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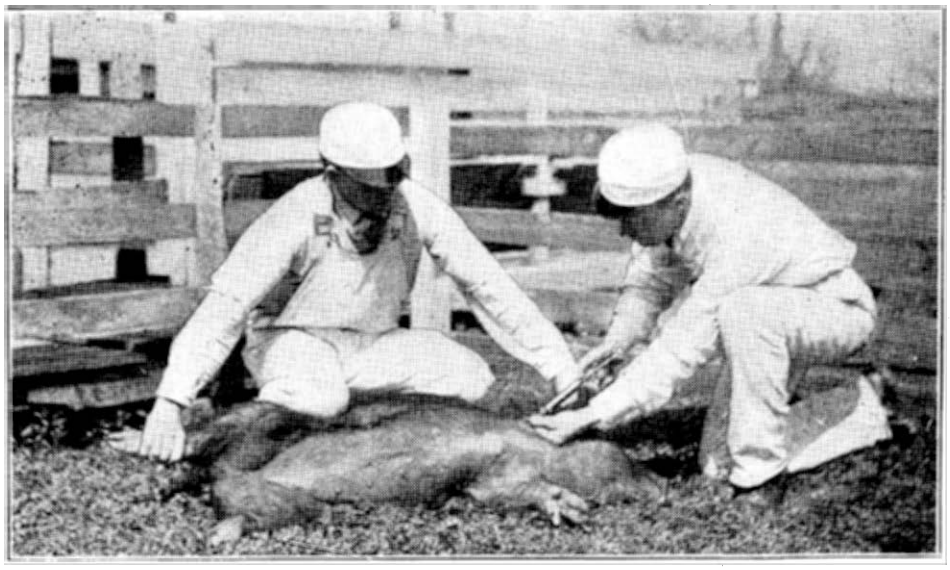
HOG CHOLERA

BY DEPARTMENT OF VETERINARY SCIENCE



METHOD OF VACCINATION

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HOG CHOLERA

BY L. L. LEWIS, W. P. SHULER, C. H. McELROY AND L. B. RITTER

GENERAL STATEMENT

The interest that has been manifested in hog cholera during the past two or three years gives some encouragement that this disease may eventually be controlled. The losses in the Middle Western States are enormous and any estimate as to what this loss has been for the past ten years would be very much of a guess. However, the losses do represent an excessively heavy charge against an important farm business. In the main, this loss is unnecessary and particularly at this time when it is known that well directed sanitary measures will largely prevent the spread of any contagious or infectious disease. In addition to sanitary measures, vaccination, when attended to at the right time, is an effective agent in preventing and controlling outbreaks of hog cholera. The use of vaccine in connection with well directed efforts along sanitary lines should accomplish something in the future.

One difficulty in handling hog cholera is, in many cases, the long delayed diagnosis of the trouble. In many outbreaks the disease is allowed to spread from farm to farm and sometimes to involve quite extensive areas before any one is certain that the trouble is cholera. If farmers will go on the general assumption that any disease that is spreading from farm to farm and that is killing a considerable percent of the hogs is cholera, there will be little chance for a mistake.

A diagnosis of hog cholera was recently made on one farm where about seventy pigs and shoats had been lost, and where there were approximately fifty sick at the time. This disease had been present for more than thirty days, and stock for breeding purposes had been sold from these infected pens. The owner first ascribed his losses to the character of feed used, later to worms, and finally to pneumonia. The delayed diagnosis of the trouble gave excellent opportunities for the disease to be carried to neighboring farms. There is no other hog disease in Oklahoma that is infectious and that kills a large number of the sick animals, and the earlier a diagnosis is made and precautionary measures employed the less likelihood there will be of extensive losses from a given outbreak.

SYMPTOMS

The symptoms in hog cholera vary according to the type of the disease. Too often when the inexperienced have had the symptoms and postmortem lesions pointed out in a given case of cholera, they expect all cases to be the same. The two well defined types of hog cholera are referred to as acute and chronic. Fever is a well marked symptom of both forms of the disease. The temperature often reading 105° F. to 107° F., the normal temperature being about 101.° F. The fever will usually be present a short time before any other symptoms are evident, and when hogs go off feed one should recognize the fact that the disease is already well established. The length of time between the exposure to disease and appearance of first symptoms will vary from six to fifteen days, the average being eight to ten days.

Usually the first symptom noticed is a tendency of the hogs to pile up in their beds with occasional chills and loss of appetite. In the acute cases there may be very little time for any symptoms to develop, as hogs are frequently found dead that were apparently healthy the day before. The usual type of cholera will show well marked symptoms for five to ten days before the animal dies. Some of the more noticeable symptoms will be loss of appetite, marked weakness in a day or two, causing the animal to reel in walking, and inflammation of the eyes and gumming of the eyelids. In the early stages of the disease the bowels are usually constipated, but this generally gives way to a diarrhoea in which the passages are often mixed with mucous or blood. The breathing will become rapid as the disease progresses and a persistent cough is often present. In some cases pneumonic symptoms will develop which will be indicated by the cough and labored breathing.

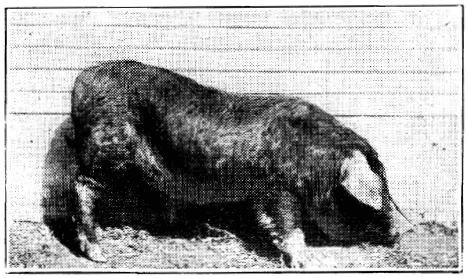

Figure 1.—A chronic case of Hog Cholera. This pig had been sick about four weeks

After a diagnosis of cholera is once made there is generally no difficulty in recognizing the usual train of symptoms for that particular type of the disease, but unfortunately a positive diagnosis can not be made in

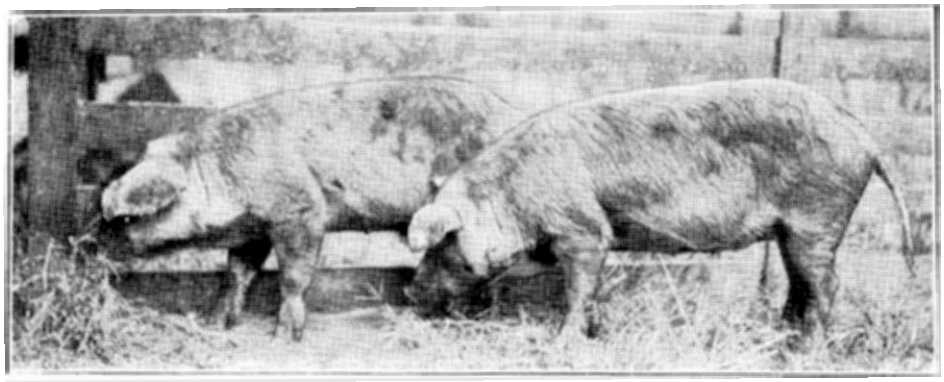

Figure 2.—Typical cases of Hog Cholera. These pigs had been sick eight days

an outbreak of cholera except by a postmortem examination. If the reddening of the skin on the belly and inside of the thighs is noticed, it may be considered as one of the most reliable antemortem indications of cholera.

Postmortem Examination

The careful examination of the carcasses of suspected hog cholera cases is of the greatest importance as this is necessary to determine as early as possible the cause of the trouble. If the trouble is cholera, the longer the diagnosis is delayed the greater the risk of loss, not only in the infected herd, but in herds on surrounding farms. There should be a careful examination made of any cases lost where cholera is suspected in the herd.

External Appearances.—In a large percent of the cases of the acute type of cholera there will be a marked congestion or reddening of the skin on the thin-skinned regions of the body. Sometimes this is found on the buttocks, inside of the hams, belly, throat or ears. Seldom is this reddening seen in all of these regions in the same case. The most usual location is the underside of the chest and belly. Frequently the congested and red areas will turn purple before death.

Lungs.—In some outbreaks of cholera the lungs will show very marked evidences of the varying conditions seen in pneumonia. In uncomplicated cases of cholera the lungs may be normal in appearance. In those cases where lung complications are marked the term "Swine Plague" is often applied to the disease, when in fact the pneumonia is only a complication, cholera being the main trouble. The dark congested areas are usually in the upper portions of the lungs and these may be very firm to the touch on account of the pneumonic changes.

Intestines.—The conditions found in the intestines are usually dependent very largely on the type of the disease and length of time the animal was sick. In acute cases the only evidence of disease may be congested places in the covering and lining of the intestines, both large and small. This will be seen particularly in the mucous lining in the region of the ileo cecal valve, the place where the small intestine joins the large intestine. Sometimes the evidence of cholera is confined to the appearance of small, red spots similar to those so noticeable on the kidney. In most cases of cholera the most constant and characteristic intestinal lesion is the appearance of ulcers in the region of the blind gut and valve where the small and large intestines join. These ulcers vary in size from a pea to a half dollar. They usually show a yellowish scab or covering, which when removed exposes the raw or ulcerated wall of the intestine. These ulcers may be located by the outside appearance of the intestinal wall, which will show marked thickening and often an inflamed or congested area over the ulcer.

Stomach.—Whenever the hemorrhagic conditions are especially well marked in other parts of the body the mucous lining of the stomach will show congested areas frequently involving a considerable portion of the

lining. Usually the outer membrane or muscles of the walls show no evidence of disease.

Kidneys.—An examination of the kidneys will usually give the best information as to the presence of hog cholera. The spotted or "turkey egg" appearance of the kidney is very characteristic in cholera. In the most acute cases no changes may be noticed, but in the average case of hog cholera the appearance of small, red spots on the kidney is very characteristic. These spots are usually no larger than the head of a pin and many are much smaller. The number of these spots vary greatly and they do not in any way indicate the severity of the disease. These spots are not confined to the surface, but if the kidney is split open they will be found throughout the outer portion of the organ.

Heart.—Generally the heart will show no marked indications of the disease. In some of the very acute cases there will appear small hemorrhagic spots varying in size from a pinhead to large, irregular blotches. These spots will generally be found on the ventricles of the heart and will be present in the heart muscles as well as on the surface.

Spleen.—The spleen or "milt" will generally show very pronounced evidence of cholera in all acute cases. The organ is usually enlarged, sometimes to twice its normal size. The gland is frequently soft and easily ruptured by slight pressure, although in chronic cases it is often very firm and much reduced in size. The best evidence of cholera infection will be the appearance of small, red spots on the under side of the gland and along the edges. These are not so noticeable on the upper surface.

Liver.—There are usually no noticeable changes in the liver that would be indicative of hog cholera. In acute cases the gland may be found congested and either dark or mottled in appearance.

Mucous Membranes.—The condition of the lining of the stomach, intestines and bladder vary a great deal, depending somewhat on the type of the disease. Small hemorrabic spots may often be seen in the lining of the stomach and bladder, and occasional cases are seen where the lining of the bladder is so badly congested as to be either red or purple in color.

Lymph Glands.—The condition of the lymph glands is very important in connection with hog cholera. The glands generally examined are the inguinal glands that are located just under the skin and high up on the inside of the thighs, the glands in the membranes attached to the intestines and the glands lying near the heart and lungs. The normal gland is small and of a yellowish-white color, while these glands in cases of cholera are generally enlarged and congested. Sometimes the congestion is so severe as to give the gland almost the appearance of a blood clot.

PRODUCING HOG CHOLERA SERUM

The method of immunizing hogs against cholera was devised by Drs. Dorset, Niles and McBride and published in Bulletin 102 of the United States Department of Agriculture. This work placed before those interested in the control of hog cholera an efficient remedy that has proven of great value and has fully met the expectations of those familiar with the conditions under which it should be used. The vaccine or serum requires great care in its preparation and should be carefully handled at all times through the various stages of preparation and distribution until it reaches the user. Carelessly prepared serum may not only be without value so far as preventing cholera is concerned, but it may cause much damage by containing septic organisms which may cause abscess formation at the point of injection and occasional losses on account of septicaemia (blood poisoning).

When hogs are purchased for serum production they are first immunized against cholera by receiving both virus and serum. In ten days after this treatment they receive a slightly larger dose of virus. Before the hog is ready to be used for serum production it must receive a very large amount of virus or blood from a cholera hog. The amount of virus injected depends upon the method employed.

The intravenous method of injection is employed at the A. and M. College laboratories and 6 cubic centimeters of virus per pound weight is injected into each hog after it has received the serum and a small amount of virus. After the injection of a large amount of virus, either subsutaneously or intravenously, the hog is said to be hyperimmunized. The blood of such a hog is what is used for serum.

After the hogs are hyperimmunized, a period of ten to fifteen days is allowed to pass before any blood is collected. At the end of this time the hog is bled from the tail once, taking 6 cubic centimeters of blood per pound weight, and after another period of seven to ten days the hog is butchered

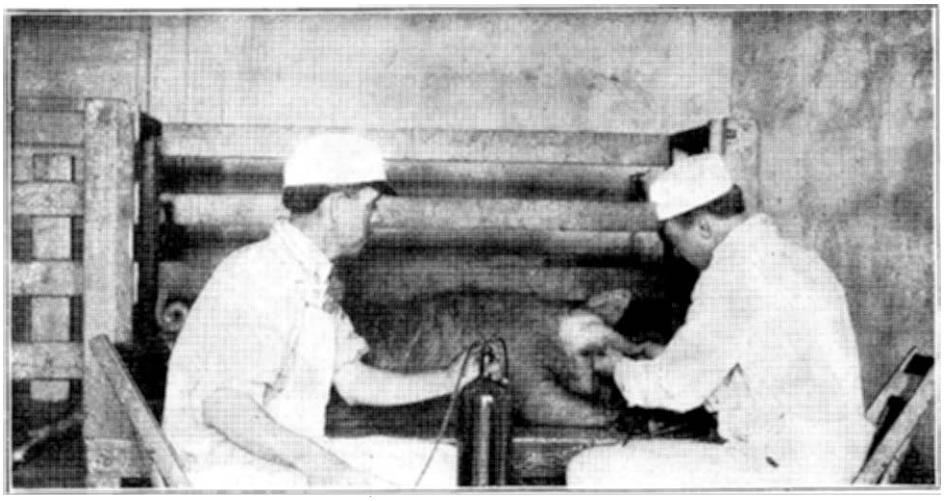

Figure 3.—Injecting Hog Cholera Virus into the vein of the ear. (Hyperimmunizing). This hog will be killed in ten to fifteen days after the treatment to secure the blood for vaccine

when all of the blood is collected for serum. When blood is secured either by tail bleeding or butchering it is beaten with a sterile wire brush to prevent clotting. After standing a few minutes the blood is strained through sterile gauze into bottles and has ½% of carbolic acid added as a preservative, after which the serum is stored in a cool place.

Testing Serum.—After several hundred doses of serum have been secured a test is made in order to determine its strength. Usually small shoats weighing from sixty to eighty pounds are used for the test. Five hogs are generally used. Two of the hogs receive virus alone and the three remaining ones receive the same amount of virus and varying amounts of serum. One cubic centimeter of virus is used on all, and the three receiving vaccine receive doses of 15, 20 and 25 cubic centimeters per fifty pounds weight. The usual result of such a test is that in from ten to fourteen days the two pigs receiving virus sicken and die with cholera, while those receiving the virus and serum remain well. The serum will retain its potency for

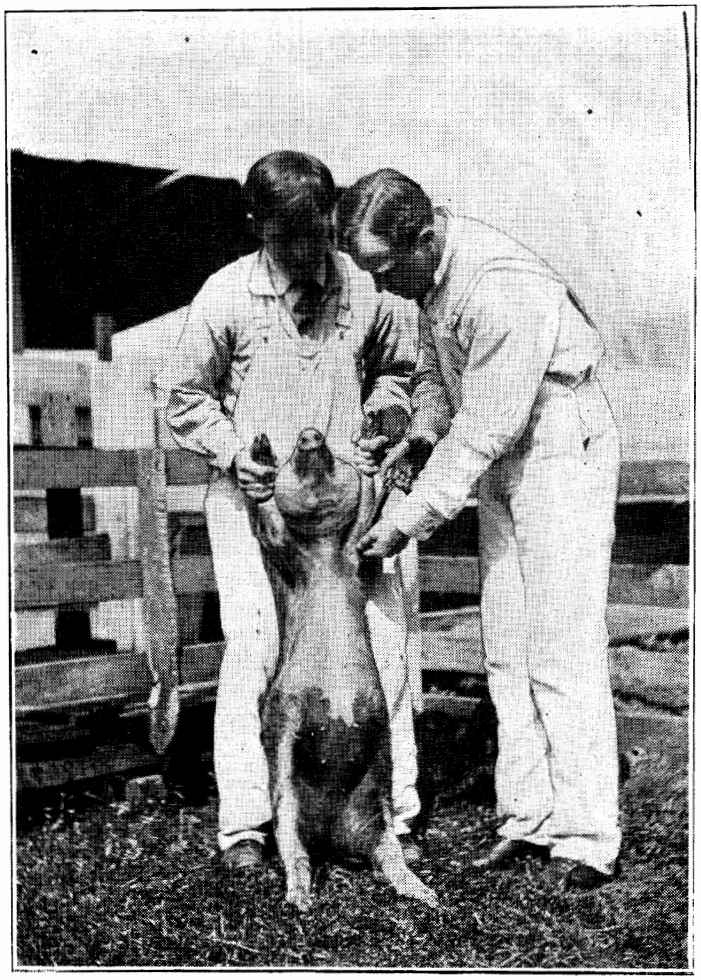

Figure 4.—Showing easy method of holding light hogs and region to vaccinate just back of the foreleg

several weeks after it is collected, but it should always be kept in a cool, dark place.

Administering Vaccine.—In order to administer the vaccine it is necessary to use a hypodermic syringe, as the injection is made subcutaneously, or in some cases into the muscle. The work of administering the vaccine is not difficult and for this reason the serum is shipped direct to the stockman or farmer. Before any serum is injected the syringe should be washed in a 5% solution of carbolic acid or else boiled for thirty minutes in water, to which has been added a small amount of soda. Prepare a gallon of disinfecting solution of some coal tar dip, as Kreso or Zenoleum, by adding one-half pint of dip to one gallon of water. This is to be used in thoroughly cleansing the skin before the serum is injected. The injection may be made into the thigh, flank, behind the fore leg, in the case of light hogs, and behind the ear or in the flank in heavy hogs, where it is not advisable to throw them.

Using the Vaccine.—The amount of vaccine injected and the treatment used, that is, whether single or double, depends very largely upon the object to be attained in vaccination. As a general rule it is not advisable for the inexperienced to handle the virus in any form whatever. The inexperienced person can easily make a mistake in the amount of virus administered or can handle the material carelessly and in this way start an outbreak of cholera in a community. As a rule virus is not sent to any one unless serum is first administered, when a second treatment can be administered in eight to ten days, using both serum and virus.

The different methods of vaccination are sometimes confusing to those

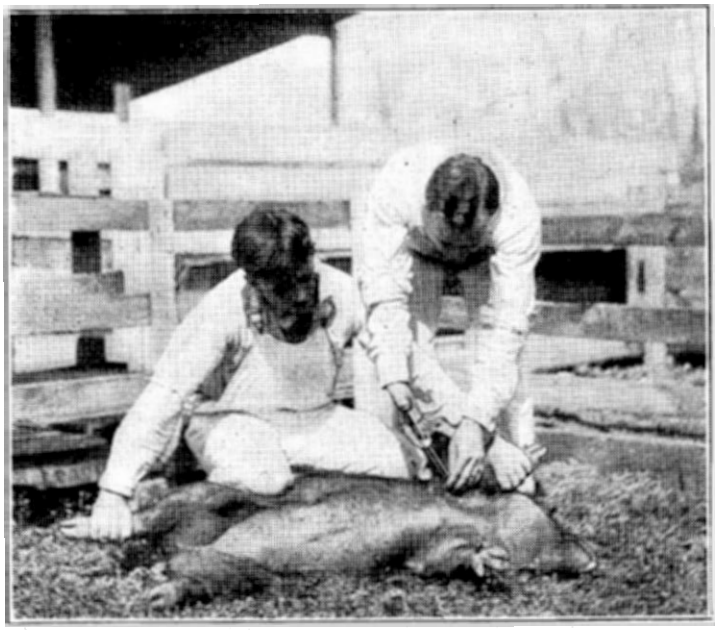

Figure 5.—Another method of holding light hogs and vaccinating behind foreleg

not familiar with its use. The following are the most common methods used. The manner of administering the serum and object sought is given under each head:

Serum Alone Method.—In this method of vaccination only serum is used in such doses as indicated in the table on page 11 of this bulletin. This method is used either where the cholera is already established or where immunity is desired for only a short time, as in the case of hogs that are to be marketed. The immunity conferred by this treatment will last from four to eight weeks, being of shorter duration in young hogs than in mature animals.

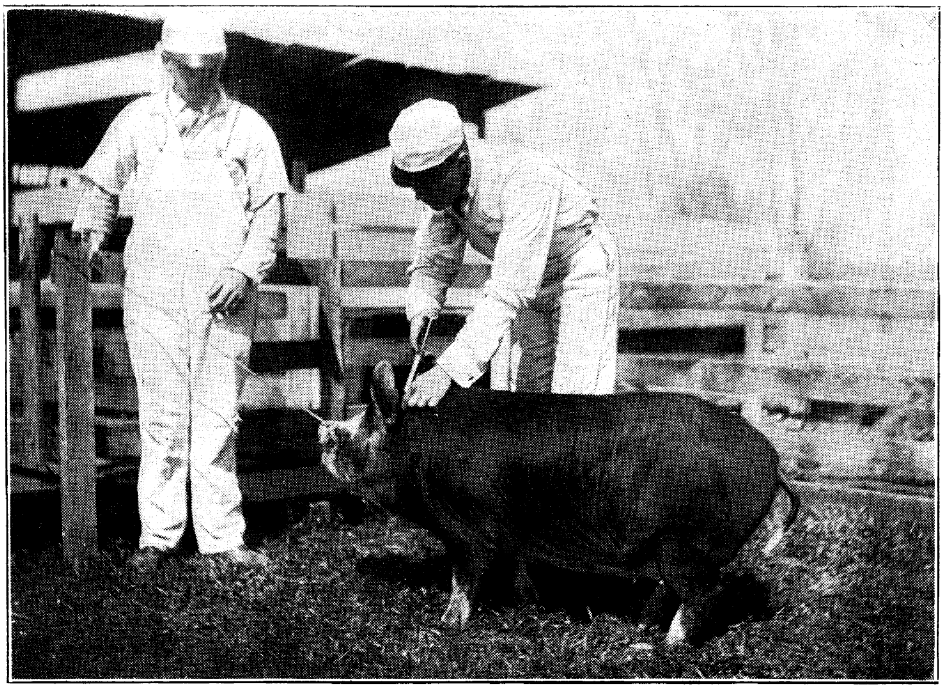

Figure 6.—Heavy hogs can be tied to a post in this manner and vaccinated behind the ear

Intermittent Method.—Each pig is treated with a proper amount of serum as is used in the serum-alone treatment. After a period of about ten days these pigs are again given serum, and at the same time in another place ½ to 1 cubic centimeter of hog cholera virus. Two syringes must be used in this treatment, one for the virus and one for the serum. Vaccination by this method will give permanent immunity and it can be done with a minimum of risk as the hog is immunized by the first treatmet to such an extent that the administration of the virus and vaccine in the second treatment will not cause any risk from loss.

Simultaneous Treatment.—This treatment consists of giving the animal the proper amount of vaccine and ½ to 1 cubic centimeter of virus at the first treatment. There is always some risk to be run in using this method,

and in actual field experience it frequently is said that cholera has been started by this line of treatment. We do not advise the use of virus under any condition in the first treatment.

The intermittent treatment can be used by any one who is familiar with the use of a hypodermic syringe and careful in adjusting the dose of virus. When this method is used it is not considered any great risk to use virus. If, in herds that have been vaccinated by the double treatment, a small percent of the hogs sicken and die, it does not increase the chances of cholera in that herd among the vaccinated hogs as they have been rendered immune by their treatment, but infection may be easily carried from such a pen to neighboring farms and in this way serve as a center for an outbreak of cholera in what would have been otherwise a non-infested community.

When to Use Serum.—All animals kept in clean surroundings have a tendency to keep free from diseases. Cleanliness of quarters and yards as well as proper feed and care will be a great asset in the way of prevention. Dipping, using any of the recognized effective mixtures, as the coal tar preparations, is a very good practice to keep hogs healthy and free from lice and skin diseases.

Inasmuch as the serum treatment is for well hogs and not sick ones, it is very necessary to act without delay when cholera breaks out in the neighborhood herds. Do not wait until your hogs are infected and begin to die, but protect yourself against a probable heavy loss by the use of serum when the disease first appears in the community.

In herds where infection already exists it is best to take temperatures of every hog treated, as this is the only way by which the disease may be recognized in the early stages. If the infection is extensive the administration of virus is unnecessary as the exposure to the infection already on the premises is sufficient. Vaccination with serum alone will save many of the cases where there is only a slight rise of temperature, and a large percent of the cases in the chronic type of cholera may be saved by early vaccination.

The following is a safe scale of doses according to weight and has been found generally satisfactory:

1 cubic centimeter per pound up to 10 pounds
10 cubic centimeters for weights between 10 and 20 pounds.
20 cubic centimeters for weights between 20 and 50 pounds.
25 cubic centimeters for weights between 50 and 75 pounds.
30 cubic centimeters for weights between 75 and 100 pounds.
40 cubic centimeters for weights between 100 and 150 pounds.
50 cubic centimeters for weights between 150 and 200 pounds.
60 cubic centimeters for weights between 200 and 250 pounds.
70 cubic centimeters for weights between 250 and 300 pounds.

Since the quantity of serum administered varies with the weight of the hog it is convenient to have some definite amount to represent what may be termed a dose. On this account it has been customary to designate 20 cubic centimeters as a dose, which is the amount recommended for hogs weighing between twenty and fifty pounds.

Care of Hogs.—Some special care should be given hogs both before and after vaccination. The hogs should be kept in a dry, clean pen and given very little feed or water for twenty-four hours before they are to be vaccinated. Hogs should not be turned into muddy pens after treatment. Infection takes place easily and many of the small lumps seen at the place of vaccination are due to infection at the time the serum is injected or to later infection rather than to the serum itself. Sloppy feed should be used for a few days after vaccination or, if seasonable, the hogs should be allowed to run on some form of green pasture as alfalfa, cowpeas or grass.

Sick hogs that are infected with a light type of the disease may be benefited by receiving only a small amount of feed such as bran or shorts made into a thin slop. Crude carbolic acid, one-half ounce to twenty hogs, may be given in the slop twice a day. Heavy feeding should not be permitted, and it is best not to give any solid feed as corn. The liberal use of disinfectants should be practiced about both the sleeping and feeding places. As soon as trouble is noticed among the hogs such simple precautions as mentioned should be put into practice. Separate the sick from the healthy hogs as well as possible, if this can be done without increasing the chances for the infection to spread to neighboring farms. If in summertime, provide shade and plenty of fresh water, but it is not necessary to have wallowing holes. All litter and refuse should be burned. If above precautions are followed in cases where the disease is of a light type a considerable percent of the herd may be saved, but it is doubtful if any success will follow such methods where the disease is of a virulent type.

Every year there are a number of communications received stating that the writer has a cure for cholera. Some of these remedies have been tried out in the course of the work of serum production. None of the so-called remedies have proven of any value. The use of some of these preparations in mild types of cholera may have given such parties encouragement, as many of these cases will recover without treatment. However, it must be admitted that at the present time there is no hog cholera cure, and stockmen who have infected herds should not allow themselves to be delayed in securing a correct diagnosis and to put into effect such simple sanitary measures as tend to improve the condition of the well hogs of the herd. Stockmen should remember that all of the so-called cures have failed when tested out in an experimental way. They should also bear in mind the fact that there is no breed of hogs that is immune to hog cholera.

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THE SPREAD OF HOG CHOLERA

Hog cholera is an infectious disease and one that is very easily spread to neighboring farms. In many cases those most interested fail to appreciate the ease and the great variety of ways by which cholera may be carried from farm to farm. One factor in the spread of cholera that makes it difficult to impress upon stockmen the necessity for quarantine is the length of time elapsing after exposure before symptoms are noticeable. This period is very variable and depends upon the type of disease. The time be-

tween exposure and coming down with the cholera will vary from a few days to three weeks. This uncertainty as to when the disease will appear after infection is introduced makes it difficult in many instances for the stockman to know by what means the disease may have been brought to his farm. It is quite probable that in many cases no specific instance can be given as to time and means of introducing the infection. However, there is one thing that should always be borne in mind—that is, hog cholera never exists without the presence of the specific cause. The cause of hog cholera is an invisible organism that is found in the blood and other fluids of the body. The organism has not been studied in the laboratory and is now known only by the effect it produces when inoculated into healthy pigs. Cholera never exists without the presence of the invisible organism. The disease may appear in very unexpected places and under unusual circumstances, but in every case the invisible organism has been conveyed from some other case of cholera by some agency. Worms, acorns, musty corn and many other things usually thought to cause cholera have nothing to do with causing hog cholera. They may cause unthriftiness and in this way make the hogs more susceptible to the disease, but they never start hog cholera.

Of the various means of spreading cholera, the infected hog is the most dangerous factor. The period of incubation is sufficiently long to allow the introduction into the herd of hogs that appear healthy at the time, but such stock may have been exposed to infection in shipping or by some other means. This is too often the case with hogs that have been on fair circuits or of recent purchase from a breeder. The hog may be healthy and free from infection when shipped, but express cars, loading platforms, etc., may become infected, and hogs shipped under these conditions may cause trouble. After introducing such apparently healthy hogs into the herd, the owner is much surprised in eight to ten days to notice some hogs off feed. This is too often the history of outbreaks of cholera in territory that had previously been free from the disease. The only safe plan to follow is to hold all new purchases, as hogs that have been on show circuits or that may have been shipped from distant points, in quarantine for twenty days before allowing them the run of the farm.

Since the infecting agent of cholera is eliminated from the body by the kidneys and bowels it is easy to understand how the infection becomes so plentiful in pens, railroad yards, cars, or, in fact, in any place where sick hogs have been. This infection can be carried from farm to farm by people on their shoes, clothing, by birds, dogs, on wagons or by running water. Too frequently hogs lost from cholera are allowed to decompose on top of the ground. Such a practice affords every opportunity for scattering the disease to neighboring farms. Such a practice will permit crows, buzzards and dogs to feed on the carcass, and they in turn may scatter the disease for miles. Water draining from infected pens becomes an active means of disseminating hog cholera. The usual history of cholera epidemics is that they extended along water courses faster and further than in directions away from streams. If sick hogs are allowed access to a stream, or if their pens drain into a stream of water, the disease is likely to appear at any time on

farms located lower down the stream where hogs have access to the water. An uncontaminated water supply is a necessity, and whenever a stream becomes polluted with cholera infection all hogs should be fenced away from it and watered from wells or other sources.

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EXPERIMENTAL DATA

During the routine work of serum production there have been many opportunities for doing experimental work on sick hogs and to make observations with reference to many phases of the disease. Studies have been made of the blood in many cases, urine analyses have been made during the process of hyperimmunizing, also analyses of urine in sick cases. Hypodermic injections have been made of many drugs to study the effect of such treatment on the course of the disease, also some preliminary work to determine the length of time the virus will live or retain its virulence in the blood of hogs that have been hyperimmunized. The data reported here is selected from the large amount of material that has accumulated during the past two or three years.

Observations On the Blood.—Observations that have been made on the blood in uncomplicated cases of hog cholera show, as a rule, that very great changes take place in this fluid. While all of the cases observed do not show these changes to the same extent, the general tendency is a reduction of the red blood cells, a reduction of the amount of hemoglobin present, and a lowering in the count of the white blood cells, although this is not so uniformly present as the other conditions mentioned.

In the two cases tabulated below it will be noticed that the red cells in No. 53 showed the day before inoculation 5,740,000 per cubic millimeter and eighteen days later the count showed only 2,000,000 cells present per cubic millimeter. Pig No. 54 did not develop a severe case of hog cholera, but the blood count showed marked changes as the disease progressed. The number of red cells at the time of inoculation numbered approximately 6,000,000 per cubic millimeter and fourteen days later showed only 2,126,000. Five days later the count had risen to 3,480,000 per cubic millimeter.

The following table shows the temperature and counts of both red and white cells in two cases of cholera. One (No. 54) a non-fatal type, and the other a fatal case, though a slower type than is usually met with in experimental work.

Pig No. 54

	Temperature.	Hemoglobin. Percent.	White Blood Cells.	Red Corpuscles.
May 30	101	90		
May 31	.....	....		Inoculated
June 3	101	90	32,000	6,282,000
June 5	102	80		4,976,000
June 7	105	80	38,500	3,826,000
June 8	104	....		
June 10	103.6	80		3,540,000
June 11	103	80	38,000	3,164,000
June 12	103	...		
June 13	103	70	22,000	2,568,000
June 14	103	70		2,126,000
June 17	103	70	20,000	2,796,000
June 19	102.5	80	28,000	3,480,000

Pig No. 53

	Temperature.	Hemoglobin. Percent.	White Blood Cells.	Red Corpuscles.
May 30	101	....		5,740,000
May 31	.....	....		Inoculated
June 3	101	95	25,000	5,678,000
June 5	107	90		4,960,000
June 7	104	80		4,006,000
June 8	105	....		
June 10	104.4	70	18,000	3,560,000
June 11	106	65	13,000	2,672,000
June 12	105	....		
June 13	104.6	70	12,000	2,560,000
June 14	104	60		2,370,000
June 17	105	50	7,000	2,000,000

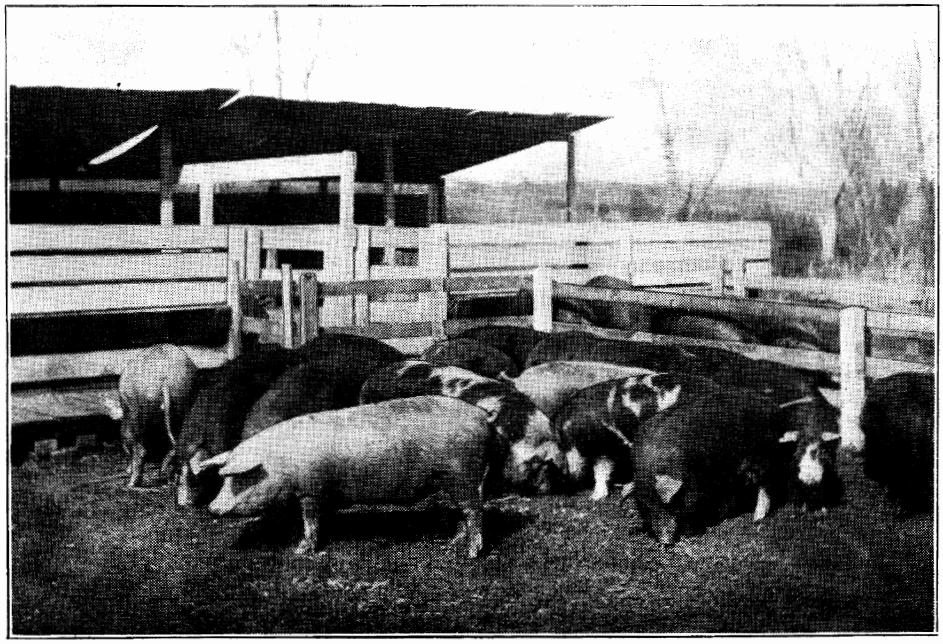

Figure 7.—These hogs have all been immunized and are ready for the work of serum production

Pig No. 54 recovered and showed very marked improvement on the date the temperature and blood counts were last made.

Observations made on other cases do not always show the same regular decrease in cellular contents of the blood, although this is true in most cases.

Record of Observations of Changes Produced in the Blood By Hyperimmunizing and Successive Bleedings from the Tail

Two pigs (Nos. 587 and 613) were selected for this test, the object of which was to determine the effect on the blood cells and hemaglobin when hyperimmunized by the slow or subcutaneous method followed by consecutive bleedings from the tail at intervals of from eight to twelve days.

The result of this experiment is given in the following tables and the count of the red blood cells is graphically represented in Figure 8.

Hog No. 587

Date.	Red Cells.	White Cells.	Hemoglobin. Percent.	Remarks.
March 13	9,176,000	20,000	90	
March 14	9,692,000	20,000	85	
March 16	9,224,000	32,000	90	
March 18	.....	.....	....	Injected 800 cc. virus.
March 19	8,048,000	32,000	90	
March 20	6,568,000	24,000	80	
March 21	7,232,000	16,000	80	
April 4	4,736,000	48,000	80	
April 5	7,800,000	56,000	90	
April 8	.....	.....	....	Injected 1,000 cc virus.
April 10	7,624,000	75,000	90	
April 11	6,024,000	16,000	90	
April 22	8,266,000	43,000	80	First bleeding from tail.
April 23	6,720,000	32,000	80	
April 24	7,640,000	40,000	80	
May 2	7,888,000	24,000	80	Second bleeding from tail.
May 4	7,240,000	40,000	80	
May 6	6,552,000	16,000	90	
May 13	6,344,000	16,000	90	Third bleeding from tail.
May 14	6,656,000	32,000	80	
May 21	8,048,000	32,000	70	Fourth bleeding from tail.
May 22	6,848,000	32,000	70	
May 31	4,328,000	16,000	70	Killed.

Hog No. 613

Date.	Red Cells.	White Cells.	Hemoglobin. Percent.	Remarks.
March 13	10,048,000	40,000	80	
March 14	9,932,000	20,000	80	
March 16	9,408,000	16,000	90	
March 18	.....	.....	....	Injected 600 cc. virus.
March 19	7,800,000	24,000	80	
March 20	8,400,000	24,000	90	
March 21	6,696,000	16,000	90	
April 4	7,640,000	48,000	90	
April 5	7,768,000	48,000	90	
April 8	....	....	....	Injected 850 cc. virus
April 10	6,576,000	88,000	80	
April 11	4,848,000	56,000	90	
April 22	6,862,000	40,000	80	First bleeding from tail.
April 23	7,096,000	32,000	70	
April 24	5,344,000	80,000	70	
May 3	7,152,000	32,000	80	Second bleeding from tail.
May 4	5,456,000	32,000	80	
May 6	6,232,000	32,000	80	
May 13	6,832,000	48,000	80	Third bleeding from tail.
May 14	6,224,000	48,000	80	
May 21	6,216,000	40,000	70	Fourth bleeding from tail.
May 22	5,544,000	48,000	70	
May 31	4,232,000	24,000	70	Killed.

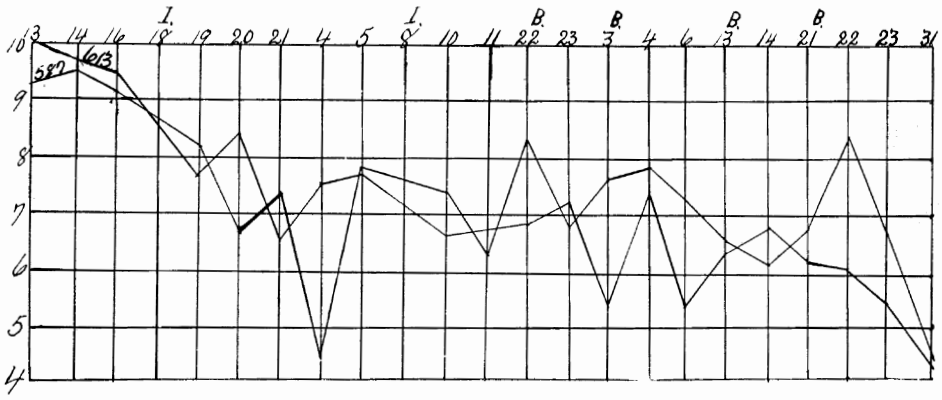

Figure 8.—This shows the variation in blood count caused by successive bleedings from the tail

The introduction of the virus appears to lessen very materially the red cell count, but does not affect the leucocytic count to the same extent. The amount of blood taken at each bleeding was approximately 750 cc. (6 cubic centimeters per pound weight). The blood counts on the dates of the four bleedings were made at the time of bleeding. The very marked fall in the number of red cells following the fourth bleeding on May 21 would seem to indicate that a continuation of bleeding would probably keep the count very low. Neither the leucocytes nor the percent of hemoglobin appear to be affected in a marked degree.

The following experiment was carried on in connection with the hog cholera serum work to ascertain if possible the changes in blood of hogs during hyperimmunizing when the intravenous method of injection was

used. Data was secured on the blood of hogs before hypering in order to get the normal; then during hypering and after, until the blood count was back to what was considered normal for that pig. There were four pigs carried in the experiment at this particular time. They were completed and temperatures were taken just after hypering as the table following will show. Changes in the following was ascertained: Temperature, hemaglobin, red blood corpuscles and white blood corpuscles.

No. of Pig.	Date.	Temperature.	Erytherocytes.	White Corpuscles.	Hemoglobin Percent.
101	12-3, '13	102	6,260,000	96,000	80
	12-4, '13	102	6,192,000	120,000	80
	12-5, '13	102	6,304,000	84,000	80
	*12-8, '13	102			
	12-9, '13	102.6	6,440,000	126,000	90
	12-10, '13	102.2	6,816,000	136,000	80
	12-12, '13	103	6,516.000	128,000	90
	12-13, '13	103	6,260,000	114,000	80

*Gave 1,450 cc. virus. Temperature after injection, 103 degrees.

No. of Pig.	Date.	Temperature.	Erytherocytes.	White Corpuscles	Hemoglobin. Percent.
102	12-3, '13	101	5,132,000	112,000	80
	12-4, '13	100.6	5,632,000	104,000	80
	12-5, '13	101.2	5,470,000	96,000	80
	*12-11, '13	102.4			
	12-12, '13	103	7,480,000	180,000	80
	12-13, '13	106.2	5,808,000	126,000	80
	**12-14, '13	106.8	5,142,000	132,000	80

*Gave 1,065 cc. virus. Temperature after injection, 101.8 degrees.
**Pig off feed and showed symptoms of cholera. 12-22, '13, pig recovered.

No. of Pig.	Date.	Temperature.	Erytherocytes.	White Corpuscles.	Hemoglobin. Percent.
104	*12-3, '13	105	7,392,000	88,000	80*
	12-4, '13	101.9	6,504,000	88,000	80
	12-5, '13	102	7,044,000	80,000	80
	**12-11, '13	103.2			
	12-12, '13	106.8	8,484,000	250,000	90
	12-13, '13	107	7,288,000	196,000	80
	***12-14, '13				

*Had been hard to get in crate.
**Gave 1,075 cc. virus. Temperature after injection 102.8.
***Pig showed symptoms of cholera; off feed. 12-18, '13, pig recovered.

No. of Pig	Date.	Temperature.	Erytherocytes.	White Corpuscles.	Hemoglobin. Percent.
105	12-3, '13	102	4,192,000	98,000	80
	12-4, '13	101	3,496,000	60,000	80
	12-5, '13	102	3,968,000	58,000	80
	*12-8, '13	102.6			
	12-9, '13	103	6,740,000	72,000	90
	12-10, '13	102	6,088,000	96,000	80
	12-12, '13	103.3	3,296,000	112,000	80
	12-13, '13	102.6	4,060,000	104,000	80

*Gave 1,380 cc. virus. Temperature after injection, 102.8 degrees.

A study of the data in the above tables shows that there is a reaction in from one to four days after immunizing, the temperature rising from 1 to 5 degrees. There does not appear to be any marked effect on the percent of hemoglobin. The white blood corpuscles are increased in each case after the injection of the blood, and as a rule a slight rise in the number of red cells will be noted.

Experiment With Quinine Hydrochlorate.—For this experiment four hogs were selected that would weigh about eighty pounds each. These were designated as 601, 602, 603 and 604. All were to be inoculated with the same amount of virulent blood, kept in the same pen and to be treated alike, except that 601 and 603 were to be given quinine hydrochlorate hypodermically as indicated by the notes in the following table. Each table shows the record of a treated and untreated pig so arranged as to be easy of comparison. Virus in all cases was injected on January 17, 1914.

Pig.	Date.	Temperature.	White Corpuscles.	Red Corpuscles.	Remarks.
601	17	102	16,000	8,021,000	Gave 2.5 cc. virus
602	17	102.1	8,000	9,168,000	Gave 2.5 cc. virus.
601	19	100.8	16,000	5,749,000	Gave quinine.
602	19	102.4	12,000	9,464,000	
601	22	103	24,000	8,556,000	Gave quinine.
602	22	104	20,000	2,600,000	
601	23	102	12,000	4,096,000	Gave quinine.
602	23	105.8	12,000	6,600,000	
601	24	101.6	8,000	5,680,000	Gave quinine.
602	24	102.8	8,000	5,880,000	
601	25	104	12,000	9,320,000	Gave quinine.
602	25	.....	16,000	10,520,000	
601	26	104	12,000	3,708,000	Gave quinine.
602	26	105.8	12,000	7,484,000	
601	27	104.6	16,000	4,072,000	Gave quinine.
602	27	106	8,000	5,800,000	
601	28	104.4	40,000	8,145,000	
602	28	102	24,000	5,986,000	
601	29	104.4	24,000	4,444,000	Killed.
602	29	104.2	36,000	7,056,000	Killed.

Pig.	Date.	Temperature.	White Corpuscles.	Red Corpuscles.	Remarks.
603	17	102.2	16,000	7,896,000	Gave 2.5 cc. virus.
604	17	103.8	16,000	7,032,000	Gave 2.5 cc. virus.
603	19	102	16,000	10,996,000	Gave quinine.
604	19	103.8	20,000	4,316,000	
603	22	105	12,000	5,440,000	Gave quinine.
604	22	105.6	12,000	4,964,000	
603	23	105.6	8,000	9,596,000	Gave quinine.
604	23	104	8,000	5,592,000	
603	24	103	8,000	8,140,000	Gave quinine.
604	24	101.2	8,000	5,576,000	
603	25	104.8	8,000	7,244,000	Gave quinine.
604	25	.....	12,000	4,416,000	
603	26	106	12,000	5,524,000	
604	26	104.2	12,000	4,416,000	
603	27	106.4	8,000	5,220,000	
604	27	103.8	12,000	3,704,000	
603	28	102	12,000	6,980,000	
604	28	106.4	32,000	1,333,000	
603	29	99.4	32,000	8,864,000	Killed.
604	29	104.8	20,000	1,744,000	Killed.

The blood count in these pigs is at considerable variance with blood counts on other hogs that were under different treatment. The period of incubation in 601 was eight days. While the temperature record of 603 was variable, the high temperature on January 22 indicates the end of the period of incubation for this case.

In the check series (602 and 604) the period of incubation terminated on the fourth day for both cases. So far as these four cases are concerned, quinine in the amounts given failed to influence the course of the disease, but did appear to have some effect on the period of incubation.

The blood count in these cases was variable, but the general tendency of all the hogs was to show a lower count toward the termination of the disease. Temperatures were variable and did not show any effect of the administration of the quinine solution. Quinine hydrochlorate was administered hypodermically in 14.3-grain doses. All of the pigs were killed on January 29, as their physical condition indicated that death would occur within a short time.

The following cases show the effect of injecting intravenously cold physiologic salt solution and a large amount of vaccine in one case:

Pig No. 220.

3-20, '14 Gave 1 cc. of hog cholera virus.
4- 1, '14 Pig sick with hog cholera symptoms—scouring; temperature 104°.
4- 4, '14 Gave this pig intravenously cold, physiologic salt solution. This was given to the amount of 5 cc. per pound. Temperature immediately before injecting, 104.3°. Immediately after, 104.2°.

4- 5, '14 Temperature 104°. Scouring was not so severe.
4- 6, '14 Temperature 103°. Pig eating.
4- 8, '14 Temperature 103.6°. Apparently much better.
4-10, '14 Eating regularly and not scouring.
4-15, '14 Pig apparently well.

Pig No. 215.

3-20, '14 Gave 1 cc. of hog cholera virus. Pig rather slow to show infection.
4- 4, '14 Symptoms of cholera with a very unsteady walk; no scouring, and temperature 104.8°. This pig was given cold physiologic salt solution to the amount of 6 cc. per pound. Temperature just before injection, 104.8°, and immediately after, 103°. Temperature one hour later, 103.2°.
4- 5, '14 Pig seemed better.
4- 6, '14 Temperature 105°. Apparently no better; showed lung infection.
4- 8, '14 Temperature 104.6°. Labored breathing.
4-10, '14 Pig died, showing no outward symptoms of cholera. Postmortem: Typical pneumonia, but spleen lesions indicating cholera. Lungs adhering to chest wall.

Pig No. 3.

6-30, '14 Pig was off feed and showed a temperature of 106°. 150 cc. of cold, physiologic salt solution was given intravenously. Temperature before injecting was 106°. Immediately after, 106.3°.
7- 1, '14 Temperature 106°. Hemaglobin 35%. Erytherocytes, 966,000.
7- 2, '14 Temperature 107°. Hemaglobin 20%. Erytherocytes, 850,000. Pig killed and posted. Postmortem indicated a great deal of pneumonia.

Pig No. 4.

6-26, '13 Pig sick with cholera; temperature 105°. Eyes closed with mucous. Gave this pig 200 cc. of cold hog cholera vaccine with the following reaction: A severe scouring, which followed vomiting.
6-28, '14 Pig was apparently better, with temperature 106°.
7- 1, '14 Temperature 105°. No scouring. Hemaglobin 75%. Erythero-cytes, 2,712,000. Leucocytes, 80,000.
7- 2, '14 Hemaglobin 60%. Erytherocytes, 2,228,000. Leucocytes, 70,000.
7- 4, '14 Pig apparently better. No temperature taken; was gaining appetite.
7-10, '14 Pig well.

Experiments to Determine Length of Time Virus Remains Active in the Blood of Hogs that Have Been Hyperimmunized

The experiments were conducted in connection with the hog cholera serum work to determine the time after hyperimmunizing before the blood from the hypered or treated hog ceases to be virulent to normal hogs. The test was planned so that checks could be had on the virulence of blood used for hypering and to keep the test pigs in pens free from any outside infection. Pig No. 154 was ready for hypering and on January 6, 1914, was given intravenously 1,100 cubic centimeters of virus. As a check on this virus, pigs 152 and 153 were each given 1 cc. These pigs came down with cholera and were killed on January 17, 1914. Postmortem showed cholera lesions.

Blood was taken from the tail and ears of pig 154 (hypered pig) at the end of twenty-four hours, forty-eight hours, seventy-two hours, ninety-six hours, 192 hours and 216 hours from the time of hypering. To test the virulence of this blood six pigs were used. The following table will give the date of injection, amount of blood used from No. 154 and the condition of the pigs ten to twenty days after treatment:

January 7, 1914, pig 160 received 2.5 cc. of blood—pig healthy on January 27
January 8, 1914, pig 161 received 2.5 cc. of blood—pig healthy on January 27
January 9, 1914, pig 164 received 5 cc. of blood—pig healthy on January 27
January 10, 1914, pig 165 received 5 cc. of blood—pig healthy on January 27
January 14, 1914, pig 166 received 10 cc. of blood—pig healthy on Janaury 27
January 15, 1914, pig 173 received 10 cc. of blood—pig healthy on January 27

While it was not expected that pigs 166 and 173 would come down with cholera, as hogs are often bled in seven or eight days after hypering, but it would not have been surprising if cholera should have appeared in pigs receiving blood drawn twenty-four to ninety-six hours after hypering. The pigs were kept in clean pens and not in any way exposed to cholera infection. Since they appeared normal for ten to twenty days after treatment it was decided to test them to see if any immunity had been conferred by the treatment. To determine this they were inoculated with virus. On January 27, 1914, pigs 160, 164 and 166 were placed in clean pens and each given 1 cubic centimeter of virus. The virus used on January 27 and February 10 was tested and found virulent.

A further test of some of the pigs receiving blood from No. 154 was desired. For this purpose 20 cubic centimeters of blood was taken from pig No. 183 and injected into pig No. 161 on January 28, 1914. Pig No. 183 was hypered by the intravenous method on January 27, using 6 cc. of virus per pound weight. Pig No. 161 showed no symptoms of cholera at any time, and on February 10 was given 2 cubic centimeters of virus. The blood used to hyper No. 183 was tested for virulence on pigs 184 and 185 and found to be virulent. A review of the condition of pig No. 161 shows that it may have been immunized by the first injection of blood from pig No. 154, taken forty-eight hours after hypering. This also appears to have been the effect of such treatment on pigs 106, 164 and 166.

One feature of this experiment that is worth considering is the possibility of securing a true vaccine from the hypered hog. It is undoubtedly true that the virulence of the virus is gradually attenuated in the hypered hog until all pathogenic property is lost. If a vaccine can be secured in this manner it would lessen very materially the cost of vaccine production.

Condensed history of the six hogs used in this test:

Pig No. 160.

1- 7, '14 Gave 2.5 cc. of virus bled from hog hypered only 24 hours
1-27, '14 Gave 1 cc. of virus
2- 5, '14 Gave 5 cc. of hog cholera virus
3-14, '14 Gave 5 cc. of hog cholera virus
3-28, '14 Gave 700 cc. of hog cholera virus

This pig showed no symptoms of cholera at any time during the process of hyperimmunizing.

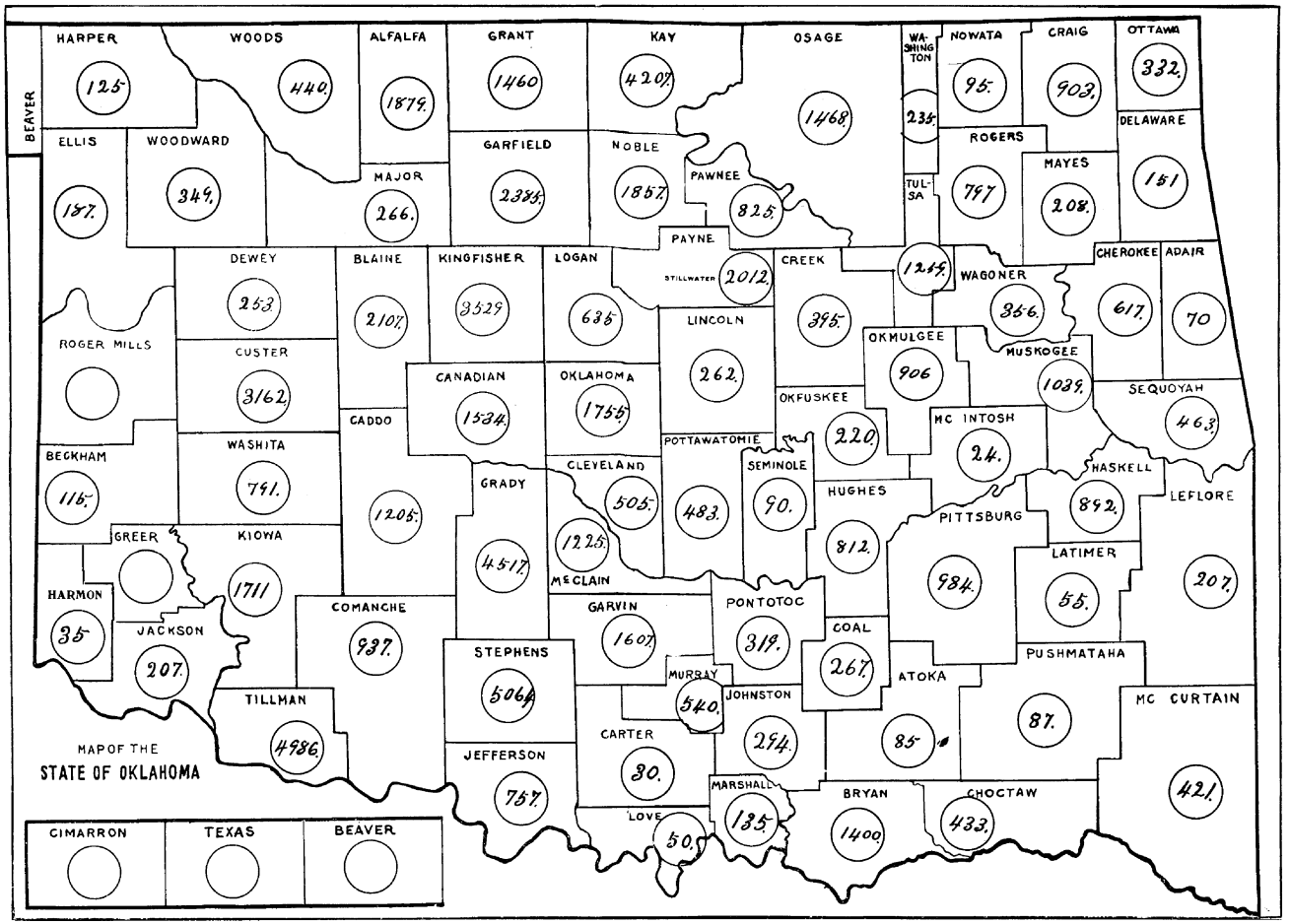

Figure 9.—This cut shows the general distribution of Hog Cholera in Oklahoma and the number of doses sent to each county during the first two years of distributing Hog Cholera Serum in the State

Pig No. 161.

1- 8, '14 Gave pig 161 2.5 cc. of blood from hog hypered 48 hours
1-27, '14 Gave pig 161 20 cc. of blood from hog hypered 24 hours
2-10, '14 Gave 2 cc. of hog cholera virus
3- 5, '14 Gave 5 cc. of hog cholera virus
3-14, '14 Gave 5 cc. of hog cholera virus
3-20, '14 Gave 675 cc. of hog cholera virus

No ill effects from any treatment.

Pig No. 164.

1- 9, '14 Gave pig 164 5 cc. of blood from hog hypered 72 hours
1-27, '14 Gave pig 164 1 cc. of virus
2-10, '14 Gave 2½ cc. of hog cholera virus
3- 5, '14 Gave 5 cc. of hog cholera virus
3-14, '14 Gave 5 cc. of hog cholera virus
3-20, '14 Gave 675 cc. of hog cholera virus

No ill effects from any treatment.

Pig No. 165.

1-10, '14 Gave pig 165 5 cc. of blood from hog hypered 96 hours
2-10, '14 Gave pig 165 1 cc. of hog cholera virus
2-17, '14 Gave pig 165 2½ cc. of hog cholera virus
3- 5, '14 Gave pig 165 5 cc. of hog cholera virus
3-20, '14 Gave pig 165 5 cc. of hog cholera virus
3-28, '14 Gave pig 165 750 cc. of hog cholera virus

Pig developed cholera and was killed.

Pig No. 166.

1-14, '14 Gave pig 166 10 cc. of blood from hog hypered 8 days
1-27, '14 Gave pig 166 1 cc. of hog cholera virus
2-10, '14 Gave pig 166 2½ cc. of hog cholera virus
2-27, '14 Gave pig 166 4 cc. of hog cholera virus
3-14, '14 Gave pig 166 5 cc. of hog cholera virus
3-20, '14 Gave pig 166 850 cc. of hog cholera virus

No ill effects from any treatment.

Pig No. 173.

1-15, '14 Gave pig 173 10 cc. of blood from hog hypered 9 days
2-10, '14 Gave pig 173 1 cc. of hog cholera virus
2-27, '14 Gave pig 173 2 cc. of hog chelora virus
3-11, '14 Gave pig 173 5 cc. of hog cholera virus
3-24, '14 Temperature 106°
3-25, '14 Developed cholera and was killed

The following experiment was in a measure a duplicate of the previous test, the general plan being the same.

Two pigs were immunized and hypered, using in both instances cold fresh virus at a temperature of 33° F. These pigs are numbered 130 and 132.

The plan of the experiment was to get different amounts of blood from the tail of these pigs every twenty-four hours after hypering and to use this for inoculating normal pigs. These two pigs, Nos. 130 and 132, were hypered on February 26, 1914, and every twenty-four hours afterward for five successive bleedings blood was drawn in amounts of 5, 10, 15, 20 and 25 cc.

and given hypodermically to pigs 195, 194, 203, 204, 205, 206, 207, 208, 209 and 210.

Nos. 195, 203, 206, 207 and 209 were treated with blood from pig 130.
Nos. 194, 204, 205, 208 and 210 were treated with blood from pig 132.

2-27, '14 No. 195 received 5 cc. of blood from Pig No. 130
2-27, '14 No. 194 received 5 cc. of blood from Pig No. 132
2-28, '14 No. 203 received 10 cc. of blood from Pig No. 130
2-28, '14 No. 204 received 10 cc. of blood from Pig No. 132
3- 1, '14 No. 205 received 15 cc. of blood from Pig No. 132
3- 1, '14 No. 206 received 15 cc. of blood from Pig No. 130
3- 2, '14 No. 207 received 20 cc. of blood from Pig No. 130
3- 2, '14 No. 208 received 20 cc. of blood from Pig No. 132
3- 3, '14 No. 209 received 25 cc. of blood from Pig No. 130
3- 3, '14 No. 210 received 25 cc. of blood from Pig No. 132

These pigs after receiving blood drawn from pigs 130 and 132 were placed in clean pens and were not treated with further injections until March 14, 1914. Temperatures were taken at intervals to determine if possible if the pigs were having a light form of chelera. The temperatures are as follows:

Time.	194.	195.	203.	204.	205.	206.	207	208.	209.	210.
2- 6, 1914	100.8	102.2	101.8	101	101.2	101.6	101	102.8	101.6	101.8
3-10, 1914	102	102	101	101.6	100.8	101.6	101.6	101.8	102	102
3-11, 1914	102.2	102.8	102	101.6	101	101.4	102.4	102	101.8	102

These pigs did not show any sign of cholera from the first treatment. All ate well and seemed normal in all particulars. On March 14 the pigs were normal as far as could be determined and were all given 1 cc. of hog cholera virus, except the following, which were given more:

Pig No. 195 received 2 cc
Pig No. 206 received 2½ cc.
Pig No. 209 received 2½ cc
Pig No. 210 received 2½ cc
3-28, '14 Pig No. 203 developed cholera
3-29, '14 Pig No. 204 developed cholera
3-26, '14 Pig No. 205 developed cholera
3-28, '14 Pig No. 206 developed cholera
4- 1, '14 Pig No. 208 developed cholera
4- 1, '14 Pig No. 194 developed cholera
4- 4, '14 Pig No. 195 developed cholera

Out of the lot of ten pigs inoculated seven became infected with cholera after giving 1 cc. of virus. Three—Nos. 207, 209 and 210—remained normal and were given more virus with no bad results. The first injection of blood from the hypered pig did not seem to injure them whatever, but when the fatal dose of virus was given they were not sufficiently immunized. The

result of this test shows that blood drawn twenty-four hours after hypering does not contain virulent material; also that the blood drawn after four or five days is not sufficiently potent as a vaccine to be relied upon to protect a hog when given in the usual amount against a fatal dose of virus administered later.

In the following experiment it was planned to use the blood from a pig that had been hyperimmunized two days, in the same manner as a vaccine is used. The pig was hyperimmunized by giving 5 cc. of virus per pound weight; weight of pig about sixty pounds. The blood was injected intravenously on March 17, 1914, and forty-two hours later the pig was killed and the blood secured was treated as vaccine; that is, it was defibrinated and had ½ percent carbolic acid added as a preservative.

This blood was then used on four normal pigs on March 20, 1914. Of the four pigs used, No. 121 received 2½ cc.; No. 122, 5 cc.; No. 123, 7½ cc.; and No. 124, 10 cc.

No other treatment was given these pigs at this time, and to be sure that they were not affected with a slow or chronic type of cholera they were let run until April 14, 1914. They showed no signs of disorder during this time. On April 14 they were each given 1 cc. of fresh hog cholera virus. On April 28 these pigs had not developed any signs of cholera. At this time they were put in general pens and the immunizing process completed for serum production.

Effect on Temperature When a Large Amount of Virus Is Injected Intravenously

In hyperimmunizing it is found best to reduce the temperature of the virus to near the freezing point before injecting it into the veins. Since such a large amount of virus is injected, observations as to the effect of this material on temperature was thought to be of interest. Temperatures were taken just before and after injections.

No. of Hog.	Date.	No. of cc. of Virulent Blood Given.	Temperature Before Injecting.	Temperature After Injecting.
98	12-8, '13	700 cc.	103.2	103
100	11-29, '13	1,200 cc.	102.4	103
101	12-8, '13	1,450 cc.	102	103
102	12-11, '13	1,065 cc.	102.4	101.8
103	11-29, '13	1,070 cc.	101.8	103.2
105	12-8, '13	1,380 cc.	102.6	102.8
107	12-11, '13	1,200 cc.	101.8	102.8
146	12-27, '13	850 cc.	101.2	102
147	12-27, '13	825 cc.	102	101.6
106	1-9, '14	1,050 cc.	103	103
108	1-9, '14	925 cc.	103.8	102.6
109	1-9, '14	1,000 cc.	102.8	102.6
162	1-9, '14	1,300 cc.	103.8	102.4
163	1-9, '14	960 cc.	101.8	102.6
154	1-27, '14	1,080 cc.	102	102
121	1-27, '14	980 cc.	104	102.1
123	1-27, '14	650 cc.	104.2	104.6
183	2-13, '14			104.2

URINE ANALYSIS

Since in immunizing hogs for the production of serum there is necessarily a large amount of blood injected intravenously, it would appear that we might expect considerable variations from the normal from certain secretions of the body immediately following this injection. This would seem to apply especially to the urine, and it was for the purpose of determining these variations that the following analyses were made. Table I is the only analysis given of the urine of the hog sick with cholera, while Tables II, III, IV and V represent data secured from hogs that were immunized by the injection of large quantities of defibrinated blood intravenously. The data shows very little change from the normal by the intravenous injection of blood or by the course of the disease of the animal, as indicated in Table I.

Note.—The following abbreviations are used to note the findings in these tables:

Sl. Ac.—Slightly, though unmistakably acid in reaction to litmus.
Ac.—Plainly acid to litmus.
Sl. Alk.—Slightly, though unmistakably alkaline.
Alk.—Plainly alkaline in reaction.
Pres.—Present in moderate amount.
Tr.—Trace of substance noticed.
Sl. Tr.—Very slight trace.

TABLE I

Pig No. 185.

Date.	Serum Given.	Virus Given.	Temperature F.	React. & Sp. G.	Albumen.	Urea Wt. Per-cent.	Sugar	Indican.
1-27, '14		1 cc.		ac. 1,039	None	4,982	None	Tr.
1-28, '14			103.0					
1-29, '14				ac. 1,010	None	0.869	None	None
1-30, '14			102.1					
1-31, '14				sl. ac. 1.010	None	1.095	None	Sl. Tr.
2- 2, '14			103.2	ac. 1.032	None	3.961	None	Tr.
2- 3, '14			103.1	1.002	None	0.251	Pres.	None
2- 5, '14			104.0	sl. ac. 1.002	None	0.187	None	None
2- 8, '14			104.0					
2-10, '14			105.4					
2-17, '14			105.0	Killed				

TABLE II

Pig No. 123.

Date.	Serum Given.	Virus Given.	Temp. Fahr.	Reac. & Sp. G.	Albumen.	Urea Weight Percent.	Sugar.	Indican.
12-12, '13	1 dose	0.5 cc.						
12-27, '13		2.5 cc.						
1- 9, '14		5. cc.						
1-16, '14				Neut. 1.002	None		Trace	None
1-22, '14				ac. 1.020	None	2,645	None	None
1-27, '14		1.150 cc.	(104.0) (104.6)					
1-28, '14			102.2	ac. 1.030	None	2.558		None
1-29, '14			103.2	Neut. 1.021	None	2.827	None	Tr.
1-30, '14			103.2	ac. 1.012	Pres.	1.429	Tr.	None
1-31, '14			103.8	Neut. 1.017	None	2.782	None	Pres.
2- 2, '14			104.1	Neut. 1.009	None	1.371	None	Tr.
2- 3, '14			103.4	sl. ac. 1.021	None	3.475	None	Pres.
2- 4, '14			103.1	alk. 1.019	None	2.376	None	sl. tr.
2- 5, '14			103.0	Neut. 1.008	None	0.995	None	None
2-10, '14			103.0	Neut. 1.011	None	1.489	None	sl. tr.
2-11, '14				sl. ac. 1.007	None	0.903	None	sl. tr.

TABLE III

Pig No. 250.

Date.	Serum Given.	Virus Given.	Reac. & Sp. G.	Albumen.	Urea Weight Percent.	Sugar.	Indican.
5-20, '14			Neut. 1.003	None	0.219	Tr.	None
5-21, '14			Neut. 1.001	None	0.125	None	None
5-22, '14			Neut. 1.002	None	3.941	None	Tr.
5-23, '14		1,200 cc.	Neut. 1.001	None	0.202	None	Tr.
5-24, '14			alk. 1.013	None	1.679	None	.....
5-25, '14			alk. 1.020	None	3.168	None	Pres.
5-26, '14			ac. 1.010	None	1.834	None	Pres.
5-27, '14			ac. 1.013	None	2.164	Tr.	Pres.

TABLE IV

Pig No. 248.

Date.	Serum Given.	Virus Given.	Reac. & Sp. G.	Albumen.	Urea Weight Percent.	Sugar.	Indican.
5-20, '14			Neut. 1.005	None	0.312	None	None
5-21, '14			Neut. 1.003	None	0.187	None	sl. tr.
5-22, '14			1.005	None	0.152	None	None
5-23, '14		1,100 cc.	Neut. 1.007	None	1.067	None	Pres.
5-24, '14			alk. 1.015	None	2.154	None	Pres.
5-25, '14			alk. 1.015	None	2.364	Sl. tr.	Tr.
5-26, '14			ac. 1.003	None	0.274	None	Tr.
5-27, '14			alk. 1.014	None	1.815	None	Tr.

TABLE V

Pig No. 246.

Date.	Serum Given.	Virus Given.	Sp. G. Reac. &	Albumen.	Urea Weight Percent.	Sugar.	Indican.
5-20, '14			Neut. 1.005	None	0.437	None	Tr.
5-21, '14			Neut. 1.005	None	0.437	None	Tr.
5-22, '14			Neut. 1.002	None	0.303	None	sl. tr.
5-23, '14		1,000 cc.	Neut. 1.002	None	0.454	None	sl. tr.
5-24, '14			Neut. 1.005	None	0.242	None	sl. tr.
5-25, '14			alk. 1.009	None	2.211	None	Pres.
5-26, '14			sl. ac. 1.014	None	2.157	None	Tr.
5-27, '14			Neut. 1.013	None	2.225	None	Pres.