackleg meat for six and one-half hours at a temperature of 88° to 89° C., and is put up in yellow-paper packets, plainly marked,

Until the beginning of 1903 the vaccine sent out by the department was prepared by heating the first of the double vaccine from 59° to 100° C. for six hours, and the second. vaccine at 85º to 86º C. for six hours. The single was heated at 92° for six hours. While there was little danger in using these vaccines, it was found that they were a a little too strong for use by the average stockman, particularly during the winter season, as the immediate loss following vaccination was too high. By experiment, it was found that heating the first of

the double vaccine at 99° to 100°C., and the second at 88° to 89° C., for seven hours, and the single vaccine at 92° to 93° C. for six and one-half hours, more satisfactory results were obtained. The immediate loss was much less and the degree of immunity conferred about the same.

The vaccine made by this department is furnished to stockmen for one cent per dose, either single or double, which covers the cost of making and sending out.

The amount of vaccine made and sent out by this department for the years 1901 and 1902 is as follows:

1901.	Single doses.	Double doses.	1902.	Single doses.	Double doses.
January	5,740	6,070	January	5,635	7,705
February	3,060	3,645	February	1,515	4,850
March	4,050	8,265	March	5,815	12,700
April	6,795	9,655	April	11,980	14,395
May	6,270	7,850	May	7,190	10,235
June	8,785	7,330	June	5,290	4,720
July	5,410	4,000	July	6,385	5,960
August	3,230	5,480	August	11,940	6,340
September	5,465	8,415	September	7,320	13,215
October	14,225	20,770	October	17,565	25,105
November	18,480	20,250	November	16,160	17,655
December	6,340	20,355	December	7,760	5,680
Totals	87,850	122,285	Totals	104,555	128,560

Practically all of this vaccine was used in Kansas. To this amount must also be added the vaccine furnished by the Bureau of Animal Industry, at Washington, and commercial vaccines purchased upon the market. This forcibly illustrates the general use of vaccine by stockmen of the state, and the fact that young cattle have been vaccinated adds considerable to their market value.

The vaccine prepared by this department is made with great care and is always tested upon a bunch of calves before being sent out.

VACCINATING INSTRUMENTS. To use the vaccine it is necessary to have a hypodermic syringe, mortar and pestle, graduate, funnel, and filter paper. Such an outfit can usually be purchased upon the market for four or five dollars. To accommodate Kansas stockmen, this department always keeps a supply of vaccinating outfits on hand. By purchasing them in large quantities we are able to furnish them for $3.50, complete. In some localities several stockmen own an outfit in common. The department also has on hand supplies for outfits, such as needles, plungers, filter-paper, etc., which are supplied at cost. The outfit which we can supply comes in a neat hardwood case. The accompanying illustration shows the box and its contents.

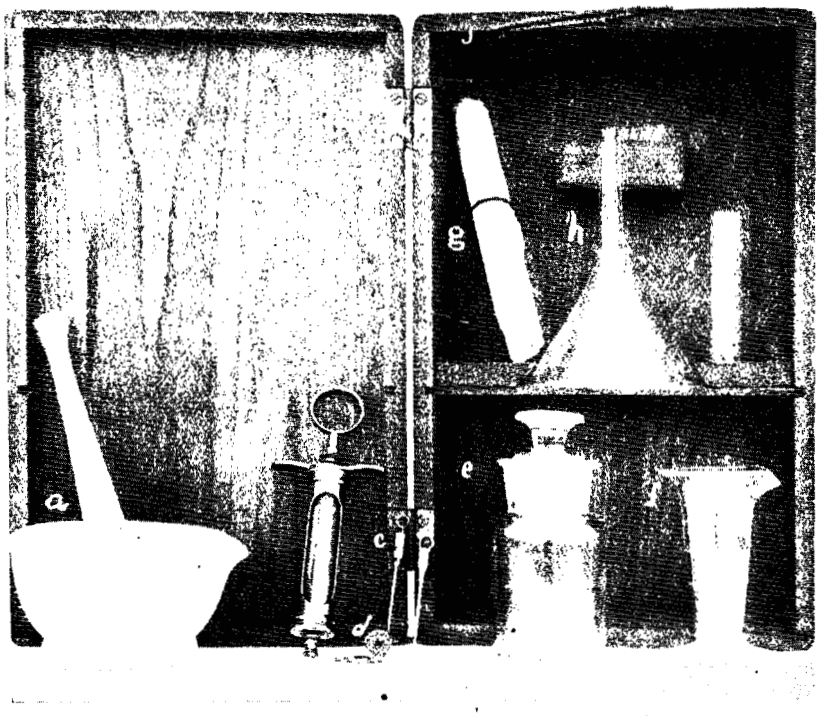


PLATE II.—VACCINATING OUTFIT.

a, Mortar and pestle; *b*, syringe; *c*, two needles; *d*, extra washers and plunger; *e*, bottle for holding filtered vaccine; *f*, graduate; *g*, filter-paper; *h*, funnel; *i*, extra glass barrel for syringe; *j*, ring for holding funnel.

THE SYRINGE. The vaccinating syringe holds five or six centimeters; that is, sufficient vaccine for five or six yearling calves. The graduations are marked on the plunger stem. There is also on the stem a small nut that can be screwed down so that the dose can be accurately determined. The plunger of the syringe should be adjusted so that, when the inside of the syringe is wet it will work smoothly. This adjustment can be regulated by pushing the plunger clear down and turning the thumb ring to the right or left, to tighten or loosen the plunger. There is a screw cap (b) which should be kept on the syringe when not in use, to protect it from dirt. A small washer should be kept on the nipple where the needle screws on, to prevent the vaccine leaking. Two needles (c) that screw on are supplied with each syringe. The needle points should be kept sharp by using an oilstone if necessary. A small wire (d) is furnished with each needle, to be inserted when the needle is not in use; this wire protects the point of the needle and keeps the dirt out. Do not

put oil in the syringe, as it will ruin the rubber plunger and rubber washers at the end of the barrel.

STERILIZING THE INSTRUMENTS. It is very important that the vaccinating instruments be kept as clean as possible. After using the syringe it should be disinfected by filling with a five-per-cent. solution of carbolic acid or a two-per-cent solution of creolin. This should be left in the syringe for a few minutes; then the syringe should be rinsed with clear water that has been boiled. The bottle, funnel and graduate should be treated in the same manner. Do not pour boiling water on the syringe, graduate, funnel, or bottle, as they are liable to break. They may be placed in warm water which can gradually be brought to the boiling-point.

If blackleg exists in the herd at the time of or just previous to vaccinating, the needle should be disinfected by dipping it into a strong disinfecting solution, such as a five-per-cent solution of carbolic acid. This is to prevent infecting other calves, should a calf having blackleg be vaccinated. Otherwise, other calves might become inoculated from the infected needle. Should any calves show symptoms of blackleg, they should be left until the last, and the instruments be thoroughly disinfected after vaccinating them.

AGE TO VACCINATE. Young cattle can be vaccinated at any age, although it is rarely advisable to vaccinate calves under three or four weeks old. Calves or young cattle should not be vaccinated when they are suffering from any debilitating disease, or when debilitated from shipping, driving, or a lack of feed or care. It is not advisable to vaccinate animals at the time they are dehorned or castrated. Calves under one year old should be vaccinated frequently — every three or four months, if possible. The younger an animal the shorter seems the period of immunity conferred by vaccination. After the calf is one year old vaccination gives immunity for about five to six months; after five months, however, the immunity is much less, and while it is generally accepted that vaccinating twice a year will protect them, from observations made by this department, vaccinating three times a year gives much better results. An excellent plan would be to vaccinate at one month, four months, eight months, one year, sixteen months, and twenty months. Frequent vaccination gives the best results.

KIND OF VACCINE TO USE. We supply two vaccines — a single and a double. The single vaccine may be said to be about half-way in strength between the first and second of the double. We ordinarily recommend the double vaccine, as it is a little safer to use and gives a little greater immunity or protection against blackleg than the single.

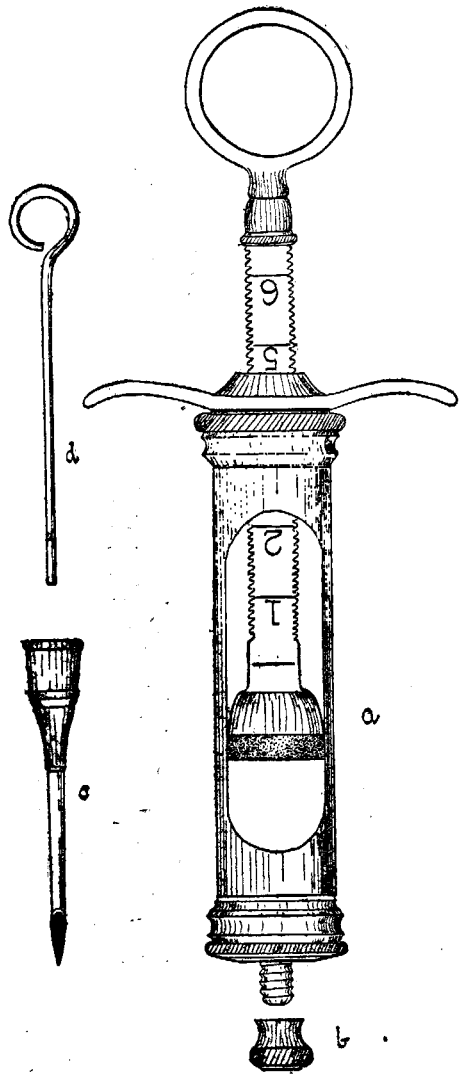


PLATE III.—Vaccinating Syringe.

If the calves are pure bred or in excellent condition, it is always advisable to use the double vaccine. This is especially true of calves that are on full feed for baby beef. Under such conditions we recommend using the first virus of the double vaccine, then in ten days use the single vaccine, and in ten days more the second virus of the double vaccine. Vaccinating with both single and double vaccine gives excellent results. If the number of calves to vaccinate is large, cattlemen usually prefer to use the single vaccine, as it saves the trouble and expense of handling the cattle twice.

When blackleg already exists in a bunch of young cattle, we advise using the single vaccine, and in ten days the second of the double.

The demand for single vaccine by the stockmen of the state has increased rapidly. Previous to 1901, less than one-third of the total amount of vaccine sent out was single, while at the present time the demand for single and double vaccine is about equal.

CONFINING THE ANIMALS. About the best arrangement for confining calves for vaccination is a narrow chute, where they can be closely crowded in. If many calves are to be vaccinated, a chute that will hold forty to fifty is very convenient. A foot-board along one side, at a convenient height for the operator to stand upon, is excellent. With such an arrangement and sufficient help to fill the chute quickly, 300 head an hour can be vaccinated. When there are only a few calves, a narrow stall, stanchion or chute makes a convenient place to confine them.

PLACE TO VACCINATE. There are several places on the animal where vaccination is commonly practiced. They are the shoulder, neck, tail, ear, and brisket. In the directions that have been sent out with the College vaccine the stockmen were directed to vaccinate in the tail, on the under side, four inches from the tip. The reason for vaccinating in the tail is that there is thought to be less danger of the animal contracting blackleg from the vaccination, and, therefore, the safest place to vaccinate. From the reports received, about one-half vaccinated in the tail and nearly one-half in the shoulder, with practically no difference in mortality. The tail is a difficult place, as the skin adheres to the bone so closely it is hard to insert the needle, and there is no loose tissue to hold the vaccine, which is likely to ooze out the needle track. Inserting the needle in this region is painful to the animal and causes struggling, and taking all together, the operator is apt to break the needle. If there is less danger in vaccinating in the tail, there seems to be less protection conferred by vaccinating at this point, probably because the vaccine leaks out, as the general results are about the same when

vaccinated in the tail or elsewhere. A good many vaccinated in the shoulder. This is a convenient place, as the skin is thin and there is considerable loose tissue beneath the skin. The objection to vaccinating in the shoulder is the danger of sticking the needle into the flesh or muscles which cover the shoulder deeply. After experimenting upon many hundred calves, we have decided that the most convenient place to vaccinate is beneath the skin of the neck, just in front of the shoulder. The skin is thin and loose in this region, The needle can be easily and quickly inserted ; there is little danger of sticking the needle into the flesh and no danger of the vaccine leaking out.

PREPARING VACCINE FOR USING. These directions assume that the vaccine used is the first of the double. Both the single and the second of the double are prepared in precisely the same manner.

Having the utensils and instruments perfectly clean, empty the contents of one or more of the packets in white paper, marked "first vaccine," into the mortar, and add a few drops of boiled but cooled water to this, and with the pestle grind or rub it *thoroughly* into a thin paste; then add for each ten-dose package of vaccine used ten cubic centimeters of the boiled water, or, if the twenty-five-dose packets have been used, add twenty-five cubic centimeters for each packet; add the water gradually, and continue to stir the mixture with a grinding motion of the pestle in the mortar. Then fold a filter paper, doubling it first so as to form a half a circle, as shown in figure 1; then fold a second time, at right angles to the first, as shown in figure 2. Then open one side, and the filter paper will form a cone (figure 3) that fits exactly the inside of the glass funnel, in which it should be placed, and wet with some of the boiled water. Allow all the water to drain off and discard it. The funnel containing the filter paper is now placed in or over the bottle with the ground-glass stopper. Stir the vaccine which has previously been prepared in the mortar thoroughly, and then pour into the filter. Practically all the liquid will paw through the filter, leaving the brown vaccine sediment in the filter. The filtered vaccine should be clear, or very slightly straw colored. Should it be dark colored, or any sediment in it, there is probably a hole in the filter paper, and it must be refiltered through a new filter paper. The vaccine should be very carefully filtered, until it is clear or slightly straw colored. This straw colored liquid is the material used for vaccination. Burn the filter paper containing the sediment; also burn the papers that the vaccine is wrapped in.

IMMEDIATE EFFECTS OF VACCINATION. If the vaccine is properly prepared and used, there are no visible effects following vaccination. The only way of telling whether the vaccine has taken effect is that the animals do not contract blackleg.

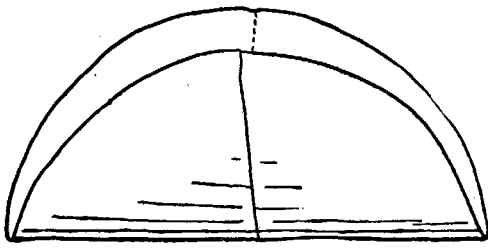


FIG. 1.

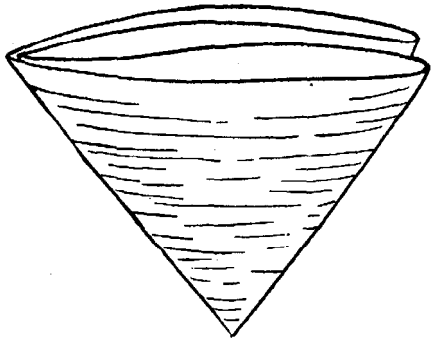


FIG. 2.

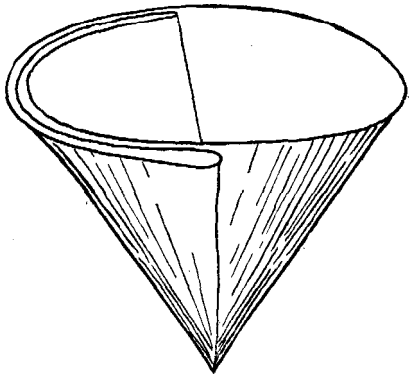


FIG. 3.

LOSS BEFORE VACCINATION. It is difficult to obtain statistics as to the loss from blackleg before vaccinating, as vaccination is so general that most of those who fill out blanks have vaccinated their cattle for some time and are unable to estimate losses previous to vaccination. In the Fifteenth Annual Report of the Bureau of Animal Industry, 1898, reports from 140 stockmen of Kansas estimate the loss among unvaccinated cattle at eleven per cent, and from similar reports the average loss from blackleg in Texas, Nebraska, Kansas, Oklahoma territory, Colorado, North and South Dakota is fourteen per cent. In the same report, the per cent of loss from blackleg, in the same length of time, the same season, before vaccination is 4.76 per cent, and the average of the states and territories mentioned is 3.36 per cent. In Bulletin No. 105 of this Station, reports of the first vaccine sent out give the loss from blackleg in an equal length of time before vaccination as 4.23 per cent. It is the opinion of the writer that the estimates of eleven to fourteen per cent are greatly exaggerated, and that the probable loss among unvaccinated cattle will vary from four to five per cent.

LOSS AFTER VACCINATION. Eight hundred and fourteen stockmen of Kansas, owning or controlling 110,616 head of cattle, reported as follows:

Number of cattle vaccinated.	Kind of vaccine used.	Number lost within five days.	Per cent. lost within five days.	Number lost within six months.	Per cent. lost within six months.
55,242	Double	38	0.0690 of 1	180	0.33 of 1
28,307	Single	32	0.1100 of 1	137	0.48 of 1
27,067	Double and single.....	20	0.0674 of 1	124	0.46 of 1
110,616	....	90	0.0810 of 1	441	0.39 of 1

It will be noticed that the double vaccine gave the best results. The immediate loss following vaccination is less, and the total loss in six months after vaccination is less than one-third of one per cent.

With the single vaccine, the total loss within six months is less than one-half of one per cent. It should be considered, however, that a large number who used the single vaccine had blackleg among their cattle at the time of using. Of 27,067 cattle vaccinated, the owners did not report the kind of vaccine used, or simply said "both." Of a total of 110,616 cattle vaccinated with both double and single vaccine, the loss within six months was 441 head—thirty-nine hundredths of one per cent. Estimating the average annual loss among unvaccinated cattle at four per cent, which is probably too low, 4425 of these cattle would have died from blackleg. In other words, practically 4000 head were saved by vaccinatien.

In 1901 there were 210,136 doses of vaccine sent out by this department. Estimating one dose to an animal, and the per cent of loss among unvaccinated cattle at four per cent, which is a low estimate, the loss would have been 8403 animals. This is reduced by vaccination to only 819 animals, or a saving of 7386 animals. In 1902, when 233,115 doses of vaccine were sent out, estimating the losses in the same manner, there would be a saving of 8417 animals as a result of vaccination. In other words, vaccination will reduce the loss from four calves in 100 to one calf in 300 when double vaccine is used, and to one calf in 260 where single vaccine is used.

These statistics are the results of the use of vaccine by farmers and stockmen. If care is exercised in the preparation and use of the vaccine, we are satisfied from our own experience that this small loss can be greatly reduced — probably half.

While a large number of flattering reports of the results of vaccination have been received by this department, most of them are based on a relatively small number of calves vaccinated. The following is inserted because of the large number of calves vaccinated, and the excellent results following; Mr. Geo. Donaldson, of Marion, Kan., had in March, 1903, 2060 range calves; blackleg broke out among them, and after sixty-seven had died from blackleg the remainder were vaccinated with double vaccine, and no further losses occurred from blackleg.

BABY BEEF. One of the greatest drawbacks to the successful feeding of baby beef has been the loss resulting from blackleg. The following experiment shows the efficiency of vaccination.

In October, 1901, the C. P. Dewey Land and Cattle Company, with feed-yards at Manhattan, began feeding 300 head of calves, ranging from six to eight months old, for baby beef. The calves were vac-

cinated with double vaccine the last of October and were fed until May 20, 1902, when blackleg broke out among them. Four died within two days. As they were ready for market the company decided to ship them. In the three or four days that elapsed before all were shipped ten head of fat calves died.

In 1902 the same company began feeding 642 head of range calves about the same age. These calves had been driven thirty-five miles before loading and then shipped about 300 miles. When placed in the feed-yards they were in rather poor condition, as a result of driving and shipping. A number were suffering from a catarrhal pneumonia. After about two weeks they were vaccinated, on November 18, 1902, using the double vaccine, and as soon as possible placed on full feed. The calves fed well until February 27, when two died from blackleg. Two calves had also died from other causes in the interval. On February 28 the remaining 628 were vaccinated with the first virus of double vaccine, on March 10 with single vaccine, and on March 19 with the second virus of double vaccine. The vaccine was all injected beneath the skin of the neck; two syringes were used, an assistant filling one while the other was being emptied. On March 10 the writer vaccinated the 628 head in two hours, and on March 19 in one hour and forty-five minutes. The calves were confined in a chute holding about forty at one time. No ill effects were noticed in any case, nor did it interfere with their feeding in anyway. These calves were kept in the same feed-yards until the last of May, when, owing to the flood, they were removed to higher ground. No other case of blackleg occurred, although they were fed on the same (probably infected) yards where ten head had died from blackleg the year before and two the present season. This experiment indicates that calves on full feed should be vaccinated every three months in order to prevent blackleg.

SUMMARY. Blackleg is a germ disease attacking young cattle from two or three weeks to two years old. It occasionally attacks older cattle.

The greatest loss occurs between the ages of six and eighteen months of age.

Calves that are in a thrifty condition or fat are most likely to contract blackleg, particularly calves that are being fed for baby beef.

The greatest losses from blackleg occur during the months of May and June and September and October.

The average loss among unvaccinated calves is probably between four and five per cent. Vaccination will reduce this loss to less than four-tenths of one per cent.

The younger calves are, the shorter is the period of immunity. Young calves should be vaccinated every four or five months.

In vaccinating, the vaccine should be filtered until it is clear, and care exercised not to inject the vaccine into the flesh, but into the loose tissue just beneath the skin.

Calves should not be dehorned or castrated and vaccinated at the same time.

The veterinary department, Kansas State Agricultural College, Manhattan, Kan., furnishes blackleg vaccine, either single or double, to stockmen of Kansas for one cent per dose, to cover cost of making and distributing. Vaccinating outfits, complete, can be furnished for $3.50.