Proceedings
FIFTY-FIRST
ANNUAL MEETING
of the
UNITED STATES
LIVESTOCK SANITARY
ASSOCIATION

U. S. BUREAU OF ANIMAL INDUSTRY
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HOTEL LA SALLE
Chicago, Illinois
December 3, 4, 5, 1947
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HISTORICAL

Records of the early meetings of the Interstate Association of Livestock Sanitary Boards are very meager. The first meeting of the organization was held in Fort Worth, Texas, September 28-29, 1897, primarily to inspect a vat for dipping cattle and sheep that had been constructed in that city.

The name of the organization was changed at the 13th annual meeting held in Chicago, Ill., in 1909, to the United States Livestock Sanitary Association. All meetings since 1909 have been held in Chicago.

<table>
<thead>
<tr>
<th>Meetings</th>
<th>Date</th>
<th>Place</th>
<th>President</th>
<th>Secretary</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Sept. 29-29, 1897</td>
<td>Fort Worth, Tex.</td>
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<tr>
<td>2</td>
<td>1898</td>
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<tr>
<td>3</td>
<td>1899</td>
<td>Chicago, Ill.</td>
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<td>*</td>
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<tr>
<td>4</td>
<td>1900</td>
<td>Louisville, Ky.</td>
<td>*</td>
<td>*</td>
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<td>5</td>
<td>Oct. 8-9, 1901</td>
<td>Buffalo, N. Y.</td>
<td>E. P. Niles</td>
<td>F. T. Eisenman</td>
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<td>7</td>
<td>Sept. 22, 1903</td>
<td>Denver, Colo.</td>
<td>W. E. Bolton</td>
<td>Hon. W. P. Smith</td>
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<td>8</td>
<td>Aug. 23-25, 1904</td>
<td>St. Louis, Mo.</td>
<td>J. C. Norton</td>
<td>Hon. W. P. Smith</td>
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<td>9</td>
<td>1905</td>
<td>Guthrie, Okla.</td>
<td>Hon. W. P. Smith</td>
<td>S. H. Ward</td>
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<tr>
<td>11</td>
<td>Sept. 16-17, 1907</td>
<td>Richmond, Va.</td>
<td>D. F. Luckey</td>
<td>G. A. Jarman</td>
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<td>14</td>
<td>Dec. 5-7, 1910</td>
<td>Chicago, Ill.</td>
<td>Chas. E. Cotton</td>
<td>J. J. Ferguson</td>
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<td>15</td>
<td>Dec. 6-8, 1911</td>
<td>Chicago, Ill.</td>
<td>John F. DeVine</td>
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<td>16</td>
<td>Dec. 5-6, 1912</td>
<td>Chicago, Ill.</td>
<td>Mazyck P. Ravenel</td>
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<td>17</td>
<td>Dec. 2-4, 1913</td>
<td>Chicago, Ill.</td>
<td>Peter F. Bahnson</td>
<td>J. J. Ferguson</td>
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<td>18</td>
<td>Feb. 16-18, 1914</td>
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<td>J. J. Ferguson</td>
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<td>20</td>
<td>Dec. 5-7, 1916</td>
<td>Chicago, Ill.</td>
<td>O. E. Dyson</td>
<td>J. J. Ferguson</td>
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<td>21</td>
<td>Dec. 2-4, 1917</td>
<td>Chicago, Ill.</td>
<td>J. G. Wills</td>
<td>S. H. Ward</td>
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<td>22</td>
<td>Dec. 2-4, 1918</td>
<td>Chicago, Ill.</td>
<td>M. Jacob</td>
<td>S. H. Ward</td>
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<td>23</td>
<td>Dec. 1-2, 1919</td>
<td>Chicago, Ill.</td>
<td>G. W. Dunphy</td>
<td>D. M. Campbell</td>
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<tr>
<td>24</td>
<td>Nov. 29-30-</td>
<td>Dec. 1, 1920</td>
<td>Chicago, Ill.</td>
<td>S. F. Musselman</td>
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<tr>
<td>25</td>
<td>Nov. 28-30, 1921</td>
<td>Chicago, Ill.</td>
<td>W. F. Crewe</td>
<td>Theo. A. Burnett</td>
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<tr>
<td>26</td>
<td>Dec. 6-8, 1922</td>
<td>Chicago, Ill.</td>
<td>T. E. Munce</td>
<td>Theo. A. Burnett</td>
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<td>27</td>
<td>Dec. 5-7, 1923</td>
<td>Chicago, Ill.</td>
<td>W. J. Butler</td>
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<td>28</td>
<td>Dec. 3-5, 1924</td>
<td>Chicago, Ill.</td>
<td>J. G. Ferneyhough</td>
<td>O. E. Dyson</td>
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<td>31</td>
<td>Nov. 30-</td>
<td>Dec. 1-2, 1927</td>
<td>Chicago, Ill.</td>
<td>L. Van Es</td>
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<td>32</td>
<td>Dec. 2-5, 1928</td>
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<td>C. A. Cary</td>
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<td>33</td>
<td>Dec. 4-6, 1929</td>
<td>Chicago, Ill.</td>
<td>Chas G. Lamb</td>
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<td>34</td>
<td>Dec. 3-5, 1930</td>
<td>Chicago, Ill.</td>
<td>A. E. Wight</td>
<td>O. E. Dyson</td>
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<td>35</td>
<td>Dec. 2-4, 1931</td>
<td>Chicago, Ill.</td>
<td>J. W. Connaway</td>
<td>O. E. Dyson</td>
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*Information not available.

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<tr>
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<th>Person 2</th>
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<tbody>
<tr>
<td>36 Nov. 30-</td>
<td>1932</td>
<td>Chicago, Ill.</td>
<td>Peter Malcolm</td>
<td>O. E. Dyson</td>
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<td>37 Dec. 6-8,</td>
<td>1933</td>
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<td>T. E. Robinson</td>
<td>O. E. Dyson</td>
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<tr>
<td>38 Dec. 5-7,</td>
<td>1934</td>
<td>Chicago, Ill.</td>
<td>Edward Robinson</td>
<td>O. E. Dyson</td>
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<td>39 Dec. 4-6,</td>
<td>1935</td>
<td>Chicago, Ill.</td>
<td>Walter Wisnicky</td>
<td>L. Enos Day</td>
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<td>1936</td>
<td>Chicago, Ill.</td>
<td>R. W. Smith</td>
<td>L. Enos Day</td>
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<td>42 Nov. 30-</td>
<td>1938</td>
<td>Chicago, Ill.</td>
<td>J. L. Axby</td>
<td>L. Enos Day</td>
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<td>43 Dec. 6-8,</td>
<td>1940</td>
<td>Chicago, Ill.</td>
<td>H. D. Port</td>
<td>Mark Welsh</td>
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<td>44 Dec. 4-6,</td>
<td>1941</td>
<td>Chicago, Ill.</td>
<td>E. A. Crossman</td>
<td>Mark Welsh</td>
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<td>45 Dec. 3-5,</td>
<td>1942</td>
<td>Chicago, Ill.</td>
<td>I. S. McAdory</td>
<td>Mark Welsh</td>
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<td>48 Dec. 6-8,</td>
<td>1945</td>
<td>Chicago, Ill.</td>
<td>C. U. Duckworth</td>
<td>R. A. Hendershott</td>
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<td>49 Dec. 5-7,</td>
<td>1946</td>
<td>Chicago, Ill.</td>
<td>William Moore</td>
<td>R. A. Hendershott</td>
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<td>50 Dec. 4-6,</td>
<td>1947</td>
<td>Chicago, Ill.</td>
<td>Will. J. Miller</td>
<td>R. A. Hendershott</td>
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<tr>
<td>51 Dec. 3-5,</td>
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</tbody>
</table>
PRESIDENT'S ADDRESS

BY WILL J. MILLER

Topeka, Kansas

I hope all of you understand how much I appreciate the honor you conferred upon me by making me president of this association. To follow in the footsteps of our past presidents is a great privilege. I wish to thank the secretary of our association, Dr. Hendershott, also, members of the various committees for the work they have done during the past year. Through their efforts a great deal has been accomplished, but much still remains to be done. All of us owe much to the Bureau of Animal Industry. We are grateful for their assistance and guidance in livestock disease problems. We have taken great satisfaction in the cooperative way our association has worked with them.

I have enjoyed being a member of the United States Livestock Sanitary Association for many years, and feel I have learned much in the control of livestock diseases. I believe it is important for other livestock men and laymen whose interests are in the control of livestock diseases, to become members of our association.

This association was organized to benefit the livestock men by controlling and eradicating ticks and scabies. Meetings were held at various cities in the south and southwest. In 1906 the constitution and by-laws were amended to provide for annual meetings to be held in Chicago during the time of the International Livestock Exposition.

During the past 41 years, since 1906, changes have taken place. Various new organizations have been formed and many of them now hold their annual meetings here during International week. Frequently, in conversation with different individuals, I have heard the remark, "Chicago is becoming too crowded with meetings. We do not have time to attend meetings which we wish to attend, and should attend."

The stimulation of membership from among livestock men should be one of our goals. I wonder if one means to this end might not be by holding our annual meetings in different cities in the country, in sections where a majority of the livestock is produced. To take our meeting to the livestock men, as it were, rather than to compete with so many other organizations here for their attendance.

A criticism I have heard in the past is that the papers presented at our meetings are too technical to appeal to the layman. We might keep this in mind in planning our programs and include more topics which would be of general interest to the livestock producer.

We have been called upon to save grain, so more would be available for export. No doubt the livestock men can assist in this program by following the best known practices in the production and feeding of livestock. These practices should include full utilization of roughage feeds and grasses. More pounds of meat and dairy products are produced from pasture than from all other sources. However,
it is well known that for finishing meat animals for market, some grain and protein feeds are essential. The same is true of the production of dairy products. A small amount of grain added to roughages is worth while and results in a better product.

At present, these practices are more necessary than usual, due to the continued demand for food supplies to be sent to hungry folk of other lands. It well becomes America to do everything possible to help feed and rehabilitate devastated lands throughout war-stricken Europe. But we must not overlook the fact that a sufficient amount of feed and food must be retained here at home if our people are to continue strong and productive. Only with well filled cribs and bins, can we better supply the need of those abroad.

My understanding of conservation is to save, not to waste or to dissipate our substance, but to utilize it in the best possible manner. This means careful attention to reserves: reserves of supplies now on hand; reserves of seed-grain supplies for producing new crops; reserves of breeding animals for future meat supplies; and reserves of feed and pastures. It takes in a lot of other things, including conservation of our water resources, our native and tame grasses and the fertility of our soils. The proper handling, feeding and grazing of livestock can contribute much to all of these programs of conservation.

Because of the higher prices obtained, this is an advantageous time for us to dispose of our undesirable animals without so much economic loss. This would be in line with disease eradication programs, and with culling scrub livestock to improve the quality of our basic herds and flocks.

We are all familiar with the tremendous amount of good and economic saving to the industry through the use of our present day insecticides. DDT has been generally accepted and widely used to control flies. Grub control should be followed more extensively. The United States Department of Agriculture estimates that cattle grubs cause an annual loss of from fifty to a hundred million dollars, through injury and loss of livestock while fighting the heel fly, through the reduction of milk flow, by lack of normal beef gains, and through the damage to hides by grub holes and scar tissue left when the hole is healed. The average devaluation on grubby cattle during this period is from $2.00 to $5.00 per hundred weight or maybe more.

Feeding tests indicate that grubby cattle on feed, treated for grubs at the proper time, gain an average of one-fourth to one-half pound per day more than similar untreated cattle in the same lots during the first 60 days after treatment.

It is gratifying to know that the loss caused by cattle grub can be eliminated. This can be accomplished by a vigorous grub control program.

Being a layman, I am not qualified to discuss the control of diseases in livestock from a professional standpoint, however, I am qualified to discuss the control of such diseases as a livestock man, and as a livestock sanitary official.

BRUCELLOSIS

The control and eradication of brucellosis presents so many problems that there is a question in my mind whether the information released in livestock journals, farm papers, and in scientific publications is adequate. We know that vaccine is an aid
and should be used as a control measure, however, in a vaccinated herd, and particularly in a vaccinated infected herd, we cannot state specifically that the reacting animal shows a titre as a result of the vaccine used and not from natural infection. When the scientists can give us a simple method of testing blood which will differentiate between a vaccinated animal and one that has natural infection, it will be a solution to this problem.

A large percent of owners are using vaccine as a control measure, however, it could be used as a subterfuge. I believe most owners of livestock should be interested enough in the control of brucellosis to stand their own losses, should there be any. With vaccine so easily procurable, in my opinion it is not wise to pay indemnity on animals which react to the blood agglutination test. I believe the sale and use of vaccine should be limited to those persons qualified to use it, who would be required to report the identification and vaccination of all animals.

I believe the United States Bureau of Animal Industry should adopt a program suitable for all interests with a view of eventually eradicating the disease. I also believe that the program should be followed in each state by the federal inspectors, in cooperation with the state livestock sanitary official. I believe there is more to controlling brucellosis than collecting blood and the reporting of such collections. Each herd presents a problem, and the owner looks to the veterinarian for advice.

I believe a most important step in the control of both tuberculosis and brucellosis would be for the Secretary of the United States Department of Agriculture to formulate regulations prohibiting the interstate movement of dairy, purebred, and breeding cattle, unless they are negative to test for tuberculosis and brucellosis within a period of thirty days prior to date of such movement. Such regulation should provide for the importation of officially vaccinated reacting cattle into states which would accept them. Concessions, also, should be made for the movement of animals for feeding and grazing purposes, which could be handled under a quarantine at destination.

Such a regulation would stop the indiscriminate movement of reactor cattle from one state to another, and would protect the state operating under a control program. We would then have a uniform method of handling cattle moving interstate.

TUBERCULOSIS

I am not familiar with the situation with regard to tuberculosis in other states, except to know that all states are modified accredited areas. From our experience in Kansas, we have reached the conclusion that, as the program has been followed, a "modified accredited area" means nothing. At the time our state was modified accredited, the livestock men and the livestock sanitary officials apparently believed the trouble was over, and that no further tests were necessary except to test enough cattle in an area to keep it on a modified accredited basis.

Our appropriations were not sufficient to employ veterinarians to devote their entire time to the eradication of tuberculosis. The only man employed on a full-time basis was an appraiser. However, the Bureau of Animal Industry continued to furnish money and veterinarians to reaccredit counties. Federal veterinarians, who were the only veterinarians employed to test cattle, went into counties and
in many cases retested the same herds every third year. They tested herds which were easily accessible and in many instances the majority of these herds were dairy cattle; therefore, the reaccreditation depended chiefly on the testing of dairy herds rather than on a representative sample of cattle in the county. Possibly these conditions were true in some other states.

This went on for several years. As a result of such testing, occasionally we received 11-C reports from meat inspectors in charge of packing plants, showing that lesions of tuberculosis had been found in cattle slaughtered. For a time 11-C reports were not regarded as significant, and little effort was made to check the herds in which the cattle originated. Herds where reactors were found were not always quarantined, and sometimes the retesting of such herds was not continued long enough to be certain that no infection remained.

We finally woke up to find that tuberculosis existed in Kansas. As a result of this awakening, we asked for and received additional state appropriations to carry on the work. Additional federal appropriations were also provided. More veterinarians were employed.

We tested all herds reported to us on 11-C’s and in a majority of these herds, tuberculosis was found. The herds were placed under quarantine and retested. We also quarantined and retested all herds in which reactors were found on initial test by practicing, federal, and state veterinarians. In some instances, cattle from herds where reactors were found had been sold into other herds for breeding purposes. These cattle were traced, and a complete test was made of the herd into which they had been introduced. When it was found that exposed cattle had been moved to other states, the officials of those states were notified.

On investigation of some of the 11-C reports we receive, we find that the cattle had been moved into Kansas, by permission, for the feeding and grazing season. In these instances, we mail the 11-C report to the livestock sanitary official of the state in which the cattle originated. This leads us to believe that possibly other states are having the same trouble we have had in Kansas in following out their reaccreditation program.

Much credit is due the Bureau officials in charge of meat inspection and to the inspectors at packing plants for their part in helping us to eradicate tuberculosis by sending us the 11-C reports. We believe it was through these reports that we first came to realize the extent of infection in our state. We must also give credit to the federal veterinarians working in our state for their cooperation with our department in the effort to eradicate tuberculosis.

We know that through a false sense of security we made mistakes in carrying out our program of tuberculosis eradication. Now, when we recommend a county for reaccreditation, we believe we are justified in doing so. In several counties, all the cattle have been tested. In others, all the cattle in a third, or a half, of the townships have been tested. We believe by following this method we will be on a par with any other state in controlling and eradicating bovine tuberculosis.

FOOT AND MOUTH DISEASE

One of the most serious conditions now confronting our country is the proximity of foot-and-mouth disease. Dr. B. T. Simms suggested that I, as President of the
United States Livestock Sanitary Association, appoint a committee of sanitary officials representing the various sections of the country, to meet with Bureau officials in Mexico to obtain first-hand information on foot-and-mouth disease as it exists in that country. Dr. J. V. Knapp, Dr. C. E. Kord, Dr. Ivan G. Howe, Dr. Ralph L. West, and Dr. W. J. Butler were appointed, however, it was impossible for all to go, and those making the tour of inspection were Dr. Kord, Dr. Howe, Dr. Wilkins acting for Dr. Butler, and myself.

From my observations, I was impressed with the tremendous undertaking of the Bureau of Animal Industry. In the first place, the nature of the country, ranging from mountainous areas through plains and fertile valleys to the tropics, makes it difficult to inspect cattle and to transport personnel and supplies. Then, too, it is more difficult for the Bureau to carry out operations on foreign soil than it would be in our own country. They are faced with many problems. The spread of the disease has been slow, but it continues relentlessly.

I firmly believe that we, in this country, must continue to be alert. As long as foot-and-mouth disease exists in Mexico, there is a possibility that it may be introduced into this country. The livestock sanitary officials and the federal inspectors in charge in the various states are investigating each suspected case of foot-and-mouth disease. The livestock man who finds a condition in his cattle that resembles foot-and-mouth disease should immediately report it to his veterinarian, to the livestock sanitary official and to the federal inspector in charge of his state.

I hope all livestock sanitary officials are prepared to meet an emergency should it arise. I feel I cannot stress too strongly the need for us to continue to be alert and watchful.

**LIVESTOCK MARKETS**

Numerous cattle are handled at central markets. This is one more place where we must be vigilant. There is no question that the inspectors available are doing a good job in checking all livestock on arrival. It is regrettable that the Bureau, through lack of funds, has been forced to decrease the numbers of inspectors at our central markets at this time when inspection should be intensified, rather than lessened.

In line with veterinary inspection at other markets, I believe that state veterinary inspectors should be maintained at all community sales to observe and to inspect livestock moving through the sale.

There are many topics of importance to this association on which I have not touched, however, a splendid program has been prepared for this fifty-first annual meeting, and it is my privilege to welcome you to listen to the fine papers which will be presented. I am sure all of us will receive much benefit from the meeting, and from our discussions together.
Mr President, Members of the United States Livestock Sanitary Association: It seems to me I recall last year promising to make a report of the activities of the Secretary. I do not have a complete report here, but I am going to try to review briefly for you some of the activities of the past year.

As you know, we started out the beginning of the year with a more or less catastrophe on our hands when we learned we had an outbreak of foot-and-mouth disease in Mexico. We had heard some rumor about it at the meeting here a year ago. There was not anything tangible or definite with regard to it at that time, but shortly after we returned home from this meeting the federal Bureau of Animal Industry was called in to make an investigation of the situation in Mexico and made a definite diagnosis of the foot-and-mouth disease in that country.

Your worthy President deemed the situation was of sufficient importance to all of us and to the livestock industry, that a meeting of the Executive Board be held to discuss the problem. This meeting was called for Fort Worth, Texas in the early days in February.

At a meeting at the Blackstone Hotel in Fort Worth there were 26 representatives of the various states and the Executive Board President. Quite a number of the livestock people of the Southwest also were in attendance. We had somewhere in the neighborhood, I would say, of a hundred and fifty people at that meeting.

We spent an entire day in the discussion of what had taken place in Mexico, how it had happened to occur, how the condition was diagnosed. We listened to a report of Dr. S. O. Fladness, Assistant Chief of The U. S. Bureau of Animal Industry, in charge of control over diseases of livestock entering the country; also from Dr. T. B. Cole, who is one of his assistants, in charge of the quarantine station at Clifton or Athenia, New Jersey, who had been removed from that post to participate in control of the movement of livestock across the United States-Mexican border; also Dr. Maurice Shahan of the pathological division, who had been investigating the outbreak in Mexico and had first-hand information relative to the situation in that country. A good many of the livestock men, as I said before, were present and entered into a rather lively discussion of the whole situation.

Out of that meeting came resolutions to the Secretary of State Marshall, the Honorable Clinton P. Anderson, Secretary of Agriculture, and to the members of Congress relative to the passage of an enabling act that would provide that the federal Bureau of Animal Industry could participate in a disease eradication program outside of the continental United States.

At that meeting we engaged a court reporter and we had the transcribed notes from the meeting in the amount of 184 pages. So, you know there was a lot of talking done, as is usually the case when regulatory officials and livestock men get together on a serious problem.
Later in the year we had other problems that were confronting the livestock sanitary people, and a meeting was held in New York City early in March to discuss a sanitation program for the poultry industry because of the appearance of Newcastle disease in flocks throughout the country.

We had tried repeatedly to get the sanitary program spelled out and written out in detail and, finally, at the New York meeting wrote up the major portion of the program which was later on presented to the Bureau of Animal Industry in Washington; and later each of us received a copy of the proposed sanitary program for the poultry industry which, not only covers the sanitation in hatcheries but in dressing plants, in auction markets, on poultry farms throughout the nation.

A number of letters went out, as you know, to the Executive Board from the Secretary's office relative to the situation as it developed in foot-and-mouth disease control, until such time as the federal government inaugurated a program of prompt reporting to us the progress that was being made in Mexico.

This has increased the mailing from our office and the work involved in the Secretary's office materially during the past year.

Later on in April it was deemed advisable that the national Committee on Rabies hold a conclave in Philadelphia. This meeting will be reported in detail to you by Dr. Brueckner, who is Chairman of the Committee on Rabies, when he makes his report this morning.

The Secretary served as one of the members of this Association delegated to that particular conference.

Later on in the year, in September, there was a meeting called by Dr. B. T. Simms, chief of the federal Bureau of Animal Industry in Washington to review the national program on brucellosis control. Again, Dr. Brueckner and I served the Association as the representatives to this particular meeting.

Out of that meeting came a lot of real good, I believe. I think it was the initial step in a national brucellosis control plan.

There was a very interesting discussion—I wish time was available to me to review for you exactly what took place there and some of the discussions that took place.

We had members from the Beef Breeds Association, who are in a responsible position relative to the breeds and advising these people relative to disease control.

The thought was expressed that we had no plan for disease control and, yet, we had at the time one state, North Carolina, which has been declared brucellosis free as a result of the procedure that has been followed in that state; and, to many of us acquainted with the control program, it would seem, instead of having no program for disease control, that we might be plagued with a multiplicity of plans.

However, I think a great deal of good came out of the meeting in Washington. I think it has laid the foundation for greater progress toward uniformity in the future.

I know it was a delight to me to be present there and meet with the men from the livestock centers out here in the West and to discuss some of our common problems with them, and I think it will certainly lead to a great deal of good.

I hope that is the initial meeting of many more that are to follow, and I feel, and have felt for a long time, we in this Association should be closer to our livestock
people; and we should have more of them sitting here this morning, too, filling this room, listening to what we say and participating in our program, bringing their problems and presenting them to us here. I think that is a goal we should set for ourselves, and every effort should be made to encourage more livestock raisers and owners to maintain membership in our Association and to participate in an active way.
MEMORIAL SERVICE

BY DR. J. L. AXBY

Indianapolis, Indiana

Mr. President, Ladies and Gentlemen: Another year having passed, this Association, pursuant to established custom and procedure, again takes time to memorialize the members who, during this year, have gone to that bourne from whence no traveler ever returns. To the best of my knowledge, their names are as follows:

Robert O. Blitz passed away in September. He was formerly with the Pennsylvania Bureau of Animal Industry, later with E. R. Squibb.

Dr. J. W. Conoway—I just learned since coming that he had died, and had no opportunity to obtain any more history of Dr. Conoway. But I might say to you that when I first attended this Association I met Dr. Conoway. He was a charter member of the United States Livestock Sanitary Association. He wrote a history of this Association. He is a past president of this Association. For the intervening years from the time I first met him, which was in 1917, up until a few years ago, we had intermittent personal correspondence. I found him to be a very wonderful individual, and one whose life was continually devoted to improvements and progress in livestock health and the control of infectious diseases of livestock.

Having mentioned the members who have died, may I respectfully ask all assembled to arise and remain standing for a moment of silent prayer.

(The audience arose and stood in silent prayer.)

They are gone, but they sowed their seed in the soil of the inalienable rights of man; and the harvest is for us to garner, to conserve, and to re-sow. Many times their eyes were blinded with tears of sorrow, worry, and pain; but they were thankful because they lived in a free America.

They found the source of the direction of their thinking in their walk and talk with God. Sometimes they had been accused of being disturbers. They may have been disturbers but, if so, they were constructive disturbers. Possibly there were times when they were not fully understood. Well, my friends, the disciples of Jesus never fully understood Him, and He had to make explanations to their disturbed minds. Now, this man from Galilee, like these men who have passed away, disturbed the slothful out of their complacency, the indifferent out of their apathy, the rich out of their greediness, and the authorities out of their arrogance. The Golden Rule is disturbing. Yes, it is disturbing to those who would like to transpose it into the Rule of Gold. Even today, there is nothing more constructively disturbing than righteousness based on justice and love.

So, may we emulate these departed brothers and, as we strive in this disturbed world of today for world peace, may we see that basically this whole matter of world peace is set on a universal pattern and only God is at home there.

Again, our prayer is that their souls may rest in peace.
RELATIONSHIP OF THE VETERINARIAN AND THE LIVESTOCK PRODUCER

By H. E. Floyd

Editor "Kansas Stockman," Topeka, Kansas

Just because nothing has ever been done about it, is no good reason why it should be further neglected. There is always the possibility that something will turn up when you start digging. A study of history reveals the fact that throughout civilization the pick-and-shovel crews have dug up a lot of valuables in the form of increased knowledge and general advancement. And one of the more profitable places to dig is in the pages of experience.

It was only a half century ago that scientists proved that airplanes would not, and could not, ever be practical. Some of our puzzled philosophers remember a farmer's grange meeting in 1910 when, and where, it was decided that automobiles would never, and could never, supplant horses as motive power. For after all, everyone had horses and what would become of man's good friend and beast of burden should people buy and use automobiles?

Just because products of the sea have never been grown on land is no good reason for dismissing the subject. You know people like oysters—they like them on the half-shell, in stews, scalloped, baked and fried. Its hard work—arduous labor—to scoop up oysters from the ocean-bed and the supply is uncertain. Therefore, it's logical to attempt their growth on trees or bushes. The results to date, while not at all startling, are somewhat encouraging.

If an oyster is grafted onto a wild cherry tree, it is said to produce a most unusual and delectable flavor. When scions are taken from the oyster tree and grafted on other cherry trees, experience indicates that it is wise to mulch with generous quantities of sea-weed. This makes the oyster feel more at home and contributes largely to its peace of mind and general contentment.

After all, it's quite a change for an oyster to come up from the murky depth of the sea into the bright sunlit air of an oyster grove. So anything that man can do to make the oyster feel more at home is a sensible precaution that will foster rapid growth and profitable development.

All of which may, or may not, be true, worth-while, or remotely pertinent to matters at hand here today.

But, by the same token anything that a veterinarian, or the veterinary profession, can do to make and keep calves in a peaceful and contented frame of mind is a distinct service to the cattle industry. Anything that will help a pig to keep itself physically fit, contented and happy, will hasten the day of its demise at the hands of a butcher.

This being true, pigs are not given to cultural habits as applied to cleanliness, sanitation and moderation in eating practices. They know little, and care less, about vitamins and calories. Little pigs are adrift on turbulent waters from the farrowing pen to the frying pan. They have no choice of diet, or associations and nothing whatever to say about whom they shall serve. Theirs, it is simply to grow and grunt.
They, therefore, need the sympathetic care and guidance of the veterinarian to help them along their way to fame as bacon or link-sausage. The approved program being to get them to market weights and finish in the shortest possible time and thus save feed, labor and delay in getting their successors started on the same road to destruction.

In recent weeks, I understand, Secretary Clinton P. Anderson, New Mexico rancher who knows his cattle, is advocating the slaughter of piggies at lighter weights in order to save feed—more grief for the little squeals.

But before dismissing that subject, it appears that somewhere in the calculations someone ran afoul of facts. For after all, what's the purpose of feeding hogs? Is it to save feed or produce pork?

In my boyhood days I knew an old German farmer who had some wholesome ideas about thrift and economy. One of his favorite sayings when discussing economy, was this: "Economy is a good policy, but at the same time it don't pay to set a hen on one egg." There's a lot of meat in that—and you can make it beef or pork, as you like.

But I must get back on the beam, if indeed I've ever been there. And I frankly admit I don't know.

In the profitable production of improved livestock, there are first essentials, and while my remarks are more specifically regarding cattle, they will apply in a large degree for other classes of animals. I talk about cattle because I know more about them—leaving the pigs to Secretary Anderson.

Among first essentials are good individuals, the right kind of seedstock; good blood-lines and the good type of animal. But along with this list of firsts, I would also place the Veterinarian. Without him we sail an uncharted sea with poorly qualified pilots.

True we have come a long way in the production of better livestock during my stretch, and yours. As for cattle, we have come from the Texas long-horns and brockled-faced, tick-infected coasters—which someone has said were crosses between sunfish and jack rabbits, to the present day broad backed, thick, deep bodied beef animals, that consume less feed and cut out far more pounds of a much better quality meat. As for hogs we have come from the shambling razor-backs to a kind of hog that produces more pounds of the desired cuts of meat—especially hams and bacon—in a shorter time and on less feed. This same degree of improvement is evident in all other classes of domestic animals. But despite this advancement, there is yet much to be done.

Of course, better breeding and feeding practices have had much to do with our progress. And while it's there in a large measure the handiwork of veterinarians does not show on the surface. Their part was to carry on in long and troublesome campaigns of disease control and eradication. An intangible thing but of great and lasting value.

Laboratory research and the application of veterinary science have had a stabilizing effect upon our livestock industry. They have been the means of preventing regular and heavy losses that formerly were taken for granted and figured along with taxes and other operating expense. A few years ago every rancher whose program included a cowherd, suffered regular and heavy losses from blackleg among
the calves. In our section of the range country, this loss was figured at about 15 per cent of the crop. That is to say, if a man had a cowherd of 100 head, and a 90 per cent calf crop, he expected to lose 15 per cent, or 13.5 calves each year, from blackleg. Among hog producers comparable losses were regularly sustained due to outbreaks of cholera.

In more recent years however, cases of blackleg in calves and cholera in hogs have been few. With proper vaccination and due regard for sanitary surroundings, there is nothing to fear from either of these causes nor from a long list of other maladies which formerly took their toll in death of livestock. When immunizing vaccines moved in, a lot of livestock diseases moved out. So I repeat—laboratory research and the application of veterinary science have had a stabilizing effect upon the industry I represent.

Considering present conditions, there should be an improved relationship between the veterinary profession and livestock producers generally. Their interests are mutual. Whatever helps one will, to a degree, help the other.

It is not for me to suggest that anyone is at fault—but rather to emphasize the fact that calves and pigs should be kept in good health and thrifty—it's not right for them to be sick, under-nourished or exposed to infections and contagions—nor should they be infected with parasites, internal or external. Lice, mites, grubs and ticks take heavy annual toll from the just profits of those who produce, feed and market livestock.

In recent years a lot of time, energy and money have been spent in campaigns to rid livestock of disease and parasites—to keep them in good growing and fattening condition—for the welfare of both producers and those who consume meat and dairy products. Intensive campaigns have been common the past few years, and a great amount of good has been accomplished through efforts of our State Colleges, Livestock Sanitary Officials, the Loss Prevention Board, and other agencies. Of course, veterinarians have been interested and active in this, but it seems somewhat difficult to get the rank and file of producers to cooperate fully in such programs. Demands upon their time for other work or the expense of cooperation, seem to be barriers to more rapid progress. So we must keep up the educational programs until there is general acceptance. For as long as my neighbor harbors rats and rattlesnakes, just so long will my position be jeopardized. And as long as your neighbor harbors lice, grubs and horn flies in his flocks and herds, just so long will your flocks and herds be in danger of infection.

And right here it may be in order to discuss something else. Perhaps veterinarians have been so ethical and strictly orthodox that they have stood in their own light. Might it not be well to call on John Jones out on his farm or ranch and discuss with him the health and general well-being of his cattle, hogs and sheep. Ethics are all right—I've nothing against ethics. But why should they interfere with work that ought to be done for the welfare of livestock. Why worry about the "Boss of the Barnlot" or what he thinks about ethics? If he has the bellyache or B-flat arches, he should consult an M.D.

But it's your job to give aid and comfort to the calves, pigs and lambs—and what do they care about ethics, especially when there are lice in their hair and grubs on their backs?
OBSERVATIONS MADE BY THE COMMITTEE ON THE FOOT-AND-MOUTH DISEASE SITUATION IN MEXICO

November 11, 1947

In view of the widespread interest in the foot-and-mouth disease situation in Mexico, it was suggested by Dr. B. T. Simms, Chief of the Bureau of Animal Industry, to Mr. Will J. Miller, President of the United States Livestock Sanitary Association, that a committee be appointed to go to Mexico and inspect operations for the control of foot-and-mouth disease and to assist in making technical information available for general use, this with a view of keeping to a minimum the number of groups who visit the infected area. Numerous visitors necessarily impose an additional heavy burden on Dr. Shahan and members of his staff. Mr. Miller appointed the following committee:

Dr. Ivan G. Howe, Albany, New York
Dr. J. V. Knapp, Tallahassee, Florida
Dr. C. E. Kord, Nashville, Tennessee
Dr. Ralph G. West, St. Paul, Minnesota
Dr. W. J. Butler, Helena, Montana
Mr. Will J. Miller, Topeka, Kansas

Unfortunately, Dr. W. J. Butler was unable to make the trip, and Dr. H. F. Wilkins, Assistant State Veterinarian of Montana, was asked to fill his appointment. Dr. J. V. Knapp and Dr. Ralph G. West found it impossible to join the committee.

On Monday morning, November 3, 1947, a meeting was held with the Mexican and American staffs. Arrangements had been made by Dr. M. S. Shahan for a meeting with Ambassador Thurston at 3:15 o’clock Monday afternoon. Ambassador Thurston greeted us very cordially and after some discussion expressed his desire that we make a very thorough and complete investigation and inspection. He intimated that not infrequently some of these investigational trips had been too hastily planned and executed to permit the committees to acquire a proper over-all picture of the foot-and-mouth disease situation.

During the afternoon we inspected the warehouses and supply depot established by the Joint Commission in a suburb of Mexico City, for the repair and reconditioning of the mechanical equipment received, and which became both a supply center for the thousands of necessary repair parts and supplies as well as a mechanical maintenance center.

We were informed that over 1400 pieces of automotive and heavy equipment are engaged in the campaign, with additional items arriving daily for field assignment. A random sampling of the major equipment items received from the United States and now in active field use included 180 jeeps, 100 light trucks, 71 bulldozers, 59 scrapers, 10 power shovels, 35 heavy trucks, 122 truck trailers, 268 power sprays, and 25 paymaster cars.

A very enjoyable and enlightening visit was made to the Mexican Livestock Disease Experiment Station offices and laboratory, which are conducted under the able direction of Dr. Alfredo Camargo.
We finished the day by securing the proper paraphernalia for a foot-and-mouth inspection. Some of this tour was to be made along a part of the northern quarantine line, which, as now drawn, extends from Tampico, on the Gulf of Mexico, in a westerly direction through Ciudad de Valles, Nuevo Morelos, San Luis Potosi, Zacatecas, thence southwest to Villa del Refugio, Moyahua, La Quemada, Etzatlan, Cocula and down through Antlan to Novidad on the Pacific Ocean. The original first and second lines have been broken and those in charge have been obliged to move a large part of their force and equipment from within back to their third line of defense, which is expected to hold, and will hold if all concerned will cooperate to that end.

Our tour of five days started at Mexico City and carried us north to Valles, thence to San Luis Potosi, Lagos and Guadalajara, and then east to Morelia and back to Mexico City. While on this motor tour of about 1400 miles we were able to visit three sacrifices (the term used in Mexico in the slaughter of livestock in connection with the foot-and-mouth disease control program) and to see foot-and-mouth disease in its various phases—from comparatively acute to recovered cases. We also saw trench-digging equipment in operation, disinfecting stations, and many of the complicating hazards with which the operating forces have had to contend.

When a sacrifice is to be made in an area, the site is selected by a Mexican and an American member of the Commission where the infected and contact animals may be slaughtered and buried. When possible, heavy dirt-moving equipment is moved in and a trench dug about 12 feet wide, 9 feet deep, and as long as is required for the number of animals to be sacrificed. On the appointed day, natives drive their animals—dairy cows, oxen, sheep, goats and hogs—to the trench, where they are appraised by both Mexican and American appraisers. As soon as the appraisers reach agreement, the animals are driven into the trench, shot, slashed, covered with lime and buried. Each owner is then paid in cash from a paymaster truck present at the site of the operation. Sometimes the owners refuse to bring in their animals, and in such cases the Mexican troops are dispatched to round up the delinquents.

On November 10 your committee, in company with other interested individuals, made a reconnaissance trip by Army plane from Mexico City over Chilpancingo, Puerto Mexico, Alvarado and Puebla, and returned. This trip was over unusually high, rugged mountain sections in which nothing but foot paths or burro trails could be seen; large, open, intensely cultivated valleys, and apparently almost impenetrable tropical areas along the coasts where rivers slowly and tortuously course their way through jungles to the sea. In these coastal areas most travel and movement of supplies is by boat and on foot. Trench digging and the covering of slaughtered animals is by hand labor. Foot-and-mouth disease is known to exist quite extensively in this southern area and to be spreading gradually toward the southern quarantine line, which extends from the town of Alvaro Obregoh, on the Gulf of Mexico, through the towns of Villa Hermosa and Tuxtla Gutierrez in a southwesterly direction along the highway to Cintalpa, down to the town of Porta Arista on the Pacific Coast.

Rugged mountains, up to at least 10,000 feet high, are inhabited and cultivated in spots to the very top. It must be remembered that such areas contain a large number of susceptible animals which can only be satisfactorily located and brought
FOOT-AND-MOUTH DISEASE IN MEXICO

out by native inhabitants when needed to be sacrificed or inspected. In the area covered by our tours by car and air, fences were seldom in evidence, other than for a few stone fences which were built by the Spaniards, probably centuries ago. In other words, the infected area is almost as open as when discovered by the Spaniards and certainly much more densely populated. Every plot of tillable ground in this southern section of Mexico is cultivated, and much of it by hand, as the steep mountain sides rise at an angle up to approximately 45 degrees, where neither oxen nor mules can be used. In the open valleys oxen, mules and tractors are employed.

Most of the people live in communal villages from which the cattle, sheep and goats are moved out to graze during the day and brought in at night, when distribution is made to the numerous owners. While grazing, the herds from adjoining villages are frequently mixed so the herders may visit, or if the herds are not mixed, the herders do congregate; hence when infection is present in one of the village herds, it is soon found in the surrounding ones. The movement of livestock is not well controlled, as observed by us and as reported by inspectors. They may be one place today and miles away tomorrow, whether in or out of infected areas. One lot of over 20 cattle from an infected area is reported to have moved in a circuitous manner through clean territory, with natural devastating results. This is only one of many similar instances reported to us by men in the field. This lack of proper quarantine has been responsible for many border extensions involving thousands of head of livestock. The people, most of whom in these poorer rural areas are Indian, move about by foot or on burro and can be seen at all times of the day and night going to market and elsewhere or returning home. These customs have prevailed for hundreds of years and now it is extremely difficult to change their way of life to fit the control program. Most of these people neither read nor write, and many of the Indians in certain areas do not speak Spanish. There has been little control of this human factor, which, in the opinion of your committee, is, and has been, a most important medium in spreading foot-and-mouth disease virus in Mexico.

There are other areas, inhabited by hostile Indian tribes, which are reported never to have been explored. At the present time infection is not known to exist in these hostile areas, but without much better control of the human and livestock factors it is reasonable to presume that all territory within the north and south lines will become infected except perhaps for some marginal or isolated areas. Such areas would most likely be where the nature of foot-and-mouth disease is understood by stockmen and where the human element has been brought under control by education or by the military.

It is reported that very little meat and milk is consumed by the natives. However, some meat and milk is required and constitutes an essential, although small, part of their diet. Those who require meat and milk, and some who may not, voluntarily restock without authority soon after the animals have been sacrificed. This is one of the many handicaps in freeing an area of infection so that it may be properly tested and safely restocked. The topography of the country involved varies from high, steep, rugged mountains; barren, rocky, arid regions to fertile valleys, intensively tilled and heavily populated, and to wet tropical, malaria-infected, mosquito-infested jungles and everglades. In the swampy coastal area transportation is of necessity by boat and on foot. In some sections saddle horses
are not available. This greatly interferes with prompt and adequate inspections and proper execution of control measures following diagnosis. Transportation by car is limited to the main highways, which are at times many miles from sites of inspection or infection. In the areas not accessible by auto, jeeps are used within limits, and then horses secured when available, and when not, the men in the field walk to the place of inspection and back. On all such trips a Mexican veterinarian must accompany the American and they by soldiers.

The purpose and intent of the campaign in Mexico has been the complete eradication of foot-and-mouth disease, which on April 2, 1947, despite the preventive efforts of Mexican authorities, had involved the following 16 Mexican states in the central portion of the Republic: Aguascalientes, San Luis Potosi, Zacatecas, Chiapas, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacan, Morelos, Oaxaca, Puebla, Queretaro, Tlaxcala, Veracruz, and the Federal District. To accomplish this, quarantine lines were established north and south of the general area where the infection existed. Quarantine restrictions were put into effect governing the movements of people, susceptible animals and animal products from infected farms, villages and municipios to uninfected ones and vice versa. These restrictions were necessary in order to give the eradication forces opportunity to isolate infected and exposed animals, slaughter and bury them, and disinfect the premises under conditions that would prevent the further spread of the disease. The key to the success of such operations was, and continues to be, the effectiveness of the quarantine restrictions. Obviously, if these restrictions are carelessly enforced, the disease will spread and tend to nullify the effects of the eradication processes. For one reason or another, this has been the case during the course of the present campaign. Although the spread of the disease has been slow, it has been relentless. Energetic eradication work has kept this spread to a minimum, but it has not been able to stop it without the same energetic handling of the quarantine operations.

Quarantine restrictions must be enforced by the Mexican Army, as it represents the only effective police power in Mexico. Commission personnel have tried through every means available to them, including representations through the United States Ambassador to the President of Mexico, to effect an adequate strengthening of the quarantine work. This has been only partially effected. Quarantine restrictions along the northern boundary of the infected states have been materially improved, and in some instances the local quarantines have been similarly improved. However, these improvements still are not sufficient to stop the disease, and in fact the inspections in recent weeks have discovered a serious spread of the infection north and west of Jalisco and Guanajuato and northward into Veracruz and Aguascalientes.

In strengthening the handling of the quarantine restrictions it has been necessary for the Commission to use a great deal of motor transport which was intended for eradication work. As the Army was supposed to furnish its own transport, it could not be foreseen that this added drain would be made upon the transport available to the Commission. The Commission also has furnished other help in the way of trained personnel to see that the restrictions are maintained in key places and to instruct and encourage the soldiers assigned to the work. Effort along these lines is being continued and intensified, particularly along the northern and southern
boundaries of the infected area, to prevent the spread of the disease beyond these points.

In working out the plan of operations for the eradication forces, it was necessary to make some changes from the procedures that had been previously used by the Mexican contingent. The two most important changes were (1) to require the slaughter and burial of exposed animals as well as those showing clinical manifestations of the disease and (2) to organize and put into the field inspection parties that would get out several miles beyond the known infection and, working back toward that point, locate the extent of the infection. It was extremely difficult to gain agreement upon these principles, but with firm insistence the necessary instructions were issued to field personnel of both sections of the Commission. Continuing throughout the campaign, we are told these two problems have recurred time and time again with discouraging regularity. In order to appease the owners, it too often has been the tendency of the Mexican veterinarians to give in to the proposition of killing only those animals showing clinical symptoms. Each such instance caused delay while instructions were renewed from the main office. And in the meantime the disease continued to spread. Mexican veterinarians have been extremely reluctant to leave duties other than inspection to qualified lay personnel of the Commission and in spite of repeated requests and directions from the main office it has been impossible to get uniform adherence to the principle of thorough, widespread inspection activities around and beyond the known foci of infection. This has resulted time and time again in the belated finding of the diseased animals some distance from the known infection areas, requiring an immediate realignment of work forces, and with constant delay contributing to the spread of the infection.

Because of these last-recited factors and the already-mentioned deficiencies in the enforcement of quarantine restrictions, the gradual spread of the disease has caused several major reassignments of forces in an effort to place the eradication crews on the extreme periphery of the infection where they can work from without toward the center. They are now engaged in the latest of this series of realignments in an effort to place the forces along the extreme north of the known infected area and along the extreme southern quarantine line. It is hoped that this realignment will be effected in time to permit the forces to get beyond the disease and continue to work from there toward the center.

Certain factors operate favorably with respect to the hope of successful operations along these lines. These factors are:

(1) The continued effort has contributed to the better understanding of quarantine restrictions on the part of some of the military officer and soldier personnel.

(2) Commission people are being placed with the military personnel at the most important places.

(3) The new line approaches the natural dividing line between the communities toward the north of Mexico and those which depend upon Mexico City and the other areas of central Mexico.

(4) The character of the terrain in many places is such that it acts as a natural barrier to the spread of the disease.

(5) These lines are approaching the areas where the local inhabitants are cognizant of the unbearable cost and loss associated with attempting to live with foot-
and-mouth disease and are, therefore, naturally actively desirous that the disease be kept from their territory. This has been evidenced in some cases through the local decision of the people to employ guards to augment the quarantine force of the Army. This point is probably the most important of the five mentioned. It is obvious that the success of the campaign will depend a great deal upon the unselfish and wholehearted cooperation of the people as well as that of the Mexican Government and the Mexican and American forces assigned to the task of eradicating this most devastating animal plague.

The need for adequate personnel to carry on the work has, of course, been one of the principal concerns. At the present time the civilian personnel available to the Commission includes 522 from the United States, as follows:

<table>
<thead>
<tr>
<th>Personnel Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarians</td>
<td>102</td>
</tr>
<tr>
<td>Sanitary Technicians</td>
<td>191</td>
</tr>
<tr>
<td>Administrative and clerical</td>
<td>92</td>
</tr>
<tr>
<td>Appraisers</td>
<td>49</td>
</tr>
<tr>
<td>Paymasters</td>
<td>73</td>
</tr>
<tr>
<td>Engineer and mechanics</td>
<td>15</td>
</tr>
</tbody>
</table>

331 employed by the Mexican Government:

<table>
<thead>
<tr>
<th>Personnel Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarians</td>
<td>100</td>
</tr>
<tr>
<td>Aides to veterinarians</td>
<td>22</td>
</tr>
<tr>
<td>Paymasters</td>
<td>73</td>
</tr>
<tr>
<td>Administrative and clerical</td>
<td>78</td>
</tr>
<tr>
<td>Appraisers</td>
<td>58</td>
</tr>
</tbody>
</table>

In addition to the foregoing, the Joint Commission has a total of 1,077 employees of which 260 were engaged in clerical duties and 817 more were in the field or shops. The total civilian personnel engaged in the campaign was thus, 1,926 in addition to about 15,000 troops of the Mexican National Army used for police duties associated with the campaign.

This is about all the people that can readily be absorbed in the program at this time. It is necessary that United States personnel work, in general, with Mexican counterparts, in order to maintain the good will of the people. It is obvious that United States personnel cannot give orders to the owners and others involved in the work. This must be done by the Mexican employees, working with them, after agreement upon the decisions to be made. The United States now has nearly 200 more people than those employed by the Mexican Government, and the American unit is unable to place any more persons in the field until more Mexican personnel can be supplied to work with them. It is of interest in this connection that several months ago when there was not more than one-half of the present number of people, the work accomplished as measured in inspections made and animals slaughtered and buried, was almost as great, and in some respects more extensive, than it is today. This indicates that factors other than the number of personnel are operating to restrict the activities of the Commission. Some of these factors are:

(1) Continued disagreements over appraisals. Each such disagreement stops slaughter operations, with an attendant waste of man-hours, until a solution can be found.
(2) The lack of transport for Mexican Army troops. Work cannot go on without the presence of these troops to keep order, and the lack of transport has often delayed the work until the troops arrived.

(3) Resistance of the people to the work of the Commission, in many ways necessitating delays in the work until the resistance can be dissolved through the use of educational aids, persuasion, or military force.

The present extent of the disease is such that the control and eradication effort will have to be continued for some considerable time, and the results will most assuredly cause a tremendous impact upon the economy of central Mexico. A realization of this is probably responsible for some of the opposition to the campaign, particularly on the part of political leaders in some of the infected areas. The Government is making every effort to counteract this effect through the formation of educational committees throughout the infected areas and the establishment of an over-all committee for rehabilitation of the areas that have been deprived of their livestock. These efforts have had considerable effect, but the impact of the disease and the program of eradication are so tremendous that it cannot be said whether the efforts of the government are sufficient to accomplish the desired ends.

One outstanding feature that we observed was the high morale of the Commission forces. Taking into consideration the many difficulties and discouraging aspects that have presented themselves, this high morale very forcibly demonstrates the sincerity of purpose and ability of the campaign personnel. To attempt eradication of foot-and-mouth disease from such a large infected area and in a foreign country requires courage, foresight and hope—a hope that every interested individual and department will give that cooperation and immediate favorable response so indispensable to immediate control and ultimate eradication. Action, speedy and positive, is the essence of success, and it is not readily obtained in a country not geared to that way of doing and to a people who do not fear or realize the far-reaching effects of the disease or fully understand the cost of delay, even of hours. The effort to hold the north and south lines—to operate from without inwardly—to attempt eradication from within, concurrently in the hope of saving thousands of animals—is commendable. This, however, has not been attainable with all of the deterring factors enumerated, including adverse and conflicting foreign propagandas and sabotage.

In view of the almost impossible terrain and the many obstacles that present themselves, your committee considers that the problem of eradication of foot-and-mouth disease in Mexico is one of the most difficult ever presented to the veterinary profession. It has been definitely proven by the Foot-and-Mouth Disease Commission of the United States Department of Agriculture that the most contagious period of the disease is in the early stages and that the virus may be eliminated in large quantities even before fever or vesicles or other indications of the disease appear. So-called exposed animals therefore may be the most dangerous and the most active spreaders of the disease. This being the case, your committee concurs with the United States Foot-and-Mouth Disease Commission and strongly recommends that wherever the slaughter or “stamping out” method is employed to eradicate foot-and-mouth disease, special consideration be given to all exposed animals and that all susceptible animals in an infected area be destroyed immediately, even though they may not show active lesions of foot-and-mouth disease.
Your committee therefore would respectfully recommend to the Congress of the United States:

(1) The establishment and maintenance of a research laboratory on an isolated island or other acceptable safe area for the intensive study of foot-and-mouth disease.

(2) Further research to determine methods for the immediate and proper disposal of carcasses by chemicals or means other than burial.

(3) The building of an adequate fence along the United States-Mexico international boundary line or adjacent thereto, as previously suggested by others.

We wish to extend our appreciation to Licenciado Oscar Flores, Director of the Commission, and Dr. M. S. Shahan and his co-workers, for their efforts to make our stay pleasant and for having made available transportation, interpreters and guides so that we could go where and when we elected.

We also wish to extend our appreciation to Mr. Charles H. Bernhard and his co-workers for securing for us pictures of operations and for supplying us with general information and statistics, and Dr. M. R. Clarkson for his valuable advice, information and assistance.

Respectfully submitted,

WILL J. MILLER, Chairman
DR. H. F. WILKINS
DR. IVAN G. HOWE
DR. C. E. KORD
REPORT OF THE COMMITTEE ON LAWS AND REGULATIONS


Your Committee on Laws and Regulations has been rather inactive during the past year. However, the various members have been consulted regarding more work on unification of Laws and Regulations and it was unanimously agreed that the states still outside the fold should be encouraged to come in.

Last year we reported that only 7 states had done little or nothing to make their interstate regulations conform with the 1944 Committee suggestions.

In classifying the Laws and Regulations for purposes of printing the booklet on interstate regulations, it was found that only a few had adopted the uniform regulations as written, though many states had essentially the same regulations. The author of such laws and regulations was apparently reluctant or unable to give up his phrasing in favor of the recommended form, which has been criticised by some as being too involved to serve as a model set of regulations, which should be as short and concise as possible.

It is the belief of your Committee that further study should be given to writing better uniform regulations and to this end that some of the best talent in our organization be put on this Committee, and that by the time we publish another booklet on interstate requirements more states can have their interstate regulations listed (See Uniform Regulations).

Your Committee, however, is not unmindful of the fact that conditions may prevail in certain localities or districts which may demand special regulations to control certain diseases, and that such regulations would have no part in a general over all set of uniform regulations.

It is believed, however, that as far as such widespread diseases as tuberculosis and Brucellosis are concerned a concerted effort should be made to bring about more uniformity in the regulations of all the states. This could probably be brought about by toning down some of the most severe regulations, if necessary, and raising some of the more slack ones.

This Committee is unanimous in the opinion that the U. S. Bureau of Animal Industry should take the lead in formulating regulations governing the interstate movement of livestock since the control and prevention of the spread of disease from animals being moved interstate is specifically their duty.

They believe if such definite regulations were made by the U. S. Bureau of Animal Industry the states could add such regulations as might be necessary to meet the local or state-wide conditions. Such interstate regulations should be implemented by a good system of reporting livestock diseases in the various states (National Livestock Vital Statistics).

A number of states have instituted special interstate regulations during the past summer, notably one on swamp fever in horses. In this connection your Committee
is of the opinion that in all interstate regulations governing the movement of horses, no exceptions should be made on horses and mules owned by the government or on horses entering the state for racing or exhibition. Such health certificates to be valid for one year on horses traveling continuously from track to track or show to show. Some Western States now require permits, in addition to the regular health certificate, to bring in cattle from all states bordering on Mexico.

The interstate regulations governing movement of vaccinated calves is one of the sore points among most of the states exporting large numbers of beef calves.

Your Committee is pleased to report that several additional states have passed laws governing community auction sales and have set up a system of veterinary supervision of such markets.
The ultimate goal of those interested in rabies control in this country is and should be the constant endeavor to bring about effective and uniform control measures through cooperative Federal, State and Local legislation. In the present absence of such legislation, it is the purpose of this paper to show that this disease can be effectively controlled at a local level through planning, diligence, perseverance, and effort.

As far back as 1941, repeated efforts were made by the Maricopa County Board of Health to control the spread of rabies infection in this health jurisdiction through quarantine measures. A total of five such quarantine resolutions were adopted prior to September of 1944. Since the rabies problem continued to grow worse while these measures were in effect, it became apparent that quarantine of pets together with the destruction of stray animals, while they might prove valuable adjuncts to a long-range control program, were not the complete answer to our problem. During the years previously mentioned, the status of the effectiveness of single dosage rabies prophylaxis for animals was in a state of flux locally, and no balance of opinion could be brought to weigh for or against the value of rabies vaccination as a control measure.

The rabies problem reached truly epidemic proportions during the first six months of 1944. An average of one case of the disease in animals was being reported to the Health Department each day. The problem also resolved itself into an additional one of economics. Cattle, horses, goats, and swine were being infected. During this period an estimated twenty thousand dollars was expended by the unfortunate victims of the bite of rabid animals and by the Maricopa County Indigent Medical Department in securing and providing Pasteur treatment where indicated. Of far greater but more tragic significance was the loss of a child's life due to rabies, as demonstrated by clinical and pathological findings. Unfortunate as it was, this incident speeded control measures.

In May of 1944, the Executive Committee of the Arizona Veterinary Medical Association drew up a rabies control program and presented it for approval to the Maricopa County Board of Health. One feature of the program called for the appointment of a County Humane Board by the Board of Supervisors to act in an advisory capacity to the Board of Health in coping with a problem seemingly out of hand. This board is composed of representatives from the Veterinary Medical Association, County Medical Association, County Department of Health, Parent-
Teachers Association, Arizona Sheep Sanitary Board, City of Phoenix Humane Board and the Arizona Live Stock Sanitary Board. The first action of this Board was to recommend with minor changes the program presented by the Veterinary Association. The program was adopted without reservation by the Maricopa County Board of Health.

In short, this program consisted of two parts: one which dealt with the emergency then existing and the other dealing with a long-range prevention program. The emergency program called for the free vaccination of all dogs in the county to be followed by a sixty day strict quarantine of all dogs and cats. The veterinary services for the emergency period were furnished free of charge by the veterinarians of the county, including U. S. Army veterinarians and Federal veterinarians. The Board of Supervisors of Maricopa County approved an expenditure of five thousand dollars to furnish free of charge the vaccine and other supplies incidental to the vaccination program. Members of local kennel clubs volunteered to assist in handling the dogs. Members of the Parent-Teachers Association handled licensing of the dogs. A county license, required by state law, was purchased at the time of vaccination. The initial vaccination campaign covered a period of one week during the month of September 1944. Eighteen vaccination stations were set up at centrally located points throughout the county. Veterinarians spent one day at each location. The urgency and need for pet owners to vaccinate and license their dogs was given wide coverage through the splendid cooperation of local newspapers and radio stations. In five and one-half days 8,425 dogs were vaccinated.

At the conclusion of this intensive vaccination program, a sixty day quarantine of dogs and cats was instituted by the County Board of Health. During the first month of this quarantine, the cooperation of the public and the majority of the peace officers responsible for its enforcement was very good. This was no doubt due to the large amount of publicity being given the control program. As days passed into weeks it became apparent that enforcement officers were becoming more and more lax with the result that owners were allowing their pets more liberty. Numerous meetings were held with enforcement officers during the quarantine period and it was decided that the best way to cope with the enforcement problem was for the County to hire full-time personnel to devote their time solely to enforcement activities. The services of the Fish and Wild Life Service were also requested through the Arizona Livestock Sanitary Board and the Sheep Sanitary Commission. This Service detailed three men to the County to aid in eliminating predators and strays. This cooperation together with the hiring of full-time enforcement personnel began to reflect its effectiveness by the number of rabies cases in animals that were being reported to the Health Department. During the initial 60-day quarantine twenty-two cases of rabies were reported, a very definite leveling off in the number of cases from the previous daily average of one case per day prior to the inauguration of the control program; however, the number of cases being reported was felt sufficient enough to warrant extension of the original quarantine for another ninety day period.

During this quarantine extension, the Arizona State Legislature convened in Phoenix and efforts, crowned with success, were instituted to have the Arizona State Law which, as already mentioned, provided for the annual licensing of dogs;
amended to provide also for compulsory annual vaccination of dogs against rabies. Also, the law was amended to permit County Boards of Health to utilize funds derived from licensing animals for all phases of rabies control work which they deemed necessary. The law was also amended to invest the State Veterinarian with the power to designate rabies control areas over the State. In areas so designated unlicensed animals are subject to destruction by peace officers.

The amended State Law became effective in February of 1945, approximately six months following the inauguration of the rabies control program; consequently, a second vaccination and licensing program was held at this time and programs have been held annually since then. Each of these has been conducted in a manner such as was outlined for the initial program. By State Law the responsibility of seeing to it that dogs are vaccinated before being licensed and the licensing becomes the duty of the constable or peace officer in each precinct over the County. Each year these officers are sent mimeographed reminders from the Department of Health informing them of the Rabies Control provisions of the State Law; supplying them with a list of veterinarians who will participate in the program—this participation has been 100%—; suggestions as to the importance of adequate publicity for the vaccination stations they plan to establish in their precincts; importance of arranging for volunteer help at these “stations” and other information tending to make for a successful vaccination and licensing program. These annual reminders have been a primary factor in keeping the percentage of animals in this area, which are protected against rabies, at a consistently high level. In 1945 there were 10,216 dogs vaccinated and licensed; in 1946 there were 11,018, and during the licensing and vaccination program for the present year there was a total of 10,601 licenses issued.

We have no accurate means of determining the dog population for this health jurisdiction, but it is the consensus of opinion among local veterinarians that two-thirds of this population has been protected annually through rabies vaccination.

The drop in reported cases of rabies during the past three years and three months is striking. The figures which follow represent disease occurrence in all types of animals:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1944</td>
<td>285</td>
</tr>
<tr>
<td>1945</td>
<td>55</td>
</tr>
<tr>
<td>1946</td>
<td>10</td>
</tr>
<tr>
<td>1947 to date</td>
<td>13</td>
</tr>
</tbody>
</table>

The figures for the last three years shown we believe to be very accurate, since veterinarians have been conscientiously reporting clinical cases of the disease which they see, and these figures are combined with the cases on which a laboratory diagnosis of rabies has been made following examination of brain tissue.

It has become a rare occurrence in this area when a human has to take the Pasteur treatment after having been bitten by a rabid animal. If predominate credit must be given any one of the control measures used in the success of our program we feel it must be given the annual vaccination program. Of all the animals so protected, only one case of rabies has developed in a vaccinated dog. In this particular instance, it was felt that exposure had already occurred prior to the time the vaccine was administered, and sufficient time had not elapsed to afford the necessary pro-
tection. Annual vaccination has proven, in our estimation, to be the keystone in the bulwark against the occurrence and spread of rabies among our animal population.

The revenue derived from licensing has proven sufficient to cover the cost of the vaccination program. The licensing fee, set by State Law, is two dollars for female dogs and one dollar for males. There is no reason for this financial discrimination. It has been a part of the State licensing law for years, and at the time changes were being sought in this law we wished to center attention primarily on compulsory vaccination and utilization of licensing funds for rabies control purposes.

Dogs have been processed, so to speak, at an average cost of $00.977 per dog. This includes the fee of the veterinarian, who receives $00.50 per animal vaccinated and the cost of vaccine and supplies. The cost of vaccine averages about $00.375 per animal.

The basic essentials of Maricopa County's rabies control program which are applicable to other local areas, may be summarized as follows:

1. Annual vaccination of dogs against rabies and annual licensing are required by law. The vaccine must be administered before a license is issued.
2. Funds derived from licensing are utilized to defray expenses of the rabies control program; especially those contingent with the vaccination program. The cost of the vaccine is free. The pet owner pays only the fixed license fee and in return receives the vaccine and the veterinarian's services free of charge. This particular aspect of the program lends itself magnificently to public appeal and has maintained the support of the general public in the annual licensing and vaccination campaigns and is popular with the Veterinary profession.
3. Rigid control of predators and unlicensed dogs through use of full-time personnel and cooperation of agencies devoting their time to predator control work.
4. The program is taken to the public. Licensing and vaccination stations are established at conveniently located "spots" over the health jurisdiction; thereby, making it easier for pet owners to avail themselves of the vaccination and licensing service. These "stations" are publicized by every means possible. In addition to the vaccination "stations," the owner may, at any time during the year, take his pet to any of the veterinarians practicing locally and receive the licensing and vaccination services. The matter of getting a license and vaccination is not made cumbersome and difficult; thus, the cooperation of the public in the program is further strengthened.
5. Promotion of the closest of cooperation among veterinary medical profession, local department of health, governmental officials and lay groups in promulgating and carrying out a rabies control program.
6. The crux of this entire program hinges upon:
   a. A program that has popular appeal and in our observation is one of the State's most popular taxes.
   b. The opportunity to render a public service to the community by the veterinary profession.
   c. The eradication of rabies.
REPORT OF THE COMMITTEE ON RABIES


Your Committee on Rabies will present the report prepared at a conference on rabies held in Philadelphia on April 9, 1947. This is essential since it is necessary that the Conference Report be submitted to all of the organizations represented, for official action.

"1. On invitation of Dr. R. A. Kelser, Chairman, Special Committee on Rabies, American Veterinary Medical Association, the following individuals representing the organizations indicated, met at the University of Pennsylvania, Philadelphia, Pa., on April 9, 1947, for the purpose of discussing a rabies control program which could be agreed upon in principle by the various agencies represented:

Representing the American Public Health Association:

Dr. Haven Emerson, Emeritus Professor of Public Health, Columbia University; Chairman, Subcommittee on Control of Communicable Diseases, A.P.H.A.; Member, Committee on Rabies, New York Academy of Medicine

Representing the American Medical Association:

Dr. Stuart Mudd, Professor of Bacteriology, University of Pennsylvania, Philadelphia, Pa.

Representing the U. S. Public Health Service:

Dr. Karl Habel, National Institute of Health, U. S. Public Health Service, Bethesda, Md.
Dr. James H. Steele, Chief, Veterinary Public Health Section, U. S. Public Health Service, Bethesda, Md.

Representing the Bureau of Animal Industry, U. S. Department of Agriculture:


Representing the U. S. Livestock Sanitary Association:

Dr. R. A. Hendershott, Chief, Bureau of Animal Industry, Department of Agriculture, Trenton, N. J.
Dr. A. L. Brueckner, Director, Livestock Sanitary Service, Maryland State Board of Agriculture, College Park, Md.

Representing the American Animal Hospital Association:

Dr. C. P. Zepp, Sr., Veterinary Practitioner, New York, N. Y.

Representing the American Veterinary Medical Association:

Dr. C. W. Bower, Veterinary Practitioner; Past President, A.V.M.A., Topeka, Kans.
Dr. Guy J. Phelps, Veterinary Practitioner, Montgomery, Ala.
Dr. Alex Zeissig, New York State Veterinary College, Cornell University, Ithaca, N. Y. (On leave with New York State Department of Health in connection with rabies control)
Dr. R. A. Kelser, Dean of Faculty and Professor of Bacteriology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, Pa.

"2. Prior to this Conference a meeting of the Special Committee on Rabies of the American Veterinary Medical Association met and prepared a group of topics dealing with rabies and its control. These were suggested as a basis for the deliberations of the Conference. On motion by Dr. Emerson, duly seconded and voted, the Conference agreed to use these topics as a basis for discussion. It was further agreed that following the deliberations and conclusions of the Conference the Chairman (Dr. Kelser), with such participants as he might designate, would edit the report of the Conference and submit it to each participant for his examination, comments, and approval or disapproval. It was also agreed that after this report has been circulated to the various participants of the Conference and approved by them, it would be submitted by the representatives to their organizations for consideration and action.

"3. It was further agreed by the Conference that when the report was approved by the various individuals in attendance, it would be in order to publish the report in suitable journals. It is to be made clear, however, that the report, while having the approval of the various individual representatives, still must be acted upon by the organizations involved. This latter will require time.

"4. Dr. Emerson called the Conference's attention to a report, now in press, from the Committee on Rabies, New York Academy of Medicine, and gave the Conference the benefit of the views and recommendations of that Committee as set forth in its report. There was also considered the report on Rabies and Its Control by a Subcommittee on Rabies, Committee on Animal Health, National Research Council.

"5. The Conference unanimously agreed on the following principles and considerations in connection with such rabies control program as might be undertaken on a national basis: (a) Rabies in the United States is of sufficient importance to make it desirable that the Federal Government participate in means for its control through cooperation with the several States, contributing funds and personnel. (b) Rabies in man is generally a disease reportable to local and state health authority. Rabies in lower animals should be specifically a reportable disease to be reported to public health or other responsible state health authority. It should be reported by States, with place of occurrence specified. Through a central Federal agency, the consolidated information should be assembled, analyzed, and distributed to all States, agencies, and individuals having responsibility in a rabies control program. (c) In a program for the control of rabies in the United States, prime consideration must be given to (1) adequate diagnostic facilities, (2) the control of animals capable of transmitting the disease and (3) mass immunization of susceptible animals, particularly dogs.

"Diagnostic facilities. To be considered adequate, facilities for the diagnosis of rabies should include not only provision for the microscopic examination of brain specimens from suspected animals but also means for the inoculation of laboratory test animals. The number and location of laboratories performing services connected with diagnosis of rabies should be adequate to provide prompt service within reasonable distances. Further, facilities should be provided for maintenance of suspected cases of rabies in lower animals under proper veterinary observation.
"Control of animals (dogs, cats, and wild life) capable of transmitting rabies. Control measures should include the following:

(a) Licensing of all dogs.
(b) Proper disposition of ownerless, unwanted, and stray domestic animal pets.
(c) As soon as rabies appears in a community, strict control of all dogs should be enforced for whatever period of time may be considered necessary. Dogs should not be permitted to run at large but should be properly confined on their owners' premises and only be permitted away from same when under proper restraint by a responsible individual.
(d) Dogs which have bitten persons or other animals, and dogs which are suspected of having rabies, should be confined in a suitable, authorized place under veterinary supervision for a period of not less than 14 days.
(e) Dogs known to have been exposed to rabies should be destroyed or kept confined for a period of not less than six months.
(f) Dogs under 6 months of age, being particularly susceptible and less satisfactorily immunized than older animals, should be confined until the area is certified as officially free of rabies.
(g) Adequate provisions and facilities for enforcing all regulations and requirements connected with the control program should be provided for.
(h) The control program should be continued for a period of at least 90 days subsequent to the last reported case of the disease.
(i) Should rabies be found to exist in wild life, prompt arrangements should be made for active cooperation with the U. S. Fish and Wild Life Service and the analogous agency of the state involved. In this connection, when rabies has become established in wild species, a program for reduction of the number of individuals of affected species should be instituted and continued until the disease disappears. Routine brain examinations should be made to determine the incidence of the disease in the wild species and when it has abated.

"Mass immunization. The vaccination of dogs, combined with other control measures as indicated herein, provides the most satisfactory method for the prompt control of rabies. Vaccinated dogs, when properly tagged, may be allowed at large 30 days after vaccination. Vaccination should consist of at least one injection of an immunizing dose of an accepted canine rabies vaccine. Evidence indicates that a single 5 cc. subcutaneous injection of an approved vaccine is effective in a mass vaccination program. However, the injection of three doses of vaccine, in 5 cc amounts, a week apart, provides greater immunization and should be advised when practical. For permanently reducing the number of susceptible dogs, it should be suggested that dog owners have their dogs immunized annually.

"6. In any rabies control program it is deemed essential that a local (county or municipal) Rabies Advisory Committee be organized to facilitate operational functions and cooperative effort. Further, the Conference agrees that an educational program should be launched by appropriate authorization, representing Federal, State, and local agencies, to explain the necessity of control measures, including the efficacy of the rabies vaccines now approved by the U. S. Bureau of Animal Industry and the National Institute of Health. The object of such an educational campaign is to acquaint the public and owners of dogs and other pet animals with
pertinent facts concerning rabies and the reasons and importance of the measures taken for the control and eradication of the malady and the value of specific immunization against rabies. The advisability and desirability of utilizing vaccination not only for the control of the disease during an outbreak, but also in building up and maintaining a relatively highly immune dog population through the annual vaccination of dogs with rabies vaccine should be pointed out.

"7. In view of the essential existing responsibility of the Bureau of Animal Industry of the U. S. Department of Agriculture, the U. S. Public Health Service, and the U. S. Fish and Wildlife Service, this Conference recommends that the function of coordinating a campaign for the control of rabies on a national scale be vested jointly in these three agencies. A plan for accomplishing this on a cooperative basis can undoubtedly be worked out through consultation of representatives of the agencies involved.

"8. The principles and recommendations on which the Conference has agreed should be considered in a rabies control program on a national scale. In general, they are in accord with the procedures recommended by the Subcommittee on Rabies, Committee on Animal Health, National Research Council1 and the report (now in press) of the Rabies Committee of the New York Academy of Medicine. There are other reports on rabies and its control by various other agencies and omission of reference to them does not mean that the conclusion of this Conference is or is not in general agreement with them. The Report of the Subcommittee on Rabies of the National Research Council and that of the Rabies Committee of the N. Y. Academy of Sciences happened to be readily available during the discussions of the Conference."

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
Bureau of Animal Industry
Washington, D. C.

April 30, 1947

INCIDENCE OF RABIES IN THE UNITED STATES
CALENDAR YEAR 1946

Statistics on the number of cases of rabies in the United States in the calendar year 1946 have been collected by the Bureau of Animal Industry of the U. S. Department of Agriculture.

There were 10,872 cases reported. There were 8,384 cases in dogs, 962 in cattle, 44 in horses, 15 in sheep, 22 in swine, 455 in cats, 12 in goats, 956 miscellaneous, and 22 in man.

This material was compiled from a questionnaire sent by the Bureau to the livestock sanitary official and the health officer in each State. In some instances, data from both sources in a State were used. When there was a difference in the number of cases reported for the same species, the greater number was used, since it is believed that the reported cases do not represent all of the cases that occurred.

Table 1 gives the number of cases reported in each State by species.
The map on page 33 shows the distribution of the cases by States.

1 National Research Council, Reprint and Circular Series, No. 126, May, 1946.
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* Includes coyote, fox, rabbit, mouse, gopher, ground squirrel, rat, squirrel, skunk, wild cat, raccoon, opossum, and muskrat.
REPORT OF THE COMMITTEE ON ANAPLASMOSIS


Your committees, last year, reported anaplasmosis from 27 States, but qualified the extent of the infection in two States as being confined to a single outbreak. In one of the latter States (Ohio), the affected herd was sent to slaughter and since then no new cases have occurred either on the farm or elsewhere in the State. Accordingly, it seems proper to remove that State from the list of those in the anaplasmosis area. All who have dealt with the control of the disease are in agreement that once an outbreak affecting a number of animals in a herd occurs in a clean area there is certain danger that a carrier will be left as a menace to the susceptible members of the herd as well as any future susceptible additions thereto and a potential permanent center of infection will be established. Your chairman has seen a cow which was experimentally infected with blood from a Florida cow in August 1927, remain a carrier of virulent infection during its entire life and even after death in February 1947, nearly 20 years later, its blood was still capable of causing fatal infection of a splenectomized calf. This year a single outbreak occurred in a new State, Pennsylvania. Fifty Hereford heifers had been introduced into the herd in the Fall of 1944 from a State where anaplasmosis is known to be prevalent. The first suspicion was noted in the late Fall of 1946 when three animals succumbed following an attack of an acute febrile disease whose symptoms were suggestive of anaplasmosis. In April of this year six other animals were attacked, four died and a positive diagnosis of anaplasmosis was made. The herd is being held in quarantine and during the summer the animals have been periodically sprayed with D.D.T. suspension. Pending the final disposition of the herd it is possible that blood samples from the entire herd may be obtained and made available for a serological diagnostic test which is presently being investigated in the Bureau laboratories and about which more will be said later. That animals from herds where the disease has broken out are being shipped for slaughter is evidenced from reports by the Federal Meat Inspection Service. In 1947, the following figures of condemnations of cattle on ante-mortem and post-mortem inspections are given by that agency: January 9, February 6, March 3, April 9, May 11, June 22, July 32, August 36, September 129, October 101, or 358 cases in the 10 months period. This appears to be about the normal trend of the disease incidence in States which have kept records of outbreaks, the majority of cases occurring in the summer months with a peak in September and October with a sharp drop in the cold months. In one instance a small lot of cattle were shipped from a point in Oklahoma to a Packing House in Pennsylvania operating under Federal inspection. One animal in the lot was found affected with anaplasmosis and condemned. The diagnosis was confirmed by laboratory examination. Reports received from the various States show that although no major outbreaks have occurred during the year there have been scattered outbreaks in a number of herds in practically all of the States in the anaplasmosis area with some disturbing losses in the Northern Marginal States.
During the year in a number of the States in the anaplasmosis area measures have been taken to control flies and ticks by regular spraying of cattle with insecticide agents. In general the reports received have indicated good results in abating fly nuisances and with better weight gains in the herds. While it can not be positively reported, it would seem that the general effect of the spraying has been a lowered incidence of anaplasmosis. A number of experiments carried out by several agencies during the year employing anti-malarial drugs and other substances reported to be indicated in overcoming blood protozoan infections, failed to show that any of the products tried were effective either as specific therapeutic agents or as being capable of destroying the carrier state. Although anaplasmosis has invaded 27 States, the principal centers of infection are still confined chiefly to the original tick fever States. Nevertheless, because of the ever encroaching of the infection on new States we are faced with a most important decision: Shall we control the disease by premunition with an avirulent strain of anaplasmosis as some other countries have done with apparent success or shall we cleave to the plan of eradication as many have hoped we might eventually accomplish?

In support of the latter plan, much work has been done to develop a practical diagnostic test for the detection of carriers of the infection such as has been done with dourine and glanders, both of which have been successfully eradicated. The Bureau undertook this diagnostic problem a number of years ago and now has achieved what we believe to be some measure of success. In the beginning attempts were made to obtain an antigen which would serve as a specific component of the complement-fixation test for anaplasmosis. Blood was drawn from an animal in the acute stages of the disease and the red cells were freed from plasma, washed in saline, lysed by distilled water and the sediment concentrated by centrifugation for use as antigen. In the complement fixation test this antigen showed evidence of definite specificity but because of the small yield it was considered as impractical. A little later ticks infected with anaplasms were used as antigen and found to show specificity but also presented the obstacle of impracticability. Persistent effort by Bureau investigators has now shown that a specific stable antigen with good keeping qualities can be produced. Briefly this method of production is as follows: Select thrifty calves 12 to 18 months old, weighing from 400 to 600 pounds, sphenectomize and 30 to 60 days later inoculate one animal with 10 cc. to 50 cc. of blood from a carrier. Collect blood at the peak of infection for passage into a fresh animal. Experience has shown that it requires four or more passages to produce a satisfactory antigen. The blood of the donor is harvested in an equal volume of Alsevers solution, centrifuged, serum removed, red cells washed in saline, packed by centrifugation, supernatant saline withdrawn and cells resuspended in an equal volume of saline. A dose of 500 cc. red cells in 500 cc. of saline is injected intravenously into a splenectomized calf. By this method the inoculated animal will usually show 0.5 to 1.0 per cent of the red cells parasitized within 24 hours and thereafter the parasite count is approximately doubled every 24 hours so that the maximum count is reached within 7 to 9 days. At that time the animal is completely exsanguinated from the carotid artery, the blood being collected in sodium citrate for antigen production. The citrated blood is immediately centrifugated, the plasma removed and the red cells washed 6 times in saline. One volume of the washed red cells is added to 50 volumes of iced distilled water saturated with carbon
dioxide, the container agitated and refrigerated overnight. The supernatant fluid is then withdrawn and the precipitate centrifuged, collected and washed three or more times in cold distilled water until no color remains. The volume of the packed precipitate is determined, 1.2 per cent sodium bicarbonate added to neutralize the acidity and saline equal to three times the volume of precipitate is added. This product which constitutes the antigen is lyophilized in ampoules, vacuum sealed and stored at -50° to -70°C. until ready for use in the test. Antigens thus prepared have shown satisfactory antigenicity after two years storage at -50° to -70°C., samples of the same lot stored in the refrigerator showed a marked loss of antigenicity after a few months. The technic of the complement-fixture for anaplasmosis differs in a number of important details from that used for the diagnosis of glanders and dourine, being based on the test currently employed for the diagnosis of malaria in man with some modifications. A detailed report of the technic of the test, and the procedure for antigen production will be published in the near future.

The test has been applied to nearly 3,000 samples of bovine serum and in general the results have been very encouraging. Analysis of results of tests of over 1,000 samples from known carriers, acute cases and normal animals showed an accuracy of about 85 percent.

A number of difficulties still remain to be overcome by continued research and it is hoped that some if not all of the agencies now engaged in the investigation of anaplasmosis will be in a position to include studies of the test in their research programs on this disease.

It is felt that the recommendations made by the committee last year should be repeated in this year's report. They follow:

1. A closer study of the ecology and methods of control of all vectors of anaplasmosis with special reference to the discovery of new drugs that may prove effective in combating them.

2. An accurate laboratory method of diagnosis of carrier animals.

3. A diligent search for drugs that will effectively destroy anaplasma marginale in the blood in both the acute and carrier state.

4. Collection of data in each State that will accurately reveal the extent of prevalence of the disease including number of herds, the number of animals affected in each herd annually, a record of the introduction of new animals into the affected herds, etc., so that a guide may be available to more accurately evaluate the true menace of the disease to our cattle industry.
EQUINE INFECTION ANEMIA IN THE UNITED STATES WITH SPECIAL REFERENCE TO THE RECENT OUTBREAK IN NEW ENGLAND

By C. D. Stein, V.M.D., and L. O. Mott, D.V.M.

Infectious anemia, or swamp fever, also known in some sections of the United States as malarial fever, slow fever, and mountain fever, is one of the most serious maladies of horses. On account of its widespread distribution, its insidious nature, and its difficulty of diagnosis, it is of grave concern to owners of horses and mules in all parts of the world. In areas where the disease exists, it is of considerable economic importance because of the great losses in horse and mule power and through deaths and destruction of affected animals.

Infectious anemia is an acute or chronic infectious disease of equines (horses, mules, and donkeys) characterized principally by intermittent fever, marked depression, progressive weakness, loss of weight, edema, congestion and icterus of the visible mucous membranes, and anemia of a transitory or progressive type.

The disease was first reported from Europe in 1843 and now has a world-wide distribution. In addition to Canada and the United States, the disease exists in certain well-defined areas in Germany, Switzerland, Sweden, Norway, Finland, Yugoslavia, Hungary, Russia, Japan, and sections of Northern Africa. Although infectious anemia has existed in the United States for at least 60 years and is one of the more important diseases of equines, it has received little attention in the veterinary literature for the past two decades.

From 1903 to the present time the disease has been authentically reported from at least 34 States. In 17 of these States diagnosis was confirmed by horse inoculation tests. Since 1940 outbreaks have been reported from at least 25 of the 48 States and from the Ottawa Valley of Canada. See map.

With the exception of the Mississippi Delta where the disease in mules appears to be well established and exists principally in chronic form, outbreaks are chiefly of a sporadic nature, being confined to small areas and showing little tendency to spread. For example, small local outbreaks have been reported from time to time in certain areas in Idaho, Oregon, Nevada, Montana, Wyoming, Louisiana, Texas, and other States.

CAUSATIVE AGENT

Although the infectious nature of the disease was known as early as 1859, the causative agent was not definitely established until 1904, when Carré and Vallée (3) demonstrated that it was a filtrable virus. This finding was confirmed by the early investigations of the Bureau and has since been repeatedly substantiated by investigators in various parts of the world.

The virus may persist in the host for years. It is apparently present in the blood and body tissues of affected animals at all times and may be eliminated with some

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of the secretions or excretions, such as the milk, spermatic fluid, saliva, eye and nasal secretions, urine and feces. The exact nature of the virus still remains a matter of discussion. It has not been cultivated in vitro and is unable consistently to reproduce itself in animals other than equines. Our studies on 10 different strains indicate that its virulence is variable and that it shows considerable resistance against disinfectants, heating, freezing, and drying (6).

While most investigators agree that infectious anemia under natural conditions is a specific disease of equines, some workers in foreign countries have reported that young goats, pigs, rabbits, and doves can be infected under experimental conditions (5). Infectious anemia in man has been reported by investigators in Germany and Holland but it is probable that man is not very susceptible to the disease (6).

**REPORTED OCCURRENCE OF EQUINE INFECTIOUS ANEMIA IN THE UNITED STATES FROM 1900 TO 1947**

- **STATES FROM WHICH DISEASE HAS NOT BEEN REPORTED (14)**
- **STATES FROM WHICH DISEASE HAS BEEN REPORTED CLINICALLY (17)**
- **STATES FROM WHICH VIRUS HAS BEEN RECOVERED BY HORSE INOCULATION TESTS (17)**

**DISSEMINATION AND TRANSMISSION**

Although experimental evidence indicates that the disease may be transmitted by injection of infectious material, by insect vectors, and by ingestion of contaminated material, the common method of its spread under natural conditions is still in doubt.

Ordinarily the disease appears to spread slowly, occurring mostly as a sporadic infection. However, during the transportation of great numbers of horses, out-
breaks may occur when infected animals are moved into new territory, and when conditions are favorable for transmission and for the exposure of large numbers of susceptible horses. Under natural conditions the disease spreads more rapidly among animals on pasture than among those kept in stables, especially during the season of the year when biting insects are most numerous.

Experimental evidence indicates: (1) That the disease is readily transmitted by the injection of blood or tissue emulsions from affected animals into susceptible ones; (2) that minute doses of the virus are infective for susceptible animals; (3) that the body secretions or excretions may contain the virus; (4) that infected mares may transmit the disease to their offspring and, therefore, should never be used for breeding; (5) that infected mares may abort during or following febrile attacks characteristic of the disease; (6) that the disease may be transmitted by external parasites, including biting flies, mosquitoes, and biting lice; (7) that it may spread slowly by long, continuous, intimate contact; (8) that carriers probably constitute one of the most common sources of the virus in nature and are chiefly concerned in the perpetuation of the disease. In adopting control measures, these factors should all be taken into consideration (7, 8, 9, 10, 11, 12, 13, 14).

FORMS OF THE DISEASE, SYMPTOMS, AND TERMINATION

The clinical symptoms are variable and depend to a great extent on the form of the disease. Infectious anemia may occur as an acute, rapidly fatal disease or, more commonly, as a chronic affection, characterized by intermittent attacks of fever, loss of weight, progressive weakness, marked depression, and dropsical swellings on the lower portions of the body and on the legs. The disease may also exist in a form in which no clinical symptoms are apparent though the affected animal carries virulent virus in the blood stream. (Plate 1 and Fig. 1.)

In the acute form of the disease the incubation period following subcutaneous injection of infected blood is usually about 12 to 15 days, though it may vary from less than a week to 2 months and possibly longer (Graph 1). The onset is sudden and is manifested by a rise in temperature, which usually goes to about 105° F. but may reach 108°. In the acute form the febrile attacks are usually severe and may be more or less continuous or very frequent. Respiration is accelerated and frequently is of the abdominal type. The animal is dejected, leg weakness is marked, the body weight is shifted from one leg to another, and the hind feet are frequently placed well forward under the body. The membranes of the eyes show congestion, followed by brownish to yellowish discoloration. Feed is refused. There may be a slight watery discharge from the eyes and nose and, if the weather is extremely warm, profuse sweating. Frequent urination may also be noted, and in severe cases diarrhea may develop. The attack usually lasts 3 to 5 days, after which the temperature returns to normal and the animal appears to be well except for a marked loss of weight. Occasionally, however, the initial attack may persist until the animal dies. Dropsical swellings of the sheath, the legs, the chest, and the under surfaces of the body may occur at any time.

The subacute and chronic forms of the disease differ from the acute in that the attacks are less severe and the intervals between them are longer. The subacute cases may terminate in death during or following one of the attacks, or the reactions
Plate 1.—Forms of infectious anemia


Fig. 1. Horse 833—A proven virus carrier for more than 11 years when picture was taken. Infected in April 1935 and still being held under observation in October 1947.
may grow less frequent, the animal finally developing into a chronic case or a clinically recovered carrier. In subacute and chronic cases, as the disease progresses evidence of anemia may develop, the red-corpuscle count may be extremely low, the blood may appear thin and watery, and in the later stages the visible mucous membranes may become pallid. The pulse is sometimes slow and weak, the heart action irregular, and a jugular pulse may be visible. There is sometimes a rapid slowing of the pulse after exercise. Muscular weakness is manifested by a wobbly or rolling gait or by partial paralysis of the hindquarters.

The inactive or latent form of the disease may follow the initial attack, but is usually preceded by several attacks of fever. Animals affected with this form of

![Graph 1](attachment:graph.png)

**Graph 1.**—Comparison of the incubation period on 122 experimentally induced cases of infectious anemia

the disease show no clinical symptoms and are known as clinically recovered carriers, but the infectious agent is always present in the blood stream. Such animals are a menace to other equines that may be near them. The inactive form of the disease may, however, become active at any time and present all the characteristics of the acute or subacute form. Unusually hard work or any debilitating influence will reactivate the infection. (Chart 1.)

**POST MORTEM FINDINGS**

The pathological alterations may be very well marked and plainly visible (in some cases so pronounced as to be striking), or they may be so slight as to escape detection except by persons having considerable experience with the disease. The lesions, which may occur in any degree of intensity or in any combination, are most commonly observed in acute and subacute cases and in chronic cases dying during an acute flare-up.

The most constant lesions of infectious anemia are hemorrhages of varying sizes on the serous and mucous membranes of the body, with enlargement and other
changes of the spleen, kidneys, liver, and heart. The hemorrhages are most frequently found on pleura, the pericardium, epicardium, and endocardium, the peri-

**Chart 1.**—The temperature curve observed in different forms of equine infectious anemia*

*The typical recurrent fever is one of the principal and sometimes the only clinical symptom.

toneum, the mucosa of the small and large intestines, the mucosa of the caecum, and the surface of the spleen and kidneys. (Plate 2.)
The spleen for the most part is enlarged. Occasionally it is three times its normal size, and the splenic pulp is soft and blackish red in color. The liver is frequently enlarged to enormous proportions and is hard and friable. It may vary from a yellowish-brown, cooked appearance to a reddish brown color. The kidneys are frequently enlarged, edematous, and lighter in color than normal, and they may

Plate 2.—Hemorrhagic lesions in acute infectious anemia
show numerous hemorrhages on the surface. The heart may be enlarged, flabby, and lighter in color than normal, or it may have a cooked appearance.

For the most part the tissue changes found in the acute and subacute cases are more extensive and more pronounced than those in the chronic cases. In chronic cases terminating in death from exhaustion following a protracted illness, emaciation, gelatinous infiltration of fat tissue, and a blanched appearance of mucous membranes are observed. In such cases the hemorrhagic infiltration of tissues and degenerative changes of the organs may be very slight or entirely absent.

In carriers and chronic cases of a mild type little or no anatomical alteration is observed on autopsy. The most constant and characteristic histopathological findings are round-cell infiltration and a heavy deposition of hemosiderin in the liver and spleen. The post mortem and histological findings are of considerable assistance in making a tentative diagnosis.

**DIAGNOSIS**

The greatest obstacles in the diagnosis, study, and control of infectious anemia are the lack of a reliable laboratory test and a suitable laboratory animal for detection of infected animals. Diagnosis of the disease is usually difficult, the only definite means being the horse inoculation test. In active cases a tentative diagnosis based on history, clinical symptoms, blood examinations, and autopsy can be made with a reasonable degree of certainty. For example, a history of rapid loss of flesh, loss of spirit and energy, evidences of muscular weakness with intermittent attacks of fever, congestion of the mucous membranes of the eye, with possibly some degree of jaundice, and dropsical swellings of the lower parts of the body, are strongly suggestive of infectious anemia. The diagnosis will be further strengthened if after the temperature reaction an examination of the blood shows a decrease in the volume of the red corpuscles, an increase in the sedimentation rate, and a decrease of hemoglobin. It must be remembered, however, that in the intervals between the attacks of fever, the blood picture, except in cases accompanied by a progressive anemia, usually returns to normal. The post mortem and histological findings in animals that die furnish additional evidence.

Infectious anemia in the inactive form is ordinarily not detected, since no clinical symptoms are present to cause suspicion.

In acute cases occurring in the field, death may occur before the usual train of symptoms develops. The disease in the acute form may be confused with anthrax, influenza, acute equine encephalomyelitis, and other acute febrile conditions. In the subacute and chronic forms it may be mistaken for trypanosomiasis (dourine, murrina, and surra) or a heavy infestation with strongyles.

Since the development of a reliable means of diagnosis is of primary importance from the standpoint of control, a considerable amount of experimental work on diagnostic procedures for the detection of infected animals was carried out by the Bureau (15). Results obtained in experimental work with laboratory tests, such as the complement-fixation test, the Fulton mercuric chloride test, and the blood sedimentation test, all of which have been advocated in the diagnosis of the disease, were frequently indefinite or nonspecific and, therefore, nondependable. Likewise, experiments with certain provocative tests suggested for diagnosis, such as copious
bloodletting or injections of infectious anemia antigens, or of proteins in large amounts, failed to provoke a specific reaction in known infected animals. None of these tests were sufficiently satisfactory to warrant their adoption as a standard diagnostic method.

**TREATMENT AND CONTROL**

In searching for an effective treatment, many investigators have tried numerous agents such as arsenical preparations, quinine, various dyes, mercurial preparations, and a number of others, but without success. The Bureau experimented with merthiolate, crystal violet, trypan blue, arsenical preparations, formin, hydrochloric acid, potassium permanganate, fuadin, sulfanilamide, penicillin, and other preparations, using both acute and chronic cases for these tests. None of the preparations, however, exerted any appreciable influence on the course of the disease, nor did any free the infected animals of the virus (16, 17, 18).

Preventive vaccination has been attempted without success by a number of investigators, including those in the Bureau of Animal Industry (19).

While no systematic control program can be undertaken until a definite means of diagnosis of chronic carriers is developed, the results of studies by Bureau and other investigators indicate that the following measures constitute the most effective means of control.

1. Flies and mosquitoes should be controlled.
2. The greatest care should always be taken to prevent transmission of the disease by unsterilized instruments, particularly hypodermic needles, tattooing needles, and bleeding needles.
3. The common practice of interchanging equipment (such as bridles, saddles, harness, brushes, spurs, whips, bandages, etc.) that may produce skin abrasions on both infected and healthy horses or absorb secretions should be avoided.
4. Only horses known to be free from the disease should be used as donors for blood transfusions.
5. All antisera of equine origin intended for treatment of horses should be heated or chemically treated to destroy the virus.
6. Mares or stallions suspected of being affected should not be used for breeding purposes.
7. Horses known to be affected with the disease should be isolated from healthy animals or preferably destroyed.
8. Horses from areas where the disease exists should be isolated, have their temperatures taken and recorded daily, and be kept under observation for 60 days after being brought on premises where normal horses are kept.
9. In places where large number of horses are assembled from various parts of the country, such as race tracks, horse shows, and county fairs, it is essential that all horses be kept in separate, clean, well-ventilated stalls free from flies and fed from separate containers and watered from separate buckets. No equipment of any kind should be used interchangeably on the horses.

**THE OUTBREAK OF INFECTIOUS ANEMIA AT RACE TRACKS IN NEW ENGLAND**

The recent outbreak of infectious anemia at Rockingham Park Race Track, near Salem, New Hampshire, is one of the most serious we have encountered and the first time the disease has occurred in a large number of thoroughbreds.

While the outbreak has attracted a great deal of attention especially in thoroughbred racing circles, it is not the first time the disease has occurred in New England.
Kelser (20) in 1936 reported an outbreak among horses of the R.O.T.C. Unit at Harvard University in Massachusetts and E. H. Jones (21) reported a case in Vermont in 1940 in the 20th Biennial Report of the Commissioner of Agriculture of the State of Vermont.

The Bureau was first notified of the trouble on August 20, 1947, when Dr. R. W. Smith, State Veterinarian of New Hampshire, asked for assistance in diagnosing a suspected outbreak of infectious anemia in horses at the Rockingham Park Race Track.

Bureau veterinarians familiar with the disease were dispatched to the scene to make an investigation and give such assistance as might be possible. Affected animals were examined, post mortems were held on horses that had died or were destroyed, and blood samples were collected from 14 suspected cases for laboratory and horse inoculation tests.

From the history, clinical symptoms, and autopsy findings the Bureau investigators were of the opinion that the disease affecting the animals was infectious anemia. This tentative diagnosis was subsequently confirmed by the results of the horse inoculation test. All the test horses developed the disease and one of them died during an acute attack. Furthermore all these samples gave negative results to the complement-fixation test for trypanosomiasis. Other facts obtained by the investigators through personal observations or interviews with veterinarians, horsemen, and others revealed the following (22).

The disease was first observed in New England in May or early in June. The first cases appeared in horses that had been wintered in Florida shortly after they had been shipped to Suffolk Downs Track near Boston. At least three horses that were shipped from Florida became sick and died of the disease at Suffolk Downs.

During the first meeting at Suffolk Downs, a number of horses that had febrile reactions appeared to recover and were moved with their stable mates to Narragansett Park. During the racing meet there, at least three horses developed symptoms of the disease and two of them died after being shipped to a farm. Following the meeting at Narragansett most of the horses were shipped back to Suffolk Downs for the second meeting (July 7 to August 9). During most of this period there was an influx of great swarms of biting flies from the nearby meadows, causing considerable annoyance to the horses, and some time after this additional cases of the disease appeared.

At the close of the second meeting at Suffolk Downs, most of the horses were shipped to Rockingham Park. However, about 200 horses remained at Suffolk Downs, while others were reported to have been shipped to other areas. The 200 horses at Suffolk Downs were later shipped to Narragansett for the second meeting. Since all these horses were exposed, it is highly probable that some infected animals were in the group sent to Narragansett and other areas. Following the arrival of the horses at Rockingham, there was a continued increase in the number of cases. The fact that a number of the horses developed the disease a short time after their arrival at Rockingham indicates that they had been previously exposed and were in the incubative stage when they left Suffolk Downs.

On August 23, Dr. Smith, State Veterinarian of New Hampshire, placed a quarantine for an indefinite period on the horses at Rockingham Park and surrounding
territory embracing an area of about 25 square miles. Dr. Smith is to be highly commended for this action as it has no doubt prevented the spread of the disease to other areas. At the time of the investigation, 47 of the 900 or more horses at Rockingham had shown symptoms of infectious anemia and 11 of the sick horses had died or been destroyed. It has since been reported that this outbreak took a toll of 76 thoroughbreds (dead or destroyed because of the disease).

![Quarantine tent at Rockingham Park where horses affected with infectious anemia were isolated](image)

Tent was located about a mile from track stables

On recommendations of the Bureau investigators a special quarantine area some distance from the stables was established for the isolation of sick horses. Measures were taken to prevent further spread of the disease among the horses at the track and a system was started for taking and recording daily temperatures on all the horses at the track. (Figs. 2 and 3.)

From the observations and histories available it appears that flies may have played a part in the early spread of the disease at Suffolk Downs and that further spread of the disease was brought about through the use of contaminated hypodermic needles and similar instruments. Any instrument that draws blood, when used first on an infected horse and then on a normal animal without being sterilized, is capable of transmitting the disease. This fact emphasizes the importance of cleaning and sterilizing such instruments as knives, floats, hypodermic syringes, needles, tattooing instruments, and surgical instruments before use on each animal.
To prevent further spread of the disease, efforts should be made to trace the movement of the 200 exposed horses that were shipped from Suffolk Downs to other areas. The proper disposal of the animals quarantined at Rockingham is also of extreme importance to the future control of the disease.

Fig. 3. One of the race horses at Rockingham Park affected with infectious anemia
Picture taken about 10 days before death

BANS BY OTHER STATES ON HORSES FROM NEW ENGLAND

Following the outbreak of infectious anemia at the New England tracks, and after the horses at Rockingham had been placed under quarantine, the following States issued regulations or restrictions to prohibit the movement of horses affected with or exposed to the disease into the State: Florida, Kentucky, Louisiana, Maryland, New York, South Carolina, Tennessee, Virginia, and West Virginia.

SUGGESTED PROCEDURE TO BE FOLLOWED BEFORE RELEASING QUARANTINED HORSES AT ROCKINGHAM PARK

To prevent the dissemination of the disease by horses now quarantined at Rockingham Park, the Bureau recommended that the following measures be taken before any of the animals are given a clean bill of health and released for shipment to other areas:

1. No animal should be allowed to leave the quarantined area until permission is granted by the State veterinarian.
2. A thorough inspection of all quarantined horses should be made by competent authorities and all clinical cases should be immediately isolated and destroyed as soon as possible. The carcasses of all such animals should be disposed of by incineration, deep burial in quick lime, or rendered for inedible purposes.

3. Suspicious cases, that is, animals showing one or more temperature reactions but no other symptoms, should not be released until cleared by individual horse inoculation tests. They should be kept isolated in quarantine away from the known infected horses and away from the supposedly negative 900 horses.

4. Temperatures of all horses under quarantine should be taken twice daily and recorded under the general supervision of a veterinarian and adequate measures should be taken to prevent further spread of the disease among the quarantined horses.

5. For the detection of carriers, among the horses under quarantine, it was further suggested that blood samples consisting of 10 cc. each of whole blood from 10 or more of the apparently well horses be pooled and inoculated into a normal test horse. If the normal test horse fails to develop symptoms of the disease within 60 days, the 10 or more horses from which blood samples were taken for the pooled test may be released provided none of them developed any symptoms of the disease following the time the test was started.

6. All horses from which blood has been collected for testing should be kept in strict quarantine, in screened or DDT sprayed stables, and be fed and watered from separate containers. Every precaution should be taken to prevent close contact of horses during exercise periods. Only sterilized surgical instruments, hypodermic needles, syringes, etc. should be used on the quarantined horses and no interchange of halters, bits, saddles, bandages, etc. should be allowed. These precautions are taken to be sure that should the horse inoculation test be negative, none of the quarantined animals are exposed to the disease during the test period.

The Bureau has been advised by Mr. Spencer Drayton, President of the Thoroughbred Racing Protective Bureau, that with few exceptions a similar outline to the procedure suggested by the Bureau will be adopted and carried out before any of the quarantined horses at Rockingham are released. This program, which we understand will be under the supervision of New Hampshire State officials, includes the destruction of known infected animals and the screening of supposedly normal horses by the horse inoculation test, and if properly carried out should result in effectively cleaning up the situation at Rockingham Park.

We also understand that a similar screening program is being carried out with the horses at the race tracks in Rhode Island.

Since the status of the quarantined horses at Rockingham Park and the race horses at the Rhode Island tracks was altered considerably between the time this paper was submitted for publication and its presentation at the Chicago meeting on December 3, 1947, the following supplementary material is added:

During the early part of November, the 40-day screening period at Rockingham Park and the 30-day screening period at the Rhode Island tracks were completed and all the horses that passed the test were released for shipment to other points. At least 3 infected horses were detected among the supposedly normal animals at the Rockingham Park stables by the screening test. On November 18, 1947, Dr.
Smith, State Veterinarian of New Hampshire, officially lifted the 86-day quarantine on the race horses confined at Rockingham Park.

The Livestock sanitary officials of New Hampshire, Massachusetts, and Rhode Island, Dr. Harold Lewis, the race track veterinarian who first suspected the outbreak to be infectious anemia, the Thoroughbred Racing Association of America, the Thoroughbred Racing Protective Bureau, and the Horsemen's Benevolent and Protective Association, are to be highly commended for their earnest efforts to control and prevent the spread of this disease to other areas.

For the future control and prevention of infectious anemia at race tracks in the United States the following recommendations have been made by the Bureau of Animal Industry:

1. For the accommodation of horses, race tracks should provide well ventilated, individual box stalls, with facilities for separate feeding and watering of animals.
2. A system of effective insect control against flies and mosquitoes by the proper use of DDT or other recognized insect repellents should be in force at all race horse stables.
3. The stables and immediate surroundings should be maintained in good sanitary condition at all times. This includes prompt removal of manure and other refuse and satisfactory drainage.
4. All horses assigned to stall space on race tracks should have a satisfactory health certificate and be subjected to careful examination by official track veterinarians.
5. The keeping of horses in stables outside the race track stables and not under direct supervision of official race track veterinarians should be discouraged or discontinued.
6. The promiscuous use of hypodermic syringes and needles by laymen at race tracks should be discouraged or discontinued.
7. The common use of any equipment that may produce skin abrasions or absorb body excretions or secretions, such as bridles, bits, harness, saddles, blankets, brushes, and currycombs, is dangerous and should be avoided.
8. All types of surgical instruments, especially those that may draw blood or that may come in contact with body excretions or secretions, such as knives, hypodermic syringes, needles, tattooing instruments, and floats, should be cleaned and sterilized by boiling for 15 minutes before use on each animal.
9. A sufficient number of uterine forceps or other instruments, as well as rubber gloves, should be provided for collecting saliva for saliva tests, so that separate sterile equipment can be used on each animal.
10. To assist in the detection of sick horses from any cause and especially to pick out early cases of infectious anemia, it is suggested that daily temperatures on all horses be taken and recorded under proper supervision.
11. Any horse showing clinical symptoms indicative or suggestive of infectious anemia should be immediately isolated from the other animals.
12. Paddocks, starting gates, and any other equipment subject to contact by different animals should be cleaned frequently and maintained in good sanitary condition.
EQUINE INFECTIOUS ANEMIA IN UNITED STATES

REFERENCES


9. Stein, C. D., Osteen, O. L., and Mott, L. O. A resume of studies and observations on infectious anemia, or swamp fever of horses, carried on by the Bureau of Animal Industry from 1935 to 1940. Mimeographed U.S.D.A.


DISCUSSION

BY ROBINSON W. SMITH, D.V.M.

Concord, New Hampshire

Mr. President, Ladies and Gentlemen, after listening to the detailed address on Equine infectious anemia (Swamp Fever) just given us by Dr. Stein of the Bureau of Animal Industry, Washington, D. C., I find that there is little left to discuss. However, you might be interested to know just how we handled the situation at Rockingham Race Track, Salem, New Hampshire. We are indebted to Dr. H. M. Lewis of Nashua, New Hampshire, track Veterinarian at Rockingham, for the efficient and painstaking way that he handled the situation. Dr. Lewis, as many of you know, has a wide practice among the thoroughbred breeders of our country, and he made almost daily visits to not only Rockingham Park, but to Narragansett near Providence, Rhode Island, and Suffolk Downs located at East Boston. Right here I believe it is advisable to give you the geographic locations of the three tracks involved. Suffolk Downs is located in East Boston as above stated, Narragansett about forty miles south near Providence, Rhode Island, and Rockingham Race Track is about forty miles north of Boston at Salem, New Hampshire, and it is their practice to transport the over-flow of horses from one track to the other during the off season. It is also important to remember that infectious anemia was not definitely diagnosed until August, 1947 at Rockingham Park, although it is very evident that horses were sick with the disease early in the Spring both at Narragansett and Suffolk Downs.

In Dr. Lewis' report he states that his first case was at Suffolk Downs in April; the name of the horse was Sky Skipper. The history of this animal as given to the Doctor by his trainer was that he was sick a month in Florida, where he carried a high temperature, receding and then flaring up again, and it was necessary to hold the shipment up over ten days in Florida because of this horse before they could ship it to Boston. Two weeks after his arrival in Boston this animal (Sky Skipper) was shipped to Rockingham Park to make room for other horses at Suffolk Downs. He was at Rockingham Park three days when he died. Because he was insured a post-mortem was held. His liver weighed 38 pounds and spleen 20 pounds. He showed definite symptoms, as we know them now, of Swamp Fever. The second horse named Sun Beau Go was taken sick at Suffolk Downs, this horse also came from Gulf Stream, Florida, and carried a temperature of 107, was treated and responded to the treatment. In ten days time, however, his temperature went back to 106. This horse lived until September 23, when he was destroyed at Rockingham Park. This horse stayed in Boston the entire thirty days of the meet. The third horse Ipso Bounds was taken sick at Narragansett the last week of their meet, which was the middle of May or the first of June. This horse carried a temperature of 107 which lasted seven days, then returned to normal. In about a week his temperature went back to 106. The Narragansett meeting came to an end, and the horse was shipped to a farm in Medford, Massachusetts where he died. This horse showed all of the symptoms of the disease. The fourth horse under treatment by Dr. Lewis was Magellen. He too took sick
at Narragansett the last of May. This horse lived the summer out, but definitely is suffering from Swamp Fever at this writing. After the Narragansett meeting in May the horses were shipped back to Boston to Suffolk Downs where Gallant Agent came down with an acute case. This horse lived about three weeks and died. From Suffolk Downs the horse was shipped to Rockingham Park about the last of July or the first of August, and as near as we can check, every horse sick at Rockingham Park could have been and probably was infected at Suffolk Downs during their second meet. We mean by this, that all cases were well within the period of incubation of the disease. Various treatments were given these horses with no success. One animal received 48,000 units of penicillin. The same horse received 8.8 drams of streptomycin in 26 hours, and was also given arsenic, mercury preparations, coal tar, and mixed infectious serum equine, together with stimulating treatment.

As soon as the disease was diagnosed the State placed a quarantine on all horses at Rockingham Race Track. Dr. Stein's assistant Dr. Mott came to Rockingham and confirmed as best he could the diagnosis that had been made, taking back with him the blood from some fourteen sick animals. This blood was injected into well animals, and a positive diagnosis was made. Previous to Dr. Mott's visit a test animal was injected by Dr. Lewis and Dr. Delano of Boston. This horse contracted the disease and died before the report from Washington was received. Immediately all sick animals were isolated in a tent one-half mile from the track, and special attendants placed in charge. The entire grounds of the race track were fogged with D.D.T. at intervals of two or three days for three or four treatments. This was very successful. As a matter of fact, search as you might you couldn't find a single fly around any of the stables.

After the sick animals had been removed, it left 961 horses apparently well, to be screened. 162 test animals were purchased, and the screening carried out, with a result that at the end of November all animals were screened and found negative with the exception of five. It might be interesting to you gentlemen to know that one test animal did not become sick until 35 days after being injected, the second animal on the 26th day.

There were approximately 65 sick horses in all including those that died and were taken out of the stables at Rockingham. As you know, the Thoroughbred Trotting Association of America became very interested and paid all owners who would sign to have their animals slaughtered $2000.00 each. With the exception of eight or ten that were carrying large insurance policies, all accepted this offer. The sick animals were taken to a rendering plant and destroyed. At the present time there are six or seven animals in quarantine about two miles from the track waiting insurance adjustments.

In conclusion, I might say that in my opinion gained from our experience at Rockingham Park, while Swamp Fever is a very serious disease when it breaks out at a racing plant, it is not too difficult to control after the disease is recognized and before it becomes epidemic, and proper precautions are taken immediately. However, we must not forget that we are not only dealing with an infectious disease of horses, but we are dealing with an industry that is returning to those states that have race tracks millions of dollars of revenue. In the little State of New Hampshire alone, the revenue turned over to the State from pari-mutual betting amounted to $2,700,000.00 in 1947, and we as sanitary officials must be alert and do everything within our power to not only control, but to eradicate this disease.
RESPONSE OF MONKEYS TO POLIOMYEITIS AFTER INJECTION WITH NEWCASTLE DISEASE VIRUS

Reginald L. Reagan; Mary G. Lillie, M.S.; Jean E. Hauser, B.S.; Leo J. Poelma, D.V.M.; and A. L. Brueckner, V.M.D.

Maryland State Board of Agriculture, Livestock Sanitary Service, University of Maryland, College Park, Md.

The adaptation of a California strain of Newcastle virus (No. 11914) to the Syrian hamster (1) led to the development of a vaccine composed of virus-bearing hamster brains. The value of the vaccine as an immunizing agent against Newcastle disease in chickens has been established (2).

The possibility of the accidental injection of this modified virus vaccine into humans during the immunization of chickens prompted the testing of pathogenicity of this virus for monkeys. Unmodified Newcastle virus was tested at the same time. The results of these injections into four rhesus monkeys (Macaca rhesus) have been reported (3). Pertinent details will be repeated here.

Serum obtained from these monkeys prior to injection showed no natural neutralizing antibodies for Newcastle virus by the embryo neutralization test. Monkey No. 2611 showed nervous symptoms and partial paralysis sixteen days after intracerebral injection of hamster-adapted Newcastle virus of the twenty-first passage. This monkey became completely paralyzed and was sacrificed when moribund on the eighteenth day after inoculation. The remaining three monkeys, exposed by intranasal instillation of the modified virus and intranasally and intracerebrally with embryo-propagated Newcastle virus, respectively, appeared normal during an observation period of thirty-four days. Serum obtained at this time showed a high virus neutralizing titer in two (26117-100,000 and 26118-1,000,000 embryo m.l.d.), and no response in the other (26120).

These monkeys were then re-injected. No. 26120 was given intracerebrally one cc. of ten per cent suspension of hamster-adapted Newcastle virus of the twenty ninth passage; No. 26117 was inoculated with one cc. of the same suspension intramuscularly; and one cc. intraperitoneally; and No. 26118 was given intranasally one cc. of a ten per cent suspension of embryo-propagated Newcastle virus, seven teenth subculture.

Monkey No. 26120 died of a lung infection one month after the second inoculation but no nervous symptoms were noted following the virus injection. Monkeys

1 The authors wish to express appreciation for advice and council received from Dean R. A. Kelser, School of Veterinary Medicine, University of Pennsylvania.
Credit is given to Miss Nancy Kincaid and Mr. Hammond Jeffry for valuable assistance in the conduct of the experiments.
2 Associate Professor—Veterinary Virology.
3 Assistant—Veterinary Virology.
4 Bacteriologist.
5 Chief of Laboratories.
6 Director.
Nos. 26117 and 26118 had shown high antibody titers against Newcastle virus after the primary exposure. These titers were increased after two subsequent injections of hamster-adapted virus given intramuscularly, intradermally, and subcutaneously in preparation for use in the following test (1,000,000 embryo m.l.d.).

For this experiment eight rhesus monkeys were injected with hamster-adapted virus of the fifty-first subculture. Three injections of two cc. intramuscularly, two cc. subcutaneously, and 0.5 cc. intradermally were given at weekly intervals for a period of three weeks. Two monkeys were discarded because of bacterial lung infections. Thirty-six days after the first injection these six monkeys, together with Nos. 26117 and 26118 and six normal controls, were challenged intracerebrally with one cc. of a 1:100 dilution of active poliomyelitis virus.

The challenge poliomyelitis virus, Brunhilde strain, was furnished by Dr. Howard A. Howe of the Poliomyelitis Research Center, Johns Hopkins University, Baltimore, Maryland. It was isolated by him in 1939. The particular pool used, Brunhilde II, has a fifty per cent endpoint of $10^{-6.8}$ in rhesus monkeys by intracerebral inoculation. According to Doctor Howe the strain had been very constant and had infected virtually 100 per cent of the animals inoculated.

Chart 1 shows that at the time of poliomyelitis challenge the antibody titers of monkeys Nos. 26117 and 26118 were high; that the control monkeys were negative; and that the six individuals given modified Newcastle virus had very low titers. All of the challenged monkeys succumbed, but there was a significant delay in the development of poliomyelitis symptoms in the injected monkeys, as compared to the controls, especially so in Nos. 26117 and 26118, which showed high antibody titers.

Because of this delay in the appearance of symptoms after poliomyelitis challenge in this group of rhesus monkeys, another experiment was conducted. Several types of monkeys had to be used because rhesus were not available. These 38 monkeys were divided into three groups, each isolated in a separate room. Chart 2 gives the experimental data for the control group of normal monkeys isolated in Room No. 1. Chart 3 includes the experimental data concerning those monkeys injected with a ten per cent suspension of embryo-propagated Newcastle virus of the seventeenth to thirtieth subcultures, isolated in Room No. 2. Chart 4 shows the experimental data for the group of monkeys inoculated with a ten per cent suspension of hamster-adapted Newcastle virus of subcultures 70 to 119, isolated in Room No. 3. The schedule of Newcastle virus injections and the antibody responses are also given in Charts 2, 3 and 4. The route of injection was changed from intradermal and subcutaneous to intramuscular toward the end of the period, in line with the observation of Morgan, Howe and Bodian (4). These workers found a greater response from injection of poliomyelitis virus into the muscle than from other methods.

Serum obtained from five monkeys of each isolated group taken before injection with unmodified or modified Newcastle virus showed no neutralizing antibodies for Newcastle virus. During the period of inoculations four monkeys developed tuberculosis and were discarded, but all others remained healthy and showed no symptoms following injections.

At intervals of 80 and 116 days after the first injection of embryo-propagated Newcastle virus, serum samples from this group showed uniformly high antibody
**CHART 1.—Poliomyelitis virus challenge of monkeys injected with hamster-adapted Newcastle virus and normal controls**

<table>
<thead>
<tr>
<th>MONKEY</th>
<th>NEWCASTLE ANTIBODIES</th>
<th>CHALLENGE</th>
<th>OBSERVATIONS FOLLOWING CHALLENGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.M.L.D.</td>
<td>4/24/47</td>
<td>4/25  26  27  28  29  30  5/1 2  3  4  5  6</td>
</tr>
<tr>
<td>1 (26117)</td>
<td>100,000 1,000,000 1,000,000</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>2 (26118)</td>
<td>1,000,000 1,000,000 1,000,000</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>3</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>4</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>5</td>
<td>0  0</td>
<td></td>
<td>Died of Pneumonia 3/28/47</td>
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<tr>
<td>6</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  S  S  P  P  D</td>
</tr>
<tr>
<td>7</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>8</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>9</td>
<td>0  0  10</td>
<td>✓</td>
<td>N  N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>10</td>
<td>0  0  0</td>
<td></td>
<td>Not Normal—Discarded</td>
</tr>
<tr>
<td>11</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  S  S  S  P  D</td>
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<tr>
<td>12</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  P  D</td>
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<tr>
<td>13</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  N  N  S  P  D</td>
</tr>
<tr>
<td>14</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  N  N  N  P  D</td>
</tr>
<tr>
<td>15</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  N  S  P  P  D</td>
</tr>
<tr>
<td>16</td>
<td>0  0  0</td>
<td>✓</td>
<td>N  N  N  N  P  P  P  D</td>
</tr>
</tbody>
</table>

N—Normal  P—Paralysis  S—Visibly sick  D—Destroyed or died

Nos. 3 to 10 injected 3/19/47, 3/25, and 4/1/47 with hamster-adapted Newcastle virus, 10% hamster brain suspension of 51st. subculture, 2 cc. intramuscularly, 2 cc. subcutaneously, and 0.5 cc. intradermally, Nos. 1 and 2 (see 26117 and 26118 in text) injected 3/25, 4/1, as above, Nos. 11 to 16 not injected prior to challenge.

Challenged 4/24/47 by intracerebral injection of 1:0 cc. of 1:100 suspension of poliomyelitis virus, Brunhilde II.
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33-98

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### Chart 3—Polioymelitis virus challenge of monkeys injected with embryo-propagated Newcastle virus

<table>
<thead>
<tr>
<th>Monkey</th>
<th>Newcastle Antibodies</th>
<th>Challenge</th>
<th>Observations After Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9/2</td>
<td>10/7</td>
<td>10/7</td>
</tr>
<tr>
<td>57-R</td>
<td>&lt;320</td>
<td>&lt;80</td>
<td>100,000</td>
</tr>
<tr>
<td>41-SM</td>
<td>0</td>
<td>0</td>
<td>100,000</td>
</tr>
<tr>
<td>40-SM</td>
<td>&gt;320</td>
<td>&gt;80</td>
<td>10,000</td>
</tr>
<tr>
<td>29-GG</td>
<td>&gt;320</td>
<td>&gt;80</td>
<td>10,000</td>
</tr>
<tr>
<td>55-GG</td>
<td>&gt;320</td>
<td>&gt;160</td>
<td>1,000</td>
</tr>
<tr>
<td>63-GG</td>
<td>160</td>
<td>0</td>
<td>10,000</td>
</tr>
<tr>
<td>62-LWG</td>
<td>&gt;320</td>
<td>&gt;80</td>
<td>10,000</td>
</tr>
<tr>
<td>30-GG</td>
<td>&gt;320</td>
<td>&gt;160</td>
<td>100,000</td>
</tr>
<tr>
<td>38-GG</td>
<td>&gt;320</td>
<td>&gt;160</td>
<td>100,000</td>
</tr>
</tbody>
</table>

R—Rhesus | N—Normal
SM—Sooty Mangabey | P—Paralysis
GG—Green Guenon | D—Destroyed or died
LWG—Lesser White-Nosed Guenon

Embryo-Propagated Newcastle Virus-California strain (No. 11914) in 10% suspension of allantoid fluid of subcultures 17 to 30.

June 13, 19, 26, July 3, 10—0.5 cc. intradermally + 0.5 cc. subcutaneously

July 16—0.5 cc. intradermally + 1.0 cc. subcutaneously

July 23, 30, August 6, 12—1.0 cc. intramuscularly

September 3—2.0 cc. intramuscularly

September 10, 17—4.0 cc. intramuscularly

Challenged 10/10/47 by intracerebral injection of 1.0 cc. of 1:1000 suspension of poliomyelitis virus, Brunhilde II.

Surviving monkeys held for 30 days after challenge. Destroyed for autopsy and collection of tissues for pathological examinations.
CHART 4.—Polio myelitis virus challenge of monkeys injected with hamster-adapted Newcastle virus

<table>
<thead>
<tr>
<th>MONKEY</th>
<th>H.I. TITRES</th>
<th>E.M.L.D.</th>
<th>CHALLENGE</th>
<th>OBSERVATIONS AFTER CHALLENGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9/2</td>
<td>10/7</td>
<td>10/10</td>
<td>11</td>
</tr>
<tr>
<td>48-SM</td>
<td>20</td>
<td>10,000</td>
<td>✓</td>
<td>N</td>
</tr>
<tr>
<td>22-SM</td>
<td>5</td>
<td>0</td>
<td>1,000</td>
<td>✓</td>
</tr>
<tr>
<td>52-SM</td>
<td>10</td>
<td>0</td>
<td>&lt;1,000</td>
<td>✓</td>
</tr>
<tr>
<td>54-SM</td>
<td>10</td>
<td>0</td>
<td>&lt;1,000</td>
<td>✓</td>
</tr>
<tr>
<td>21-SM</td>
<td>&gt;320</td>
<td>40</td>
<td>1,000,000</td>
<td>✓</td>
</tr>
<tr>
<td>28-LWG</td>
<td>&gt;320</td>
<td>40</td>
<td>&gt;1,000</td>
<td>✓</td>
</tr>
<tr>
<td>23-LWG</td>
<td>20</td>
<td>&gt;1,000</td>
<td>✓</td>
<td>N</td>
</tr>
<tr>
<td>24-GG</td>
<td>&gt;320</td>
<td>20</td>
<td>10,000</td>
<td>✓</td>
</tr>
<tr>
<td>58-GG</td>
<td>&gt;320</td>
<td>40</td>
<td>10,000</td>
<td>✓</td>
</tr>
<tr>
<td>23-GG</td>
<td>40</td>
<td>&gt;1,000</td>
<td>✓</td>
<td>N</td>
</tr>
</tbody>
</table>

SM—Sooty Mangabey  N—Normal
LWG—Lesser White-Nosed Guenon  P—Paralysis
GG—Green Guenon  D—Destroyed or died

Hamster-Adapted Newcastle Virus in 10% brain suspension of subcultures 70 to 119.
- June 13, 19, 26, July 3, 10—0.5 cc. intradermally + 0.5 cc. subcutaneously
- July 16—0.5 cc. intradermally + 1.0 cc. subcutaneously
- July 23, August 6, 12—1.0 cc. intramuscularly
- September 3—2.0 cc. intramuscularly
- September 10, 17—4.0 cc. intramuscularly

Monkeys 21 and 22
- June 13, 26, July 2, 10—1.0 cc. intradermally + 1.0 cc. subcutaneously
- June 19—2.0 cc. intradermally + 2.0 cc. subcutaneously
- July 16—0.5 cc. intradermally + 2.0 cc. subcutaneously
- July 23, August 6, 12—2.0 cc. intramuscularly
- September 3, 10, 17—4.0 cc. intramuscularly

Challenged 10/10/47 by intracerebral injection of 1.0 cc. of 1:1000 suspension of poliomyelitis virus, Brunhilde II.
Surviving monkeys held for 30 days after challenge. Destroyed for autopsy and collection of tissues for pathological examinations.
RESPONSE OF MONKEYS TO POLIOMYELITIS

61
titers, while serum samples from monkeys inoculated with the hamster-adapted virus showed variations with a tendency toward lower levels. Serum from two monkeys of the control group taken at the same time contained no Newcastle virus neutralizing antibodies.

The normal control monkeys and those injected with hamster-adapted and embryo-propagated Newcastle viruses were challenged intracerebrally with one cc. of a 1:1000 dilution of the Brunhilde strain of poliomyelitis virus, used in the previous trial.

Chart 2 shows that two of fourteen normal control monkeys lived through the intracerebral challenge with poliomyelitis virus, although one of these showed questionable symptoms for several days.

Chart 3 shows that four of ten monkeys injected with embryo-propagated Newcastle virus survived the intracerebral challenge with poliomyelitis virus. It will be noted that the period from exposure to appearance of first symptoms was longer than in the control group or in the group injected with hamster-adapted Newcastle virus. It is of interest that in three of the four survivors the Newcastle virus neutralization titers were high before challenge.

Chart 4 shows that two of the ten monkeys injected with hamster-adapted Newcastle virus showed no symptoms and survived the intracerebral challenge with poliomyelitis virus. There was a slight delay in the appearance of symptoms in this group when compared to the controls. It will be noted that one of the surviving monkeys had shown a very high titer against Newcastle virus and the other a low titer before challenge.

All monkeys surviving at the end of thirty days were destroyed. The brain and portions of the cord were saved for pathological study.

SUMMARY

One rhesus monkey injected intracerebrally with twenty-ninth passage hamster-adapted Newcastle virus showed symptoms similar to those induced by poliomyelitis virus administered by the same route. Intracerebral inoculation of embryo-propagated Newcastle virus failed to produce noticeable symptoms in one rhesus monkey. Intranasal, intramuscular, intradermal, and subcutaneous inoculations of hamster-adapted or embryo-propagated Newcastle virus failed to produce noticeable symptoms in rhesus and four other species of monkeys. Intracerebral, intramuscular, subcutaneous, and intradermal injections of hamster-adapted and embryo-propagated Newcastle viruses produced Newcastle virus neutralization antibodies in monkeys, but the embryo-propagated virus produced the greatest degree of response.

Symptoms appeared six days after poliomyelitis virus challenge in control monkeys. Two of fourteen in this group survived, although one of these showed questionable symptoms for several days during the observation period of a month.

Symptoms appeared nine days after poliomyelitis virus challenge in monkeys previously injected with embryo-propagated Newcastle virus. Four of ten in this group survived, none of these having shown symptoms at any time during the observation period of a month.

Symptoms appeared seven days after poliomyelitis virus challenge in monkeys
previously injected with hamster-adapted Newcastle virus. Two of ten in this group survived, but one of these showed questionable symptoms for two days during the observation period of a month.

DISCUSSION

It is the purpose of this paper simply to present the data as observed in experimental trials in which monkeys, injected with a virus of recent avian origin (with or without mammalian modification) evidenced some degree of resistance to active poliomyelitis virus (Brunhilde strain). Whether monkeys injected with hamster brain suspension not containing virus, or with allantoic fluid of embryos not containing virus, would have similarly withstood challenge has not been established, since such tests have not been conducted.

BIBLIOGRAPHY


THE GENESIS OF BOVINE UDDER INFECTION AND MASTITIS. 4.
THE OCCURRENCE OF MASTITIS IN A COW POPULATION, AND THE
RELATIONSHIP OF FACTORS OTHER THAN AGE TO MASTITIS AND
TO STREPTOCOCCAL (STR. AGALACTIAE) INFECTION.

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We (37) have previously observed that the spread of streptococcal infection
(almost entirely Str. agalactiae) was very closely related to the average age of the
population. This relationship showed that if the average age of the two herds
observed was two lactation periods, then streptococcal infection would have been
virtually non-existent. As the average age of the population increased, the inci-
dence of infection increased in direct ratio. Thus was formulated the principle
of an age factor. This age factor must operate as a function of age, in that only
some change occurring within the body independent of environment could explain
the infection pattern observed.

Largely on this and the previously reported (36) observation that staphylo-
coccal infection did not increase with age, four prominent predisposing-factor
theories—“teat patency,” “obvious injury to the teat,” “degree of exposure,”
and “prior sensitization”—were held to be untenable as major possibilities. Of
the two other prominent theories, “nonspecific mastitis” was refuted by the sub-
sequent observations of its authors (13), and the “hormone” theory of Francis (9)
was considered valid though not supported by any fact (37).

In addition to these theories, other conditions or circumstances are often men-
tioned as playing some part in the genesis of bovine udder infection and mastitis.
Some of these are: feeding, breed, age, milking method, climate and weather,
sanitation, and segregation.

It is the purpose of this report to relate the occurrence of mastitis in two herds
observed for a seven year period, and to consider these other conditions or circum-
stances as they might apply to the genesis of bovine udder infection and mastitis
in these herds.

METHODS

This is the fourth of several reports dealing with the natural over-all picture of
udder infection and mastitis for a seven year period (1938 to 1944 inclusive) in the
two self-contained herds of the Dairy Research Farm. One herd was composed
of approximately 60 Guernsey milking cows and the other of approximately 60
Holstein milking cows. All but a few of the cows were purebred.

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The general housing, sanitation, and management, as well as the general plan of study, the sampling and basic procedures, and the interpretation of infection already have been described in detail (36, 37). Briefly, the herds were housed separately in identical modern one-story dairy barns, the general sanitation was good but of a practical nature, the animals were fed the same ration by the same man in relation to the amount of milk produced, and were milked by the same men (at any one time) twice a day.

The quantity and quality of both the concentrates and roughages fed were maintained as uniform as was possible under ordinary operating conditions. One pound of good quality, 18 per cent dairy ration was fed for each three pounds of milk produced by Guernsey cows, and one pound for each four pounds of milk produced by Holstein cows. Roughage, which was primarily grass silage, supplemented by corn silage, hay, and pasture, was fed ad libitum.

The herds were milked by hand for the first 53 months of the study (January 1938 to May 1942) and by machines (DeLaval) for the remainder of the time (31 months). During the period of hand milking, each man was assigned a string of approximately ten cows in each herd. Each milker washed the udders of his own cows using one bucket of hot chlorine solution (200 p.p.m.) and one cloth for each string of ten cows. Each cow was washed separately just prior to being milked, so that the milker's hands were at least rinsed before he milked each cow. During the period of machine milking, one man operated the machines and the other men performed the tasks of washing udders, foremilking, stripping, and so forth. Each udder was washed with a separate clean cloth and clean hot chlorine solution, but several cows were washed in advance of the machine in order to prepare the udders for milking. The teat-cups of the milking machine were rinsed in cold water and then in hot chlorine solution prior to being used on each cow. Machines were thoroughly rinsed between herds and were dismantled and thoroughly cleaned after each milking period (a.m. or p.m.). Throughout this study the Guernsey herd was milked first and the Holstein herd second.

At time of freshening, and at 30 to 60 day intervals thereafter, quarter samples of secretion (strict foremilk) were collected by the author (at the p.m. milking) and subjected to bacteriological examination in blood (bovine) agar. A quarter was considered to be infected with streptococci if blood agar culture of \( \frac{1}{2} \) cc. of the fresh sample revealed the presence of one or more colonies of streptococci. At intervals the streptococci were subjected to cultural and serological tests. Streptococci of each of Minett's (28) groups I, II, and III, and some atypical forms, were identified during the study, but at any one time at least 90 per cent (and usually 95 per cent) of the total streptococcal infection in the herds was due to members of Minett's group I (\textit{Streptococcus agalactiae}). Inasmuch as streptococci other than \textit{Str. agalactiae} constituted an insignificant portion of the total streptococcal infection at any time, the unqualified use of the terms "streptococci" and "streptococcal" in this report is to be regarded as referring to \textit{Str. agalactiae}. Animals were at times examined at 60 day intervals, and no examinations were made during the dry period. Therefore, in calculating the monthly incidence of infection it was necessary to assume that the infection present at the last previous examination was present during either of these intervals.
During the first six years, the foremilk of each quarter of each cow was examined daily prior to the afternoon milking by means of a strip cup. This examination was made by a layman specifically trained for the purpose. The presence in the foremilk of flakes greater than one mm. in diameter (estimated), or more marked alteration of the secretion such as clots, strings, wateriness, pus, or blood was recorded. The presence of any such abnormality in the foremilk of one or more quarters of a cow made her "positive" for mastitis for that day. In reports of the monthly occurrence of mastitis at this time, such mastitis is stated as the percentage of the total cow days (for example: 30 cows milked for 30 days equals 900 cow days).

Each cow (udder) was examined at about 90 day intervals by means of the Udall System of udder physical examination (55). This examination was made by Drs. D. H. Udall and S. D. Johnson of the New York State Veterinary College, and by Dr. L. J. Tompkins of the Kings and New York Counties Medical Milk Commissions. During the first 13 months of the study no change was made in the indiscriminate standing position and milking order of the cows. On January 16, 1939, the standing position of both herds was arranged according to the results of the physical examination of the udders. In each herd the cows with the most normal udders (No. 1) were placed as a group at the end of one side of the barn where they were milked first. Then the cows with No. 2 udders were placed next as a group, then those with No. 3 udders, and then those with No. 4 udders in U-formation around the barn to follow the milking order. When heifers were added to the herds between physical examinations they were placed at the beginning of the milking line with the No. 1 cows. The standing order of each herd was revised at six month intervals to conform with later findings of the physical examination. This period, called the segregation period, lasted for 21 months. On November 1, 1940, the Holstein herd was shuffled and the standing position of the cows from then to the end of the study was independent of the physical examination of the udders. The Guernsey herd was kept segregated (by physical examination only) throughout the remainder of the study with revision of the standing positions every six months. All other practices were the same in each herd, and at no time were the laboratory examinations of the secretion allowed to influence the management of the herds. No animals were removed from the herds as a result of the physical examinations and the laboratory examinations.

For purposes of study, the seven year period of observation (84 months) has been divided into the pre-segregation period (January, 1938 to January, 1939, inclusive) of 13 months; the segregation period (February, 1939, to October, 1940, inclusive) of 21 months; the pre-machine period (November, 1940, to May, 1942, inclusive) of 19 months; and the machine period (June, 1942, to December, 1944, inclusive) of 31 months. During the pre-segregation period neither herd was segregated, during the segregation period both herds were segregated, and during the pre-machine and machine periods the Guernsey herd was kept segregated while the Holstein herd was not. The pre-machine period is that period between the time the Holstein herd was removed from segregation and the time machine milking replaced hand milking. The machine period is the time during which the herds were milked by machine.
The average daily atmospheric temperature and the total monthly precipitation for the first three years of the study are from the official records of the U. S. Soil Conservation Service. These data were obtained on the same farm, and within one mile of the barns in which the study herds were housed.

RESULTS

The average daily atmospheric temperature and total precipitation for each month of the first three years, the monthly incidence of mastitis for the first six years, and the monthly incidence of streptococcal infection in each herd for seven years are shown in Figure 1. The monthly incidence of streptococcal infection after nullification of the age factor (37) is also shown.

The actual incidence of infection in the Guernsey herd was 19.4 per cent of quarters at the onset of the study. The percentage of infected quarters decreased during 1938 to about 11 per cent, remained at about 11 per cent during 1939, gradually increased during 1940 to about 15 per cent, continued to increase in 1941 to about 19 per cent, decreased during the middle part of 1942 to about 16 per cent, and then increased to about 30 per cent by the middle of 1943. From the middle of 1943 to the end of 1944 there was a gradual decline in the percentage of quarters infected with streptococci. In the Holstein herd the actual incidence of infection at the onset of the study was 12.6 per cent of quarters. The incidence decreased during 1938 to about nine per cent, increased during 1939 to about 12 per cent, decreased in 1940 to about nine per cent, and decreased during the first half of 1941 to about five per cent. In the latter part of 1941 and the early part of 1942 the incidence of infection increased slightly, and from then until the end of 1944 there was an almost constant increase to about 30 per cent. At no time was there a spreading of infection sufficient to be termed an epizootic.

The trend of the incidence of mastitis was approximately the same in each of the herds. During the first five months of 1938 it was about ten per cent, then increased sharply in June and July (mastitis outbreak), and receded gradually during the rest of the year to about five per cent in December. During the entire year of 1939, the incidence remained at or near five per cent in both herds. During the first four months of 1940 the incidence was less than ten per cent, then increased sharply in May, June and July (mastitis outbreak), and receded sharply in August and September to about five per cent in October, and this was maintained during the rest of the year. During the entire year of 1941, the incidence remained near ten per cent, with a very gradual increase from slightly below ten per cent to slightly above ten per cent. During January, February, March, and April 1942, there was a very severe rise in the incidence of mastitis to about 25 per cent in the Guernsey herd and about 40 per cent in the Holstein herd (mastitis outbreak). This peak was maintained, approximately, during May, June, and July, and was followed by a very gradual decline during the rest of 1942 and most of 1943. It was not until October, 1943, (18 months after the peak of the outbreak) that both herds reached an incidence of ten per cent or lower. Such observations were not continued through 1944. It should be noted that the incidence of mastitis in the Holstein herd was always equal to, or greater than, the incidence of mastitis in the Guernsey herd.
FIG. 1.—The average daily temperature and total precipitation for each month of the first three years, the monthly incidence of mastitis for the first six years, and the monthly incidence of streptococcal infection (actual and corrected for age) in each herd for the entire seven years.
Fig. 2.—The closeness of the relationship between age and Streptococcal infection (correlation coefficients), and the pattern that infection and age made when observed for a period of 84 months.

Fig. 3.—The average daily pounds of milk produced per lactating cow each month during years 1939 and 1940.
In Figure 2 are shown the closeness of the relationship between age and infection (correlation coefficients) and the pattern that infection and age made when the observations covered an 84 month period (diagonal lines). The difference in the direction of these prediction lines is not considered significant because 59.5 per cent of the observations occurred in the area common to both lines plus their standard errors of estimate.

Figure 3 shows the average daily pounds of milk produced per lactating cow each month during the years 1939 and 1940 for each herd (breed). In general, milk production was at its lowest in November or December, increased each month from January to May, then decreased each month.

**DISCUSSION**

It has been shown previously (37) that the relationship between the average age (as lactation periods) of the herds studied and the incidence of streptococcal infection was so significant that all other factors of possible importance in the genesis of such infection are relegated to a subordinate position (38). But, while this was definitely the case in the herds studied, it does not necessarily follow that the many other factors or conditions, thought by so many to be of importance, are of no importance whatever. On the contrary, such a matter as the degree of exposure must be of some importance in any infectious disease, because individual resistance is merely a relative quantity that theoretically can be overcome by a sufficiently large number of the specific causative microorganisms. Thus the feeding, breed, age, milking method, climate and weather, sanitation, and segregation will be considered in relation to streptococcal infection of the udder.

So far in our reports (36, 37, 38) we have not considered in detail the inflammation (mastitis) phase of the problem. It has already been emphasized sufficiently that a distinct difference exists between the infection and inflammation phases, in that one is a cause and the other a result. However, the same influences of feeding, breed, etc. mentioned above might operate to cause or allow an infection to pass into the inflammation phase, as well as they might operate in allowing or aiding an infection to become established.

Thus it is necessary to attempt to assay such possible factors in the light of both the infection and inflammation phases. In order to do this, it is considered advantageous to deal with both phases at once (under each of the headings) as they could have been influenced in this study by any particular condition.

**Feeding**

*Infection.* The possibility is seldom mentioned in the literature that feeding might influence the resistance of the udder to infection with streptococci. Hucker and Reed (16) have shown that the feeding of irradiated yeast did not protect the udder from infection with streptococci, and Huffman and Moore (L. A.) (19) found that the feeding of cottonseed meal (to cows up to the end of their second lactation period) as the principal source of protein did not increase the susceptibility of heavy milking cows to udder infection.

In the present study there were only two points on which any discussion may be of value: a constant difference in the rate of grain feeding between the herds
(breeds), and a seasonal change in the character of the nutrient intake which
occurred in both herds when they were turned to pasture each year in the spring.
In the first case no significant difference occurred in the incidence of streptococcal
infection in the two herds (Fig. 2) during the seven year period. In the second
case, both herds were handled in the same way when the greatest influence would
be felt (first month of pasture), so that for the change from barn to pasture feeding
to have been an influence (good or bad) in infection of the udder, there would have
had to be a seasonal change in the incidence of infection. That such was not the
case can be seen by reference to Figure 1; there was no increase in infection during
the pasture months of May, June, July, August and September that could be
considered of significance with respect to the feed consumed. There was a decrease
of infection in both herds during the spring of 1940, but this began in April before
the cows were turned to pasture. No explanation of this decrease can be offered.

**Mastitis.** Most information in the literature (34) regarding the influence of
feeding on the occurrence of mastitis (general sense) appears to relate to the ability
of feeding to cause an infection to pass into the inflammation phase (mastitis in
the true sense). As such an influence, feeding has been thought of as (a) the amount
of protein, (b) the amount of corn products, or (c) the amount of feed consumed in
relation to the amount of milk produced (rate of grain feeding).

With regard to the amount of protein fed in the grain ration to dairy cows, Moore
(J. S.) (31) reported that the heavy feeding of cottonseed meal (one of the richest
of all feeds in proteins, containing from 32 to more than 37 per cent digestible crude
protein (32)) caused mastitis and loss of quarters, whereas little trouble occurred
in groups of cows that did not receive cottonseed meal, although all groups produced
similarly. Inasmuch as the groups were not known to be equally infected, however,
it is impossible to conclude with any certainty that heavy protein feeding in this
case contributed to the passing of infection from the infection phase to the in-
flammation phase. Huffman and Moore (L. A.) (19), mentioned above with
regard to the possible effect of feeding on infection, found that mastitis was not
more prevalent in cows receiving cottonseed meal as the principal source of protein.
In this instance also, no proper conclusion can be formed, inasmuch as the animals
were relatively free from infection, and therefore heavy protein feeding could not
act to excite an infection to pass into the inflammation phase.

Hotis and Woodward (15) attempted to obtain definite information on the effect
of high protein feeding (cottonseed meal) on the ability of the udder to secrete
milk of normal composition (chloride content and the number of cells). Eight
cows were studied during a 22 week period: two were maintained on a high protein
ration, two on a low protein ration, two received low protein during the first 11
weeks and high protein during the second 11 week period, and two others received
the high protein and then the low protein rations. It appears that the animals
were adequately considered from the standpoint of both infection and inflammation,
and the results showed that a high protein ration had little, if any, influence on the
composition of the milk. Miller and Wise (26) studied the effect of feeding cotton-
seed meal as the only concentrate on several components and properties of milk
(any mastitis-producing effect was not a primary purpose) and found that, after
four months of feeding, a cottonseed meal group of eight to ten cows showed differ-
ences in milk composition not shown by a control group of eight to ten cows. The change of importance here was a lowering of the casein nitrogen expressed as percent of the total nitrogen to a point that would be considered by Rowland's standards (44) as indicative of chronic mastitis. Although no observations were made from which it could be said that the groups were equal in their incidence of infection at the onset of the feeding period, and although incidental observation established the fact that no great difference was noted in the gross occurrence of mastitis in the two groups, nevertheless chemical change indicative of mastitis was apparently produced as a result of the feeding of cottonseed meal.

Thus of the four studies cited, Moore (J. S.) reported that heavy protein grain feeding caused mastitis but the study groups were not balanced for initial infection; Huffman and Moore (L. A.) reported the opposite but also failed to control the infection status of the study group; Hotis and Woodward showed, in apparently well-balanced but very small groups, that little, if any, increase in mastitis was produced; and Miller and Wise demonstrated a change in composition of the milk possibly indicative of mastitis, but, again, the groups were not known to be balanced for initial infection. It can be said, therefore, that it has not yet been established that high protein grain feeding has or has not an influence on the passing of an infection from the infection phase to the mastitis (inflammation) phase. Although the feeding of a grain ration of the same, and of a constant, protein concentration to the two herds for the duration of the study period prevents us from adding to this particular phase of the problem, information given below regarding the effect of a change from barn feeding to pasture feeding on the mastitis incidence in these herds might be relevant.

With regard to the effect of heavy corn feeding, Moore (E. N.), Henderson, Van Landingham and Weakley (30) found no significant difference in the incidence or severity of mastitis between two groups of 10 cows receiving a heavy corn ration or a normal grain ration (each ration contained 12.5 per cent digestible crude protein).

With regard to the effect of the rate of grain feeding on the occurrence of mastitis, Moore (E. N.), Henderson, Van Landingham and Weakley (30) found no difference between limited grain feeding (eight to ten pounds daily) and feeding at the rate of one pound of the same feed for each three and one-half pounds of milk produced by two groups of eight cows in their first and second lactation periods. In the present study 322 milking animals were observed during a period of seven years. Approximately one-half of these were of the Guernsey breed and were fed grain at the rate of one pound for each three pounds of milk produced, and approximately one-half were of the Holstein breed and were fed the same grain ration at the rate of one pound for each four pounds of milk produced. Yet the occurrence of mastitis in the Holstein herd was always equal to or greater than in the Guernsey herd (Fig. 1), exactly opposite to the rate of grain feeding, even though the incidence of streptococcal infection, when corrected for age, was not significantly different in the two herds. This distinct difference between the incidence of mastitis in the herds, therefore, was probably not due to the composition or rate of grain feeding (see "Breed").

In the management of these herds a radical change occurred each year in the
diet of all the cows when they were first turned to pasture in May. It was the practice for the first few weeks of the pasture season to allow the cows to graze for several hours during the morning and afternoon. They were not allowed to remain on pasture overnight until about the middle of June. No change was made in the quantity of grain fed but, because the barn feeding of roughage was ad libitum, the amount of such roughage consumed naturally decreased as the amount obtained on pasture increased. The percentages of all nutrients obtained from pasture (calculated by difference from the known amount of hay, grain, or silage fed and the actual 4 per cent fat corrected milk produced) were, for the Guernsey herd, 62.8, 36.2 and 68.3, respectively, for the years 1938, 1939 and 1940; and for the Holstein herd, 64.4, 36.1 and 66.5, respectively.

Figure 1 shows that an outbreak of mastitis which occurred in both herds in 1938, appeared in June and reached its peak in July. Another outbreak of mastitis occurred in 1940, appearing in both herds in May and reaching its peak in July. Both outbreaks began to subside in August and could be considered to have abated completely by the time all cows were confined to the barns for winter. In 1939 there was no outbreak of mastitis in either herd at any time. These outbreaks are known to have resulted from the greater activity of existing streptococcal and staphylococcal infections (the passing of infections from the infection to the inflammation phase).

Thus during the years of 1938 and 1940 when the herds were receiving from pasture 63 to 68 per cent of the nutrients consumed, there were mastitis outbreaks beginning early in the pasture season. In the intervening year, 1939, when only 36 per cent of the nutrients consumed came from pasture, no mastitis outbreak occurred. The high nutrient intake from pasture in 1938 and 1940, and the low nutrient intake from pasture in 1939, were most certainly related directly to a difference in precipitation (Fig. 1). Precipitation is a part of weather, and, inasmuch as weather is also thought by some to be related directly to the occurrence of mastitis, this aspect will be pursued further below under the heading "Climate and Weather."

Breed

Infection. We have not found any evidence in the literature that one dairy breed is any more or less susceptible to streptococcal infection or mastitis than another. In the present study (Fig. 2) there was no significant difference in the occurrence of streptococcal infection in the two breeds, Guernsey and Holstein.

Mastitis. As for mastitis, there is clearly a difference between the breeds (Fig. 1) in that the incidence of mastitis in the Holstein herd frequently was greater, and never was less, than that observed in the Guernsey herd. This difference, with its widening during periods of stress, circumstantially indicates that the infection phase passed more readily into the inflammation phase in the Holstein cows than in the Guernsey cows. It is of interest to note in this regard that Caulfield and

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This discussion is not carried beyond 1940 because adequate supporting data on weather were not available, and because the only subsequent mastitis outbreak clearly began before the pasture season and, therefore, was probably due to other factors or conditions.
Riddell (3, 4) found that the chloride content was higher and the acidity lower in milk from cows of the Holstein breed than in milk from cows of the Guernsey breed. Inasmuch as the chlorides increase and the acidity decreases in the inflammation phase, it is possible that these observations parallel those of the present study.

Age

Infection. The relationship of streptococcal infection to age has already been considered in detail (36, 37).

Mastitis. The relationship of streptococcal mastitis to age has, however, received little attention. Plastridge, et al. (40) have shown that not only does the incidence of streptococcal infection increase with age, but the resulting mastitis increases also. This is exactly as it must be, inasmuch as the predominant cause of mastitis (Str. agalactiae) increases with age, and there is no doubt that, on an individual animal basis, the same could be demonstrated in the present study. Because of the way in which the data are presented in this analysis, however, and because of the three mastitis outbreaks that occurred, it is not possible to show whether there was a month to month relationship between the average age of the herds and the incidence of mastitis.

Milk ing method

Although the method of milking is broad enough to be broken into numerous parts, most studies deal only with whether the milking act is performed manually or by machine, and whether the milking act is complete or incomplete. The latter point is usually mentioned only in relation to machine milking but might apply to hand milking also under certain circumstances.

Infection. Meigs, et al. (24), Hucker (18), and Cone (5) have demonstrated that the milk of cows (uninfected as well as infected with streptococci) milked by machine had a higher cell content or a higher chloride content than did that of cows milked by hand. Meigs et al. suggested that such change in the secretion indicated an injury to the tissues and that, if carried far enough, the injury would render the udder tissues a better medium for bacterial growth. Cone (5) and Peterson (42) apparently agreed in principle with Meigs et al., and Cone showed a greater incidence of streptococcal infection in machine milked cows than in hand milked cows, but did not consider the difference of significance. Peterson, on the other hand, although inferring that non-obvious injury to the inner lining of the teat and gland might significantly predispose to infection, has not advanced any supporting evidence. Hucker found a higher incidence of streptococcal infection in machine milked cows than in hand milked cows but, as previously pointed out (38), the true significance of any such difference cannot be determined unless a correction for the age factor is made.

In the present study, the two herds were milked by hand for the first 53 months, and by machine for the last 31 months. The change was made abruptly, and not without some difficulties, as the personnel had to become accustomed to the new method. From the actual incidence (uncorrected) of streptococcal infection before and after the change was made (Fig. 1), one could readily conclude that machine milking significantly contributed to the spread of streptococcal infection, inasmuch
as infection clearly increased within the first twelve months of the machine period and continued to increase toward the end of the study period to a height not observed prior to the introduction of machine milking. Reference to the incidence of infection after correction for the age factor (Fig. 1), however, shows that such a change in the milking method did not significantly alter the streptococcal infection status of the herd.

Espe and Cannon (7) have reasoned that with machine milked cows there is a greater danger of injury to the teat sphincter than with hand milked cows, and that a teat whose sphincter becomes eroded at the external orifice seems to offer a greater opportunity for infection of that quarter than one which shows no erosion. In the present study such "erosion," or dilatation of the streak canal's outer aspects with cornification of the lining epithelium, occurred in both herds soon after the introduction of milking machines but had never been noticed before. It was more prominent in the Guernsey breed, particularly in those individuals whose teats were pointed rather than blunt, and tended to decrease after a time but was still present to a certain extent to the end of the study. Though no detailed record was kept of the occurrence of this condition, it was definitely present, and yet no significant rise in streptococcal infection resulted. Neave, Sloan, and Mattick (39) observed this same condition in 12 cows during a mastitis outbreak, but only six of the cows became "affected with mastitis." Thus the mere presence of "erosion," or "chapping" of the external teat meatus cannot be said to predispose to infection of the quarter with streptococci.

To our knowledge, no one has presented data to show whether incomplete milking contributes to the spread of Str. agalactiae infection of the udder. During the present study, in the pre-machine period, a state of labor unrest became apparent about June 1941 and increased in severity to the time of the declaration of war by this country in December 1941. Following this the condition became acute and forced the introduction of milking machines in May 1942. Prior to June 1941, the men who milked the cows were selected for their ability to milk properly and usually remained on the job for more than one year. In the second half of 1941, good milkers became more and more scarce and the men remained on the job for shorter periods. This condition became much more marked in and following December 1941, and is considered to have been responsible for the severe mastitis outbreak that began in January 1942 and that abated only after machine milking was instituted. As a result of this unrest, hand milking was increasingly incomplete and lacking in uniformity, yet there was no significant increase in the incidence of streptococcal infection at this time (Fig. 1: Pre-Machine Period).

Mastitis. As was mentioned above, Meigs et al. (24), Hucker (18), and Cone (5) have demonstrated that the milk of cows (uninfected as well as infected with streptococci) milked by machine had a higher cell content or a higher chloride content than did the milk of cows milked by hand. Such an effect would indicate that machine milking might contribute to the passing of an infection from the infection phase into the inflammation phase. From the present study, because of the severe mastitis outbreak that occurred before the milking machines were introduced, and because of the failure to carry the mastitis observations beyond December 1943, we cannot say that machine milking did or did not contribute to
the passing of an infection from the infection to the inflammation phase. It can be said, however, that the outbreak subsided (even though very slowly) after the change in the milking method and that, if this outbreak was due to incomplete and non-uniform hand milking, as we think was the case, the use of milking machines even in relatively inexperienced hands was preferable to improper hand milking.

Inasmuch as this outbreak (a) occurred in the barn under conditions (other than those involving milking personnel) that had not been conducive to any previous outbreak of mastitis, (b) was not preceded or accompanied by an increase of streptococcal or any other infection, (c) was so prominently associated with labor difficulty, and (d) subsided when milking machines were introduced, we consider it justified to conclude tentatively that the 1942 mastitis outbreak was, in fact, brought about by incomplete and non-uniform (hand) milking. An almost identical circumstance was reported by Moss (33) in which a hand milked herd in Hawaii experienced severe labor trouble immediately following December 1941. A marked increase in clinical mastitis (infection not reported) occurred at the same time and subsided when the labor conditions were straightened out. Our observations and those of Moss lend support to the experimental results of Schalm (49) to the effect that incomplete milking precipitates mastitis in already infected cows.

**Climate and weather**

Climate and weather may affect the physiology of the cow mainly as temperature and moisture (and their combined effects), principally through direct action on the body (exposure), and indirectly by influencing the chemical composition of the food consumed and the presence and activity of other forms of animal life (insects, etc.) which at times might concern the well-being of the cow.

The distinction between climate and weather is more or less artificial, since the climate of a place is merely a build-up of all the weather from day-to-day and the weather is merely a day-by-day breakdown of the climate (11). It is a useful distinction in the present study, however, because, having made this study in only one place, we can evaluate the effect of climate on udder infection and mastitis only by comparison with the work of others. In the case of weather, on the other hand, we have been able to obtain reliable month-to-month data on temperature and precipitation for a period of 36 months, during which time considerable natural change occurred in the udder disease picture of the herds (Fig. 1). Furthermore, the importance of this relatively short period of weather observation is augmented by the fact that it coincided with the first three years of the study; in two of these years mastitis outbreaks occurred after the cows were released from barn confinement, and in the intervening year the incidence of mastitis remained throughout at a constant low level.

**Infection.** To our knowledge no evidence has ever been presented showing that climate might be a factor in the relative prevalence of streptococcal infection of the udder. The widespread occurrence (34) of infection throughout the world and the more or less general manifestation of an increasing-with-age pattern (36) demonstrate that any possible effect climate might have would be small. Simi-
larly, we know of no evidence presented showing that weather might be a factor. In addition to the fact that many of the general observations concerning streptococcal infection in the present study (36, 37, 38) are in agreement with those made in other parts of the world, no seasonal difference in the amount of infection was noted at any time (Fig. 1). Thus climate and weather probably have little bearing on the genesis of streptococcal (Str. agalactiae) infection of the udder.

The lack of any seasonal difference in the occurrence of streptococcal infection in the present study bears an important relationship to the work of Sanders (45, 46) and of Ewing (8). On the basis of artificial transmission experiments, in which flies were fed on milk containing very large numbers of streptococci, Sanders reported that Musca domestica and Hippelates spp. flies are natural vectors of the streptococci of mastitis. On the other hand, Ewing was unable to demonstrate Str. agalactiae either externally or internally in numerous M. domestica trapped under natural conditions in a dairy barn in which approximately 30 per cent of the cows were infected with streptococci. In the present study, the seasonal presence of large numbers of unidentified flies (many of which probably were M. domestica) in the unscreened dairy barns and in the pasture areas during the warmer months of each year, and the virtual absence of flies during the colder months, would make necessary a seasonal change in the natural occurrence of streptococcal infection if flies were able to contribute significantly to the spread of such infection. That such was not the case has been mentioned already.

Mastitis. It is apparent from the literature that streptococcal mastitis occurs in many climates but nothing is known of the part played by climate in the passing of an infection from the infection phase to the inflammation (mastitis) phase.

In the present study, the occurrence of outbreaks of mastitis in both herds in 1938 and in 1940, after the animals were released from barn confinement (Fig. 1), makes necessary the serious consideration of weather as a contributing cause of these outbreaks. It is possible that weather changes could so affect a cow that an existing streptococcal infection of the udder would pass into the inflammation phase as a direct result, and it is a popular conception that such things as chilling of the udder excite existing infection, thus causing flareups. Adequate observations or experimental results are, however, notably lacking in the literature. Schalm (48, 50) has observed that in California dairy herds, which are usually kept out-of-doors all year, mastitis is often more serious in winter than during other seasons. This he attributed to exposure to rain and mud which aggravated the infection. In the present study, inasmuch as distinct mastitis outbreaks occurred in both herds soon after they were allowed to graze in the spring of 1938 and 1940, both of which were known to be wet years, and inasmuch as a mastitis outbreak did not occur in either herd in 1939, a dry year, one might be justified in thinking that moisture in the cooler spring pasture months contributed to flareups through a chilling action (the animals were seldom exposed to mud deeper than their hooves.)

Although the relationship between weather and mastitis cannot be decided on the basis of data now at our disposal, reported studies on body and udder temperature in relation to environmental temperature do not encourage the assumption that weather action is entirely direct, as in chilling. Thus Gaalaas (10) has shown
that when average body temperature of cows was 101.0°F at an average air temperature of 50°F, it was raised to 103.2°F. only when the average air temperature reached 95°F. Changing from barn confinement to daytime pasture in the present study during May (average air temperature 50° to 60°F.) and then to full-time pasture in June (average air temperature 60° to 70°F.) would not be expected to upset radically the temperature regulating mechanism of the animals. Furthermore, Cornejo, Espe and Cannon (6) have shown that the teat and milk cistern temperature of cows kept in a barn at a temperature of 58° to 70°F. averaged 2.5° to 3.0° lower than their rectal temperatures, but when cows were subjected to sub-zero weather the observed differences increased to only about 5°F.

In addition to the possible direct relationship between the observed outbreaks of mastitis and the weather, the possibility of an indirect effect of weather on the occurrence of mastitis through the quality and quantity of food consumed by grazing young pastures must be considered. Young succulent herbage is richer in protein than mature plants, contains more potassium, calcium, phosphorus, and magnesium, and is higher in vitamins. The mineral content decreases and the carbohydrate content increases as plants approach maturity.

It is recognized that moisture is probably the greatest single factor influencing the yield and nutritive value of grasses. Temperature also plays an important part, as do type of soil, variety of crop, and kind and amount of fertilizer. Climatic conditions so affect respiration, assimilation, photosynthesis, and other physiological processes (of the plant) that the composition of both the mineral and organic matter of crops may be greatly modified even though they are grown upon identical soils (1).

In the present study, each herd suffered a mastitis outbreak in 1938, beginning in June. Both herds began pasture on May 1: the Guernsey herd had a continuous grazing period of 121 days during which the animals received 62.8 per cent of their nutrient intake from pasture; the Holstein herd had a continuous grazing period of 37 days during which they received 64.5 per cent of their nutrient intake from pasture.

In 1939 there was no increase in the incidence of mastitis when both herds were turned to pasture on May 10: the Guernsey herd had a first grazing period of 39 days, followed by later periods amounting to a total of 79 days during which 36.2 per cent of their nutrient intake was from pasture; the Holstein herd had a first grazing period of 28 days, followed by later periods amounting to a total of 52 days during which 36.1 per cent of their nutrient intake was from pasture.

In 1940, each herd suffered a mastitis outbreak beginning in May. Both herds began pasture on May 15: the Guernsey herd had a first grazing period of 57 days followed by later periods amounting to a total of 105 days during which 68.3 per cent of their nutrient intake was from pasture; the Holstein herd had a continuous grazing period of 46 days during which 66.5 per cent of the nutrient intake was from pasture.

Thus it can be seen that the change from complete barn feeding to barn feeding supplemented by pasture (and the change to outdoors) was accompanied by mastitis outbreaks in those years (1938 and 1940) in which precipitation was high in amount or in accumulation, whereas such a change in feeding during the inter-
vening year in which the precipitation was low was not accompanied by mastitis outbreaks. It is realized that the coincidental occurrence of mastitis outbreaks and pasturing during the wet springtime does not prove that a relationship exists between the chemical composition of the forage and the occurrence of mastitis. All that is maintained is that weather appeared to be related to the outbreaks, and that there is just as much reason for thinking that this effect could be indirect through the action of weather on the chemical composition of the plant as there is for thinking that the weather action was direct as in the sense of chilling.

Though no general body disturbance was observed in the present study, one cannot help but notice that these outbreaks bear some resemblance to grass tetany of cattle. For example, Madsen (23) asserts that while the cause of this condition is still obscure, it is probably not a simple magnesium deficiency, since pasture grass is a good source of this mineral. Young, fast-growing pasture grass on well-fertilized pastures is believed by some to contain an unbalanced content of minerals or toxic products which cause the disease. Sjollema (52) believes that heavy grain feeding in winter, together with limited roughage consumption, predispose cattle to this disease, since such rations are usually low in calcium and high in phosphorus. A condition called "grass tetany" is reported by Quin (43) to occur in Kansas, Nebraska, and Oklahoma among cattle turned out to young lush pastures of rye, wheat, or barley. Metzger (25) has found that, with few exceptions, the cases reported in Kentucky occur in cows grazing on young, rapidly growing grass, and the record rainfall during the spring of 1935 caused a marked increase in the number of cases.

In this regard, an experience of Miller and Wise (26) (beyond that mentioned above; "Feeding: Mastitis") appears to be of some significance. The data presented by these workers, concerning the chemical composition of the milk secreted by two groups of eight to ten cows, one of which was fed cottonseed meal as the only concentrate and the other a mixture of corn gluten meal, wheat bran, ground corn, and oats, but both receiving the same roughage, show that a physiological upset was experienced by several individuals of the cottonseed meal group when all the cows were turned on pasture in May (South Carolina, 1940). The upset was characterized by anorexia, decreased milk production, and abortions and was seen only in the cottonseed meal group. As previously mentioned ("Feeding: Mastitis"), the cottonseed meal group had shown chemical changes in their secretion indicative of chronic mastitis (low casein number) after four months of the cottonseed meal feeding. These changes continued in this group until the pasture period three and one-half months later, at which time they increased sharply. This sharp increase of values was undoubtedly due in part to the decrease in volume of milk secreted that occurred as part of the gross physiological upset. Nevertheless, the physiological upset appeared to have been precipitated by the change from barn feeding to pasture, and the control group, while not having shown milk composition changes of a mastitis nature prior to pasture, and while not having shown the gross physiological upset when turned to pasture, did show some lesser change in milk composition (non-casein nitrogen; iodine number and refractive index of butter fat) as a result of having been turned to pasture.

It is fully realized that Miller and Wise made no observations on udder infection
and mastitis (except some mastitis observations of a very superficial nature), and, therefore, no exact information of mastitis significance was obtained. Nevertheless, certain of the observations cannot be overlooked: (a) the change from barn feeding to barn feeding supplemented by pasture was accompanied by a disturbance of the cows measured by the chemical composition of the milk and by gross symptoms, (b) the disturbance was more clearly apparent by far in the group consuming cottonseed meal, and (c) cottonseed meal much more closely approximates young succulent herbage in its percentage content of protein and mineral than does an ordinary grain concentrate mixture.

In addition to the possibility that a direct action such as chilling, or an indirect action of the chemical composition of the food consumed precipitated the occurrence of mastitis in cows already infected with streptococci (and staphylococci), it should be mentioned for the benefit of future studies that the nature of the food consumed has a definite effect on the physiology of the rumen in ways that might be involved in the present problem.

Sanitation

Technically speaking, sanitation, as the establishment of environmental conditions favorable to health, should include such already considered matters as feeding and the milking method, and perhaps even climate and weather. It could also include segregation, in that the segregation of a diseased individual from the general mass might contribute to the establishment of environmental conditions more favorable to the health of the group as a whole.

But in the every-day use of the word “sanitation” we think more in terms of the erection of barriers to the spread of micro-organisms from one individual to another; in this case the spread of \textit{Str. agalactiae} from cow to cow. For the purpose of this discussion, therefore, we will include under sanitation those things that concern the immediate environment of the udder, such as the bedding, the stall, and the care taken (mainly through cleanliness and disinfection) to limit the secretion of one udder from contacting another. Segregation will be considered separately.

\textbf{Infection.} A great number of authors \cite{34} have expressed the opinion that better sanitation (hygiene) would be sufficient to avoid or to reduce significantly the spread of streptococcal infection. Statements such as “a successful program for the control of mastitis must be based primarily upon a knowledge of the methods by which the disease spreads... and involves establishment of milking practice and herd management methods that prevent spread of the causative micro-organisms from diseased to healthy cattle” \cite{47} are most common. Yet nowhere in the literature on bovine mastitis is there to be found adequate observational or experi-

\footnote{When the composition of cottonseed meal (CSM) and the control grain mixture (CGM) fed by Miller and Wise were estimated according to Morrison\cite{23}, it was found that, while the total digestible nutrients of the two rations were approximately the same (75 to 78 per cent and 69 to 75 per cent respectively), the carbohydrate, fat, and mineral content were markedly different: digestible crude protein 35 per cent for CSM and 14 per cent for CGM, carbohydrate 24 per cent for CSM and 50 per cent for CGM, fat 8 per cent for CSM and 4 per cent for CGM, and CSM was two to three times as rich in potassium, calcium, phosphorus, and magnesium as was CGM.}
mental evidence that sanitation can prevent the spread of *Str. agalactiae* in a herd, or even that it can reduce the spread. In every case, to our knowledge, the evidence is either inadequate or is complicated by some other measures such as segregation, elimination, or treatment.

On the other hand, Bryan (2) has reported that in one herd streptococcal infection continued to spread in spite of excellent sanitation (adequate bedding, washing udders with disinfectant prior to milking and rinsing the milking machine in disinfectant between cows). Minett (29) has very clearly pointed out that even the best managed herds, as far as cleanliness is concerned, often have as much mastitis, as or even more than, others and that it is impossible to control streptococcal mastitis by sanitary (hygienic) measures alone. Furthermore, the detailed investigations of the Imperial Bureau of Animal Health (21) have shown that *Str. agalactiae* could be isolated as frequently from the outside of the teats of cows in four herds on which disinfectant (hypochlorite) solution was used for washing the udder preceding the routine milking, as it could in three herds on which no disinfectants were used.

In the present study, sanitation was the same in both herds at any time: the bedding was adequate and the same in each barn, each cow was trained to a particular stall, stall construction provided a concrete curb to reduce contact between stalls, milking onto the floor was prohibited, udders were washed with hypochlorite solution (200 parts per million) prior to being milked (one towel and one bucket of disinfectant for each ten cows while hand milking was practiced; separate towels and clean disinfectant for each cow when machine-milking was practiced), and hands or teat cups were rinsed in disinfectant prior to milking each cow. Nevertheless, it is obvious from the month-by-month incidence of streptococcal infection (Fig. 1) that this good level of sanitation was entirely unable to prevent the spread of infection, inasmuch as the amount of infection in the herd increased and decreased at will in direct and close relationship to the average age of the herd (Fig. 2) (37). Even the use of separate towels and clean disinfectant solution during the 31 month machine milking period did not result in a lower incidence of infection than when one towel and one bucket of disinfectant were used for each ten cows during the 53 months prior to the machine milking period when the herds were milked by hand. During the last 12 months of the machine milking period the teats of all cows were dipped in clean chlorine solution (200 p.p.m.) immediately after each milking with no apparent effect on the incidence of infection.

In the light of the recent studies of Harrison (12), Hay (14), the Imperial Bureau of Animal Health (21), and Spencer, McCarter, and Beach (53), the inability of the good level of sanitation practiced in the present study to prevent the spread of infection is not surprising because: (a) when cows infected with *Str. agalactiae* are milked by hand, this organism may become part of the resident flora of the skin of the hands (12, 53), (b) washing of hands followed by rinsing in a chlorine solution will not remove all *Str. agalactiae* from the hands (12, 53), (c) *Str. agalactiae* can be recovered from the teat cups of milking machines used in herds where such infection exists (14), (d) no method of rinsing or disinfecting milking machine teat cups that has been reported in practical use would be entirely effective in removing *Str. agalactiae* during the cow-to-cow use of a machine (14), and (e) the contami-
nation of the hands of milkers apparently is passed to all objects that they touch (21).

Such evidence can mean merely that present methods of sanitation are not adequate for the prevention of the spread of \textit{Str. agalactiae}, and this was the main conclusion of the Imperial Bureau of Animal Health study (21). A fact that should have been obvious to previous workers was also pointed out in that study: if a really effective antiseptic technic were known and used, the spread of \textit{Str. agalactiae} infection would stop or significantly reduce at once and uninfected individuals could be kept in the same barn with infected individuals with little chance of becoming infected.\footnote{Further work along this line has been conducted by Hughes and Edwards (20), who have found that cetyl-trimethyl-ammonium bromide (CTAB) was distinctly superior to various chlorine and chloroxylenol preparations available in England on the basis of \textit{in vitro} experiments with \textit{Str. agalactiae}. The application of one per cent CTAB in a lanette wax-oil base, twice daily, to the teats of cows and the milkers' hands for over two months at the time of milking in a dairy herd appeared to reduce the spread of \textit{Str. agalactiae} infection. However, after application for three months, lesions of the teats developed that were apparently due to the CTAB, and there was a rapid increase in \textit{Str. agalactiae} infection.}

\textit{Mastitis.} There appears to be no information in the literature on the part played by sanitation (in the sense indicated above) in the passing of an infection from the infection phase to the inflammation phase.

\textbf{Segregation}

Segregation, as the separation of the infected individuals of a group from those not infected, is aimed at reducing or preventing the contact of an uninfected udder with an infecting organism and, therefore, at reducing or preventing the occurrence of \textit{Str. agalactiae} infection of the udder. As usually used with reference to udder infection and mastitis, the term means the separation into groups within the same building; whereas when the infected individuals are removed from the building (or the premises) the term “elimination” is usually employed. When cows are segregated within the same building for the purpose of attempting to reduce the spread of infection, they are milked in the order of uninfected ones first followed by the infected ones.

\textit{Infection.} Minett, Stableforth, and Edwards (27), Plastridge \textit{et al.} (40, 41) and Little (22) have achieved and maintained \textit{Str. agalactiae}-free herds by means of elimination. Each has pointed out, however, that, as long as an infected individual was allowed to remain in the herd, the spread of \textit{Str. agalactiae} to uninfected cows was not stopped. Stableforth, Edwards, and Minett (54), Seeleman and Hadenfeldt (51), Hucker and Harrison (17), and Hay (14) have shown that separating the infected cows within the barn and milking them last was unable to stop the spread of \textit{Str. agalactiae} infection. In some cases the spread was thought to have been reduced by the removal of some of the infected individuals, and at times other measures such as sanitation were given a share of the credit for an apparent improvement, but, as previously pointed out (38), any reduction in the
spread of *Str. agalactiae* under conditions short of elimination must deal with the age factor in order to be of any great value.

In the present study the standing position (milking order) of the cows in each of the two herds was not regulated during the first 13 months (Fig. 1). At the beginning of the study, and during this pre-segregation period, the standing position of the herds was entirely at the discretion of the herdsman, and the assurance can be given that, when the herds were not segregated as part of this study, the standing position of the cows was in no way affected by their age, infection or mastitis status. Then during the next 21 months, the segregation period, both herds were segregated according to the Udall physical examination rating (55) of each udder, and the cows were arranged in the barn so that the cows with the best udders (No. 1) were milked first, then the No. 2 udders, then the No. 3 udders, and, last, the No. 4 udders in U-formation around the barn. After 21 months of this milking order (which was revised at about six month intervals) the Holstein herd was released from segregation, was entirely mixed, and was thereafter arranged with no regard for age, infection or mastitis status. The Guernsey herd, however, was maintained in a segregated condition, revised at about six month intervals, for the rest (50 months) of the study period.

We have previously shown (35) that, based on seven physical examinations at intervals of three months, the Udall system was able to divide the cows in these two herds into four groups on non-bacteriological grounds: cows with No. 1 udders made up 1.7 per cent of the herds and none were infected with streptococci, cows with No. 2 udders made up 33.3 per cent of the herds and of these 5.2 per cent were infected with streptococci, cows with No. 3 udders made up 48.7 per cent of the herds and of these 33.2 per cent were infected with streptococci, and cows with No. 4 udders made up 11.3 per cent of the herds and of these 72.8 per cent were infected with streptococci.

With the formation of such groups during the time the herds were segregated, therefore, it would be expected, on generally maintained principles, that, though the spread of streptococcal infection would not be stopped, it should be reduced. Figure 1 shows that streptococcal infection was not reduced during the time both herds were segregated (segregation period). During the next 50 months (on the basis of actual incidence of infection) the incidence of streptococcal infection was almost constantly twice as great in the segregated Guernsey herd as in the non-segregated Holstein herd. What appears to be an increased rate of spread of streptococcal infection brought about by segregation is seen to be merely the result of the greater age of the Guernsey herd during this time, for, when corrected for the age factor, the incidence of streptococcal infection remained constant during the time these herds were segregated. Thus the popular conception that the spread of *Str. agalactiae* can be prevented by milking cows in the order of their infection status is not supported by these observations.

**SUMMARY**

Two self-contained herds of equal size (approximately 60 cows each), but of different breeds (Guernsey and Holstein-Friesian), were maintained separately under almost identical circumstances on the same farm for a period of seven years for the purpose of studying the natural behavior of streptococcal (90 per cent or
more of which was due to *Streptococcus agalactiae* infection and mastitis. The present study of the data obtained was undertaken in order to supplement the previous finding of a major relationship (correlation coefficient $+0.86 \pm 0.019$) between streptococcal infection and the average age as lactation periods (*age factor*) by considering the incidence of mastitis in relation to the incidence of streptococcal infection, and by discussion the possible relationship of such often-mentioned features as age, breed, feeding, milking method, climate and weather, sanitation, and segregation. Each of these was considered for its possible effect on both infection (as inhabitation of the mammary gland) and mastitis (as the inflammatory response of the gland to irritation).

*Feeding.* The two herds (breeds) were fed the same feed at any one time. The incidence of infection (when corrected for age) and the incidence of mastitis were always parallel in each herd. No effect of general feeding therefore could be measured. Although the two herds were fed as uniformly as possible throughout the seven-year period, a distinct change occurred when the animals were turned to pasture in the spring. Two of the three mastitis outbreaks that were observed coincided with such a change.

*Breed.* There was no significant difference in the incidence of infection when such incidence was corrected for the age of the herd. The incidence of mastitis rose and fell in both herds at the same time, but it was frequently greater (and never was less) in the Holstein herd than in the Guernsey herd, thus suggesting a breed difference.

*Age.* The relationship between age and streptococcal infection was not considered further because of previous extensive studies. Any relationship between age and the incidence of mastitis, which must necessarily follow, was obscured by the three outbreaks of mastitis obviously due to factors other than age.

*Milking method.* In general, the herds passed through three periods, so far as the method of milking was concerned: during the first 34 months the cows were milked uniformly and well by hand; during the next 19 months milking was by hand but was increasingly non-uniform and incomplete; and during the last 31 months the cows were milked carefully and uniformly by machine. The incidence of streptococcal infection when corrected for age showed no significant difference during any of these periods. The character of the milking method therefore had no significant bearing on the spread of infection. Two of the three mastitis outbreaks occurred during the period of uniform hand milking and clearly were not associated with the milking method; the other mastitis outbreak occurred in the barn during the winter and toward the close of the period during which hand milking was increasingly non-uniform and incomplete, and was considered to have been brought about by such improper milking. Each of the mastitis outbreaks was known to be due to the greater inflammatory activity of already existing infection.

*Climate and weather.* Because of the general similarity of studies on streptococcal infection and mastitis throughout the world, it was pointed out that climate probably is not of great significance. Weather, on the other hand, as the day-by-day breakdown of climate, was shown to have had no bearing on the incidence of streptococcal infection, inasmuch as there was no seasonal difference. This was also pointed out to mean that flies could have had no significant part to play in the spread of streptococcal infection. However, weather appeared to have played a
definite role in the occurrence of two of the three mastitis outbreaks. These outbreaks occurred when both herds were turned out to pasture in the spring of 1938 and 1940 when the total or accumulated moisture was relatively high, whereas no such outbreak occurred in either herd in 1939 when the moisture was relatively low. It was considered that these mastitis outbreaks were caused either by a direct action of weather, as in chilling, or by an indirect action of weather on the chemical composition of the forage that was consumed.

Sanitation. This was considered on the basis of the every-day use of the term, meaning the erection of “barriers” to the spread of micro-organisms from one individual to another. The cows were housed in modern dairy barns with concrete curbs between stalls, they had ample stall-bed space and were well-bedded, their udders were washed with a solution of sodium hypochlorite 200 p.p.m. (one bucket of solution and one clean cloth for each ten cows during the first 53 months, and a separate clean cloth and clean chloride solution for each cow during the last 31 months), their teats were dipped in clean chloride solution (200 p.p.m.) immediately after milking during the last 12 months, the milkers’ hands were dipped in chlorine solution during the first 53 months and the machine teat cups were so dipped during the last 31 months. It was apparent that this good level of sanitation was unable to stop the occurrence of streptococcal infection, and that the better sanitation practiced during the last 31 months did not significantly alter the occurrence of infection. It cannot be predicted, of course, what would have happened to the herds if the level of sanitation had been more in keeping with that observed in the majority of general farm herds.

Segregation. Segregation, as the separation of a group of cows into those infected with streptococci and those not infected with streptococci within the same barn, was investigated by maintaining an indiscriminate (from an infection standpoint) standing position and milking order in both herds during the first 13 months, by rearranging the standing position and milking order of both herds during the next 21 months according to physical examination of the udder (Udal1 system), and by maintaining this segregation (revised every six months) in the Guernsey herd during the last 50 months at the same time that the Holstein herd was replaced on an indiscriminate basis. Though a distinct separation into infected and uninfected groups could not be obtained by means of the physical examination, a separation into four groups, each of which had a different incidence of streptococcal infection (somewhat of the order of no infection in No. 1 cows, 5.2% in No. 2, 33.2% in No. 3, and 72.8% in No. 4), was accomplished and the cows were milked in this order. It was expected by this means that the occurrence of streptococcal infection would be less during the segregation periods than during the periods when the animals were not segregated. Such was not the case, however, as there was no significant difference in the incidence of infection (after correction for age) between such periods.

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SOME PRACTICAL ASPECTS OF MILK HYGIENE

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Many professions are vitally interested in and concerned with the sanitary production, processing and distributing of a safe milk for the consuming public. All members of these professions must have a wide perspective of the ultimate goal in order that each may best integrate his efforts with all others for insuring the best milk for all. To accomplish this end the veterinary profession and the disease control officials must be ready to advise dairymen accurately concerning all phases of dairy hygiene even though, in general, their contribution lies mainly in the field of disease control and treatment. Above all, if the farmer is to successfully apply the sanitary procedures recommended to him they must be economically sound. Some practical aspects of milk hygiene are presented.

A CITY MILK SUPPLY

The overall picture of a city milk supply is complex, but an understanding of its various aspects is essential to comprehend the far-reaching effects of any advice in milk hygiene given to a dairyman. The milk picture for the city of Lansing, Michigan with a population of almost 100,000 will illustrate a typical setup:

- 10,000 cows producing the milk on
- 1,000 farms, with
- 45 haulers conveying the milk to the
- 10 city milk plants where it is processed, and delivered to the consumer by
- 120 wagons and trucks (100 retail, 20 wholesale)

THE ESSENTIALS OF CLEAN AND SAFE MILK PRODUCTION

The health of the cows and the methods of caring for the cows, the utensils, and the milk on the farm determine the type of milk that is produced. The need for adequate barn and milkhouse facilities and dairy equipment is recognized so no data are presented on these subjects. An appreciation of the influence of each essential item upon the quality of the milk will stimulate the correction of conditions, where needed, to make possible the production of good and safe milk.

1. Clean and healthy cows. The health of the dairy cow is the keystone of a safe milk supply of high quality. The fitness of cattle to produce such milk is determined by their freedom from disease. Under no circumstance should the milk be used if the cattle are obviously suffering from any disease. The data of Table 1 reveal the influence of udder infection on the quality of milk produced for in each case of udder infection the percentage of cattle producing milk with a bacteria count of over 1000 increases greatly.

The influence of the cleanliness of the cow on the bacteriological quality of the milk produced is presented in Table 2. These results indicate the value of either
clipping the long hair on the udder and rear quarters several times a year, by reducing the number of bacteria per cc. from 20,000 to 5,000, or of disinfecting the udder and teats prior to each milking in maintaining the high quality of milk, indicated by the bacteria count of 6,800, as it is obtained from the healthy cow. The best results were obtained when both clipping and disinfecting were done for here the bacteria count of milk produced was only 550.

2. Clean and healthy handlers. The clothes of the handlers should be clean, especially during the milking process, so as to preclude the possibility of them ever becoming a source of contamination. Since the hands have a more intimate contact with milk a study of their influence is indicated. An opportunity presented itself to study the bacteria count of milk produced by hand milking under various conditions; the results are presented in Table 3. In all cases only clean and sanitized utensils were used to handle the milk, thus reducing to a minimum the bacterial contamination from this source.

The bacteria count of milk collected aseptically was normal for healthy cows, 300 and 400 respectively for the two groups of cows. The dry brushing of udders prior to milking was not enough to prevent dandruff and some other debris with bacteria from falling into the milk as revealed by the 16,000 count of milk from the apparently clean cows and 350,000 from the obviously dirty cows. Wiping with

| TABLE 1.—The bacteria count of milk produced by healthy and diseased cows
| The samples were collected aseptically from the cows |
|-----------------|-----------------|------------------|
| **UDDER INFECTION** | **BACTERIA PER CC. OF MILK** | |
| | Per cent with less than 1,000 | Per cent with more than 1,000 |
| None | 95 | 5 |
| Brucella | 76 | 24 |
| Streptococcus | 30 | 70 |
| Staphylococcus | 25 | 75 |
| Coliform | 15 | 85 |

| TABLE 2.—The bacteriological condition of the milk produced by hand milking of apparently clean, healthy cows under varying management conditions
| (A chlorine solution of 300 parts per million of available chlorine was used for disinfection) |
|-----------------|-----------------|------------------|
| **MANAGEMENT CONDITION** | **BACTERIA PER CC. OF MILK** | |
| Hair on udder and rear quarters | Disinfection of udder and teats | |
| Not clipped | None | 20,000 |
| Not clipped | Yes | 6,800 |
| Clipped | None | 5,000 |
| Clipped | Yes | 550 |
water alone removed some of the gross dirt, but the bacteria count of milk obtained was higher, 56,000 for the clean and 425,000 for the dirty cows, than where only dry brushing preceded the hand milking process. Disinfection of the udders and teats although not perfect, resulted in the production of milk with a very low bacteria count; 700 by the clean and 1500 for the dirty cows. The value of clipping and disinfection is obvious from these results. A study of milk borne disease outbreaks reveals the importance of health of the dairy worker.

3. *Clean and sanitized utensils.* Improperly cleaned and sanitized utensils may be the sources of many bacteria and may easily transform a high-quality milk to an inferior or even an unacceptable product. To demonstrate the value of proper cleaning and sanitization rinse counts were made of utensils ready for use as found on the farm. A few days later an unannounced visit was made to each farm. This time the utensils were sanitized with a chlorine solution (50 p.p.m.), allowed to drain for 30 minutes, and were then rinsed with sterile sodium thiosulfate water to inactivate the chlorine that was left. Bacteria counts were made of all of these rinsings to determine the number of bacteria removed by the water; see Table 4. Normally these bacteria get into the milk as the utensils are used during the milking process. These data are convincing evidence of the value of sanitization of all dairy utensils, especially those on the farm. *Clean* utensils have very few bacteria on their surfaces and, therefore, will not contribute many bacteria to the milk handled therein.

4. *Prompt and efficient cooling.* Milk is a good food for bacteria as well as for man and other animals. As it comes from the cow it is of an ideal temperature for multiplication of the bacteria that gain access to the milk. According to the data of Table 5, the practical procedure for dealing with these bacteria is to immediately cool the milk to 50°F or lower and to hold it at that point until it goes to the receiving station.

5. *An adequate water supply that is both satisfactory and safe.* The dairy animals need a constant supply of clean and fresh drinking water if they are to produce at a maximum. A similar water supply is essential for the proper cleaning of dairy utensils and for the cooling and storage of milk. Occasionally the water supply, used for these purposes, becomes contaminated with specific types of bacteria that produce undesirable changes in the milk in addition to being objectionable merely on account of their presence. The ropy milk bacteria come under this category.

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**Table 3.—The bacteria count of milk produced by the hand milking of healthy cows (whose udders had been clipped) and that were either reasonably clean or reasonably dirty when the udders and teats were either dry, wiped with water only, or disinfected (solution of 300 p.p.m. available chlorine or 1 to 1000 quaternary ammonium solution)**

<table>
<thead>
<tr>
<th>APPEARANCE OF REAR QUARTERS AND UDDERS OF COWS</th>
<th>BACTERIA PER CC. OF MILK PRODUCED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collected aseptically from cow</td>
</tr>
<tr>
<td>Reasonably clean</td>
<td>300</td>
</tr>
<tr>
<td>Reasonably dirty</td>
<td>400</td>
</tr>
</tbody>
</table>
A recount of two experiences will direct our attention to some of the aspects of overcoming the ropy milk problem. An outbreak of ropy milk presents the following two characteristics: (1) The milk is normal in physical appearance as it is obtained from the cows, and (2) A tenacity of the contaminated milk, and especially the cream, develops within 12 hours if the milk is not properly cooled. A number of organisms, including some of the coliform group, are capable of causing ropy milk but the main one is Alcaligenes viscosus. The original source is not always known but stagnant water in the barnyard or pasture should be immediately suspected, while the immediate source is usually the coat of the cow or surface water that gains entrance to the well water.

Table 4.—The number of bacteria on dairy utensils

<table>
<thead>
<tr>
<th>FARM</th>
<th>EQUIPMENT RINSED WITH 500 CC. OF STERILE WATER</th>
<th>BACTERIA ON EQUIPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Utensils ready for use as found on the farm</td>
<td>Utensils sanitized with chlorine</td>
</tr>
<tr>
<td>1</td>
<td>1 pail and 1 strainer</td>
<td>28,000,000 1,500</td>
</tr>
<tr>
<td>2</td>
<td>&quot; &quot;</td>
<td>700,000 500</td>
</tr>
<tr>
<td>3</td>
<td>&quot; &quot;</td>
<td>2,000 1,000</td>
</tr>
</tbody>
</table>

Table 5.—The bacteria counts of milk obtained upon the storage of milk at different temperatures for varying periods of time when cooled to those temperatures immediately after production

<table>
<thead>
<tr>
<th>PERIOD OF STORAGE</th>
<th>BACTERIA COUNT OF THE MILK</th>
<th>BACTERIA COUNT OF THE MILK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperature of immediate cooling and storage of milk</td>
<td>Temperature of immediate cooling and storage of milk</td>
</tr>
<tr>
<td></td>
<td>Original count 5,000</td>
<td>Original count 100,000</td>
</tr>
<tr>
<td>40°F.</td>
<td>50°F.</td>
<td>60°F.</td>
</tr>
<tr>
<td>5 hours</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>10 &quot; &quot;</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>15 &quot; &quot;</td>
<td>5,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

In one case studied the milk apparently became contaminated, during milking, from the exterior of the cow. The cows were immediately prevented from gaining access to stagnant water in the pasture where they had gone to keep cool during the summer heat, but the ropy milk trouble continued. A thorough check-up revealed that the farmer always rinsed the stirring rod in the cooling tank between cans and between milkings. Thus the cooling tank water was inoculated from the contaminated milk on the stirrer. As a result of this insanitary practice the cooling tank water became heavily inoculated and through the stirring rod became the immediate source of subsequent contamination of the daily milk. A thorough cleansing and disinfection of the cooling tank and the stoppage of the practice of rinsing the stirring rod in the cooling water overcame the difficulty on this farm.

The second case was very similar insofar as the original source and its elimination
was concerned. The contaminated area was in the poorly drained barnyard. It was dissimilar in that the farmer did not rinse the stirrer in the cooling tank water, yet ropiness appeared rather consistently by morning in his night's milk. On this farm the milkhouse was situated directly over the well which was the source of water used for washing and rinsing equipment and for the cooling of the milk. The cement cover of the well, which was also the floor of the milkhouse, had a crack in it so that water from the milkhouse could seep back into the well. Apparently the milkhouse floor became inoculated with ropy milk bacteria from the farmer's shoes. This inoculum had an opportunity to build up in the well by the daily addition of contaminated water from the floor. Since no chemical sanitizer was used as a final treatment of dairy utensils on this farm and since the dairy detergent did not inactivate the ropy milk organisms the utensils were always contaminated and served to inoculate the milk. To overcome the water-milk utensil-milk utensil washings-floor and well, chain of contamination a new well cover was installed. The working surfaces of the milkhouse and cooling tank were thoroughly cleaned and then disinfected with a chlorine solution. A strong chlorine solution was prepared (1 pound of chlorine powder containing 15% available chlorine was dissolved in five gallons of water) and placed into the well. After one hour the pump was run for 15 minutes to draw this water through the pump and pipes. Apparently this served to destroy the ropy milk bacteria because none could be recovered from the water after this treatment and no more ropy milk troubles were experienced.

SUMMARY

The application of the five essentials to milk production will go a long way toward realizing a safe milk of high quality. They are:
1. Clean and healthy cows.
2. Clean and healthy handlers.
3. Clean and sanitized dairy utensils.
4. Prompt and efficient cooling.
5. An adequate water supply that is both satisfactory and safe.
REPORT OF COMMITTEE ON MEAT AND MILK HYGIENE

A. R. MILLER, D.V.M., Chairman

The meat and milk hygiene interest of the Livestock Sanitary Association is a very real one. Clearly, such an Association has as its objective an economically sound livestock industry in this country. Its concern with the health of animals obviously is not an esthetic one; on the contrary, it is a real, practical awareness that healthy animals are one of the essentials to an enduring, sound livestock economy.

Similarly, its interest in meat and milk hygiene is primarily an economic one. It stems from a realization that the products of an extensive livestock industry which are principally meat and milk, must have ready acceptance by the consuming public. This ready acceptance is best assured when the consuming public has confidence in the wholesomeness and fitness for food of these products.

All animal health programs sponsored by this Association and others interested in the well-being of the American livestock industry have the single objective of bringing to the market an abundant supply of healthy animals. These animals have value only because there is a popular demand for their products. It is to maintain this popular demand that this Association takes an active interest in the methods employed by commercial enterprises such as meat packers and dairy concerns in handling and preparing meat and milk products for the consuming public.

We know that the consuming public will purchase the products of an expanding livestock industry only if it knows that it is buying products that are free from filth and disease and that they have been prepared under clean conditions. The science of meat and milk hygiene has been developed to a stage where, if applied effectively to the processes in the preparation and distribution of meat and milk, it will assure to the consuming public a clean and wholesome supply of these products. While our Association has an interest in the science itself, it is in the application of the science of meat and milk hygiene that our principal concern lies.

Sanitary controls which are the essence of meat and milk hygiene have been applied with a somewhat different pattern in the field of meat distribution than in that of milk distribution. I mean by this, actual inspectional controls over the processes of production by contrast with mere objective controls such as seizures of unfit finished products as they happen to be found in the channels of trade. In the meat-packing industry, the inspection control in the Federal jurisdiction has been adequate for more than 40 years. Generous appropriations by the Congress have made it possible to organize and operate an efficient Federal meat-inspection system. Livestock and meat interests have exhibited considerable concern from time to time in the meat-inspection coverage for meat products from the time they leave federally inspected plants until they reach the consumer, and for the substantial amount of meat which is prepared locally and which does not come within the Federal jurisdiction. Actual inspectional controls of milk production and handling have developed.

1 Chief, Meat Inspection Division, Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture
pretty much according to milksheds. That is, a large consuming center like New York City will, through its power to exclude milk unless it meets its requirements, exercise sanitary control over the production of milk in a large area from which comes the milk supply for that city. Here again the control is limited in its scope. That is, milk which is not prepared for consumption in the particular consuming center is, of course, not subject to the sanitary control.

It is the desire of this Association and all other groups of similar interests to have the principles of meat and milk hygiene apply to all meat and milk and their products distributed to the consuming public in this country. Many obstacles have stood and will continue to stand in the way of attaining this objective. Your Committee has nothing that is new to offer in the way of proposals or plans to accomplish a broader application of the principles of meat and milk hygiene to the products of the American livestock industry. A significant change has been made in the financing of the Federal meat-inspection program during the present fiscal year which may, however, exercise some influence in this direction. Instead of appropriating funds for financing Federal meat inspection as it has in past years, the Congress placed the inspection service on a self-supporting basis by requiring inspected meat packers to pay the full cost of maintaining and operating the inspection. As Federal meat inspection may now be extended to any plant which meets the requirements and is willing to pay the prescribed fees, it is visualized that in time the inspection will be extended to a much broader field than in the past. It may be that this rather unexpected development in the Federal field will, as time goes by, go a long way toward applying adequate sanitary controls to a large portion of the so-called locally prepared meats.

In recent years information of disease occurrence on post mortem examinations conducted in connection with meat inspection has assumed greater significance in the animal disease control field. For example, as the tuberculosis-eradication program progresses to that point where practical eradication has been accomplished, sporadic occurrences of the disease detected on post mortem examinations by veterinary meat inspectors permits tracing the infection to its source, and with the use of conventional eradication methods, prevents the foci of infection from spreading. Similarly, more exact information concerning occurrences of animal diseases as to areas of infection can be had through systematic evaluations of post mortem reports made by veterinary meat inspectors. This is nothing new in the functioning of meat inspection but its value in checking on the effectiveness of any particular animal disease program is being increasingly realized.

The relation of meat inspection to meat grading has received a good deal of attention since the close of the war. As part of the administration of ceiling prices for meats during the last war, it was required that all meats be identified as to grade. This gave considerable publicity to grades of meat, and as a result, the purchaser became quite conscious of the mark indicating grade. These grade designations which were required to be applied to all meats during the war appeared on meat whether or not it had been prepared under inspectional supervision. At the close of the war the Meat Grading Service of the United States Department of Agriculture received a great many requests for its grading service. That organization has promulgated regulations which contemplate that its grade marks appear only on
meats which had received official inspection. This regulation represents a sound policy which gives full recognition to the expectancy of the consumer that the official grade designation carries with it assurance that the meat so identified is not only of a particular grade but it is also wholesome and fit for human food. Also, that it has been prepared from healthy animals free from disease at the time of slaughter, and handled under sanitary conditions.

It is your Committee's recommendation that this Association adopt as part of its policy of meat and milk hygiene that official grades used on products of the livestock industry be applied to those products either by an official grader personally or under his direct supervision, and then only after the product had been prepared under official sanitary controls.

In the marketing of milk and its products I have pointed out that sanitary controls are pretty much limited to inspectional activities organized in centers of milk consumption and applied to the milk shipped to them from surrounding areas. This falls short of an adequate sanitary control for the marketing of milk and its products, first, in that there is considerable lack of uniformity as between milksheds and, second, this control is quite limited in its application. The United States Public Health Service has drawn up a milk ordinance, and a code for the application of the ordinance. This provides material that is available for milk sanitarians so that they may apply recognized control measures uniformly. The International Association of Milk Sanitarians is preparing an ordinance which that Association hopes will be acceptable throughout the country. The real problem remains to so organize the milk control program throughout the country so as to provide an adequate organization locally under the direction of an office preferably at the State level with effective Federal coordination between States. The over-all responsibility for the program and its supervision should not be lower than the State jurisdiction, and it should be so organized that the milk inspectors are subject to State civil service and free from political control. Although such a plan of accomplishing an effective nationwide milk control is practical from the point of view of workability, to actually hope to accomplish such an organization objective in this country with its many separate jurisdictions borders on being visionary. Nevertheless, it is your Committee's recommendation that this Association avoid any compromise which would fall short of an effective plan for applying adequate sanitary controls to the Nation's milk supply.

By way of summary I would like to emphasize that meat and milk hygiene is a very real factor in gaining a universal consumer acceptance for the products of a large and healthy livestock industry, and to this extent, it might be considered as one of the keystones on which a sound livestock industry can be developed in this country. This Association therefore should bend every effort to assist those who are endeavoring to apply effective sanitary controls to the entire meat and milk production of this country.
Outbreaks of hog cholera have been observed from time to time in which the clinical characteristics generally considered typical of the disease in the early stages were not clearly manifested. The course was less acute and the symptoms were less definitely displayed. For these reasons the term sub-typical is being used as a convenient way of describing the course of events that prevailed in these outbreaks.

Before discussing the sub-typical course and symptoms, a definition of the term is in order. Sub-typical, by way of definition, expresses an inferior position of the essential characteristics of a type. Carrying this to the problem before us, then sub-typical hog cholera is hog cholera in which the clinical course and/or symptoms, in terms of their intensity or magnitude, are somewhat below and less definitive of the course and symptoms observed in most outbreaks. In our cases it will be noted that it is the course and symptoms which occurred in the early stages of the outbreaks that are referred to as sub-typical.

To use the term sub-typical presumes that a series of clinical events are recognized as the essential characteristics typical for hog cholera. To this we must affirm.

In many outbreaks of hog cholera one or more pigs become ill and die from one to six or seven days before other members of the herd give evidence of being sick. As a rule, it is not until the client finds several pigs sick before he becomes aware of the fact that a contagious disease appears to be spreading among the members of the herd. Too often the idea still prevails that when cholera strikes in a herd it affects many pigs simultaneously. Thus, if only one or a few of the pigs in the herd are sick, cholera is not suspected. The attending veterinarian seldom has the opportunity to observe the first or early cases, and, unless by careful interrogation, he may never learn that a pig or two was sick and died prior to time his services are requested. From the viewpoint of the client, the duration of the disease, in these early cases, extended over a short period of time. He reaches this conclusion because it was for only a matter of a day or two that he could perceive any definite signs of illness. To the untrained observer a progressing general body weakness, muscle twitchings, quivering characteristic of chills, and the failure to take feed are the indicators of disease. Diarrhea and vomiting are other symptoms he sometimes observes.

The fact is that the duration of the illness was actually longer than the one, two or three days reported by the client. Rectal temperatures of these cases would have disclosed temperature readings of 104.0°F or higher for at least two days previous to the appearance of the more obvious symptoms. Fever is one of the early objective symptoms of hog cholera. Cholera-affected pigs often carry temperatures of 105.0 to 106.0°F for a day or more before other symptoms are displayed. The exception to this is the fact that the total white blood cell count per unit volume

1 Paper No. 617 Miscellaneous Journal Series, Minnesota Agricultural Experiment Station.
of blood begins to decline before the fever starts to rise. This symptom, however, is seldom obtained under general field conditions.

Some outbreaks of hog cholera actually begin with five or more pigs becoming noticeably sick almost simultaneously. We interpret this to mean that whatever the number of pigs sick when first noticed, they all contacted the infection about the same time. Here again, it is the client who first notices that pigs are sick in his herd, and when he finds several sick on any one day, which in his judgment were well the day before, he becomes interested to learn the nature of the illness and is anxious to correct the present condition and to prevent its further spread. In this case as in the former, hog cholera has already progressed two or more days beyond the period of incubation and represents the fourth or fifth day of its clinical course.

Reference has already been made to the importance of rectal temperature in hog cholera. Fever is a characteristic of this disease and rectal temperatures of 105.0 to 107.0°F. are typical. At the same time that the body temperature is elevated, the body often feels cold to the touch, and shivering or chills will be observed. This means that the heat loss by radiation and convection are reduced: the result of peripheral vaso-constriction. Intermittent chills are a very common symptom in hog cholera.

A general physical weakness is a characteristic of hog cholera. This is seldom displayed in the early course of the disease. In fact the pig may have a high fever for one to three days before signs of weakness are noticed. The weakness progresses rapidly after it is manifested, and many cholera sick pigs become prostrate by the sixth or seventh day of their illness. The weaving, wobbling and staggering gait of the posterior limbs in particular is a very characteristic and typical objective sign in this disease.

The loss of appetite or the refusal of food is another characteristic typical of cholera. This symptom, like many of the others, seldom occurs in the early stages of cholera. They may “nibble” or “pick” on feed for a day or two following the signs of physical weakness but subsequently refuse feed entirely. The desire for water continues longer than the desire for feed. The inability to get to water is often conditioned by their extreme physical weakness. Dehydration and emaciation follow the failure to consume water and feed. Dehydration is further effected when diarrhea ensues.

Early in the course of the disease there is a tendency for the pigs to become constipated, and in some cases it persists throughout the course. In most cases, however, a diarrhea sets in about the third day of the gross observable symptoms and continues until death or convalescence.

A fatal terminus is another definite characteristic of hog cholera. Death comes to 90 per cent or more of the pigs affected with cholera where no attempt has been made to interrupt its progress. The course of the disease is usually between seven and ten days.

The over-all picture of an outbreak of hog cholera in a herd is represented by the summation of the history, course and symptoms of the disease among the individuals comprising it. The size of the herd and the environmental conditions, including stable, yard and pasture accommodations and the provisions for feeding and watering, are important factors which have a bearing on the over-all picture. The opportunity for the rapid dissemination of the infection is greatest in small herds and in
H. C. H. KERNKAMP AND R. FENSTERMACHER

herds that are closely confined. The previous vaccinal history on the herd, the freedom from other diseases, and the innate resistance to cholera virus that some pigs seem to possess are also factors which influence the course of the disease in the herd as a whole. There is a tendency to be reluctant about the disease being hog cholera when the history reveals that the sick pigs had already been vaccinated. Many of our sub-typical cases of cholera had a previous vaccinal history.

The outbreaks of hog cholera we were privileged to investigate and which form the basis of this report were consultation cases with attending veterinarians. We are indebted to these veterinarians and their clients for much of the history of the outbreak prior to the time of our visit. A few briefed protocols will illustrate the kind and nature of the outbreaks investigated.

Herd 1; October; 5 brood sows, 69 shoats. The sows were housed and yarded separate from the shoats. Our visit to the farm was 22 days after the attending veterinarian was first summoned to prescribe for Sow A, the only animal sick at the time. She was reluctant to move, ate sparingly and carried a slight temperature. Swine erysipelas anti-serum was administered, but no change in the general condition of the patient was noted. She continued to remain about the same for 14 days at which time her general condition became progressively worse and death occurred 3 days later. The temperature reached 106.0°F. about 7 days before she died and remained at that level until the day of her death. During the 17 days of her noticeable illness, 3 injections of erysipelas anti-serum had been given and two doses of sulfathiazole. The post mortem revealed lesions which were suggestive of hog cholera. Sows B and C sickened 5 days after Sow A was first seen to be sick. The symptoms in these cases were quite similar to those manifested by Sow A in the early stages of her illness, and they continued to be rather vague for about 10 days. After this, the temperature rose to between 106.0° and 107.0°F. They became progressively weaker and began to scour profusely until they died, which was approximately 18 days from the time of their first signs of illness. Nine days after Sow A was found to be sick, Sow D sickened. The clinical course on this sow was comparable to the course in the former cases, and the effort to interrupt its progress with erysipelas anti-serum met with equal failure. She died and at autopsy lesions characteristic of hog cholera were observed. Sow E and three of the shoats became noticeably sick 17 days following the first indications of disease in Sow A. The symptoms and course of the disease became more typical of hog cholera in the later cases.

Herd B; September; 53 shoats. These pigs occupied the same housing facilities and were yarded together in a comparatively small pasture. Thirteen days before the date of our visit, according to the owner, eight of the pigs were slow about coming to the trough for feed. The following day he had to urge some of them to arise from their nests, and then they would walk toward the feeder in a listless manner. The veterinarian was called and temperatures were taken on some of the pigs. No readings greater than 104.0°F. were obtained, and he could find no reason to suspect a respiratory or enteric disease but prescribed an intestinal antiseptic. Two days later eight or ten more pigs were sick. They did not care to eat, they were listless and inactive, but carried no significant elevated temperatures. Temperatures were taken on some of the earlier cases and they were not significant from the standpoint of increased temperature. Although there were no very definite signs of enteric disease, nevertheless the therapy was directed toward this end. The veterinarian
visited the herd for the third time five days after his first call and found about 10 more pigs sick. Many of the early cases showed signs of considerable weakness and when temperatured, readings of 105.0°F. and over were obtained. A diagnosis of swine erysipelas was rendered and the entire herd was treated with the specific anti-serum. No benefit was derived from this treatment. From day to day thereafter, more pigs were coming down with disease and some were beginning to die. With the passing of time the disease more and more began to assume the characteristics of acute hog cholera. The final diagnosis was hog cholera.

Herd 3; September; 235 shoats and feeders. All had access to a large alfalfa pasture, and they were fed a supplemental grain ration in troughs that were moved from time to time to new locations. The watering utensils were not movable. All of the pigs had been vaccinated against cholera by the serum-virus method at least ten weeks prior to the outbreak cited below. The owner reported that on a certain day early in September a pig was found dead near a strawpile. He accepted this as an accidental death and thought nothing more about it. A few days later another dead pig was found, and again he looked upon it as an experience he might expect among so large a herd. After finding two more pigs dead on the following day he sought the assistance of his veterinarian. It must be stated at this point that the labor of carrying out the feeding and watering operations was not done by the owner but by hired help who apparently had no particular interest in the herd and failed to notice any premonitory signs of disease.

Together, the veterinarian and the owner carefully inspected the herd but failed to discover any indications of disease. Since nothing of significance was discovered, it was decided to await for further developments. After a lapse of 3 or 4 days, it was apparent that some of the pigs were not as healthy and vigorous as they might have been. Some of the pigs were not too anxious to partake of the supplemental grain. Their hair coats became coarse and dry. They walked with a slow and somewhat unsteady gait; and when standing, the back was arched with the head drooping and the tail straight and limp. These symptoms became more exaggerated with the passing of time; they became emaciated and dehydrated. Diarrhea was not common, but when it was observed it occurred toward the terminal stages of the disease. The rectal temperatures usually were between 104.5° and 106.0°F. The signs indicative of chills were not uncommon. The clinical course of the disease was seldom shorter than 14 days. Unfortunately no accurate information could be obtained on the duration of the clinical course in the early cases, but apparently it was short.

The long and sub-typical course, plus the fact that hog cholera anti-serum and hog cholera virus had been used as a preventive measure against the occurrence of hog cholera, made it puzzling to those close to the outbreak with respect to the real cause of the disease.

Many more protocols could be included to illustrate what we have elected to call sub-typical hog cholera. It is not intended that the term should come into general use; but instead, if we have focused attention to the fact that all outbreaks of hog cholera do not conform to all the characteristics which typify it nor are the characteristics always displayed with the magnitude and intensity usually described for them, then we will have accomplished what we set out to do, namely: keep hog cholera foremost in mind when dealing with infectious diseases of swine.
A TRANSMISSIBLE GASTRO-ENTERITIS IN SWINE

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During the past 10 or 12 years or perhaps longer there have been observed occasional sporadic outbreaks of a disease in swine having the clinical features of an acute gastro-enteritis. Heavy death losses have been limited to young pigs. The disease also occurs in older hogs. In the older animals the death loss has been quite small as compared with losses in young pigs.

Previously this disease showed little tendency to become widespread. During the past year or two, however, there probably has been an increase in incidence. It has been said that thousands of baby pigs died of this disease in some areas last spring. It is certain that thousands of pigs did die last spring, but there may be reason for a difference of opinion as to what caused these heavy losses. A good many cases of gastro-enteritis have been seen in which the disease failed to recur where sows whose litters had died of the disease were rebred and produced more litters within the year. However, it has recurred on some farms in two or more consecutive farrowings. It has occurred in fall as well as in spring litters. In a few instances what appears to be this disease has been seen in herds of shoats on farms where there were no baby pigs. In one instance a herd of 150 shoats about 4 to 5 months of age became affected. Within a few days apparently nearly every animal in the herd showed symptoms. They had profuse diarrhea, some vomited and many lost considerable weight; none died. Except for the loss of weight, the herd appeared practically normal at the end of 5 or 6 days after the first symptoms appeared. On this particular farm the farrowing period started soon after the herd of shoats had been affected. The new-born pigs died in large numbers showing evidence of gastro-enteritis. In some cases the disease apparently spread from brood sows and pigs to shoats on the same farm, usually without any death loss in the shoats.

The death rate in young pigs is sometimes as high as 80 per cent or higher. The younger the pigs the higher the death rate. In some outbreaks a few sows have died. Usually however, the affected sows recovered in 5 or 6 days with little or no death losses. When sows become sick the difficulty of keeping young pigs alive is increased because milk production by the sows decreases or stops. The most nearly constant symptom of the disease is diarrhea. Vomiting also occurs commonly. In young pigs the bowel discharge is usually greenish or whitish in color. In many cases the ingested milk passes from the bowel of the young pig almost unchanged. The vomitus consists principally of curded milk. In some cases the vomitus also contains bile. The young pig shows rapid dehydration and may quickly become thin. Many of the pigs die within 3 or 4 days after they first show symptoms. Affected brood sows usually have a profuse diarrhea, vomit, go off feed and often lose weight very rapidly. Ordinarily the sows are apparently normal at the end of 5 or 6 days after the first symptoms are noted.

The most obvious lesion of the disease is acute inflammation of the stomach and
TRANSMISSIBLE GASTRO-ENTERITIS IN SWINE

intestine. However gross evidence of inflammation of the stomach and intestine is not always found. The stomach and intestine are frequently filled with milk in cases showing severe gastro-enteritis. Both the small and the large intestine may be affected. The stomach is sometimes a deep cherry-red color. The intestine frequently show marked hyperemia and some hemorrhage in the mucosa. The most nearly constant postmortem finding in young pigs is a large amount of fluid intestinal content having a whitish, yellowish or greenish color. The kidneys usually show degenerative changes and often contain urates. The few affected sows which have been examined on postmortem showed well marked enteritis; and also gastritis in some cases.

The results of research work on this disease done at the Purdue University Agricultural Experiment Station agreed quite closely with what had been observed in the field. These research results indicated that the specific cause of the disease is a filterable agent. This causative agent is readily transmissible from pig to pig by both direct and indirect contact. The incubation period may be as short as 18 to 24 hours. When a naturally affected pig was put with a litter of 8 healthy one-day-old pigs some of the contact animals showed symptoms at the end of 24 hours; and some died during the third day after the beginning of the exposure. All of the contacts were dead by the fifth day. The sow became sick on the third day. She went off feed, had a profuse diarrhea, vomited and lost weight rapidly. On the fifth day after the sow first showed symptoms she was apparently well except that she was gaunt and milk secretion had decreased or stopped entirely. Numerous experiments were made in which the disease was reproduced by placing small amounts of triturated stomach and intestinal wall in the mouths of healthy pigs. Filtrates of these triturates also reproduced the disease. The symptoms and lesions found in experimental pigs were indistinguishable from what were found in naturally affected animals.

While conducting experiments it became evident that this disease can spread rapidly among young pigs kept close together, even where there is no direct contact. Under conditions where a number of litters of young pigs are kept close together, practically all of the animals may become affected within a few days, even when ordinary sanitary measures are used. It was found that the spread of the disease could be prevented by using complete isolation, that is by keeping the unexposed pigs in separate buildings and having them cared for by persons who had no contact with affected animals.

Thus far not much has been learned about the resistance or survival of the causative agent under ordinary conditions. It was found that triturated stomach and intestinal wall from an affected pig produced the disease after being frozen for 70 days.

Penicillin and sulfathalidine were tried to see if they had any preventive or curative effect. No beneficial effect was observed in the one experiment in which these agents were tried.

DISCUSSION

It is apparent that this disease will be a serious threat to swine production if it becomes widespread. As has been mentioned, according to the opinion of some
observers, it was responsible for heavy losses in rather large areas during the spring of 1947. There is no question about its destructiveness in herds where it occurs. The recognition of this disease as a distinct entity should be of considerable value in solving the complex problem of baby pig death losses. Gastro-enteritis, in its typical form, is rather easily recognized by the symptoms, rapid spread and by the lesions found on postmortem examination. Of course there is a question as to what extent the disease occurs in atypical forms. It can hardly be expected that such a disease will always occur in the classical form.

The exact nature of the causative agent of gastro-enteritis remains to be determined. Experimental results show that this agent is capable of passing through filters which retain ordinary bacteria. The manner in which the disease spreads indicates that the causative factor is capable of multiplication or propagation similar to what occurs in living microorganisms or viruses. The shortness of the incubation period would not rule out the possibility of a virus as the causative agent, since some virus diseases are known to have short incubation periods. There are many features, theoretical and practical, of the disease which remain to be determined.

As regards the means of control, isolation is the only method which has given promise so far. If the disease occurs under conditions where a number of litters of young pigs are assembled in a small area, the death losses are likely to be high. In the early part of an outbreak in a central hog house or where a number of individual houses are in a small area, moving sows which have not farrowed out into fields or distant lots may check the spread of the disease. Scattering the farrowing places over as wide an area as is practical should help to prevent serious losses. Visiting of farms where this disease is present should be discouraged. Cases have been observed where the disease was apparently spread by persons going from diseased herds to healthy ones.

**SUMMARY**

A disease recently called transmissible gastro-enteritis has been observed to occur sporadically in swine for several years. The disease has shown itself to be extremely destructive of baby pigs in affected herds. It occurs in older swine, but has not been recognized as an important cause of death in the older animals. Some observers report that the disease has become more prevalent during the past year.

The specific cause is a filterable agent which may remain active for several weeks when frozen.

The disease develops quickly in baby pigs that are exposed to the causative agent; and spreads rapidly if a number of young animals are kept close together. The death loss is frequently more than 50 per cent.

Keeping unexposed litters at a safe distance from affected animals, is at present, the only reliable means known for reducing the spread of the disease.
TYPES OF SWINE ENTERITIS

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The various types of swine enteritis will be reviewed in this report. Those types caused by infections will be considered first. This will be followed by a review of the types of enteritis caused by deficiencies and a brief outline of some of the nutritive requirements of pigs; deficiencies which do not necessarily result in enteritis or diarrhea. It has often been suggested that overfeeding and improper feeding predisposes to enteritis or are sometimes the actual cause. An example is “overfeeding on concentrates.” There is not much evidence in the literature that this is actually the case, hence, these possible causes of enteritis will not be considered. Poisons and toxins that might cause enteritis are excluded also.

Naturally, a review of the literature is rather intricate so that all points may not be entirely clear in a brief consideration of all features. In addition, some points are controversial but an attempt will be made to evaluate these insofar as possible, at the present time. The types of infectious swine enteritis will be considered in somewhat of a chronological order of their discovery.

Enteritis of swine in which Salmonella choleraesuis is the apparent cause has been designated infectious enteritis, necrotic enteritis, “necro,” salmonellosis, swine dysentery, paratyphoid infection, caseous enteritis, and infectious necrotic enteritis. Salmonella choleraesuis infection was first described by Salmon in 1885 and 1886 in his monumental work on hog cholera. This was the first discovery of any of the Salmonella group of organisms and in recognition the genus has been so named. The report of 1885 leaves little doubt but that Salmon was dealing, at least in part, with hog cholera.

In 1894, Smith and Moore reported the results of a further study of S. choleraesuis. It was not until 1903, when de Schmeinitz and Dorset showed hog cholera was caused by a virus, that it was possible to distinguish between the two diseases. It appears that Whiting, Doyle, and Spray (1921) were working mainly with bloody dysentery or true swine dysentery, a distinct disease entity to be considered later. Their description of the disease indicates that this was the case even though they isolated S. choleraesuis from 16 or 23 animals examined. In contrast to this is our experience that S. choleraesuis is rather rare in cases of bloody dysentery. Later Whiting (1924) reported a swine dysentery which was of the bloody type. It is very evident that he was dealing with bloody swine dysentery not related to true S. choleraesuis infection. Those two references are mentioned here because they are usually included with references dealing with S. choleraesuis enteritis.

In 1922, Kinsley described the common type of enteritis which was so prevalent at that time. He employed the name, necrotic enteritis, which was then in general usage. S. choleraesuis appeared to be the cause. Still later Murray, Biester, Purwin, and McNutt (1927 and 1929) and Biester, Murray, McNutt, and Purwin (1927) studied the same disease. They came to the conclusion that the cause was S. choleraesuis and that Actinomyces necrophorus, long under suspicion, was largely
a secondary invader. Their conclusions were based on bacteriological and pathological studies. *S. choleraesuis* was isolated from all cases of the condition which they termed infectious enteritis. When these strains of *S. choleraesuis* were fed to experimental pigs, the disease was reproduced in 100 per cent of the animals and the organism was again isolated from the experimental animals.

Paratyphoid has been reported from many parts of Europe (Hutyra, Marek, and Manninger, 1938). Blount (1933) and Breckett (1934) reported Salmonella enteritis in England, Shanks in Ireland (1939), Hindmarsh, Stewart and Hart (1939) in Australia, and Marshall (1938) in New Zealand.

Levine, Peterson, and Graham (1945) examined 123 cases of swine enteritis. They found that 17 per cent yielded *S. choleraesuis*, variety Kunzendorf, on culture. One hundred and ten serum samples did not agglutinate *S. choleraesuis* in a titer higher than 1:160, which was considered within the normal range, indicating that the animals were not actively infected with *S. choleraesuis*. These authors did not succeed in reproducing the disease with strains of *S. choleraesuis* except when large doses were employed and then only a part of the experimental pigs sickened. Rubin, Scherago, and Weaver (1942) examined the lymph nodes of normal swine. They isolated *S. choleraesuis* from five per cent of such animals. It is common knowledge among those versed in the diseases of captive fur animals that it is dangerous to employ fresh hog livers and tissues of hogs in the feeding of foxes and mink because of the occasional presence of *S. choleraesuis* in the tissues of hogs. Such feed very often results in Salmonella infection or food poisoning. Lovell (1932) studied the presence of Salmonella agglutinins in the sera of normal animals. He found that such sera often contained agglutinins. Titters as high as 1:160 were obtained. Similar findings have been reported from Europe (Hutyra, Marek and Manninger, 1938).

Dale, Meriweather, and Schoening (1944) found a *S. choleraesuis* bacteriophage in swine feces and suggested that this may account for one’s inability to isolate the organism in some instances. Kernkamp (1930) following a common formula, employed a mixture of lye and copper sulfate, barley or oats, and milk or buttermilk in the treatment of infectious necrotic enteritis. In 1942, Cameron (1942) employed sulfaguanidine with good results in the treatment of Salmonella enteritis. He used one g. for each 20 pounds of body weight, four times a day for five days. There were recurrences. In 1943, Kernkamp and Roepke reported good results with the same drug. Sixty-nine per cent of the treated pigs recovered as compared to 16 per cent of the untreated pigs. The dosage was 0.3 to 1.5 g. per ten pounds live weight per day. Graham, Peterson, Morrill, Hardenbrook, Whitmore, and Beamer (1945) employed sulfathalidine. Eighty-eight per cent of the treated animals recovered as compared to 44 per cent of the untreated. The dosage was 0.1 to 1.1 g. per ten pounds body weight for six to eight days. Edmonds (1945) found that sulfathalidine was of value in the treatment of enteritis in suckling pigs as well as feeder pigs.

From what has already been reported in the literature, it is obvious that there is a salmonellosis of swine which may manifest itself in several different forms. Those who have worked with the disease feel very definitely that there is an infectious necrotic enteritis caused by *S. choleraesuis*. Nevertheless, the available information
is often confusing. The term necrotic enteritis itself is one that has caused much confusion. Were it understood that necrotic enteritis is a lesion and not a specific disease entity, a much better understanding would prevail, because it is certain that there are several causes for the lesion. Thus, one reads in the literature that a worker has produced necrotic enteritis experimentally by one method whereas others have done so by quite different means. By inference, one is to believe that in all instances the disease is the same. Actually in each instance, a necrotic enteritis has been produced—a type of lesion has been reproduced which by itself is not a specific disease. Davis and coworkers (1940) produced a necrotic enteritis in pigs which were deficient in niacin. Because the lesions were somewhat similar to infectious necrotic enteritis, attempts were made to show that all cases of necrotic enteritis were nutritional in nature and that Salmonella was a secondary invader. McEwen (1937), Hogan, Johnson, and Cahley (1938), Miller, Keith, Thorp, and McCarty (1943) and others also produced nutritional necrotic enteritis which was not associated with *S. choleraesuis*. Edgington (1942) fed one group of pigs a ration low in niacin or nicotinic acid and placed another group on a high level of niacin. The animals were eventually exposed to *S. choleraesuis*. Both groups sickened about equally indicating that the level of niacin feeding has little to do with the Salmonella infection in swine. These experiments will again be considered under the nutritional types of swine enteritis. Breed (1942) summed up the matter in a simple manner. He stated that there are two types of necrotic enteritis, one is the infectious type caused by *S. choleraesuis* and the other is the nutritional type. According to Breed infectious necrotic enteritis is characterized by a sudden onset, high temperature and inflammation of the lymph nodes, liver and kidneys, while in the nutritional type the onset is slow, without appreciable increase in body temperature, without marked inflammatory changes about the necrotic lesions in the intestines, and without inflammation of the kidneys and lymph nodes. When there is secondary infection, it is understandable that these criteria do not apply.

Bloody dysentery or swine dysentery has been recognized as a specific disease entity for many years. Occasionally *S. choleraesuis* has been isolated from cases of bloody dysentery, but perhaps no more commonly than in the case of normal pigs. Whiting, Doyle, and Spray (1921) were among the first to describe the disease, although there may have been some difficulty in differential diagnosis at that time. Some cases of salmonellosis might have been included in the report. Whiting (1924) again described swine dysentery in a continuation of the above study. One of his illustrations shows what appears to be a vibrio. Bloody enteritis was differentiated from infectious necrotic enteritis at the time Murray, et al. (1927) reported on "infectious enteritis." In this work, mention was made of a "spirillum." Hofford (1936), Wilson (1940), Truax (1941), Steenerson (1942), and Doyle (1943-1945) gave popular discussions of bloody swine dysentery. Doyle (1944) reported that a vibrio was the possible cause of the disease and a year later Doyle (1945) stated that he was unable to transmit "necrotic enteritis" by feeding the tissues of affected animals whereas swine dysentery was readily transmitted by this method. The Indiana workers were able to transmit dysentery when the intestines or feces were fed to experimental pigs but feeding other internal organs did not cause the disease. Filtrates of feces or of the content of the digestive tract did not
cause the disease when fed to experimental pigs. James and Doyle (1947) fed cultures of a vibrio isolated from affected swine to experimental pigs. They found that the cultures alone did not cause sickness but when such cultures were mixed with "gastric mucin," the animals promptly sickened with swine dysentery.

Our experience has been like that of Doyle in that vibrios are very common in the intestinal content of affected swine, and in that the disease is readily transmitted to experimental pigs when feces or intestines are fed. Other viscera or bacteria free filtrates of feces, however, do not contain the infectious agent when judged by the results of feeding experiments. In the isolation of vibrios in pure culture from the feces of pigs we have employed Berkefeld N filters. The vibrios that were isolated in pure form rather readily passed such filters; always did so if given sufficient time. We occasionally have observed that hogs sickened with a bloody dysentery when following feeder cattle, ceased dying when isolated, and again began to sicken when placed with the cattle once more.

*Balantidium coli* has been observed in the intestines of hogs by many workers. In pigs dying of unidentified types of enteritis, it has often been found that some of the animals show a moderately severe infestation with this protozoan, whereas others are entirely free. The parasites may penetrate deeply into the mucosa but with little inflammatory reaction around them. These and similar observations have caused most investigators to conclude that Balantidium rarely causes swine enteritis. Ray (1937) observed hogs that were affected with a rather severe enteritis associated with a watery, blood tinged diarrhea and a heavy infestation with *Balantidium*. There was a heavy death loss. He believed that the Balantidium was responsible for the disease.

One of the more recent reports of swine coccidiosis is that of Novicky (1945). He observed death losses and stunting of pigs on two farms in Venezuela and in a survey of the hogs in that area obtained coccidia, *Eimeria debliecki*, from 27.4 per cent of the hogs. He believed that the losses were due to coccidiosis but that stunting caused by the disease was of still greater importance.

Next to be considered is swine enteritis caused by viruses and virus like agents. Agapov (1940), writing on the etiology of a disease in Russia which he termed swine dysentery, stated that it was caused by a new virus. The disease was either acute or chronic. Temperatures of affected animals were increased to about 41°C. Examination of affected animals revealed hemorrhagic gastritis, sometimes hemorrhagic enteritis, swelling and hyperemia of the mesenteric lymph nodes and petechiae of the bladder and kidneys as in hog cholera. The feces were thin and often contained blood and mucus. Many animals died. Pigs could be infected either by contact or parenteral injection of the virus. There was no cross immunity with hog cholera. Guinea pigs, rats, and rabbits were not susceptible.

Androw (1940) also in Russia, investigated an enteritis in which 400 young pigs either died or had to be killed. When the disease was transmitted by contact, the incubation period was two to three weeks. Ingestion or intraperitoneal injection of bacteria-free filtrates of bowel contents or of the various organs, produced symptoms of dysentery. Although bacteriological examinations revealed a variety of bacteria, it was believed that the disease was due to a virus, primarily. Bacteria that were found were thought to be largely secondary invaders. In 1946, Doyle
(1946) reported a transmissible gastro-enteritis of small pigs which was perhaps due to a virus. There were no outstanding features of diagnostic significance. The feces were somewhat watery and whitish. There was extreme dehydration. Vomiting was common. Older hogs on the farms often showed vomiting and diarrhea from which they soon recovered. A gastritis and enteritis was associated with engorgement of the mesenteric vessels. The disease could be transmitted in series by feeding experimental baby pigs with feces or with filtrates of feces from affected pigs.

For the past few years we have observed a condition in swine that is much like that described by Doyle. In many instances the condition is much more severe in the older pigs than Doyle described. Feeder pigs have often shown a very severe vomiting and diarrhea with a loss of about a fourth of their weight within three to four days. None of the older animals have actually died. The disease appears to be progressively less severe as the animals become older, but brood sows several years old are still susceptible and the condition is especially destructive among the new born when the sows sicken at the time of farrowing. One attack does not cause animals to become resistant to later attacks. Many animals are affected every few weeks. Thus, if the disease is infectious, as indicated below, a single sickness does not result in permanent immunity. The condition persists year after year in large herds, especially when a large number of sows are farrowed over a considerable period of time. It would seem that the disease is maintained by carriers in such large herds. In smaller herds, it often happens that only one pig crop is lost after which there is no more trouble, which indicates that only an occasional animal is a carrier, perhaps, a temporary carrier. In such herds it was possible to move sows yet to farrow to quarters strictly isolated where their pigs survived, whereas sows farrowing in the infected quarters lost their pigs. In addition, sows have been allowed to farrow in isolation where their pigs remained healthy, but when the sows and pigs were again moved back to the original quarters, the pigs promptly sickened with diarrhea and many died. When all animals have been removed from the original quarters in which the pigs were dying, such quarters have been safe for new born pigs within a very few weeks, especially where it has been possible to clean and disinfect such quarters. Bacteriological examination have revealed no bacteria of significance; usually artificial media that has been inoculated with material from affected pigs remained free of bacterial growth. Some of the affected pigs show a little inflammation of the lungs and from such lungs we have been able to isolate a virus which is much like that of swine influenza but still differs from swine influenza virus greatly enough to identify it as a distinct entity. It remains to be demonstrated whether these strains of viruses, three of which have been isolated, are similar to “Ferkelgrippe” (grippe of small pigs) which was described by Waldmann (1936) and by Kobe and Fertig (1938). Investigation of their significance as primary causative factors in relation to other forms of infectious enteritis is desirable also. A similar virus has been reported by McNutt, Leith, and Underbjerg (1946). In this instance, the virus caused arthritis in pigs, and the authors were able to reproduce the disease in experimental pigs. Once isolated in chicken embryos these strains of virus were pathogenic for small pigs and embryos only.

We carried out transmission with much the same success as indicated in Doyle’s
Intestines and intestinal content from affected pigs when fed to a litter of two day old pigs, caused the pigs to sicken within less than 24 hours. The pigs started dying in less than four days and were all dead or had been killed within six days. When a mixture of intestines and intestinal content was triturated in a physiological salt solution and filtered free of bacteria, the disease was again reproduced by feeding a litter of two day old pigs with such filtrate. The disease was carried through still a third litter. Unexposed control pigs of the same age, from sows out of the same group remained healthy. Vomiting and diarrhea, together with rapid dehydration were the common symptoms. Autopsy revealed a moderate enteritis, hepatitis, and nephritis. Gastritis was not at all marked. We concluded that the disease was transmissible, perhaps a virus enteritis. Our observations on infected farms indicated that it was highly contagious.

Whitehair (1947) working with the same or a very similar disease, obtained evidence of the infectious nature of the condition based on transmission experiments. In reporting the disease, he states that inflammation was found particularly in the distal part of the small intestine affecting the mucosa and submucosa. The inflammation was of a less degree in the stomach and large intestines. The known infectious diseases of swine were not found. Sulfathiazole promoted the most response in the way of a curative effect. Vitamins A and C deficiencies could not be associated in a primary way as the initiating cause. Supplements of all the known vitamins included in the B-complex and crude sources of unrecognized growth factors gave no curative response. Wheat and oats in the sow ration aided in the treatment, evidently due to the increased lysine and tryptophane, but was not curative.

It is unfortunate that there is no certain means of differentiating the above transmissible gastroenteritis from the “three day sickness of Hurt (1935–1936–1937–1938–1939) “the acute hypoglycemia” of Graham, et al. (1941), and of Morrill (1946), the “uric acid infarcts” of Madsen, Earl, Heemstra, and Miller (1944), the “toxemia” of Kernkamp and Roepke (1947) and the “baby pig disease” of Young and Underdahl (1947). It would appear that several of these terms apply to the same disease. If there is any relationship to “transmissible gastroenteritis,” it is not yet known, although anything is possible, inasmuch as their cause is not understood. Because of these uncertainties, it seems best to consider this “group” of diseases next. It must be admitted that diarrhea is not always present in every case reported by the above authors.

In a series of papers, Hurt reported a disease with a high mortality in young pigs. No infection was recognized. Because the new born died on about the third day, he termed the condition “three day sickness”. Graham, Sampson and Hester (1941) described a condition of new born pigs which caused a loss of from 5 to 95 per cent. The rations of the sows seemed adequate. Of 23 pigs from eight litters, there was an average of 24.8 mg. of blood sugar per 100 cc. of blood compared to a normal value of 114 mg. in 39 pigs of the same age. Fasting of pigs 12 to 24 hours of age produced hypoglycemia, whereas pigs 120 to 140 hours of age were refractory. The blood studies showed the levels of ketones, calcium, and inorganic phosphorus to be normal. There was nothing distinctive about the symptoms, which were
inactivity, weakness, coma, and death, which took place 24 to 36 hours after the symptoms were first noticed. Morrill (1946) continued the same study and found an increase in the non-protein nitrogen and urea nitrogen of the blood, with almost no glycogen in the liver, whereas normal pigs showed about 5 per cent. Morrill found also a high uric acid content of the kidney with urates in the pelvis and tubules, thus confirming the work of Madsen (1944). Madsen found no infection; the disease, however, occurred usually a little later, at about five days and diarrhea was a common symptom. Urates and uric acid in the kidney pelvis, ureters, and bladder were a prominent feature. Blood sugar values were nearly normal. The findings of Kernkamp and Roepke (1947) were very similar to those of Madsen et al. There are several references in the literature, particularly the older literature, on uric acid infarcts. According to Nieberle and Cohrs (1931), their significance is in doubt. By some, they are even thought to be of usual physiological occurrence.

Finally, Young and Underdahl (1947) reported a condition which they named baby pig disease. An epizootiological study of the condition in a large herd was presented. They found no evidence that nutrition, heredity, and environment played a part in the disease. A theory of reverse anaphylactic shock was presented. It was postulated that the antigen was an undetermined infectious agent.

Grummer (1946) in association with Whitehair (1947) studied the same herd of hogs in which there was a high death loss due to enteritis. His conclusions were as follows:

1. New born pigs are very low in plasma vitamin A, relatively high in vitamin C.
2. Colostrum increases the plasma level of both vitamin A and vitamin C within 24 hours.
3. The plasma vitamin C level for suckling pigs is about .8 mg per 100 cc decreases to .5 mg after weaning.
4. Pregnant sows have a lower vitamin C level than growing pigs. Parturition has no effect on either A or C.
5. The plasma vitamin A level of suckling pigs is about .25γ per 100 cc. This decreases to about 0.15γ after weaning.
6. Pregnant sows have about the same vitamin A level as growing pigs.
7. New born pigs have about 8γ of niacin per 1 cc of blood plasma. This value decreases gradually during the suckling period to about 5γ.
8. Vitamins A and C are extremely variable in growing pigs but niacin is quite constant.
9. The type of digestive disturbance considered causes a rapid and marked decline in plasma vitamin A and C but does not affect plasma niacin.
10. Niacin, biotin, riboflavin, B₆, vitamin C, vitamin A, and vitamin E did not prevent, modify, or cure the digestive disturbance.
11. Pantothenic acid and sulfathiazole, when fed to pigs during the recovery period exhibited a beneficial influence.
12. There is no measurable amount of carotene in swine blood.
13. Sow's colostrum contains about 10 mg of vitamin C per 100 cc.
14. Chlorobutinol and lactose have a stimulating influence on vitamin C in pigs blood.

There are many nutritional deficiencies which manifest themselves in part by inflammation of the digestive tract and diarrhea. Madison, Miller, and Keith (1938)
observed a group of pigs that sickened with diarrhea while on a diet of corn, oats, wheat middlings, tankage, a little skim milk, and pasture. The animals made a remarkable recovery when fed niacin. Before administration of niacin 40 out of 76 had died. The authors termed the disease “swine pellagra.” They were convinced that the disease was one of niacin deficiency. It should be noted that a lack of niacin was one of the first deficiencies to be recognized as a cause of enteritis and diarrhea in pigs. Also in 1938, Hughes showed that hogs required niacin. In the same year Chick, McCrae, Martin, and Martin (1938) observed that pigs sickened when on a ration consisting largely of corn, and that the addition of niacin to the ration had a curative effect. Continuing this work, the same authors (1938) fed two pigs white corn, pea meal, purified casein, cod liver oil, and a salt mixture. Both pigs developed a severe diarrhea from which they recovered within 24 hours when injected with niacin. Davis, Freeman, and Madsen (1940), Davis, Hale, and Freeman, (1943) and Davis and Freeman (1940) found that pigs on a common swine ration developed a necrotic enteritis that could be cured with niacin. In their early report these authors tentatively concluded that niacin deficiency predisposed to S. choleraesuis infection. This again raised the question whether or not S. choleraesuis could cause a necrotic enteritis independently. Many believed that S. choleraesuis entered the picture only in cases of deficiency, that all cases of necrotic enteritis were due to a primary lack of niacin. Later the same authors found that niacin had little effect on a necrotic enteritis caused by S. choleraesuis. Animals on a satisfactory level of niacin made better gains after recovery than did those on lower levels. In contrast to this, they found that sulfaguanidine helped to prevent and cure S. choleraesuis necrotic enteritis, while niacin prevented and cured the necrotic enteritis caused by the specific deficiency. Hughes (1943) reported that the minimum requirement of niacin for pigs was 5 to 10 mg per day for 100 pounds of weight. Wintrobe, Follis, Alcayaga, Paulson, and Humphreys (1943) observed no diarrhea in pigs on a ration “free” of niacin and felt that the niacin requirement of hogs needed re-evaluation, however, there was the possibility that the ration fed by Wintrobe and co-authors was rather high in tryptophane, which in the light of Krehl’s work might explain these contradictory results. Krehl (1945) demonstrated a sparing interaction between niacin and L-tryptophane. Worden and Slavin (1944) found that a pellagra producing ration caused a necrotic enteritis but the skin remained in good condition. They also demonstrated the absence of known pathogenic organisms in such animals. Four per cent brewers yeast prevented the condition in control pigs.

Regarding niacin, Powick, Ellis, Madsen, and Dale (1947) reached the following conclusions in their experiment:

The mean effect of absence of nicotinic acid from an otherwise adequate diet consisted in a highly significant depression of growth, a conspicuous impairment of appetite with high incidence of diarrhea, high mortality, and a high incidence of necrotic lesions of the colon and cecum.

Occasional animals appeared to thrive with no nicotinic acid while others appeared to vary in their requirement. The level of nicotinic acid required for optimal growth appeared to be between
0.6 to 1.0 mg per kilogram live weight per day for growing pigs between the age of three and nine weeks. . . Studies failed to disclose a simple method of diagnosis.

A deficiency of pantothenic acid in pigs also causes a diarrhea. Hughes (1942) fed a ration deficient in pantothenic acid and found that the animals lost their equilibrium, showed incoordination, often fell, and "goose stepped." The feces were watery and sometimes bloody. Later in the same year Hughes and Itner (1942) found congestion, hemorrhages and ulcers of the stomach and intestines of deficient pigs. Wintrobe and co-workers (1943) also noted the abnormal gait of pantothenic acid deficient pigs. A diarrhea was always present in such animals as well as poor growth, anorexia, and alopecia.

Swine require riboflavin but apparently a deficiency does not always result in diarrhea. Hughes (1940) found the daily requirement to be a minimum of 1 to 3 mg. per 100 pounds live weight. Wintrobe (1943) observed a diarrhea in pigs that were deficient in riboflavin but this was a multiple deficiency since the animals were also deficient in pyridoxine. Later Wintrobe, Buschke, Follis and Humphreys (1944) continued the study of riboflavin deficient pigs. The animals showed an abnormal gait, dermatitis and lens opacity.

Hughes and Squibb (1942) found that a diarrhea developed in pigs which were deficient in pyridoxine. The pigs also showed convulsions and anorexia. In experiments conducted by these authors the daily requirement for young pigs was not more than 5 mg. per 100 pounds of weight. Wintrobe and co-workers (1943) observed diarrhea in pigs deficient in pyridoxine and riboflavin.

The work of Krehl (1945) has already been mentioned. He found that 50 mg. of l-tryptophane or 1.0 mg. of niacin per 100 g. of ration completely prevented growth retardation in rats, caused by 40 per cent corn grits in a low protein ration. He suggested a sparing interaction of each of these materials for the other. Whitehair (1947) observed that wheat and oats in the sow ration aided in the treatment of the diarrhea of swine in which he was interested. He believed that such benefit was due to the increased lysine and tryptophane in the ration but pointed out that such feeding was not curative. Luecke, McMillen, Thorp, and Toll (1947) studied the relationship of niacin, tryptophane and protein in the nutrition of the pigs. They found that supplements of 0.2 g. of d, l-tryptophane daily cured severe enteritis occurring in 8 to 16 week old pigs on a corn ration containing 14 per cent protein. Hughes, Crampton, Ellis, and Loeffel (1944) stated that a lack of thiamin causes diarrhea in pigs. Earlier work of Hughes (1938) suggested that vitamin B', thiamin, was needed for the pig.

A deficiency of vitamin A also causes diarrhea in pigs. In 1928, Hughes stated that a lack of vitamin A resulted in reproductive failure, incoordination, and impaired vision. Guilbert, Miller, and Hughes (1937) found that the minimum physiological requirement of vitamin A for pigs was 18 to 24 I.U. per kilogram of body weight per day. They also stated that a mild deficiency of vitamin A predisposed to diarrhea in the young. Benham (1943) showed that vitamin A level of suckling pigs depended on the intake of the sow. In Norfeldt's (1944-45) experiments, vitamin A deficient sows gave birth to normal sized litters but the pigs were weak. Many of these soon died. A prominent symptom was diarrhea.
There are still unrecognized substances that are required by pigs. A deficiency of these substances results in diarrhea. The case is well stated by McRoberts and Hogan (1944). New born pigs were placed on a purified diet containing all the known water soluble vitamins together with all the other known elements needed for pigs, yet the pigs developed a severe diarrhea within 24 hours of the start of the experiment. Water extracts of yeast and liver prevented the disease. Thus such extracts apparently contained the unrecognized vitamins required by the pigs.

Wintrobe (1939) found that when small pigs were placed on a purified diet containing all the known vitamins and food elements together with yeast, the animals died. Diarrhea was a prominent symptom. The diet was satisfactory after the pigs reached 4 to 5 weeks of age.

Hughes and coworkers (1928) reported that swine did not require vitamin C. He kept hogs on a vitamin C “free” diet for three generations. The experimental animals remained healthy as did the controls. Wintrobe and coworkers (1944) reported that swine do not require inositol or p-aminobenzoic acid. Cunha (1946) produced biotin deficiency in pigs when desiccated in egg white was fed. McRoberts and Hogan (1944) reported that swine do not require vitamin E, vitamin K, choline, biotin, inositol and p-aminobenzoic acid in the ration.

For the “recommended nutrient allowances for swine” the reader is referred to the report of Hughes, Crampton, Ellis, and Loeffel (1944). The report includes an excellent list of references.

In summary, it may be said that a partial list of the types of enteritis and diarrhea is as follows:

**Enteritis caused by infection:**
1. Infectious necrotic enteritis caused by *S. choleraesuis*.
2. Swine dysentery evidently caused by a vibrio.
3. *Balantidium coli* enteritis?
4. Enteritis caused by coccidia.
5. Transmissible gastro-enteritis possibly caused by a virus.
6. Virus enteritis of Russia.

**Enteritis or diarrhea caused by deficiencies:**
1. Vitamin A deficiency.
2. Thiamin deficiency.
3. Riboflavin deficiency.
4. Niacin deficiency and tryptophane deficiency.
5. Pantothenic acid deficiency.
6. Pyridoxin deficiency
7. Deficiencies of unknown water soluble substances found in liver and yeast.

**Enteritis or diarrhea of unknown cause:**
Perhaps many diarrheas of new born pigs.

For direct and indirect assistance in compiling information, the authors wish to thank C. K. Whitehair, R. H. Grummer, G. K. L. Underbjerg, and C. A. Brandly.

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REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES OF SWINE


The Committee on Transmissible Diseases of Swine considers the following three conditions as major problems of the swine industry: hog cholera, transmissible gastro-enteritis of pigs, and the enteritis complex. The preceding papers upon recent developments in relation to these disease problems were arranged in hope that they would help livestock sanitarians in combatting these diseases.

A questionnaire was forwarded to all state livestock sanitary officials. These were filled out and returned from 44 states. They revealed many interesting facts. (We thank these officials for their cooperation.)

The incidence of hog cholera increased during 1947, in only 4 of the states reporting and none of these are in the major swine producing area. Thirteen states reported no change in the incidence of this disease and 27 experienced a decrease. Most of the principal swine raising states were included in the latter group.

Swine erysipelas was diagnosed officially in 31 states during 1947. Its incidence increased in 9 states, remained unchanged in 16 and decreased in 11. It is worthy of note that Nebraska, one of the first badly infected states, showed a decreased incidence of this disease. However, some other major swine producing states experienced an increase. One state raised the question of the danger it faced in allowing the importation of purebred animals from swine erysipelas infected areas. Evidence of infection had followed a few such importations.

Only 12 states have specific or general regulations for the control of swine diseases associated with enteritis. No distinction is made as to the different kinds of enteritis in swine in 28 states. In states where a distinction is made, it is based on the cause and/or clinical findings.

Death losses in baby pigs were considered an important factor in 28 states. Transmissible gastro-enteritis in baby pigs was recognized in 12 states and 2 others made a tentative or questionable diagnosis of this disease.

Improper husbandry, including bad management, housing and sanitation, were listed by 32 states as a primary cause of death losses in baby pigs. Listed also as important causes of such losses were nutritional disturbances, improper feeding of the sow during gestation and lactation, pig anemia, intestinal disorders, including infections and so called transmissible gastro-enteritis. Hypoglycemia, pneumonia, navel infection, rhinitis, brucellosis, vesicular exanthema, parasites and injuries account for most of the other losses.

Only one state listed an anaplasmosis-like disease or icteroanemia as an important disease. However, it is the opinion of the committee that this condition is becoming more widespread and deserves careful consideration in the future.

In answer to the question, "Is anything being done to control swine brucellosis in your state?", 12 officials answered, "Yes," and 15 indicated that individual
effort on the part of swine raisers was being carried out to control the disease on their premises although no state-wide program was in effect. One state reported 6 swine herds as brucellosis accredited and about 50 herds being tested with the idea of becoming accredited.

Respiratory diseases have been especially prevalent in Midwestern swine during 1947. In many cases the mortality was high and frequently the economic loss was considerable before the surviving animals were back on feed. Pasteurellosis and streptococcic infections have been common complicating factors.

A few swine droves have been reported where *Brucella bronchisepticus* (commonly associated with respiratory infections in the canine species) was found to be the primary cause of trouble. Extensive losses were experienced in some of these cases where young pigs were involved. Chronic lung complications seemed to prevail. A diagnosis depends on the isolation of *Brucella bronchisepticus* from the affected pig.

The control of transmissible diseases of swine is an increasingly important problem. Too little is known about the cause and prevention of many swine diseases and little work is being done to correct this lack of information. The committee recommends that more attention be given swine brucellosis control and that veterinarians take more effort to identify causative factors of swine diseases by use of diagnostic laboratory service. Also, that these laboratories direct more attention toward the identification of the causative factors involved, especially, in respiratory and intestinal infections of swine.

The swine industry in the United States ranks second in livestock values. To help protect these values, this committee also recommends that the U. S. Livestock Sanitary Association use its influence to promote increased research in transmissible diseases of swine.
Mr. Chairman, Gentlemen: I can assure you that this is a great honor for me to be able to attend this very, very important meeting in Chicago. I am very much indebted to Dr. Simms for having made it possible for me to be present here.

I have had a most unique opportunity not only to see this wonderful International, but I was afforded an opportunity to be present at the meeting of your Deans of Faculty, and also at the meetings of the Animal Research Workers.

Sir, I would be very much indebted if you could allow me just one or two moments.

I would like to stress one or two points—matters that were actually raised in this meeting.

Now I feel, sir, that we should establish closer contact. We are today within two and a half days flying either with South Africa or with America. We have naturally very difficult problems, and it is essential for us to contact the workers in America where far more intensive research work is being carried out.

I am convinced that our disease conditions and that our very severe climatic environment stresses points which may be of tremendous importance to you in your research work. May I perhaps cite one or two instances?

The problem of infectious anemia of equines is one. We had a very severe outbreak in 1930. I have been very closely associated with Sir Arnold Theiler, the late Sir Arnold Theiler, in the study of that disease. We were of the opinion at that time that that disease was introduced by the carrier; and that all our cases that occurred were in artificial infection for experimental purposes. The disease has died out in spite of the fact that these animals were continually in very close contact with biting insects, flies, etc. Now, is there a carrier? What is the transmitting agent?

Another important feature I would like to bring to your notice is this problem of dipping. You have here your decholeraators. With our dipping over an extensive area in South Africa, for East Coast Fever, one might also say for the last 40 years along the coastline of South Africa—and more or less very much confined—we find today an arsenic-resistant tick.

It doesn't matter whether you use 5 dectapin or 7 dectapin—you cannot eradicate that tick; and as I indicated to you, sir, it is very much confined.

That has given a stimulus to research work in connection with other dips; and over the last three or four years we have been using, extensively, DDT, benzine-hexichloride; and these two dips conjointly with arsenic. And I can assure you that the results are so promising that a time may come that we may perhaps exclude arsenic from the eradication of some of our ticks. We cannot do that at the present moment because there are certain drawbacks.

In the first place, it is a question of expense.

The second is the question of tests for these dips. You know that in connection with our arsenic dips we have the laboratory test; we have field tests; and that is one of the big drawbacks at the present moment.
Sir, in listening to your discussions I have been stimulated. I have gained a tremendous amount of information in this country. The only thing I am sorry about is this: That I haven’t the time to visit these various colleges with which I have made contact.

There is one thing that I would like to stress, and I think you have these difficulties in the states: People are of the opinion that the animal is a machine. A virus is found; a bacterium is found; a protozoa is found—now, produce your vaccine.

Gentlemen, I think our research work, especially in recent years, has shown us, in studying structure and function, that our knowledge, not only with us but also with the medico, requires a tremendous amount of overhauling and very intensive research.

When we, for instance, take today the question of sterility, the problem of the changes that are brought about in the Endocrine system. Recent work completed in the Union of South Africa showed, with delayed breeding you establish, you produce in the pituitary very, very vital lesions; and when we produce these pathological conditions we gain a great deal of information as regards the normal structure and normal function.

I feel, sir, that the time has come—and that is what we are more or less trying to adopt in South Africa—for teamwork on a considerable scale with all our problems—not only the veterinarian, the pathologist, but also the chemist and the physio-chemist, and the animal husbandry officer.

Mr. Chairman, Mr. Secretary, Gentlemen: I once again wish to thank you for this wonderful opportunity offered to me by the Chief of the Bureau, your counsel, sir, and the deans of the various faculties, for this very unique opportunity offered me.

South Africa has been in the limelight to a very great extent within the last few years, and perhaps if I might just recall one story, and that is that of a South African farmer who expressed the opinion that the Book of Genesis is not quite correct—and that the ten plagues did not take place in Egypt but in South Africa.

Thank you, Mr. Chairman.
REPORT OF THE COMMITTEE ON POLICY


Your Committee on Policy begs to report that there have been no recommendations referring to policy received by the Committee during the past year.

Your Committee, however, in view of the fact that there is a definite scarcity of food throughout the world; that the U. S. will have to produce an increased quantity of food; that the loss of animals from disease is enormous and that the veterinary profession with the cooperation of growers of livestock can greatly reduce this unnecessary loss, recommends:

1. That a special invitation be extended to all persons interested in disease control and animal and poultry production to join the U. S. Livestock Sanitary Association and to enter into its deliberations.

2. That in our programs a reasonable time be set apart for discussion of papers presented in which all may participate.

3. That it be the definite policy of the U. S. Livestock Sanitary Association to assist in the development of veterinary service and build up disease control departments within the various states and that special attention and assistance be given for the construction and maintenance of diagnostic laboratories.
REPORT OF THE COMMITTEE ON COMMUNITY AUCTION SALES

C. E. Fidler, Chairman, Springfield, Ill.; G. E. Botkin, Indianapolis, Ind.; Justin Cash, Kansas City, Mo.; D. C. Hyde, Columbus, Ohio; William Moore, Raleigh, N. C.

With the well established and extensive operation of community auction sales, definite disease control problems are presented:

1. Adequate control of community auction sales by individuals, licensing, bonding, and veterinary supervision;
2. Adequate, consistent regulations governing the passage of animals through community auction sales to purchasers whereby livestock disease spread may be controlled;
3. The installation of qualified veterinarians for the supervision of the sanitation and general operation of the community auction sale.

It is the attitude of the Committee on Community Auction Sales, previously expressed, that the control of a community auction sale rests in the legislation requiring proper licensing and adequate bonding whereby the community auction sale becomes accountable to the livestock sanitary official of the state in which it operates for its conduct in the sale and transfer of animals from one owner to another and whereby, by adequate bonding, the person or persons entering into transactions with the community auction sale are protected against fraud, and that adequate and complete records of all transactions be maintained and available.

Recommendations of the Committee in this regard have been as follows:

1. That community sales laws should provide that they operate under bond, which must be completed and filed before the issuance of license;
2. That the law require that the grounds and buildings of a community auction sale be adequate, maintained in good repair, and in a good state of sanitation at all times;
3. That records be kept by the community auction sales operator, upon the premises of the establishment, such records being held open for inspection by all police officers or officials at all reasonable times, and retained and preserved for a period of at least two years, such records to include name and address of the consignor, a description of the property which in the case of livestock should include kind, approximate age, sex, and any ear tag numbers, brands, or other identification, the method by which the property was delivered to the community sale and, in the case of property delivered by motor vehicle, the name of the operator, the make of the manufacturer and the state license number of such vehicle, the name and address of the purchaser of said property, the price for which the property was sold or exchanged, and the commission or other fees charged by the community sale.
4. A transcript of such record should be filed weekly, monthly, or periodically with the sanitary livestock official.

The sale barn licensing law should also provide for the installation and maintenance of competent veterinary supervision of the sales barn grounds and quarters.
and general activities. Particularly should the veterinary supervision apply to the passage of animals through the community auction sale, beginning with the state of repair and sanitation of all barns, yards, and equipment, the inspection of all animals upon their presentation to the community sale to determine the existence of any disease at the time of their presentation, the isolation of visibly sick animals, the separation of animals to be sold for immediate slaughter from those that are being returned to the farm, the application of all tests as required by regulations to determine the eligibility of animals for transfer through the community auction sale and their association with other animals. Also, all vaccinations and inspections, cleaning and disinfecting of all trucks or vehicles employed in the transportation of animals to and from community auction sales.

The veterinarian employed to inspect and supervise community auction sales should be duly licensed and accredited and approved by the livestock sanitary official of the state in which he resides, and should at all times be under the direct observation of the state livestock sanitary official. For the best performance in veterinary inspection and supervision of community auction sales, it is felt that the veterinarian so employed and installed in a community auction sale should be an employee of the state Division of Livestock Industry and his salary paid by the state. To provide funds for the payment of veterinarians' salaries, it is suggested that the license fee of community auction sales be increased to provide all or as much as possible of the salary of veterinarians employed for the inspection and supervision of community auction sales; the community auction sale licensing law further providing appropriate and adequate penalty for failure to observe provisions of the law.

The above represents the opinion of the Committee on Community Auction Sales.
FIELD CONTROL EXPERIMENTS WITH BRUCELLOSIS IN SWINE

L. M. Hutchings, B.S., D.V.M., M.S., Ph.D.

Unfortunately proposals for the control of swine brucellosis cannot be substantiated by the vast experience which accompanies proposals for the control of bovine brucellosis. There are no official recommendations, rules or regulations for the control of swine brucellosis that have been tried on a statewide or nationwide basis. In fact livestock sanitarians, veterinarians, and owners have been prone to ignore the effects of swine brucellosis. Interest and demand for the control of this disease of swine has only recently been forthcoming. For the most part the practicing physician has not recognized that undulant fever may be transmitted to humans from swine as well as from the milk of infected cows. Undulant fever caused by *Br. suis* has long been known to be one of the serious hazards inherent in those occupations where direct contact between man and swine is inevitable. This disease is just now being recognized in official quarters as an occupational, compensable disease.

Investigators, who have been cooperating in a study of this disease, have recently drawn up a set of recommendations to be submitted to the committee on brucellosis of this Association. The adoption of these recommendations would be a step in the right direction although the final answer to swine brucellosis control is probably a matter for the future.

The published works on control of swine brucellosis are scarce. Connaway, Durant and Newman (1) reported that swine brucellosis could be eradicated from any herd by blood testing, isolation of infected animals and proper disinfection of the premises. Their results with live culture vaccination led them to consider the use of live culture vaccines as a hazardous procedure. Hadley and Beach (2) recommended a program of test, isolation of reacting sows and vaccination of the open, negative sows. Craig (3) outlined a general control program which entailed grouping the sows in small groups in an effort to prevent spread. He was the first to mention segregation of the pigs from the infected sows at weaning time.

Project 1046 (swine) (4) sponsored by the Department of Animal Pathology and Hygiene of the University of Illinois is a swine brucellosis control plan which provides for blood testing, slaughter of reactors or isolation from the herd, disposal of aborting sows, disinfection of the premises, and eventual accreditation of the herd.

McNutt (5) stated that measures which apply to control of brucellosis in cattle are applicable to swine. The United States Department of Agriculture, Bureau of Animal Industry (6) present suggestions for control of swine brucellosis based on test and slaughter or isolation of reactors and separation of pigs at weaning time.

At the present time there are no vaccines which have received the sanction of investigators. Manthei (7) was unable to show any merit in the use of Strain 19

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1 Published as Journal Series Paper No. 320 of the Purdue University Agricultural Experiment Station. These studies were supported in part by a grant from the Bureau of Animal Industry, Agricultural Research Administration, U. S. Department of Agriculture.
as a vaccine for swine brucellosis. His results with a low virulent strain of *Br. suis* showed a better protective power, but the effects were transient and the virulence of this live culture of *Br. suis* for the human was questionable. Hence the control of swine brucellosis seems to fall of necessity into the category of some form of test and eradication of the disease.

Several difficulties play a major role in control efforts for swine brucellosis. Among these difficulties are the lack of interest on the part of some veterinarians, the task of obtaining suitable blood specimens for testing, the relative inaccuracy of the agglutination test for the individual animal, and the management practices inherent in swine raising.

Many qualified veterinarians are reluctant to draw blood samples from swine because it is time consuming and the pressure of other duties is great. Others report an inability to obtain the samples. Swine blood does not stand shipment well, and may hemolyze when due care has not been taken in obtaining and caring for the samples.

From experimental studies of the last seven years, it is known that the standard agglutination blood test as now applied is adequate as a herd diagnostic procedure but may not be sufficiently reliable to base judgement on the infection status of the individual animal. Thus it is obvious that, with present methods, control resolves itself into a herd problem rather than an individual animal problem. This fact alone is highly important since control of this nature presents innumerable difficulties for any sanitary official when rules and regulations covering the interstate or other movement of swine are involved. In other words there is relatively little precedent or experience on which to base official rules and regulations governing interstate movements of animals when control is conducted on a herd rather than an individual animal basis.

Management factors contributing to control difficulties are numerous. The large numbers of swine in a herd, the prolificacy of sows, the community boar, the widespread use of the sale barn, and breeding for two litters a year all have an effect on the control of swine brucellosis.

During the past five years, field control experiments have been conducted in connection with the research program on swine brucellosis at Purdue University. The following herds and data are presented for your consideration in connection with swine brucellosis control.

Herd No. 1 is a purebred Berkshire herd which had a history of infection for two years prior to the time control efforts were started. An initial complete test of 215 animals (80 sows and boars, 135 weanling pigs) showed 67.5 per cent of the sows and boars to be reactors or suspects. Since only seven of the 135 weanling pigs were showing any agglutination titer it was decided to keep the negative pigs separated from the infected parent stock and test the pigs once per month up to breeding time.

This plan was rigidly followed until November of 1942 when the herdsman felt it necessary to bring the infected parent stock into the same barn with the clean gilts for breeding. Between November 1942 and January 1943 infection appeared in the clean gilts and some observed abortions resulted. In view of this failure to maintain the established segregation, it was decided merely to follow the agglutination response and history of this herd for a year before attempting any further
control. The percentage of infection remained relatively constant during this interval. No serious abortion rate was observed, but sterility in sows and orchitis in boars and the birth of weak litters were noted. No special effort was made to separate the pigs from the sows at weaning time and many of the pigs became infected with the exception of one group which was isolated at eight weeks of age.

In August, September and October of 1944, late spring and summer pigs were weaned at eight weeks of age, tested, and separated from the infected parent stock by removal to clean grounds and houses. This separation was followed by monthly testing for three months and then tests were made at irregular intervals up to the present time. Since October 1944 no reactors have been found in the pigs raised from this herd. All of the infected breeding swine were disposed of for slaughter by the late spring of 1945. The blood lines have been maintained. The results of tests on this herd are presented in Table 1.

Herd No. 2 consisted of 155 purebred Hampshire sows and boars. This herd was located on premises where commercial hog production had been maintained on a large scale for 30 years. In this 30 year period the owner stated that about six to eight sows aborted at each farrowing time. Orchitis and adhesions between the testes and scrotum were evident in young boar pigs at the time of castration. Such history strongly suggests that brucellosis had been present in this commercial herd, but had never seriously curtailed the enterprise. The owner had been ill for a number of years with an obscure type of malady which a physician had later diagnosed as undulant fever. With the change to a purebred herd in 1941 a few abortions were seen and the owner's son decided to investigate the cause. On the initial test in November 1942 only 16 of 155 breeding swine showed any significant agglutination titer. With this low percentage of reactors and suspicious animals it was decided to dispose of all 16 reacting swine and test the remainder of the herd plus some additional summer gilts once per month. Circumstances prevented the first monthly retest, but two months later there were 16 reactors and suspects in the 216 breeding animals tested. These reactors were promptly removed. Illness of our personnel prevented further testing in this herd until July 19, 1943, at which time there were 84 reactors and suspects in 101 swine tested. Thus the test and slaughter method, based on agglutination tests of individual swine, had failed under the conditions existing in this herd. These animals had farrowed in the meantime with relatively poor results as judged by litter size and livability, but only one definite abortion was observed.

It was then decided to rebreed these infected sows, separate the fall pigs from the sows at weaning time, and conduct no further tests until the pigs were about breeding age. This plan was in agreement with some recommendations for control being advocated at that time. As can be seen in Table 2 this failed since of 82 gilts and boars so separated in the fall of 1943, 50 were reactors or suspects in the spring of 1944. It should be pointed out here that the recommendations for separation of the pigs from the infected sows and removal to clean ground were not followed, as the sows were removed from the pigs at eight weeks of age and the pigs were left on the original ground where they were farrowed. This could be an important cause of the failure.

The original infected breeding stock was still present on this farm and had been
CONTROL EXPERIMENTS WITH BRUCELLOSIS IN SWINE

rebred for a late spring farrowing in 1944; so it was decided to test, wean, and separate the negative pigs from the infected sows and put the pigs on clean ground. This was done with the results that no positive reactors have been found among the pigs.

TABLE 1.—Results of agglutination tests conducted on Herd No. 1

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<th>DATE</th>
<th>BREEDING STOCK</th>
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<td>86</td>
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Pos. indicates complete agglutination at 1:25 dilution or above.
Sus. indicates incomplete agglutination at 1:50 dilution, but no complete agglutination at any dilution.
Neg. indicates completely negative agglutination at each dilution.

since September 1944 and no positive reacting swine have been found on this farm since the original infected brood stock was disposed of in the summer of 1945.

From our observations the economic loss attributable to brucellosis in this herd other than inability to sell breeding stock, was due to the high percentage of sterility in infected sows, small litter size and poor livability of pigs. During the 1943 spring breeding season 37 of the first 100 sows and gilts bred had failed to conceive.
Now that brucellosis is not present in this herd the owner reports that sterility or difficult breeding are much less noticeable than formerly.

Herd No. 3 was referred to our department after the local veterinarian had conducted the original herd test. This herd was composed of purebred Poland China swine. The initial tests in September 1945 showed 33 of 41 yearling boars, five of 26 yearling gilts and 15 of 22 older swine to be reactors. Thus this herd showed 59.5\% reacting animals. Posterior paralysis due to spondylitis was present in one sow and Br. suis was isolated from this sow at the time of autopsy. The yearling boars were castrated and isolated together with the infected sows and put on a separate pasture with other fattening swine. The owner was desirous of attempt-

### Table 2.—Results of agglutination tests conducted on Herd No. 2

<table>
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<tr>
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Totals: 98 | 42 | 1312 | 51 | 22 | 695 | 2220 |

Pos. indicates positive agglutination at 1:25 dilution or above.
Sus. indicates incomplete agglutination at 1:50 dilution, but no complete agglutination at any dilution.
Neg. indicates completely negative agglutination at each dilution.
CONTROL EXPERIMENTS WITH BRUCELLOSIS IN SWINE

ing to salvage some of the yearling gilts so an additional test was made on the 21 negative gilts after an interval of three weeks. This second test showed eight more reactors among the 21 gilts. It was decided to keep 12 of these 13 negative yearling gilts, and purchase, subject to test, six additional gilts and 14 sows, and to wean, test and segregate the fall pigs from the infected parent stock despite their rather advanced age, which was 9 to 11 weeks. Segregation facilities were not too desirable, but a start was made. It will be noted from Table 3 that some pigs reacted at weaning time and although they were removed promptly, additional reactors occurred periodically on subsequent tests. The negative yearling gilts, purchased gilts and sows remained negative after breeding until they were put together in a field adjacent to the young pigs in February of 1946. Then, as shown by the test conducted on March 26, 1946, a serious spread had occurred as evidenced by agglutination reactions in all groups of swine on this farm. Thus the procedures followed in this herd had failed to control brucellosis.

After the spring farrow of 1946, the pigs were weaned at eight weeks of age, tested, and the negative pigs placed on clean ground. No reactors have occurred in these pigs to date.

In this work all blood samples were drawn from the anterior vena cava, a hypodermic syringe and needle being used as described by Carle and Dewhirst (8). The

### Table 3.—Results of agglutination tests conducted on Herd No. 3

<table>
<thead>
<tr>
<th>DATE</th>
<th>BREEDING STOCK</th>
<th>FIGS</th>
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<td>4/22/47</td>
<td></td>
<td>64</td>
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</tr>
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</table>

Totals . . . . | 25 | 23 | 725 | 33 | 15 | 415 | 1236 |

Pos. indicates complete agglutination at 1:25 dilution or above.
Sus. indicates incomplete agglutination at 1:50 dilution, but no complete agglutination at any dilution.
Neg. indicates completely negative agglutination at each dilution.
### Table 4.—Natural transmission from weanling pigs

<table>
<thead>
<tr>
<th>NO.</th>
<th>AGGLUTINATION AND BLOOD CULTURAL RESPONSE</th>
<th>POST MORTEM BACTERIOLOGIC FINDINGS</th>
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<td>-- --</td>
<td>PT--</td>
</tr>
<tr>
<td>384</td>
<td>-- --</td>
<td>-- --</td>
</tr>
</tbody>
</table>

- indicates no agglutination.  + indicates complete agglutination.  P indicates partial agglutination.  T indicates trace of agglutination.

Pos. indicates positive bacteriologic results for *Br. suis*. 
serum samples were tested by the standard agglutination procedure, using both the rapid and test tube methods. The antigens used were prepared and furnished by the Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture. The tests were conducted in dilutions of 1:25, 1:50, 1:100, 1:200 and 1:400. Interpretation of the agglutination test results was rigid. Any animal reacting positively at the 1:25 dilution or above was considered a reactor. Incomplete reactions at the 1:25 and 1:50 dilutions were considered suspicious.

Some workers have thought that the testing of pigs at weaning time was an unnecessary procedure since they felt that the young, unbred gilt pigs and sexually immature boar pigs, even if infected, did not present a serious problem in the transmission of brucellosis to other pigs. Recent evidence accumulated at the Purdue Agricultural Experiment Station indicates that the young, infected pig is a source of spread of brucellosis. In Table 4 are shown the results of exposing five non-infected pigs to five naturally infected weanling pigs by pen contact. It can be readily seen that the disease was transmitted to these non-infected pigs as demonstrated by both the development of agglutination titers and the finding of Br. suis at postmortem.

The policy of using the agglutination test as a herd diagnostic procedure rather than to use the test to base judgement on the disease status of individual animals has also been criticized. The results presented in Table 5 which show the effect of using the standard agglutination test in an attempt to salvage negative animals from an infected group of gilts indicates that the agglutination test is not too reliable when applied to individual swine. It can be readily seen that the removal of 16 reactor gilts from the 65 gilts tested did not result in any beneficial effects in establishing a clean group of gilts. The next test conducted 30 days later showed an additional 19 reactors in the 49 gilts which were negative on the original test.

### Table 5—Results of agglutination tests conducted on Herd No. 4

<table>
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<tr>
<th>DATE</th>
<th>BREEDING STOCK</th>
<th>FIGS</th>
<th>TOTAL TESTS</th>
<th>REMARKS</th>
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<td>49</td>
<td>65</td>
</tr>
<tr>
<td>10/10/47</td>
<td>12</td>
<td>8</td>
<td>29</td>
<td>49</td>
</tr>
<tr>
<td>Totals...</td>
<td>21</td>
<td>15</td>
<td>78</td>
<td>114</td>
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</tbody>
</table>

Pos. indicates complete agglutination at 1:25 dilution or above.
Sus. indicates incomplete agglutination at 1:50 dilution, but no complete agglutination at any dilution.
Neg. indicates completely negative agglutination at each dilution.

DISCUSSION

The herds reported on here and other herds form a part of the research program being conducted at Purdue University on swine brucellosis. No herds are taken
into the program without the cooperation of the local veterinarian and without an
appreciation of research on the part of the owner. This freedom of action is taken
so that as much experimental evidence as possible may be gathered. It may be
noted that procedures were changed at times in all three of these herds and that at
least two types of control were attempted in herds Nos. 2 and 3. It is obvious that
our objective was not necessarily immediate control, but was to learn as much as
possible about control and the pitfalls to be expected. As the field work progressed
additional experimentation in our and other laboratories naturally suggested
changes in methods or reasons for failure of methods under observation.

From the history and data presented on these three herds of swine, it seems ap-
parent that valuable blood lines may be maintained and negative replacement gilts
and boars can be produced from infected parent stock by the separation and testing
of pigs from their infected dams at weaning time. Considerable attention must be
paid to maintenance of segregation. Clean premises must be provided for the
newly weaned pigs, and enough testing must be applied to the clean group of pigs
to remove any latent infection which may be present.

Experimental evidence accumulated by Hutchings, Delez and Donham (9) and
Cameron and Carlson (10) indicates that the agglutination test is adequate as a
herd or group diagnostic agent, but may not be sufficiently reliable for diagnosis of
brucellosis in the individual animal. The results reported here tend to substantiate
this opinion which was originally developed from controlled experiments with in-
fected swine maintained in our own experimental herd. For example, of 170 swine
of all ages experimentally exposed at Purdue, 25 (14.7%) yielded cultures of *Br.
suis* from their blood 5 to 69 days prior to the time that a diagnostic agglutination
titer was demonstrated in the blood (11). Such findings, along with unsatisfactory
results in controlling the disease in the field by use of a test and slaughter pro-
cedure, have suggested that when infection is present to any appreciable degree the
entire breeding herd should be considered infected and handled as a unit rather than
to attempt to salvage negative reacting aged swine from among the positive swine.
Test and salvage of negative breeding swine failed in herds Nos. 2, 3 and 4 as re-
ported in this paper.

Ultimately, however, after the positive herd has been segregated for some time it
may be possible to salvage some individuals. Cameron (12) has reported: "valu-
able individuals may be salvaged from a positive unit when the unit is being dis-
posed of . . . a residual low titer remains in many of these animals, but incomplete
unpublished data, supported by the findings of McNutt indicate that they are not
spreaders. . . . According to these data an animal that previously reacted at a
higher dilution but which now had a 1:25 titer would be much less dangerous than
one completely negative in an infected or unknown herd." Thus the disposal for
slaughter of all valuable breeding stock may be inadvisable in some instances when
adequate segregation can be maintained for a prolonged period. Such procedures
were not attempted in the herds reported here because high prices had not been paid
for the breeding stock and the financial aspects were not of primary concern to the
owners.

According to this study and that of Cameron and Carlson (13) many pigs farrowed
and nursed by infected sows are not infected at weaning time. Our results indicate
that it is advisable to wean the pigs by eight weeks of age, test all the desirable pigs and place the negative ones on clean ground. The longer the pigs remain with the infected sows and on potentially infected premises, the greater is the risk of such pigs contracting brucellosis. Weanling pigs have been shown to be susceptible and if not segregated early may become infected. In substantiation of this statement, note the results of failure to isolate the pigs on clean ground in Herd No. 1 during 1943 and 1944 and Herd No. 2 during the fall of 1943. It is also interesting to note the results of failure to isolate the boar pigs on clean ground in Herd No. 1 during this period. Repeated isolation of Br. suis from the semen of six of these boar pigs has been reported in another paper (14). Cameron (12) has further shown that such segregation of pigs should be maintained because as he says: “The basis of the unit-segregation system is, first, the efficiency of the test when applied to a group; second, the breaking of the chain of infection from infected sow to bred gilt, and from aborting gilt back to the resistant, but potential spreader sow.”

The tendency for infected swine of all ages to recover, insofar as cessation of agglutination reaction and symptoms are concerned, may tempt one to believe that pigs may be readily immunized by procedures comparable to those now in use for cattle. However, two sobering considerations should be kept in mind, first, swine are a serious source of undulant fever and second, both natural and experimental exposure and reexposure studies with swine have indicated that although abortions may not occur frequently upon reexposure, many swine do become reinfeected and are potential spreaders of brucellosis to other swine and to the human (12 and 15). The turnover in swine is rapid and a clean herd may be established within a period of one year. The economic loss caused in swine by brucellosis is apparently much less serious than in cattle. In view of these factors, it seems more logical to attempt control by means of test, segregation of pigs, and eventual disposal of the infected herd.

GENERAL RECOMMENDATIONS

The need for a uniform program for swine brucellosis control must be emphasized. This program should be such that there is a possibility of nationwide adoption. It would seem logical that such a plan could best arise from the United States Livestock Sanitary Association and the United States Bureau of Animal Industry. Acceptance of a plan by these bodies would tend to promote uniformity and acceptance by all the states and should result in at least a measure of control.

Such a program should clearly present information concerning prevention as well as actual details of control. The pitfalls and failures should be dealt with as well as the reasons for each step in the plan. It has been our experience that owners are prone to cooperate in any disease control plan provided they are made aware of the reasons behind the proposals. Hence much effort should be made to educate the owners as well as the state control officials and veterinarians. In fact all agencies which have an influence on thinking of farmers should be brought into a cooperative educational program. It would seem necessary to incorporate in the educational program both swine brucellosis and bovine brucellosis control despite differences in procedure. In other words we must face the fact that brucellosis control is our ultimate objective irrespective of the species involved.
SPECIFIC RECOMMENDATIONS

**Prevention.** The most important preventive measure is to prevent the introduction of infected swine into a brucellosis free herd. This is best accomplished by purchasing replacements or additions from herds known to be free of brucellosis. In the event such is not possible, each addition should be tested and no animal showing an agglutination reaction in any degree should be accepted; replacements from herds of unknown history should be kept in isolation for at least three months and retested before entry into clean herds is permitted. The practice of assembling a swine herd from many different sources is dangerous. It is safer to purchase fewer animals from one source, if possible, and thus lessen the chances of purchasing an infected hog which is not reacting to the agglutination test. Herd sires should be purchased well in advance of breeding time in order that at least two blood tests with an interval of one or two months can be made prior to breeding time.

Community boars are not conducive to brucellosis control. The practice of loaning boars to a neighboring herd should be discouraged because of the danger of infection being spread both ways. Show swine may spread or contract brucellosis while at fairs and shows. Such swine should be held in isolation upon their return before entering the main herd.

Purebred owners should be encouraged to sell breeding stock only from herds completely free of brucellosis as evidenced by *entire* herd tests. It is known that negative reacting groups of breeding swine from infected herds have been offered for sale. These animals may spread brucellosis although they are negative to the blood test at the time they are offered for sale.

It may be that the most important action that this body could take would be to encourage all swine breeders to know what they are doing before they make a sale or a purchase. The agglutination test and isolation are valuable in this connection.

**Control procedures.** Since neither test and immediate slaughter of reactors nor vaccination have been satisfactory in the control of swine brucellosis the following two plans of control are presented for consideration:

**Plan 1. Sale of entire herd for slaughter.**

This plan is useful in herds, large or small, where the primary consideration is the production of pork. It is quick, easy, and economical. An interval of 3 to 6 months may be necessary to dispose of the entire herd, feeder pigs and all, and to clean and disinfect the premises and equipment. Replacement of the infected herd should be from herds free from infection. Periodic blood tests should be conducted on the newly purchased herd as a means of detecting infection that might be resident about the premises. Brucellosis is primarily an animal to animal contact disease hence early detection of animals that may become infected from the premises is essential to the entire replacement herd.

**Plan 2. Test, segregation and delayed slaughter of infected herd.**

The details of this plan are:

1. **Blood test the entire breeding herd.**
2. **If infection is present consider the entire herd as infected rather than remove the positively reacting animals. Manage the herd as a unit.**
3. **Raise pigs from this infected unit. Wean and test the pigs at eight weeks of age. Isolate the negative pigs on clean premises as far removed as possible.**
from the infected parent herd. Maintain this isolation until the infected parent herd is disposed of.

4. Blood test the pigs up to and during the first pregnancy. Remove all reactors as they may occur. Breed only gilts which are negative to the blood test to non-infected boars.

5. Dispose of the original infected herd as soon as it is obvious that the plan is giving satisfactory results.

6. Premises where the infected herd was kept should be cleaned and disinfected thoroughly prior to admission of the clean replacement herd.

This plan provides for the raising of negative pigs from the infected parent breeding stock in such a manner that clean replacements of known blood lines are available. Ultimate disposal for slaughter of the original infected herd is necessary, but is delayed until the quality, quantity, and the disease status of the pigs is known. This plan avoids the necessity of purchasing replacements from unknown sources and also aids the breeder in maintaining desirable blood lines.

Plan 2 has been used under experimental field conditions and has given satisfactory results. It is the method of choice for purebred herds or in herds where improved blood lines have been developed even if the ultimate objective of the owner is pork production rather than the sale of breeding stock.

The time of disposition of the infected herd will depend upon whether the “one litter” or “two litter” system is employed. Naturally the “two litter” system will be more difficult since numbers of swine alone will tend to complicate control. A decrease in numbers of breeding swine is advisable in Plan 2. In either the one or two litter system it is necessary to maintain complete, permanent segregation of the infected parent swine from the weaned and tested offspring.

Plan 2 does not necessitate complete cessation of swine production at any time during the operation of the plan, but the chances of success are enhanced if the size of the herd is reduced during the period of segregation.

The writer recognizes that nowhere in these recommendations has the use of vaccines been advocated. It is my opinion that until such time as a vaccine may be developed, which is not infectious for the human, and which has been demonstrated to have real merit that this body should not go on record as advocating the use of vaccine. The above recommendations have been tried on limited scales and have been workable as well as advantageous in the control of swine brucellosis, but do not present a panacea or effortless method of control.

**SUMMARY AND RECOMMENDATIONS**

Control procedures for swine brucellosis are described and discussed. Results are presented on the use of test and slaughter of reactors and on test and segregation of pigs from the infected breeding stock, the same herd being used as its own control. The results indicate that a system of test and segregation of negative pigs from the infected parent stock furnishes a satisfactory method of control. This system is based on the use of the agglutination test as a herd diagnostic procedure and the usual absence of infection in many pigs at weaning time.

Control efforts directed towards the eradication of swine brucellosis have not received much attention. So far as we know, there are no official plans of control in any of the states of the United States nor any federal plans of control.
REFERENCES


The control of bovine brucellosis or Bang's disease, has been a major problem confronting those interested in livestock sanitation, for more than 30 years. Vast amounts of painstaking, detailed research have been conducted, and we now have more accurate and definite knowledge pertaining to this great animal plague than nearly any other disease of domestic animals. No claim is made that we know all the answers, or that further research is not indicated, but by using the knowledge of brucellosis which we now possess, we have demonstrated beyond question that herds may be freed from this disease and maintained free year after year, and we have also found that by applying the same procedure to all herds in a township or county, the disease can be eliminated therefrom. In spite of our knowledge and our demonstrated ability to control brucellosis, our progress in eradicating this disease from the United States has been discouragingly slow. It seems necessary that we take stock at this time and try to determine why we have failed to carry this project through with the same success which has characterized our campaigns against other diseases, many of which present more baffling problems than does brucellosis.

The records of the United States Bureau of Animal Industry show that the first organized effort to eradicate bovine brucellosis on a nationwide scale, was started in 1934. During the fiscal year ending June 30, 1935, 3,317,760 cattle were tested disclosing 11.5 per cent infection. More cattle were tested each succeeding year and each year showed a steady decrease in the percentage of infection until 1941, 7,465,254 cattle were tested under a Federal-State program, disclosing only 2.4 per cent infection; up to that point, a most remarkable and successful campaign. On the other hand, since 1941 each year has shown a decrease in the number of cattle tested under the Federal-State program, and an increase in the incidence of infection, until in the year ending June 30, 1946, the last year for which figures are available only 4,876,866 cattle were tested disclosing 5 per cent infection, practically as high as was disclosed in 1937, two years after the plan was initiated.

What happened in 1941? For one thing a war came along with all the disturbance of domestic activities which that implies; the resulting shortage of personnel, high prices for livestock and a tremendously increased and uncontrolled movement of cattle, all increased the difficulty of efficient administration of disease control regulations. Another disturbing factor that cannot be ignored is that in December 1940, the United States Bureau of Animal Industry reported results of experiments with brucella abortus vaccine, Strain 19, and recommended that this product be used in problem herds as an adjunct to other methods of control. As announced by the Bureau, the use of this vaccine offered additional ammunition in the battle against brucellosis, but in all too many instances, it has not been, and is not now being used as recommended.
Time does not permit going into detail as to the reasons for the use of brucella abortus vaccine in numerous instances where it cannot be justified in the light of our present knowledge. Misleading advertisements by commercial interests quoting phrases of reports by Bureau and State research workers and control officials out of context are largely responsible. Also the natural desire of cattle owners and veterinarians to adopt an easy and painless method of reducing losses in individual herds by adopting procedures so glowingly advertised, losing sight of the goal of eradication, have contributed to this unsound practice. Whatever the cause or causes, it is undeniable that the unsound and uncontrolled use of brucella abortus vaccine, a product of great value and assistance in the control program when properly used, has been the principal cause of the serious slow-down of the control of brucellosis since 1941. Furthermore, it is the opinion of this writer, that State Livestock Sanitary Officials, the United States Bureau of Animal Industry and leaders in the field of livestock sanitation, represented by organizations such as this, must assume the principal responsibility and bear the blame for the present state of confusion into which we have allowed the control of brucellosis to deteriorate.

In too many instances we have temporized and hesitated—listening to the same old arguments used by those who have always been opposed to disease control. The same reasons that were advanced for the delay and discontinuance of our campaigns against tuberculosis and other diseases, have been resurrected in slightly modified form and are now being used by the same forces against a continued orderly plan of brucellosis eradication. We have too often failed to face the issue squarely and courageously and to express what we as sanitarians know to be the truth, that there is no easy and round about way to win the fight against this greatest enemy of American animal health, but that it can be won by uncompromising, direct attack which is the only way we have ever eradicated or satisfactorily controlled any disease in this country.

Our hesitation and indecision has produced results which might have been expected. How else can we explain action taken by state legislatures and regulatory bodies in recent years? By what manner of reasoning can one justify the course now followed in some states allowing animals known to be infected with this devastating, easily transmissible disease, to go unquarantined and even unidentified, to enter channels of trade without restriction, spreading their loathsome infection high and wide as they go? I cannot conceive of any group of livestock growers advocating or legislative bodies enacting such provisions had we had the courage to place the facts as demonstrated by research and experience, squarely before them. Nor would such deleterious laws have been enacted had there been available, a plan based on rational sanitary principles and backed by this Association, the disease control officials of the various states and the United States Bureau of Animal Industry.

It seems to me that we have now arrived at a point where the livestock industry and the veterinary profession must definitely decide whether we are to continue our efforts to eradicate bovine brucellosis from the United States, or whether we are to resign ourselves to living with this enemy indefinitely, as we now live with hog cholera, as the Europeans live with foot-and-mouth disease, carrying on a hap-
hazard guerilla warfare as we have done in recent years. In making this decision, the following facts cannot be ignored:

1. Brucellosis or Bang’s disease causes more economic loss to the livestock industry than any other disease of livestock now existing or that has ever existed in the United States. It is transmissible to human beings, causing more human suffering and inefficiency than was ever caused by bovine tuberculosis.

2. We know the disease can be eradicated with the knowledge now in our hands and both the livestock industry and the general public are demanding that something be done.

3. We have set our hands to the wheel with complete eradication as our goal and to now discontinue our efforts, would be an admission of failure which I do not believe either the livestock industry or the veterinary profession can afford or can even survive if we are to remain leaders in the field of control of diseases of domestic animals.

If we decide to reaffirm our faith in ourselves and to perform our duty as livestock sanitarians, what course must we take to regain the ground lost since 1941, and to carry the campaign forward to a successful conclusion? In my opinion, the following procedures are fundamental.

1. We must stop patting ourselves on the back for past accomplishments in the control of tuberculosis, tick fever, glanders and dourine, and realize a new game has started, and that it is essential that we quit fumbling the ball around and passing the buck to one another. We must realize the serious nature of this disease and develop a program which we can all get behind and through concerted teamwork, carry through to a successful conclusion.

2. We must develop a plan based on sound time-tried sanitary procedure which includes searching out and finding every animal affected with the disease, and the elimination of such animals at the earliest practical moment; in the meantime identifying the diseased animals and restricting their movement by proper quarantine.

3. We must keep in view our ultimate goal of clean herds and eventually clean areas, and must not be deviated therefrom by those pessimistic individuals who claim the job is impossible, or perhaps those persons selfishly interested in delaying the program, offering temporary relief from the losses caused by the disease without much thought to its eventual eradication.

4. We must use all the knowledge which we now possess in developing a program of eradication using known procedures, including testing to disclose the diseased animals, proper disposition of these animals, vaccination of susceptible animals where indicated and proper herd management and sanitation, giving each step its proper place, and above all determining the part vaccination should play and confine its use to that role.

5. We must concentrate our efforts in such a way that our money and energy is not dissipated. This involves eradicating the disease from one area at a time, adopting such means as are necessary for protecting clean areas as the disease is eradicated, and going on from there to extend our efforts to other areas, preferably those adjoining, until this plague is eradicated from our country.

6. We cannot ignore the existence of the disease in areas where our efforts are not being intensively exerted, but must provide encouragement and assistance so
far as possible to individual owners in such areas who desire at their own expense, to maintain their herds free from disease and to prevent so far as possible, an increase of the present incidence of the disease in such areas until funds and personnel are available to initiate intensive eradication programs therein.

In Minnesota, we are following this program. The Area Plan is the basis of our control. A law providing for this program was enacted by the 1939 Legislature and we now have 29 of the 87 counties in the State which have adopted the Area Plan of control. Twenty-one of these counties have now been declared Modified Accredited Bang’s Disease-Free Areas; six are in the process of accreditation and two counties are on the waiting list. Petitions are being circulated in additional counties at this time.

We believe that any campaign for the eradication of disease under the Area Plan must be based on a law requiring all livestock owners to submit their livestock to the necessary examination and tests in order to determine where the disease exists, and to enable the sanitary officials on whom the duty is imposed to carry out the eradication procedures to adopt and enforce such regulations as are necessary to protect the area once the disease has been eradicated or reduced. While the Area Plan as conducted in Minnesota, was based originally on the plan which has proven so successful in the control of tuberculosis, we have realized that brucellosis like all other diseases presents an individual problem, and the State law and the rules and regulations providing for area control have been amended from time to time as experience has shown desirable, because of these differences in the character of the disease and as new developments have been disclosed by research and experimentation.

In the eight years in which this plan has been in effect in Minnesota, a number of interesting facts have been disclosed. First, we have found that the percentage of infection in our State is much lower than was anticipated. The highest infection disclosed in any county tested to date, was 4.8 per cent cattle infection disclosed in 28 per cent of the herds. In other words, when the testing was first started in this badly infected county, nearly three-fourths of the herds and 95 per cent of the cattle were free from the disease before the work was started. We believe the greatest value of Area Plan of control and the first duty of those administering such plan, is to exert every effort to protect this vast majority of herds already free from brucellosis.

We have further found that nearly four-fifths of the infected herds, 78 per cent to be exact, have been freed from the disease within the first year of testing and retesting, and have remained free thereafter. About 13 per cent of the infected herds we have found to be what we term semiproblem herds, where reactors appear from time to time on retests, but in which the incidence remains low. Most of the infection disclosed in these herds can be attributed and traced to improper herd management. Less than 10 per cent of the infected herds which is from 1 to 2 per cent of the total herds in any county, have we found to be real problem herds. In these herds, the infection is active and highly virulent, spreading rapidly from animal to animal. When an owner of a herd which falls in this category, feels that he must maintain a fairly constant number of cattle, either to meet milk quotas or for other reasons, he adds cattle to these herds as rapidly as the reactors are removed.
The most efficient means of eradicating the disease from such a herd would be to ship the entire herd for slaughter and establish a new herd. This is of course impractical in most instances under the present plan of the State and Federal Governments for the payment of indemnity, although it is sometimes followed by an owner who is genuinely interested in eradicating the disease from his premises. If an owner of one of these problem herds considers it necessary to make replacements each time reactors are removed, and is unable to wait until the disease has been controlled as shown by at least two successive negative tests, we believe the best alternative to complete elimination of the herd, is the temporary retention of the reacting animals together with the vaccination of calves in order to produce resistant replacements and to eventually establish a negative herd. If the calf crop in such herds is too small to produce sufficient replacements as rapidly as desired, owners are urged to purchase calves under vaccination age and to vaccinate them after arrival on the premises.

I realize this procedure at first thought appears to be contrary to the principles of sound disease control. In my opinion, however, it is one of the modifications indicated by the character of the disease with which we are dealing, and at least until the disease is brought well under control, presents a method of overcoming one of the really difficult problems with which we are faced.

When reactors in these few problem herds are eliminated after each test and replacements made of negative animals, new fuel is added to the fire month after month, resulting in a high percentage of abortions. These recently infected animals are probably much more dangerous as spreaders to both other animals and man, than the reactors which have overcome the most violent symptoms of the disease. Furthermore, when all reactors are sold for slaughter following each test, there are no restrictions placed on the herd between tests other than the infected herd quarantine established on all herds in which reactors are disclosed. This quarantine restrains the herd to the owners' premises but no provision is made for further protection to neighboring herds. Also owners disposing of all reactors to each test have a sense of security which is not justified in these badly infected herds and often fail to take such steps as may be possible to protect themselves, their families and their employees which they are advised to do when known reactors are retained on the premises.

Our experience in Minnesota has disclosed another most interesting phenomenon. We have found no greater percentage of the infected herds found on retests of counties for reaccreditation, which become problem herds or in which the disease has become excessively virulent, than we find in the initial tests in such counties. This observation is, I believe, quite important and contradicts the statement so often made, that when a herd is once free of the disease, the owner is in more danger of heavy losses should the disease gain entrance, than he had been before the disease was eliminated. In other words, the proverbial "powder keg" is somewhat of a myth.

Perhaps the most important observation pertaining to the area plan of Bang's disease control, is the effect of this plan on human health. In the calendar year 1946, the State Department of Health reported undulant fever from 72 of the 87 counties in Minnesota. Of the fifteen counties in which no cases were reported, 12 were Modified Accredited Bang's Disease-Free areas and two counties were in the
 process of accreditation. From only one county which had not adopted the Area Plan of control were no cases of undulant fever reported. Further, in 1939 before the Area testing got under way in Minnesota, the cases of undulant fever in human beings reported from the 21 counties which have since that time been declared Modified Accredited Bang's Disease-Free areas, represented 13 per cent of all the cases reported in the State. In 1946, after the disease in cattle in these same counties had been reduced to less than one per cent, the human cases reported from these 21 counties represented 3.73 per cent of the cases reported in the entire State. Still more striking, is the fact that each and every case of undulant fever reported in 1946 from counties in Minnesota which have adopted the Area Plan of Bang's disease control, have a history of exposure, either through contact or the consumption of dairy products, to the very small percentage of infected herds remaining in these counties.

In Minnesota, since 1942, all Bang's disease testing by State and Federal personnel has been carried on in counties which have adopted the area plan of Bang's disease control. We have not, however, forgotten the other counties in our State and have encouraged in every way possible, the establishment of Bang's disease-free herds, short of furnishing veterinary personnel for conducting the tests. Indemnity is paid for reactors disclosed in such herds when the owner adopts the Certified Herd Plan of control and our State law requires the testing of all female cattle and bulls over six months of age sold for purposes other than immediate slaughter. Even following this procedure, we have spent more public funds for the payment of indemnity in the counties which have not adopted the area plan of control than for the testing and indemnity combined in the counties which have adopted this plan. I believe, however, the expenditure is justified as we can in this way keep the incidence of brucellosis within bounds until the area plan can be extended. This fact brings up another point which is often overlooked. As the area plan is extended, payments of indemnities drop and without question, the total cost of periodic testing if and when the area plan is extended over the entire State, will be materially less than the present cost of indemnity payments in the counties where now only haphazard testing is conducted.

SUMMARY

1. We must decide soon whether we are to continue our efforts to eradicate Bang's disease or if we are to live with this insidious enemy of livestock and human beings indefinitely.

2. If we are to proceed with control, with eradication as our goal, it is imperative that a definite program backed by state regulatory officials, livestock breeders and veterinarians, with the United States Bureau of Animal Industry leading the way, must be determined upon and followed by all agencies concerned. This program must include the proper place vaccine shall play in the control program and enforceable regulations set up governing such use and the distribution of this product.

3. We must discontinue temporizing with this great animal plague, realizing we have a serious disease of both domestic animals and human beings to contend with and adopt a program similar to those which have been successful in the past in dealing with other diseases of domestic animals.
4. We must concentrate our efforts on areas of such an extent as our funds and personnel permit, using every means at hand in such areas to eradicate this plague and extend these areas as rapidly as possible, realizing that in doing so, the eventual expenditure of public money will be less than under the present haphazard methods employed.

5. We must encourage in every way possible, cattle owners in areas where we are not yet ready to expend our efforts intensively, to maintain clean herds at their own expense and hold the line so far as possible until we are ready to add such areas to those where intensive work is being carried on. A most important step to accomplish this purpose is to prevent the sale or movement of cattle for any purpose other than slaughter unless they have been tested and found free from brucellosis.
CONTROL OF BRUCELLOSIS IN DAIRY HERDS

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Brucellosis is without question the most important, the most critical problem facing the dairy cattle industry today. From north to south and east to west it is on the minds of dairy farmers everywhere. They have seen their losses mount year by year. Cows have aborted and failed to conceive again, calf crops have been depleted, production has been decreased to a very major extent and they have witnessed the vicious storm as the disease sweeps through a herd.

The cost to the dairy cattle industry in milk production alone is estimated conservatively at a minimum of fifty million dollars annually. If you were to combine the cost of veterinary services, the loss in calf crops, and the ruination of breeding programs, this figure would undoubtedly climb to a much higher level. We all appreciate that our investment in control programs and procedures is a mere pittance compared to the cost of the disease year after year in this country.

When the first brucellosis control program was initiated on a national scale in the middle thirties, it was of course test and slaughter and there was not too much objection to the program because it provided a means of reducing our herds and at the same time getting rid of an insidious disease. Very creditable progress was made during these years as we reduced the incidence of the infection down to a very low percentage in the late thirties and the early forties. At that time calfhood vaccination appeared on the scene as a valuable adjunct to the national control effort.

Then, of course, the war came along and with it a shortage of veterinary personnel, a shortage of milk and milk products and, equally important, an increased amount of traffic in dairy cattle. The combination of these three factors set us back on our road to eventual eradication of the disease. For six years you gentlemen suffered along working from hand to mouth doing the best possible with the limited personnel you had available.

All of us were looking forward to the day when these conditions would pass from the scene and we could go ahead again with a national program and eventually clean our herds of brucellosis. Then about two years ago a new sentiment rippled through the dairy cattle industry. A flame of resentment and discontent was sparked by several articles appearing in the agricultural press, particularly in dairy breed publications. These articles merely reflected a growing sentiment on the part of the purebred dairy industry.

There came with the advent of vaccination an ever increasing feeling that vaccination would replace sanitary practices and eliminate the necessity of working toward complete eradication of the disease. Veterinarians and other professional personnel as well as laymen in the industry wrote and spoke against the blood test in particular and the national program in general. Last June the following comments were prominently featured in a national dairy breed publication.

My experience convinces me that compulsory vaccination for Bang's and junking of the blood test is the cheapest method of control for the breeder. Combined with
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pasteurization it is the safest also for the consumer of dairy products. Present conditions are intolerable. Let us admit that Bang's control was started on a false foundation and begin over again on a sounder basis.

I have talked with breeders in all parts of the country. As a group they are bewildered as far as Bang's control is concerned. They want advice. Who am I to give it? I am no scientist. One man recently wrote me four pages on his troubles. He wanted advice as to whether to send his positive cows to the butcher immediately or wait till they calved. I told him to quit being a sucker and keep them as long as they were profitable to him. His answer was that the night after he got my letter he had the first good night's sleep in weeks.

Not long ago we received a letter from a midwestern dairyman who has a herd of 150 Jerseys. He had been having a lot of breeding troubles. He asked our consulting veterinarian for suggestions on what the causes might be. He specifically requested that we not suggest Bang's disease because he "wouldn't dare to think about it."

At a state dairyman's association meeting last winter we heard a very well trained and prominent dairy breeder stand and—with tears in his eyes—declare that it was time we began to recognize the facts, throw out the blood test and go to wholesale calfhood and adult vaccination. In still another state the inter-breed dairy council passed a resolution stating "... that following an official vaccination (including a negative pre-test) no further test shall be required during the life of the animal for intrastate shipment or state shows and sales." The same council went on to lay plans to have the resolution inaugurated into law. We have not learned whether or not they were successful.

In an eastern state last winter we heard the state dairyman's association pass a resolution requesting a complete revision of their state legislation controlling Bang's disease. The resolution itself was not as dangerous as the sentiment in which it was passed. There was widespread discontent with the blood test. Man after man condemned it bitterly.

We must appreciate that most of the criticisms that are leveled at the blood test and at state and national programs originate largely from the leaders in the livestock industry, the breeders of registered high value dairy cattle. These are the men who are suffering heavily from the disease. They feel they can seldom afford to sacrifice animals in order to clean up their herds in a comparatively short period of time.

There are many causes of the attitudes that have developed among dairymen in most of our dairy regions. First, there has been a critical shortage of reliable information available to all livestock owners. Without any question this has been the weakest link in our national brucellosis control effort. Some of you have overcome the shortage of information through personal effort. We were particularly pleased last winter to attend a week long dairy short course in one of the eastern states. At that short course the state veterinarian was present throughout every session. When questions arose with reference to disease control problems he was on hand to give the correct answers and to keep the records straight. It was significant to us to note that there was very little criticism of the blood test or the state and national programs in that particular state. The same is true in other states that we have visited. We wish it were true in all states. We believe that much of the difficulty
could be alleviated were well qualified professional men present at all state, district and local livestock meetings. When we realize that so very little information has been made available to the livestock owner, it is not surprising to find him accepting the first detailed "explanation" of the disease and its logical method of control. It so happens that in many areas, the first explanation and the only voice he hears is that of the caustic critic of the blood test and the state and national programs. If we are to pave the way for a definite unified national program in the future then it is absolutely essential that livestock sanitary control officials or their representatives make it a point to attend all dairy cattle meetings of any consequence. We realize, of course, that it is impossible for a small group of men to individually contact all dairymen in their respective states. It falls then to the practicing veterinarian to carry the best information available on to his clients' dairy farms. There has been a tendency on the part of too many veterinarians to wrap their work in secrecy and surround their activities with an air of mystery. Too many veterinarians have not discovered that their best clients are well informed clients. Veterinarians cooperating in state and national control programs must be induced to do their share of the educational work.

Another reason for the criticisms that have been leveled at our control programs lies in the fact that some of our state laws have either been inadequate or unrealistic. Those of you who are state veterinarians can well appreciate how some of these laws came to be passed. We attended a hearing last winter before a joint house and senate agriculture committee in one of our midwestern states. At that hearing not one livestock disease control official was present to testify. Practically all of the testimony entered before this joint committee was given by a layman legislator with twenty-three positive animals, a man who desired to throw out the blood test entirely. Another portion of the testimony was given by his veterinarian who was of the same opinion. When we inquired as to the absence of the livestock disease control officials of that state, we were informed that they had been ordered to stay clear of the hearings because of possible political repercussions. This is a dangerous condition to allow to exist in any state. We doubt, however, that many persons would be inclined to sacrifice their own conscience and the interest of the people of the state for which they work.

To recoup our losses of the past few years and to prepare for a better future, we must determine to do a thorough job of education and to provide strong, confident leadership. Before this educational work can get under way we must have a complete bill of proven facts. We understand that the National Research Council has a committee working on such a bill of facts at the present time. It is long overdue. A state commissioner of agriculture told us a short while ago that when he took office about six years ago he saw that the foremost agricultural problem before the state was that of controlling brucellosis. He called in members of his staff and requested that a complete and detailed bill of facts be prepared and that their recommendations for a state brucellosis control program be set forth in a clear, simple, concise manner. This commissioner of agriculture told us that he and his staff were unable to gather together the bill of facts and consequently were unable to make recommendations to their state legislative body. In no place could they find all of the available, most recent information on brucellosis research and its application under farm conditions. This is not a healthy condition to allow to exist.
The educational program that will follow the preparation of a bill of proven facts should include the attendance of disease control personnel at dairy farmer meetings, the issuance of weekly press releases, the preparation and delivery of radio talks, and the preparation of magazine articles for the agricultural press. To some it may appear that this is a time consuming proposition. Actually, it will be one of the most economical investments in time that we can make in the few months ahead of us. No national program can obtain acceptance and cooperation without an educational program preceding it. We would advise that you enlist the aid of professional writers in the agricultural field to help in the preparation of articles, radio talks, and press releases. As technicians there is an inclination to speak over the heads of the people you wish to inform. Some member of your respective organizations should be assigned the specific responsibility of preparing press releases and other informative material at regular intervals throughout the year.

Among the questions that dairymen will want answered are the following. They are typical of those we receive daily from our 300,000 dairy farmer readers.

1. Is the blood test reliable? A farmer will not accept just a “yes” or “no” answer to this question now. He wants it explained and proved. Unless the veterinarian is well informed and prepared to discuss the test he can’t expect to make many converts.

2. If the test is reliable, why, then, are the results so variable when the herd is coming down with the disease? Here the veterinarian must be well supplied with the facts concerning the blood test during the incubation period.

3. Why is it that a cow will abort at seven months, react negative to the blood test and thirty to sixty days later be positive?

4. Does the blood test measure resistance to the disease? Isn’t this resistance desirable? Here the veterinarian must have a logical explanation of the agglutinin-antibody relationship.

5. When should I vaccinate? With reference to this question, most farmers can receive as many different pieces of advice as there are veterinarians in his locality.

6. How long does immunity last? How complete is that immunity?

7. What do I do when immunity runs out? Shall I vaccinate my adults? This question requires very careful consideration. The promiscuous vaccination of adult animals is endangering the control of the disease in some areas. It should be approved only after careful analysis by well qualified livestock sanitary officials. Adult vaccination without a doubt does have its place in the control of the disease but like all good things it is subject to abuse and misapplication. These abuses must be reduced and eliminated.

8. Why are our regulations different in this state from those that exist in other sections of the country?

We could prepare our entire paper around the questions that are received day by day from dairymen throughout the country. These, and innumerable other questions must be answered, not from the state administrative disease control office, but in dairy meetings at state, district, and local levels. They can be answered through national and state farm magazines and through regular press releases to local state newspapers. No program can be successful without the confidence of a well informed dairy cattle industry.

It will be important, too, to breach the gap between research and the field workers
who are attempting to apply that research to actual farm conditions. We know that some effort is being made in this direction at the present time. We hope that this effort will be continued and that we can profit from the results in days ahead.

It appears to us, too, that we must have an accurate measure of the incidence and distribution of the disease. A survey is just being evaluated in Iowa that may have a far reaching effect on the livestock world. As proposed by the National Research Council this survey is designed to measure the economic losses suffered by the livestock industry as a result of diseases, injuries, or other health factors. This survey in Iowa is being conducted by Iowa State College, the Bureau of Animal Industry of the United States Department of Agriculture and Swift and Company. It is possible that this preliminary work may cast a ray of light on our national problem and set up a method of keeping an accurate check on total livestock losses and the areas of intensity. Such a project is sorely needed. We believe an adequate system of reporting is absolutely essential if our disease control programs are to be effective, adequate, and economically administered.

After we are armed with accurate information regarding the incidence and distribution of the disease and after we have provided the industry with all of the facts of the disease, then we can go ahead and build a national program and put teeth in it. The program must have a broad application. We believe the blood test must be mandatory until a better diagnostic aid becomes available. The blood test is particularly desirable in those areas that are inclined to depend solely upon vaccination. It is foolhardy to attempt any control program without having some method of measuring the results of that program. Along this line, then, it is essential that there not be a penalty for using the blood test under such circumstances. The national program must also emphasize the reduction in traffic of reactors. The activity of cattle dealers in this country is contributing more to the higher incidence of the disease than any other factor. They must come under strict supervision and penalties for violation thereof must be severe. Their crimes result in tremendous losses to society.

As we get ready for the long final drive to eliminate the disease from our national herd, we might do well to convince some of our dissenting veterinarians that are leading the fight against the blood test and state and national programs. As professional men, they receive a receptive ear and they can nullify a good program or stalemate a legislative hearing.

Meanwhile, research is going on in many institutions of this country that may paint a brighter picture for the days ahead. We certainly hope so. We must endeavor to give these men all possible personnel and financial assistance that we can. One of your past members suggests that more work be done to try to determine the effectiveness of intradermal vaccination and whether or not it has advantages over the subcutaneous method. We know, too, from several recent visits, that Dr. Huddleson at Michigan State College is doing a great deal of work with a new type vaccine. As a result of his extensive studies, he has also been successful in treating brucellosis in experimental animals and humans through the use of sulfadiazine and blood plasma. This work is of course still in the experimental stage but it does show promise. We must give every possible encouragement to this type of research.
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We want to know, too, more about lyophilized vaccine. One of your members writes

It is our feeling here that in view of the way we have seen liquid vaccine handled in the field that the only safe way to proceed is to employ a desiccated or lyophilized product. It seems to me that in any vaccination program it is highly important to have a standardized stable product for employment on each and every calf. It is also my opinion that there is only one way to guarantee this and that is through the use exclusively of desiccated vaccine.

We appreciate of course that the production problems involved in supplying lyophilized vaccine are holding back its wider use. If its use is desirable, then perhaps this association should move to encourage the expansion of production facilities. Along this line, we strongly encourage a very thorough check on the vaccines that are being used throughout the nation at the present time. We are convinced that a great deal of the vaccine now being used has been mistreated in shipment and in final handling.

We have covered a great number of varying points in our paper. We intended to emphasize, by all means, that there is a definite need for a strong educational movement in the dairy cattle industry. Without it, the future of a national control program is in jeopardy. This request for information comes not from the dairy farmers alone.

The following resolution was introduced last month at the annual meeting of The National Association of Commissioners, Directors and Secretaries of Agriculture:

Be It Resolved, by the National Association of Commissioners, Directors and Secretaries of Agriculture that the United States Livestock Sanitary Association be requested to assemble and set forth in a clear, concise statement all of the known facts relating to Brucellosis, the measures for the control thereof, and the results of plans thus far employed; and

Be It Further Resolved that the United States Livestock Sanitary Association be requested to formulate and recommend a national plan of Brucellosis control based on such known facts.

The battle ahead will not be easy. It will require the active, coordinated efforts of livestock sanitary officials, livestock owners, veterinarians, educators, and the agricultural press.

We are pleased to hear of current activity along the lines discussed in this paper. The group that met with Dr. Simms recently and the paper prepared by President Miller indicate that this group is again organizing for action, testing its strength, and preparing to lead the nation in eradicating our industry of its major burden—brucellosis. You have many allies awaiting your leadership. They will rally to you when you present the facts and a sound, unified national program based on those facts.
A REPORT ON PRELIMINARY STUDIES OF BRUCELLOSIS IN INDIANA

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Brucellosis is a subject that generates much heat but only occasionally some light. Many completely unsubstantiated statements relative to this subject have been made by people in various fields involving both human and animal disease control. In an effort to throw some light on a few of the aspects of brucellosis in Indiana, these studies have been undertaken as a combined effort of the Indiana State Board of Health, Purdue University, the U. S. Bureau of Animal Industry and U. S. Public Health Service. Each agency contributed whatever it was best equipped to do.

When the study was planned in June, 1946, the following were listed as objectives:
1. A survey of brucellosis in representative samples of the rural population of Indiana and in the animals associated with it, and as a consequence, correlation studies from these data.
2. A study of the incidence of reactors to brucella antigen in groups that are presumably highly exposed such as veterinarians, and slaughter house and rendering-plant workers.
3. Epidemiological studies of individual cases of brucellosis especially where the organism had been isolated from human blood.
4. Evaluation of the efficiency of blood-clot culture technique for the isolation of brucella organisms by a parallel inoculation into guinea-pigs and a determination of the types of Brucella found.
5. Any other phase of the subject which might arise that could be handled by the cooperating groups with the facilities at their disposal.

Under the last heading it can be reported that there has been established at the Indiana State Board of Health a library of human and animal blood sera from many sources which involve the known types of Brucella organisms. The sera are frozen and kept at 20° below zero Fahrenheit. Any qualified research worker can secure whatever type of serum he desires. Thus far a number of institutions have taken advantage of this offer.

On many occasions personnel connected with this study have been called upon to lecture before medical societies, veterinary societies, home economics clubs, Farm Bureaus, breed associations, and any other groups interested in brucellosis. These people are told that brucellosis is like an iceberg—only one-fifth is readily visible but that the submerged four-fifths is the real danger. The dramatic act of abortion is pointed out as only one part of the whole disease picture. To complete the story, the farmer and the public must remember that the biggest single factor that should

1 Supported in part by a research grant from the National Institute of Health, U. S. Public Health Service.
2 Senior Assistant Scientist, U. S. Public Health Service, on loan to the Indiana State Board of Health.
make people demand the eradication of brucellosis, aside from the human health hazard, is the financial loss.

In addition to learning what other domestic animals are susceptible to the different varieties of Brucella organisms, and what the manifestations of brucellosis in them are like, audiences are also told that it is possible to eliminate the disease in one species without necessarily eliminating the disease in all species simultaneously. However, from the viewpoint of human health, the only sensible procedure is the complete eradication of brucellosis from all species of animals. And the different approaches to control and eradication for the various domestic animals are enumerated. The limitations of each procedure are also given. The desirability of complete elimination of brucellosis is always emphasized and held to be the goal toward which all action should be directed.

Using experimental data from all over the world and a mathematical approach worked out by statisticians of the Indiana State Board of Health, it is possible to show the magnitude of financial loss in one particular product. The method worked out gives a more conservative figure than previous methods but it is felt that a more accurate estimate of the losses results.

Table 1.—Milk yields in brucella-infected cows compared with those not infected

<table>
<thead>
<tr>
<th>INVESTIGATORS</th>
<th>STATUS OF COW</th>
<th>NO. OF COWS</th>
<th>NO. OF LACTATIONS</th>
<th>AVERAGE MILK YIELD</th>
<th>DECREASE</th>
<th>PERCENT-AGE DECREASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooper</td>
<td>Not infected</td>
<td>6</td>
<td>6</td>
<td>5949 lbs.</td>
<td>2147 lbs.</td>
<td>35*</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>12</td>
<td>12</td>
<td>3802 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White et al.</td>
<td>Not infected</td>
<td>38</td>
<td>108</td>
<td>9315 lbs.</td>
<td>1600 lbs.</td>
<td>17†</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>45</td>
<td>129</td>
<td>7715 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simms and Miller</td>
<td>Not infected</td>
<td>31</td>
<td>31</td>
<td>8542 lbs.</td>
<td>3832 lbs.</td>
<td>45*</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>48</td>
<td>48</td>
<td>4710 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fritz and Barnes</td>
<td>Not infected</td>
<td>209</td>
<td>379</td>
<td>9937 lbs.</td>
<td>2622 lbs.</td>
<td>26*</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>120</td>
<td>203</td>
<td>7315 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graham and Thorp</td>
<td>Not infected</td>
<td>28</td>
<td>28</td>
<td>9740 lbs.</td>
<td>2128 lbs.</td>
<td>22*</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>11</td>
<td>11</td>
<td>7612 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rich</td>
<td>Not infected</td>
<td>115</td>
<td>115</td>
<td>8100 lbs.</td>
<td>1450 lbs.</td>
<td>18†</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>115</td>
<td>115</td>
<td>6650 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minett and Martin</td>
<td>Not infected</td>
<td>115</td>
<td>154</td>
<td>8803±117 lbs.</td>
<td>666±298 lbs.</td>
<td>10†</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>38</td>
<td>42</td>
<td>8137±274 lbs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total and Averages</td>
<td>Not infected</td>
<td>542</td>
<td>821</td>
<td>8626+ lbs.</td>
<td>2063+ lbs.</td>
<td>23+</td>
</tr>
<tr>
<td></td>
<td>Br. infected</td>
<td>389</td>
<td>560</td>
<td>6563 lbs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Uncorrected yields.
† Corrected yields.
The most obvious product to talk about is milk. On the basis of the percentage of reactor cows and the present milk production the loss can be calculated. The decrease in milk production due to brucellosis is shown in Table 1. This table appeared in a reprint of Huddleson’s speech given before the New York Academy of Science in March, 1946.

Minett and Martin have given a summary of the factors which have to be taken into consideration for correcting the yields. These are quoted from their work in the Journal of Dairy Research for 1936: "Corrections have to be made in the first place for age (as judged by the number of calvings), length of dry period, service period (interval between calving and the next effective service), and month of calving. Comparison of yield can only be made with animals of the same breed living under the same conditions of animal husbandry and being milked by the same system—by hand or machine, as the case may be. After all those conditions have been satisfied, it has to be remembered that other diseases may have a bearing on the issue."
The office of the Indiana State Veterinarian reports that for the fiscal year ending June, 1947, of all the cows tested, approximately 7% reacted positively. Using this data, and from Table 1 using a figure of 20% decrease for infected cows, it can be shown mathematically that if the entire cow population of Indiana were free of brucellosis then the increase of production would be 1.499%. Although this seems to be a small increase, when translated into concrete terms it means that Indiana last year lost 55.4 million pounds of milk. At $4.00 a hundred this represents a loss of $2,216,000. But the dramatic thing about these figures is not the monetary loss, but the number of people this could feed.

The average American whose food consumption is the highest and most extravagant in the world, uses about 400 pounds of fluid milk a year. On this basis, the milk loss in Indiana in one year could supply all of the 130,000 people of Fort Wayne, Indiana’s second largest city, with their milk requirements for one year. If the complete milk, cheese, butter, ice-cream, milk powder, condensed milk and all other dairy product requirements are taken into consideration this lost milk would take care of Hammond, Indiana's population of 75,000 for one year.

Translating this to terms of a desperately hungry Europe, this lost milk could meet the requirements of the whole population of Messina, the chief city of Sicily, or Lübeck, an important port of Germany, or Reims, the cathedral city of France.

To show what would happen, theoretically, to milk production if brucella-infected cows were replaced with normal cows of the same breeding and same production status, graphs have been prepared demonstrating the increase. The different curves represent different estimates of loss of production that is experienced because of Brucella infection.

These graphs and charts do not take into consideration the grain lost in feeding non-productive cows, nor the labor, nor the overhead, nor the calf crop, nor the increased veterinary bills. The only loss being demonstrated is the milk loss and the only gain being shown is increase in milk production.

It must be kept in mind that most of what is reported here is based on partial work. Before any conclusions can be drawn much more work must be done. And an expansion of activities will put the study on a much more representative basis.

In the survey of brucellosis among rural populations and their animals only two townships in the southwestern part of the state have been completed. The survey of a third township in central Indiana was organized but did not develop because an outbreak of foot-and-mouth disease in Mexico caused the U. S. Bureau of Animal Industry to withdraw the veterinary personnel that was working on the project. It is hoped that their services will again be available at an early date.

Organizing the townships was a stimulating experience in veterinary public health work. Too much praise cannot be given to the county agents for their efforts in getting the community leaders interested in the project. Without them, the project would have been practically impossible. All the publicity was directed at making these efforts appear as purely local projects being run by local people. The appointed committees signed everything. And it looked as though the physicians and veterinarians were working for them. With this approach and steady newspaper publicity and township meetings, success was assured. All the farms but one consented to have their animals tested. And 80 per cent of the people were bled.
It should be emphasized that all this was voluntary on the part of the people. There were no elements of compulsion. The excellent response was due entirely to the intensive educational campaign pointing out that the people had everything to gain and nothing to lose by submitting themselves and their animals for test. All testing was free to the people and everybody was invited to take advantage of the opportunity. Many started to get their herds accredited as a result of these tests.

The animal bleeding was done by veterinarians of the U. S. Bureau of Animal Industry and the tests were made on the spot by a trailer laboratory supplied and maintained by the B.A.I. Humans were bled by physicians of the State Board of Health and the agglutination tests were performed at the state laboratory.

Results, based entirely on agglutination tests, showed the same thing that county-wide testing in Minnesota revealed. The percentage of reactors was extremely low and the number of premises where no brucellosis existed was extraordinarily high.

### Table 2—Brucellosis survey: Animal tests

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>NO. OF PREMISES</th>
<th>NEGATIVE</th>
<th>SUSPECT</th>
<th>REACTORS</th>
<th>TOTAL</th>
<th>PER CENT REACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>268</td>
<td>1477</td>
<td>41</td>
<td>27</td>
<td>1545</td>
<td>1.75</td>
</tr>
<tr>
<td>*Swine</td>
<td>90</td>
<td>746</td>
<td>84</td>
<td>37</td>
<td>746</td>
<td>4.96</td>
</tr>
<tr>
<td>Horses</td>
<td>56</td>
<td>110</td>
<td>11</td>
<td>1</td>
<td>122</td>
<td>0.82</td>
</tr>
<tr>
<td>Goats</td>
<td>5</td>
<td>9</td>
<td>—</td>
<td>—</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>Sheep</td>
<td>1</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Totals</td>
<td>272</td>
<td></td>
<td></td>
<td></td>
<td>2509</td>
<td></td>
</tr>
</tbody>
</table>

* All swine in the area were not tested because veterinary personnel were withdrawn.

Total farms in the area 273.

In the human testing, the number of reactors was also low. A reactor for the purpose of this survey is defined as anyone whose blood serum showed any agglutinins in a dilution of 1:80 or higher.

It is interesting to note that every time a human reactor was found, there were animal reactors on the premise.

All these people drank raw milk. The only difference in exposure was contact with animals. And along such lines, the sex differential becomes quite obvious.

This area was chosen because it was felt that little brucellosis would be found there. We used it to perfect our organizational technique. It must be stressed that this is not a fair sample of Indiana and therefore no widespread conclusions can be made from these data.

An area in the northern part of the state where brucellosis is supposed to be rampant will be tried next. The local veterinarians and physicians have indicated their desire to cooperate in this endeavor.

The surveys among highly exposed people corroborate what has been found by other investigators.

At the 1947 meeting of the Indiana State Veterinary Medical Association in
Indianapolis, blood samples were taken of persons who were willing to be bled. Physicians of the State Board of Health took the samples. The same procedure was used at the annual convention of the American Veterinary Medical Association meeting at Cincinnati. This time the bleeding was done by physicians from the Cincinnati Board of Health. To stimulate interest tests were run immediately but were checked again at the Indiana State Board of Health laboratory.

Interest in rendering plant personnel was aroused as a result of a survey for tularemia among these workers. Since the blood was available it was decided to test the serum with a brucella antigen. In each plant management and labor were consulted and both parties agreed to the tests. Only physicians were given the results of individual tests.

In the course of the survey, one young man who was doing a good day’s work gave a strongly positive specimen from which Br. melitensis was isolated. He admitted under questioning that a month previous he had been ill but he had attributed his chills and fever to malaria contracted in the navy.

About two-thirds of all Indiana plants were surveyed. The remaining one-third is still to be done.

Thus far only two slaughter-houses have been surveyed. In both instances management and labor were approached and each agreed to cooperate. Results of individual tests were sent to the compensation physician. Summaries of results were sent to both the plant owners and the union local. In all cases care was taken to impress all parties that a positive reaction was no indication of active illness.

It is obvious that some jobs in the plant offer a greater hazard of exposure than others. It is interesting that not a single female reacted to the test.

As a control group it was decided to use the state institutions which had animals where, with one exception, the cattle and swine were free of brucellosis.

Routine epidemiological studies gave evidence of the great suffering and tragic losses caused by brucellosis. One case in particular stands out. A farmer bought a pure-bred boar to use on 23 sows and gilts. When the farmer was through with the boar he lent him to his brother-in-law who used the animal on 13 sows and gilts.

<table>
<thead>
<tr>
<th>EPIDEMIOLOGICAL HISTORY</th>
<th>NO. OF SAMPLES</th>
<th>REACTORS</th>
<th>PER CENT REACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No contact with animals</td>
<td>218</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Contact with animals:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Men</td>
<td>190</td>
<td>7</td>
<td>3.7</td>
</tr>
<tr>
<td>B. Women</td>
<td>128</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>C. Children:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Boys</td>
<td>114</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>2. Girls</td>
<td>73</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>721</td>
<td>11</td>
<td>1.5</td>
</tr>
</tbody>
</table>

These represent 80 per cent of the people in the area.
Of the 36 females bred, 20 aborted and six others gave birth to pigs that died within three hours of parturition. That would not be too bad because the loss was only monetary. But the three men who handled these animals contracted undulant fever and from two of these men, Brucella suis has been isolated. Naturally, the boar was tested, found positive and sold for slaughter. Six months after the onset of the disease, the three men still experience attacks of undulant fever. And the organism is still being isolated from one of them.

Table 6 is a list of people from whom Brucella organisms have been isolated and relevant epidemiological data that goes with each case.
### Table 6.—Epidemiological data on patients from whom brucella organisms were isolated

<table>
<thead>
<tr>
<th>CASE NO.</th>
<th>SERUM TITER</th>
<th>ORGANISM</th>
<th>OCCUPATION</th>
<th>SEX</th>
<th>AGE</th>
<th>ANIMAL CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1:320</td>
<td>Melitensis</td>
<td>Farmer and slaughterer</td>
<td>M</td>
<td>49</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>2</td>
<td>1:320</td>
<td>Suis</td>
<td>Slaughterer</td>
<td>M</td>
<td>21</td>
<td>Hogs</td>
</tr>
<tr>
<td>3</td>
<td>1:80</td>
<td>Melitensis</td>
<td>Rendering plant worker</td>
<td>M</td>
<td>26</td>
<td>All animals</td>
</tr>
<tr>
<td>4</td>
<td>1:1280</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>27</td>
<td>Cattle</td>
</tr>
<tr>
<td>5</td>
<td>1:320</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>59</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>6</td>
<td>1:80</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>32</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>7</td>
<td>1:1280</td>
<td>Melitensis</td>
<td>Slaughterer</td>
<td>M</td>
<td>52</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>8</td>
<td>1:160</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>40</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>1:1280</td>
<td>Abortus</td>
<td>Service station operator</td>
<td>M</td>
<td>23</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>10</td>
<td>1:640</td>
<td>Suis</td>
<td>Farmer</td>
<td>M</td>
<td>43</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>11</td>
<td>1:1280</td>
<td>Suis</td>
<td>Truck driver</td>
<td>M</td>
<td>29</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>1:160</td>
<td>Abortus</td>
<td>Stenographer</td>
<td>F</td>
<td>25</td>
<td>None</td>
</tr>
<tr>
<td>13</td>
<td>1:160</td>
<td>Suis</td>
<td>Housewife</td>
<td>F</td>
<td>60</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>14</td>
<td>1:320</td>
<td>Abortus</td>
<td>Student</td>
<td>M</td>
<td>23</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>15</td>
<td>1:40</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>66</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>16</td>
<td>1:640</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>41</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>17</td>
<td>1:640</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>27</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>18</td>
<td>1:640</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>22</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>19</td>
<td>1:640</td>
<td>Abortus</td>
<td>Housewife</td>
<td>F</td>
<td>25</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>20</td>
<td>1:1280</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>30</td>
<td>None</td>
</tr>
<tr>
<td>21</td>
<td>1:160</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>45</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>22</td>
<td>1:160</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>40</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>23</td>
<td>1:320</td>
<td>Abortus</td>
<td>Convict</td>
<td>F</td>
<td>29</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>24</td>
<td>1:640</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>22</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>25</td>
<td>1:1280</td>
<td>Abortus</td>
<td>Laborer</td>
<td>M</td>
<td>30</td>
<td>None</td>
</tr>
<tr>
<td>26</td>
<td>1:320</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>50</td>
<td>Cattle</td>
</tr>
<tr>
<td>27</td>
<td>1:1280</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>39</td>
<td>None</td>
</tr>
<tr>
<td>28</td>
<td>1:320</td>
<td>Suis</td>
<td>Farmer</td>
<td>M</td>
<td>31</td>
<td>Hogs</td>
</tr>
<tr>
<td>29</td>
<td>1:40</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>25</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>30</td>
<td>1:320</td>
<td>Suis</td>
<td>Slaughterer</td>
<td>M</td>
<td>25</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>31</td>
<td>1:160</td>
<td>Abortus</td>
<td>Farmer</td>
<td>M</td>
<td>35</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>32</td>
<td>1:320</td>
<td>Melitensis</td>
<td>Slaughterer</td>
<td>F</td>
<td>40</td>
<td>Cattle</td>
</tr>
<tr>
<td>33</td>
<td>1:80</td>
<td>Suis</td>
<td>Farmer</td>
<td>F</td>
<td>30</td>
<td>None</td>
</tr>
<tr>
<td>34</td>
<td>1:80</td>
<td>Abortus</td>
<td>Quarryman</td>
<td>M</td>
<td>30</td>
<td>None</td>
</tr>
<tr>
<td>35</td>
<td>1:640</td>
<td>Abortus</td>
<td>Housewife</td>
<td>F</td>
<td>39</td>
<td>None</td>
</tr>
<tr>
<td>36</td>
<td>1:800</td>
<td>Suis</td>
<td>Farmer</td>
<td>M</td>
<td>29</td>
<td>None</td>
</tr>
<tr>
<td>37</td>
<td>1:160</td>
<td>Abortus</td>
<td>Laborer</td>
<td>M</td>
<td>37</td>
<td>None</td>
</tr>
<tr>
<td>38</td>
<td>1:160</td>
<td>Suis</td>
<td>Farmer</td>
<td>M</td>
<td>51</td>
<td>Cattle and hogs</td>
</tr>
<tr>
<td>39</td>
<td>1:80</td>
<td>Suis</td>
<td>Slaughterer</td>
<td>M</td>
<td>14</td>
<td>Cattle and hogs</td>
</tr>
</tbody>
</table>
Table 7 summarizes these data.

A number of cases merit some attention. Case number 35 is an isolation from a woman who has been chronically ill with undulant fever for four years and whose blood contains no agglutinins whatsoever. She had been to a number of physicians; each one dismissing her as a neurotic. Cases 37 and 41 came from people who have extremely weak agglutination titers.

During the investigation of one of the cases, a rather unexpected discovery was made. Br. melitensis was isolated from cow's milk. As far as could be determined this was the third time such isolation had been made in the United States. The significance of this finding cannot be stressed too strongly with an audience aware of the public health significance of brucellosis.

The classification of the Brucella species deserves some consideration. For the most part there has been no difficulty in typing the strains. However, there are a few that have behaved peculiarly. These are number 15, 36, and 43. Number 15 grows very slowly under CO₂ and not in air. It will not grow on any dye plates. Its production of H₂S in small quantities for a short time led to its classification as an abortus. Number 36 grows in air and grows equally well on both thionin and fuchsin. However its H₂S production is exactly like that of a suis rather than a melitensis. Tentatively it is being placed in the suis class until isolations are made from the hogs with which this man has been in contact. Number 43 grows only on fuchsin but it does not need CO₂, and its H₂S production is exactly zero. This leads to its classification as a melitensis.

Because of these peculiarities in immunologic and biochemical behavior, it has been suggested by some that the brucella organism be studied more closely to see whether further distinguishing characteristics such as those found in salmonella, for instance, can be determined.

The comparison of blood-clot culture with guinea-pig inoculation has proved most interesting. All the guinea-pig work has been done at Purdue University.
Distribution of brucella organisms isolated from humans in Indiana
March 1948-October 1947

At the beginning of the study, only blood clots that came from patients whose serum showed complete agglutination at titers of 1:40 or higher were cultivated. Using these selected specimens the number of isolations was approximately 8 per cent.
of all cultures tried. However, when the work became well organized it was decided to attempt isolations on all clots that gave any agglutination whatsoever. The

<table>
<thead>
<tr>
<th>CULTURE TECHNIQUE</th>
<th>GUINEA PIG INOCULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen</td>
<td>Isolations</td>
</tr>
<tr>
<td>990</td>
<td>37</td>
</tr>
</tbody>
</table>

**TOTALS**

<table>
<thead>
<tr>
<th>TOTAL SPECIMEN</th>
<th>ISOLATIONS</th>
<th>PER CENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>990</td>
<td>51</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Isolations before cooperation .................................. 10
Isolations by Guinea Pig only .................................... 14
Isolations by Culture Technique only .......................... 16
Isolations by both methods ...................................... 11
Total ............................................................... 51

**Chart 2.—Titer of sera from whose clots brucella organisms were isolated**

The increased number has cut down the percentage of isolations. However, as can be seen, from the summary, had this not been done, approximately 8 per cent of the isolations would have been missed.
These blood samples are received from physicians all over the state of Indiana. Generally there is no precaution about placing the samples in sterile containers. Consequently the amount of contamination is often great. The physicians do not make any attempt to take a specimen at a time favorable for getting the organism in the bloodstream—when the temperature is rising. And it is surprising, not that so few isolations, relatively, are made, but that any isolations are secured at all.

It is true that there are not many data at present, but what exists seems to point to the fact that for the maximum number of isolations, both blood-clot culture and guinea-pig inoculation should be used.

There have been suggestions made that cultivation on the embryonating chicken egg be tried. The State Board of Health is preparing to set up such routine work to determine the efficiency of such technique as a diagnostic aid.

This paper is a description of some work being done in just one state. The U. S. Public Health Service is sponsoring studies on brucellosis in other states such as Wisconsin, Utah and Arizona. With the release of data secured by different approaches to this big problem of animal and human disease, it is felt that the need for decisive action will become apparent and that the public will demand the eradication of brucellosis as it demanded the eradication of tuberculosis.
Until the past few years it has been possible to show consistently fine progress in the annual reports on cooperative bovine brucellosis control. However, present accomplishments are well below what had been expected. It is quite apparent that the primary factor involved is the disturbed economic situation. Beginning during the late pre-War period, all values began to climb and have continued to do so. The effect of this unusual condition was quickly seen in heavy demands for all commodities, especially meat and dairy products, which, in turn, were responsible for an unprecedented need for veterinary service by the livestock industry. As a consequence, general practice has become far more attractive to recent graduates than any other veterinary occupation. Needless to say, regulatory activities, staffed largely by veterinarians, have suffered accordingly.

SHORTAGE OF VETERINARIANS

During the War, a reduction in qualified State and Bureau personnel was expected and the most that was hoped for was to hold as nearly as possible the ground already won until the emergency was over. We all know from painful experience that the emergency did not entirely end with the cessation of hostilities. The continued uncertainties and confused economy of post-War years have not relieved the veterinary situation as had been expected. In fact, the prospects of filling something like 150 Bureau vacancies in tuberculosis and brucellosis eradication field work within the immediate future are not at all bright. Further complications have developed as a result of the foot-and-mouth disease outbreak in Mexico. In order to meet the demands of this top-priority undertaking, it has been necessary to transfer temporarily a number of key men from the already depleted tuberculosis and brucellosis control force to Mexico. The seriousness of the veterinary problem is best illustrated by pointing out that the Tuberculosis Eradication Division now has on its rolls 525 veterinarians, as compared with the peak of 813 in 1939.

Considerable effort has been directed toward interesting more young veterinarians in regulatory service. So far, this has met with only nominal success, and in all probability there is little reason to expect any appreciable change in this regard so long as the financial inducements offered by general practice continue at current levels. At the present time, salaries of Bureau veterinarians are higher than ever before, and opportunities for promotion have been greatly improved. In addition, the Bureau is in the process of setting up a number of positions that may be likened to fellowships, in that they provide the opportunity for limited graduate work to veterinary personnel in charge of Bureau brucellosis-testing laboratories located in areas where educational facilities are available. These moves have been taken to stimulate added interest in Bureau work and to help encourage more veterinarians to participate.
In the final analysis, the problem of meeting personnel requirements for regulatory work is rightly the responsibility of the veterinary profession itself. The keystone of all livestock disease control programs has always been and continues to be the availability of qualified manpower with which they can be implemented. Primary consideration must be given, therefore, to solving this problem as it relates to future brucellosis control service in the field.

NECESSITY FOR UNIFORM CONTROL PROCEDURES

The same economic disturbances which have accounted for the acute shortage of veterinarians have also interfered seriously with other phases of the program. Under normal conditions, the movement of livestock, both within and between states, is difficult to regulate from a disease control standpoint. With the present inflated demands being made on the industry, these difficulties have multiplied well beyond the stage where available personnel and existing regulations will permit the administration of adequate sanitary precautions. This condition allows for increased dissemination of all livestock diseases and is the cause of many of the new sites of Brucella infection that are being detected in previously clean areas. Moreover, prevailing high prices being paid for dairy and meat products have resulted in a general lack of interest in following certain disease control plans that are restrictive in character. This is to be expected and will, no doubt, continue until values have finally subsided to a more permanent level.

Although the influence of national economy on the delayed progress of brucellosis control is recognized as an important element, it is believed that the lack of uniform regulations and recommendations governing the project are, in part, responsible also and should be reviewed. It has been repeatedly demonstrated that the advances already made in various parts of the country are closely related to the thoroughness with which suitable procedures have been applied. This underlines the fact that in Strain 19 vaccination and the test-and-slaughter method, we already possess the tools needed to control bovine brucellosis, if they are intelligently and energetically employed. Considerable thought and study are being given to the need for regularizing the rules and procedures that should be followed on a national scale to insure more uniformity in practices employed and maximum benefits for the program as a whole. The results of recent meetings held in connection with this subject by interested groups have, for the most part, been unanimous in the demands expressed for a unified brucellosis control effort.

A case in point was provided by a conference called by Dr. Simms in Washington on September 23 and 24 of this year for the purpose of discussing the brucellosis situation. At the conclusion of the meeting, which was attended by representatives from a wide range of related fields, a committee report was prepared and approved. A prominent part of this report dealt with the need for more standardization of control procedures, and it was proposed that existing plans be reviewed by appropriate committees, the object being the adoption by this association of uniform rules and regulations governing the eradication of brucellosis. With the support and encouragement that can be expected from the livestock industry for an all-out effort to curb the losses from this disease, the veterinary profession and disease control agencies can do no less than accept the responsibility for seeing that the job is carried out. It is believed that general agreement on suitable methods and
regulations such as was necessary in all past livestock disease eradication projects must be reached before maximum results from brucellosis control can be expected. By preparing in advance for the time when we hope adequate personnel will again be available, an organised plan of attack can be adopted that will not only be efficient, but will lend itself to later expansion.

VOLUME OF WORK PERFORMED

With regard to the work carried out in connection with the cooperative brucellosis project during the past fiscal year, there are a few figures that should be presented in order to emphasize some of the points already discussed in the foregoing part of this report. Complete summaries covering details are available here at the meeting, or can be obtained on request from the Washington office of the Bureau of Animal Industry.

During the fiscal year ending June 30, 1947, slightly more than 5 million blood agglutination tests were conducted. This is approximately the same number recorded for the previous year, but is a decrease of nearly 3 million from the 8 million run in 1937. A reduction such as this cannot be ignored, if the number of blood tests is any index of the progress being made. Of the more than 5 million samples tested during 12 months of 1946-47, 4.5 percent were classed as reactors, as compared with 5 percent for the same 1945-46 period, and 11.5 percent for the original 1934-35 cooperative testing. It should be borne in mind, however, that the percentage of reactors disclosed by records collected after initial tests have been made does not necessarily represent the true incidence of infection, because of the undetermined number of retests that are included in the calculation. Presumably, the number of reactors would be somewhat higher if results were confined to primary herd tests alone.

STATUS OF ACCREDITATIONS

North Carolina has the distinction of being the first and as yet is the only accredited brucellosis-free State in the Union. As of October 24, 1947, the number of accredited counties in the United States had dropped to 502, a loss of 26 from the preceding year, and 98 from the all-time high of 600 in March 1945. Moreover, 183 of those counties now accredited are overdue for remodification.

In contrast with the reduction of accredited counties listed in October of this year, there was a slight increase of 855 individual accredited herds over the 41,546 recorded at the same time last year. However, in comparison with the 76,488 accredited herds in existence in June 1942, the over-all loss in this category is significant.

VACCINATION

As would be expected, the downward trend is completely reversed when vaccination is considered. The volume of calfhood vaccination conducted under official supervision has shown progressive increases each year since it was officially endorsed by the Bureau in 1940. During the fiscal year ending June 30, 1947, a total of 891,709 official vaccinations were reported. This number surpasses last year's record high by approximately 200,000. Unfortunately, it does not include an estimated like number of animals that were vaccinated either as calves or adults outside of the official program.
FEDERAL AND STATE INDEMNITIES

Federal-State payment for brucellosis reactors continues to be made in all but eight States. With one exception, however, some provision is made by every State for financial aid in meeting operating costs.

During the last fiscal year, combined Federal and State indemnities amounted to approximately $3,800,000. Of this amount, about $1,770,000 came from Federal sources, the remainder being provided by State appropriations. The average appraisal and salvage received for cattle reacting to the test were $178.25 and $82.93, respectively. These figures again reflect the changing economy of the country when they are compared with the $93.28 appraisals and $37.68 salvage for the same period in 1940-41.

CONCLUSIONS

Because of associated economic losses, bovine brucellosis continues to be one of the vitally important livestock diseases in the world today. Furthermore, with the human health aspect of the disease becoming increasingly evident, there is added inducement for controlling brucellosis as rapidly as possible. The complex nature of the disease is such that its control is proving more difficult than was originally expected. However, by modifying the program so that the proven advantages of adapting selective procedures to individual herd conditions can be assured, there is reason to believe that the problem can be solved. While vaccination alone is no more the full solution than is test-and-slaughter, it has been shown that by complementing one with the other along lines best suited for individual herd requirements, real progress can be made in combating brucellosis in cattle without undue disturbance to the livestock industry generally.

Research directed along lines that will clarify some of the more obscure phases of the disease must, of course, be continued. Worthwhile improvements in methods or materials resulting from these investigations should be incorporated into the program as quickly as their value is established. Technical investigations are being supplemented by detailed studies of field results obtained during the past several years in representative areas of the country, for the purpose of evaluating further the effectiveness of different procedures now being used. It is confidently expected that this information, when completely assembled, will be helpful in outlining more efficient control recommendations.

Another point that cannot be overlooked is the high cost in dollars as well as animals that will have to be paid before eventual eradication is achieved. However, the price tag on final elimination of brucellosis will in the end prove to be small in comparison with the manifold economic and public health benefits that can be expected. Although progress at times seems discouragingly slow, it is well to remember the difficulties that have been surmounted in other disease control undertakings. By recognizing and correcting the errors in our procedures, as they become apparent, we are accomplishing a great deal more than records alone will show. The task of complete control and eradication is admittedly a difficult one. Nevertheless, we have learned much during the past several years that can be profitably used to promote greater progress in the future. Success will be certain when the work is extended along uniformly constructive lines that have the unqualified support of the livestock industry, regulatory agencies, and the veterinary profession.
REPORT OF THE COMMITTEE ON BRUCELLOSIS


Brucellosis continues to be one of the most serious infectious diseases of cattle in this country. Although good progress has been made in the past in many areas, the Program must be enlarged if the disease is to be controlled and eradicated.

The control and eradication of Brucellosis require the full cooperation of the cattle owners and the livestock sanitarian. Cattle owners must be informed as to the part they must play in the Program.

It is generally admitted that the problem of the control of Brucellosis in man is dependent upon the reservoir of the infection in animals and that the most effective method for reducing human brucellosis is the control of the disease in animals. It is evident that a major effort needs to be directed to bringing the disease under control in animals with consideration of all and not just several important species that may act as reservoirs or a means of transmission to man.

Therefore your Committee on Brucellosis submits for your consideration the following report:

LEGISLATION

Recommendations for Congressional Action

Authorization for the Secretary of the United States Department of Agriculture to promulgate regulations governing interstate movement of animals affected with or exposed to brucellosis.

Recommendations for State Legislation

1. Provisions for requiring participation in one of the plans for eradicating the disease by all owners of livestock in a given area when 65% of such owners holding at least 51% of the cattle have placed their cattle under supervision of any one of the plans.

2. Reports to State and Federal cooperating agencies of all activities, such as agglutination tests and vaccination, in connection with the disease, on forms furnished by the State or Federal cooperating agencies must be compulsory.

3. A permanent brand with the letter “B” not less than 2 inches high and 2 inches wide on the left jaw of all reactors, excepting registered purebred cattle otherwise permanently identified, and quarantine of such reactors to the premises where found, limiting movement of these animals by permit of State officials, to slaughter at points where State or Federal inspection is maintained, except in case of valuable purebred animals, which must be permanently identified and may be allowed to move on permit of State officials, to other herds where Brucella infection is known to exist.
4. All services in connection with brucellosis control as outlined in paragraph 1 to be made available to the owner without expense to him so long as funds for such purposes are available, except for the handling of his cattle. When State and/or Federal funds are not available, it is recommended that the breeder shall continue his program at his own expense with his private veterinarian, and under the supervision of State and Federal veterinarians.

5. Only vaccine approved and manufactured under license of United States Department of Agriculture, Bureau of Animal Industry, shall be used in any brucellosis control program.

6. Authorization for those engaged in the project to enter premises, etc.

7. All phases of official brucellosis control programs to be conducted under supervision of full-time employed State, Federal, county or municipal veterinarians. This provision does not intend to eliminate the practicing veterinarian, but is intended to promote and include his services and to provide for supervision of his activities by regularly employed veterinarians.

8. Permanent identification of all vaccinated cattle with tattoo “V” in the right ear, preceded by numeral of the quarter of the year and followed by the last number of the year. A calf vaccinated in December 1947 would be marked “4V7”, or hot iron brand on the right jaw, “CV” for vaccinated calves and “AV” for vaccinated adults. Special ear tags should also be used in the right ear of all vaccinated animals, to aid in recognizing them.

9. A future date should be set after which no female cattle or breeding bulls more than 6 months of age shall be sold, except for slaughter, unless such cattle either

(a) have been tested for brucellosis and found negative within 30 days prior to the date of sale, or

(b) are under 24 months of age and were vaccinated against brucellosis with an approved vaccine when they were not less than 6 months nor more than 8 months of age and were identified as provided in paragraph 8 and reported at the time of vaccination to State and Federal cooperating agencies, excepting beef cattle in range or semi-range areas which may be vaccinated not less than 6 months nor more than 12 months of age, or

(c) are in a brucellosis-free accredited herd or area at the time of sale. Accredited herd certificates shall be issued only by the Bureau of Animal Industry, United States Department of Agriculture, and State Livestock Sanitary officials, under provisions adopted by the United States Livestock Sanitary Association and approved by the Bureau of Animal Industry.

10. Legislation should be broad enough to authorize promulgation of regulations by State livestock sanitary authorities after hearings before representative livestock producers, public health authorities, and veterinarians to include the following methods of procedure for eradicating brucellosis:

Plan A. Test-and-slaughter; with or without calf vaccination.

Test-and-slaughter has the advantage of being a short-time program, since many lightly infected herds may be freed and remain free of the infection after a limited number of tests. Where negative herds are surrounded by heavy infection, the advantages of calf vaccination should be explained.
Test-and-slaughter is recommended for infected herds in which the immediate removal of reactors will not cause serious economic losses, provided owners appreciate fully the necessity of following recognized sanitary procedures. These procedures must include prompt removal of reactors, thorough cleaning and disinfection of barns or buildings in which reactors have been kept, and retests at frequent intervals not to exceed 30 days until the disease has been eradicated.

Test-and-slaughter is apt to be unsuccessful unless all of these procedures are followed. However, it has been successful in thousands of herds where suitable precautions have been observed.

Calf vaccination should be encouraged in infected herds and areas, but shall not be a substitute for sound sanitation and management, and it should be explained that failure to follow sound management practices, so far as replacements are concerned, accounts for most of the breaks in clean herds. Owners should be warned that as is true in many other disease control programs, occasional herds do not respond satisfactorily.

**Plan B.** Test, calf vaccination; temporary retention of reactors until they can be disposed of for slaughter without excessive loss to the owner under provisions of the law.

The objective should be to dispose of reactors for slaughter as soon as possible. Full recognition is given to the fact that vaccinated calves will not all be resistant. However, with a high percentage of vaccinated animals having an increased resistance to brucellosis, the percentage in favor of vaccination is sufficient to support its wider use.

**Plan C.** Calf vaccination without test of any part of the herd. This plan to be confined to those herds restricted in movement except under permit from proper livestock sanitary official.

**Plan D.** Adult vaccination, only when approval is received in writing from State and Federal cooperating agencies prior to the time of vaccination, which should be confined to herds where there is evidence of rapid spread of virulent infection indicating the need for emergency measures, and only after the owner has been informed in writing that the vaccinating of his adult animals may not prevent the spread of infection. In herds where adult vaccination is adopted, the herd must be subjected to the agglutination test prior to vaccination, reactors identified as provided for in paragraph 3, and vaccine administered only to negative animals within 10 days after the completion of the official test.

11. Reactors will be classified as under present policies of the United States Bureau of Animal Industry, except that calves vaccinated from 6 to 8 months identified as outlined in paragraph 8, and reported at the time of vaccination to State and Federal cooperating agencies, shall not be classed as reactors until after reaching the age of 2 years.

**EDUCATIONAL POLICIES**

Education should be promoted as follows:

All properly verified facts concerning the disease and methods of control should be kept before the public under the direction of those trained in disseminating information. This should include bulletins and leaflets more attractively illus-
trated, based on and confined to our present knowledge of the disease which has been properly verified by research and practical application; moving pictures; news releases; radio programs; and all known methods of publicity.

It is recommended that the President of the United States Livestock Sanitary Association and the Chief of the Bureau of Animal Industry appoint for immediate action a joint committee of livestock sanitary officials and research workers to prepare a bill of proven facts explaining the foundation for the foregoing recommendations for State legislation.

Frequent group meetings should be held, led by regularly employed State or Federal cooperating veterinarians, in the interest of eliminating confusion.

All properly verified useful information which becomes available through research should be disseminated, in connection with the control of brucellosis in other animals, including swine, goats and sheep.

When these plans have been adopted by the United States Livestock Sanitary Association, and approved by the United States Bureau of Animal Industry, they shall be made a part of the memorandum of understanding between the United States Bureau of Animal Industry and the cooperating States.

**Swine brucellosis**

The United States Bureau of Animal Industry anticipates the release soon of a statement on Swine Brucellosis which is designed to serve as a preliminary guide to veterinarians and swine raisers for the control of this disease.

**CONTROL OF BRUCELLA Abortus VACCINE (STRAIN 19) AND BRUCELLA ANTIGEN**

In accordance with following resolution adopted by the National Association of Commissioners, Secretaries and Directors of Agriculture, this Committee urges this Association to inaugurate and carry out appropriate action to accomplish the designated objectives:

**WHEREAS;** the uncontrolled distribution, sale and use of brucella abortus vaccine (strain 19) and brucella antigen interfere with the diagnosis of brucellosis and the safe, orderly movement of cattle;

**BE IT RESOLVED:** That the Secretary of the United States Department of Agriculture be requested to promulgate the necessary regulations requiring manufacturers and distributors of brucella abortus vaccine and brucella antigen to render a concurrent report to the chief livestock sanitary official of the State of destination covering all sales and distributions of such products.
INTRODUCTION

Losses directly attributable to bovine venereal trichomoniasis, currently being experienced by the cattle raisers of the United States, cannot be precisely determined because the distribution and incidence of infected herds are unknown. Although this disease has been recognized in almost every State, only in Wisconsin have efforts been made to determine its occurrence and relative importance. Morgan, of the University of Wisconsin, reports that in the 6 years from 1941 to 1946, 61 infected herds were found by the University's diagnostic service (5).

In the area within approximately 100 miles of the Agricultural Research Center, Beltsville, Maryland, 9 trichomonad-infected herds, having a total of more than 800 cattle, have been observed by members of the Zoological Division since 1943. Of these, 4 were purebred Aberdeen Angus; 2 were Guernsey, 1 purebred and 1 grade; and 3 were Holstein-Friesian, 1 purebred and 2 grade. These herds are in no way a significant indication of the occurrence of bovine venereal trichomoniasis in our area, as we have been making no special effort to locate infected herds. Their owners solicited the professional aid of either the University of Maryland Livestock Sanitary Service or the U. S. Bureau of Animal Industry. Nevertheless, we believe the financial reverses experienced in these 9 herds to be highly significant. Two hundred thousand dollars is a conservative estimate of the loss of potential production of milk and calves and the loss of value of infected sires up to the time that bovine venereal trichomoniasis was recognized as responsible for the reproductive failures in these infected herds.

Table 1 is a condensed version of a detailed graphic analysis of significant factors relative to the reproductive operations in one of the herds studied. This was a herd of grade Holstein-Friesians and was operated by a public institution to supply milk for use at the institution. On study of these data, the marked adverse alterations of each category during the period of infection are readily apparent. The disastrous consequent effects upon the economy of this herd are obvious. By impairing reproduction, bovine venereal trichomoniasis strikes at the fundamental operation of cattle husbandry.

NATURE OF THE DISEASE

It is extremely unfortunate that bovine venereal trichomoniasis is so generally considered primarily an "abortion disease," incidentally associated with pyometra, genital discharges, and vaginitis. Our studies of experimentally infected females
indicate that these obvious symptoms occur in relatively few affected heifers and cows. Furthermore, in none of the 9 infected herds which have been studied in detail, was the owners' complaint the occurrence of abortions or genital discharges. Rather, their complaints were that many females, heifers in particular, had failed to settle despite frequent services, that those females that were settled had required many services, and that some females when thought to be settled had returned to heat. They were unaware of the occurrence of the symptoms most frequently described as characteristic of trichomoniasis. Re-examination of the nature of this disease and placing of its various manifestations in their relative order, there-

### Table 1.—Ten-year summary of reproduction in Herd A

<table>
<thead>
<tr>
<th></th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
<th>1940</th>
<th>1941</th>
<th>1942</th>
<th>1943</th>
<th>1944</th>
<th>1945</th>
<th>1946</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average ♀♀ per month in breeding herd</td>
<td>67</td>
<td>66</td>
<td>68</td>
<td>72</td>
<td>74</td>
<td>77</td>
<td>66</td>
<td>62</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>No. susceptible ♀♀ added during year</td>
<td>7</td>
<td>9</td>
<td>14</td>
<td>12</td>
<td>11</td>
<td>23</td>
<td>15</td>
<td>8</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>No. ♀♀ dropped during year</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>15</td>
<td>16</td>
<td>30</td>
<td>13</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>No. services or inseminations</td>
<td>104</td>
<td>97</td>
<td>109</td>
<td>117</td>
<td>130</td>
<td>204</td>
<td>206</td>
<td>137</td>
<td>103</td>
<td>93</td>
</tr>
<tr>
<td>No. recognizable pregnancies initiated</td>
<td>60</td>
<td>53</td>
<td>59</td>
<td>57</td>
<td>37</td>
<td>51</td>
<td>38</td>
<td>47</td>
<td>54</td>
<td>52</td>
</tr>
<tr>
<td>No. calves</td>
<td>66</td>
<td>53</td>
<td>55</td>
<td>59</td>
<td>58</td>
<td>36</td>
<td>36</td>
<td>44</td>
<td>56</td>
<td>55</td>
</tr>
<tr>
<td>Average lag in days per pregnancy from 1st coitus to initiation of a recognizable pregnancy or last coitus prior to disposal</td>
<td>28</td>
<td>28</td>
<td>33</td>
<td>39</td>
<td>72</td>
<td>121</td>
<td>141</td>
<td>38</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Average of percentage of days of normal reproduction per month</td>
<td>90</td>
<td>86</td>
<td>89</td>
<td>87</td>
<td>76</td>
<td>57</td>
<td>51</td>
<td>78</td>
<td>88</td>
<td>87</td>
</tr>
</tbody>
</table>

Bovine venereal trichomoniasis probably introduced June 1941.
Bovine venereal trichomoniasis diagnosed September 1943.
1 Condensed version of Figure A (1).

Bovine venereal trichomoniasis is caused by the flagellate protozoan, *Trichomonas foetus*. It occurs naturally only in cattle, and is transmitted ordinarily only at coitus. However, mechanical transfer can occur readily through artificial insemination with semen from infected bulls as well as through genital examinations by a careless operator. Isolated incidents of supposed non-venereal transmission of trichomoniasis occurring under natural conditions have been reported. Our observations, however, have indicated that such cases, if they occur, are exceedingly rare and our experiences have evinced that under practical conditions non-venereal transmission needs no consideration.

The disease is invariably a herd or breeding unit problem. It cannot occur...
sporadically in either individual females or bulls. If an infected bull is in service, he is infecting most of those susceptible females with which he has coitus. Likewise, presence of an infected female member of a herd is indication that an infected bull is in service and that other infected females have been, are, or will be present. The only exceptions possible are animals recently added to a herd, or those exposed through natural "outside" service or through artificial insemination with semen from an "outside" source. Such infected animals must properly be considered members of other breeding units.

In bulls, T. foetus ordinarily lives only on the surface of the penile and preputial membranes, produces no symptoms of infection significant in diagnosis, and, ordinarily, affects neither his fertility, nor, appreciably, his potency. Bulls remain permanently infected, transferring T. foetus at practically every coitus.

Trichomoniasis in bulls does not alter the probability of their initiating pregnancies in uninfected females. However, should infection develop in an exposed, susceptible female in which a pregnancy was initiated the conceptus is usually killed, the time of its death largely governing the specific symptoms produced.

In females, the uterus is the definitive and persistent site of infection. The vagina apparently develops a local immunity as a result of its short initial parasitic attack, subsequently (a) playing only a passive, inconsequential role in the progress of the disease in the affected female, and (b) providing a relatively unreliable source of T. foetus for diagnosis. Epizootiologically, however, the vagina's role is very important as this organ harbors T. foetus during infection at the time of estrum and furnishes at coitus the place of contact for bulls. Vaginal immunity is responsible for the rapid disappearance from the vagina of trichomonads originating from the uterus, where the infection persists. Later, when the uterus likewise becomes resistant to T. foetus, the infection is terminated. Acquired immunity of either or both organs is believed responsible for the variations in course and symptomatology of re-infections, and the ability of most recovered females to reproduce normally despite the sire's infectivity.

The majority of females experiencing initial infections return to estrum within 3 to 5 weeks post coitus, indicating either very early termination of pregnancy or failure to become fertilized. A catarrhal trichomonad endometritis then persists for 5 or 6 months, the estrual cycle being essentially regular, and a state of temporary infertility existing. In some females the conceptus may develop for 2 or rarely 3 or 4 months before it is killed. Such females either resume cyclical estrums subsequent to aborting their conceptus or discharging it liquefied as pus, or, should the corpus luteum of pregnancy persist, they may develop frank pyometra of indefinite duration. Previously infected females tend, on reinfection, toward the latter types of cases, their pregnancies advancing further before being terminated. Occasionally, pregnancies have been observed to proceed apparently unaffected despite infection; also, appearance of T. foetus during the postpartum period has been reported.

Most recovered females are resistant to reinfection for one to several years and may reproduce normally from coitus with infected bulls. However, in individual females, the duration of this immune period is unpredictable. Immunity is not developed as a female grows older, as was once thought to be the case, previously uninfected aged cows being at least as susceptible as virgin heifers.
Genital discharges in trichomoniasis are uterine in origin and may occur irregularly from those females in which time and circumstances have permitted pus to accumulate. Such cases are relatively infrequent among those affected. Trichomonad discharges are always *post coital* rather than postpartum and the pus is never putrescent. Vaginitis due to *T. foetus* is not sufficiently characteristic or consistent in occurrence to consider in diagnosis.

It is possible that variations in virulence in strains of *T. foetus* may exist and that such variations may be reflected in altered symptomatology. Strains that require longer in developing their populations would obviously tend to produce more recognizable abortions and instances of pyometra.

In this discussion of recognition of trichomonad-infected herds only the features of the disease of importance in diagnosis will be considered. Detailed descriptions of the diagnostic techniques employed have been previously published (3, 6).

![Fig. 1.—Vaginal and preputial pipettes used for collection of samples to be examined for *T. foetus*

**RECOGNITION**

Herd experiencing reproductive failures should be suspected of *T. foetus* infection:
(a) when most females—in newly infected herds—, or most heifers and some cows—in herds with long standing infection—, require several services before becoming recognizably pregnant; (b) when the intervals between calvings are found in many otherwise apparently normal females to be markedly extended despite regular service; (c) when unexpected return to estrum of females thought pregnant is a relatively common occurrence; and (d) when, in addition to the foregoing,
instances of the less frequently occurring, but more dramatic symptoms of trichomoniasis are observed in some females, such as, early abortions, occasional discharges from the genitals of odorless, mucoid pus, particularly when lying down, and known instances of postcoital (not postpartum) pyometra. In some herds, none of these symptoms may have been evident, or, at least, careful questioning of the owners fails to reveal them. Their importance in the total picture of trichomoniasis is frequently relatively minor.

Positive herd diagnosis rests wholly on identification of T. foetus in the genital exudate of any animal that has participated in the herd's breeding operations. Identification of T. foetus is not difficult once an examiner has become thoroughly familiar with this organism as it appears in the various natural exudates. A few hours spent in actual concentrated study of T. foetus containing material are more valuable than formal acquaintance with the entire gamut of protozoology. Contaminant protozoa requiring critical differentiation are infrequent in samples meticulously collected with sterile equipment and examined within a few hours after collection. Culture media afford no advantage in diagnosis. Diagnoses made on symptomatology alone or attempts at remedial action before first demonstrating the etiological agent are manifestly irrational, since there are, unfortunately, other genital disorders of obscure nature which can produce a clinical picture resembling

Fig. 2.—Distribution of T. foetus on the genital membranes of bulls¹

Average number of T. foetus per cc. in scrapings from designated areas taken at monthly intervals from genital membranes of trichomonad-infected bulls²

<table>
<thead>
<tr>
<th>Area</th>
<th>Bull 208 Average of 5 scrapings</th>
<th>Bull 207 Average of 5 scrapings</th>
<th>Bull 214 Average of 4 scrapings</th>
<th>Average of all scrapings</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>1,720</td>
<td>224</td>
<td>350</td>
<td>744</td>
</tr>
<tr>
<td>B</td>
<td>27,626</td>
<td>582</td>
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<td>C</td>
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<td>1,601</td>
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<td>D</td>
<td>616</td>
<td>236</td>
<td>15</td>
<td>288</td>
</tr>
<tr>
<td>E</td>
<td>1,514</td>
<td>140</td>
<td>22</td>
<td>557</td>
</tr>
</tbody>
</table>

¹ Figure 1 (2).
² Condensed version of Table 1 (2).
trichomoniasis in many respects. In some instances the diagnostician may be so fortunate as to be presented with an aborted embryo or fetus, or perhaps some pus discharged from a female. Should he identify *T. foetus* in this material no more need be done, because the herd diagnosis is thereby established; but, the diagnostician should not expect to be so fortunate often. Usually, a planned search for the organisms in suspect animals is necessary.

We believe that most accurate results can be expected when genital samples are collected with pipettes of the type shown in Figure 1. These pipettes may be constructed of 8 mm pyrex glass tubing, are easily sterilized, very efficient, relatively durable, and safe.

![Graph 1](image1.png)

**Occurrence in vaginal samples when return to estrus was early and estrual cycle was resumed**

Sample from bulls are collected by scraping the surface of the glans penis with the preputial pipette and then flushing the smegma obtained from the pipette into a test tube of physiological saline solution. No fluid is introduced into the preputial cavity. Samples from females are collected by introducing a vaginal pipette containing 5 to 7 cc. of physiological saline into the vagina, compressing the bulb several times to flush the vagina, and then withdrawing the sample and ejecting it into a test tube.

In collecting samples for examination, cognizance must be taken of the factors established as those of greatest importance to accurate diagnosis in each sex. In bulls, this factor is the precise source of the material selected for examination, in females it is the time of collection of the sample in relation to the exposure of the

![Graph 2](image2.png)

**Occurrence in vaginal samples during pregnancy**

A = Estrus

**Fig. 3.—Fluctuations in populations of *T. foetus* in the bovine vagina during initial infection**

Samples from bulls are collected by scraping the surface of the glans penis with the preputial pipette and then flushing the smegma obtained from the pipette into a test tube of physiological saline solution. No fluid is introduced into the preputial cavity. Samples from females are collected by introducing a vaginal pipette containing 5 to 7 cc. of physiological saline into the vagina, compressing the bulb several times to flush the vagina, and then withdrawing the sample and ejecting it into a test tube.

In collecting samples for examination, cognizance must be taken of the factors established as those of greatest importance to accurate diagnosis in each sex. In bulls, this factor is the precise source of the material selected for examination, in females it is the time of collection of the sample in relation to the exposure of the
female. Also, in bulls the primary site of the infection is sampled, whereas in females the vagina is sampled, which organ plays a role sometimes correlated with but not reflecting the activity of the parasites in the uterus, the latter being the primary site of infection.

Experimental studies of infected bulls have shown clearly the area of genital membrane harboring the relatively greatest accessible population of *T. foetus*, as shown in Figure 2. Samples should be collected from the surface of the glans and surrounding prepuce only. Introduction of any fluid into the preputial cavity or swabbing will collect extraneous debris from low population areas. This increases the difficulty of microscopic examination and introduces more or different bacteria which seem to shorten the life of *T. foetus* in samples (3).

<table>
<thead>
<tr>
<th>BULL NO.</th>
<th>RATIO AND PER CENT OF SAMPLES CONTAINING <em>T. FOETUS</em></th>
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<tbody>
<tr>
<td>214*</td>
<td>49:57 85.96</td>
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<tr>
<td>207</td>
<td>168:199 84.92</td>
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<td>93:116 80.17</td>
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<td>54:68 79.26</td>
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<tr>
<td>193</td>
<td>52:66 78.80</td>
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<td>274</td>
<td>60:91 65.98</td>
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<tr>
<td>214</td>
<td>10:16 62.50</td>
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<tr>
<td>275</td>
<td>31:51 60.78</td>
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<td>218</td>
<td>8:41 19.50</td>
</tr>
<tr>
<td>261</td>
<td>4:47 8.51</td>
</tr>
</tbody>
</table>

* 2nd infection.

1 Condensed version of Table 1 (3).

Studies of many experimentally exposed females have evinced that failure to demonstrate *T. foetus* in daily vaginal samples, up to several weeks, is not necessarily an indication of the true status of an infected female except following initial exposure. After the initial vaginal phase of infection, the vaginal tissues are able rapidly to destroy those trichomonads periodically discharged from the uterus.

Figure 3 shows the results of daily examination of vaginal samples from 2 females during initial infections. Typically, following a short prepatent period, the patterns of appearance of trichomonads in the vagina are essentially consistent during the vaginal phase of infection which lasts usually up to about 4 weeks *postcoitus*; thereafter, the pattern is sometimes less predictable. In the case of females that return to estrum early and continue with regular estrual cycles (181), the pattern of trichomonad fluctuations is correlated with the estrual cycles. In females with interrupted estrual cycles (238), there is no such rhythm. Should these same animals have been re-exposed at regular breedings during subsequent years, their vaginal pictures would have been unpredictable, not only because from most re-
exposures no infection would have resulted, but because true vaginal infection would not necessarily have recurred even if re-infection resulted.

Table 2, showing the results of examination of a total of 800 preputial samples collected weekly from 10 infected bulls (12 infections), likewise indicates the problem involved in determining the status of individual bulls by sampling.

Rapid, accurate, "one sample" determination of the status of neither individual bulls nor individual females is possible with the diagnostic techniques now available. This fact is the outstanding deterrent to effective interherd control of bovine venereal trichomoniasis extant.

**INTRAHERD ERADICATION**

Eradication of trichomoniasis from infected herds involves steps as follows: (a) recognizing infected bulls and promptly withdrawing them from service; ideally, subsequent to successful treatment these previously infected bulls are restored to service. (b) maintaining a breeding program for all females in the herd, regardless of their status, and systematically breeding each potentially infected female when she becomes free of infection and preventing her re-exposure.

Treatment of trichomonad-infected bulls is still on an experimental basis, but two methods subjected to limited but carefully controlled experimental trials have shown considerable promise. These are (a) intravenous administration of large doses of sodium iodide, and (b) topical application of a German developed proprietary product, "Bovotavin-Salbe." The former method was developed at Beltsville by the author of this paper; the latter by Abelein of the Veterinary Clinic at Munich. Abelein states that he treated more than a hundred infected bulls with this material and that he cured a majority of them. His report indicates that the product has merit, but since his post-treatment testing procedure was inadequate, the relative efficacy of the product cannot as yet be evaluated. Results of our experiments employing these two methods are shown in Table 3. It is apparent that at present the "Bovotavin-Salbe" technique shows the greater efficacy. However, evidence exists that the efficacy of the sodium iodide treatment can be improved; if so, it would have the decided advantage of ease of administration as compared with the topical technique. The latter requires very careful manipulation of the penis while the bull is under epidural anesthesia, either cast, or by a special procedure, in the standing position. Treatment of bulls by either method is a lengthy, exacting, and costly procedure requiring frequent handling and observation of the subject over a period of 6 months or more by a veterinarian familiar with trichomoniasis. Infected bulls not of exceptional value as sires should always be promptly slaughtered. Nevertheless, the economic feasibility of treatment of selected infected bulls is clearly demonstrated by the fact that in our experiments, 11 of the bulls which were privately owned and valued at $27,000 or more, have been restored to service in their respective herds of origin. Details relative to the techniques for carrying out the chemotherapeutic measures in bulls have been described elsewhere (4, 7).

For females no chemotherapeutic measures capable of modifying the course of infection have been developed. Therefore, it is logical to take advantage of the self-limiting nature of the disease, and accomplish eradication from all the females
by a systematic scheme of controlled breeding practices in the herd. This scheme is based on knowledge of the fundamental characteristics of the course of infection in females. Although most females are free from infection before a successful pregnancy is initiated, occasional ones may continue gestations despite existing infec-

Table 3.—Results of experimental treatment of trichomonad-infected bulls

<table>
<thead>
<tr>
<th>BULL NO.</th>
<th>TRIAL ONE</th>
<th>TRIAL TWO</th>
<th>TRIAL THREE</th>
<th>TRIAL FOUR</th>
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<tr>
<td>B††</td>
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“Bovoflavin-Salbe”

<table>
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<th>TRIAL TWO</th>
</tr>
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<tbody>
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<tr>
<td>302</td>
<td>Success</td>
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</tr>
</tbody>
</table>

† Second infection
‡† Cases reported by Sippel et at. (9)
* Potassium Iodide orally
** Sodium Iodide intravenously followed by potassium iodide orally

1 Condensed versions of Tables 1 and 2 (4).

...tion. However, most of these latter lose their infections before parturition. In very exceptional instances T. foetus has been reported present in the vagina as long as 6 weeks following calving.

The premise on which the scheme operates is that (a) subsequent to completion of a normal pregnancy, (b) passing 2 estrums, and (c) resting at least 90 days post partum, previously infected females may be safely permitted coitus with unin-
Fig. 4.—Diagrammatic representation of a hygienic breeding program for elimination of bovine venereal trichomoniasis from an infected herd.
BOVINE VENEREAL TRICHOMONIASIS

Infection persists in a female several years and through 2 apparently normal pregnancies before causing termination of a third pregnancy and abortion (8). Such an occurrence has not been observed by any other worker. In our opinion this report should be kept in mind while proceeding for the present on the practical premise described.

Figure 4 shows the system of hygienic breeding which embodies the premise and several other principles and practices. It is fully discussed elsewhere (1). This program is neither entirely new nor original. Rather, it is a new method of presentation intended to simplify the procedures employed in handling the females in infected herds. The program has been installed in 8 herds. In 2 herds that have been under constant supervision since 1943, the disease has not reappeared. In 4 other herds in which it was not possible to carry on such detailed observations, results were equally effective. In another herd, sufficient time has not yet passed to permit critical evaluation. On one herd trichomoniasis was again found 2 years subsequent to the installation of the program. In this herd instructions relative to withholding services postpartum were not followed. Also, an aged bull, the one later found infected, had been introduced into the herd without prior determination of his status. It appears more probable that the presence of this disease was the result of failure to carry out the program rather than the result of a "leak" in the program itself.

INTERHERD CONTROL

Herd owners introducing animals for breeding may afford their herds considerable protection by observing a few principles and precautions, namely: (a) Knowledge that the reproductive efficiency in the herd of origin is satisfactory is an excellent safeguard against selecting infected cattle. (b) Thorough examination of new suspect bulls by the diagnostic methods now available and examination of the first several females with whom he is permitted coitus are indicated. (c) By prohibiting coitus of new, non-virgin, non-pregnant heifers, and of new, non-pregnant cows
that have had coitus since their latest parturition, introduction of trichomoniasis by females is precluded. The breeding of such females should be accomplished by artificial insemination only. New cows that have not had coitus since their latest normal parturition, should be withheld from coitus until they have passed at least 2 estrums and rested at least 90 days postpartum.

So far as can be determined, no regulatory agency has dignified bovine venereal trichomoniasis by specific mention in regulations governing quarantine of infected herds or movement of member animals. Trichomoniasis is covered generally, however, by the usual prohibition against movement of animals harboring infectious contagious, or communicable diseases. Field reports make readily apparent that interherd transmission of trichomoniasis is occurring frequently, incident to the movement for breeding purposes of purebred livestock. It is equally evident that our present sanitary regulations are not effectively preventing further dissemination. Evidence of freedom from trichomoniasis is not ordinarily stipulated in the terms for entry of breeding stock in public sales. Instances are known, however, of occasional sales by private treaty when freedom from trichomoniasis has been guaranteed and specific arrangements made governing diagnosis.

The lack of an accurate, rapid, and more practical means of determining the status of individual cattle, particularly bulls, is obviously our greatest handicap in trichomoniasis control. Only through further, intensified research will come improvement of the present methods. However, for the present, more general utilization of available methods is desirable. The tremendous losses experienced when bovine venereal trichomoniasis is introduced into a herd more than justifies the considerable effort necessary to assure against such an eventuality.

**SUMMARY AND CONCLUSIONS**

1. Paucity of data relative to occurrence of bovine venereal trichomoniasis in the United States precludes estimation of the total annual losses. However, in infected herds losses in potential production and loss of value of infected herd sires are exceedingly high.

2. Bovine venereal trichomoniasis is a disease of cattle caused by the flagellate protozoan, *Trichomonas foetus*, characterized in the bull by its permanent nature and absence of symptomatology, and in the breeding female by early termination of pregnancy with early return to estrum and temporary infertility. Abortion or pyometra in the female sometimes occurs. Females recover spontaneously; after an appropriate rest interval postpartum they may be considered free from infection.

3. Careful study of the breeding records will reveal suggestive information in infected herds. Diagnosis is dependent upon demonstration of the etiological agent in samples of genital exudate, usually, careful selection of suspect females being necessary.

4. Infected bulls must be withdrawn from service. Slaughter or application of one of two experimental treatments, intravenously administered sodium iodide or "Bovoflavin-Salbe", is indicated. Infection may be eliminated from females by a hygienic system of breeding.

5. Increased utilization of our present methods of diagnosis in locating infected cattle and increased efforts in preventing interherd movement of trichomonad-infected purebred breeding stock are indicated.
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CATTLE GRUB ERADICATION

H. R. Smith, B. S.

General Manager, National Live Stock Loss Prevention Board, Chicago

At no period in history has there been a greater shortage of food for the peoples of the World than now. We in America, who have been more fortunate, are doing our utmost to send all we can possibly spare to the starving people of Europe and Asia. In our efforts to produce more we must, at the same time, strive to conserve food by eliminating waste.

From records we have available, there was lost for human consumption in the United States in 1946 a total of approximately 154,000,000 pounds of meat from animals which died or were crippled in transit, bruised in marketing, and on carcases condemned as inedible for disease. It would be impossible to eliminate completely these losses, which are indirectly borne by producers in large part, but they can be greatly reduced. If we could estimate as accurately the waste of meat from animals that die from disease on our farms and ranches, the total loss would be amazing.

The U. S. Livestock Sanitary Association and the veterinary profession in general, have performed a notable service in combating all diseases for the common good. We need many more well trained men to safeguard still better this industry which means so much to the nation. I have been asked to discuss today one large item of waste and modern effective means of reducing it to a minimum.

Cattle grubs, also called "warbles" and "wolves" have been a pest in this and other countries for years. Some have shown little concern because they have not been conscious of the full extent of the losses caused by these parasites. Ranchmen do see their herds stampede, going over fences and other obstacles, frequently resulting in serious injuries, when heel flies make their appearance in the spring. Here is a photo of dairy cattle, with tails high in the air, running away from heel flies. However, it is not known to what extent meat and milk production are reduced by the irritation as the larvae, hatched from the eggs deposited on the hair, burrow through the skin and through the tissue on their way to the gullet and thence to the back, occupying a period of approximately nine months.

Practically every cattleman has had the experience of pressing out grubs and knows of the irritation and pain that must take place when the holes are cut through the sensitive skin. We have records of 300 or more grubs taken from the back of one animal. I have in mind a cow so weak from heavy grub infestation that she could not get on her feet for several days after their removal and had to be fed and watered while lying down.

MEAT WASTED

What a revelation it would be if more producers would visit the coolers during the season of the year when the greatest damage is being done to see grub infested cattle, after slaughter, with the loins showing masses of yellow gelatinous meat unfit for human consumption. It is estimated that each year not less than 12,000,000
pounds of the most valuable part of beef carcasses are trimmed out around grub holes from cattle slaughtered in the United States. But this waste is only half the story. The trimming so detracts from the appearance that the entire cut sells at a lower price per pound.

**HIDES DAMAGED**

Then the producers should visit the hide cellars to observe the damage to this valuable byproduct. I have here a section of calf hide peppered with grub holes. Look at this shoe sole from the best and thickest part of the hide completely punctured with grub holes and of no value. We have in our office many samples received from tanners and shoe manufacturers which are sent to agricultural colleges, county agents, and vocational teachers of agriculture in the various states for demonstration purposes.

In the trade, it is customary to discount a hide 1 cent per pound if it contains 5 or more grub holes. Records received from the Tanners’ Council of America reveal that 38 per cent of the hides from all native steers slaughtered at Chicago, Kansas City, Omaha, Sioux City, South St. Paul and St. Louis during the first half of 1947 were sold at this discount because of grub damage. Branded steers at the same markets averaged 59 per cent, indicating a greater damage in range territory than in the farming areas. These data also show approximately the same percentage of native cow hides damaged by grubs, and the same increase in the percentage of branded cow hides damaged.

At the South St. Paul market the damage to native steer and cow hides is much less than at the other markets partly because of the large area in the Red River Valley in western Minnesota and eastern North Dakota where the grubs, deposited on the level ground, often wet, are killed before the flies emerge. However, the percentage of branded hides damaged by grubs at the South St. Paul market is nearly as high as at the other markets named.

Data for the second half of this year show a smaller percentage damaged during July and August though the loss on hides is continuous throughout the entire year and is especially heavy in the southern states during the fall months. A year ago last October I inspected beef carcasses in San Antonio, Texas, coolers at which time many of them showed the presence of grubs. The damage in the far west and in the southwest is just as great as at the markets named. It is somewhat less in the east and southeastern parts of the country. However, it is conservative to say that at least one-third of all cattle hides produced in the United States during 1946 were so damaged by grubs that they had to be sold at a discount.

The Tanners’ Council of America estimated the loss on hides last year at $20,000,000. In Farmers’ Bulletin No. 1596, published in 1929, the U. S. Department of Agriculture estimated the total annual loss caused by grubs as between $50,000,000 and $100,000,000 per year. It was wise to give this wide range because of the inability to estimate the losses resulting from lowered meat and milk production. If the loss was nearly $100,000,000 then, it is certainly above that figure now because of the larger number of cattle slaughtered (14,080,279 under federal inspection during the fiscal year 1947), an increase in the prevalence of grubs, and the much higher price of meat wasted and hides damaged.
While the loss to the cattle industry from the ravages of grubs has been very large for many years, little progress has been made in the eradication of this pest until recently when it was discovered that rotenone, contained in the roots of the cube plant produced in South America and the derris plant in the East Indies, is very effective as a killing agent. This is one of the roots of the cube plant from Peru. These imported roots, containing about 5 per cent rotenone, are ground to a dust in this country and are distributed through regular trade channels. It is applied to the backs of cattle, after the openings appear, as a dust, a wash, a spray, or a dip. The dust or wash are used on small herds. The U. S. Department of Agriculture recommends mixing the dust with tripoli, pyrophyllite, or volcanic ash in proportions of 1 pound of the dust to 2 pounds of one of these forms of earth. Approximately 3 ounces are required for each animal, depending upon size. The mixture is applied with a shaker can or a glass jar with about 15 holes about one-quarter inch in diameter, punched outward through the lid. It is rubbed in the holes by a rotary motion of the finger tips rather than with the flat hand or a brush, which tends to brush the powder away instead of down through the hair into the openings. Because the holes are not cut through the hide during one relatively short period, some making their appearance later, it is necessary to apply the treatment twice or three times, about 30 days apart. In the northern states where both the *Hypoderma lineatum* and the *Hypoderma bovis* are found, it is often necessary to treat cattle more than three times because holes made by the *bovis* specie come later in the season.

The wash, made by mixing 12 ounces of the dust with 2 ounces of granular laundry soap and 1 gallon of warm water, can be applied by the use of a hand brush. With larger herds, the spray method is much in favor. A power-operated orchard sprayer capable of maintaining a pressure of at least 400 pounds at the nozzle is used. It is equipped with at least 50 feet of high-pressure hose and a trigger-operated spray gun with a \( \frac{1}{4} \) inch nozzle opening. If more powerful sprayers are used, they may be equipped with two leads of hose and two spray guns. Strong but not too violent agitation in the tank is essential to keep the powder in suspension. The cattle are run through an ordinary chute provided with a catwalk the full length. In many of the states preference is given to pens about 8 feet wide and any length desired with catwalks around it so that the operator can spray the backs of all the cattle with the nozzle not more than 12 to 16 inches above the animal. A solid stream, applied with high pressure, is wasteful and may injure the tissue of the grub cysts, whereas a spray too fine will not penetrate the dense hair often found on range animals. One hundred gallons of the spray will treat 100 to 125 animals, depending upon their size and the density of their coats. The mixture recommended by the U. S. Department of Agriculture for spraying is 7\( \frac{1}{4} \) pounds of 5 per cent cube or derris to 100 gallons of water.

The dipping method is in use largely in the south where many vats are available, some having been used for the eradication of fever ticks. This method is best suited for range animals where the winters are not severe. The formula recommended consists of 10 pounds of cube or derris containing 5 per cent rotenone, 2
CATTLE GRUB ERADICATION

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ounces of wetting agent (sodium lauryl sulfate) and 100 gallons of water. The dip is more effective when prepared a few hours before use. It should be thoroughly stirred for uniform suspension. The dip has one advantage in that the entire body is submerged to kill the lice at the same time. If complete lice eradication is desired, the cattle should be dipped about 16 days after the first dipping to destroy the lice that hatch from eggs on the hair when first dipped, then 30 days after that for a third treatment to kill the remaining grubs. The dipping method is used quite extensively in Texas where the grub holes make their first appearance in the southern part of the state about November 1, at which time the first treatment should be given.

NUMBERS TREATED

According to surveys made by the U. S. Bureau of Entomology, a total of approximately 3,000,000 cattle were treated for grubs in the United States by these different methods during the 1944-45 season, 4,000,000 in 1945-46, and 7,000,000 during the past 1946-47 season. Enough individual herds have now been treated to prove its effectiveness. The fact that the number has steadily increased each year indicates that farmers and ranchmen who have tried it, are well satisfied with the results. In many herds over 90 per cent of the grubs have been killed in one season's treatment.

A discouraging feature in the treatment of isolated individual herds is that there is almost certain to be some reinfection from the untreated infested herds on neighboring farms or ranches. Entomologists say that the heel fly that deposits the eggs does not move through the air more than a mile, but this will result in reinfection to adjoining herds that may have been made free.

COUNTY AREA TREATMENT

Just as tuberculosis in cattle has been eradicated to the extent of 98 per cent, as revealed by statistics from the Division of Meat Inspection of the U. S. Bureau of Animal Industry, accomplished largely through the county area plan of testing, so will it be possible to eventually eradicate cattle grubs almost completely from the nation under the area plan whereby all cattle in the area will be given a sufficient number of treatments to accomplish the results desired. To be successful, it must be a community project.

Such a demonstration was recently made by the U. S. Bureau of Animal Industry on all herds in three adjoining townships in Colorado where 97 per cent of the grubs were killed, as determined by actual count, the first season of treatment. As expected, there was some reinfection from untreated herds on the outer edges of that area.

There will, of course, be some reinfection around the outer edges of a county, but this will be greatly reduced as adjoining counties are cleared of this parasite. To accomplish this, it will be necessary to have the voluntary consent of every owner in a county where such a demonstration is made. There is reason to believe that because of the results obtained to date, a large majority of the cattle owners in many counties would be willing to pay the entire cost which will not exceed 9 cents per head, including labor, for each treatment. However, there is always a minority
who, for financial or other reasons, do not wish to cooperate in such a community enterprise. It would not be fair to compel an owner to treat his cattle and pay the cost. Rather, there should be an incentive whereby a large part of the cost will be paid out of public funds to get the voluntary consent of all owners in the county selected.

**PENDING LEGISLATION**

Last winter there was introduced in the House of Representatives in Washington HR 1043 by Congressman George W. Gillie of Indiana, the only veterinarian, in Congress, which bill provides for the authorization of an appropriation for cattle grub eradication. A companion bill was introduced in the Senate by Senator Kenneth S. Wherry of Nebraska, which bill was recommended for passage by a unanimous vote of the Agriculture Committee of the Senate June 25, 1947, and passed the Senate July 3, 1947. Because of emergency legislation pending, it was not possible to have the hearing before the House Committee on Agriculture during the last session. However, a letter from Congressman Clifford R. Hope, Chairman of the Committee, dated July 31, 1947, reads:

I am sorry that it was not possible for the Committee to reach this legislation during the session just closed. However, I am putting it down on the list for consideration early in the next session and at that time I hope we will be able to make a favorable report on the bill from the Committee.

It is expected that if this bill passes both Houses and becomes a law, it will provide later a fund of approximately $300,000 for the use of the U. S. Department of Agriculture in doing further research work on the grub problem and in providing funds to pay the cost of the rotenone and necessary equipment for cooperative area work with the various states, conditional upon funds being provided by such states or counties, or both, to supplement federal funds. The owner of the cattle would be expected to provide the necessary labor in applying the treatment as his share of the cost.

It is believed that there will be at least one county in each of the range states, as a starter, that will be willing to cooperate in a demonstration of this kind to determine the possibilities of the area treatment. These demonstrations should start in range territory because this is our source of supply and there are relatively few cattle that come into such counties from the outside, whereas in the cornbelt, many feeders are brought in each year.

There is every reason to believe that if certain counties can be made practically free from grubs, such cattle will command a premium on the feeder market for it is generally known that cattle free from grubs make better gains than infested cattle. It is also known that when such cattle are fattened and sold, they will command a somewhat higher price. Cattle salesmen have told me that during the grub season, cattle apparently free from grubs sell for 25¢ to 50¢ per hundred pounds more than the same quality cattle that show the presence of grubs at the time of purchase. If cattle from areas virtually free from these parasites command a higher price, it will give great momentum to the county area plan.
ERADICATION OF NATIONAL IMPORTANCE

That this project is in the national interest there can be no question. With this menace to the cattle industry, there is a reduction in both meat and milk that effects the consumer as well as the producer and applies to those who buy shoes as well as meat. Then, too, cattle contribute greatly to the future wealth of the nation for they utilize a large quantity of roughage that would otherwise be wasted, of which a large part consists of leguminous crops such as clover, alfalfa and lespedeza which draw nitrogen from the air to store it in the soil and, with the manure, to increase the fertility of the land. Any handicap to the cattle industry such as this is of national concern.

ROtenONE NOW IN ADEquate SUPPLY

At the hearing before the Senate Committee, the question was asked why a broad program of eradication was not undertaken sooner. It was explained that until recently the availability of rotenone has been a very limiting factor. The East Indies were occupied by the Japs who destroyed much of the derris crop under cultivation. There was no importation of rotenone material from the East Indies during the War, but it is expected that it will be available from there soon. The importation of the cube plant from South America was also cut down during the War period. Now that it is being much more extensively grown in South America, particularly in Peru, we have assurance of an adequate supply. A commercial company, importers of the roots, made the following statement under date of May 2, 1947:

There will be a fully adequate supply of rotenone next fall and winter for any conceivable expansion of the cattle grub control program. South American production is at a relatively high level and although the situation in the Orient is confused and uncertain politically and economically, derris definitely is becoming more available. There is every reason to believe that sufficient quantities of derris will be available later this year to supplement the South American production.

Again under date of September 10, 1947, they wrote:

It seems safe to say that the days of the rotenone shortage are definitely over and that the eradication of cattle grubs will not suffer from inadequate supplies.

The veterinarians of the United States, under able direction by federal, state and county officials, and with the cooperation of the cattle industry, have done a thorough job in eradicating tuberculosis which has resulted in a great economic saving and, at the same time, has been a large factor in reducing the human death rate from 22.5 per 100,000 population in 1917 to 2.5 in 1946 from non-respiratory tuberculosis—a reduction of 90 per cent. While the grub menace is a minor human health problem, there are a few medical cases on record, cited in Farmers' Bulletin No. 1596, where children on farms and ranches have become infested. This group has also been successful in combating many other diseases to the great benefit of the nation and there is every reason to believe that with proper organization and with adequate funds supplied by the Congress, the state legislatures and county
boards, the grub menace may, in time, be just as completely eliminated, in which task there will be required the full cooperation of the entomologists throughout the nation, particularly in the performance of needed research work.

There is a possibility that there may eventually be found a chemical that can be injected under the skin to kill all of the grubs in the body with one treatment. This would be a wonderful help, particularly in the northern states where the two species exist, one appearing somewhat later than the other which necessitates more treatments than is required in the southern half of the country.

Excellent progress has been made in Denmark in the eradication of cattle grubs earlier by hand extraction and later with rotenone. A letter from the Denmark Ministry of Agriculture received a year ago states that in 1941 a total of 48,201 herds were found infested and in 1945 only 16,788, or 8% of all herds in Denmark.

England tried compulsory treatment before the War but it did not succeed. The Ministry of Agriculture cancelled the compulsory order when the Japs overran the East Indies cutting off the supply of derris.

Monsieur P. Lorrondo of the Office of the Leather Industries, Paris, France, gives data to indicate that their grub damage to hides is similar to ours. They have in mind "the creation of an anti-warble grub National center." He sent me this poster which, translated, reads:

The removal of grubs gives the country more milk—more meat—more leather. Breeders: Use the salve distributed free of charge. Apply with the service 'Campaign Against Grubs' under the direction of Departmental Veterinary Service.

We have in the United States the intelligence, the organizing ability and the means to effectively combat the cattle grub menace. Now that we are assured of an adequate supply of rotenone, we should lose no time in freeing our nation of this handicap to our great cattle industry.
THE ROLE OF DDT IN EXTERNAL PARASITE CONTROL

D. E. HOWELL, B.S., M.S., Ph.D.

The compound DDT was first prepared by Zeidler (1) in 1874, but indications of its value for external parasite control were not published until 1940 when an application for a patent on its insecticidal use was filed in Switzerland. Wiesmann (2) demonstrated its value in house fly control and soon it was extensively studied by American, English, and German workers. Publicity resulting from widespread use of DDT during the war created an unprecedented demand for this material, and it was widely used by the public before adequate research had shown the most effective manner of use. Furthermore, the results obtained from DDT are greatly affected by weather conditions, type of water, amount of sunlight, and the extensiveness of a control program. As a result there is still considerable confusion as to the desired concentration and method of application. This confusion is indicated in succeeding articles in a national journal which suggest a concentration of 0.2 per cent DDT for horn fly control in Kansas (3) and 2.5 per cent in Florida (4). Similar variations are found in the recommendations for use attached to DDT containers.

Variations due to weather, concentration of parasites, and farming conditions must be considered in determining the DDT formulation to be used in any area. Since the action of DDT varies materially with different insects, its use can be discussed most readily if each group is considered separately.

FLIES

DDT is probably the most valuable insecticide available for the control of flies. The amount needed to obtain control is dependent upon sanitary conditions, weather, and extensiveness of control, but the most important consideration is the species of fly. Therefore the flies will be considered according to species.

House Fly, Musca domestica Linn. These pests do not bite but they are of real importance because of their ability to transmit disease and cause annoyance by their presence. They breed in manures or other organic matter that is moist and warmed by the heat of decomposition. Favored resting places are inside farm buildings out of the sun and wind. As a result they may be controlled by spraying the inside of such structures. The DDT deposits are thus protected from the deleterious effects of sunlight and rain, so that a much greater residual effect is obtained.

The sanitation of the area markedly affects fly control. In an extensive control program at the Oklahoma Experiment Station, in 1946 excellent control of house flies was obtained by spraying barns, where good sanitation was practiced, twice during the season with a 2.0 per cent spray (approximately 80 mg. per sq. ft.). Where sanitation was poor a 5.0 per cent spray (200 mg. per sq. ft.) failed to give good control with four applications. Only two sprayings with 0.5 per cent were needed during the 1947 season where sanitation was excellent.

In Florida (5) it was demonstrated that the extensiveness of the fly control pro-
gram greatly influences the amount of DDT needed. Barns near the center of a 350 sq. mi. treated area remained fly free for several months longer than those on the periphery.

General recommendations suggest the use of 2.0 per cent DDT as soon as flies appear in the spring and as often as needed thereafter, probably a total of 3 sprayings. If cattle are sprayed for horn flies, the same concentration used on the cattle will control house flies in the barn until it is necessary to spray for horn flies again.

Application is best made with an 80° fan nozzle and pressures from 100–200 pounds. Greater pressures tend to waste material and lower pressures may not penetrate. The surface of the barn is important. Fresh whitewash often rapidly deteriorates DDT, and rough wood or porous cement takes up large quantities.

At the Oklahoma station, wettable powders have been most effective and most pleasant to apply but they may leave an unsightly residue. In areas where this is objectionable, water emulsions or oil solutions may be used.

**Stable Fly, Stomoxys calcitrans** (Linn.). These pests closely resemble house flies in size and color, but they may be easily separated from them by the presence of bayonet-like mouthparts projecting from the lower portion of the head. These flies have a vicious bite and they may spread disease.

Breeding habits of stable flies are similar to those of the house fly, but they frequently develop in rotting organic matter not contaminated with feces. Typical examples are wet straw stacks or piles of decaying grass. Unlike house flies, they prefer to remain outside of barns except under unusual weather conditions. They do enter with cattle or may often be found just inside the barn out of the wind but in the sun. Other preferred resting places are fences, sheltered walls, and vegetation.

These habits of the stable fly make their control much more difficult. When their usual resting places are treated, the DDT deposits are exposed to sun and weather which causes them to deteriorate more rapidly. Stable flies were not controlled around barns where the interiors only were thoroughly wet with 4.0 per cent DDT (160 mg. per sq. ft.). Careful spraying of the fences and the north barn walls with 2.0 per cent provided practical control. When flies are numerous concentrations of 0.25 to 0.5 per cent DDT have not provided adequate control even when put on the cattle and on the inside and outside of barns.

**Horn Fly, Siphona irritans** (Linn.). Frequently several thousand of these pests may be found on a single animal and the irritation and loss of blood due to feeding must be extensive. These flies are about two-thirds the size of a house fly. They are found on the backs of cattle during the cooler periods but during hot spells they go to the underline.

Breeding occurs only in fresh cattle droppings, and feces deposited more than three hours are not attractive for oviposition. As a result, breeding is not concentrated but occurs wherever cattle run. Because the adult spends almost all its time on the host, relatively small residual DDT deposits are sufficient to provide control. The concentration of spray or dip to be used depends upon several factors: the ease with which cattle may be brought in for treatment, water, weather, extent of treated area and the other uses to which the equipment may be put.

Under similar conditions in Oklahoma, doubling the concentration of DDT from
0.25 to 0.5 per cent increased the duration of control approximately 30 per cent. Increasing the concentration to 1.0 per cent increased the control about 20 per cent more. This indicates that animals that are easily and frequently handled, such as dairy animals, may profitably be sprayed with lower concentrations. With range animals the savings in labor costs and weight loss due to working the cattle will more than offset the additional cost of DDT if larger concentrations are used. If the spray equipment is used to treat barns and cattle, it is often advantageous to increase the quantity used on cattle and lower the quantity used on the barns so that one concentration will do for both (6). Waters with high alkaline or iron content tend to decrease the residual action of DDT. Hard dashing rains may wash off much of the spray.

General recommendations in Oklahoma suggest 0.25 per cent DDT as a spray for dairy animals and 0.5 per cent for range animals. It is usually sufficient to wet the top line with 1-2 quarts but some additional control is obtained by wetting the entire animal. Dipping is effective but usually more expensive (4).

Horse Flies and Deer Flies (Family Tabanidae). Flies belonging to this family cause extensive losses in animals by their vicious bite and ability to transmit important diseases. They breed only in water or moist areas but may be so numerous that cattle are unwilling to graze while the flies are active and the resulting milk and weight losses are serious.

The flies spend nearly all of their time resting in trees, bushes, or taller vegetation and only a few minutes a day on the host. As a result, they are but briefly exposed to DDT if the host animal has been sprayed. Extensive experiments in Oklahoma during the past three years have shown that most of the flies die after feeding to repletion on animals within 3 days after the animals have been sprayed with 1.0 per cent DDT or higher. Unfortunately, death occurs 2-24 hours after exposure when the flies have had an opportunity to feed again and spread disease. Furthermore, emergence from the pupal stage continues over a long period of time so that the animals seldom are free of flies. Bruce and Blakeslee (5) state that when all cattle and barns in a 350 sq. mi. area were sprayed with 2.3 per cent DDT there was almost no effect on the black horse fly T. atratus Fab., but the striped horse fly T. lineola Fab. and deer flies Chrysops spp. were reduced 50 per cent.

Heel Flies or Grubs, Hypoderma spp. The damage to cattle resulting from fear of the adult flies and the activities of the larvae in the body combine to make the heel fly one of the more important pests of cattle.

Available data suggest that DDT will be of little value in the control of this parasite. The adults are in contact with the body for only a few seconds so cannot be controlled by residues of DDT on the host. Meager experiments indicate that such residues will not control the young larvae before they enter the body nor can the more mature larvae be killed by DDT after they have cut a hole in the hide along the backbone.

Blow Flies (Family Metopiidae). The role of DDT in the control of this diverse group has not been evaluated adequately. Five per cent DDT emulsions have been used successfully to control concentrated breeding areas such as abattoirs, fish markets, and hide processing plants (7, 8) when carefully sprayed on adult resting places. The use of at least 0.5 per cent DDT as a spray or dip will
materially reduce screwworm or fleece worm infestations but supplemental controls are needed even though large areas are covered (5, 7).

**Sheep-Tick or Keds, Melophagus ovinus (Linn.).** These small wingless parasites that resemble ticks are actually degenerate wingless flies that spend all their life on the host. The young are retained in the body of the female until fully developed, therefore they pupate soon after being deposited in the wool. Because of this habit they are easily controlled with DDT. Emulsions or suspensions containing at least 0.2 per cent DDT provide control with a single treatment. Treatment with one-half pound of derris or cube powder containing 5.0 per cent rotenone in 100 gallons of water is equally effective and somewhat cheaper.

**Blackflies, (Family Simuliidae).** The vicious biting habits and disease carrying ability of blackflies or buffalo gnats make them a serious pest in limited areas. The adults usually stay fairly close to the streams where the immature stages develop. They have been controlled with emulsions or water suspensions added to the swiftly running streams where they live so that the concentration of DDT in the stream varies from 5 (10) to 0.1 (11) p.p.m. for as little as 35 minutes.

**Ticks**

The role played by ticks in the transmission of disease and the damage resulting from their feeding is well known. Their life habits greatly influence the ease of control. Those that live on a single host during their entire feeding period, such as the cattle tick, *Boophilus annulatus* (Say), or the winter tick, *Dermacentor albipictus* (Pack.), are more easily controlled than three host ticks such as American dog ticks, *D. variabilis* (Say), or lone star ticks, *Amblyomma americanum* (Linn.) that feed for a week or less on three different animals. Soft ticks, *Agasidae*, that feed many times for a few minutes only, can seldom be controlled by spraying or dipping the host.

The early work that developed arsenical dips was a major contribution but something is needed that will be less toxic to animals and provide longer residual action. DDT shows promise here. Horses may be protected for 45 days against reinfestation by winter ticks with an 0.8 per cent DDT wash (12). In Florida, the Gulf Coast tick, *A. maculatum* Koch, is controlled by the routine sprays for horn flies when 2.3 (5) to 2.5 per cent (4) DDT is used. Practical control of the lone star tick in Oklahoma usually is obtained with 0.5 per cent DDT, but it lasts for about 2 weeks only. At times even 2.0 per cent DDT dips fail to provide control. Relapsing fever ticks may be controlled with 10 or 20 per cent DDT but the cost is excessive (13).

In limited areas the American dog tick can be controlled by 2.5 pounds of DDT as a dust or a spray per acre. The lone star tick and the black legged tick, *Ixodes scapularis* Say, may be controlled during the entire active season with 1 pound to the acre (14). Application with ground equipment provided better results than planes.

**Lice**

During the winter, lice often become a serious problem on animals. They develop rapidly and spend all of their time on the host, often greatly reducing its vigor. The usual control is rotenone as a dip or spray, but it requires at least two treat-
ROLE OF DDT IN EXTERNAL PARASITE CONTROL

Sprays or dips containing 0.2 per cent DDT are adequate to control sheep lice Trichodectes ovis (Linn.) (15) and goat lice Trichodectes hermsi Kellogg and Nakayama, T. caprae Gurlt. and Linognathus stenopsis (Burm.) (16) for a season, but 0.35 to 0.5 per cent is needed for cattle lice, particularly if the long-nosed louse Linognathus vituli (Linn.) is present. When pressures of 300 pounds or more are not available, it may be necessary to increase the DDT content to 1.5 per cent. If spraying is not feasible, a 10 per cent dust applied at the rate of 6–8 ounces per adult animal may be used. A second treatment applied 3 weeks after the first is required (17, 18).

FLEAS

DDT is very effective against fleas and an infestation can be wiped out easily. Light dusting of infested areas with 10 per cent dust is adequate. Pets should be similarly treated; but care must be taken to protect cats, which may ingest toxic, quantities while cleaning themselves (19). Where DDT cannot be dusted about, cylinders charged with DDT and placed in rat runs will provide enough DDT to eliminate rat fleas (20).

PRECAUTIONS IN THE USE OF DDT

Extensive work by many investigators has demonstrated that DDT is toxic to higher animals but much less so than some of the common insecticides. For rabbits, arsenic trioxide is 3–10 times as toxic, sodium arsenate 2–6 times, acid lead arsenate 0–3 times, and sodium fluosilicate has about the same toxicity. Unfortunately, animals may ingest small quantities of DDT daily and store it in the tissues, particularly fat tissue, until relatively large amounts are present. Wilson and others (21) in Wisconsin showed that a cow feeding for 127 days on silage containing a daily average of 1.64 grams per 1000 pounds of body weight had 3.8 p.p.m. of DDT in muscle tissue and 221 p.p.m. in the fat. Mixed milk from a group of 5 animals fed in a similar manner averaged 15 p.p.m. A calf born to one of them and fed such milk for 33 days averaged 305 p.p.m. in its fat.

Howell and others (22) sprayed dairy cattle with excessive amounts of DDT for 40 days and obtained milk containing 33 p.p.m. of DDT. Animals sprayed with 2 quarts of 0.25 per cent DDT wettable powder spray at 14 day intervals produced milk with 3 to 6 p.p.m. Fat from beef animals sprayed twice during the fly season with 0.5 per cent water suspendable DDT showed 15 to 30 p.p.m. of DDT. This material was not entirely removed by cooking.

The animals storing the DDT were not adversely affected, nor were the calves and rats fed on the milk. However, the level of storage that can be tolerated before toxic symptoms appear, and the effects of eating tissues containing large amounts of DDT, have not been determined. Caution dictates the use of the smallest amount of DDT possible to obtain satisfactory parasite control, and it may be necessary to substitute other toxicants if possible.

Mr. C. W. Crawford, Associate Commissioner of the Federal Food and Drug Administration, has stated the Administration's position on the use of DDT in dairy plants. Mr. Crawford states:

1 Newsletter of Ex. Sec. Amer. Butter Inst., October or November.
A food is deemed to be adulterated under the Federal Food, Drug and Cosmetic Act if it contains any added poisonous or deleterious substance which is not required in the production of the food or which can be avoided by good manufacturing practice. DDT is a poisonous substance; it is not required in the production of milk or other dairy products; and its presence in milk obviously can be avoided by good manufacturing practice. Milk or milk products containing DDT by reason of indirect contamination... would clearly be adulterated, and any uses of DDT which will result in such contamination of foods should be diligently avoided.

Extensive experimental work has demonstrated that wildlife may be adversely affected by small amounts of DDT. Spraying woodlands with 1–2 pounds per acre caused extensive losses of the fish in the streams (23). Five pounds per acre caused an estimated loss of more than 50 per cent of the birds (24). Public Health Service data indicate that amounts necessary for mosquito control may be used with little danger to wildlife (25).

**LITERATURE CITED**

REPORT OF COMMITTEE ON PARASITIC DISEASES


The report of the Committee on Parasitic Diseases this year is devoted entirely to a review of the control of internal and external parasites of cattle. The report covers the following items: (1) coccidiosis, (2) bovine venereal trichomoniasis, (3) gastrointestinal helminths, (4) lungworms, (5) liver flukes, (6) cattle grubs or ox warbles, (7) lice, and (8) spinose ear ticks.

CONTROL OF COCCIDIOSES IN CALVES

Strict sanitation and isolation of young calves are the most important methods of control of coccidiosis in dairy calves. Two types of isolation pens are recommended as follows:

(1) Individual pens are raised about 18 inches from the ground. These pens have one inch wooden slats or heavy wire mesh (1 inch) to form the bottom. The wire mesh is preferable. Feed and water buckets are hung on the outside at one end near two openings just large enough to admit a calf's head. Each calf is moved once a week to a clean pen which has been exposed to the sun for a week.

(2) Individual, unfloored portable pens, measuring approximately 10 by 5 feet, and 3 feet high, are used outdoors in an area which has not been contaminated by cattle droppings. The pens are constructed of 4 wooden panels which are wired together. Each is moved to an adjacent uncontaminated site twice a month to prevent ingestion by the calf of too many sporulated oocysts. In mild weather, a flat wooden frame covered with roofing material covers one end of the pen and acts as a sun and rain shelter. In cold weather, a portable "doghouse" shelter, 3 feet wide and large enough to shelter a calf, replaces one of the end panels. The shelter has a wire-mesh floor raised 8 inches from the ground. In colder weather, burlap is used as a curtain over the doorway.

In areas where it is not feasible to leave calves outside in cold weather, or where individual pens cannot be used, it is possible to separate calves into four age groups and thus prevent infection of young calves with oocysts passed by older carriers. Separate pens or stalls in a barn are used for calves of the following ages: (1) less than 3 weeks; (2) 3 to 6 weeks; (3) 6 weeks to 3 months; (4) over three months.

BOVINE VENEREAL TRICHOMONIASIS

Although bovine venereal trichomoniasis has been reported from almost every State, the actual incidence of infected herds in the United States is still unknown. Although the disease is better known generally in dairy herds, it occurs also in beef herds, and has been found rather prevalent among Aberdeen Angus herds in the Middle Atlantic States. Also, bulls of this breed, originating from herds in western States, have been found infected on arrival in the East.

Economic losses in herds harboring Trichomonas foetus, the causative organism, are
PARASITIC DISEASES

sometimes ruinous. On introduction into previously uninfected herds, breeding efficiency typically falls to less than half normal for more than a year, and then may rise to somewhat higher, though still decidedly unprofitable, levels.

Interherd transmission probably occurs most frequently incident to movement of infected breeding animals to uninfected herds. The disease can be readily transmitted by artificial insemination, if trichomonad-infected bulls be used as sources of semen.

Increased efforts should be made to discover herds infected with this disease. Movement of infected breeding animals out of herds should be more effectively prevented than is done at present by enforcing appropriate quarantine measures. Procedures for diagnosis and means of coping with bovine venereal trichomoniasis to the point of ultimate eradication within individual infected herds are available. However, these involve the use of precise technique and necessitate veterinary supervision for a period of several years. Recognition of and withdrawal from service of trichomonad-infected bulls, coupled with a rigid system of hygienic breeding, will eliminate the disease from the females in a herd. Treatment of females is without value.

Encouraging results in experimental treatment of trichomonad-infected bulls by two methods, namely, (1) intravenous administration of sodium iodide, and (2) topical application of a German-developed proprietary product, "Bovoflavin Salbe," are being reported. These treatments may make possible the restoration to usefulness of very valuable trichomonad-infected sires. However, treatment of bulls is a precise, time consuming, costly operation justified only in the case of very valuable individuals.

CONTROL OF GASTROINTESTINAL HELMINTHS OF CATTLE

Mature cattle are not usually heavily parasitized. Therefore, management practices designed to protect young animals from heavy exposure to the infective stages of worm parasites are important control measures. On dairy farms it is possible to raise calves to weaning age entirely free, or almost entirely free, of helminths by using any one of the methods of isolation described for the control of bovine coccidiosis. As milk in the diet has been found to inhibit the development of stomach worms, it should be used in the diet as long as possible. When on pasture, weaned dairy and beef calves with dams should be segregated so that they do not graze over ground contaminated with the droppings of older calves and yearlings. Since moisture favors the development and survival of the infective stages of worms parasites on pasture, low, poorly drained pastures should be avoided. Even well drained, improved pastures should not be overstocked as this increases contamination of the grazing area. Rotation of pastures will improve grazing and allow an appreciable number of the infective stages of parasites to succumb, before susceptible animals graze there again. If pastures not planted for winter grazing are vacated overwinter, very few helminth larvae will survive. To avoid introducing helminths into a herd, or to avoid contaminating a clean pasture with these parasites, it is advisable to isolate and then treat stock introduced from the outside or from contaminated pastures.

Treatment is an important step in the control of parasites, and phenothiazine is
the drug of choice. It may be given as a powder in capsules, compressed in a bolus, or suspended in water as a drench at a dose rate of 20 grams per 100 pounds body weight, with a maximum dose of not more than 60 grams. Because of variable conditions, the frequency of treatment depends on competent diagnosis. In any event, treatment is unnecessary until calves have been grazing for at least one month.

CONTROL OF LUNGWORMS OF CATTLE

The lack of an effective anthelmintic for lungworms makes the control of these parasites dependent upon special management practices, in addition to those recommended for the control of the gastrointestinal helminths. Lungworms are not as common as other roundworm parasites, but when diagnosed, it is recommended that (1) infected animals be isolated for 1 to 4 months or until larvae are no longer being passed with their droppings; (2) animals showing severe clinical symptoms be placed in clean, dry quarters and given symptomatic treatment and liberal quantities of nutritious feed; (3) all cattle be removed from contaminated pasture for at least 6 weeks, to allow infective larvae to die, and (4) newly purchased animals be examined and the infected ones isolated until lungworms have been eliminated.

CONTROLLING LIVER FLUKES BY MEDICATION

In cattle, liver flukes can be destroyed effectively and economically with hexachlorethane, a synthetic drug. The drug should be prepared as an aqueous suspension and administered as a drench.

The hexachlorethane suspension is prepared by mixing the ingredients on the basis of one pound of finely ground hexachlorethane (60-mesh size) and 1½ ounces of bentonite (a finely powdered clay) with 25 ounces or slightly over 1½ pints of water. The addition of about one-quarter teaspoonful of white flour facilitates the mixing and improves the resultant suspension. Mixing may be done with a power-driven apparatus of sufficient speed and force to insure thorough distribution of the ingredients, or by passing the mixture twice through a screen having 20 meshes to the linear inch. When mixed in the above proportions, approximately one quart of suspension is produced.

Large quantities of the suspension may be prepared by using a barrel and mixing apparatus of sufficient speed and power to obtain thorough mixing. An outboard motor makes a very satisfactory mixer. When preparing large quantities of the suspension, the bentonite and flour should be added slowly to the water while stirring it rapidly with the mixer. After the water and bentonite are well mixed, the hexachlorethane is added slowly while continuing the stirring. The prepared suspension may be stored in gallon jugs.

A measured dose of 64 ounces of the suspension for cattle, and 3½ ounces for calves over 3 months old, is given by means of a metal dose syringe of 4-ounce capacity or greater. Calves under 3 months of age need not be treated because any flukes they might harbor would be too young to be killed by the treatment.

When administered as an aqueous suspension, hexachlorethane has a wide margin of safety for the treatment of all classes of range cattle, with the exception of very debilitated ones. Extremely weak animals should be treated with caution since, occasionally, unfavorable effects, such as staggering and reeling, sometimes prostration and death, may result from giving a full dose.
One dose of hexachlorethane suspension is usually sufficient to kill a large part of the adult flukes in the bile ducts; young flukes are somewhat resistant to the treatment. The dead flukes pass from the liver, by way of the common bile duct, into the intestine, and to the outside with the droppings.

In cases where the poor or unthrifty condition of the cattle is due to liver flukes, there is generally a remarkable improvement in the weight and appearance of animals within a short time after treatment with hexachlorethane. Exceptions occur, however, in instances where the damage to the liver is so extensive that the animals are unable to recover, even though the flukes that they harbored are destroyed.

Though treatment will relieve fluky cattle of the drain produced by the parasites, it will not effect eradication for the following reasons: (1) Some adult flukes, and many preadult ones, are unaffected by the medication; (2) infected snails on pasture continue to shed cercariae, which are the infective stages of liver flukes; and (3) reservoir hosts, principally jack rabbits, continue to propagate the parasites.

In planning a program for controlling liver flukes, the time of treatment should be chosen so as to take advantage of the weakest point in the life cycle of the fluke. In general, the flukes are most vulnerable in the spring and fall, and it is probably at this time that the treatment may be given most advantageously.

In the Gulf Coast region, the season of snail activity is during the mild, wet winter and spring. It is during this time that the infective stages of the liver fluke are able to come out of the snails and get on the grass. Treatment of all the cattle in the herd in the spring, or at the beginning of the dry season, when the snails go into the soil, and again in the late fall before the onset of the wet season, gives excellent results. This arrangement takes advantage of the fact that many of the cysts on the pasture have been killed by the heat and drought during the summer, and the majority of the flukes already in the liver are mature and readily killed before the snails become active again in the winter.

In regions where cattle are taken off pastures and not subjected to continuous infection during the cold winter months, treatment should be given at the time when the animals are removed from the infested range in the fall and again in the spring before they are returned to it. The fall treatment kills the flukes that have reached maturity during the grazing season and the spring treatment destroys those flukes that were too small to be killed readily at the time of the first treatment. Animals treated in this manner should be practically free of the parasites when they are returned to the range. Such a program not only kills the greatest number of flukes but also reduces the possibility of infection of more snails on the pasture the next grazing season. A program of drenching cattle twice a year, however, will not eradicate liver flukes but it will greatly reduce their numbers and improve the health of the cattle.

CONTROLLING CATTLE GRUBS

Rotenone-containing powders are the only medicaments that are known to destroy cattle grubs. These powders may be used (1) dry with a carrier, as dusts, or (2) suspended in water and used as (a) a spray or (b) a wash, and (c) a dip.

Sprays are suitable for use on large herds. Use 7 1/4 pounds of derris or cube powder (5 per cent rotenone) per 100 gallons of cold water. Apply to backs of cattle by means of high pressure orchard sprayers, at 400-500 pounds nozzle pressure. Hold
spray nozzle between 2-3 feet above back of the animal, using a coarse, hard spray and applying 2 quarts per animal. This method of application destroys between 85 and 100 per cent of third instar grubs, while its effectiveness against second instar grubs is low.

**Washes** are suitable for small and medium size herds. The wash is compounded as follows:

- Ground cube or derris (5 per cent rotenone) .................. 12 ounces
- Granular laundry soap ........................................ 4 ounces
- Warm water ....................................................... 1 gallon

Apply 1 pint per animal, using a stiff brush to rub the material into the hair coat and onto the skin. This method of treatment is highly effective against second and third instar grubs.

**Dusts** are dry preparations of rotenone are suitable for use on small herds in especially cold weather. They may be prepared as follows:

- Ground cube or derris (5 per cent rotenone) .................. 1 part by weight
- Double ground tripoli earth ....................................... 2 parts by weight

Or

- Ground cube or derris (5 per cent rotenone) .................. 1 part by weight
- Pyrophyllite (325 mesh) ............................................. 2 parts by weight

The powders should be applied to the backs of cattle from shaker-type cans, and the material rubbed into the skin with the finger tips. About 3 ounces per animal are used on the average.

This method of treatment is not highly effective against either second or third instar grubs, and frequent treatments are usually required for satisfactory results.

**Dips** are costly and are suitable for use only where very large herds are involved. The dip is prepared as follows:

- Ground cube or derris (5 per cent rotenone) .................. 10 pounds
- Wetting agent (sodium lauryl sulfate) ......................... 2 ounces
- Water ........................................................................ 100 gallons

The animals should be held in the vat in a swimming position for 2 minutes and if possible, their backs should be rubbed with a long-handled brush. This method of grub control is recommended when lice are also present. The effectiveness against second and third instar grubs is generally not as high as that afforded by either sprays or washes.

**CATTLE LICE**

A satisfactory dip or spray is a DDT emulsion containing:

- DDT (technical grade) .............................................. 0.3 per cent
- Xylol .......................................................................... 0.3 per cent
- Saponified pine oil .................................................. 1.5 per cent
- Water q.sad .............................................................. 100 per cent
To prepare this dip, add DDT to xylol at 130°F. and stir until partially dissolved. Add saponified pine oil and stir until DDT is completely dissolved. To this solution an equal volume of water at 130°F. is added, with agitation. The resulting thick, white emulsion constitutes a stock solution, which can be diluted with cold water before use as a spray or dip. The use of xylol can be omitted if certain saponified pine oils containing emulsifiers are used, but for ordinary saponified pine oils, xylol is required.

Complete eradication of louse infestations in large herds, following a single dipping in this mixture, has been achieved. Infestations were also eradicated from small numbers of corralled animals following single applications of the above medication by the spraying method. This mixture named is not ovicidal, and frequently does not remain effective on the animal long enough to destroy all newly-hatched lice. A second dipping or spraying, after a lapse of approximately 20 days will usually result in eradication.

Another satisfactory DDT emulsion is the following:

- **DDT (technical grade)**: 0.25 per cent
- **Xylol**: 0.5 per cent
- **Emulsifiable petroleum oil**: 0.75 per cent
- **Water qsad**: 100 per cent

This mixture, used as a spray or dip, usually eradicates lice from cattle following two applications, 21 days apart.

Aqueous suspensions containing 1 per cent wettable DDT (0.5 per cent actual DDT) are very effective in controlling infestations of cattle lice, but are not known to bring about eradication in one dipping or spraying. These suspensions are now in common use and should be recommended to stockmen.

**SPINOSE EAR TICK**

The following preparation is recommended:

- **Benzene hexachloride (15 per cent gamma isomer)**: 5 per cent
- **Xylol**: 10 per cent
- **Pure pine oil—qsad**: 100 per cent

  (gamma isomer content of preparation—0.75 per cent)

Instill one-half ounce per ear, preferably from spring-bottom oiler with spout cut down to 2-inch length and tipped with rubber tubing. This treatment destroys all nymphs and larvae in the ear within one hour, and prevents larval reinfestation for a period of 17 days.
REPORT OF THE INTER-ASSOCIATION COUNCIL ON ANIMAL DISEASE AND PRODUCTION

R. A. HENDERSHOTT

During the past year the Council held a meeting in November at Chicago. The program, "Protecting and Promoting the Livestock Industry," was reviewed. Because of the delays encountered in obtaining approval from the member associations, the Council had been unable to activate the program. In the meantime, however, the interest created by the proposals as they were considered by the membership of the associations had served to provide wide acquaintance with the program. As a result, practically all of the proposals are being studied by appropriate committees of the Agricultural Board of the National Research Council. Consequently, the Council felt it would not be advisable to attempt to duplicate such committees and tabled the program as having accomplished the desired action.

The need for a more comprehensive study and program on brucellosis in all its aspects is being met by the appointment of a new committee of the National Research Council.

One of the most important subjects discussed at the annual meeting was the shortage of animal scientists. Actually, this represents only a portion of the Nation's shortage and the Association's attention is directed to the National Research Council Reprint and Circular Series Number 127, April, 1947, on "The Shortage of Professional Workers in Agriculture and in Forestry." The estimated need for new men with Ph.D. training will total 5,080 in the decade 1946-1955. This is approximately 50 per cent larger than the number now engaged in these fields. To meet the demand, concerted action on a broad front is indicated and the Council favored the formation of an Institute of Biologists. Rarely is one association large enough to meet its own needs for public relations programs, but the pooling of resources of all associations would provide for satisfactory action without undue strain upon small individual associations.

The Council recommends that the member associations continue to have symposia at their annual meetings in order that subjects of common interest to two or more associations will be discussed from the widest possible points of view.

Due to the pressure of responsibilities as head of the Agricultural Research Administration, of the U.S.D.A., Dr. Lambert found it necessary to resign. The American Society of Animal Production has appointed Dr. E. A. Livesay, West Virginia University, to fill Dr. Lambert's unexpired appointment.

The Council recommends that the member associations continue their financial support on the same basis as established earlier.
REPORT OF THE COMMITTEE ON LEGISLATION

Mr. Will. J. Miller, Chairman, Topeka, Kan.; Dr. T. O. Brandenburg, Bismarck, N. D.; Dr. W. J. Butler, Helena, Mont.; Dr. J. S. Campbell, Little Rock, Arkansas; Dr. R. A. Hendershot, Trenton, N. J.; Dr. Wm. Moore, Raleigh, N. C.; Dr. B. T. Simms, Washington, D. C.; Mr. A. A. Smith, Sterling, Col.

It is suggested that our committee give consideration to the following proposed regulations and legislation.

1. That appropriations be continued for the eradication of foot-and-mouth disease.

2. That increased appropriations be made available to the Bureau of Animal Industry to provide additional veterinarians at central markets for the purpose of maintaining rigid inspection of livestock.

3. That the bill known as the Garbage Disposal bill, which, with amendments, was passed by the Senate and the House and pocket vetoed by the President, be reintroduced into the Congress and that this association lend full support to the passage of this bill.

4. That our association continue to work for legislation which would make it possible for the Department of Agriculture to have jurisdiction over domestic animals, with a view to controlling rabies in the United States.

5. To recommend legislation which would give the Department of Agriculture control over the sale and distribution of biological products such as swine erysipelas vaccine, ovine ecthyma, laryngotraechitis, fowl pox, hog cholera, Newcastle virus vaccine, anthrax, products made from Brucella organisms, tuberculin, mallein, and such diagnostic agents as enter into the control of these diseases.

6. That the Secretary of the United States Department of Agriculture be requested to formulate regulations prohibiting the interstate movement of dairy, purebred, and breeding cattle unless they are negative to test for tuberculosis and brucellosis within a period of thirty days prior to date of shipment, the regulation to provide for the movement of officially vaccinated reacting cattle into states which will accept them.

7. That the Secretary of the United States Department of Agriculture be requested to alter the regulations relative to the inter-country movement of livestock from Canada, with particular reference to the free movement of cattle into the United States which originate in TB modified accredited areas. That cattle imported from Canada should originate in a TB free herd, or an accredited herd, or negative test herd in an accredited area.

8. That our association recommend to the House Agricultural Committee that S. 1249, by Wherry, May 8, 1947, authorizing additional research and investigation into problems and methods relating to the eradication of cattle grubs, be passed, provided the clause which might give authority to undertake compulsory eradication be eliminated.

9. That the Secretary of the United States Department of Agriculture be requested to promulgate sanitary regulations covering the loading, unloading, holding, and transportation of poultry by mail, to prevent the spread of Newcastle disease, and other communicable diseases of poultry.
REPORT OF THE COMMITTEE ON BIOLOGICS


The members of your Committee on Biologics have, during the year, actively discussed by letter and in person many problems. Many of the problems are complex and not immediately susceptible of solution. Among these is the question of the unrestricted dissemination of live viruses and vaccines that are capable of setting up new centers of infection or that change the reaction of animals on which indemnities are paid when they show a positive reaction. Another, is the types, strains and proportions of organisms now used in the preparation of certain mixed bacterins. We feel that the members of this Committee are reaching a general understanding of these and other problems. We have not yet, however, arrived at the point where we can offer a clear cut solution nor have we had time to collect all of the information and data necessary. It is hoped that within the year a meeting can be held of all licensees together with federal officials toward the improvement of various biological products. We are recommending therefore that the membership of this Committee be continued for another year to complete the work in progress or that contemplated.

Our Committee anticipates major contributions in the field of biological prophylactics against animal and avian diseases within the next few years. For example, active experimental work is already under way with rabbit-passed hog cholera virus, mucoid phase brucella cultures, mutations of virus strains and other constructive types of research.

In recent years several chemicals and pharmaceutical products have been introduced for treatment or use in animals. Among these are D.D.T.; diethylstibestral; protamine; thiourasil; Sulfanamides; antibiotics, and other agents. Antibiotics are made by biological processes yet are classified as pharmaceuticals. Some of the other agents are chemicals that stimulate or depress endocrine glands and modify the functions of animals treated with them. At present this Association has no Committee assigned to study and report on these classes of substances which are of increasing importance in animal work. We recommend therefore, that the name of this Committee be changed to the “Committee on biologics and pharmaceuticals” to cover the entire field rather than an indefinite section of it.
THE IMPORTANCE OF ANIMAL DISEASE MORBIDITY AND MORTALITY STATISTICS TO PUBLIC HEALTH

JAMES H. STEELE, D.V.M., M.P.H.

Chief, Veterinary Public Health Division, Communicable Disease Center
U. S. Public Health Service

Animal disease and death has become the vital concern of all society today. In these days of acute food shortage throughout the world the people and leaders of all nations realize this much more than formerly. Anyone who has been in Mexico recently knows what the epizootic of Foot and Mouth Disease has done to their supply of animal protein. This has undermined their nutritional health, by depriv- ing children, adolescents, and adults of the food necessary for their development and health. The importance of an animal population free of disease is essential to the nutritional health of a nation.

Animal disease and death is also of vital concern to the health of a nation in keeping their human population free of communicable diseases that are transmissible from animals to man. There are more than 75 diseases found in animals to which man is susceptible. Fortunately, many of these diseases are not found in the United States. (Table 1.)

The most important animal diseases communicable to man in the United States are the every day problems of all veterinarians, whether they be regulatory officials or practitioners. These diseases include actinomycoses, anthrax, brucellosis, encephalomyelitis, swine erysipelas, leptospirosis, ornithosis, Q fever, rabies, salmonellosis, staphylococcus and streptococcus infections, beef tapeworm, trichinosis, tuberculosis, and tularemia. All these diseases are the cause of illness in man. The U. S Public Health Service reports the incidence of some as shown in Table 2.

There is no way to determine the incidence of the other animal diseases known to be communicable to man because many of these diseases are reported under food poisoning, dysentery, dermatitis, and diarrhea. Among other human diseases reported in 1946 that have or may have animal reservoirs are coccidiodomycosis, favus, glanders, lymphocytic choriomeningitis, psittacosis, Q fever, rat bite fever, relapsing fever, and ringworm.

If there were similar figures available for animal morbidity and mortality they would be invaluable to the health officer or epidemiologist in determining the source of these human illnesses. The health officials would then have a means of determining if a certain human illness was due to animal disease in the community to which the person had been exposed or to food products which were contaminated. But of even more importance would be the availability of animal disease statistics to the health officials who are concerned with preventing disease.

The health officer could then plan a preventive disease program to take measures to prevent the transmission of animal diseases to the human population. Such plans could include local rabies control, pasteurization of all dairy products, meat and poultry inspection, health education, greater emphasis on rural sanitation and many other public health measures. There are many disease problems of common
TABLE I (1, 2).—Diseases Found in Animals Which Are Communicable to Man

<table>
<thead>
<tr>
<th>Type of Disease</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Virus diseases</td>
<td>14</td>
</tr>
<tr>
<td>II. Rickettsial diseases</td>
<td>7</td>
</tr>
<tr>
<td>III. Bacterial diseases</td>
<td>19</td>
</tr>
<tr>
<td>IV. Fungus diseases</td>
<td>9</td>
</tr>
<tr>
<td>V. Protozoal diseases</td>
<td>7</td>
</tr>
<tr>
<td>VI. Parasitic diseases</td>
<td></td>
</tr>
<tr>
<td>Trematode diseases (Flukes)</td>
<td>7</td>
</tr>
<tr>
<td>Cestode diseases (Tapeworms)</td>
<td>8</td>
</tr>
<tr>
<td>Nematode diseases (Roundworms)</td>
<td>8</td>
</tr>
<tr>
<td>VII. Arthropodla diseases</td>
<td>2</td>
</tr>
<tr>
<td>VIII. Toxin produced diseases</td>
<td>3</td>
</tr>
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<td>Total</td>
<td>84</td>
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I. Virus diseases
1. Cowpox
2. Encephalomyelitis

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<thead>
<tr>
<th>Disease</th>
<th>Organism</th>
<th>Animal Host</th>
<th>Geographical Area</th>
<th>Vector or Method of Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowpox virus</td>
<td>Cattle, horses</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>St. Louis virus</td>
<td>Birds, equidae</td>
<td>N. America</td>
<td>Mosquitoes, triatomas, ticks</td>
<td></td>
</tr>
<tr>
<td>Eastern virus</td>
<td>Birds, equidae</td>
<td>N. and S. America</td>
<td>Mosquitoes, triatomas, ticks</td>
<td></td>
</tr>
<tr>
<td>Western virus</td>
<td>Birds, equidae</td>
<td>N. and S. America</td>
<td>Mosquitoes, triatomas, ticks</td>
<td></td>
</tr>
<tr>
<td>Venezuelan virus</td>
<td>Equidae, monkeys</td>
<td>S. America</td>
<td>Mosquitoes, triatomas, ticks</td>
<td></td>
</tr>
<tr>
<td>Japanese B. virus</td>
<td>Equidae</td>
<td>Asia</td>
<td>Mosquitoes, triatomas, ticks</td>
<td></td>
</tr>
<tr>
<td>B. virus</td>
<td>Monkeys</td>
<td>Asia</td>
<td>Mosquitoes, triatomas, ticks</td>
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</table>
| No. | Disease                                           | Virus          | Hosts                          | Distribution                          | Mode of Transmission
<table>
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<tbody>
<tr>
<td>3</td>
<td>Equine infectious anemia</td>
<td>Equine anemia virus</td>
<td>Horses</td>
<td>World-wide</td>
<td>Flies, mosquitoes, midges, ingestion, contact, wound</td>
</tr>
<tr>
<td>4</td>
<td>Foot and mouth diseases</td>
<td>A virus</td>
<td>Cattle, sheep and swine. Wild herbivora. Rarely in carnivora</td>
<td>World-wide except N. America and Australia</td>
<td>Contact and ingestion</td>
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<tr>
<td>5</td>
<td>Louping ill (infectious encephalomyelitis of sheep)</td>
<td>C virus, O virus, Louping ill virus</td>
<td>Sheep</td>
<td>Europe, N. America</td>
<td>Ticks (Ixodes ricinus) (castor bean tick)</td>
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<td>6</td>
<td>Lymphocytic choriomeningitis</td>
<td>L.C.M. virus</td>
<td>Mice, dogs</td>
<td>World-wide</td>
<td>Ingestion</td>
</tr>
<tr>
<td>7</td>
<td>Newcastle Disease (avian pneumoencephalitis)</td>
<td>Newcastle virus</td>
<td>Chickens and birds</td>
<td>World-wide</td>
<td>Contact</td>
</tr>
<tr>
<td>8</td>
<td>Ornithosis</td>
<td>Ornithosis virus</td>
<td>Birds</td>
<td>United States</td>
<td>Contact</td>
</tr>
<tr>
<td>9</td>
<td>Psittacosis</td>
<td>Psittacosis virus</td>
<td>Birds</td>
<td>World-wide</td>
<td>Contact, inhalation</td>
</tr>
<tr>
<td>10</td>
<td>Rabies</td>
<td>Rabies virus</td>
<td>All warm blooded mammals</td>
<td>World-wide except Pacific Islands and Cr. Br.</td>
<td>Bite or saliva in wound</td>
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<tr>
<td>11</td>
<td>Rift Valley fever (Enzootic hepatitis)</td>
<td>Rift Valley fever</td>
<td>Sheep and cattle</td>
<td>Africa</td>
<td>Contact</td>
</tr>
<tr>
<td>DISEASE</td>
<td>ORGANISM</td>
<td>ANIMAL HOST</td>
<td>GEOGRAPHICAL AREA</td>
<td>VECTOR OR METHOD OF SPREAD</td>
<td></td>
</tr>
<tr>
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<td>------------------</td>
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<td></td>
</tr>
<tr>
<td>12. Sheep sore mouth (contagious ecthyma)</td>
<td>Virus of sheep sore mouth</td>
<td>Sheep</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>13. Yellow fever</td>
<td>Jungle yellow fever virus</td>
<td>Monkeys, marsupials</td>
<td>S. America and Africa</td>
<td>Mosquitoes</td>
<td></td>
</tr>
<tr>
<td><strong>II. Rickettsial diseases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Endemic typhus</td>
<td><em>Rickettsia prowaseki</em> var. mooseri</td>
<td>Rodents</td>
<td>World-wide</td>
<td>Fleas</td>
<td></td>
</tr>
<tr>
<td>2. Fievre boutonneuse</td>
<td><em>Rickettsia rickettsi</em> var. conori</td>
<td>Dogs</td>
<td>Mediterranean area</td>
<td>Dog ticks</td>
<td></td>
</tr>
<tr>
<td>3. Q fever</td>
<td><em>Rickettsia burneti</em></td>
<td>Cattle, bandicoots, opossums</td>
<td>Australia, U. S., Europe</td>
<td>Ticks, contact, inhalation</td>
<td></td>
</tr>
<tr>
<td>4. Rocky mountain spotted fever</td>
<td><em>Rickettsia rickettsi</em></td>
<td>Rodents, dogs</td>
<td>N. America</td>
<td>Ticks</td>
<td></td>
</tr>
<tr>
<td>5. Sao Paulo fever</td>
<td><em>Rickettsia rickettsi</em> var. <em>Sao Paulo</em></td>
<td>Dogs, rodents, rabbits, opossums, agouti</td>
<td>S. America</td>
<td>Ticks</td>
<td></td>
</tr>
<tr>
<td>6. South African tick bite fever</td>
<td><em>Rickettsia rickettsi</em> var. <em>South Africa</em></td>
<td>Dogs</td>
<td>South Africa</td>
<td>Ticks</td>
<td></td>
</tr>
<tr>
<td>7. Tsutsugamushi fever</td>
<td><em>Rickettsia tsutsugamushi</em></td>
<td>Mice and rats</td>
<td>Asia</td>
<td>Mites</td>
<td></td>
</tr>
<tr>
<td><strong>III. Bacterial diseases</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1. Actinobacillosis</td>
<td><em>Actinobacillus lignieresii</em></td>
<td>Cattle and sheep</td>
<td>S. America, N. America, and Europe</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>2. Actinomycosis</td>
<td><em>Actinomyces bovis</em></td>
<td>Cattle and swine</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
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<tr>
<td>3. Anthrax</td>
<td><em>Bacillus anthracis</em></td>
<td>Sheep, cattle, horses and other herbivora. Swine are resistant. Dogs, cats, rats and birds are relatively insusceptible.</td>
<td>World-wide</td>
<td>Flies mechanical carriers; contact and ingestion</td>
<td></td>
</tr>
<tr>
<td>4. Bacillary dysentery</td>
<td><em>Shigella dysenteriae</em></td>
<td>Monkeys, dogs</td>
<td>Trop. and subtr.</td>
<td>Ingestion—flies</td>
<td></td>
</tr>
<tr>
<td>5. Brucellosis</td>
<td><em>Shigella gallinarum</em></td>
<td>Chickens</td>
<td>World-wide</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Brucella abortus</em></td>
<td>Cattle</td>
<td>World-wide</td>
<td>Ingestion and contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Brucella suis</em></td>
<td>Swine</td>
<td>World-wide</td>
<td>Ingestion and contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Brucella melitensis</em></td>
<td>Goats, swine and other animals</td>
<td>World-wide</td>
<td>Ingestion and contact</td>
<td></td>
</tr>
<tr>
<td>6. Erysipelas (Erysipeloid)</td>
<td><em>Erysipelothrix rhusiodpathiae</em></td>
<td>Swine, birds, cattle, fish, sheep, mice</td>
<td>World-wide</td>
<td>Contact and ingestion</td>
<td></td>
</tr>
<tr>
<td>7. Glanders</td>
<td><em>Malleomyces mallei</em></td>
<td>Horses, mules, cats, dogs, goats, asses</td>
<td>World-wide</td>
<td>Contact, ingestion, inhalation, wound infection, Ingestion</td>
<td></td>
</tr>
<tr>
<td>8. Leptospirosis</td>
<td><em>Leptospira canicola</em></td>
<td>Rats, rodents, dogs, foxes, cats, horses, swine</td>
<td>World-wide</td>
<td></td>
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<tr>
<td></td>
<td><em>Leptospira interrogans</em></td>
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<tr>
<td></td>
<td><em>Leptospira sp.</em></td>
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<tr>
<td>9. Listerellosis (listeriasis)</td>
<td><em>Listeria monocytogenes</em> (Listeria monocytogenes)</td>
<td>Rabbits, rodents, cattle, sheep, swine, chickens</td>
<td>Africa, Europe, N. America and N. Zealand</td>
<td>Contact and ingestion</td>
<td></td>
</tr>
<tr>
<td>10. Melioidosis</td>
<td><em>Actinobacillus pseudomallei</em> (Malleomyces whitmorei)</td>
<td>Rats, cats, dogs, and rodents. Horses not susceptible usually</td>
<td>Malay States, Ceylon, East Indies, China</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td>11. Necrobacillosis</td>
<td><em>Actinomyces necrophorus</em></td>
<td>Cattle, sheep, horses, swine and birds. Wild animals except wild carniv.</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>12. Plague</td>
<td><em>Pasteurella pestis</em></td>
<td>Rats, rodents</td>
<td>World-wide</td>
<td>Fleas</td>
<td></td>
</tr>
<tr>
<td>13. Rat bite fever</td>
<td><em>Spirillum minus</em></td>
<td>Rats and mice</td>
<td>Europe, North America</td>
<td>Bite</td>
<td></td>
</tr>
<tr>
<td>TABLE I—Continued</td>
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<tr>
<td>DISEASE</td>
<td>ORGANISM</td>
<td>ANIMAL HOST</td>
<td>GEOGRAPHICAL AREA</td>
<td>VECTOR OR METHOD OF SPREAD</td>
<td></td>
</tr>
<tr>
<td>14. Relapsing fever</td>
<td><em>Spirochaeta recurrentis</em></td>
<td>Rodents, squirrels, opossums, chipmunks</td>
<td>World-wide</td>
<td>Ticks (Onithodoros)</td>
<td></td>
</tr>
<tr>
<td>15. Salmonellosis</td>
<td><em>Salmonella</em> sp.</td>
<td>Birds and mammals</td>
<td>World-wide</td>
<td>Lice (Pediculi)</td>
<td></td>
</tr>
<tr>
<td>16. Staphylococcus infections</td>
<td><em>Staphylococcus albus</em> <em>Staphylococcus aureus</em></td>
<td>All animals</td>
<td>World-wide</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td>17. Streptococcus infection</td>
<td><em>Streptococcus</em> sp. except type A <em>Mycobacterium tuberculosis</em> var. <em>bovis</em>, var. <em>avium</em></td>
<td>All animals</td>
<td>World-wide</td>
<td>Ingestion and contact</td>
<td></td>
</tr>
<tr>
<td>18. Tuberculosis</td>
<td><em>Pasteurella tularensis</em></td>
<td>Cattle, herbivora, birds, swine</td>
<td>World-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Tularemia</td>
<td><em>Salmonella</em> sp.</td>
<td>Rodents, sheep, dogs, swine, birds</td>
<td>N. America, Europe and Asia</td>
<td>Fleas, flies, ticks, ingestion and contact</td>
<td></td>
</tr>
<tr>
<td>IV. Fungus diseases</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1. Aspergillosis</td>
<td><em>Aspergillus fumigatus</em> <em>Blastomyces dermatitidis</em></td>
<td>Birds, cattle</td>
<td>World-wide</td>
<td>Inhalation</td>
<td></td>
</tr>
<tr>
<td>2. Blastomycosis (Gilchrist's disease)</td>
<td></td>
<td>Dog</td>
<td>N. America, S. America, and Europe</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>3. Coccidioidomycosis</td>
<td><em>Coccidioides immitis</em></td>
<td>Rodents, cattle, sheep, dogs</td>
<td>SW United States</td>
<td>Inhalation and ingestion</td>
<td></td>
</tr>
<tr>
<td>4. Favus</td>
<td><em>Coccidioides</em> sp. <em>Achorion</em> sp.</td>
<td>Dogs</td>
<td>S. America</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>5. Histoplasmosis</td>
<td><em>Histoplasma capsulatum</em></td>
<td>Dogs, horses, cats, cattle, swine, birds</td>
<td>World-wide</td>
<td>Contacts</td>
<td></td>
</tr>
<tr>
<td>6. Lymphangitis</td>
<td><em>Cryptococcus farriminosus</em> <em>Trichophyton</em> sp. <em>Microsporum</em> sp.</td>
<td>Dogs, rodents, cattle</td>
<td>N. &amp; S. America</td>
<td>Inhalation and ingestion</td>
<td></td>
</tr>
<tr>
<td>7. Ringworm</td>
<td>Horses, mules and cattle</td>
<td>Horses, cattle, swine dogs, cats</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>Organism</td>
<td>Hosts</td>
<td>Geographic Distribution</td>
<td>Mode of Transmission</td>
<td></td>
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<tr>
<td>8. Sporotrichosis</td>
<td><em>Sporotrichium sp.</em></td>
<td>Horses, commonly, dogs, rodents, plants</td>
<td>World-wide</td>
<td>Ingestion and contact</td>
<td></td>
</tr>
<tr>
<td>9. Thrush</td>
<td><em>Odium albicans</em></td>
<td>Birds</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>V. Protozoa diseases</td>
<td></td>
<td></td>
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<tr>
<td>1. Amoebiasis</td>
<td><em>Endamoeba histolytica</em></td>
<td>Monkeys, rats, cats, dogs, swine</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>2. Blantidiasis</td>
<td><em>Blantidium coli</em></td>
<td>Swine, rats, monkeys</td>
<td>World-wide</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td>4. Giardiasis</td>
<td><em>Giardia lamblia</em></td>
<td>Rodents</td>
<td>World-wide</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td>5. Leishmaniasis</td>
<td><em>Leishmania tropica</em></td>
<td>Dogs, cats and agouti</td>
<td>Asia, Europe, Africa, S. America</td>
<td>Flies, Sandflies, Contact</td>
<td></td>
</tr>
<tr>
<td>6. Sarcocytosis</td>
<td><em>Sarcocytosis sp.</em></td>
<td>Cattle, sheep, rats, horses, swine, birds</td>
<td>World-wide</td>
<td>Ingestion</td>
<td></td>
</tr>
<tr>
<td>7. Toxoplasmosis</td>
<td><em>Toxoplasma gondii</em></td>
<td>Rodents, dogs, birds, sheep, cats, cold blooded animals</td>
<td>World-wide</td>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>8. Trypanosomiasis</td>
<td><em>Trypanosoma gambiense</em></td>
<td>Herbivora, horses, swine</td>
<td>Africa</td>
<td>Tsetse fly</td>
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<tr>
<td>VI. Parasitic diseases</td>
<td></td>
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<tr>
<td>A. Trematode infections</td>
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</tr>
<tr>
<td>1. Clonorchiasis</td>
<td><em>Clonorchis sinensis</em></td>
<td>Cat, dog, swine, wild animals</td>
<td>Asia</td>
<td>Ingestion of fish</td>
<td></td>
</tr>
<tr>
<td>2. Echinostomiasis</td>
<td><em>Echinostoma ilocanum</em></td>
<td>Rats, dogs</td>
<td>Asia</td>
<td>Ingestion</td>
<td></td>
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<tr>
<td></td>
<td><em>Echinostoma revolutum</em></td>
<td>Geese and dogs</td>
<td></td>
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<tr>
<td></td>
<td><em>Gastrodiscus hominis</em></td>
<td>Swine and mice</td>
<td></td>
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<tr>
<td>DISEASE</td>
<td>ORGANISM</td>
<td>ANIMAL HOST</td>
<td>GEOGRAPHICAL AREA</td>
<td>VECTOR OR METHOD OF SPREAD</td>
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<tr>
<td>3. Fascioliasis</td>
<td>Fasciolopsis buski</td>
<td>Sheep, cattle, swine</td>
<td>World-wide</td>
<td>Ingestion of cercariae cysts</td>
<td></td>
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<tr>
<td></td>
<td>Fasciola hepatica</td>
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<tr>
<td></td>
<td>Dicrocoelium dendriticum</td>
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<tr>
<td>4. Heterophyiasis</td>
<td>Heterophyte heterophyte</td>
<td>Dogs, cats, foxes</td>
<td>Africa, Asia</td>
<td>Ingestion of fish</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Metagonimus yokogawai</td>
<td>Dogs, cats, pigs</td>
<td>Africa, Asia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Paragonimiasis</td>
<td>Paragonimus westermani</td>
<td>Pig, dog, cat, cattle, wild animals</td>
<td>Asia, Africa, S. America</td>
<td>Ingestion of fish, water crabs and water ingestion</td>
<td></td>
</tr>
<tr>
<td>6. Schistosomiasis</td>
<td>Schistosoma japonicum</td>
<td>Cattle, swine, cats, dogs, monkeys, horse, sheep, rabbits, mice, herbivora</td>
<td>Asia, S. America, West Indies, Africa and Asia</td>
<td>Water, contact and ingestion</td>
<td></td>
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<tr>
<td></td>
<td>Schistosoma mansoni</td>
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<td>Schistosoma bovis</td>
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<td></td>
<td>Schistosoma spindalis</td>
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<tr>
<td>7. Schistosoma dermatitis</td>
<td>Schistosoma sp. Cerca riae</td>
<td>Birds</td>
<td>World-wide</td>
<td>Water contact</td>
<td></td>
</tr>
<tr>
<td>B. Cestode diseases (tape-worms)</td>
<td></td>
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</tr>
<tr>
<td>1. Taeniasis</td>
<td>Taenia saginata</td>
<td>Cattle</td>
<td>World-wide</td>
<td>Ingestion of intermediate arthropods or flesh</td>
<td></td>
</tr>
<tr>
<td>2. Taeniasis</td>
<td>Taenia solium</td>
<td>Swine, dogs, monkeys, camels</td>
<td>World-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Taeniasis</td>
<td>Diphyllolothrium latum</td>
<td>Dogs, cats, bears</td>
<td>World-wide</td>
<td></td>
<td></td>
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<tr>
<td>4. Taeniasis</td>
<td>Hymenolepis nana</td>
<td>Rats, mice</td>
<td>World-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Taeniasis</td>
<td>Hymenolepis diminuta</td>
<td>Rats, mice</td>
<td>World-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Taeniasis</td>
<td>Diphylidium caninum</td>
<td>Dogs, cats, wild carnivora</td>
<td>World-wide</td>
<td></td>
<td></td>
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<tr>
<td>7. Hydatid disease</td>
<td>Echinococcus granulosus</td>
<td>Wolf, dog, cats, wild carnivora, sheep, cattle, swine</td>
<td>World-wide</td>
<td></td>
<td></td>
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<tr>
<td>8. Cysticercosis</td>
<td>Cysticercus cellulosae</td>
<td>Swine, dogs, monkeys, camels</td>
<td>World-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Nematode Diseases (round worms)</td>
<td>Toxocara canis</td>
<td>Dog, wild carnivora</td>
<td></td>
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<tr>
<td>1. Ascariasis</td>
<td>Toxocara cati</td>
<td>Cat, wild cats</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Lagochilascaris minut</td>
<td>Leopard</td>
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</tr>
<tr>
<td>2. Ancylostomiasis</td>
<td>Ancylostoma duodenale</td>
<td>Gorilla, tiger, civet cat, swine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Creeping eruption)</td>
<td>Nector americanus</td>
<td>Swine, monkeys, dogs</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3. Dipetalonemiasis</td>
<td>Ancylostoma caninum</td>
<td>Dog, cat, wild carnivora</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Dracontiasis</td>
<td>Ancylostoma braziliense</td>
<td>Dog, cat, wild carnivora</td>
<td></td>
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</tr>
<tr>
<td>5. Strongyloides stercorealisis</td>
<td>Dipetalonema perstaus</td>
<td>Gorilla, chimpanzee</td>
<td></td>
<td></td>
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<tr>
<td>6. Strongyloides dermatitidis</td>
<td>Dracunculus medinensis</td>
<td>Dogs, horses, cattle, primates, wild carnivora</td>
<td></td>
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<td></td>
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<tr>
<td>7. Trichinosis</td>
<td>Strongyloides ratti</td>
<td>Dog</td>
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<tr>
<td></td>
<td>Strongyloides vituli</td>
<td>Rats</td>
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<tr>
<td></td>
<td>Trichinella spiralis</td>
<td>Calves</td>
<td></td>
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<tr>
<td>8. Other rare nematode infections</td>
<td>Capillaria hepatica</td>
<td>Swine, rats, bears, carnivora</td>
<td></td>
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<tr>
<td></td>
<td>Dictophyme renale (kidney worm)</td>
<td>Rodents, dogs, monkeys</td>
<td></td>
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<tr>
<td></td>
<td>Onathostoma spinigerum</td>
<td>Dog</td>
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<tr>
<td></td>
<td>Hemonchus contortus</td>
<td>Carnivora</td>
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<tr>
<td></td>
<td>Metastrongyplus apri</td>
<td>Sheep</td>
<td></td>
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<tr>
<td></td>
<td>Oesophagostomum apioastomum</td>
<td>Hogs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Europe, Europe, N. America, S. America, Tropics and subtropics, Tropics and subtropics, World-wide, N. and S. America

Ingestion, Ingestion, Ingestion, Ingestion and contact, Ingestion and contact, Ingestion and contact, Ingestion and contact, Ingestion

Africa, Africa, Africa

Midges, Cyclops, Larvae, Larvae

Ingestion, Ingestion

India, Australia, Brazil, World-wide, Asia, Africa

Europe, Europe, N. America, S. America, Tropics and subtropics, Tropics and subtropics, World-wide, N. and S. America

Ingestion, Ingestion, Ingestion, Ingestion and contact, Ingestion and contact, Ingestion and contact, Ingestion and contact, Ingestion

Africa, Africa, Africa

Midges, Cyclops, Larvae, Larvae

Ingestion, Ingestion

India, Australia, Brazil, World-wide, Asia, Africa
<table>
<thead>
<tr>
<th>TABLE I—Continued</th>
</tr>
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<tbody>
<tr>
<td><strong>Disease</strong></td>
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<tr>
<td>Other rare nematodes—Cont'd</td>
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<tr>
<td>VII. Arthropodal diseases</td>
</tr>
<tr>
<td>1. Chicken mite itch</td>
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<tr>
<td>2. Scabies</td>
</tr>
<tr>
<td>VIII. Toxin Diseases</td>
</tr>
<tr>
<td>1. Botulism</td>
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<tr>
<td></td>
</tr>
<tr>
<td>2. Tetanus</td>
</tr>
<tr>
<td>3. Tick paralysis</td>
</tr>
</tbody>
</table>

* Animals are passive carriers.
interest in which the veterinarian and health official can cooperate in controlling, provided they are informed.

This past summer there was an acute epizootic of eastern equine encephalomyelitis among horses in a southern State. A full report of the epizootic is being prepared by the officials who were directly concerned with the outbreak, but I wish to use this disease episode as an example of the value of animal morbidity and mortality statistics to public health. The disease attacked several thousand horses or more and there were 16 human cases, 4 of which were fatal. Subsequent investigation by health authorities indicated the disease first appeared in the early summer but it is my understanding that neither the state veterinarian nor the state health officer was informed until August. If this disease had been reported when it first appeared, many human lives and thousands of horses could have been saved through cooperative efforts of the state officials. It is well known that encephalomyelitis is transmitted by insects. An extensive insect control program might have saved these lives and animals for such efforts can be put forth when a problem is presented that jeopardizes life and property.

<table>
<thead>
<tr>
<th>Table 2 (3)</th>
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</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Actinomycosis</td>
</tr>
<tr>
<td>Anthrax</td>
</tr>
<tr>
<td>Brucellosis</td>
</tr>
<tr>
<td>Encephalitis</td>
</tr>
<tr>
<td>Rabies in man</td>
</tr>
<tr>
<td>Salmonellosis</td>
</tr>
<tr>
<td>Tularemia</td>
</tr>
</tbody>
</table>

The salmonella investigations of the Michigan Department of Health have demonstrated another aspect of animal disease which is important to human health. This epidemiological study is exploring the incidence of salmonella and other enteric infections in animals that may be of public health significance. The first group of animals studied were dogs, which were ill and had symptoms of distemper or gastro-enteritis. A total of one hundred dogs were studied, of which 18 per cent were found to be infected with salmonella organisms. Animal infections of this kind which are known to be infectious for man should be reported. In establishing an animal disease morbidity and mortality reporting system, we must not overlook the small animal diseases. Many of their diseases are important to man.

We have discussed the influence of animal morbidity and mortality on the nutritional health of man, the epidemiological importance in establishing the cause of disease, and the public health significance in planning disease prevention. There is one very important public health aspect that has not been mentioned. It is a problem of our modern society and progress which reemphasizes itself at every turn. World air transportation has shrunk the world until today we can think of the world as being the size of the United States in 1910. This thrusts a new problem upon us
in the control of both human and animal disease. Veterinarians in the future will have to be familiar with tropical diseases of animals such as Jungle Yellow Fever and encephalitis in monkeys, atypical rabies, leishmaniasis, rickettsial fevers, and dysenteries in animals. He will be responsible for recognizing these diseases in animals before they become widespread and attack man. To be cognizant of the tropical animal diseases it will be necessary to establish an international reporting system. Organizations such as the Pan American Sanitary Bureau, Food Agriculture Organization, and the World Health Organization may provide the facilities for compiling the data.

An example of what may occur has recently come to our attention in a southeastern city. A monkey was purchased in Key West, Florida early in October as a household pet. About fifteen days after it was brought home it died after being ill for five days. The animal was submitted to the state health department for examination and it was found positive for rabies, both on direct examination for Negri bodies and mouse inoculation. Further investigation at Key West established that the monkey had only arrived in the United States from South America five days before being sold. Monkeys and other animal pets can import numerous diseases which are important to human health. To control small animal traffic it is necessary to have accurate reporting of animal diseases in foreign countries. What we learn from our animal morbidity statistics will also be of value to other nations.

It is well known that no country can have a healthy economy without a sound animal industry. It is even more true that no nation can have a healthy population without the necessary animal proteins and fats which make an optimal diet. And it is also true that human health cannot be maintained if there are animal reservoirs of disease threatening the population. The control of any disease is based on the known incidence and prevalence. To assemble such data it is necessary to have a good reporting system which is based on sound diagnosis.

The value of animal disease information will be three-fold to the nation. In the field of economics it will prevent unnecessary losses of animal units. These additional animals saved will contribute to a better human nutrition level. And the control of diseases in animals will prevent any threat or spread to man.

The Bureau of Vital Statistics of the U. S. Public Health Service will be glad to assist in any way they can in seeing a program of animal morbidity and mortality reporting established.

**SUMMARY**

Animal health is of direct concern to everyone in the world today. The shortage of food, power, and the disruption of animal disease control measures in the war-torn areas has emphasized this problem. To combat animal disease in the United States it is necessary to have an accurate system of disease reporting to state and national officials. Such reporting is based on the local veterinarians and the diagnostic laboratories.

It will benefit the public health of the nation by informing livestock disease control officials of potential animal epidemics who then can take measures to control or prevent their spread. Such action will prevent animal losses which would cut down
our supply of meat, milk, wool and leather. All these animal products are necessary to protect the nation's health.

Animal disease data would be invaluable to health authorities in taking steps to prevent the spread of certain animal diseases to man. There are over 75 animal diseases that are communicable to man. Fortunately the United States is free of many of these diseases. This does not come naturally but largely through the efforts of national and state veterinary officials in eradicating or controlling disease when it has appeared.

Health authorities know it is just as important to have an animal population free of disease as it is to control infectious diseases in man if they are to maintain optimal health for man. The basis of all disease control is knowing the incidence and prevalence of disease. This can only be known through a good vital statistical service.

REFERENCES

AN EXPERIMENT IN THE COLLECTION OF MORBIDITY AND MORTALITY DATA ON FARM ANIMALS

GEORGE W. SNEDECOR

Statistical Laboratory, Iowa State College

During the fall of 1945, conversations between Dr. R. C. Newton, Chairman of the Committee on Veterinary Services for farm Animals of the National Research Council and Dr. R. E. Buchanan, Director of the Iowa Agricultural Experiment Station, led to the initiation of a sampling project to examine the problem of getting information from Iowa farmers about morbidity and mortality among their livestock. Funds were provided jointly by Swift and Company, the Iowa Agricultural Experiment Station and the Bureau of Animal Industry, United States Department of Agriculture.

The objectives of the project were:
1. To learn the extent to which information about morbidity and mortality may be obtained directly from farmers in Iowa.
2. To acquire judgment as to the merits of various ways of getting the information.
3. To get cost data on alternative methods of conducting such surveys.
4. To observe and inquire about sanitary conditions and practices, including attitudes toward veterinary services in Iowa.
5. To make rough estimates of the losses in Iowa due to morbidity and mortality among livestock.

Using the materials and methods of the master sample, 177 farms were drawn at random. These farms were situated in 20 of Iowa's 99 counties, four counties from each of the five type-of-farming areas into which the state is divided. The map, Figure 1 shows the counties that fell into the sample.

An initial inventory was taken during April, 1946. For every farm in the sample a record was made of the number of animals in each of these species: hogs, cattle, sheep, chickens and turkeys, horses, and mules. Along with this inventory questions were asked concerning the tenure of the farm operator, total acres in the farm, land in crops, attitudes of farmers toward veterinarians together with their use of local veterinary services, and questions about practices in handling livestock.

At three-month intervals, subsequent inventories were made and information was obtained about sales, purchases, births, deaths, and animals butchered. The last inventory was in June, 1947.

Following the first inventory, the sample was divided randomly into four equal parts. Each subsample contained one of the four counties in each type-of-farming

1 Journal Paper No. J-1499 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project 963, in cooperation with Swift and Company and with the Bureau of Animal Industry, United States Department of Agriculture.

The following members of the staff collaborated in designing the sample, constructing the questionnaires, supervising the interviewers and summarizing the results: R. J. Jessen, A. J. King, R. K. McMillan, D. P. Dodd, and Dorothy S. Cooke.
Fig. 1.—Twenty counties in Iowa from which sample farms were drawn
A subsample is comprised of one county from each of the type-of-farming areas
area. Beginning with the second inventory, one of the subsamples was assigned to Dr. Daniel P. Dodd, a young veterinarian who had recently been demobilized. The farms in this subsample were visited monthly to get information about morbidity and mortality. Farms in the other three subsamples were visited only at the times of the three-month inventories. These latter subsamples were handled by women who were interviewers of Kay Fuller, Research, a sampling organization of Des Moines.

From the data and experiences available, I have abstracted parts which would seem to be particularly interesting to this group. This is in the nature of a preliminary and partial report.

EXTENT TO WHICH INFORMATION CAN BE OBTAINED

During early discussions of this project, skepticism was expressed as to whether farmers would or could give the information desired. Moreover, there was some uncertainty as to the attitudes of the veterinary practitioners in the state: they might resent questioning about conditions that fell within their own field of interest. To forestall the latter criticism, arrangements were made to have Dr. Newton address the annual meeting of the Iowa Veterinary Medical Association, explaining the objectives and methods of the project and enlisting the sympathy and cooperation of the veterinarians of the state. In only one instance did we encounter any opposition: in all other contacts we found the veterinarians uniformly helpful.

As for the farmers, no unusual difficulties arose. A few refusals are always to be expected—in this survey there were 15 in the original sample of 177. Some who granted the earlier interviews later withdrew. Our interviewers got the impression that the refusals were due in part to suspicion that the inventories might fall into the hands of taxing agencies. A few farms could not be reached on account of poor roads; at others, no one could be found at home. For repeated visits of this kind, covering 14 months, I think it notable that the interviewers were nearly always received in friendly fashion and supplied with the information sought. In many instances, record books were consulted so that answers might be correct. One of Dodd's clients broke off a visit to a neighbor when he saw the car driving into his place—he came walking up just as Dodd was about to leave.

There was great variation in the accuracy of the information that could be supplied. Even with monthly visits, changes in inventory would be forgotten. Interviewers had to be persistent in jogging memories. Occasionally, the inventories could not be balanced so that some guessing had to be done. Doubtless, among baby pigs there were occasional losses that were overlooked. Chickens, especially, aren't kept track of very carefully; the farmer usually ignores them when discussing his farm animals. He knows how many chicks were bought, but he often doesn't know what becomes of them. His wife is helpful in this part of the inquiry. Despite these lapses from accuracy, the interviewers got the impression that most of the changes in inventory were accounted for satisfactorily. The respondents were conscientious about trying to report the fluctuations in their animal populations, and for the most part seemed to do it very well.

It should not be forgotten that, in this survey of only one per thousand farms the sampling error is sizable. My guess is that the errors in getting information on total
mortality, though doubtless in the nature of a bias, are small in comparison to sampling variation.

Concerning the accuracy of diagnoses there will doubtless be some skepticism. However, the farmers seem to be well acquainted with the symptoms of the more common diseases though their designations were vague. Dr. Dodd found little occasion to disagree with their judgments when he discussed the cases with them. When there was doubt in the farmer's mind about the cause of death, he was asked to call his local veterinarian for diagnosis. We had made arrangements to have this done at the expense of the project in order to have as accurate information as possible. Twelve calls of this kind were made, each followed by a report made direct to Ames.

So far, reports on morbidity have not been summarized. It is clear, however, that they are not so extensive or so adequate as those on mortality.

In summarizing this part of the report, it would seem that information about deaths can be obtained with accuracy sufficient for ordinary purposes. Greater accuracy can be gained at greater expense. But for much policy making, it seems to me that somewhat less accuracy is required, and this could be had much more cheaply.

ESTIMATES OF DEATH LOSSES

1. Swine. The major portion of the losses among swine occur at birth. Of the 16,507 pigs farrowed during the year following June 1946, 3,017 which is 18.3 per cent did not survive until weaning, most of them either stillborn or dying within a few hours. The principal causes are detailed in Table 1.

Among the older pigs there were 553 deaths in an average inventory of about 10,000; that is, 3.5 per cent.

As a rough estimate of state totals, multiply the numbers above by 1,000. This tends to underestimate the correct totals because of the sample farms for which records were not completed. An idea of the reliability of this estimate may be got by comparing our estimate of the January 1 inventory, 11,000,000 with that made by the Bureau of Agricultural Economics, 11,494,000. For these latter figures, I am indebted to Mr. Leslie M. Carl, State Statistician in Des Moines.

The owners of the swine were asked to assess the value of those lost by death.

The average values with corresponding losses are shown in Table 2. As before, estimates for the state may be got by annexing three zeros.

2. Cattle. Losses among cattle are not so spectacular as those for swine. Some 9.8 per cent (99 among 1006 births) of the calves died at or within one month of birth. For ages greater than one month, the annual death rate was 2.4 per cent; that is, 115 in an average inventory of 4724. The principal causes of deaths of calves over one month old were pneumonia (24 per cent of all deaths) and hemorrhagic septicemia (17 per cent). Among the younger calves, those stillborn and dying at birth accounted for most of the deaths.

Using the average values of the animals, as estimated by the farmers, the economic loss is shown in Table 3. For state losses, the usual multiplier, 1000, gives rough estimates.

It may be observed that, among cattle, the total economic loss due to death
increases as one passes from the younger age groups to the older. For swine, the opposite trend is evident: this is caused by the great numbers of deaths among the young pigs.

Table 1.—Causes of death among pigs less than eight weeks old. Iowa sample. One year following June, 1946

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs farrowed</td>
<td>16,507</td>
<td></td>
</tr>
<tr>
<td>Stillborn</td>
<td>415</td>
<td>14</td>
</tr>
<tr>
<td>Weak and runty, died at birth</td>
<td>208</td>
<td>7</td>
</tr>
<tr>
<td>Crushed by sow</td>
<td>1,820</td>
<td>60</td>
</tr>
<tr>
<td>Exposure</td>
<td>153</td>
<td>5</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>138</td>
<td>5</td>
</tr>
<tr>
<td>Other deaths at birth</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>Miscellaneous, birth to 8 weeks</td>
<td>241</td>
<td>8</td>
</tr>
<tr>
<td>Total dead</td>
<td>3,017</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2.—Numbers and estimated value of swine lost by death. Iowa sample. One year following June, 1946

<table>
<thead>
<tr>
<th>Class</th>
<th>Number Dying</th>
<th>Average Owner's Estimate of Value per Animal</th>
<th>Sample Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to weaning</td>
<td>3,017</td>
<td>$2.37</td>
<td>$7,150</td>
</tr>
<tr>
<td>Weaning to 6 months</td>
<td>305</td>
<td>13.96</td>
<td>4,258</td>
</tr>
<tr>
<td>Over 6 months</td>
<td>48</td>
<td>59.00</td>
<td>2,832</td>
</tr>
<tr>
<td>Total</td>
<td>3,370</td>
<td></td>
<td>$14,240</td>
</tr>
</tbody>
</table>

Table 3.—Numbers and estimated values of cattle lost by death. Iowa sample. One year following June, 1946

<table>
<thead>
<tr>
<th>Age</th>
<th>Number Dying</th>
<th>Average Owner's Estimate of Value per Animal</th>
<th>Sample Total Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 month</td>
<td>99</td>
<td>$16.64</td>
<td>$1,647</td>
</tr>
<tr>
<td>One month to 1 year</td>
<td>76</td>
<td>47.58</td>
<td>3,616</td>
</tr>
<tr>
<td>More than 1 year</td>
<td>39</td>
<td>156.74</td>
<td>6,113</td>
</tr>
<tr>
<td>Total</td>
<td>214</td>
<td></td>
<td>$11,376</td>
</tr>
</tbody>
</table>

ESTIMATES OF PREVENTABLE ECONOMIC LOSS

Dr. I. A. Merchant of our Veterinary College, in consultation with other members of the staff, estimated the preventable losses for each cause of death. I asked him
to make two estimates, practical and ideal. The first was the saving he thought practicable on a farm with reasonable care, nutrition, veterinary service, equipment, and sanitary conditions. The ideal was such as might be attained if money and attention were lavished on the animals regardless of cost. I suppose every one of you would arrive at different estimates, but the effort seemed worthwhile. The results appear in Table 4.

As before, rough state estimates are reached by multiplying each number by 1,000. Evidently, a good deal of money might be spent profitably in reducing such losses.

Table 4.—Estimate of preventable animal economic loss at two levels. Sample of Iowa farms

<table>
<thead>
<tr>
<th></th>
<th>Swine</th>
<th>Cattle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sample Loss</td>
<td>$14,240</td>
<td>$11,376</td>
<td>$25,616</td>
</tr>
<tr>
<td>Estimated Preventable:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical</td>
<td>7,699</td>
<td>5,406</td>
<td>13,115</td>
</tr>
<tr>
<td>Ideal</td>
<td>11,274</td>
<td>7,478</td>
<td>18,752</td>
</tr>
</tbody>
</table>

**ATTITUDES OF FARMERS**

Having visited his sample 14 times, Dr. Dodd recorded his impressions of the attitudes of each farmer toward the survey, and also toward the veterinary services available to him. The following comments are typical of the most common attitudes toward the survey:

1. "The first few times a refusal was expected, but as time went on this attitude changed to a more receptive one."
2. "Very reluctant to give information, especially on inventory."
3. "Cooperation excellent. Was very exact about inventory and all information was given freely. Asked me to drop in if ever in the vicinity again."
4. "Was interested enough in the study to ask that results be sent to him."
5. "Was cooperative, but couldn't see why we had picked his farm which had so few animals."
6. "Would go into detail about each ailment, and would check inventory records before giving figures."
7. "Gave information freely and discussed many unrelated problems. Was able to help him by having some bulletins sent from the College."

Attitudes toward veterinarians and their services are typified by these five comments:

1. "Think they are all right." This is the most common comment.
2. "Uses veterinarian when he needs one."
3. "Can't get along without one."
4. "He is hard to get—too busy", or "too far away".
5. "Does not call the veterinarian until everything else has been tried."
Among the unusual comments, the following are the most interesting:

1. "Vet. services not any good—they just get your money."
2. "At one time I thought they spread disease by not being careful enough."
3. "One of our vets is always on a bender and the other doesn't know much."

This seemed to be common knowledge in that community.

Some considered the fees were too high, but most clients thought them reasonable.

On the whole, veterinary services in Iowa seem to be highly valued but somewhat inadequate. Clearly, the typical farmer is likely to apply common treatments himself, calling the veterinarian for the more difficult and serious cases.

For anyone contemplating a similar survey, one recurring comment should be noted. To secure and keep the farmer's cooperation, it is necessary not only to explain carefully and fully the objectives of the survey but also to repeat the "sales talk" at each of the first two or three visits. Dr. Dodd recommends a letter to each sample farmer shortly before the second visit; this letter to emphasize the objectives and to ask for continued help.

Table 5.—Number and percentages of pigs crushed by sow in four types of farrowing houses. Iowa sample. One year from June, 1946

<table>
<thead>
<tr>
<th>TYPE OF HOUSE</th>
<th>NUMBER PIGS FARROWED</th>
<th>NUMBER CRUSHED</th>
<th>PERCENTAGE CRUSHED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety devices</td>
<td>1475</td>
<td>168</td>
<td>11.4</td>
</tr>
<tr>
<td>None</td>
<td>1686</td>
<td>228</td>
<td>13.5</td>
</tr>
<tr>
<td>Total</td>
<td>3161</td>
<td>396</td>
<td>12.5</td>
</tr>
<tr>
<td>Portable:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety devices</td>
<td>1070</td>
<td>91</td>
<td>8.5</td>
</tr>
<tr>
<td>None</td>
<td>516</td>
<td>51</td>
<td>9.9</td>
</tr>
<tr>
<td>Total</td>
<td>1586</td>
<td>142</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Sanitary Conditions

1. Swine. Some of the survey data bear on sanitary conditions of the farms. Interpreted broadly, I shall take this to include the installation of guard rails, shelves or other safety devices. This is of first importance since more pigs were lost from being crushed by sow than from any other cause.

Of the 38 farms from which information was got, 18 had farrowing houses supplied with safety devices. Possession of such devices was not related to size of house, but was more prevalent in portable houses than in permanent ones. The latter relation could, however, be an accident of sampling ($P = 0.12$).

In both permanent and portable houses a smaller proportion of the pigs was crushed where safety devices were installed, but in neither case was the difference statistically significant (Table 5). There is no obvious reason why larger per-
percentages of pigs should have been crushed in the permanent houses than in the portable. This might be due to greater care by the operators who use portable houses; this point is being investigated.

On the majority of farms (74 per cent) the same houses are used for successive fall and spring farrowings. Practically all houses (95 per cent) are cleaned before being used again. The practice of turning the pigs out on different ground for grazing is followed by half the farmers interviewed.

Among the 64 farms with permanent houses, 31 have cement floors on which to turn out the pigs.

The question as to whether these practices are related to the incidence of infectious diseases has not as yet been investigated.

2. Cattle. The information about sanitation among cattle is limited mostly to tests and vaccinations for brucellosis. Calves on only 27 of 139 reporting farms (19 per cent) were vaccinated during the spring of 1946.

Testing for brucellosis seems to be practiced infrequently but somewhat uniformly over the years. In the spring of 1946 the herds on 63 of 136 farms (46 per cent) had been tested, but only eleven of them that year. Twelve were tested in 1945, thirteen in 1944, and four or five in each preceding year back to 1940. In the spring of 1947, eight of 159 farmers had tested their herds during the foregoing six months. During the years, fourteen of the 63 herds tested had contained reactors, and these were all marketed.

In the spring of 1946, of 1,427 cows bred 329 (23 per cent) had been vaccinated, but no information was obtained as to their ages. Eighteen abortions were reported that spring and twelve in the spring of 1947. Sterile cows for the two seasons were 12 and 15, the averages being approximately one per cent abortions and one per cent sterile each year. As to incidence of abortion, no clear distinction could be observed between cows that had been vaccinated and those not
DISCUSSION OF IOWA EXPERIMENT ON COLLECTION OF MORBIDITY AND MORTALITY STATISTICS

DR. R. C. NEWTON

_Swift and Company, Chicago, Ill._

Mr. Chairman, Members of the United States Livestock Sanitary Association:

I hadn't expected to make any talk, but there are one or two points that occurred to me during Dr. Snedecor's presentation of this very complicated subject that I would like to comment on.

In the first place, the question of accuracy maybe doesn't mean the same to any two people, and possibly does not mean the same to me that it does to Dr. Snedecor. I realize that it is impossible to get an absolutely mathematically accurate estimate of the losses, let alone diagnosis of the cause of losses; but it occurs to me the difficulty with the figures that we have had in the past is that they were not only inaccurate, but they were estimates and therefore unreliable. We did not know the degree of accuracy which we had.

Now, with this kind of survey it is hoped that we will have a little more accuracy than we have had in the past, and that we will also have figures that are reliable to the extent that we know about the degree of accuracy.

It was with that point in mind that the Committee of the National Research Council, and also Dr. Schraeder's Committee of this Association, were interested in seeing such a survey made. Our National Research Council Committee studied for some time the facilities for making such surveys, discussed it with the B.A.E. in Washington, and Dr. Snedecor's Statistical Laboratory at Ames, and finally came to the conclusion that such a sample survey was the only possible way to get reliable information which would include the diagnosis.

They very kindly consented to handle this project and employed a veterinarian, Dr. Dodd, who helped them to organize it from the scientific standpoint, and secured cooperation from veterinarians in Iowa.

The method was proposed as a methodology study in Iowa, hoping that they would get enough information so that they could, if it still seemed desirable, carry it on a national basis.

There are a lot of uses that can be made of reliable information on morbidity and mortality losses in livestock. Dr. Steele has very ably covered the public health significance of such data. The research of the experiment stations in the Department of Agriculture on diseases could be more intelligently carried out if we had a better picture of the extent and the cause of these losses.

The programs of control instituted through the states and the Federal Government could be more intelligently handled if we knew the extent and causes.

I think when Dr. Snedecor gets through the analysis of his data on morbidity, they will give more interesting results than the data he has presented today on the death losses. There are sources of information which are more reliable, or maybe less unreliable on death losses than there are on morbidity losses. And it is the suspicion of a number of people who have had enough experience to have an opinion
on this subject that the morbidity losses, economically, may greatly outweigh the
death losses in our livestock operation. And yet, there is not too much done about
it. Even your practicing veterinarian is almost entirely practicing on sick animals.

I know there are some outstanding examples in which the veterinarian has estab-
lished such a close working relationship with the farmer that he consults the farmer.
But that is the exception rather than the rule.

Now it is hoped that if we have enough information on morbidity losses, that
gradually a new and we think more important type of practice will grow up in the
veterinary profession.
REPORT OF THE COMMITTEE ON MORBIDITY AND MORTALITY STATISTICS


This committee's 1945 report confirmed the findings of others that reliable morbidity and mortality statistics of domestic animals showing cause are not available from any source.

The 1946 committee report made recommendations and proposed the adoption of resolutions concerned with methods for assembling and reporting morbidity and vital statistics of animals, and for stimulating interest in such a program.

The function of this committee is to continue to gather opinions with the ultimate goal of presenting supportive evidence to legislators indicating the value of morbidity and mortality statistics. The committee should eventually show (1) the cost of a maintained program, (2) how the experts feel about the various phases of such a program, and (3) indicate the benefit that will follow the establishment of such a program.

The specific cause of death in all instances would be difficult, if not impossible, to determine. Although all-inclusive morbidity data are desirable the problems concerned with their collection, even in a sampling program, seem to be almost insurmountable. A less extensive program might be initiated now, however. Sampling schemes, as designed and used by the Iowa project described in these proceedings, are workable. We are concerned about how much information we can get, at what cost, and for whose benefit. The answers should be learned this year, in part at least.

The 1947 report is concerned with the findings of an opinion poll which includes, in principal as questions, both the committee's 1946 resolutions, and proposals suggested by members of this Association. The questions were directed to 272 persons, and included those who might immediately take part in the accumulation of vital statistics. Branches of the Federal Government, including the U. S. Department of Agriculture, Bureaus of Animal Industry and Agricultural Economics, and the Department of Commerce, Bureau of Census, were excluded since it is these groups which are seeking the opinion of other organizations and individuals.

One hundred twenty returns were received from 35 state livestock sanitary officials, 38 animal pathologists, including research workers and teachers, and the balance from directors of state experiment stations, teachers of animal husbandry, land grant college presidents, deans of veterinary colleges, manufacturers of biologicals and pharmaceuticals, and officers of national husbandry associations. We feel that the findings represent a cross section of opinion of widely varied groups, and should point out to legislators of both state and federal governments the trend of thinking of those people concerned directly with veterinary medical education, animal disease research, animal husbandry, diagnosis, the prevention, control and

The 18 graphs presented illustrate the opinions of animal pathologists, state livestock sanitary officials, and a miscellaneous group including land grant college presidents, manufacturers, teachers of animal husbandry, directors of experiment stations, deans of veterinary colleges, and others.

Chart Key

Animal Pathologists
State Livestock Disease Control Officials
Others including:
  Directors of Experiment Station
  Land-grant college presidents
  Deans of veterinary colleges and colleges of agriculture
  Professors of animal husbandry
  Producers of biologicals and pharmaceuticals
  Officers of animal husbandry associations

Where Should the Primary Collecting Agency for Mortality Statistics Be Located?

A. Office of state livestock disease control official
B. Office of county veterinarian
C. State-operated diagnostic laboratory
D. Existing U.S. BAI laboratory
E. Existing state college diagnostic and statistical laboratories
F. Existing State Experiment Station
G. Federal Statistical Laboratory (new set up)
H. Other agency

Where should the primary collecting agency for mortality statistics be located? (Chart 1.) Obviously, the flow of both morbidity and mortality data must originate on the farm, then, preferably, through the veterinarian, or, in his absence, by any
other means, to the county veterinarian, or, directly to the office of the state veterinarian—state livestock disease control office. That agency might then move the data on to the body responsible for final compilation, printing, and distribution. It becomes apparent that the group which answered the questionnaires are overwhelmingly in favor of establishing the office of the state livestock sanitary official as the central state collecting agent for mortality statistics.

Where should the primary collecting agency for morbidity statistics be located? (Chart 2.) The office of the state livestock disease control official is the majority choice for the collecting agency of morbidity statistics, the data again originating on the farm.

Where Should the Primary Collecting Agency for Morbidity Statistics Be Located?

<table>
<thead>
<tr>
<th>A</th>
<th>Office of state livestock disease control official</th>
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<tr>
<td>B</td>
<td>Office of county veterinarian</td>
</tr>
<tr>
<td>C</td>
<td>Office of regional laboratory U.S. B.A.E.</td>
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<tr>
<td>D</td>
<td>State Experiment Station</td>
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<tr>
<td>E</td>
<td>Office of county agent or farm advisor</td>
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<td>F</td>
<td>New federal agency (statistical laboratory)</td>
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<td>G</td>
<td>New state agency (statistical laboratory)</td>
</tr>
<tr>
<td>H</td>
<td>Other agency</td>
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Chart 2

Where should final compilation be made? (Chart 3.) A new Division of Vital Statistics of the Bureau of Animal Industry is proposed. Remarks made on the questionnaires indicated that until such a division is established, the existing U.S.B.A.I. Pathological Division office should care for the immediate reporting of mortality statistics.

In what form should the statistical data be distributed? (Chart 4.) The opinion is overwhelmingly in favor of annual distribution of a complete report, with monthly supplements to aid those concerned with disease control. Other suggestions included (1) weekly bulletins, (2) a regular monthly issue, (3) a quarterly bulletin with yearly summary, (4) releases to be made according to the need.

What should the report include? (Chart 5.) Most all reporters were in favor of a detailed and complete form. Many stressed the importance of the economics of disease losses which would directly influence appropriations for research. Some
III
Where Should Final Compilation Be Made?

A. U.S. D.A., Wash., D.C.
   1. Bureau of Agricultural Economics
   2. Bureau of Animal Industry Pathological Division
   3. B.A.I., New Division Vital Statistics

B. U.S. Dept. of Commerce, Division Vital Statistics

C. Other agency

CHART 3

IV
In What Form Should the Statistical Data Be Distributed?

A. Annual distribution in a single unit

B. Annual distribution with monthly supplements and notes - current disease problems

C. Other method

CHART 4

V
What Should the Report Include?

A. Detailed report including mortality and morbidity statistics by month for each animal species (including poultry) in numbers and dollar value, divided into age groups (immature and mature), and diseases (a) nutritional, (b) infectious, (c) parasitic, (d) other, by (1) county, (2) state, (3) division, (4) territory, with supplemental foreign report

B. Other form

CHART 5
reporters indicated that the data must lead to prevention and control, pointing out that, otherwise, the program would be worthless. It was the general opinion that, although reports with great detail might not be expected for many years, they should be the goal.

Who should receive the report? (Chart 6.) All were in favor of general distribution of the reports. The importance of having the public health official in each community receive a copy was stressed. Many indicated that they should be made available to libraries, and brought to the attention of the press.

Should the publication be distributed without charge? (Chart 7.) It was the overwhelming opinion that all releases have free distribution. Many suggested,

VI
Who Should Receive the Report?

<table>
<thead>
<tr>
<th>A. Veterinarians</th>
<th>B. Public distribution on request</th>
<th>C. Others</th>
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CHART 6

VII
Should the Publication Be Distributed without Charge?

| Yes | No |

CHART 7

however, that free distribution might be too costly and, perhaps, wasteful, and that possibly a small charge, probably less than the printing cost, would prevent waste. It was pointed out that all contributors should receive the report which, in itself, would show the value of their contributions and further encourage their participation.

Which agency should bear the cost of the survey? (Chart 8.) There was a slight margin in favor of the state bearing the cost of assembling morbidity and mortality statistics within the state, and that the Department of Agriculture bear the cost of final compilation, printing, and distribution.

Should standard methods of laboratory diagnosis be adopted, printed, and distributed for uniformity? (Chart 9.) Although some men in important posts felt that there was no immediate need for an especially prepared manual of standard
methods of diagnosis, the group as a whole were overwhelmingly in favor. It is interesting to note that, with one exception, pathologists who man the diagnostic

Which Agency Should Bear the Cost of the Survey?

A. Federal Government
   1. Department of Agriculture
      a. Gathering statistics
         within the state
      b. Assembling and publication
      c. Distribution
   2. Department of Commerce
      a. Gathering statistics
         within the state
      b. Assembling and publication
      c. Distribution
B. State Government
   a. Gathering statistics
      within the state
   b. Assembling and publication
   c. Distribution
C. Other
   a. Gathering statistics
      within the state
   b. Assembling and publication
   c. Distribution

Which agency should prepare and distribute standard methods of diagnosis? (Chart 10.) The majority expressed the opinion that the Pathological Division of the U.S. Bureau of Animal Industry should prepare and distribute a manual of standard
methods for the diagnosis of disease of animals, similar to Standard Methods now prepared by the U. S. P. H. S., Laboratory Methods of the U. S. Army, or Standard Methods by Wadsworth (New York State Laboratories). Many proposed that a charge be made for the manual to completely cover cost of printing.

Should a standard manual on nomenclature of animal diseases as outlined by Committee on Nomenclature, A.V.M.A., be published? (Chart 11.) It was the overwhelming opinion that the Department of Agriculture should publish a manual on nomenclature of animal diseases. Some suggested that the manual be prepared

X

Which Agency Should Prepare and Distribute Standard Methods of Diagnosis?

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<tr>
<td>A. Pathological Division - U.S. B.A.I.</td>
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<td>B. Special committee - A.V.M.A.</td>
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<td>C. Other agency</td>
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CHART 10

XI

Should a Standard Manual on Nomenclature of Animal Diseases as Outlined by Committee on Nomenclature A.V.M.A. Be Published by

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<td>A. U.S. Department of Agriculture</td>
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<tr>
<td>B. U.S. Department of Commerce</td>
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<td>C. Other agency</td>
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CHART 11

and distributed through the National Research Council, others that the manual be prepared and distributed by the American Veterinary Medical Association. It was also pointed out that the content of the manual be approved by all groups concerned. Many asked the status of the material for inclusion in such a manual. They asked specifically whether the material is ready for printing and if there is any assurance that it will be ready in the near future. The report of the Committee on Nomenclature of the A.V.M.A. for 1947 indicates that progress is being made.

Which established diagnostic laboratories should be used to initiate the study? (Chart 12.) Most replies indicated that all existing facilities should be used and that some co-operative arrangement should be made whereby the findings of all would be directed to the office of the state veterinarian.
Should entirely new diagnostic laboratories be set up? (Chart 13.) It was the marginal majority opinion that entirely new diagnostic laboratories need not be set up to start the program, but that such laboratories should only be established where none now exist.

Should any form of activity other than determining cause of sickness or death be conducted by diagnostic laboratories?
ducted by diagnostic laboratories? (Chart 14.) Opinion was almost equally divided as to whether or not the diagnostic laboratories should serve in any capacity other than merely presenting laboratory findings. Some proposed that the diagnostic laboratory now, and in the future, should steer clear of diagnosing, suggesting treatment, or conducting research in animal disease.

To whom should the diagnostic laboratory report? (Chart 15.) It seemed to be the general opinion that all concerned with a diagnosis should receive a report, that, for purposes of disease control, both the state veterinarian and the central federal agency should receive a report, and that, obviously, the veterinarian submitting the specimen should be given an immediate report. The majority of the pathologists, experiment station directors, and animal husbandmen asked to have the farmer-owner receive a report.

Should reporting of infectious disease outbreaks be required by law and carry a fine for failure to report? (Chart 16.) Although many states now require the reporting of a specific group of infectious diseases, many do not. Although the majority agreed that the reporting of infectious disease outbreaks should be required by law, a great many pointed out that a fine for failure to report could not be enforced, but that a reasonable program should be encouraged. Some reporters stated that
persistent failure of the licensed veterinarian to make reports should be cause for revoking his license.

How do you suggest bolstering the inadequate supply of veterinary pathologists? (Chart 17.) It was almost the unanimous opinion that increasing the salary of the veterinary pathologist would quickly fill the admitted shortage. One reporter stated that we need more veterinary pathologists with or without “this fantastic program”!

**XVII**

How Do You Suggest Bolstering the Inadequate Supply of Veterinary Pathologists?

<table>
<thead>
<tr>
<th>Option</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A. Improve curriculum</td>
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<td>B. Encourage and support postgraduate study</td>
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<td>C. Increase salaries</td>
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<td>D. Self-correctable</td>
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<td>E. Establish more schools and increase enrollment</td>
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<td>F. Do not recognize a shortage</td>
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</table>

**CHART 17**

**XVIII**

Should Some Form of Program Concerned with the Collection, Publication, and Distribution of Morbidity and Mortality Statistics Be Instituted Immediately?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Percentage</th>
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<tr>
<td>Yes</td>
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<tr>
<td>No</td>
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**CHART 18**

Should some form of program concerned with the collection, publication, and distribution of morbidity and mortality statistics be instituted immediately? (Chart 18.) It was generally agreed that some form of program should be established.

**SUMMARY**

In 1945 it was shown that there were no formal agencies engaged in collecting, compiling, printing, and distributing morbidity and mortality statistics for animals in the United States. It has also been shown with unanimous agreement that there is an urgent need for vital-statistics reports. The type of program which this com-
committee feels is desirable was outlined and approved by the executive committee of this organization in 1946. The results of a poll participated in by those who will be actively engaged in collecting field information, making diagnoses, assembling data, and, finally, using this data for the control of disease, has been presented.

A separate paper prepared by Professor Snedecor, describing "An Experiment in the Collection of Mortality and Mortality Data on Farm Animals," conducted in the State of Iowa, initiated by the National Research Council, and directed by the statistical laboratory of Iowa State College, has been presented as a guide for the initiation of a collecting program. A paper, "The Public Health Significance of Morbidity and Mortality Statistics of Domestic Animals," presented by Dr. James H. Steele, Chief, Veterinary Public Health Section, States Relation Division, U. S. Public Health Service, Washington, D. C., indicates a separate need.

The committee is aware of the time and thought given by the reporters who completed the questionnaire, and wish to express their gratitude.
THE ERADICATION OF BOVINE TUBERCULOSIS
FROM ISOLATED CENTERS

E. V. Moore, D.V.M.
Assistant Commissioner of Agriculture and Markets, Albany, N. Y.

The eradication of tuberculosis from isolated centers is one of our greatest economic problems in disease control today. A review of the record of our tuberculosis eradication program in this country and in New York State shows the great task that has been accomplished and stresses the necessity of ferreting out the last isolated case of this great enemy of the livestock industry.

Thirty years ago bovine tuberculosis caused the greatest economic loss, both actual and potential, to the dairymen and beef breeders in this country. Few cattle diseases are more ancient in origin, have spread over a larger portion of the earth's surface, are more chronic in nature or more insidious in their dissemination. Since 1882, when Robert Koch, a German bacteriologist, discovered the microorganism which causes this disease, the livestock industry has been planning some way to control it.

In 1916, a joint Federal-State plan was inaugurated to eradicate bovine tuberculosis from the entire United States by the test-and-slaughter method, with indemnity payments to the owners for reactors. Many then believed that this would be impossible. No other country had ever attempted such a large disease-eradication program.

A statement compiled from the records of the United States Division of Meat Inspection shows that in 1917 the carcasses of 195,488 cattle were retained because of tuberculosis; 40,746 of these were condemned. This indicates how frequently advanced tuberculosis was found in animals sent to federally inspected packing houses. Many animals in the advanced stages were not shipped to such establishments as there were other slaughterhouses that did not have federal inspection where questionable animals could be consigned. During the same year, 76,807 hogs were condemned for bovine tuberculosis. These figures give but a partial idea of the magnitude of the economic loss from bovine tuberculosis in this country in 1917, since they represent only the losses of animals slaughtered in establishments that were under federal meat inspection. The enormous economic loss that our dairymen and breeders were suffering because of bovine tuberculosis at that time will never be known.

Professor H. R. Smith, General Manager of the National Livestock Loss Prevention Board, recently presented the following under the caption "Bovine Tuberculosis Declines 98 Per Cent":

The Federal meat inspection records, which give us a true picture of conditions, show that in 1916, the year before the national tuberculosis eradication campaign was started, 2.35 per cent of all cattle slaughtered had tuberculous lesions. By 1943, only .048 per cent of all cattle slaughtered under Federal inspection showed lesions and were retained for the disease—a reduction of 98 per cent from the 1916 figure. The number of beef carcasses condemned has been reduced from 40,746 in 1917 to 1,248 in 1943, also a reduction of 98 per cent.
In addition to this great economic loss, bovine tuberculosis also caused considerable infection in man. The studies of prominent research men indicate that the full extent of bovine tuberculosis infection in man was not recognized until recently.

A great educational campaign was required preceding the actual program, since many responsible people, including breeders, opposed the testing procedure. It took thirty years and 250 million dollars appropriated by the federal government, the states and the counties to bring this disease under control. As a result of concerted effort, the national percentage of infection has been reduced to less than one-fourth of one per cent. Nearly four million reactors to the tuberculin test have been slaughtered; one-fourth of them originated in New York State.

In New York State, such an eradication campaign threatened to be particularly hazardous to the dairy industry because of our large cattle population and high percentage of infection. This state has spent more than sixty million dollars in addition to the millions spent by its counties and the federal government to reduce the average infection from 26.6 per cent to 0.15 per cent. In New York State—and I assume this to be true throughout the United States—the decrease in the number of reactors and the lowering of the percentage of infection have created the impression that bovine tuberculosis is eradicated and that our Bureau of Animal Industry has been relieved of most of its work in connection with this disease. This is far from the truth. Bovine tuberculosis is still a threat to our livestock industry. The conservation of tuberculosis-free herds is just as important as their creation. They must be retested regularly to prevent re-infection. As evidence of the need for constant vigilance, during the fiscal year ending April 1, 1947, we tested 51,917 herds comprising 1,186,232 cattle, of which 1835, or 0.15 per cent, reacted.

It will take longer to eliminate the last hundred reactors from our herds than it did the first million. This campaign will not be so spectacular as was the earlier one but it will be a great service to the livestock industry. We must constantly check our herds until the last reactor is removed. If this is neglected, the disease will re-establish itself in a few years and all the effort which has been expended to control the No. 1 enemy of the livestock industry will be lost.

The conservation of our tuberculosis-free herds is economically sound. The economics of the tuberculosis-eradication program is clear and definite. The vast saving in beef alone has more than paid for all federal, state and county expenditures for the eradication campaign. Provided we keep the disease under control, this saving will continue to pay for the program over and over again in the years to come. In other words, the great economic saving to the livestock owners and the benefit to the human family because of a safer milk supply really have cost nothing. Tuberculosis eradication has been a paying investment and a great tribute to the livestock officials and the army of veterinarians who made it possible. It is the first time that any contagious disease of such widespread and vast economic importance has ever been brought under control in an entire nation. It is a perfect example of what well-organized cooperative control measures can accomplish. All the cooperating groups are to be congratulated for accomplishing what seemed to be an insurmountable task in 1917.

The federal meat-inspection records show that animals retained for tuberculosis increased 300 per cent from 1908 to 1917. This shows how rapidly tuberculosis
spread in the livestock of this country in nine years. If the national program of eradication had not been inaugurated in 1917, our situation at the present time would be similar to that in England today. L. Jordan, of the British Medical Research Council, states:

No less than 30 per cent of the cattle in England are affected by tuberculosis. In England, 5.2 per cent of all deaths in man due to tuberculosis are the result of the bovine tubercle bacilli and 25 per cent of the deaths from non-pulmonary tuberculosis are due to the bovine tubercle. Milk samples from various cities show virulent tubercle bacilli in from 2.9 to 11.1 per cent.

In his "Bovine Tuberculosis in Man' written in 1937, A. Stanley Griffith of the British Royal Commission on Tuberculosis states:

It is impossible to compute how many people have died from infection with the bovine tubercle bacillus since 1911, or what it has cost or is costing in providing institutional treatment for crippled and in other ways incapacitated human beings. When to all this are added the economic losses from bovine tuberculosis among animals, the tribute paid to the bovine bacillus must be enormous.

In view of this situation, it is questionable whether an eradication program would be economically sound in England at present.

We must not let our conditions revert to those in England; we must maintain the economic advantage we have won in controlling bovine tuberculosis. We have only to look at the record to appreciate the ground that has been gained. The death rate in man from nonpulmonary tuberculosis was 22.5 per 100,000 population in 1917. This had been reduced to 2.4 per 100,000 in 1945. During the same period, federal meat-inspection figures show that the number of cattle condemned has been reduced from 40,746 to 1,248, which is a reduction of 98 per cent. The same records show that hogs condemned for tuberculosis had been reduced from 0.19 per cent in 1917 to 0.022 per cent in 1943.

In military campaigns, when the conquering nation has the strength of the enemy greatly reduced, the war is over. In disease-control work this is not true. The small percentage of cattle left which harbor the infection can extensively recreate the disease in a very short time. In New York State our Bureau of Animal Industry realizes its responsibility in controlling bovine tuberculosis. We are trying to solve the problem of eradicating the disease from the herds in which it still exists. We have realized for some time that when the routine testing procedure was applied to such herds it sometimes failed to reveal all of the open cases of tuberculosis that existed.

Our Bureau of Animal Industry, in a cooperative program with the New York State Veterinary College, secured the services of Dr. Alexander Zeissig to study our tuberculosis eradication problems in New York State. Dr. Zeissig was a Bacteriologist at the Veterinary College and is now associated with the New York State Department of Health. His work has been very helpful to us in planning a campaign to control bovine tuberculosis in this state. Dr. Zeissig's report entitled "Report on the Joint Project of the Department of Agriculture and Markets and
the New York State Veterinary College at Cornell University for the Study of Problems in Connection with Tuberculosis Eradication" states:

Participating in the postmortem examination of the animals studied in this project soon taught us three things: First, reactors from herds subject to routine testing in clean areas prove on postmortem to be mostly no-visible-lesion cases; second, most reactors from known infected herds show evidence of recent infection, the open case responsible being only occasionally found among them; third, the only way to comprehend what the tuberculin test you conducted has accomplished is to observe the postmortem examination yourself.

Two distinct problems became clearly defined: First, to reduce the slaughter of no-visible-lesion cases from noninfected herds, which objective we found retesting would accomplish; and second, and more important, it was obvious that routine testing was usually inadequate to detect the open cases in infected herds. We undertook studies in such herds to evaluate special procedures. Experience extending over a period of two years has convinced us that the field control of tuberculosis should be similarly divided.

We recommend the following procedures based on this experience:

A. Routine testing of presumed uninfected herds

As long as tuberculosis continues to exist anywhere, there is always a degree of possibility of an infected animal being introduced into a herd due to the interstate and intrastate traffic in dairy cattle. In order to detect these infected animals as soon as possible, routine testing of all herds of cattle should continue.

The accredited veterinarian conducting a tuberculin test on a presumed uninfected herd is placed in a difficult position if he encounters reactions. Unfortunately, cows do not oblige by reacting either positively or negatively in a clear-cut fashion. The swellings presented to the veterinarian for his judgment range from the slightest enlargement at one extreme to the other extreme of fist-sized swellings in which there are hemorrhage and necrosis. The latter are true tuberculin reactions due to a tuberculous infection. Experience has taught us that animals in which such severe reactions are seen will show evidence of recent infection on postmortem examination. They are at the peak of the allergic state. Such reactions present no problem. The less conspicuous ones, however, either may be observed in an animal in which the allergic state has been dulled, as in one extensively infected, or they may be due to sensitization with some other organism related to the tubercle bacillus. The veterinarian must decide which of these causes is responsible. We propose that the term "reactor" be applied to those reactions of unquestioned nature, and suggest that the term "deviator" be applied to those the significance of which is doubtful.

We propose that:
1. All reactions, regardless of size, be recorded on the test chart.
2. If the accredited veterinarian would like assistance in interpreting the reactions which he observes, he be urged to seek consultation from a colleague or an official veterinarian.
3. The situation in each herd be thoroughly studied and evaluated before a decision is arrived at.

We suggest the following guiding principles:

Where reactors are found: If there is an unquestioned tuberculin reaction in any individual, all of the animals showing swellings of any size whatever, in-
ERADICATION OF BOVINE TUBERCULOSIS

including deviators, should be condemned. The animal with the smallest reaction may be the open case which caused the outbreak.

*Where only deviators are found:*

a. Search carefully for skin lesions. If these are found in all deviators, the animals may be safely recorded as suspects and left in the herd.
b. Deviators without evidence of skin lesions, in practically all instances, can be safely left in the herd as suspects.
c. All deviators left in the herd shall be recorded as suspects.
d. They shall be retested on the opposite side in 60 days. On this retest animals infected with tuberculosis will usually react as well or better than on the original test. On the other hand, in animals which would prove to be no-visible-lesion cases on postmortem, the reaction, being of a temporary nature, will either fade or disappear altogether.
e. The final decision on the status of the animal shall be based on this 60-day retest.
f. Where suspects are passed clean on this 60-day retest, the entire herd should be retested one year after the date of the original test. This should be done even though herds in that area are ordinarily retested at greater than yearly intervals.

4. Herd status shall be based on the results of the postmortem examination of the reactors slaughtered. For example, if reactors from an accredited herd fail to show lesions of tuberculosis on postmortem examination, the accredited status of the herd shall continue without retest.

*B. Special testing of known infected herds*

Routine testing of known infected herds is entirely inadequate to solve the problem of finding the open case. These herds require special attention. They should be in charge of a specialist who will work with the accredited and local official veterinarians in solving this problem. Such a specialist will develop skill kept keen by the experience obtained in frequent observation of true tuberculin reactions. He must also exercise considerable ingenuity in searching for the source of the infection.

We recommend that:

1. The known infected herd must be placed under the strictest quarantine. Animals removed must be slaughtered immediately.
2. The postmortem examination of the original reactors should be observed, if possible. If this is not done, the postmortem reports should be carefully studied in an effort to determine if an open case was included in the original reactor group.
3. The herd should be subjected to special tests, such as the cervical or a modified subcutaneous.
4. The specialist should actually observe the postmortem examination of all reactors which are removed from known infected herds. This is the only way that he can evaluate what he has accomplished by his testing and this practice also gives him a basis for deciding his future course of action.
5. Cattle with open lesions are almost always the source of infection. However, in rare instances where special tests (under 3) fail to reveal an open case in the herd, the possibility of a human as the source of infection should be investigated. Sometimes this search, too, proves fruitless. In one instance in a problem herd which formed part of this experiment, a dog was found to be responsible.
6. The entire purpose of this work with problem herds should be to find, and elim-
inate, the open case of the disease. All too frequently this animal does not react to routine tests and sometimes she gives only a slight reaction even with the special tests.

C. Postmortem examination

1. Postmortem examination of reactor cattle should be observed by all veterinarians at every opportunity. If the accredited veterinarian can not do this, then the official veterinarian responsible for that area should be present.

2. Meat-inspection reports contain only data required for the disposition of carcasses for human consumption. They are not satisfactory for disease-control work. They should be altered to include the necessary information, or a special supplementary form should be provided for the livestock sanitary official on which the information he needs would be recorded. The disease-control official is interested in whether or not the case was open, even if the tuberculosis is local. He would also like to know whether the animals slaughtered represented recent infection or whether the infection was of long standing. He would thus be in a position to gain some insight into the situation he faces in trying to eradicate tuberculosis from the herd.

In our Bureau of Animal Industry we have been following these recommendations of Dr. Zeissig in controlling tuberculosis in our problem herds, and the results have proved them to be both practical and effective. We are concentrating on herds where bovine tuberculosis is known to exist, and at the same time are testing all the cattle in the state at least every three years.

We believe that our program is sound and that we are getting results. The bovine tuberculosis control situation, in New York State at least, is like a forest fire that has been stopped by heavy rain but in which big logs are still smoldering. They can burst into flame after a few days of dry weather and sunshine and recreate the forest fire. I hope that all the agencies which brought bovine tuberculosis under control in this country will reunite in a final effort to extinguish the last remaining sources of infection. Constant vigilance is the premium we must pay to insure the continuance of our present favorable economic position.
A CONTINUATION OF THE STUDY OF NO VISIBLE LESION REACTION TO TUBERCULIN

C. E. FIDLER, M.D.C., Superintendent, AND L. R. DAVENPORT, D.V.M.
Division of Livestock Industry, Springfield, Ill.

During the December, 1946, meeting of this Association, Dr. Fidler presented a paper entitled, "No Visible Lesion in the Bovine and Its Relation to Avian Tuberculosis." Dr. Fidler's paper recognized the progressively increasing number of no visible lesion reports. His paper recognized certain theories, previously advanced, relative to the cause of no visible lesion reactions to tuberculin:

1. The possibility of bovine sensitization to the avian strain of the tuberculosis organism and the corresponding relationship between no visible lesion reactions and avian tuberculosis infection;

2. Bovine sensitization to tuberculin by prior invasion of the bovine strain of the tuberculosis organism;

3. The development and existence of tubercles prior to the injection of tuberculin;

4. The theory of mutation or transformation of the tuberculosis organism from one type or strain to another with particular reference to the possibility of the transformation of the avian strain to the bovine strain wherein the early presence of the avian organism might sensitize the bovine to tuberculin without the production of lesions;

And, lastly, the theory of bovine sensitization to tuberculin resulting from certain saprophytic, non-pathogenic, organisms.

Dr. Fidler presented a personal view, dealing with the period or stage of incubation in tuberculosis infection, suggesting a correlation between the incubative stage and no visible lesion findings. He proposed a possibility of discrepancy in the field application of the tuberculin test wherein localized areas of swelling might result from localized trauma or infection, such areas of swelling simulating typical tuberculin reactions accounting for some of our no visible lesion reports. Finally, Dr. Fidler's paper reported the findings of a survey made in Stephenson County, Illinois, where a sudden "break" or rise in bovine tuberculosis incidence had occurred. The survey was made in an attempt to prove a relationship between no visible lesion bovine reactions and avian tuberculosis but, contrary to previous contention, the survey indicated an inverse relationship between no visible lesion bovine reactions and avian tuberculosis since the greater percentage of no visible lesion reactions occurred in areas of lesser avian tuberculosis infection as demonstrated by test.

The purpose of this paper is to report further study into the cause of no visible lesion bovine reaction to tuberculin, with particular attention to the stage of incubation, using for study material that same county upon which Dr. Fidler's report of last year was made.

Investigation of the bovine tuberculosis history of Stephenson County over a 6-year period immediately preceding the "break" in 1945 has revealed an average bovine tuberculosis incidence of 0.26 per cent. This percentage represents infection
in an average of 46 herds over this period, with an average of 119 total reactors of which 61, or 52 per cent, were no visible lesion reactors and 58, or 48 per cent, were lesion reactors. This 6-year average incidence involved fourteen of the seventeen townships of this County. One township, near the center of the County, and two adjoining townships, in the extreme southwest corner of the County, presented no history of tuberculosis prior to 1945. During the 1945-46 tuberculosis "break" in this County, 158 reactors were taken from the 46 herds with a previous history of infection representing an incidence increase of over 32 per cent over the previous incidence. Of the 158 reactors, 50 per cent were no visible lesion and 50 per cent were lesion reactors. During this period, 552 herds with a previous negative tuberculosis history showed infection, with a total of 1502 reactors. Of this number,

<table>
<thead>
<tr>
<th>Chart 1.—Cattle population for Stephenson County from 4/22/46 to 6/10/46—47,448 (2119 herds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Break down reactors in the respective herds prior to 1945</td>
</tr>
<tr>
<td>Reactors</td>
</tr>
<tr>
<td>46</td>
</tr>
<tr>
<td>Ratio—52 per cent no visible lesions, 48 per cent lesions</td>
</tr>
<tr>
<td>2. Relationship of above history to 1945 and 1946 reactors</td>
</tr>
<tr>
<td>Same herds as in No. 1 with reactors found in 1945 and 1946</td>
</tr>
<tr>
<td>Reactors</td>
</tr>
<tr>
<td>158</td>
</tr>
<tr>
<td>Ratio—50 per cent no visible lesions, 50 per cent lesions</td>
</tr>
<tr>
<td>3. 1945 and 1946 infection of herds previously negative</td>
</tr>
<tr>
<td>Herds</td>
</tr>
<tr>
<td>552</td>
</tr>
<tr>
<td>Ratio—48 per cent no visible lesions, 52 per cent lesions</td>
</tr>
</tbody>
</table>

730 or 48 per cent were no visible lesion, and 772 or 52 per cent were lesion reactors. Of the 552 previously negative herds, 374 produced lesion reactors, 243 of which produced initially 82 per cent lesion reactors. Of the 552 herds, there were 157 herds producing no visible lesion reaction only.

In the retesting of this County, the herds producing only no visible lesion reactions initially have shown no subsequent reaction and have been cleared. Retests of herds showing heaviest lesion reaction initially have produced an increased percentage of no visible lesion reactors. As shown by a breakdown of the retest history of 114 previously negative herds—that is, negative prior to the "break" in 1945—five herds showing initial lesion infection have shown subsequent lesion infection by retest. Three herds showing initially no visible lesion reaction have shown subsequent lesion reaction by retest whereas fifteen herds showing initial lesion reaction have shown subsequent no visible lesion reaction, with approximately forty herds showing no visible lesion reaction on last retest.

In attempting to analyze events in Stephenson County over the past seven years, we find only about 2 per cent of the herds of this County showing reaction to test
TUBERCULOSIS WITHOUT VISIBLE LESIONS

prior to the "break" in 1945. We find an average infection incidence of 0.26 per cent with a no visible lesion incidence of 52 per cent.

We find three townships in this County with no infection prior to 1945, one of these townships completely surrounded by infection or by townships in which infection had been found.

We find that tuberculosis incidence in the counties adjoining Stephenson County no higher than 0.41 per cent.

CHART 2.—Retest history—findings in 552 herds with no history of infection prior to 1945. Initial reaction and retest reaction trend

1. Herds with only no visible lesions (initial reaction)

<table>
<thead>
<tr>
<th>Herds</th>
<th>No lesions</th>
<th>Retests</th>
<th>Cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>157</td>
<td>No lesions</td>
<td>256</td>
<td>cleared</td>
</tr>
</tbody>
</table>

2. Herds with more than one reactor with mixed lesions and no visible lesions initial reaction

<table>
<thead>
<tr>
<th>Herds</th>
<th>Lesions</th>
<th>Cond.</th>
<th>Retests</th>
<th>Les.</th>
</tr>
</thead>
<tbody>
<tr>
<td>151</td>
<td>283</td>
<td>6</td>
<td>27</td>
<td>29</td>
</tr>
</tbody>
</table>

3. Herds with 82 per cent lesions on initial test

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>243</td>
<td>451</td>
<td>4</td>
<td>35</td>
<td>30</td>
</tr>
</tbody>
</table>

4. Herds with no lesions on initial test. Lesions on next test

<table>
<thead>
<tr>
<th>Herds</th>
<th>No lesions</th>
<th>Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>41</td>
<td>26</td>
</tr>
</tbody>
</table>

CHART 3.—Findings in 114 previously negative herds with heavy initial lesion and lesion—no visible lesion reaction—showing retest reaction trend

<table>
<thead>
<tr>
<th>Lesion to lesion</th>
<th>N.V.L. to lesion</th>
<th>Lesion to N.V.L.</th>
<th>N.V.L. last test</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 herds</td>
<td>3 herds</td>
<td>15 herds</td>
<td>40 herds</td>
</tr>
</tbody>
</table>

Average intervals between types of reaction as disclosed by retest

<table>
<thead>
<tr>
<th>type of reaction</th>
<th>interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 5 months</td>
<td>8 to 10 months</td>
</tr>
</tbody>
</table>

We find the areas from which the greater percentage of cattle were imported into Stephenson County with a tuberculosis incidence of approximately 0.04 per cent with a no visible lesion incidence of 52 per cent.

Then, suddenly, on the 1945 reaccreditation test, we find an increase of over 32 per cent in the infection incidence in the herds with previous infection history. In addition, we find 552 herds with no previous history of tuberculosis infection producing reaction.

With this, we find a high percentage of initial lesion reaction in the herds with previous negative history and an increased percentage of lesion reaction in herds with previous infection history with a generalized initial lesion and no visible lesion incidence.
We find a consistent lesion to no visible lesion trend in the retests in this County, with an increased percentage of no visible lesion reactions as the retesting progresses. In previously negative herds producing only no visible lesions on initial test, we find an exceedingly low percentage of subsequent reaction to retest, with the prompt clearing of 157 herds, as previously stated.

The evidence presented in this one County in Illinois at least tends to indicate a relationship between lesion and no visible lesion reactions in tuberculin testing and correspondingly to identify no visible lesion reactions with bovine tuberculosis infection as demonstrated by lesions. It is felt that the evidence obtained from the records in this one County is not sufficient for a definite orientation of the no visible lesion reaction. Perhaps a similar study of the tuberculin testing over a greater area and on a greater number of animals would indicate more clearly the true significance of the no visible lesion reaction. It is believed however that sufficient evidence has been produced by this County to indicate that the stage or period of incubation should be given credence in the study of no visible lesion reactions. This feeling results from the study of the reaction sequences disclosed by the retests of herds showing initial lesion reaction. In the retest disclosure of no visible lesion reactions, we find intervals of greater length on the average between no visible lesion and no visible lesion reaction following initial lesion reaction in a herd than is found in the no visible lesion to lesion reaction.

In this direction, it is impossible to even approximate from the evidence so far obtained the time element involved in the incubative stage of bovine tuberculosis infection but we have discovered definitely that in the individual herds showing infection prior to 1945 such infection was statically of a mixed lesion and no visible lesion character with a greater percentage of no visible lesion reactions. We have found that, co-incidental with the discovery of the increased infection in this County, the mixed character of the reaction persisted but with a change in the occurrence of the two types of reaction wherein the no visible lesion to lesion ratio was reversed. We have found also that with the decline in incidence of infection in this County, herds showing initial lesions and mixed lesion and no visible lesion reactions produced an increasingly greater number of no visible lesion reactors as the retesting progressed, returning the no visible lesion to lesion ratio to the pre-break status.

Accepting the 6-year pre-break infection incidence of 0.26 per cent as a normal static condition and the corresponding 52 per cent no visible lesion reaction as a normal static condition, in view of the sudden occurrence of lesion and mixed lesion and no visible lesion reaction we may well assume that animals could react to the tuberculin test and be removed as no visible lesion reactors during the incubative stage of infection prior to the development of lesions. In view of Dr. Fidler’s report of last year and the evidence presented at this time, this conclusion seems far more logical and acceptable than any inference which might result from the application of theories relative to a relationship between no visible lesion bovine reactions and avian tuberculosis; bovine sensitization to certain saprophytic non-pathogenic organisms, or the theory of mutation or transformation. In view of the evidence herewith presented relative to the consistent lesion and the mixed lesion and no visible lesion reactions initially produced in herds and the subsequent
finding upon retest of an increased no visible lesion reaction in those herds, the theory relative to discrepancies in the field application of the tuberculin test is likewise discounted.

In conclusion, it is acknowledged that this report is the result of only casual or superficial observation of an exaggerated tuberculosis incidence in the state of Illinois. It is not intended by any means that this report will answer the question arising out of the numerous no visible lesion reactions, nor provide an answer to the increasingly serious economic and sanitation problem arising out of the progressively increasing number of no visible lesion reactions. Nevertheless, in view of our studies of the no visible lesion situation in the state of Illinois, it is firmly felt that the no visible lesion reactor should be regarded as a definite and dangerous component of bovine tuberculosis infection and it is earnestly hoped that this report has presented data which will assist in a more productive research of the no visible lesion situation.
THE IMPORTANCE OF THE CONTINUATION OF SYSTEMATIC TESTING IN THE CONTROL OF BOVINE TUBERCULOSIS

A. J. GLOVER

Fort Atkinson, Wis.

This nation has bovine tuberculosis under control. It is an open question whether this disease can ever be entirely eradicated. The time may come when we have an improved diagnostic agent that will lead to the complete eradication of all living animals stricken with bovine tuberculosis. It is well that we keep in mind we still have the "seed" for producing bovine tuberculosis and, unless care is taken, we can be back in the same position, or even worse, than we were in the year 1917 when we started to systematically eradicate this scourge from our livestock.

To me it is a great compliment to our organization that we were able to subdue bovine tuberculosis and place it under complete control. This not only emphasizes good work on the part of the membership of our organization and those who cooperated with us, but it should strengthen our belief in how effective a democracy can be when it devotes itself to doing the right thing in the right way and at the right time. No other nation in the world has ever attempted to eradicate bovine tuberculosis. In these times, when we are speaking rather lightly of the effectiveness of democracy, we should take time to dwell for a moment on the advantages of eliminating one of the great scourges of the nation, or at least placing it under full control.

In pointing out the importance of continuous testing to keep bovine tuberculosis under control, let us consider the reasons. It is my opinion the contracting of bovine tuberculosis by humans was the most important reason for getting rid of it in our livestock. Only five years ago Dr. D. C. Lochead of the City Health Department of Rochester, Minnesota, discussed the subject, "Bovine Tuberculosis in Humans." In that address he made the following statement:

It must be very gratifying to you who have labored and fought so long to prevent bovine tuberculosis in humans, to realize how well you succeeded. Twenty-five years ago in medical clinics and even on the streets everywhere, humped backs, twisted spines, ruined hip joints, and scrofulous neck glands were common sights. Today such are seldom seen, and medical clinicians have difficulty finding cases for demonstration to their students.

In the year 1941 at our annual conference Dr. J. Arthur Myers discussed the subject, "Bovine Tuberculosis Eradication in the United States and Its Resulting Beneficial Effects on Human Health." I quote a paragraph from his address:

In the entire history of tuberculosis control, there is no accomplishment which even approaches that of the veterinarians and their allies in the United States. There are not sufficient superlatives in the English language to adequately describe your accomplishments and pay the tribute that you deserve. In reviewing much of the
literature by men and women who advocated the control of tuberculosis in cattle, one finds a constant predominant aim; namely, to protect human beings against the bovine type of tubercle bacillus.

Bovine tuberculosis is both a health and an economic question. It is unnecessary to discuss in detail the livestock losses sustained when this disease was prevalent throughout the nation. Briefly, the losses can be shown by quoting some of the statistics. (See Table 1.)

These statistics give a partial understanding, at least, of the losses sustained by harboring tuberculosis in our herds and flocks. Those of us who were in contact with farmers, had the opportunity to visit them and see their herds, discovered many losses that were never recorded. So far as I know, no estimate was ever made of the loss of feed used in diseased herds, nor the loss sustained from lower prices in the market for animals due to their physical condition, nor the loss of time and the expense in raising replacements. I doubt whether the statistics on the losses of animals slaughtered, as given here, really represent a true picture of the expense of this disease. We believe we can estimate the annual loss at several millions more than were reported by our federal government.

Let us see what may happen where estimates of losses are not taken into account. The breeding of livestock is a long, slow process. We haven’t done as good a job of breeding as we should. We were handicapped at one time because of bovine tuberculosis. Now, with a little care, we need sustain no loss from this disease. Take a good herd of dairy cows that has been bred through the years by the selection of proved bulls and the locating of brood cows. Records are made to find the

**Table 1.—Decreases in losses from tuberculosis in cattle and hogs**

Table showing the number of cattle, exclusive of reactors, slaughtered under Federal Inspection, the number and percentage retained, and the number and percentage of entire carcasses sterilized and condemned for tuberculosis. Compiled from records of the United States Division of Meat Inspection.

<table>
<thead>
<tr>
<th>Fiscal Year Ended June 30</th>
<th>Number Slaughtered</th>
<th>Number Retained</th>
<th>Per Cent Ret.</th>
<th>Number Sterilized</th>
<th>Per Cent Ster.</th>
<th>Number Condemned</th>
<th>Per Cent Cond.</th>
<th>Per Cent Ster. and Cond.</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States cattle (all markets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1917</td>
<td>9,276,049</td>
<td>195,488</td>
<td>2.10</td>
<td>8,468</td>
<td>.08</td>
<td>40,476</td>
<td>.43</td>
<td>.51</td>
</tr>
<tr>
<td>1927</td>
<td>9,810,797</td>
<td>112,924</td>
<td>1.15</td>
<td>4,342</td>
<td>.04</td>
<td>27,413</td>
<td>.28</td>
<td>.32</td>
</tr>
<tr>
<td>1937</td>
<td>10,853,778</td>
<td>15,816</td>
<td>.14</td>
<td>615</td>
<td>.005</td>
<td>3,388</td>
<td>.031</td>
<td>.036</td>
</tr>
<tr>
<td>1947</td>
<td>14,080,279</td>
<td>4,017</td>
<td>.025</td>
<td>112</td>
<td>.0007</td>
<td>939</td>
<td>.006</td>
<td>.0067</td>
</tr>
<tr>
<td>United States hogs (all markets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1917</td>
<td>40,210,847</td>
<td>3,978,168</td>
<td>9.99</td>
<td>91,543</td>
<td>.22</td>
<td>76,807</td>
<td>.19</td>
<td>.41</td>
</tr>
<tr>
<td>1927</td>
<td>42,650,443</td>
<td>5,777,708</td>
<td>13.54</td>
<td>78,232</td>
<td>.17</td>
<td>59,656</td>
<td>.14</td>
<td>.31</td>
</tr>
<tr>
<td>1937</td>
<td>36,226,309</td>
<td>3,435,434</td>
<td>9.48</td>
<td>17,667</td>
<td>.04</td>
<td>15,854</td>
<td>.04</td>
<td>.08</td>
</tr>
<tr>
<td>1947</td>
<td>45,073,870</td>
<td>3,043,732</td>
<td>6.75</td>
<td>8,756</td>
<td>.019</td>
<td>10,756</td>
<td>.023</td>
<td>.042</td>
</tr>
</tbody>
</table>
strains that would not only produce well but would reproduce regularly; will have longevity; be free from ills, especially calving difficulties and udder troubles. We recognize we haven't done too much in accomplishing these desirable traits in our animals, but there is the opportunity now of doing it without the threat of bovine tuberculosis wiping out our life's work.

The loss which would come to the owner of a herd that is bred to produce and reproduce well, where the animals live a long time and are free from ailments, is greater than we can express in dollars and cents because all true breeders have a great pride in their work and in their accomplishments. It is well that we have this, for simply making money is not the stimulant which really leads us forward in this nation. It is, rather, the stimulant of the desire to accomplish something that is of value to all humanity.

Too much cannot be said concerning the importance of keeping tuberculosis under control, since it requires more than a lifetime to breed better dairy herds, better beef herds, better swine, or better flocks of chickens. To have all these years of endeavor wiped out, as they used to be when we had tuberculosis well disseminated throughout the nation, is nothing less than a great tragedy.

While we have bovine tuberculosis well under control, there is need for us to be concerned about the avian type. According to a pamphlet prepared by H. R. Smith on tuberculosis in poultry and swine, I find the following:

There are still many hogs infected with the avian type, from contact with poultry, though less than in 1922. In 1908, 2.0 per cent; in 1917, 9.9 per cent, and in 1922, 14.3 per cent of all hogs slaughtered under federal inspection in the United States were retained for tuberculosis.

In 1945 there were 3,556,582 hogs retained for tuberculosis, or 7.2 per cent of the total slaughter, and 12,445, or .025 per cent condemned in their entirety under federal inspection in the United States, nearly all of which was of the avian type. The great bulk of these were hogs produced in the north central states where tuberculosis is very prevalent in poultry and the chickens are generally allowed the run of the premises.

It is rather shocking to find in the pamphlet, from which I again quote, that out of a total of 3,000,000 chickens tuberculin tested in the north central states during recent years, 10 per cent of the birds over 18 months old reacted as compared with 1.3 per cent of those under that age. Nearly half of the flocks disclosed one or more reactors and were, therefore, tuberculous. On the average, out of six flocks that disclosed reactors only one showed external evidence of the disease such as thin breast, pale comb and, occasionally, lameness.

Professor H. O. Stuart, head of the Department of Poultry Husbandry, Rhode Island State College, writes:

I would say that in this state farmers dispose of all birds at the end of the first laying year to the extent of replacing 96 to 98 per cent of the yearlings with pullets. There is no more practical way of eliminating tuberculosis in poultry that I know of. You are correct in your assumption that this has been the general practice in the northeastern states for, lo, these many years; and it is usually the reason we ascribe to the low incidence of tuberculosis in poultry in this area.
Roy E. Jones, extension poultryman of the University of Connecticut, writes:

Tuberculosis is a very uncommon disease on Connecticut poultry farms. I have been in this work over thirty years and I think I have encountered only three cases of tuberculosis in poultry. We have recommended disposing of all layers at the end of the first year for a number of years because of economic reasons. The pullets lay on an average of 50 eggs more per year than hens, and those 50 eggs are the profit.

In 1945 the Poultry Department of Iowa State College published a folder, entitled “The All-Pullet Flock for Greater Profits,” in which it listed the following advantages:

1. Lay more eggs in a year than hens;
2. Live better than a mixed flock;
3. Produce lower cost eggs than hens;
4. Protect the hogs from avian T.B.

It is well known that here and there throughout the United States we are having outbreaks of bovine tuberculosis. So far as we know, none of them have been particularly serious, but they have been of sufficient number and so well disseminated throughout the United States that they should stimulate us to a definite action, and should emphasize that bovine tuberculosis has not been wiped out.

Perhaps I should give a few concrete examples. I will not mention states, but I quote the following from a letter by one of our state officials:

We, too, have become entirely too lax during the war years when veterinary service was scarce and hard to get. Fortunately for us, there never has been any very extensive infection of tuberculosis in this state. Everyone of the 77 counties was accredited on one test, which means that infection found was less than one-half of 1 per cent. Lately, however, we have become just a little disturbed over the situation. Our per cent of reactors took a sudden jump in January that we are unable to account for, and which brings it strongly to our mind that perhaps we have not paid as much attention to tuberculosis control and eradication as we should have done in past years.

Just recently we ran on to another herd of approximately 25 cattle in which 13 reactors were found. This herd has not been tested for seven or eight years to our certain knowledge. I am wondering if our experience here is being duplicated all over the nation. I happen to know that it is in our neighboring states on the north and, if that is a fair sample of what is going on in other states, there is truly cause for concern, if not alarm, and it is plainly evident that we are going to have to tighten up all along the line.

In our official testing program we test just enough cattle in each county every three years to meet the minimum requirements for remodification. In some counties we test as high as 10 or 15 per cent of the cattle population, but in most of them the figures are considerably less. In addition to our official work, there is, of course, a considerable amount of testing by private practicing veterinarians but, all in all, I doubt very much if much more than 2 per cent of the cattle population is tested every year.

In my own community last year on the road which leads past my farm there were two herds that had reacting animals. One was accidentally discovered when the
owner had all the animals tested, both for brucellosis and tuberculosis, for a sale which he was to hold on his farm. To this man's surprise, out of a herd of some 70 head 29 reacted. Down the road on the other side of my farm was another herd with just a few reacting animals. This herd had reactors and it is being closely watched.

The question immediately arose, "Where did the herd with 29 reactors get its infection?" The man was not buying in cattle, so we couldn't reason it was brought in in that manner. Did it come from the birds? Did it come from visitors? This man was feeding raw skim milk to his calves which was secured from a creamery. It doesn't particularly matter how the disease got into these herds, except perhaps to give us a more intelligent understanding of the way this disease spreads. We must ever remember, so long as we have these germs in our land, there will be some way of disseminating them. This means we must everlastingly be testing in order to be certain of keeping the disease under complete control.

The presence of reacting animals in these two herds caused me to appear before the directors of the State Department of Agriculture and urge the making of an area test in our county. They granted this request. The test was made. In the whole county reactions amounted to 0.03 per cent. In other words, there are very few infected animals in our county, even though there are a considerable number of animals brought in each year. I should add that the farm next to the one with the 29 reactors recently tested and reactors were found.

Incidents like these lead to the question, "How often should all counties or accredited areas be tested in order to be sure we are keeping bovine tuberculosis under control?" It is my opinion we should test every herd in an accredited area at least once every five years.

We all appreciate this nation has been at war and it has not been possible to do as much testing as is essential in order to keep bovine tuberculosis under control. There has been a tendency, also, for many to think after all reacting animals had been eliminated, it is useless to test oftener than once in ten years. We must always remember men in every accredited area are bringing in animals, people are coming there, and infection may travel in other ways. It seems to me it would be a serious mistake on our part if we made it a rule to test not oftener than once in ten years. A five-year period is long enough if we wish to keep the losses from tuberculosis at a minimum.

This doesn't mean no testing should be done in a county except every five years. Take the herds in our county that were found to be infected last year, and the farm next to it this year. It is my judgment these herds should be tested every sixty days until they have had two clean tests. Then it would be well to wait six months and test them all again. If no reactors were found, we would then place such herds on a yearly basis for testing for two or three tests. If no reactors are found, then they could be tested in the regular five-year period. I wish to emphasize it is a great mistake to neglect testing in any herd where infection is found. In other words, to say that an area test should be given every five years does not emphasize, as it should, the necessity of testing more often those herds that carry infection, and continuing frequent tests until it is certain all infection has been eliminated.
The accredited areas in Canada are tested oftener than are the accredited areas in our country. It is my understanding if the infection is reduced a certain percentage, not to exceed one-half of 1 per cent, the area will be accredited for three years. If the infection does not exceed two-tenths of 1 per cent, the area may be accredited for six years. When infection is found, three tests are made six months apart. This, it seems to me, recognizes the importance of testing more often than once in eight or ten years as is the belief of some in our country.

We have an accredited nation. But cattle are coming in from the outside. Certain restrictions are required. But, are they sufficient? In the past years we know a considerable number of infected cattle have been imported from Canada. We know, too, some of these infected cattle have been brought here because of crooked cattle dealers. They have them in Canada; we have them in this country. We all know, no matter what rules are laid down, these men will try to violate them. The duty of officials in this country and the duty of officials in Canada is to do all they possibly can to stop crookedness in the handling of cattle, for it is through them that much tuberculosis is spread in this nation.

The question does arise, "Should we permit cattle to come in from any herd, from any state or nation, if they do not react to the tuberculin test and are held in quarantine for sixty days?" This means we could take cattle from herds that have tuberculosis if the animals selected did not react to the test, were held for sixty days, and were found to be non-reactors upon a retest. It is my judgment it would be a mistake to do this. It is well known to those of us who had experience with T.B. eradication that many herds were reinfected by taking non-reacting cattle from infected herds and putting them into clean ones. We can all agree this practice should not be permitted.

Then comes the question, "Shall we receive cattle from areas where they have eliminated all of the reactors but have not been accredited?" These cattle, of course, would be tuberculin tested, they would be non-reactors, held in quarantine for sixty days, and retested. I can imagine a great many would say we should permit cattle to come from such areas, and especially from herds that are accredited. It is my judgment we shouldn't even permit cattle to come from such areas. In short, we have arrived at a time when no cattle should be permitted to come into this country unless they come from accredited areas and accredited herds.

Of course, I can understand there are those who would say, "Couldn't we bring in cattle from unrestricted areas if we held them in quarantine for six months?" I am not so sure but that we could permit something like that but wouldn't it be better for the livestock industry of Canada, the same as it was for us, to eliminate all reactors and make their entire country accredited?

It is my opinion the sooner our neighboring country becomes an accredited nation, the more satisfaction will come to the officials and more profits to the livestock interests. We found that to be true here, why wouldn't it be so in Canada? We all desire to exchange our livestock; it is to the advantage of both nations, but let us have the courage to require ourselves and other nations to formulate the right practices on which we can maintain healthy animals free from tuberculosis. We have only to review our history to know the cost in human lives, the cost in money, to have emphasized to us that no other course is safe.
RESEARCH ON JOHNE'S DISEASE AT THE REGIONAL LABORATORY

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Agricultural Research Administration, U. S. Department of Agriculture,
Auburn, Ala.

The Regional Animal Disease Research Laboratory was established in 1937 for the purpose of doing fundamental research on infectious and parasitic diseases of livestock and poultry. Representatives from the experiment stations of the thirteen states of the region and of the Bureau of Animal Industry selected the disease conditions on which work was to be done. The diseases selected were: Johne's disease, internal parasites, and coccidiosis—all of cattle.

Johne's disease was selected as the infectious disease to be studied because of the realization of its effects on the cattle population in some foreign countries plus its potential danger to our own country and the fact that we had no workable knowledge for its satisfactory control.

Work on the Johne's disease project was started in 1938 under the direction of Dr. B. T. Simms, who was director of the laboratory until he became Chief of the Bureau of Animal Industry in November, 1945. The leader of the project was Dr. Howard W. Johnson until July, 1946, when he returned to the Animal Disease Station, Beltsville, Maryland. From 1938 to 1942 Dr. B. F. Cox also worked on the project. In 1942 Dr. A. B. Larsen, who is now leader of the project, was assigned to work with Dr. Johnson.

Many problems confronted the staff because of the numerous phases that needed to be explored. It was decided that greatest progress in control of Johne's disease could be accomplished if a more satisfactory diagnostic agent were available. Johnin and avian tuberculin had been used but neither had proved entirely effective in detecting animals infected with M. paratuberculosis, the cause of Johne's disease.

However, before johnin could be produced in any considerable amounts, it was necessary to improve the media on which the organisms are grown in the laboratory. Unlike many organisms, strains of M. paratuberculosis are very difficult to grow on artificial media. Before any degree of success was attained, it was necessary to try several hundred different media, both liquid and solid.

It was found that there is much variation between different strains of the organism. Some strains would grow well on certain media and not at all on others. It was also found that while some media were satisfactory for the growth of stock cultures, they would not work for the primary isolation of M. paratuberculosis.

During this same period studies were being made of the growth phases of the organism in relation to the potency of the johnin. It was found that in order to produce a johnin of high potency, it is necessary to have rapidly growing strains of M. paratuberculosis.

In making these studies on johnin and similar studies on tuberculin and the inter-
action between johnin and tuberculin, rats, mice, chickens, calves, and finally adult cattle were used in an attempt to find a suitable procedure.

The procedure that has proved to be most satisfactory and which is now in use involves the artificial sensitization of yearling cattle by introducing one gram of heat killed acid-fast organisms in 60 cc. of sterile mineral oil directly into the abdominal cavity.

Four to six weeks after receiving the sensitizing dose these cattle are highly sensitive to the allergens which are being studied and they are ready for use. The hair is clipped from areas four to six inches apart, the skin thickness is measured in millimeters with a specially designed dermal thickness gauge, and exactly 0.2 cc. of the allergen is injected intradermally. Forty-eight hours later the skin is again measured and the amount of reaction recorded. A different one cc. blue line glass syringe and a three-eighths inch 27 gauge needle is used for injecting each product.

Field tests that were made soon after the production of a potent experimental johnin was accomplished, revealed that about one-third of the animals that react to johnin, also react to tuberculin. It was this development and the increasing number of N.V.L. tuberculin reactors which emphasized the need for more specific diagnostic agents to use in testing animals that are sensitized by some member of the acid-fast group of organisms. Cooperation of the chemists of the Pathological Division of the Bureau of Animal Industry and of the Allergen Division of the Bureau of Agricultural and Industrial Chemistry was sought on this phase of the problem. The above agencies have prepared and furnished to the Regional Laboratory for testing several hundred of these allergens. The testing of such products is still in progress.

It was realized that there was, and still is, very little information on the amount and extent of Johne's disease present in the United States. In an early effort to acquire such information a limited survey was made in the southeastern states where 92 herds containing 7011 cattle were tested. Of this number 1053 cattle in 86 herds gave positive reactions to intradermal johnin. Later work showed that this was too high a percentage to give an accurate picture of the Johne's disease situation. It developed that most of these herds had some history of Johne's disease having been present for variable periods.

A most interesting observation resulted from the testing of these 92 herds; namely, that there are three types of infected herds. Type one includes herds in which there is 10 to 25 per cent annual mortality from Johne's disease. Type two includes herds in which the annual mortality from the disease is one to two per cent. Type three includes herds in which there are cattle that react positively to intradermal johnin and from which postmortem organisms can be recovered that are indistinguishable from *M. paratuberculosis*. There is, however, no history of clinical cases of Johne's disease in type three herds.

Recently the Tuberculosis Eradication Division, Bureau of Animal Industry has cooperated in studies to determine the amount of Johne's disease present in certain areas. In conjunction with the reaccrediting for tuberculosis of Montgomery and Jefferson Counties in Alabama, all of the herds were tested with both tuberculin and johnin. Observations were made on the 72nd hour. Herds in Mobile County are presently being tested in the same manner. It is hoped that all of the cattle
in representative counties of other states can be tested under the same plan. Results of these tests are given in Table 1.

Stained smears from the rectal mucosa of 163 cattle that gave positive or suspicious reactions to johnin were examined for acid-fast organisms indistinguishable from *M. paratuberculosis*. Such organisms were demonstrated in 50.9 per cent of the reactors and 31.9 per cent of the suspects.

Considerable study has also been made of the gross and microscopic pathology of Johne's disease. Two types of macroscopic pathology were observed. The first type appeared to be less extensive, involving only the upper third of the villi, while the second and more severe type involved the entire wall of the intestine, with even a pin-point peritonitis apparent. There appears to be a correlation between the type of pathology and the type of herd, on the basis of clinical cases and mortality.

The extensive testing of cattle, artificially sensitized with different members of the acid-fast group of organisms, seems to justify the observation that probably acid-fast organisms of soil origin, play a minor part in the non-specific sensitization of bovines.

This series of tests in which intradermal injections of many allergens were made in different skin areas, demonstrated considerable variation in the sensitivity of these areas. The areas in order of their sensitivity are: first, the flank and the side of the neck, excepting the upper border; second, the side of the animal, and third, the back and caudal fold. No difference exists between the respective areas on the two sides of the animal. It may also be mentioned that two operators using the dermal thickness gauge can duplicate skin readings on the same animal with very slight differences.

### Table 1.—Data on Johne's disease survey conducted in Jefferson, Montgomery, and Mobile Counties, Alabama, in conjunction with the tuberculin test for reaccreditation of these counties

<table>
<thead>
<tr>
<th>TUBERCULOSIS</th>
<th>JOHNE'S</th>
<th>NO. OF CATTLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Jefferson</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>3</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>5252</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>14</td>
</tr>
<tr>
<td>D</td>
<td>+</td>
<td>14</td>
</tr>
<tr>
<td>+</td>
<td>D</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
<td>25</td>
</tr>
<tr>
<td>-</td>
<td>D</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

+ = positive reaction (3 mm. increased thickness or more).
- = negative to test.
D = deviator (less than 3 mm. increased thickness).
Specimens from the intestinal tracts of 254 no visible lesion reactors have been examined for the presence of acid-fast organisms indistinguishable from \textit{M. paratuberculosis} with results given in Table 2.

A total of 1096 specimens from the intestinal tracts of reactors to johnin and/or clinical cases of Johne's disease have been examined for acid-fast organisms indistinguishable from \textit{M. paratuberculosis}. Of these 266 were positive, 32 were suspicious, and 798 were negative.

Because no successful method of treating Johne's disease is available, effective control must consist of preventing exposure of susceptible healthy animals. Since intradermal johnin is still in the experimental stage, and because there is a lack of information on the economic effects of johnin reactors in herds without clinical Johne's disease, eradication has been attempted only in herds made economically unprofitable by the disease.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|c|c|c|}
\hline
 & NO. & & NO. & & NO. & & NO. & \\
 & POSITIVE* & PER & & SUS- & & NEGATIVE & PER & \\
 & & CENT & & CENT & & & & \\
 & & POSITIVE & & SUS- & & NEGATIVE & & \\
 & & & & PIOUS† & & & & \\
\hline
N. E. States & 9 & 13 & 7 & 10 & 52 & 77 & 68 & 27 \\
Middle West & 11 & 10 & 1 & 1 & 112 & 89 & 124 & 24 \\
South & 15 & 24 & 3 & 5 & 44 & 71 & 62 & 49 \\
\hline
Total & 35 & 13 & 11 & 7 & 208 & 80 & 254 & \\
\hline
\end{tabular}
\caption{Results of N.V.L. Studies}
\end{table}

* Positive = clumps of acid-fast organisms indistinguishable from \textit{M. paratuberculosis}.

† Suspicious = a few scattered individual or paired acid-fast organisms indistinguishable from \textit{M. paratuberculosis}.

Testing at 3 to 6 month intervals of all animals in such herds and the removal at the end of 48 hours of all animals showing 3 mm. or more increase in skin thickness, plus thorough cleaning and disinfection of premises should be practiced. This with the raising of calves, which are the most susceptible animals in the herd, entirely separate from the adult cattle, has been successful in ridding such herds of Johne's disease.

To summarize briefly:
1. Research on Johne's disease began at the Regional Laboratory in 1938.
2. Suitable media were developed for maintaining stock cultures of \textit{M. paratuberculosis}.
3. An experimental johnin of comparatively high potency is being produced.
4. Laboratory animals have been found to be unsatisfactory in Johne's disease studies.
5. Artificially sensitized year-old cattle are satisfactory for potency and specificity studies of allergens produced from members of the acid-fast group of organisms.
6. There are marked differences in sensitivity of different skin areas of cattle.
7. Some cattle that are sensitized with *M. tuberculosis* will react to johnin and some of those sensitized with *M. paratuberculosis* will react to tuberculin.
8. A dermal thickness gauge was developed to accurately measure the skin thickness of experimental cattle.
10. The pathology of Johne’s disease varies with the type of Johne’s disease infected herd.
11. Surveys have been made to determine the extent of Johne’s disease in certain areas.
12. The test-and-slaughter method, with strict sanitation applied to the rearing of calves in isolation has been successful in eliminating Johne’s disease from several herds that were economically unsound because of the disease.
13. Continued effort is being made to find diagnostic agents of greater specificity for Johne’s disease and tuberculosis.
THE APPLICATION OF RESEARCH FINDINGS IN THE ERADICATION OF BOVINE TUBERCULOSIS

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The continued decrease in the incidence of bovine tuberculosis from about 5 per cent in 1917 to less than 0.2 per cent in 1943 with the establishment of every State in the Union on a modified accredited status is generally accepted as a remarkable achievement. Since the beginning of the war, with the decrease in field personnel in tuberculosis eradication, together with a certain amount of complacency in accepting our accomplishment as a completed job, this low percentage has been static until the last two years, when there has been an indication of a slight rise. It is evident from field reports recently obtained that the seeds of infection that remained may have been allowed to sprout and that the incidence of bovine tuberculosis may continue to increase. It seems that all concerned in tuberculosis eradication must be awakened and their efforts concentrated to finish the job for which we have accepted much praise.

It is therefore thought advisable to discuss the possible field application of recent acid-fast research findings to the problems encountered in bovine tuberculosis eradication.

DETECTION OF ALL TUBERCULOUS ANIMALS

It would be ideal if all animals could be tested with a perfect test, the reactors slaughtered and the contaminated environment completely freed of the tuberculosis organism, all with one visit to each farm. However, we have long understood that this was impossible. The author, in collaboration with Drs. A. B. Larsen and A. H. Groth of the Regional Animal Disease Research Laboratory, Auburn, Alabama, Dr. Dennis Sikes, Agricultural Experiment Station, Knoxville, Tennessee, Mr. R. R. Henley and Dr. L. A. Baisden, Pathological Division, B.A.I., have endeavored therefore to study the factors which may influence the detection of tuberculous animals.

Many have noticed that there is a marked difference in sensitivity or reactivity in different animals, naturally infected with tuberculosis. It has been shown in sensitive humans (1) that a positive intracutaneous reaction may be obtained with an amount of Purified Protein Derivative equivalent to 5 millionths of a mg. of tuberculin (O.T.) while (2) in other infected individuals it may require as much as 10 mgs. to produce a similar reaction. Critical studies made in these cooperative bovine tuberculosis-eradication programs have demonstrated a similar wide variation in the degree of sensitivity to tuberculin manifested in tuberculous cattle. Therefore, it is understandable that the degree of sensitivity of the individual is one factor which influences the size of the reaction produced by the injection of tuberculin.

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It was found further that the response to tuberculin in an individual cow was
directly proportionate within certain limits, to the amount of tuberculin injected.
It is essential, therefore, that measured uniform injections be made if an accurate
interpretation of the response to tuberculin is to be obtained.

Experiments were also conducted employing a dermal thickness gage (3) to
study the influence of: size and length of needle, type of syringe, variation in body
region sensitivity, operator's agreement, and the local desensitization factor.

Detailed results will be published later, but some points may be summarized
here. Marked variations were shown when needles of different length and gage
were used. It was found that 25-28 gage needles \( \frac{3}{4} \) of an inch in length gave the
most satisfactory results, also that a syringe with a small bore facilitated the injec-
tions. There were also significant differences in sensitivity of the skin in different
body regions. The skin region of low sensitivity is an area about 6" wide below
the top line from the dorsal extremity of the scapula to the pin bone and including
the skin over the rear quarters. The skin regions of high sensitivity are in the
cervical or neck area from six inches ventral to the crest of the neck and over the
flanks. The skin on the upper six inches of the neck and over the ribs, from six
inches ventral to the top line, is of medium sensitivity.

The application of the intradermal tuberculin test to the cervical region has
proved valuable for the detection of tuberculous animals with a low degree of
sensitivity. However, because of the greater sensitivity of the cervical region a
larger number of non-specific reactions will be elicited than when the intradermal
test is applied to the caudal fold. Therefore, the cervical intradermal test should
be used only in known tuberculous herds.

It was found further that there are no important differences in sensitivity between
parallel skin areas on either side of the same animal. Also it was found that no
important differences occurred between inoculations and readings made by experi-
enced operators.

A most important factor, previously recognized but forcibly proved in these
investigations, was that local desensitization occurs following the intradermal in-
jection of tuberculin. The extent of duration of the desensitization is indirectly
proportionate to the degree of sensitivity of the animal. As an example, if a cow
injected with a standard dose of tuberculin reacts only very slightly, there will be
a very long period of local desensitization as compared with a similarly injected
area on an animal of greater sensitization. Therefore, it is important when re-
testing cattle with intradermal tuberculin to inject previously unused injection
sites at least 4 inches distant from formerly injected areas. This would be parti-
cularly important in retesting suspicious animals.

A survey conducted this last year indicated tendency towards some lag in time
between retests on known tuberculous herds. Also there was a tendency to con-
sider tuberculosis as having been eradicated from an infected herd after one or two
clean tests. It is believed that the knowledge gained by past experiences has shown
that continuous regular 60-90 day retests with proper supervised cleaning and dis-
infection of the premises are essential. This should always be continued until an
accredited herd status has been reached, if tuberculosis eradication is our goal.
ERADICATION OF BOVINE TUBERCULOSIS

N.V.L. CASES IN KNOWN INFECTED HERDS, NON-TUBERCULOSIS HERDS, AND HERDS OF UNKNOWN STATUS

When the tuberculin testing program was first begun it was assumed that all reactions in cattle following the injection of tuberculin were the result of sensitization by the bovine tubercle bacillus. It was undoubtedly true in those days, when the incidence of disease was high, that a great majority of such reactions were the result of a specific sensitization. The same is true today when we are employing the tuberculin test in known tuberculous herds.

We must keep foremost in our minds that our chief aim is to eradicate bovine tuberculosis and to accomplish this end, no reacting animal should be left in a known tuberculous herd. This will mean that N.V.L. cases will be seen at the time of slaughter. However, it is well known that early lesions of tuberculosis are very difficult to detect even on microscopic examination and also that it is impossible to examine all parts of an animal at postmortem. Therefore, the fact that no gross lesions were observed is not proof that the disease was not present. In known infected herds our concern is with the possible tuberculous animal which failed to react, not in the animals in which we failed to demonstrate lesions.

After having talked with a considerable number of people interested in the ultimate eradication of bovine tuberculosis, it seems to be taken for granted that many reactors in herds of unknown status or in supposedly non-tuberculous herds are not removed when they are found. They are considered to be "deviators" and as such are ignored in the records. If cattle are classed as deviators and not reported, all calculations on reactors are undependable. In this connection the chances of a "deviator's" being tuberculous are probably as great as that of a reactor being tuberculous. In other words, if 60 tuberculous animals are found in 100 reactors (which is nearly the present percentage), 100 deviators might furnish an equal number of infected animals. The probabilities could be calculated if sufficient material were available. Results indicate a high incidence of tuberculosis among some of the so called "deviators." In one test 22 animals were classed as deviators by one operator. In the next test they were classed as reactors and were slaughtered, and 14 were reported to be tuberculous.

CAN TUBERCULOSIS BE ERADICATED BY THE AMOUNT AND TYPE OF PRESENT TESTING?

As late as 1935 the percentage of reactors was 1.5. The percentage now is about 0.23 after having reached a low of about 0.18 in 1943. Although it is far more difficult to detect a reactor now than it was in 1935, there is a fairly large reservoir of infection remaining. The extent of the difficulty and of the reservoir is indicated by the following:

In 1935 the animals tested were:

<table>
<thead>
<tr>
<th>Number of animals tested</th>
<th>Reactors</th>
<th>N.V.L. cases</th>
<th>Tuberculous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25,237,532</td>
<td>376,023</td>
<td>319,132</td>
</tr>
</tbody>
</table>

For every ten tuberculous animals detected, about 800 tests were made.
In 1946 the animals tested were:

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of animals tested</td>
<td>8,454,463</td>
</tr>
<tr>
<td>Reactors</td>
<td>19,464</td>
</tr>
<tr>
<td>N.V.L. cases</td>
<td>7,739</td>
</tr>
<tr>
<td>Tuberculous</td>
<td>11,725</td>
</tr>
</tbody>
</table>

For every ten tuberculous animals detected, about 7200 tests were made. Therefore, about nine times more tests were required to detect a tuberculous animal in 1946 than in 1935.

If the 8,454,463 cattle tested in 1946 may be considered a fair sample, about 0.14 per cent of the cattle in the country were tuberculous. There were 79,791,000 cattle in the Country last year. Based on these figures and if the infection were equally spread in all classes of cattle, there were about 111,000 tuberculous animals remaining. To detect those at the 1946 rate of 7,200 tests for ten diseased animals, 80,416,880 tests would be necessary. Obviously, there is no likelihood of removing the infected animals by one test or one series of tests. Just as obviously, a considerable reservoir of infection will remain if the diseased animals are not detected. Whether the disease will eventually be eradicated will apparently depend upon whether infected animals are detected faster than animals become infected. That in turn may depend upon the number tested per year and also upon whether the animals tested are either a group of average infection or a group with more than average infection.

How many cattle should be tested annually to maintain the status quo? That is, to detect animals as fast as they become infected. Dr. F. M. Wadley, a statistician in the U.S.D.A. was asked if the published statistics on tuberculosis eradication would throw any light on the question as to how many animals should be tested per year to control the spread of the disease. Calculations made by him and based on figures contained in the 1946 issue of Agricultural statistics, indicate that the 8 and 9 million cattle that have been tested annually in recent years are not quite sufficient to control the disease even if it is assumed that the disease is confined to dairy herds.

Another question is: are the animals tested a fair sample? If by any chance a number of the cattle tested in any year were tested in the preceding years, the results will represent conditions in a selected group. Unless the cattle tested represent a fair sample, the extent of the infection will not be known. A fair sample should be defined. It would seem that the sample should consist chiefly of animals that have not been repeatedly tested and contain cattle from practically every type of county in each State, and from every type of subdivision in each county.

CONTROL OR ERADICATION?

If the aim is control, it would seem advisable to reorganize our objective. Thus, under the control procedure, a deviator class could be recognized and deviators left in the herds from which lesion cases were not obtained on one or more recent tests. However, it should also be recognized that a deviator classification of an animal is based solely on judgment and there is no way to class a reactor as infected
or non-infected except by autopsy. Records should be kept and reports made of all deviators. To do this would require a radical change in the procedures as practiced.

If the aim is eradication, the objective would be reached more quickly if a considerable number of cattle are tested each year with follow-up tests in infected areas, if new areas are tested each year and if all reactors are removed.

The "if" has never really been in our thinking. Eradication has been and is our objective. As the job of eradication becomes more difficult, it will be necessary to review and improve the tools and methods used in order that we may finish the job we have assigned to ourselves. The following suggestions are offered for your consideration:

1. Needles of 25-28 gage and 8 inches long should be employed for all intradermic tuberculin injections.
2. Measured uniform injections should always be injected.
3. The skin of the neck region (cervical test) is an area of greater reactivity; therefore, may be employed in known infected herds to identify some infected animals which fail to react when tuberculin is injected into areas of lesser sensitization.
4. When like concentrations of mammalian tuberculin and johnin are applied simultaneously to the same tuberculous animal, the tuberculin will usually elicit a greater reaction. When the same procedure is carried out on a Johne’s diseased or avian tuberculosis sensitized animal, mammalian tuberculin would usually produce the lesser reaction.
5. As shown by Zeissig (4) a majority of reactors from herds with only 1 or 2 reactors will prove to be N.V.L. cases.
6. As shown by Zeissig and McBee (5), it is probable in many of these N.V.L. reactors that the reactability is a temporary one.
7. There is a local desensitization for two weeks following the intradermal injection of either tuberculin or johnin. This area should be avoided when animals are retested.
8. When tuberculosis is found retests should be made regularly until the herd has reached the accredited herd status.
9. The prescribed sanitary measures (cleaning and disinfection) should be prompt and supervised.
10. The possibility of extraneous sources of infection should be considered and investigated completely.
11. Studies should be made to determine the number of cattle necessary to test each year in order that eradication can be hastened.
12. The amount of increase in the rate of condemnations for tuberculosis which could be considered significant should be calculated for use as a yard stick of our progress or lack of progress towards the goal of “complete eradication of Bovine Tuberculosis.”

REFERENCES


THE ERADICATION OF TUBERCULOSIS OF POULTRY

GEORGE B. SENIOR, V.S., B.V.Sc.

General Supervisor, Avian Tuberculosis Eradication, United States Bureau of Animal Industry, Des Moines, Iowa

The average farm in the corn belt region carries 105 hens and 5 sows. These species, of course, reproduce their kind, and at certain times of the year the average is considerably increased. On the average farm, there is cohabitation of these species and from this fact stems our problem—the eradication of tuberculosis.

From experience we have learned some of the answers. Among them is the "clean ground" proposition. That is to say, move away from the infection and let Nature, with what aid we can give her by cleaning and disinfecting the housing and yarding facilities, do what she can during the summer months towards killing the disease producing organisms.

If we can visualize this situation—a farm with poultry and swine feeding together—and multiply it by 165,000, we will have an idea of the task which confronts us in the average corn belt state.

It is evident that there are not enough people available from the combined ranks of the State and Federal regulatory veterinarians, the poultry extension forces of the College, the county agricultural agents and from the people yearly employed by the poultry and swine industries to visit any appreciable percentage of these farms and see that a rational program looking to the control of tuberculosis is instituted and carried on. This being the case, our great hope of further reducing the number of tuberculous fowls and the number of tuberculous swine can best be realized by activating the owners.

There may be many ways of doing this, but here, in our opinion, is one which offers the most promise. This is not one man's idea. It is the composite idea of many individuals and groups who have watched the consistent reduction of tuberculosis for several years and who believe that the continued operation of the plan will show a smaller number of hogs being retained for tuberculosis and also a lesser instance of the disease at poultry eviscerating plants.

The head of the state regulatory force should take the initiative in assembling all factors which are interested or will be benefited by the control of tuberculosis. When this has been done, a comprehensive plan should be agreed upon and henceforth followed by everyone telling the same story as to what is desirable and necessary for the poultry and swine owner to do to combat the disease on his premises.

We might add here that poultry clinics, where practicing veterinarians and others autopsy diseased fowls, offer the most convincing proof of the actual presence of disease and consequently the need for its control. The owners should be reminded continually that one case of tuberculosis comes from another case of tuberculosis and that strong birds—birds with vitality and quality—cannot be produced in the presence of disease.

Quality poultry being the object of our effort, we recognize the important part taken by the animal husbandry men collaborating with us, and submit some of
their suggestions in flock management which are essential in any disease control program:

1. Start poultry flock with strong, healthy chicks from disease free parent stock having records of production.
2. Provide a well-constructed, sanitary brooder house with good light and ventilation.
3. Maintain poultry flock at all times on adequate, well-balanced ration in sanitary feeders.
4. Supply water in abundance at all times in adequate and sanitary waterers.
5. Separate the cockerels from the pullets when they are 6 to 8 weeks of age in the case of light breeds—or 10 to 12 weeks of age in heavy breeds.
6. House the pullets in summer shelters on clean ground separately from the laying flock.
7. Market each year all birds at the end of the first year of production.
8. Clean and disinfect poultry house and equipment.
9. Keep only pullets.
10. Birds held for more than one year for either production or breeding purposes should be housed separately from the pullet flock.

This poultry husbandry idea, commonly known as the “all-pullet flock program,” has been espoused by numerous elements of the poultry industry in several states long enough to assay the results which are reflected in a downward trend in the instances of avian tuberculosis.

The information as to the presence of the disease in poultry and swine has been gathered from two principal sources:

A. The tuberculin testing of numerous poultry flocks, and,
B. The percentage of the swine showing tuberculosis at the abattoirs.

Beyond this, some data has been gathered from the many autopsies which have been made by veterinarians who have visited farms incident to the testing of cattle for Brucellosis and tuberculosis.

Records are available on the tuberculin testing of 653 flocks of poultry, aggregating 113,393 birds. Of this number 269 flocks were found to be infected with 7,630 birds showing positive reaction. This testing occurred during the year ending June 30, 1947.

On the testing of 432 herds of swine (mostly brood sows) by the use of avian tuberculin, reactors were found in 153 herds. This is equivalent to 35.4 per cent herd infection. Of the total number of swine tested, 2,339—14.8 per cent or 346 were reactors. Obviously, the more closely the avian-swine project is integrated with the general bovine tuberculosis eradication program, the more thorough it will be.

The general program is largely one of education; it should include in its scope all those who are interested and benefited, and be such that it becomes an essential part of successful poultry husbandry. There must be organization and leadership established with a general manifestation of interest among all branches of the poultry and swine industries, and there also must be a sublimation of views into one definitely established program to which all may subscribe if the plan is to be successful.
ERADICATION OF TUBERCULOSIS OF POULTRY

Where it is known that tuberculosis exists in varying degrees among poultry and swine, and further where the presence of the disease is economically detrimental, informative tuberculin tests should be made of both species, testing the swine simultaneously with both avian and mammalian tuberculin.

The testing of a representative number of all-pullet, hen and mixed (hen and pullets) flocks and breeding swine in different parts of a county, equal in numbers to the poultry and swine population of one township, is probably the best way to arrive at an estimate of the extent of the disease and to make a comparison of the percentage of infection that exists between the all-pullet, hen and mixed flocks. In order that information of this nature may be of the most value, it should be given State-wide publicity through a committee set up for that purpose and which is sponsored by the poultry and swine industries.

To give impetus to the control and eradication of tuberculosis in counties where informative tuberculin tests have been made, poultry clinics should be held in collaboration with the local practicing veterinarians, County Farm Bureau organization, Smith-Hughes Department of the high schools, local papers and all other poultry and swine interests. Moving pictures on avian tuberculosis eradication should be shown and as many other pictures on poultry and swine husbandry as time will permit.

Recent testing of poultry in Iowa, which includes a total of 58,844 birds in 276 flocks, shows that less than one-half of one per cent (0.35 per cent) of the birds in the all-pullet flocks have tuberculosis; while 5.01 per cent of the birds in the flocks where old hens have been kept reacted to the test. On the basis of all flocks tested, it was found that only 3.3 per cent of the birds have tuberculosis.

Contrasting these results with those obtained ten years previously, it is shown that there is decided improvement in the disease situation. At that time 8.5 per cent of the birds tested showed tuberculosis.

A much higher percentage of the poultry flocks is free from disease than was the case ten years previously. The recent tests show that 44.20 per cent of the flocks contained tuberculous birds while ten years previously 69.79 per cent were infected.

Again, ten years ago the retention of swine for tuberculosis at some packing plants in Iowa ran as high 18 per cent while the average was in the neighborhood of 14 per cent. Retentions have gone down year by year with the exception of a short time during the war, until at the present time they are hardly more than half of that amount.

In conclusion, let us remember that unlike many other important projects, the eradicator in the instance of avian tuberculosis must be the owner himself. He is the one who must provide the clean ground, the necessary segregation and arrange for the slaughtering of older birds. The most that the forces fostering the project can do is to point out the probable loss from disease and adroitly suggest a comprehensive way to prevent it. It is for this reason that as many factors as possible should take part in the educational program, for as we have previously stated, there is an average of 165,000 farmers in each of the corn belt states who must be reached in some way if efforts in the eradication campaign are to be successful.
REPORT ON BOVINE, AVIAN, AND SWINE TUBERCULOSIS

A. K. KUTTLER, D.V.M.¹

On many occasions I have sat in meetings of this Association and received renewed enthusiasm to go back where the routine had become somewhat monotonous, and try to do my work better. This has been especially the case after listening to words of praise by those in positions of leadership in their various fields, who have so freely given credit to veterinarians, livestock producers, and others concerned, for the splendid accomplishment of bovine tuberculosis eradication.

CELEBRATION OF ACCREDITATION OF ALL COUNTIES IN THE UNITED STATES

In 1942 this Association gave special recognition to those leaders in livestock disease-eradication work who had the vision and courage to undertake, many years before, what seemed to their critics to be an impossible task. All counties in the United States had, in 1940, received the classification of accreditation as practically tuberculosis-free. Many were heard to say then, and even before that, “We have eradicated bovine tuberculosis; now let us turn our attention to other livestock diseases which urgently need attention.” The year following this special recognition by the Association saw the lowest percentage of bovine tuberculosis ever to be recorded in cattle in the United States, which was 0.18 per cent of all animals tuberculin tested.

INCREASE OF BOVINE TUBERCULOSIS

Since 1943 the number of veterinarians available for tuberculin testing has continued to decrease, and the percentage of bovine tuberculosis has increased. This increase is not alarming at present; however, it shows a trend we must recognize and correct. The investment in funds as well as energy on the part of the veterinary profession and the livestock industry is certainly sufficient to merit our best efforts to reach the goal set for us by those who had the faith and vision to undertake bovine tuberculosis eradication.

REVIEW OF BENEFITS OF BOVINE TUBERCULOSIS ERADICATION

We should on occasions such as this review the benefit this project has wrought in our generation. In 1917, when bovine tuberculosis eradication was begun, there were being condemned as unfit for human consumption between 45,000 and 50,000 whole carcasses annually. This great loss of food has been reduced so that in 1947 there were condemned less than 1,000 carcasses. The vast saving of food is overshadowed by the benefits to public health, since the type of disease transmitted from cattle to man has been reduced in man in direct ratio to the reduction of the disease in cattle. The accumulation of beef in this country resulting from the tuberculosis eradication project, made available at a time when it was most

¹Dr. Kuttler is in charge of the Tuberculosis Eradication Division, Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture.
urgently needed, amounts to more than all Lend-Lease shipments of beef made during the war years, and in this way has contributed to checking the spread of tuberculosis in man, since as we know, undernourishment is one of the greatest predisposing factors, and that the bovine type of the disease may be transmitted to man. I think it well that we be reminded of the fact that tuberculosis, the great white plague, has come back under conditions which favor its spread, so that it now flourishes among the ill-fed millions of the world, and once again, among the infectious diseases of man, is the chief cause of death.

REPORT BY THE U. S. LIVESTOCK SANITARY ASSOCIATION COMMITTEE ON TUBERCULOSIS

The Tuberculosis Committee which reported at the 1946 meeting of this Association in my opinion gave us one of the best reports ever rendered by any committee of this Association. The Bureau has had this report mimeographed, and furnished copies to all employees of the Bureau who are engaged in bovine tuberculosis eradication work. In addition, sufficient copies were supplied to the inspectors in charge so that other regularly employed veterinarians who are engaged in bovine tuberculosis eradication work could have the report.

I am well aware of the fact that we like to read about the battles that are won, and that we feel some degree of antipathy when someone undertakes to tell us about our mistakes. Yet we are all cognizant of the need for making improvements in methods of doing our work, if we are to keep step with a progressing world. When tuberculosis eradication was begun in 1917 on a nation-wide scale, we encountered a great deal of organized opposition. Failure to reach our goal could in those days have been charged to that opposition; however, at the present time there is no organized opposition. The medical profession, the livestock industry, and the consuming public have given us everything we have asked for, including our request that the project be kept directly under veterinary supervision. The responsibility for any backward step at this time will fall directly upon the shoulders of the veterinary profession.

I do not wish to burden you with too many details; however, I should like to mention just one herd of between 1,000 and 1,200 dairy cattle, which supplies milk to one of our capital cities located in a State where there was never a very high percentage of bovine tuberculosis. The city ordinance requires an annual tuberculin test of all herds supplying milk to the city. Replacements have been made in this particular herd almost entirely from one source in a nearby State. For a number of years one veterinarian reported the annual test of the herd, to comply with the city health ordinance. For the same period of time a veterinarian at the yards where, so far as we have been able to determine, all replacements were purchased, reported the test and issued health certificates for all replacements. This herd was recently found to have more than 25 per cent tuberculous infection, and illustrates without amplification what can happen when it is assumed that bovine tuberculosis has been completely eradicated.

I hope all who are in positions of responsibility in the bovine tuberculosis-eradication project will take time to read or re-read the 1946 report of the Tuberculosis Committee of this Association.
RESEARCH ON BOVINE TUBERCULOSIS

The question is frequently presented as to whether research is being conducted in the interest of improving our methods of eradicating bovine tuberculosis. As you know, the no-visible-lesion problem has given nearly everyone associated with the bovine tuberculosis-eradication project a great deal of worry. Under the direction of Dr. A. H. Groth, at Auburn, Alabama, work is being done on the acid-fast group, particularly *Mycobacterium paratuberculosis*, and *Mycobacterium tuberculosis*, avian type, in the interest of determining to just what extent bovine animals may be sensitized to tuberculin by these organisms. Several meetings have been held during the past few years, and reports have been made by veterinarians who are working on this problem. The last meeting was in March 1947.

Surveys have been made in several localities by injecting johnin in the caudal fold not used for the tuberculin test, at the same time the tuberculin test is made, in an effort to determine the extent of Johne's disease, which is perhaps the greatest offender, aside from the bovine type of *Mycobacterium tuberculosis*, in sensitizing bovine animals to tuberculin.

Dr. Groth is very anxious to secure properly verified information as to the extent of Johne's disease, which may have been observed clinically, or following the use of the johnin test, and will make requests of veterinarians in charge of Bureau stations and State officials for assistance in securing data on this disease, which may have been diagnosed either clinically or by the use of johnin or avian tuberculin.

Some encouragement is offered that we may have a more specific tuberculin; however, the present product will, when properly applied and interpreted, give satisfactory results.

INTERDERMAL INJECTIONS OF TUBERCULIN IN THE CERVICAL AREA

Consideration should be given to the use of intradermal tuberculin in the cervical area. The intradermic test applied in this area has been demonstrated through careful research to be very helpful in locating diseased animals which may have escaped detection by tests made in the caudal-fold area. Those who have given the most consideration to finding the last tuberculous animal are convinced that the reactors which we fail to find in an infected herd are those of low sensitivity to tuberculin. It has been demonstrated that these animals of low sensitivity are the ones which in many instances are in the most advanced stages of the disease. In a good many instances such animals have given clear-cut reactions to the test in the cervical area after having been negative to a number of tests in the caudal-fold area. For this reason I have been hopeful that the test in the cervical area would be given a thorough trial to determine its value in our efforts to locate the last infected animal.

Until we secure a more specific tuberculin it would be very unsound to recommend the application of the tuberculin test in the cervical area in any except known infected herds, since to do so would add to our present no-visible-lesion problem. The no-visible-lesion reactor is in my opinion not a problem in the known infected herd, since we are agreed that in order to eliminate bovine tuberculosis we should remove those infected animals which have not yet advanced to the point that they
show macroscopical lesions. The most serious problem confronting us today in our bovine tuberculosis eradication project is indifference, which is the result of the general assurance that bovine tuberculosis is a thing of the past, and a failure in too many instances to concentrate on known infected herds. When making tuberculin tests today we are searching for something infinitely more difficult to find than when the bovine tuberculosis-eradication project was begun. Too often the search is made with much less interest than was manifest in the early days of our tuberculin testing, when the finding of diseased animals was an every-day occurrence. If the intradermic test in the cervical area proves to be as effective in demonstrating reactors of low sensitivity when used as a routine procedure in known infected herds as its limited use gives us reason to hope for, it will do more than any one thing to enable us to concentrate on known infected herds properly, since we are not handicapped when using tuberculin in the cervical area by the need for allowing a lapse of 60 days or more between tests on account of a desensitized area. It has been determined that desensitization occurs following injection of intradermic tuberculin in an area not in excess of four inches from the site of the previous injection.

AVIAN AND SWINE TUBERCULOSIS

Avian tuberculosis continues to receive attention. Its eradication is a problem which is recognized to be largely a matter of education. Reports from establishments where poultry inspection is maintained show that over 40 per cent of all condemnations of poultry are due to this disease. It has been conservatively estimated that losses to the poultry industry are well in excess of three million dollars a year as a result of this disease. It is also well known that a very high percentage of condemnations of swine as a result of tuberculosis found on post-mortem inspection is due to the avian type of the disease. The loss from swine condemnations amounts to between two and three million dollars annually.

At the annual conference of State representatives of the National Poultry Improvement Plan and the National Turkey Improvement Plan, held in Cleveland, Ohio, on July 18 and 19, 1947, avian tuberculosis eradication was given consideration, and the following action was taken:

The National Plans Conference endorses for the purpose of avian tuberculosis eradication and the elimination of other poultry diseases transmitted from older to younger birds the maintenance of all-pullet flocks except in flocks where it is desired to retain birds after the first laying year for breeding purposes. In flocks retained after the first laying year in areas where avian tuberculosis is prevalent, it is recommended that an annual tuberculin test be made with removal for slaughter of all reactors to the test together with proper cleaning and disinfecting of poultry houses and all birds retained should be completely segregated.

I wish to encourage every veterinarian who makes tuberculin tests of cattle to discuss with every owner of poultry the importance of avian tuberculosis eradication, for this disease in poultry can sensitize cattle to the tuberculin test, and thereby add to the no-visible-lesion problem.

Encouraging owners of poultry maintained for egg production only to dispose of
all such hens after the first laying year is most profitable to the owner, both from the standpoint of production and disease control. Pullets lay from 20 to 30 per cent more eggs than in any subsequent year.

MEMORANDUMS OF UNDERSTANDING BETWEEN THE BUREAU AND STATE OFFICIALS

The Bureau has had under consideration for some time the matter of renewing memorandums of understanding covering the eradication of tuberculosis, since in most States these memorandums have not been changed since the early years of the project, and it is felt that the renewal of these memorandums of understanding, in the light of advancements made since the project was started, will be very beneficial. In this connection, I should like to recommend to the Association that the Uniform Methods and Rules for the Establishment and Maintenance of Tuberculosis-Free Accredited Herds of Cattle and Modified Accredited Areas be revised.

Statistical data compiled each year by the Bureau for members of this Association, covering the entire period of the bovine tuberculosis eradication project, have been prepared, and will be available here on the speaker's desk, and if additional copies are required they may be obtained by writing to the Bureau.

CONCLUSIONS

1. There is a vital need for recrudescence of our interest in bovine tuberculosis-eradication, for bringing up-to-date the uniform plans and methods, and for renewal of memorandums of understanding, which should be based upon the improved and accepted methods for finding the last bovine animal affected with tuberculosis.

2. Improvements should be made in the present methods of tracing to the point of origin animals found to be tuberculous on post-mortem inspection, and provision should be made for greater concentration on known infected herds by the application of the tuberculin test at more frequent intervals and stricter enforcement of quarantines.
REPORT OF THE COMMITTEE ON TUBERCULOSIS


Your committee wishes to emphasize the necessity of continued systematic testing to further reduce the incidence of bovine tuberculosis. It is the firm belief of this committee, with the exception of range and semi-range areas, complete tests of all cattle should be conducted at periods not to exceed six years.

Experience shows that spot testing to maintain area accreditation is not satisfactory, therefore, your committee recommends that "the uniform methods and rules for the establishment and maintainence of tuberculosis free accredited areas" be amended, before January 1, 1951, to provide that all cattle in an area shall be tuberculin tested at intervals of not to exceed six years before accreditation or re-accreditation after that date excepting areas in range and semi-range areas.

It is further recommended that areas that have not completed the accrediting of the area shall immediately comply with the requirements of accreditation or be dropped from the status of modified accredited tuberculosis free areas.

Complaints continue regarding the importation of cattle into the United States from Canada which show positive reactions to the tuberculin test when retested after arrival in this country. Since all of the counties in the United States are now declared Modified Accredited Tuberculosis-Free Areas, it is recommended that U.S.B.A.I. Order 6379 be amended to provide that cattle shall not enter the United States from Canada unless (1) they have passed a tuberculin test without evidence of reaction within thirty days (30) of entry and have originated from a tuberculosis free accredited herd or (2) have originated from a herd in a modified tuberculosis free accredited area in which herds no reactors have been found within one year and have passed a negative tuberculin test within 30 days of entry.

No cattle shall be accepted for entry into the United States from Canada from herds in which reactors have been found, unless and until the entire herd has subsequently passed three negative tests the first of which tests shall be conducted not within sixty days after the date when reactors or infection otherwise was disclosed and the second and third tests conducted at not less than six months of the test immediately preceding. This change in regulation shall not be construed to apply to range and semi-range cattle covered by B.A.I. Order 379.
LOSSES CAUSED THE POULTRY INDUSTRY BY NEWCASTLE DISEASE

THEODORE C. BYERLY, PH.D.

Bureau of Animal Industry, U. S. Department of Agriculture

A committee on losses caused by Newcastle disease was formed at the conference on Newcastle disease research called by Dr. B. T. Simms, Chief of the Bureau of Animal Industry, U. S. Department of Agriculture, in Baltimore, Md., on November 18–20, 1946.

This committee consists of—

T. C. Byerly, Chairman, Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture
H. E. Biester, Veterinary Research Institute, Iowa State College
A. J. Durant, Department of Veterinary Science, Missouri Agricultural Experiment Station
I. M. Moulthrop, Maryland State Livestock Sanitary Service Laboratory
C. M. Hamilton, Division of Veterinary Medicine, Western Washington Agricultural Experiment Station

This committee recommended that the Bureau of Animal Industry collect data on the incidence and course of Newcastle disease through the State Livestock Sanitary authorities and other agencies. The Pathological Division of the Bureau of Animal Industry requested the State Livestock Sanitary authorities to report cases of Newcastle disease, together with the number and kinds of poultry affected and the diagnostic criterion. Poultry pathologists were requested by the Bureau to report more complete case histories on typical cases in their vicinities.

In order to supplement these voluntary reports with more complete data for a limited area, a veterinary survey of a Middle Atlantic broiler region was planned and carried out by Dr. L. C. Heemstra of the Animal Husbandry Division and W. A. Hendricks of the Bureau of Agricultural Economics. This survey was planned in consultation with the staff of the Pathological Division and was carried out under the supervision of Dr. H. W. Schoening, Chief of that Division. The present report will review briefly the results obtained from the voluntary reports and the veterinary survey; publication of the full report by Dr. Heemstra and Mr. Hendricks may be anticipated shortly.

Preliminary to consideration of the data to be reported, previous information and opinions on mortality and morbidity from Newcastle disease will be reviewed briefly. Some poultrymen have asserted that Newcastle as it exists in the United States is of little economic importance. Cases have been cited in which mortality was negligible and it is generally conceded that the disease in the United States has displayed less virulence than in known outbreaks in other countries. Pathologists have debated inconclusively the reasons for the apparent lower virulence of the disease in the United States. There has been much speculation as to the probability that virulence may increase to the proportion exhibited in other parts of the World.
A committee consisting of representative poultrymen, pathologists and regulatory officials was invited by the California poultry industry to make field examinations in that State where Newcastle has been enzootic for several years. This committee visited California poultry areas and reported a history of moderate mortality losses from the disease generally with the exception of a 1944 outbreak in a commercial egg production area in which 120,000 of a total population of 600,000 layers were said to have died from the disease. Newcastle was reported to be of minor importance in turkeys. California hatcheries were complimented by the committee with respect to their generally excellent sanitation programs and especially with respect to their uniform practice of selling only day-old chicks and poults.

With this brief background we will proceed to consider the results of voluntary reports and the veterinary survey.

The voluntary reports from State Livestock Sanitary authorities and pathologists include 545 flocks in 176 counties in 21 States, while the disease has been officially diagnosed in 43 States. Data for many of the outbreaks are incomplete. Among 171 flocks for which data on kind of poultry affected were included, 118 were young chickens, 52 adult chickens and one turkey flock. Outbreaks usually lasted for about four weeks but variation was great. The percentage of birds, in these flocks, affected by the disease was very high. Laying flocks usually showed a very severe decline in egg production.

Mortality reported varied widely. The average mortality among flocks of young chickens was about 40 per cent, among adult chickens about 20 per cent. The average estimated monetary loss based on flock-owner opinions was more than $200 per affected flock.

With respect to origin of the affected flocks, it is noteworthy that 33 of the 118 young chicken flocks for which such information was reported were obtained as started chicks. Thus approximately 30 per cent of these flocks were obtained as started chicks while the average percentage of chicks obtained as started chicks probably does not exceed 10 per cent.

One specific case history involving started chicks may be of interest. A hatchery obtained 200 chicks from a breeder in another State, several hundred miles distant. These chicks were shipped by common carrier and arrived at the hatchery in apparently healthy condition. Upon arrival they were placed in a battery with chicks produced at the hatchery. Started chicks from the battery, including small lots of the imported chicks, were distributed to several flock owners who soon reported disease outbreaks. These outbreaks were diagnosed as Newcastle disease. During the same period, many lots of day-old chicks were distributed from the hatchery without subsequent reports of Newcastle. This example and the voluntary reports emphasize the serious problems of started chicks and common carriers as means of disseminating Newcastle disease. The disease may spread in the absence of these means, however.

The veterinary survey, to be described by Dr. Heemstra, includes a statistically adequate sample of broiler flocks in the Eastern Shore region of Delaware, Maryland, and Virginia in May and June, 1947. Of the 83 flocks covered in the survey 25, or about 30 per cent, were found to be affected with Newcastle disease. The 83 flocks comprise a population of about one million broilers. All of these broilers
THEODORE C. BYERLY

were obtained as day-old chicks, with no apparent difference between lots transported by common carrier from distant hatcheries and those delivered by private carrier from nearby hatcheries.

Death loss in affected flocks is estimated to total about 20 per cent for affected flocks to market weight and about 10 per cent for flocks not affected by Newcastle. Apparently about 2 additional weeks are required for affected flocks to reach market weight beyond the time required by unaffected flocks. Since about 100,000,000 broilers are produced in this area annually, 3,000,000 are probably lost due to Newcastle. Fifty million chick weeks are wasted due to increased time required to reach market weight.

It will be noted that the veterinary survey data indicate only about 20 per cent mortality in flocks of young chickens as compared to 40 per cent in the voluntary reports. This discrepancy may be more apparent than real. It is probable that a disproportionate number of mildly affected flocks escape notice and go unreported.

In conclusion, it may be pointed out that if Newcastle at its present virulence reaches the level of 30 per cent of all flocks indicated by the veterinary survey and the 10 per cent additional mortality above that from other causes that it may result in annual loss of 30,000,000 young chickens. This is a number comparable to our present losses from pullorum disease.
INVESTIGATIONS OF FIELD OUTBREAKS OF NEWCASTLE DISEASE IN A GIVEN AREA

LOUIS C. HEEMSTRA, D.V.M.

U. S. Bureau of Animal Industry, Beltsville, Md.

Accurate and comprehensive reporting, particularly with respect to morbidity and mortality, is of primary importance in the control of transmissible diseases. Indeed, without a knowledge of these "vital statistics" it is difficult, often impossible, for livestock sanitary officials to set up adequate control measures. While it is true that many of our infectious diseases are, by law, reportable to the various livestock sanitary control boards, too often we are dependent upon voluntary submission for reports of disease outbreaks. It would seem advisable, therefore, sometimes to give consideration to other means whereby sanitarians can become better informed as to the incidence and the extent of disease outbreaks and the probable manner of their dissemination from area to area. The survey method, while not new, but one that has infrequently been made use of in veterinary medicine, offers one such possibility.

Field outbreaks of Newcastle disease in the broiler-growing area of the Delmarva peninsula have recently been investigated by the Bureau of Animal Industry through the medium of a survey. This report, which is preliminary to a more extensive and detailed account to be published after factual data have been statistically treated, will endeavor to show that the survey method is sound as well as practicable and may be profitably applied to the study of disease of any class of livestock. At the same time, morbidity and mortality figures on Newcastle disease in this important poultry-growing area will be released. The report will also cite a few case histories and the deductions to be inferred from them which may add something to the sum total of knowledge concerning Newcastle disease in the United States.

METHODS AND OBJECTIVES OF THE SURVEY

This survey was conducted during May and June, 1947 by the Pathological Division of the Bureau of Animal Industry, and as a part of the coordinated research program on Newcastle disease which was initiated by the Bureau and concurred in or adopted by the National Newcastle Disease Committee. The survey was designed by statisticians in the Bureau of Agricultural Economics of the U. S. Department of Agriculture. The writer was assigned the task of making all field contacts and the gathering of the factual data.

Two methods of conducting a disease survey are commonly employed. One is to draw area samples within the boundaries of a designated universe. The other is to interview a predetermined percentage of farmers from a prepared register of operators within an area. The area sample method was adopted as being most suitable for the purposes of this survey.

Sampling was confined to the more intensive poultry raising portions of the peninsula. This survey area, covering approximately 3200 square miles, was
divided on the basis of the known number of farms into 1629 segments of area. Of this total number of segments 40, or approximately 2 1⁄2 per cent, were selected for the enumeration. The plan called for the survey veterinarian to visit every poultry farm in each of the segments designated as sample segments and to interview the owner or some responsible attendant. At the same time the flock was to be examined for clinical symptoms of Newcastle disease or any other disease present at that time. A small blood sample (1–2 cc.) was to be collected from each of any 10 birds in the flock to be pooled for serum-neutralization tests in order to substantiate the clinical diagnosis or to establish evidence that the birds had previously been in contact with the virus.

Only those farms having a poultry population of approximately 500 or more were considered in this survey. The establishment of this minimum eliminated many time-consuming and meaningless interviews in small farm flocks maintained as a sideline to other operations and under no particular system of poultry husbandry or originating from no definitely known source.

When plans and procedure for this survey were considered a number of objectives were held in mind:

(1) The collection of comprehensive and accurate data on the incidence of Newcastle disease and the losses caused by it.

(2) The collection of data on the incidence and loss caused by other poultry diseases, and the possible relationship between the losses caused by those diseases and the losses caused by Newcastle disease.

(3) The determination, if possible, of the source of the infection in the various farm flocks.

(4) A study of the possible relationship between certain poultry husbandry practices and the incidence or spread of Newcastle disease.

(5) The determination of the practicability of such a sampling method as applied to the study of poultry diseases.

With these objectives in mind a questionnaire was prepared by the statisticians outlining in considerable detail the information desired from each grower in each of the segments under survey. By adhering closely to the scheduled questions the interviewer was enabled to obtain factual answers, uncolored by the statements of one individual who might be inclined to over-estimate the importance of a disease outbreak on their particular premises.

Of the 40 segments selected for the enumeration, 12 were found not to contain any poultry farms of sufficient size to be included in the interviews. These "blank" segments, however, do not detract from the sample being drawn as they undoubtedly reflect a distribution of the broiler growers operating within the survey area. In the remaining 28 segments there were 83 farms, all of which were visited and the owner or some responsible attendant interviewed. In no instance, and this is important in this type of work, was the survey veterinarian refused permission to enter the poultry yards or houses for the clinical examination of the flock or for the collection of the blood samples. The utmost precautions, however, were always observed to avoid the possible spread of infection from farm to farm through the medium of the interviewer. Houses or yards were never entered without first donning sterile rubber coats, overshoes and gloves. Pans and instruments used in the bleeding operation were maintained in a sterile condition.
FIELD OUTBREAKS OF NEWCASTLE DISEASE

Owners or attendants were also very cooperative in answering questions and there is no reason to believe that the answers given or the data furnished were anything but accurate to the best of their knowledge or recollection.

Requests were frequently made by the owners for autopsies on sick or dead birds. Such requests were always refused on the grounds that such operations would greatly increase the possibility of contamination and thus promote the spread of infection from farm to farm. After such an explanation there was never any antagonism on the part of the owner because of the refusal.

EXTENT OF THE DISEASE

Of the 83 broiler flocks, totaling 928,000 birds, 25 of the flocks were found to be affected with Newcastle disease. On a percentage basis this indicated that 30.1 per cent of the flocks in the area were affected. An interesting observation can be made here. This figure, while relatively high, is considerably lower than the average estimate of the incidence made by the growers themselves. Newcastle disease, at the time this survey was conducted, had assumed foremost importance in the minds of the majority of the growers, hence, the tendency to over-estimate the incidence of the disease in the area.

Serum neutralization tests were available to confirm the diagnosis for 22 of the 25 positive flocks. Such tests were available for only 27 of the 58 negative flocks, mainly because the birds had already been marketed and the diagnosis had to be based principally upon a history of the flock as supplied by the owner and an examination of the mortality charts from starting date to broiler sale.

So far as could be determined, affected flocks contracted Newcastle disease at ages ranging from 1 to 9 weeks. Outbreaks began most frequently at 4 weeks. Only one grower reported that the disease had apparently started when the chicks were less than a week old. This brood of 4000 consisted almost entirely of cull chicks unloaded by the hatchery at bargain prices. There were numerous "gapers" on arrival at the farm and a number of chicks were showing typical nervous symptoms by the end of the first week. This flock was not seen by the survey veterinarian until the 18th week, at which time death losses had exceeded 50 per cent. Daily mortality charts were not available but the owner reported that there had never been a peak loss. At 18 weeks, when marketing had already been delayed for at least 4 weeks because of the disease condition, apparently well birds were still coming down with the nervous-type symptoms without showing any respiratory distress. In addition to the 50 per cent loss reported there were more than a hundred birds showing extreme weakness, paralysis and atactic symptoms. No sick birds had been removed from the flock, no attempt had been made to clean up, and husbandry practices generally were very poor. During the previous season a brood of 4000 had been raised on this farm with no serious loss.

One brood of 18000 was visited when the chicks were 8 days old. Losses up to that time had been less than 0.3 per cent. No clinical symptoms suggestive of Newcastle disease were noted but a serum-neutralization test was positive (10%). Because of this positive test the flock was re-visited on the 26th day. Losses at that time had slightly exceeded 1 per cent. Numerous "gapers" were noted but there were no chicks showing any nervous symptoms. A serum-neutralization test at this time on a pooled blood sample of 10 chicks, including 5 showing re-
spiratory symptoms, was negative. On the 42nd day losses had been very light and there was no clinical evidence of Newcastle disease.

Average mortality figures would be meaningless because of variation in the ages of the birds in the various flocks. Figures 1 and 2 show the relationship between the age of the birds in positive and negative flocks and the per cent lost at the time of the survey.

Data for all positive and negative flocks, including those classified by clinical diagnosis alone, were used to construct these charts. When the birds had already been marketed at the time of the survey, the age at marketing and total loss up to that age were used. A study of the trend lines shows that mortality in the positive flocks is considerably higher than in the negative flocks after about the seventh week of age. Up to 7 weeks the mortality in the affected flocks was no higher than in the negative flocks.

This survey showed a distinct relationship between per cent mortality and the number of birds started. Mortality seemed to run higher in the smaller flocks; this was true of both positive and negative flocks. Such a trend is probably contrary to general expectations. Sanitarians, as a rule, advocate smaller units for more effective disease control. The present finding can probably be explained by the observation that the raising of broilers in large units was generally the sole occupation of the owner, appeared to be conducted in a more business-like manner, and more particular attention was being paid to accepted sanitation practices; the smaller units were often carried as a sideline to other operations, and sometimes appeared to suffer considerably from neglect.

**RELATIONSHIP OF OTHER POULTRY DISEASES TO NEWCASTLE DISEASE**

A study was made of the incidence of other poultry diseases and their possible relationship to the incidence of Newcastle disease. Coccidiosis, coryza and in-
fectious bronchitis frequently preceded an outbreak of Newcastle disease. These
diseases, however, were also frequently encountered in the negative flocks and no
definite proof is offered that they contributed towards an outbreak of Newcastle
disease. In one flock the owner reported an outbreak of fowl typhoid at about
the 5th week of age; Newcastle disease occurred in this flock at about the 10th
week. A number of flocks were encountered where a diagnosis of infectious bron-
chitis had been made. Seen at a later date the condition was diagnosed by the
survey veterinarian as Newcastle disease. Positive serum-neutralization tests
substantiated these diagnoses.

A study was also made of vaccination practices and their possible association
with Newcastle disease. No flocks were encountered in which pox vaccination
had been carried out prior to the survey visit. Very few owners reported that
they routinely vaccinated their broiler birds against pox but in the few instances
where it had been done in previous broods there had been no subsequent outbreak
of Newcastle disease. Laryngotracheitis vaccination was a much more common
practice. The survey disclosed that there was more laryngotracheitis vaccination
in the 25 positive flocks than in the 58 negative flocks. In no instance, however,
was it possible to trace an outbreak of Newcastle disease as having any relationship
to previous laryngotracheitis vaccination. In two instances the owners, in re-
counting the history of broods raised, stated that laryngotracheitis vaccination
at about the 7th week was followed by disastrous results. Neither believed that
the losses were related to Newcastle disease. On both of these farms the present
broods, which had not yet been vaccinated, were negative for Newcastle disease
both on clinical examination and by serum-neutralization test.

OTHER FACTORS BEARING ON NEWCASTLE DISEASE

A determination of the probable source of infection proved to be very difficult
and no definite statement can be made. The 928,000 birds covered by this survey
were all purchased as baby chicks. Approximately 27 per cent came into the area
from the New England States. The remaining 73 per cent were locally hatched
in as many as 24 different hatcheries. No figures were gathered as to the egg
source of these hatcheries, nor is it known if they purchased baby chicks from
outside the area for redistribution to their clients. Of the 25 positive flocks 19
(76 per cent) were derived from local sources; 46 (79 per cent) of the 58 negative
flocks were started from locally hatched chicks. There is no evidence that the
location of the hatchery was associated with the incidence of the disease.

Only one owner having Newcastle disease in his flock at the time of the survey
visit, or having had an outbreak in previous broods, would express an opinion as
to the source of the infection. This owner, flatly stated that the chicks were
infected on arrival and, of course, blamed the hatchery. Others stated that despite
more than the usual precautions to prevent the introduction of infectious diseases
they nevertheless suffered outbreaks of Newcastle disease. One instance is recalled
in which an owner, having destroyed his old broiler houses and having built a new
plant on a different location, was promptly greeted by an outbreak of Newcastle
disease when the chicks were less than 4 weeks old.

On all but 8 of the 83 farms visited some kind of disinfection practice was done,
usually after the sale and removal of the finished broilers. The usual practice
was to remove all litter, including several inches of sand which had formed the base of the deep litter, then wash and scrape the walls and fixtures and follow with a spray of some cresylic disinfectant or with lye water. The most desirable job appeared to be done by commercial disinfecting crews who usually applied the disinfectant solution under pressure. No evidence was disclosed by means of this survey that the method of disinfection, the product used, or the frequency of disinfection of houses and yards had any direct bearing on either the incidence or the severity of Newcastle disease outbreaks.

Other factors which might have a bearing on the disease were considered. These include the exclusion of visitors from the premises, the removal of sick birds and the prompt removal of dead birds from the houses, the degree of wild bird and rat infestation, and roaming cats and dogs. None of these appeared to be of statistical importance in the incidence of the disease or the course of the disease once it had become established in a flock.

Two common practices were observed which appeared to the survey veterinarian to be particularly bad. One of these is the practice by poultry buyers of dumping unclean crates from the buyer trucks near the entrance of broiler houses followed by a vigorous sweeping of all loose refuse from the truck onto the poultryman's premises. The other is the practice by feed dealers of picking up unused sacks of feed, often from infected premises, for redistribution to other farms.
Delaplane, Batchelder and Higgins (1) reported the use of sulfaquinoxaline in preventing *Eimeria tenella* infection in chickens under laboratory and field conditions and observed that the drug also had value in preventing *Eimeria necatrix* infection. Grumbles et al. (2), continuing these studies, obtained further evidence of the value of sulfaquinoxaline in overcoming this infection.

Field experiments (2) were conducted with 43,305 chickens which were given sulfaquinoxaline, and 3,085 birds which comprised the untreated controls. Groups of chickens were fed 0.05 per cent sulfaquinoxaline two days out of five (2–3 schedule), one day out of four (1–3 schedule), one day out of five (1–4 schedule), two days out of six (2–4 schedule), four days out of eight (4–4 schedule), and 0.0125 per cent continuously. Of the birds which died from coccidiosis in these groups, 0.63, 0.25, 0.27, 0.22, 0, 0.13 and 0.13 per cent respectively, showed *E. necatrix* infection. These figures were in contrast to 7.45 per cent in the unmedicated controls.

Studies were undertaken to determine whether these observations could be substantiated on an experimental basis because the experience of the authors has shown that under field conditions *E. necatrix* ranks next in importance to *E. tenella* in losses from coccidiosis.

MATERIAL AND METHODS

A wheelbarrow load of litter from the College poultry plant, known to be highly infective with *E. necatrix* and *E. tenella* coccidia, was placed in each of two 8' by 10' experimental pens. Previous studies using sulfaquinoxaline in treating chickens exposed to the same litter had shown the drug was effective in preventing losses from coccidiosis. In the first experiment the birds in Pen 1 served as the controls, and those in Pen 2 the medicated ones. In succeeding experiments the groups were rotated and Pen 2 became the control.

Five-weeks old chickens which had survived exposure to *E. tenella* from other experiments were used in the studies because it was believed they would be resistant to *E. tenella* but susceptible to *E. necatrix*. Hence, any differences in body weight or deaths would result from the latter infection, and the results would serve as an index of the damage caused by *E. necatrix*. It was realized that the previous infection with *E. tenella* had adversely affected the birds so that they could not be considered normal experimental animals. Normal birds would have been less desirable, however, because of the impossibility of determining which infection had been responsible for the damage.

1 This study was made possible by a grant from Merck & Co., Inc., Rahway, N. J.

2 Contribution No. 708 of the Rhode Island Agricultural Experiment Station, Kingston, R. I.
The birds used in Experiments I and II were White Leghorn cockerels; those in Experiment III were Barred Rock-New Hampshire crosses of both sexes.

**RESULTS**

The results of Experiments I, II and III are shown in Table 1. The first experiment was originally intended to determine the therapeutic value of 0.02 per cent sulfaquinoxaline given in the drinking water at the onset of symp-

### Table 1.—The prophylactic value of 0.0125 per cent sulfaquinoxaline against Eimeria necatrix infection in chickens

<table>
<thead>
<tr>
<th>PEN</th>
<th>NO.</th>
<th>BIRDS</th>
<th>MEDICATION</th>
<th>MORTALITY</th>
<th>AVERAGE WEIGHT IN GRAMS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Beginning</td>
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<tr>
<td>Experiment I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>77</td>
<td>W.L.</td>
<td>None</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>77</td>
<td>W.L.</td>
<td>0.02% SQ in water on 1st day of mortality</td>
<td>34</td>
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</table>

Experiment II

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<tr>
<th>PEN</th>
<th>NO.</th>
<th>BIRDS</th>
<th>MEDICATION</th>
<th>MORTALITY</th>
<th>AVERAGE WEIGHT IN GRAMS</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td>Beginning</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>W.L.</td>
<td>None</td>
<td>14 (35%)</td>
<td>215.65</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>W.L.</td>
<td>0.0125% SQ in mash for two weeks</td>
<td>0</td>
<td>215.65</td>
</tr>
</tbody>
</table>

Experiment III

<table>
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<th>PEN</th>
<th>NO.</th>
<th>BIRDS</th>
<th>MEDICATION</th>
<th>MORTALITY</th>
<th>AVERAGE WEIGHT IN GRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Beginning</td>
</tr>
<tr>
<td>1</td>
<td>38</td>
<td>Cross</td>
<td>0.0125% SQ in mash for three weeks</td>
<td>0</td>
<td>182.79</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>Cross</td>
<td>None</td>
<td>2 (5.26%)</td>
<td>187.54</td>
</tr>
</tbody>
</table>

SQ—Sulfaquinoxaline.
W.L.—White Leghorn Cockerels.
Cross—Barred Rock-New Hampshire crosses, both sexes.

The birds in both groups suffered losses from *E. necatrix* infection which began on the fifth day, continued through the ninth day, then ceased. Thirty-five of the untreated and 34 of the medicated group (in which medication had been started on the fifth day) died from infection. This result indicated that the *E. necatrix* contamination was much greater in the litter than had been anticipated and that under such conditions of exposure, birds quickly developed resistance to this infection. It also showed that medication had been too late to be of value in changing the course of the infection.
In an effort to confirm the observation that immunity to *E. necatrix* was rather quickly established under the experimental conditions cited, it was decided to use 0.0125 per cent sulfaquinoxaline in the feed from the start of exposure and to discontinue its use at the end of two weeks.

The results of Experiment II show that the 40 control birds of Pen 1 suffered a death loss from *E. necatrix* of 14 birds, while there were no losses in Pen 2, given the treated feed.

Both groups of birds were of equal weight at the beginning of the experiment. At the end of the fifth week, when the birds were 10 weeks old, the controls averaged 530.22 grams as compared to 633.33 grams for the medicated group. It was observed that during the second week of the experiment (Fig. 1) the controls made smaller gains than the treated birds. When the medicated feed was discontinued in the treated group, no birds showed clinical evidence of infection and the rate of gain was not interrupted. This fact indicated the development of substantial immunity and no interference by the drug.

In Experiment III the birds of Pen 2 served as the controls and those in Pen 1 the medicated group. There were no losses in the latter and only two in the controls. At the end of the second week, five birds from each pen were sacrificed and examined for lesions of coccidiosis. All five of the controls showed extensive lesions of *E. necatrix*, while only three of the medicated group showed mild lesions of infection. The average rate of gain was much less in the controls as compared to the medicated birds. At the end of the fifth week, when the birds were 10 weeks of age, the control pen averaged 641.45 grams as compared to 783.54 grams for the medicated group. In this experiment the death loss in the control group

![Graph comparing growth rate between chickens receiving 0.0186 per cent sulfaquinoxaline in the feed and the untreated controls exposed to *Eimeria necatrix* infection.](image)
was low, nevertheless, sufficient infection had occurred to interfere with the normal rate of growth (Fig. 2).

There was a distinct difference in the appearance of the medicated and the control birds in both experiments. The chickens in the control pens were characterized by lack of vigor when compared to those given the 0.0125 per cent sulfaquinoxaline in their feed for two weeks. The results confirmed the observation of the first experiment, namely that chickens exposed to surroundings severely contaminated with *E. necatrix* develop a high degree of resistance within a period of two weeks.

![Diagram](https://via.placeholder.com/150)

**Fig. 2.**—Comparison of growth rate between chickens receiving 0.0125 per cent sulfaquinoxaline in the feed and the untreated controls exposed to *Eimeria necatrix*

The birds consisted of Barred Rock-New Hampshire cross of mixed sex (third experiment)

**DISCUSSION**

The results of the first experiment showed that the litter to which all the subsequent experimental groups of birds were exposed contained highly infective numbers of *E. necatrix* and that chickens using such litter quickly developed a high degree of resistance to further exposure. This result was further substantiated in Experiments II and III, for the birds which had been medicated failed to develop clinical evidence of infection when medication was discontinued after two weeks. Also, the birds continued to show a normal rate of growth over a five-weeks period of observation. In contrast, the controls showed death losses and a slower rate of growth, particularly during the second week. In Experiment III where the death losses were small, the controls were adversely affected as indicated by retarded growth during the second week of exposure.
It is unlikely that resistance to E. necatrix develops as quickly in chickens under field conditions as under the conditions of the work herein described.

The numbers of infective forms of E. necatrix would be a factor in the time required for birds to develop immunity to the infection. In the poultry diagnostic laboratory, observations of specimens submitted by poultrymen indicate that under most farm conditions immunity to E. necatrix is not acquired in as short a period of time as occurred in these studies.

SUMMARY

Laboratory studies confirm the observations made under field conditions that 0.05 per cent sulfaquinoxaline in the mash fed intermittently, or 0.0125 per cent fed continuously, is of value in preventing losses of chickens by death and retarded rate of growth due to E. necatrix infection.

The data show that immunity to E. necatrix is quickly developed by birds subjected to severe exposure.

BIBLIOGRAPHY


HOW CAN POULTRY DISEASE CONTROL MEASURES KNOWN AT PRESENT BE APPLIED TO FURTHER REDUCE CURRENT LOSSES?

PANEL DISCUSSION

CHAIRMAN BRANDLY: With this rather imposing group we have selected out of a large number, we anticipate that it may be possible, if it doesn't take too long, to entertain questions from the floor after the majority of these questions have been submitted to the experts.

First I want to introduce the men who have consented to contribute. On the end, Dr. C. P. Bishop of Pennsylvania. Next to him, and coming down the line, we have Dr. F. R. Beaudette, New Jersey; Dr. C. H. Cunningham, Michigan; Dr. H. Van Rockel, Massachusetts; Dr. Bushnell, Kansas; Dr. J. R. Beach, California; Dr. T. O. Brandenburg, North Dakota; Dr. E. Jungherr, Connecticut; Dr. T. C. Byerly, Washington, D. C.; Dr. J. P. Delaplane, Rhode Island; Dr. Tucker, Indiana; and Mr. Christie.

I think we have represented here not only a group which you admit are experts, but who do represent a wide approach to the subject.

Questions have been listed under a number of headings. The first is, "Education;" second, "Diagnosis—Scope and Accuracy!"; third, "Means of disease spread—and control"; fourth, "Immunization"; fifth, "Eradication"; sixth, "Preventive and curative chemotherapy"; seventh, "Breeding and Management"; eighth, "Regulatory and Supervisor measures"; ninth, "National Poultry Improvement Plan."

The first question is, "Is there any way in which knowledge, long known, or information newly obtained can be digested fairly and factually and presented in an understandable manner rapidly enough to avoid undue emphasis on any certain part of the information or methods proposed?" Dr. Byerly?

DR. BYERLY: I have been looking for a method for several years. I have worked with groups, conferences. This particular outline that Dr. Hendershott called attention to is the product of the only way I know, and that is for people to work together, to con over each other's opinions and come up with the consensus.

The consensus may also be wrong—I don't know; but this is a consensus of the opinions of livestock sanitary officials; poultrymen; poultry pathologists, and anyone else who was present to submit an opinion as to sanitary practices. If there is a way, this is the only way I know of doing it; and if this is no good, we will have to find another way.

CHAIRMAN BRANDLY: Thank you, Dr. Byerly.

Question 2: "By what means can poultry raisers be made to appreciate the benefit to be derived from sanitary measures in the prevention and control of poultry disease and be persuaded to put them into use?" Dr. Beach.

DR. BEACH: My answer to this question might be said in the words, "Seeing is believing." Emphasis that has been put on the importance of sanitation in everything that has ever been written and said by anyone connected with any educational institution or regulatory organization; but it has been our observation
that the average poultryman doesn’t take these recommendations too seriously until they have exhausted everything else.

We have found, I think, the best way to make poultrymen realize the importance of sanitary measures, and what can be accomplished by them, is, so to speak, to set up demonstrations in areas where the poultrymen in those areas can see if they visit the place, or can learn by talking with the owner of the farm that they are effective and worth-while.

When that has been done, in a number of instances I know it has tended to spread throughout the area, and become rather common practice.

I don’t know of any shorter cut to accomplish it than that.

Mr. Christie, would you like to present your viewpoint from the standpoint of the poultryman, the producer and breeder?

Mr. Christie: Mr. Chairman, May I say a few words before that? Do we have the time?

Chairman Brandly: Yes, certainly; go ahead.

Mr. Christie: First of all, I am glad to know this thing is movable because I don’t like those stationary microphones. They remind me too much of a spittoon. (Laughter)

Now that I have that out of my system, I want to say that I am rather happy and privileged to be here, because we of the industry have felt, for a long time, and I know a good many of your own people have felt the same way, that we had so many things in common that it was about time we got together and discussed some of these common problems of ours.

Another reason I am glad to be here is that I did not know until today that an ordinary chickenman like myself, who cannot boast of any degree—only an eighth-grade diploma—is eligible to membership in this organization. I think that is a wonderful opportunity for us to be members and receive reports, and so forth; and we appreciate that very much. Of course, I can’t call you fellow-members yet, because I understand I haven’t been voted on yet. Whether I am going to get blackballed or not, I don’t know.

It seems to me the trouble on disease control and sanitation among our growers in some states and regions has been mainly due to failure of our people to become better acquainted with state regulatory authorities; and as a result, there has been a lot of lack of cooperation. In some instances, the state officials have proceeded to impose regulations without first consulting with the industry.

I come from a region in New England where for 20 years or more we have cooperated with our state regulatory authorities 100 per cent; and that, gentlemen, has not been by compulsion. It has been because the poultrymen have appreciated that they are interested in prosperity and salvation. I believe, therefore, that if we can institute similar programs to be carried on in other parts of the country—whether they be region or state—where the poultrymen and the regulatory authorities can cooperate, the same as we have in New England, while the millennium may not be at hand, we have made wonderful progress.

I believe, also, that if that existed there would be no need for any compulsory laws, because we would be doing away with misunderstanding and would have
confidence in each other; and we would have 100 per cent cooperation between the poultrymen and the state livestock sanitary authorities.

CHAIRMAN BRANDLY: Thank you, Mr. Christie, for your very good analysis from the standpoint of the industry.

The next question: "What type of educational program can be presented to the poultrymen that will make them eager to obtain early diagnoses in spite of the possibility or probability of quarantine? How should it be presented?" Dr. Bushnell.

DR. BUSHNELL: In answering this question I can only report what we have done about such a program in Kansas. The early publicity given Newcastle disease by outside sources made Kansas poultrymen Newcastle-disease-conscious. However, I am of the opinion that many poultrymen in that state are beginning to lose interest. We have definitely diagnosed 17 widely-scattered outbreaks in Kansas, but as far as can be determined there has apparently been very little spread to neighboring flocks. I have made many inquiries of extension workers and others who travel widely in the state, and it appears to be the general opinion that the disease is not very important at present. For this reason many poultrymen are losing their fear of it. This is probably an unfortunate situation but it is doubtful if there will be an increased interest unless the losses become more severe next year than they have been during the past year.

The Kansas Station has put out a considerable amount of information about poultry diseases in the past and has published an Experiment Station circular which was sent to all newspapers, county agents, hatcherymen, veterinarians, and many others. We believe that the information about poultry diseases has been widely distributed in the State.

In addition we give free diagnosis and advice to anyone who wishes to bring diseased birds to the laboratory.

In my State, the poultrymen have had no experience with the quarantine of diseased flocks. They send in birds because they wish to know how to stop losses. In the few instances of Newcastle disease we have quarantined flocks, or even insisted on slaughter, and there has been no serious objection. However, if the practice becomes widespread for other diseases there are sure to be many who will object to it and not try to obtain a diagnosis. I believe that the best results will follow an educational program similar to that used with the National Plan for pullorum disease control. This would emphasize the value of disease control which is the most important consideration at the present time.

CHAIRMAN BRANDLY: Thank you, Dr. Bushnell.

The next question: "Until such time as the number of and interest by veterinarians in poultry diseases becomes adequate, poultry raisers must look elsewhere for help with their disease problems. The other sources of information available to them are veterinarians of state livestock disease control organizations and agricultural experiment stations, the agriculture extension service, service men of feed distributors and poultry and egg buyers, and representatives of manufacturers and distributors of so-called poultry remedies. What steps might be taken to ensure the poultrymen getting adequate and sound advice from these sources?"

Dr. Byerly, will you attempt that?
DR. BYERLY: It is my opinion that these men can serve a very valuable service to themselves, to the poultry industry, and to the diagnostic laboratories, whether they be state or agricultural experiment station laboratories, or private laboratories, by seeing to it that their customers are acquainted with the service offered by such laboratories and locations, and by insisting that their customers get the material to the laboratory by private carrier so that the diagnosis can be properly made and information returned to the farmer in time to do him some good.

CHAIRMAN BRANDLY: Does anyone else have any comment on that?

The next question is suitable particularly for Dr. Tucker, in view of his great interest in poultry disease control: "What can be done to increase intelligent active participation by the veterinary practitioners in poultry disease work?"

DR. TUCKER: I think as a practitioner, and we as veterinarians, before we can expect to have the confidence of poultrymen, must first fortify ourselves with sufficient knowledge on poultry diseases and disease control so that we can talk intelligently and convincingly to poultrymen on their problems.

If we are not able to sell ourselves to the poultrymen, gain their confidence (without which we can accomplish very little), we are going to be up against it to interest them very much.

We must first fortify ourselves so that we can talk convincingly—in such a way as to convince the poultryman that we know more about poultry diseases and their control than he does.

I think there has been some work done in some states. There has been some adult education; some institutions have had veterinarians hold regional meetings for veterinarians on poultry diseases, and the results have been quite satisfactory.

Another thing should be directed to our educational institutions, our veterinary colleges—I think it would be quite desirable if they would increase their educational curriculum on poultry diseases. Here we have a two billion dollar industry, and I think the young men coming out of colleges now could use a whole lot more poultry disease education than they are getting.

This poultry industry is a major agricultural industry, widely distributed. Most veterinarians coming out of college can have an opportunity to render service, and I think before we can, as I said, sell ourselves to the industry, or to the poultryman, we must have sufficient knowledge that we can talk intelligently on their disease problems.

CHAIRMAN BRANDLY: Thank you, Dr. Tucker.

Certainly full appreciation of this responsibility in so far as veterinary practitioners are concerned will help alleviate the situation from the viewpoint of the laboratory man who has contact with practitioners who do poultry practice.

DR. CUNNINGHAM, will you comment on that, please?

DR. CUNNINGHAM: Dr. Tucker mentioned the veterinary schools. I happen to be a member of the staff of Michigan State College. Our formal education for the veterinary practitioner for poultry work consists of a formal course in poultry pathology, lectures and laboratories, which helps to make them cognizant of the several major poultry diseases as we see them in the laboratory.

We also have a clinical service for the senior students in the poultry laboratory.
We also conduct post-graduate conferences, where clinical material is available for inspection by the practitioner; and we have formal lectures during the post-graduate conferences.

Our primary purpose is to produce veterinarians, and we try to instill in them the interest for poultry pathology. If they are not receptive, we can't do much more; but we do present the material for what it is worth.

CHAIRMAN BRANDLY: In addition to this comment, it has been suggested by members of this and other groups that it would certainly be helpful in so far as stimulating work in poultry disease is concerned if there were available more veterinarians to take care of this need.

There certainly is a need there.

Are there any other comments here, other than those?

The next question would seem to be designed particularly for a regulatory official. We will ask Dr. Brandenburg to answer it.

"Would an educational campaign to direct more intimate contact between flock owners and hatcherymen with their local veterinarian, who is in contact with regulatory groups, result in better control of poultry diseases, particularly as regards transmission through live bird traffic?"

DR. BRANDENBURG: This would seem desirable, but I believe would be of limited value until such time as we have adequate veterinary service to service the livestock industry and the poultry industry.

CHAIRMAN BRANDLY: The next question, Dr. Beaudette: "How can the need for greater use of the diagnostic laboratories and the desirability for improved understanding of their functions and limitations best be emphasized to poultrymen, lay service personnel, and the veterinary profession?"

DR. BEAUDETTE: I believe the first requisite in answer to this question is that the diagnostician be a competent person. In too many laboratories, persons who are ill-trained and who have had too little experience are filling the position of poultry pathologist. Obviously, no such person can render a diagnosis and get results that will be respected by the poultryman or the veterinarian in the field. Therefore, the first requisite, as I see it, is a competent diagnostician in the laboratory; and a well-equipped laboratory, so that any service that may be required can be rendered. However good the diagnostician—or however good the equipment, there is still that need of contact with the field, with the man who needs this information; and that contact with the field will be had in different ways, depending upon the state in which the man is operating.

In our own state, which is small (having only 8,300 square miles), with good transportation facilities and good roads, we have ready access to the field. We have county agents in 20 of the 21 counties in the state, and there is a very close relationship between our laboratory and the county agents; and these county agents have been given special instructions on what to do in case of an outbreak of poultry diseases, so that they can get specimens to our laboratory in New Brunswick, or to the branch laboratory which we maintain in Vineland, New Jersey.

We also have contact in the field through the medium of the vocational high school teachers. On three separate occasions we have given these vocational high school teachers, training—special training—on the fundamentals of disease control
so that they have been warned of the dangers of making a diagnosis with the meager knowledge which they have, so that when they are presented with a problem on poultry diseases, they, too, bring the specimens to the laboratory or see that they get in there.

And lastly, we have a well-organized poultry industry in our state. Of the 21 counties, 20 have local poultry organizations. One county has four poultry associations.

We are regularly asked to speak at these poultry associations so that we have very close contact with our industry.

Then, too, the very nature of our industry, which is commercial poultry farming, lends itself to making use of a diagnostic laboratory, because if they don't they are not in business.

Then, as I see it, to summarize, it is a question of a well-trained diagnostician; a well-equipped laboratory; and close contact with the field. Then when diseases such as Newcastle come along, a disease which resembles other respiratory diseases, or diseases which may not be primarily respiratory, these poultrymen appreciate the advantages of the exact diagnosis, and they will avail themselves of laboratory facilities.

CHAIRMAN BRANDLY: "Can all state regulatory officers be brought up to date on poultry disease recommendations? Should there not be some central information bureau set up so that state officials would make similar recommendations for a specific poultry disease?"

This looks like a good one for Dr. Bishop.

DR. BISHOP: On the first question, I say that the regulatory official can be brought up to date on poultry disease recommendations—especially if he is fortunate enough to have a poultry pathologist on his staff, or a poultry disease control service, and has enjoyed the cooperation of the established agencies in that state, as well as the public agencies, those that are qualified in poultry disease control work—and possibly a veterinary school, such as we have in our state—including several private agencies which have been very helpful.

On the second question, all I can say is that would be important and very helpful.

CHAIRMAN BRANDLY: It has been suggested that this Association meeting serve as a sort of central information agency. Do you agree with that, Dr. Bishop?

DR. BISHOP: Yes, sir; very much.

CHAIRMAN BRANDLY: Dr. Byerly, this question: "What can be done to temper extravagant, empiric and unwarranted promotion of newly developed treatments or new uses for old drugs, such as the 'all-out' use of sulphonamides for control of coccidiosis, coryza, fowl cholera, pullorum disease, without regard for the variable conditions found within the poultry industry?"

DR. BYERLY: Dr. Brandly, I am very glad to see this question included in the list. It calls attention to a circumstance I have thought about quite a lot.

As the food and drugs become increasingly effective in limiting claims for various proprietarys; and as research has produced effective compounds for the control of disease, we are faced now with the situation that people are now using potent remedies, some of them in excessive quantities—certainly dangerous—often expensive; and it is a situation that I do not believe is readily controlled.
I think this question should more properly be addressed to everyone in this audience.

The only thing I can see is that we should all beat the drum for the fact that treatment is a poor substitute for adequate sanitation and prevention.

CHAIRMAN BRANDLY: You rather feel then that this situation will level off with more education, and perhaps less emphasis on the value of drugs over old and approved measures?

DR. BYERLY: I hope so.

CHAIRMAN BRANDLY: There were other questions under those that dealt with "Education;" however, we will have to move along to some of the others. I will say, though, that the ones that were included carried as much punch as any. There was no desire on the part of any of the committee to evade questions which might be considered to relate to something a bit on the borderline, or possibly embarrassing.

Under the questions on "Diagnosis," Dr. Bishop, I put this: "What information is available as to the present incidence of tuberculosis in poultry? To what extent can the present tuberculin test be used in the control and eradication of the disease?"

DR. BISHOP: According to the report received today from the Federal Bureau of Animal Industry, it has dropped from 6.2 to 2.1 in 1947; and the tuberculin test is certainly considered an effective means in detecting tuberculosis, especially when used in breeding flocks.

CHAIRMAN BRANDLY: The next question, Dr. Beaudette: "Where the veterinarian practitioner suspects Newcastle disease, what are the immediate steps to take in making a diagnosis?"

DR. BEAUDETTIE: In this instance, diagnosis will have to be based on the recovery of the virus—unless there is no immediate need for diagnosis and the affected birds can be allowed to recover, and their status determined later by HI or neutralization tests.

Since here we are dealing with recovery of the virus from the affected specimens, then quite obviously the thing to do is to get the specimens to a laboratory, not by a common carrier but by personal messenger, so that the laboratory can attempt to recover the virus. Care should be taken in the selection of specimens so that long standing cases are not included, because these are not good sources of virus.

CHAIRMAN BRANDLY: Another question on that same subject: "What is the possibility of having a standard high-titer Newcastle virus for use as antigen in the HI test?"

DR. BEAUDETTIE: Such an antigen, of course, can be had. The question is, it seems to me, whether we need such an antigen. Some months back when Newcastle disease was supposed not to be as widespread as it now is, many states wanted such an antigen, inactivated, so that the use of it would not be a hazard to the industry in their particular state. But now that the disease has been diagnosed by one or another means in 43 of the 48 states, I think the need of such an antigen is becoming less and less. If it is needed, however, such an antigen could be produced.

I don't, believe that this has to be produced by any one laboratory. It seems to me that since we are going to be called upon from now on to diagnose Newcastle disease, that every laboratory had better equip itself for that job, and prepare
its own antigen. Moreover, I think we will be called upon to diagnose the active disease rather than what the past infection was; and it is only past infection that can be diagnosed by the HI test.

**Chairman Brandly:** Dr. Jungherr, here is a question I think someone sent in for you specifically: "What reliance can one place on culling birds with 'grey eyes' in view of recent publications to the effect that those lacking pigment, but with regular pupils are not pathological?"

**Dr. Jungherr:** There is evidence available that factors of heredity, nutrition, and egg production may bring about a diffuse fading of the eyes; but spotted depigmentation of the iris, and especially changes in the pupillary outline, such as angularity and narrowing of the pupil, and decreased power of accomodation to light are the most important signs of ocular lymphomatosis.

**Chairman Brandly:** *Which one of those would you recommend for the practitioner in the field?*

**Dr. Jungherr:** Primarily examine the outline of the pupil. Any abnormal outline suggests ocular lymphomatosis.

**Chairman Brandly:** Another one on that same disease: "What progress has been made in the early diagnosis of leukosis?"

**Dr. Jungherr:** There are no certain methods at the present time for the early diagnosis of leukosis. A test using lymphocytes as antigen has been suggested; but so far the tryouts at the United States' Regional Poultry Research Laboratory at East Lansing have not shown the test to be completely reliable.

**Chairman Brandly:** The next question is directed to Dr. Brandenburg: "What may or should be done to eliminate the practice by hatcheries, especially those shipping interstate, of keeping chicks in hatcheries in the same buildings with incubators?"

**Dr. Brandenburg:** I think this should be brought about by regulation—regulations under the National Plan—and for those hatcheries not under the Plan, made mandatory through livestock sanitary agents or agencies.

**Chairman Brandly:** Varying a little but bearing on this situation, too, is this question: "Are any precautions taken to prevent baby chicks shipped by common carrier from coming in contact with diseased birds during transit? If not, what should be done?"

**Dr. Brandenburg:** For the first part of the question I will have to answer, "No." I doubt if very much can be done, only possibly through education. The people who have the shipment of these birds, or advise the shipments of birds to hatcheries could counsel against taking in dead and sick poultry into laboratories through common carrier.

**Dr. Byerly:** I have a notion, which is pure speculation, which I have spread around in a place or two; and I think I would like to spread it here because somebody may have an idea on it.

It seems to me it should be possible to devise a package into which chick boxes could be placed, which would be supplied with sterile air. I think it needn't be very complicated, any airtight box, that could be drawn together at the top—a stopper put through it; a cylinder of compressed air attached to it, with a reducing valve so the air could be forced to the bottom of the case to inflate the bag; with a little outlet at the top to keep the air moving. That might do the job.
It seems to me this shipping package is an important item, and that is the reason I am asking you to think about a better package to ship chicks in—one that could be sterile with sterile air in it.

There are cylinders that are supplied for lazy people to pump up automobile tires. That was Mark Welsh's thought.

Chairman Brandly: Thank you. That is a good suggestion. I hope all the inventors here will get at that, including yourself.

Dr. Bishop, "Are there any regulations concerning the shipment of diseased birds by common carrier to a laboratory for diagnosis?"

Dr. Bishop: I do not know of any state that has any special regulations in this regard. It is a difficult problem, and it has been recommended at different times that diseased birds should be transported to a laboratory by private carrier.

Chairman Brandly: The question is raised, Is it the obligation of the express agency to take shipments that are presented for transportation to laboratories or to other destinations?

Dr. Bishop: As far as I know, they are.

Chairman Brandly: They are required to accept them?

Dr. Bishop: Yes; as long as there is no regulation.

Chairman Brandly: They are urged not to if they show evidence of disease; is that not true?

Dr. Bishop: Yes.

Chairman Brandly: The next question: "Can the movement of diseased birds be controlled by regulation?"

Dr. Brandenburg: I have my doubts.

Chairman Brandly: Dr. Van Roekel, "What is the most effective approach in aiding the hatcherymen to avoid the dissemination of Newcastle disease? Infectious bronchitis?"

Dr. Van Roekel: In avoiding the dissemination of Newcastle disease and infectious bronchitis via the hatchery it is recommended that adequate facilities be provided to carry out an effective sanitary program by the hatcherymen. The sequence of operations in the hatchery should be carried on in a "one directional" manner and separate rooms should be provided for each of the major operations in a hatchery program. Physical facilities should be such as to permit thorough cleaning and disinfection. Personnel of the hatchery should be thoroughly trained in the practice of hatchery sanitation.

Hatching eggs should be accepted only from flocks which are not regarded as a hazard in disseminating either Newcastle disease or infectious bronchitis. Monthly inspections of all supply flocks and their egg records would help to identify possible sources of trouble which might result in hatchery infection and a disease outbreak in chicks produced by the hatchery. According to current opinion hatching eggs may be selected with apparent safety from affected flocks one month after the flock has regained normal egg production.

Chairman Brandly: Are there other comments or questions, pertaining to the two sections of that question?

The next question, Dr. Delaplane: "What sound measures may be put into effect to reduce disease spread from shows and contests?"
DR. DELAFLANE: At State College we have an egg-laying contest, and we make the recommendation to the poultry owner that under no circumstances should he return those birds to his flock unless he has isolation facilities, well removed from his poultry buildings on his home farm, and observes the birds for a long period of time after that; and even then, we try to discourage it.

With regard to poultry shows, I think that we would disseminate much less disease if we could, in some way, make it possible for those birds to not leave the show except as market birds. I realize that would be quite a handicap to showmen, but after all, a man who is a good showman, and does not have some good representative breeding stock at home should not put the birds in the show in the first place.

CHAIRMAN BRANDLY: Are there other comments?

I think it is evident that when the exhibitor and the man who sends his birds to contests realizes that he is creating more of a hazard for himself than for others, that he will begin to abide by those rules, or by those phenomena.

The next question, Dr. Van Roekel: “Would it be practical and safe to permit eggs laid by birds in a poultry show or egg-laying contest to be returned to the farm for hatching?”

DR. VAN ROECKEL: Eggs laid by birds in a poultry show or egg-laying contest should not be returned to the farm for hatching. If progeny is desired from show or contest stock the eggs should be incubated on a separate premise. Likewise the chicks should be reared in quarantine until their health status is known.

DR. BEAUDETTE: I should like to point out that there is a hen laying contest in Vineland, New Jersey, and they do send males there for the explicit purpose of getting fertile eggs that can be returned home.

CHAIRMAN BRANDLY: That certainly is an important point. I know all here remember what problems arose, what dissatisfaction arose, when certain regulations were imposed on the shows shortly after the Newcastle outbreak; and the one point that was well emphasized in discussions that arose in the Committee, the National Committee, was that the birds going to shows and contests represent a particular hazard because they represent two-way traffic. Chicks going to farms usually are kept there; oftentimes they never leave except as market birds. But birds going to contests and shows return to the flocks of origin or to other farms and may spread the disease.

The next question, Dr. Jungherr, “What control measures should be put into force in a Newcastle disease infected flock supplying eggs to a hatchery? Should a hatchery become infected, what measures should be put into effect, regulatory and other?”

DR. JUNGHERR: In the case of a breeding flock infected with Newcastle disease, one should withhold shipment of eggs for 30 days following complete return of egg production.

All utensils on the farm should be cleaned and disinfected.

I believe when egg shipment is resumed, new crates should be used.

With respect to the handling the disease in the hatchery, Dr. Van Roekel has answered this question, or has touched upon it. But I believe that hatchery infection should be controlled by disposing of all eggs and the started chicks at the
time of the outbreak and subjecting the entire premise, including equipment, to thorough cleaning and disinfection.

By the time such a program has been carried out conscientiously, hatching may be resumed; but a small lot of these chicks should be hatched in order to check on the survival of the virus.

Chairman Brandly: On this same problem, Dr. Beach, you have concerned yourself for quite a long time with the hazards of carriers of Newcastle disease, and we will therefore direct this question to you: "How long has a bird been known to be a carrier of Newcastle virus after natural infection? After artificial infection? What factors are most important in survival of the virus in nature?"

Dr. Beach: I can answer the first part of the question easily. The longest we have demonstrated carriers after an actual infection was three months. This was the isolation of virus from the lungs of birds which had had respiratory symptoms only. We have done nothing with respect to determining whether or not artificially-infected birds would remain carriers; and as far as I know there is no information on that from other sources.

The last part of the question, I know nothing about, and so I will not try to answer.

Chairman Brandly: Dr. Jungherr, from your experience have you determined the length of time a bird has been known to be a carrier of Newcastle virus after artificial infection; or, have you determined at what period, what maximum period after infection, you demonstrated the virus?

Dr. Jungherr: We have tried to demonstrate carriers after artificial infection, and we have not been able to find the virus, either in nasal discharges or in the stools, longer than 12 days following infection. However, these experiments have to be repeated.

It is very difficult to isolate the virus after about two weeks following infection.

Chairman Brandly: How about recovery from eggs? Have you anything on that?

Dr. Jungherr: Yes. We have recovered the virus from eggs which we believe have been laid at the time egg production was recovering in the flock.

Chairman Brandly: And that in what, a period of one or two months?

Dr. Jungherr: One to two months.

Chairman Brandly: The next question: "Which chemical disinfectants are most satisfactory and effective against Newcastle virus?" Dr. Cunningham.

Dr. Cunningham: I will cite our experiences in the laboratory at Michigan State College. We tested a number of chemical agents for their effect on the virus of Newcastle disease in chickens, using as an experimental criterion embryo mortality. The ones I will give you now are the ones that will probably be of most use to the livestock sanitary officials.

Our results are based on a three-minute reaction period of the chemical agent and the virus.

The following chemical agents were effective in inactivating the virus within three minutes or less: Bichloride of mercury, 1 to 1,000; Roccal, 1 per cent of the stock solution; dislyn, which is another ammonium compound, a 1 to 512 dilution. This was based on the manufacturer's recommendations of so many ounces per so many gallons of water. Phenol, 3 per cent. We tested phenol at 1 per cent, and it was
without effect on the virus. Cresol, 3 per cent; lysol, 3 per cent—that is, cresol, 3 per cent—1 per cent; and lysol, 3 per cent—1 per cent; creolin, 3 per cent and 1 per cent; Clorox, 5 per cent. We purchased a bottle of Clorox from the local grocery store and made the dilutions from the commercial bottle of Clorox. Tincture of iodine, 1 per cent; and sodium hydroxide, 2 per cent.

All of these chemical agents, as I said before, were completely effective in inactivating the virus within a three-minute period, or less.

Recent work has been reported by Tilly and Anderson of the U.S.B.A.I., and they found sodium hydroxide, 2 per cent, was completely effective against the virus; and I recall their reaction period was four minutes. And Cresol, 1 per cent—those were the only two chemical agents which they tested, which were comparable in per cent to those which we tested.

CHAIRMAN BRANDLY: Dr. Bushnell, this question we would like your opinion on:

"Are the recent reports of Newcastle virus infection in man significant as regards public health? As regards man acting as an active spreader to poultry?"

DR. BUSHNELL: In answer to the first question concerning Newcastle disease as a public health hazard I think that it is of little importance. We have followed several outbreaks quite carefully and have not observed evidence of any special type of infection among the persons who have been in very close contact with the diseased birds.

The second question can probably be answered in the affirmative. Just how this virus is spread under natural conditions is not known. In our laboratory we have placed normal chickens in the same cage with birds in all stages of Newcastle disease and have yet to find a single contact that developed the disease, or a positive HI reaction. It may be that the diseased bird spreads the virus only for a very short period of time, or that there are atmospheric conditions favorable for the dissemination. To me it is quite possible for a human being to serve as a mechanical carrier of the virus but not as a reservoir of infection for chickens.

DR. BEACH: I would like to add just a little to what Dr. Bushnell said.

We checked on one owner of a flock who developed an acute conjunctivitis at the time his flock was infected. This was done by serological methods, and he was found entirely negative. Further serological tests have been made on several members of our staff who have been autopsying infected birds—and in other ways handling infectious material—for several years; and in no case were any neutralizing antibodies for the virus present in the serum.

CHAIRMAN BRANDLY: I might add this, Dr. Beach: In tests with individuals who had contact with the virus in Boston during the war, as well as some outside individuals who had no contact, all showed some neutralizing antibodies. What they meant we, of course, did not know.

Another thing that might be of passing interest is that the report of some contact infections in Palestine (I think it was the report of Shimkin), it was stated that women who contracted eye infection in handling poultry did not transmit it to their husbands, so possibly they would not transmit it to other birds. (Laughter)

The next question we have on our list, Dr. Jungherr, is, "What progress is being made in studying and assessing the importance of spreading the more important infectious diseases of poultry via non-living objects—such as feedbags, egg crates and such?"
Dr. Jungherr: Studies are under way at the present time to test the viability of certain disease producing bacteria and viruses on feedbags, egg flats, clothing, and utensils, at various temperatures and various degrees of humidity.

The results, so far, indicate a surprising tenacity of such infectious agents. For example, *Salmonella pullorum* may live for at least 100 days on feedbags, and Newcastle disease virus for about 50 days, at ordinary room temperatures. But whether or not such findings hold true under practical conditions requires further investigation.

Chairman Brandly: The next question: "In the light of present knowledge, what steps should be taken to reduce the hazard of disease transmission via feedbags or sacks?"

Dr. Jungherr: As we see it, the most important factor in reducing disease transmission by feedbags is to separate completely, the operation of feed distribution and collection of old or used feed bags.

The latter should be subjected to thorough mechanical cleaning and then stored in a warm, dry atmosphere for as long as possible before re-use.

Chairman Brandly: The next question: "What action has been or should be taken to require poultry haulers to clean and disinfect poultry crates and trucks?"

Dr. Jungherr: As far as we know, some modern cooperatives have instituted measures for the disinfection of crates and trucks, and we believe that voluntary measures, especially in cooperative marketing associations, will work better than regulations.

Chairman Brandly: Here is a question bearing on a matter on the national level, we can say, and Dr. Byerly, will you answer it: "What can be done about setting up a Federally controlled disinfecting service for poultry crates and trucks at the large shipping centers? Should not systematic fumigation and disinfection of express cars be required?"

Dr. Byerly: Dr. Brandly, I would like to pass the buck on this one to one of the regulatory officials of the Bureau, but I don't see any of them in the room.

Dr. Schoening is here, and I will ask him to check me.

It is my opinion that the Bureau does not now have funds available for setting up such facilities, or for employing personnel to do such a job.

It is also my opinion that it would be a serious problem to find adequate veterinary supervisors to handle the program. I think they could only be had by robbing some other program at the present time.

Chairman Brandly: But that would not discount the desirability of such a program.

Dr. Byerly: No, sir!

Chairman Brandly: Next question: "What disinfectants should be recommended in the laying house and how should they be applied or used?" Dr. Van Roekel.

Dr. Van Roekel: The use of any one of the cresylic preparations on the list of "permitted disinfectants" published by the Bureau of Animal Industry, U.S.D.A. is satisfactory for laying house disinfection providing the quarters have been thoroughly cleaned. The disinfectant should be applied with a pressure spray apparatus.

I would also recommend that you obtain the copy on poultry sanitation that
POULTRY DISEASE

has been published by the U.S.D.A.; it is a very valuable piece of information and guidance.

CHAIRMAN BRANDLY: Dr. Van Roekel is referring to the outline that Dr. Hendershot referred to and discussed.

The next question—we pass along now to those questions which were submitted on “Immunization”—Dr. Cunningham, here is a good one—“Are bacterins alone or in combination of sufficient protective or curative value to warrant their use? In view of general lack of evidence of their efficiency should not some official agency evaluate them and eliminate those that are found to be worthless? Would such tests permit prohibition of their production in B.A.I. licensed plants and thus prevent useless expenditures of money and question of loss of confidence in other useful products and measures given official sanction?”

DR. CUNNINGHAM: End of question, period. (Laughter)

In answer to the first part, I would say that as far as I know, experimental evidence indicates that bacterins alone or in combination are not of sufficient protective or curative value to warrant their use.

The second part of the question—“In view of general lack of evidence of their efficiency should not some official agency evaluate them and eliminate those that are found to be worthless?”—I think that would be a worth-while undertaking.

The third part of this question—“Would such tests permit prohibition of their production in B.A.I. licensed plants and thus prevent useless expenditures of money and question or loss of confidence in other useful products and measures given official sanction?”—well, it would seem to me that based on the results of these tests, if the Bureau wished to do so they could use their own judgment.

As far as I understand it at the moment, the production of these products is only through license, and it does not constitute a Bureau endorsement of the product.

It would seem that an evaluation of bacterins would certainly be of considerable importance.

CHAIRMAN BRANDLY: Dr. Beach, I believe I remember a number of years ago you concerned yourself with this problem and did some experimental work on it. Would you comment on it?

DR. BEACH: My only further comment is that it seems to me the simplest procedure is if, as Dr. Cunningham states, these bacterins are worthless, why should their production be licensed?

CHAIRMAN BRANDLY: Dr. Beaudette, the next question: “Under what circumstances should the use of laryngotracheitis vaccine be advocated?”

DR. BEAUPETTE: Vaccine, as is recommended for young stock on farms, which have had laryngotracheitis in the past. Vaccination is usually done sometime between the ages of six weeks and three months, or as the case may be, if a pox vaccination is to be done on the same farm, then at the same handling.

The second condition under which vaccination is recommended is for emergency purposes; that is, on a farm which is having its first outbreak of the disease.

If the diagnosis can be made early in the course of the outbreak, then one is justified in vaccinating the non-affected birds.
Thirdly, poultry farms in thickly-populated and in infected poultry districts should practice vaccination.

And lastly, susceptible birds coming into a known infected flock—that is, one that is known to have had an outbreak and therefore to contain carriers, should be vaccinated—but I should add that no one should ever bring live birds into a flock anywhere.

Chairman Brandly: That might raise the question, which is proposed and perhaps still has some application, would you advise, at the present time, consideration of so-called autogenous vaccine, prepared from the same flock where the disease exists?

Dr. Beaudette: Well, quite frankly, I don’t see any difference between an autogenous vaccine and any of the others.

Chairman Brandly: We are talking about laryngotracheitis.

It has been done and practiced, with fowl pox—to use the infection present in an outbreak for vaccination of the birds on the premises.

Dr. Beaudette: Would I be answering your question if I said that since there is no difference in strains of either fowl pox or the laryngotracheitis, that there is no reason why an autogenous vaccine should give any better results?

Chairman Brandly: Except for one thing—the matter of diagnosis of the outbreak.

Dr. Beaudette: You mean, to prepare vaccine from already-stricken birds?

Chairman Brandly: Yes; in the field, where the diagnosis may not have been completed.

Dr. Beaudette: The hazard there, if I understand your question properly, is that taking material from the trachea—of natural cases—and making this into a bacterin or vaccine might also include other organisms which would be undesirable. And then, of course, one wouldn’t have much of an idea of dosage in a case like that.

Chairman Brandly: One thing that I think prompted that question was the experience reported by the Italians when they first diagnosed Newcastle disease as laryngotracheitis, and employed tracheal exudate for vaccination of their flocks; and, of course, they induced Newcastle infection and heavy losses resulted.

The next question, one similar and pertaining to bronchitis is the second part of No. 36—"Under what circumstances should the use of planned immunizing exposure to bronchitis be advocated?" Dr. Van Roekel.

Dr. Van Roekel: Artificial exposure of birds to infectious bronchitis for flock immunization is advocated in flocks in which the disease has occurred during the previous year and in flocks located in thickly-populated poultry areas. Birds ranging in age from six to 16 weeks and in healthy condition may be exposed to the infectious bronchitis virus with little or inapparent set-back in growth. The resultant immunity appears to be permanent in character. This immunizing procedure protects the flock owner against losses from this disease in laying-flocks.

Now, if the flock is also to be vaccinated for pox, we advise a four-week interval between the two operations; and it doesn’t matter whether you do the pox first, or the bronchitis first, but a four-week interval should elapse between the two operations.
CHAIRMAN BRANDLY: Thank you, Dr. Van Roekel.

The next question: "Can immunization procedures be developed to the point where lymphomatosis losses can be reduced materially?"

DR. JUNGHERR: We have no evidence that immunization will be of aid.

CHAIRMAN BRANDLY: Dr. Beaudette, "What success has been attained in the development of satisfactory vaccines for the control of Newcastle disease?"

DR. BEAUDETTE: For purposes of description, immunizing products for Newcastle disease may be divided into two classes, namely, those which are inactivated and those which are active.

The inactivated agents may be rendered inactive either by formalin, or other chemical agents. Formalin is usually the most common one used; or by ultraviolet light.

The results of experiments to date seem to indicate that in general the inactivated vaccines do not immunize all birds; that the number immunized is in relation to the age—the younger the bird, the fewer immunized; that under the best of conditions probably not more than 85 per cent will develop an immunity; and that when the bird is immunized, the immunity may be as short as one month, and probably not longer than four months.

The active vaccines, or the so-called modified—biologically modified vaccines—may be modified by serial passage in eggs, either hen or other eggs; or, they may be modified by passage in some animal, such as the hamster or duck, and used as active agents.

In any event, these active products do seem to immunize all animals, and the duration of immunity is probably throughout life.

Now, as to the degree of satisfaction, this should be understood to be relative. For example, in India, the so-called Mukteswar vaccine serves their purpose merely because the reaction produced by this virus is so mild in relation to the natural disease that they can afford to use it. However, this vaccine will produce a disease that is comparable to our American disease, and therefore would serve no purpose whatsoever in this country. But it is of use in India, where the mortality is 100 per cent, or approximately that.

If a relatively mild immunizing product can be made from a strain of virus that ordinarily kills approximately 100 per cent of the birds, then it is reasonable to suppose that one can begin with the American type of virus, which is mild in comparison with the Oriental types and produce a correspondingly milder strain. That is to say, one that will not produce a low mortality, and certainly a low incidence of paralysis, and conceivably eventually one might be produced which would have very little effect even on egg production.

It is already evident from the remarks that one gathers at a meeting like this, that several investigators, many of them around the table here, already have strains that are comparatively mild, and conceivably could be used right now, and are being used in a measure to produce immunity against this disease. So, my guess is that sometime in the not-too-distant future, probably several such strains will be available for immunization of chickens.

CHAIRMAN BRANDLY: I am sorry we don't have time to ask other people who have had experience with this disease—with living vaccines as well as dead ones—
to comment on it. However, we will have to move along. Possibly some questions can be brought up later.

Under the heading of "Eradication," Dr. Bishop, this question: "In some countries the 'slaughter policy' has checked the rapid spread of Newcastle disease. Since recovered birds may become carriers, are there areas in the United States where this policy would be of value?"

Dr. Bishop: In light of our present knowledge in regard to the possibility of recovered birds becoming carriers, it wouldn't seem to be very important, especially if they are held for a period of approximately two or three months.

I know from experience we have had that a number of poultrymen did expose pullets to recovered birds about 30 days after they had apparently recovered, and couldn't infect them.

I think research is being conducted now, that will give us more information in that connection.

Chairman Brandly: Dr. Brandenburg, "Should State and Federal Livestock Disease Control Agencies give serious consideration to programs for poultry disease eradication on an area basis as has been done with certain diseases of other farm animals?"

Dr. Brandenburg: At the present time I do not think so, due to lack of personnel. There are certain districts, however, where avian tuberculosis is a serious problem, and I believe some area work is being done at this time; and there are other areas that should consider it.

Chairman Brandly: Dr. Bishop, will you answer this question: "Would it be wise and feasible to pay indemnity for losses involved in slaughter efforts to control certain diseases which occur infrequently in certain areas, especially fowl cholera and fowl typhoid?"

Dr. Bishop: It might be feasible for certain diseases, but possibly not for cholera and typhoid because of the incidence and possible wide spread in most areas.

It could be if it would be limited to a certain area, a small area, and a few flocks.

Chairman Brandly: Dr. Beach, this question: "Can infectious coryza (H. gallinarum infection) be easily eradicated? And will the same measures be effective against the enzootic form of fowl cholera?"

Dr. Beach: We have several poultrymen in our state who have successfully eradicated infectious coryza, and the farm has remained free from it for a period of as long as 10 years.

I think it could be done anywhere by a complete depopulation and restocking with baby chicks, and never bringing to the place again anything other than baby chicks. The success of that depends, to some extent, however, on the location of the farm with respect to others on which the disease may be present.

But even under such conditions, if the poultryman keeps his fences up to be sure that none of his neighbors' chickens stray over there; or, as one poultryman I know of does, always has a 22-rifle handy, and if he sees a chicken loose, he is a pretty good marksman, and it is a dead chicken. He determines later whose it is — whether it is his or his neighbor's — I think that is a pretty wise precaution.

I know many poultrymen who would depopulate again at the drop of a hat if
they found infectious coryza again in their flocks. I know one who has depopulated twice.

There are two methods of doing that—one is to sell for slaughter all of the live birds on the premises, and that means all—not all but a few. But in the case of a breeding flock, the loss from such a procedure would be pretty severe. It also may be handled very successfully by the owner renting another farm at some distance away, to which he moves all of his breeding flock and keeps them there until all of them are disposed of in the natural manner. Then he loses nothing in the way of the breeding practices which he has been following for several years.

I imagine the same thing would apply to the enzootic form of fowl cholera, although I don't know of any instances where it has actually been carried to completion. I do know of one, however, in which it is in process of being tried at the present time. I am not too optimistic of success here, because the buildings on the farm to which these breeding birds were moved is not quite far enough away, in my opinion, for entire safety, especially with respect to stray birds.

CHAIRMAN BRANDLY: The next question on our list, Dr. Delaplane, "Is the use of ultra-violet radiation of practical value in the prevention and control of respiratory virus diseases (e.g., Newcastle and infectious bronchitis)?"

DR. DELAPLANE: Dr. Brandly, I think it is quite fortunate that we have some work by Levin and Hofstad occurring at the present moment in the last issue of the Cornell Veterinarian that gives us an answer in connection with infectious bronchitis; and from reading their article, it is quite apparent that the answer is, "No."

With regard to Newcastle disease, in my opinion, the same answer would apply.

CHAIRMAN BRANDLY: Dr. Bushnell, "At the present stage of our knowledge of antibiotics and sulfonamides, can they be considered a legitimate part of a disease control and prevention program?"

DR. BUSHNELL: Dr. Byerly has fairly well covered that.

The only objection to using these, or any other types of treatment, is the fact that their limitations are not known. However, I can advance no objection to their use as long as their value is established, or whenever their value is established.

CHAIRMAN BRANDLY: Dr. Beach, "Would it be possible and desirable to obtain public or private support of research to assay the value of medicaments in natural outbreaks of certain diseases in chickens and turkeys?"

DR. BEACH: In answer to that question I would say, first, it would certainly be desirable; and I think it is being done all the time, perhaps not in the same sense that is inferred by this question.

It is being done by the manufacturers of these products supplying them, without charge, to experiment stations for trial. I think all of these must be tried in the field before their true value can be determined.

I think these manufacturers might perhaps go a bit further, however, than simply supplying the drugs. Not all experiment stations have all the money they can use, and I imagine some of them would welcome a little financial support to help defray the cost of these field trials.

I think it probably is true that if they are to be effective, or most effective, there must be this provision: Their use must be started in the early stages of an outbreak.
And if the drugs were not on hand, the delays necessary to get them, from a producing laboratory might be so great that no information would be obtained. It would seem desirable that ample supplies of new drugs be distributed among institutions which are interested in undertaking field trials so they would be on hand for use whenever the opportunity arises.

Another point in connection with these trials—and where money as well as the drugs might help—it is to my mind quite important that all these field trials be controlled and only part of the flock be treated and the remainder left untreated. It is not every poultryman who is willing to embark on such a cooperative program, but he might be more willing if he could be compensated for any difference in the loss that occurred between the treated and the untreated portion of his flock.

**CHAIRMAN BRANDLY:** Dr. Tucker, would you care to answer this one? "Are poultry disease losses increased or decreased by sale of widely advertised remedies of questionable merit?"

**DR. TUCKER:** I cannot conceive of disease losses being decreased through the use of such remedies.

Here is a comment.

**MR. CHRISTIE:** The unfortunate part about that is that some gullible poultryman accepts the advertising copy of sales organizations of questionable merit, and by using those so-called remedies, lull themselves into false security when they should be looking for the real trouble instead of falling for that propaganda or that type of evidence.

**CHAIRMAN BRANDLY:** It has been a matter of education to avoid people developing confidence in or anticipating that they will gain something from that sort of procedure.

Dr. Delaplaine, "Would the effectiveness of sulfonamides be enhanced if poultry raisers could obtain them only when prescribed by a veterinarian instead of druggists, feed and poultry supply dealers as is now often the case?"

**DR. DELAPLANE:** In general I would say, "Yes,"—there may be some exceptions. There is one other disadvantage that we have talked about here this afternoon in some areas. That is, there is a lack of adequate veterinary personnel; and there may be some doubt in some of these areas.

**CHAIRMAN BRANDLY:** Dr. Van Roekel, another question here on sulfonamides: "Have the sulfonamides aided materially in the reduction of pullorum disease in the over-all National program?"

**DR. VAN ROEKEL:** At this time it is impossible to determine the true influence that the use of sulfonamides have had on the reduction of pullorum disease in this country. While it is recognized that sulfonamides can check losses from pullorum disease to a certain degree, their true value as a control agent for general adoption has not been fully established. Veterinarians, Regulatory officials and flock owners should recognize that complete eradication of the disease from flocks through testing or buying pullorum clean replacement stock is the most satisfactory means of combating pullorum disease.

**CHAIRMAN BRANDLY:** Again, one on medication, Dr. Cunningham, "Are there any safe and efficient medications for the control of tapeworm and roundworm infestations?"
DR. CUNNINGHAM: For tapeworm infestation none of the products are fully efficient.

For roundworms, phenothiazine is effective against cecal worms—phenothiazine—benzonite—and nicotine sulphate—are effective against cecal worms and ascarides.

CHAIRMAN BRANDLY: On the subject of “Breeding and Management,” this question: “How effective is an all-pullet program in reducing laying flock mortality?”

I am going to call on Dr. Tucker for his observations on this one.

DR. TUCKER: It is accepted that with an all-pullet flock each year on the farm that the incidence of tuberculosis is well under control. That has been experienced, and that is a good practice each year.

As the most important means of control of tuberculosis, we might list that of having an all-pullet flock. However, an all-pullet flock may not be desirable in some of the other diseases.

The theory that has been advanced, and I think it is based on some pretty good facts that breeding from older birds is desirable in controlling some of the other diseases, such as possibly leukosis.

CHAIRMAN BRANDLY: Dr. Byerly, “To what extent can our present knowledge of breeding for resistance now be applied in the field of disease control?”

DR. BYERLY: Although there are some who will not agree with me, I think that the application of our knowledge for breeding for resistance can be applied to only a very, very limited extent in the field of disease at the present time.

The fact of genetic resistance to specific diseases is well established; the problem of breeding resistant stocks is only beginning to be explored. It will be a long time before it is an effective means of disease control, if ever.

CHAIRMAN BRANDLY: The next question, Dr. Beach: “What part do drafts play in causing coryza?”

DR. BEACH: If, as I assume, the writer of this question has in mind, infectious coryza, it is my opinion that it has no significant effect whatsoever in the cause; it might have in the severity.

CHAIRMAN BRANDLY: Dr. Delaplane, “Is sanitation satisfactory in protecting breeder replacement birds against coccidiosis or should one depend on sulfa drugs?”

DR. DELAPLANE: Dr. Brandly, for a great many years in the New England Area, we have practiced or have been asking our poultrymen to practice careful sanitation in the rearing of their birds, and they certainly have been successful.

Now, that does not mean that sulfa drugs may not be used during the growing period to assist in this respect. But certainly they are not necessary because we have had good success in all the New England States for a great many years relying primarily on sanitary methods.

CHAIRMAN BRANDLY: Dr. Hendershott assures us that these questions which time does not permit the answering will be put into the records, so you will have an opportunity to get them later.

DR. BYERLY: “In what ways can more publicity on the true meanings of the U. S. National Poultry and Turkey Improvement Plan pullorum disease grades (U. S. pullorum Disease Clean, etc.) aid in reducing national losses from pullorum disease?”

DR. BYERLY: I think there will be more publicity available on the Plan which your Coordinator is now engaged in preparing.
I think everybody, with respect to losses from pullorum disease and other diseases, has a job of information to do with farmers.

The best summary I have seen is the one we have put together here, part of which reads, under "Brooding and Rearing,"—

"Buy healthy day-old chicks or poults, preferably from a local hatchery, either one operating under official supervision or one which you know enforces a rigorous disease-prevention program. Insist that the chicks or poults be delivered in clean, new boxes. Locally hatched chicks or poults are likely to suffer less brooding mortality than chicks or poults of equal quality transported long distances.

"Put these healthy day-old chicks or poults in a clean brooder house, with clean equipment, separated by at least 200 feet from any other poultry . . ."

When every poultry-raiser in the United States knows that and follows that practice, I think you will have taken the first real step toward disease control in poultry flocks.

CHAIRMAN BRANDLY: There are several questions here which we will direct to Dr. Van Roekel and Dr. Byerly to discuss. They deal with pullorum testing, particularly as regards the X or Canadian variant strain; and we might start with this question: "In sections of the country where the X or Canadian variant strain of Salmonella pullorum has not yet been identified, what procedure should be adopted in the laboratory and in the field which would aid in spotting this type of infection?"

Who wants to comment on that first, Dr. Van Roekel?

DR. VAN ROEKEL: Well, I can only give you our attitude toward this situation as it exists in New England.

So far we have not been concerned about the variant type of infection. However, we have isolated the variants in a few instances.

Our policy is to type every pullorum culture that we isolate from reacting birds and from chicks, submitted to our diagnostic service to get a survey as to the prevalence or incidence of the variant type of infection in Massachusetts. I hope we can persuade neighboring states to do likewise, if it is at all possible.

When we identify a flock that has a variant infection, which we did this Fall, with just one reactor—and it proved to be a variant—we plan to re-test that flock or flocks with both the standard antigen and the variant antigen. We use the tube test so we use two different antigens representing the standard and variant strains.

This one flock we identified this Fall is just in the process of being re-tested, and we have not found any reactors on re-tests with the standard antigen; but we did find many doubtful reactors, probably 50 or 60 per cent with the variant antigen. But they are slightly doubtful in a good many cases; and if we recover the organism I shall be very much surprised. However should we recover the variant organism, then we will retest the flock using variant strain antigen.

DR. BYERLY: The Bureau of Animal Industry sent into the field this Fall, Dr. Heemstra, Dr. Walter Hall, and Dr. McDonald to investigate reports of the occurrence of the X-variant pullorum in several of the states.

As a result of that trip, and the subsequent laboratory diagnosis, they found birds from which pullorum was isolated, some of which have been typed and are of the XII_2 variant type. Therefore, we have a problem with which to deal.

A letter has been prepared, which will be sent to all of the official state agencies.
Another letter, I believe, Dr. Schoening, will go out to the manufacturers apprising them of this situation.

It is not an easy situation, because, as I understand it from those who are in the field, it is not yet certain that this XI12 component is a constant factor. In other words, a strain of pullorum which carries the XI12—one can't always be sure that one can cultivate an antigen from that, and that it will be constant. It will have to be checked in each case.

DR. VAN ROEKEL: May I add just a few remarks?

With regard to typing these cultures that are isolated, our Antigen Committee of the Northeastern Pullorum Conference is preparing an outline for conducting typing procedures and we hope that every laboratory in the Conference will be in the position to do their own typing.

I think our Federal Bureau might do the same thing for the country at large.

We all recognize the very valuable work they have done with respect to Newcastle disease. They have given us a very great deal of valuable information and suggestions, and I think the same thing should be done with the variant and standard types of pullorum strains.

It is only in that way that we can get an accurate picture or approach an overall picture as to the prevalence of variant and standard strains as they are isolated in this country.

CHAIRMAN BRANDLY: There still are many questions, and I am sorry that time will not permit us to complete the list.

I think you will all join me in a vote of thanks to the panel for the very valuable information they have given us.

We want to thank you for being a very patient and attentive audience.

If there are further questions, I am sure that the various members of the panel will be willing to answer them after this meeting.

Does anyone have any questions they would like to ask from the floor?

I see no hands, so I will recess this meeting.
REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES OF POULTRY


Faced with the current necessity of substantially curtailing the quantity of grain used for feed, the poultry industry must look toward more efficient production to meet the unprecedented demand for its products. Disease continues a major barrier to the poultry economy and further emphasis on reducing preventable losses is imperative. The threat of Newcastle disease together with an increasing appreciation of the value of research has greatly stimulated and expanded investigation of poultry diseases during the post war period. Facilities and personnel for accurate diagnosis have been augmented. Yet it is quite apparent to members of this Association and others aware of the situation that the serious application of proved control measures would markedly lessen the toll currently being exacted by preventable disease.

In recognition of the need for simple, concise and definite instructions or directions on sanitation, understandable to all and applicable to every branch or segment of the poultry industry, there has been made available “An Outline of a Sanitation Program for the Poultry Industry”. This extensive outline was prepared through the cooperative effort of poultry veterinarians, representatives of the poultry industry and state and federal sanitary and regulatory officials. Printing of the outline and its wide distribution is being accomplished effectively by the Bureau of Animal Industry, U. S. Department of Agriculture.

The anticipation that such a feature would emphasize, clarify and extend available knowledge prompted your Committee to arrange for this year’s program the panel discussion “How Can Poultry Disease Control Measures Known at Present be Applied to Further Reduce Current Losses?” The assistance of Dr. Hendershot in soliciting questions for the panel and the aid of many others in providing stimulating and pertinent questions is gratefully acknowledged by the Committee.

In keeping with precedent the more significant developments in the control of poultry diseases from the viewpoint of the livestock sanitarian will be reviewed. At the same time, the present situation as well as certain implications of new findings will be discussed with particular reference to the current and future needs in research and application.

PULLORIM DISEASE

Further development of the pullorum disease control program is revealed in the latest data provided through courtesy of Mr. Paul B. Zumbro, Senior Poultry Coordinator, In Charge, National Poultry Improvement Plan.

Forty-seven states are now cooperating in the National Poultry Improvement Plan (all States except Nevada) and 45 States are cooperating in the National
Turkey Improvement Plan (all States except Delaware, Nevada, and Rhode Island).

The results of pullorum testing for the past 11 years are given in Table 1. A continuous reduction in the percentage of chicken reactors on first test since 1938-1939 will be noted.

**Table 1.**—Chickens and turkeys officially tested for pullorum disease, number and percentage of reactors, 1936-1946

<table>
<thead>
<tr>
<th>YEAR BEGINNING JULY</th>
<th>States reporting</th>
<th>Chickens Tested (first test)</th>
<th>Reactors</th>
<th>States reporting</th>
<th>Turkeys tested (first test)</th>
<th>Reactors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Number</td>
<td>Number</td>
<td>Per cent</td>
<td>Number</td>
<td>Number</td>
</tr>
<tr>
<td>1936</td>
<td>31</td>
<td>6,030,032</td>
<td>200,510</td>
<td>3.33</td>
<td>11</td>
<td>31,837</td>
</tr>
<tr>
<td>1937</td>
<td>36</td>
<td>5,608,533</td>
<td>180,102</td>
<td>3.21</td>
<td>13</td>
<td>45,246</td>
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<tr>
<td>1938</td>
<td>45</td>
<td>8,115,970</td>
<td>291,104</td>
<td>3.28</td>
<td>22</td>
<td>126,359</td>
</tr>
<tr>
<td>1939</td>
<td>47</td>
<td>11,184,460</td>
<td>345,389</td>
<td>3.09</td>
<td>26</td>
<td>315,394</td>
</tr>
<tr>
<td>1940</td>
<td>47</td>
<td>12,229,138</td>
<td>349,827</td>
<td>2.86</td>
<td>29</td>
<td>332,584</td>
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<tr>
<td>1941</td>
<td>47</td>
<td>16,850,592</td>
<td>446,688</td>
<td>2.65</td>
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<td>1942</td>
<td>47</td>
<td>18,469,256</td>
<td>443,080</td>
<td>2.40</td>
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<td>1943</td>
<td>47</td>
<td>23,817,732</td>
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<tr>
<td>1944</td>
<td>47</td>
<td>21,906,026</td>
<td>422,900</td>
<td>2.00</td>
<td>38</td>
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<tr>
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<td>47</td>
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<td>495,644</td>
<td>1.84</td>
<td>41</td>
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</tr>
<tr>
<td>1946</td>
<td>47</td>
<td>30,329,608</td>
<td>543,194</td>
<td>1.79</td>
<td>41</td>
<td>2,031,583</td>
</tr>
</tbody>
</table>

The maximum tolerance for the U. S. Pullorum-Tested class which was "fewer than 5 per cent of reactors" in 1946-47 has been changed to "fewer than 4 per cent of reactors in 1947-48 and fewer than 3 per cent reactors in 1948-49". At the end of the 1948-49 hatching season the U. S. Pullorum-Tested class is to be deleted from the plan.

There has been an increase each year in participating hatcheries. In 1946-47 there were 4,498 participating hatcheries with an egg capacity of 325,633,235 of which 576, with a capacity of 36,294,307 were rated as U. S. Pullorum-Passed and 998 with a capacity of 38,237,820 eggs, as U. S. Pullorum-Clean.

Isolation of Salmonella pullorum from the coot, Fulica americana for the first time (Rausch, 1947) adds another avian host to the broad infection spectrum of this organism and its recovery (Cass and Williams, 1947) from a wild pheasant (Phasianus colchicus torquatus) further emphasizes a potentiality for spread to and by nondomesticated species.

Pullorum disease studies during the past year include two papers on the use of the whole-blood stained antigen test for detection of the disease in turkeys. Gauger (1947) using “K-antigen” found agreement between the whole-blood and tube tests when complete agglutination in 1-25 or higher dilution was used as a diagnostic titer for the tube test. Copron, Bivins, and Stafseth (1947) found that the tube test was the more sensitive of the two tests, and gave positive reactions earlier in the course of the disease than did the whole-blood test.

At the 50th annual meeting in 1946, Edwards and Bruner (1946) discussed the
relationship of the so-called XII₄ variant of *S. pullorum* to eradication programs. It has now been definitely established that this variant is a factor to be considered in eradication programs, and the need for finding strains of *S. pullorum* containing the complete IX, XII₁, XII₂, XIII₁ formula which will be suitable for producing antigens is evident. Wright (1947) reported the finding of one such strain. It is hoped that other laboratories will attempt to find similar strains for use in preparing antigens that will detect all types at a single operation.

The strain isolated by Cass and Williams (1947) from a wild pheasant in Minnesota was the XII₄ variant of *S. pullorum*.

It is proposed, as a step toward clarification of the pullorum control program in this country, that there be followed the lead of the Dominion of Canada Government in adoption of the term “non-pullorum reactors” when referring to so-called non-specific reactors in the pullorum disease program (Hinshaw, 1947).

**OTHER SALMONELLA AND PARACOLON INFECTIONS**

The serologic identification of *Salmonella* has been simplified by the findings of Ewing and Bruner (1947), and by Kauffman and Edwards (1947). They suggest the use of a polyvalent antiserum, both for the early recognition of *Salmonella* and the exclusion of other organisms. Furthermore, by employing a modified procedure a minimal number of sera may be used to identify only the more important types of *Salmonella*, the remaining ones being referred to an identification center.

Fence lizards have been added to the list of animal reservoirs of *Salmonella* and paracolon bacteria by Hinshaw and McNeil (1947a). *S. rubislaw* and two paracolons having *Salmonella* antigens were isolated by them from these lizards. This again emphasizes the dangers of reptiles as possible carriers of *Salmonella*.

Attention to the recent literature reviews (Brandly, 1947) reveals incrimination of several *Salmonella* species, including *S. pullorum* and of other poultry pathogens in outbreaks of food poisoning in man. This problem emphasizes a fundamental responsibility of the veterinary profession in the important field of public health work.

**SWINE ERYSIPelas**

The high infective propensity of this organism is exemplified by its incrimination as the cause of a serious epizootic among birds in a zoological museum (Urbain, 1947). Of 30 birds stricken there were represented turtle doves, black birds, parakeets, green finches, gold finches and char finches.

**AVIAN SPIROCHETOSIS**

Avian spirochetosis caused by *Borrelia anserina* (Sakharoff) (*Spirochaeta gallinarum*, Blanchard) was diagnosed in North America for the first time by Hoffman, Jackson and Rucker (1946) and Hoffman and Jackson (1946) from California. During the past year Burroughs (1947) has reported a case of the disease in a chicken which was used for feeding fowl ticks (Argas Persicus) obtained from a poultry farm in Texas. A second outbreak of the disease has been diagnosed in California by Hinshaw, McNeil, and Kissling (unpublished) in 1947 in a turkey.
flock located 150 miles from the original California outbreak. No relationship of the two outbreaks could be discovered. No fowl ticks could be found on the California infected ranches. These reports definitely establish the presence of avian spirochetosis in at least two sections of the United States, California and Texas. Hinshaw and McNeil (1946) studied the spirochete obtained from Hoffman’s outbreak and found it to have all the characteristics of *Borrelia anserina*. The spirochete isolated from the second California outbreak was found by Hinshaw, McNeil and Kissling, (unpublished data) to be identical to the one isolated by Hoffman, *et al.* The isolation of a spirochete from embryonating chicken eggs (Steinhaus and Hughes, 1947) warrants further caution in the selection of source flocks for eggs employed for propagating and studying infectious agents and for preparation of egg-grown vaccines.

**NEWWCASTLE DISEASE**

To date this serious malady has been identified by virus isolation or neutralization tests in 43 states and the District of Columbia. Wide dissemination of Newcastle disease stresses not only the native high diffusibility of the infection but the absence of any organized regulatory measures aimed at preventing its dissemination. The occurrence of recovered carrier birds, the presence of virus in and on the eggs during early active infection and later carrier stages, as well as the high resistance of the virus in nature represent fundamental problems bearing importantly on control by sanitation and regulation. Practical questions concerned with spread of the virus by inanimate “carriers”, such as the clothing and service personnel, feed sacks, shipping crates, trucks, freight and express cars require diligent study. Here attention is called to observations on spread of the infection as reported to the Association last year (Jungherr and Terrell, 1946).

Valuable information on chemical disinfection of Newcastle virus has been provided by the experiments of Tilley and Anderson (1947) and Cunningham (1947).

In view of the diagnosis of the disease in pheasants in this country, (Levine *et al.*, 1947) and its known wide infectivity range for birds, pathologists are urged to be alert for outbreaks in other species of wild as well as domesticated birds. Experimental infection of mammals including hamsters (Reagan *et al.*, 1947) and monkeys (Meyer and Mack, unpublished data, 1946) are of greater interest as a consequence of further reports of ocular infection in man (Anderson, 1946; Yatom, 1946; Shimkin, 1946) as a result of contact with the virus in the laboratory or with infected chickens.

Developments in the several diagnostic laboratory procedures for Newcastle disease permit positive demonstration of active or prior infection by examination of eggs as well as birds. Recent findings deal with application and simplification of the test and reduction of variables (Osteen and Anderson, 1947; Hanson *et al.*, 1947; Brandly *et al.*, 1947). The determination of the pH stability ranges for Newcastle and fowl pest viruses as a ready means of differentiation between them (Moses, Brandly and Jones, 1947) suggests further application of this method for differential virus disease diagnosis.
The results of laboratory as well as field vaccination trials with several modified strains of Newcastle virus derived from egg, duck or hamster passages give promise of early availability in this country of a vaccine producing a substantial and prolonged immunity with no more than a mild systemic reaction (Iyer and Dobson, 1942; Brandly et al., 1946; Goor and Moses, 1946, 1947; Komarov, 1946; Reagan et al., 1947).

No little confusion has resulted in the matter of nomenclature of this malady. This has involved the implication that Newcastle disease, being designated avian pneumoencephalitis when it first appeared in this country without its identity being suspected, differs essentially from the infection which had occurred previously in the Eastern hemisphere. The usual feature of relatively low flock mortality from Newcastle disease in this country has been observed occasionally also in other countries (Komarov, 1947, unpublished data). The substitution at present of an additional synonym to the some dozen or more already proposed would seem to serve no useful purpose. The Committee urges that decision on the matter of a satisfactory name, one which will, in part at least, obviate the disadvantages of eponymic designation as well as of cumbersome symptomatic descriptive terminology, be referred to a duly constituted committee on nomenclature, e.g., that of the American Veterinary Medical Association.

**Other Virus Diseases**

*Infectious bronchitis.* An important contribution to the knowledge of this disease is the finding (Jungherr and Terrell, 1947) that specific virus neutralizing antibodies appear in the yolk as well as the serum of infected birds, but in field flocks usually not until the third week after infection. In view of the similarity of the respiratory symptoms of Newcastle disease and bronchitis pathologists are urged to isolate more strains of bronchitis virus in order further to define the requirements for isolation and the characteristics of the virus.

A method of rapid egg adaptation which permits prompt differential diagnosis of bronchitis from Newcastle disease has been reported by Delaplaine.

Observations by Berg, Bearse and Hamilton (1947) showed that the economic loss from attacks of Newcastle disease cannot be measured only in mortality, impaired development and decreased egg production. In addition, there results a loss of egg quality by some birds which as a rule is permanent in nature. This change which results in an abnormally low albumen index occurs simultaneously with an increase in roughness and decrease in shell thickness; the latter shell alterations, however, not being permanent. Impaired hatchability has been reported in the field in the case of eggs from birds recovered from Newcastle disease.

*Infectious laryngotracheitis.* The report (Molgard and Cavet, 1947) that inoculation of laryngotracheitis virus by the feather follicle method causes a swelling of the follicles and subsequent immunity will require studies to determine whether this immunity is as durable as that provoked by the cloacal method of vaccination.

*Equine encephalomyelitis in pheasants.* The almost annual appearance of equine encephalomyelitis in New Jersey pheasants (Beaudette and Black, 1947) raises the question as to whether the disease is peculiar to the conditions existing in New Jersey or whether it occurs elsewhere and is not being diagnosed. In view
of the possible public health problem involved and to secure more information poultry pathologists should be urged to investigate suspicious outbreaks to the extent of inoculating embryonated eggs with brain suspensions. If the disease is found to be peculiar to New Jersey then the conditions which contribute to the infection should be investigated along the lines already followed by Hammon and Reeves in their studies of the western type of infection.

Pox in turkey. The repeated reports that turkeys vaccinated with fowl pox vaccine do not always retain their immunity through the breeding season requires investigation to determine whether the fault lies in the method of vaccination or in the type of virus used. The study would seem to require the isolation of several strains of virus from spontaneous outbreaks in turkeys and an immunological study of these in relation to fowl pox strains.

Foot and mouth disease. Since the disease exists in Mexico, perhaps more thought ought to be given to the possibility of mechanical transmission of the infection by migrating birds such as recorded from England by Stockman and Garnet (1923) and Thompson (1924).

Navel infection of chicks and poults. Eveleth, Bolin and Goldsby (1947) report navel infection of chicks and poults caused by a specific virus which is apparently egg transmitted. Some evidence indicates survival of the virus in an incubator for longer than a year. These workers suggest that certain types of peritonitis and salpingitis in hens may be due to the same virus infection.

THERAPY AND PREVENTION

The impact of the remarkable advances of the sulfonamide and antibiotic age has somewhat modified the approach to control of the transmissible diseases. Over-enthusiasm engendered by the ambitious claims of poorly informed or unscrupulous druggists, remedy salesmen and others coupled with the age-old tendency toward a short-cut in effort not infrequently leads the poultrymen to disappointment and financial loss. Too often the availability of the newer drugs and biological products encourages reliance upon temporary measures largely to the exclusion of long range planning for disease control based upon known effective management and sanitation practices. The situation obviously prompts further emphasis by this Association of the fundamental soundness of sanitary programs in controlling infectious and parasitic diseases and the encouragement of efforts toward providing adequate bona fide veterinary service to this as well as other branches of our animal industry.

Bacterial diseases. Reports on the use of sulfonamides for the control of poultry diseases include studies on their value against pullorum disease, fowl typhoid and para-typhoid by Anderson, et al., (1947); Bottorf and Kiser (1947); MacNamee (1947); Holtman and Fisher (1947); and Clark (1948). The findings of these investigators confirm previous reports that this group of drugs has value in reducing losses from Salmonella infections. It should be emphasized, however, that in no report yet published has there been any evidence presented to indicate that drugs will reduce the number of carriers among the survivors of an outbreak. Drugs, therefore, must not be used as a substitute for a control or eradication program based on elimination of carriers.
The effectiveness of penicillin for the control of erysipelas in turkeys has been reported by Gifford and Jungherr (1946) and Grey (1947). These investigators found penicillin effective in reducing losses, and economical enough to warrant its use in outbreaks. Grey (1947) reported that a single dose of 140,000 micrograms of streptomycin was also effective against experimentally produced cases of erysipelas.

Sulfathiazole at one per cent level in the mash was found beneficial by DeVolt (1947) in the control of acute fowl cholera in flocks of chickens and turkeys. Sulfamerazine, 0.5 per cent of the mash, caused spectacular reduction in losses in a cholera outbreak in a large flock of turkeys (Alberts, 1947). However, in both those instances, the disease recurred when the drug was discontinued. The successful use of sulfiquinoxaline in outbreaks of acute fowl cholera among captive pheasants (Brandly and Green, unpublished, 1947; Delaplane and Green, unpublished, 1947) may also be recorded. The drug was given at two alternate three day intervals at the rate of 0.025-0.03 per cent admixed in the mash or dissolved in the drinking water.

Coccidiosis. Sulfonamide treatment in conjunction with intentional exposure as a means of producing immunity has been investigated with some promising results (Swales, 1947; Seeger, 1947). Sanitation as a basic measure and the judicious emergency use of the sulfa drugs may, however, not be discounted.

Of more than passing interest and importance and indicative of concern for the basic welfare of the industry is the consummation of plans for the first World's Poultry Congress since 1939. The meeting will be held in Copenhagen, Denmark, August 20-27, 1948.

REFERENCES


TRANSMISSIBLE DISEASES OF POULTRY


REPORT OF COMMITTEE ON RESOLUTIONS

J. V. KNAPP, Chairman, Tallahassee, Florida; D. M. CAMPBELL, Chicago, Ill.;
R. S. ROBINSON, Pierre, S. Dak.; H. A. TRIPPEER, Olympia, Wash.;
H. S. WILKINS, Helena, Mont.

RESOLUTION 1

WHEREAS; Foot-and-mouth disease has been known to exist in the Republic of Mexico, and

WHEREAS; the Government of the Republic of Mexico and the Government of the United States have been cooperatively conducting a program of foot-and-mouth disease eradication since April 10, 1947, in sixteen central Mexican States and the Federal District of Mexico, involving the slaughter of infected and exposed animals, and

WHEREAS; due to the extent of the areas and great number of animals involved, and other numerous factors, which have created insurmountable obstacles impeding the prompt control and eradication necessary for expected results which would warrant a continuation of the elimination by slaughter method of eradication due to the enormous economic losses involved, including social and economic impact upon Mexico, and

WHEREAS; relaxation of efforts to eliminate or control foot-and-mouth disease in Mexico at the earliest date possible, alarmingly enhances the threat and danger to the livestock of the United States and the present free areas in Mexico,

Now, Be It Resolved: That the Honorable Clinton P. Anderson, Secretary of the United States Department of Agriculture, be urged to exert through the Bureau of Animal Industry and other agencies a continuation of cooperation with the Mexican Government consistent with funds now available and which, it is the unqualified consensus of opinion of the members of the United States Livestock Sanitary Association, must be made available by the Congress of the United States for the continuation of this program.

RESOLUTION 2

WHEREAS; The United States Department of Agriculture announced on November 26, 1947 that it has accepted a proposal by Mexican officials, through the Mexican-United States Commission for the eradication of foot-and-mouth disease, to change the present foot-and-mouth disease program in Mexico, and

WHEREAS; the revised program will include vaccination of susceptible animals together with quarantine, and, when necessary, slaughter of infected and exposed animals; therefore be it

Resolved: That the United States Department of Agriculture undertake immediate and extensive research work at a suitable location to evaluate the efficacy and practicability of vaccines as an adjunct to quarantines and slaughter measures, and be it further resolved that the United States Livestock Sanitary Association desires to express its continued confidence in the slaughter method of foot-and-
mouth disease eradication when and if the entire program is placed in the hands of the United States Department of Agriculture.

In consideration of the report presented by the Committee appointed by the United States Livestock Sanitary Association sent to Mexico to gather firsthand information relative to the situation as it now exists in that country: It is our opinion that the Bureau of Animal Industry has done everything humanly possible, under the existing conditions, to bring foot-and-mouth disease under control and should be absolved from blame for lack of success in complete eradication by the previous methods used successfully in the United States.

RESOLUTION 3

WHEREAS; The highly infectious disease known as Equine Infectious Anaemia (Swamp fever) was determined to exist among race horses at several tracks during the past Summer and Fall racing season, and

WHEREAS; this disease of Equines spreads rapidly under certain conditions and management practices and unless controlled could seriously endanger the thoroughbred industry as well as the economy of many states,

Therefore: The United States Livestock Sanitary Association suggests that the following recommendations applicable to management practices at race tracks be furnished the Thoroughbred Racing Association for distribution to all race track officials in the United States for their guidance.

1. A system of effective insect control against flies and mosquitoes by the proper use of DDT or other recognized insecticides should be in force at all race horse stables. All stalls and adjacent premises should be fogged before the acceptance of horses begins and at necessary intervals thereafter to maintain an insect free environment for the season.

2. All horses assigned to stall space on race tracks must be accompanied by a satisfactory health certificate and be subjected to careful examination by the official track veterinarians.

3. For the accommodation of horses, race tracks should provide well ventilated, individual box stalls, with facilities for separate feeding and watering of the animals.

4. The stabling of horses in stables outside the race track stables and not under direct supervision of official race track veterinarians should be discouraged or discontinued.

5. The stables and immediate surrounding should be maintained in good sanitary condition at all times. This includes prompt removal of manure and other refuse and satisfactory drainage.

6. The promiscuous use of hypodermic syringes and needles by laymen at race tracks should be discouraged or discontinued.

7. The common use of any equipment that may produce skin abrasions or absorb body excretions or secretions, such as bridles, bits, harness, saddles, blankets, brushes, and currycombs is dangerous and should be avoided.

8. All types of surgical instruments, especially those that may draw blood or that may come in contact with body excretions or secretions, such as knives,
hypodermic syringes, needles, tattooing instruments, and floats, should be cleaned and sterilized by boiling for 15 minutes before use on each animal.

9. A sufficient number of uterine forceps or other instruments, as well as rubber gloves, should be provided for collecting saliva for saliva tests, so that separate sterile equipment can be used on each animal.

10. To assist in the detection of sick horses from any cause and especially to pick out early cases of swamp fever, it is suggested that daily temperatures on all horses be taken and recorded under proper supervision.

11. Any horse showing clinical symptoms indicative or suggestive of swamp fever should be immediately isolated from the other animals.

12. Paddocks, starting gates, and any other equipment subject to contact by different animals should be cleaned and disinfected frequently and maintained in good sanitary condition.

RESOLUTION 4

WHEREAS; In the presentation of the program of the United States Livestock Sanitary Association and in the preparation of its several committee reports the services of men well qualified in their respective fields of activity are required, and

WHEREAS; these gentlemen contribute freely and graciously of their time and effort, therefore,

Be It Resolved: That the United States Livestock Sanitary Association convey its sincere thanks and assurance of appreciation to each speaker on the program and to each member of the several committees for their valuable assistance.

Be It Resolved: That the United States Livestock Sanitary Association hereby express our appreciation to the manager and employees of the La Salle Hotel for the satisfactory accommodations provided, and for the many courtesies extended to our members and visitors.

Be It Further Resolved: That the President and Secretary-Treasurer of this Association be and are hereby authorized to supply copies of the foregoing resolutions to the appropriate persons and by letter direct their attention to these resolutions.

REPORT OF THE AUDITING COMMITTEE

Your committee has carefully reviewed the books of the Secretary-Treasurer covering the financial transactions of this Association and are pleased to report that the records of receipts and disbursements of all funds are kept in an orderly and businesslike manner, and further they are correct and in balance as presented in his report of December 3rd, 1947, for the present fiscal year.

Respectfully submitted,

(signed) J. V. KNAPP
(signed) T. C. GREEN
(signed) C. F. CLARK
REPORT OF THE NOMINATING COMMITTEE

Dr. West: Mr. President, Members of the Association: Your Committee takes pleasure in presenting the following names in nomination:

For President: Dr. J. V. Knapp, State Veterinarian of Florida
For First Vice-President: Dr. T. O. Brandenburg, State Veterinarian of North Dakota
For Second Vice-President: Dr. C. P. Bishop, State Veterinarian of Pennsylvania
For Third Vice-President: Mr. F. E. Mollin, Denver, Colorado, Executive Secretary of the National Livestock Association

I move the adoption of this report.

Chairman Hendershott: Gentlemen, you have heard the report of the Nominating Committee.

Nominations are open to the membership from the floor.

Do I hear any nominations from the floor, if not, I will entertain a motion from the floor that the nominations be closed, and the Secretary cast the ballot for the men named for their respective elective offices as reported by the Nominating Committee.

Dr. Kuttler: Mr. Chairman, I move that the report of the Nominating Committee be adopted, and that the Secretary of the Association be instructed to cast the unanimous ballot of the Association for the officers nominated.

Chairman Hendershott: Do I hear a second to that motion, gentlemen?
Dr. Good (Wyoming): I second the motion.

Chairman Hendershott: All in favor of the motion as put indicate by the usual sign; those opposed, like sign; the "ayes" have it.

I, therefore, as instructed by you hereby cast the unanimous ballot of this Association for the following men for their respective offices during the ensuing year:

For President: Dr. J. V. Knapp, of Florida
For First Vice-President: Dr. T. O. Brandenburg, of North Dakota
For Second Vice President: Dr. C. P. Bishop, of Pennsylvania
For Third Vice-President: Mr. F. E. Mollin, of Colorado
Dr. Green, kindly escort the First Vice-President to the rostrum.
Is Dr. Brandenburg in the room.

Unfortunately, Mr. Mollin is not with us. He was here during the early days of our meeting, but the difficulty relative to the foot-and-mouth disease situation in Mexico necessitated his attendance at conferences in Washington, and he left for that city the day before yesterday.

We will, however, notify him of his selection for the office in this Association.

It is unfortunate, indeed, that our retiring President, Will J. Miller, is not here to turn over to his successor the office of the presidency of this Association.

I would like to speak in more or less a dual capacity today—one, in some part of it, for Will J. Miller, and again, in other parts, for the regulatory official from New Jersey.
From the standpoint of the Secretary of the Association, it has been a decided and distinct pleasure to me personally to work with such a splendid President as we have had during this past year. I, probably more than anyone else in the Association, obviously am better acquainted with the tremendous volume of work that this man has carried on in behalf of the Association during his term as President.

Few of us in regulatory positions working for the state could devote of our time to the extent that Will Miller did on behalf of the livestock industry and on behalf of the Livestock Sanitary Association. He was untiring and gave of himself very freely, to the credit of this Association.

Early in the year he was not well, and the fact that he had such a serious responsibility did not aid in his early recovery. Despite the fact that he was not in the best of health, he repeatedly did things against his doctor's orders that he felt were necessary in order to keep us, as a group of sanitary officials in the livestock industry, apprized of the situation as regards the foot-and-mouth disease outbreak in Mexico. Numerous letters and innumerable long-distance telephone calls transpired between his office and mine. It was not uncommon at all for Mr. Miller to continue to telephone me if I was out, and wait until twelve, one or two o'clock in the morning in order to talk.

We never can repay the kind of service that he rendered the Association. I doubt, as I said before, if there are many of us in the Association who can equal or better what he did.

I know he regrets that he is not here to turn over to his successor, the office of President, and I am certain that in speaking in his behalf he would say that it has been a distinct honor and a pleasure for him to serve you, and that he understands and believes that he is turning over this fine office to a very able and competent successor, and that he would wish him all of the good luck and success that should go with a position of this sort, and all of the support that he can possibly give him in carrying out the duties of the presidency.

It gives me pleasure to present to you your President for the ensuing year, J. V. Knapp, of Tallahassee, Florida. (Applause)

PRESIDENT-ELECT KNAPP: Thank you, Mr. Chairman.

Gentlemen of the United States Livestock Sanitary Association, I assure you that I deeply feel the honor and the privilege that you have conferred on me in making me your President for the ensuing year.

I also assure you that I will bend my every effort and interest to the purposes and ideals of this Association; and I solicit the full and complete cooperation of the committees and also of the membership, to make this one of the best years in a troubled time that we have.

I sincerely thank you. (Applause)

CHAIRMAN HENDERSHOTT: Thank you, Mr. President.

It now becomes my painful duty (laughter) to expose to you my good friend, T. O. Brandenburg, from Bismarck, North Dakota, who will fall heir to the position vacated by our new President.

This fellow has a square jaw, and he means everything he says; and I know he is going to tell you how well he is going to carry on the duties of this high office. I am sure we are looking to him to come through as he always has on every other assignment.
It is a pleasure to introduce and present to you, Dr. T. O. Brandenburg, the new First Vice-President. (Applause)

First Vice-President-Elect Brandenburg: Thank you, Dr. Hendershott.

I want to take this occasion to thank the members of this Association for the great honor they have placed on me in burdening me with this high office. I shall do all I can to help President Knapp to carry on for another year in the hope that this Association may go forward as it has been going on for some 50 years.

I also stand ready in case the young man here should become sick, or not be able to get to the meeting.

It might be of interest in this connection to state that in going over the history of this organization I was surprised—we joke about these things, but we are not young any more, none of us. I was amazed to know that this has happened: That on one occasion it happened just the day before this Association was called into session; and at that time, it happened to be—Dr. Knapp, I hope you are not superstitious—(laughter)—it happened that it was the time that Dr. Carewe, also a good veterinarian from North Dakota, First Vice-President of the Association, came to this meeting only to find that it was necessary for him to serve as chairman. And he served this Association for two years as chairman.

Gentlemen, I thank you. (Applause)

Chairman Hendershott: Thank you, Dr. Brandenburg, for that somber note. (Laughter)

Seriously speaking, it is a pleasure for me to present to you, your new Second Vice-President, Dr. Charles P. Bishop, of Harrisburg.

Second Vice-President-Elect Bishop: I sincerely appreciate this honor to serve as Second Vice-President of this Association, and I assure you it is a pleasure and a privilege to work with the officers of the Association; and I shall always work to the best interests of this organization.

Thank you. (Applause)

Chairman Hendershott: I will now turn the meeting over to your President for this year.

President Knapp: Gentlemen unless there is something the members wish to present we will adjourn the Fifty-first Annual Meeting and proceed with the meeting of the executive board. This meeting is adjourned.
FIFTY-SECOND
ANNUAL MEETING

DENVER, COLORADO

October 13, 14, 15, 1948