Proceedings
FORTY-SIXTH
ANNUAL MEETING
of the
UNITED STATES
LIVE STOCK SANITARY
ASSOCIATION

HOTEL LA SALLE
Chicago, Illinois
December 2, 3, 4, 1942
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**HISTORICAL**

Records of the early meetings of the Interstate Association of Live Stock 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 Live Stock Sanitary Association. All meetings since 1909 have been held in Chicago.

<table>
<thead>
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<th>Meeting</th>
<th>Date</th>
<th>Place</th>
<th>President</th>
<th>Secretary</th>
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<td>1</td>
<td>Sept. 28-29, 1897</td>
<td>Fort Worth, Tex.</td>
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<td>2</td>
<td>1898</td>
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<td>3</td>
<td>1899</td>
<td>Chicago, Ill.</td>
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<td>4</td>
<td>1900</td>
<td>Louisville, Ky.</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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<tr>
<td>14</td>
<td>Dec. 5-7, 1910</td>
<td>Chicago, Ill.</td>
<td>Chas. E. Cotton</td>
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<td>15</td>
<td>Dec. 6-8, 1911</td>
<td>Chicago, Ill.</td>
<td>John F. Devine</td>
<td>J. J. Ferguson</td>
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<td>16</td>
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<td>Chicago, Ill.</td>
<td>Mazyck P. Ravenel</td>
<td>J. J. Ferguson</td>
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<td>17</td>
<td>Dec. 2-4, 1913</td>
<td>Chicago, Ill.</td>
<td>Peter F. Bahnsen</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>
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<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>M. Jacob</td>
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<td>Dec. 1-2, 1919</td>
<td>Chicago, Ill.</td>
<td>G. W. Dunphy</td>
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<td>24</td>
<td>Nov. 29-30, Dec. 1, 1920</td>
<td>Chicago, Ill.</td>
<td>S. F. Musselman</td>
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<td>1921</td>
<td>Chicago, Ill.</td>
<td>W. F. Crewe</td>
<td>Theo. A. Burnett</td>
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<td>26</td>
<td>Dec. 6-8, 1923</td>
<td>Chicago, Ill.</td>
<td>W. J. Butler</td>
<td>O. E. Dyson</td>
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<td>27</td>
<td>Dec. 5-7, 1924</td>
<td>Chicago, Ill.</td>
<td>J. G. Ferneyhough</td>
<td>O. E. Dyson</td>
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<td>29</td>
<td>Dec. 2-4, 1926</td>
<td>Chicago, Ill.</td>
<td>John R. Mohler</td>
<td>O. E. Dyson</td>
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<td>30</td>
<td>Dec. 1-3, 1927</td>
<td>Chicago, Ill.</td>
<td>L. Van Es</td>
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<td>31</td>
<td>Nov. 30- Dec. 1-2, 1928</td>
<td>Chicago, Ill.</td>
<td>C. A. Cary</td>
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<td>Chas G. Lamb</td>
<td>O. E. Dyson</td>
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<td>32</td>
<td>Dec. 2-5, 1930</td>
<td>Chicago, Ill.</td>
<td>A. E. Wight</td>
<td>O. E. Dyson</td>
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<td>33</td>
<td>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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<td>E. T. Faulder</td>
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<td>T. E. Robinson</td>
<td>O. E. Dyson</td>
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<td>Edward Records</td>
<td>O. E. Dyson</td>
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<td>Walter Wisnicky</td>
<td>L. Enos Day</td>
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<td>R. W. Smith</td>
<td>L. Enos Day</td>
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<tr>
<td>Nov. 30-</td>
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<td>D. E. Westmorland</td>
<td>L. Enos Day</td>
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<td>H. D. Port</td>
<td>L. A. Merillat</td>
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<td>Dec. 4-6,</td>
<td>1940</td>
<td>Chicago, Ill.</td>
<td>E. A. Crossman</td>
<td>Mark Welsh</td>
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<td>I. S. McAdory</td>
<td>Mark Welsh</td>
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<tr>
<td>Dec. 2-4,</td>
<td>1942</td>
<td>Chicago, Ill.</td>
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ADDRESS OF THE PRESIDENT

BY I. S. McADORY

Professor of Surgery and Associate State Veterinarian, Alabama Polytechnic Institute, Auburn, Alabama

This, the Forty-sixth Annual Meeting of the United States Live Stock Sanitary Association, occurs amidst contrary feelings, those of satisfaction and gratitude on the one hand, and anxiety and uncertainty on the other.

Let us first give some attention to the brighter side. At the conclusion of his address before the meeting of this Association last December, Dr. A. E. Wight, Chief, Tuberculosis Eradication, made the following remark; "At the time of the meeting of this Association next year, a quarter of a century will have elapsed since the adoption of the accredited herd plan by this Association here in Chicago. Therefore, would it not be well to give consideration to a little extra program on the subject at this time?" Following out Dr. Wight's suggestion, that part of the program which concerns tuberculosis has been prepared with this in mind. The meeting of 25 years ago marked the beginning of a program, on a nation-wide scale, which had for its goal, the eradication of bovine tuberculosis, a disease that was wide-spread and prevalent in many sections of the country, especially among dairy cattle. While the average incidence, taking the country over, was small compared to what it was and still is in Europe, in some localities the percentage of infected animals was high. Moreover, the disease was spreading with sufficient rapidity to cause concern, particularly because of its public health significance. A great amount of research had already been done and the nature of the malady and its causal agent and modes of transmission had been carefully studied. Furthermore, a considerable amount of testing of individual herds had been done, using the subcutaneous test. However, in the early days of the tuberculin test, it was thought by many that a nation-wide eradication campaign would be impossible, because there would not be enough man power available to test even a relatively small portion of the cattle in the country even once. That was probably true at the time, but the possibility of the development of a simplified test, which would greatly increase the number of animals that could be tested per veterinarian in a given time, was not taken into account, when this statement was made; such a test, the interdermic test, was developed and has made it possible to greatly speed up the work of detecting infected animals and helped to make it possible to bring about the present happy condition regarding bovine tuberculosis, which is to the effect that in every state in the union, the incidence of tuberculosis in cattle has been reduced to one-half of one per cent or less; and that all of continental United States is in the Modified Accredited Area. This, of course, does not mean that every tuberculous animal has been found and slaughtered, but it does mean that the disease is well under control and that with repeated testing at the intervals recommended, the disease will finally reach the vanishing point. We cannot hold the enviable position we have attained, however, without continuing our efforts; for, a lapse of vigilance for a few years might undo the work that has been accomplished.
I have mentioned the role played by the interdermic test in eradicating bovine tuberculosis, but this was only one of the things that helped. The principal contributions to the work were the driving force and persistence of the Bureau of Animal Industry, its chief, and his force of assistants, inspectors and other employees, State Livestock Sanitary officials and their assistants, working in cooperation with progressive dairymen and cattle owners. Much credit is also due Public Health Officials and persons interested in public health matters for their splendid support and cooperation.

The work has been costly, to be sure, but it has already paid exceedingly large dividends in money and in improved health and peace of mind of our people. It is the third great eradication program accomplished in our country. The first of these was the eradication of contagious pleuropneumonia, then tick eradication, and lastly tuberculosis. Of these achievements we have reason to be proud and to be grateful to those who have made them possible.

I would like to mention one condition in regard to bovine tuberculosis and public health. It is this, about 24 years ago a careful study of all factors led Doctor William Hallock Park, Director of Laboratories of the Department of Health of New York City, and his associates, to estimate that about 10% of all deaths caused by tuberculosis among children under five years of age, who drank the average raw milk, were due to bovine tubercle bacilli. Tuberculosis in children due to the bovine tubercle bacillus is at present rare indeed, thanks to the tuberculosis eradication work and pasteurization.

Several of the men who attended the meeting twenty-five years ago and took part in some of the discussions that led to the inauguration of the eradication work, are with us today, and we all, I am sure, will want to thank them for helping to get so valuable a piece of work done and to hear from some of them at least.

The other side of today's picture, the one about which we are anxious and uncertain, has to do with the world upheaval and the war that has been forced upon us. A war of tremendous proportions; one in which we are fighting for our national existence, and the right to live as free men and women. A war so destructive to life and property will require many years to repair the damage done. In such a catastrophe, the world's livestock industry must necessarily suffer, not only from the increased spread of disease incident to the war and the possible breaking down of quarantine barriers; but also from the lack of man power to properly care for the animals and to raise feed for them. Fortunately we in America are not suffering from any serious increase in the incidence of disease among our food and work animals, but we are already facing a shortage of farm labor which is becoming acute. This dearth of competent help in the presence of a demand for more meat and milk is likely to lead to slackness in the care of the animals and increased risk of spreading disease. There is much work for an organization such as this in the way of formulating practical means for controlling disease under unfavorable conditions with a minimum amount of labor, and in the face of the necessity of increasing the density of the animal population. Truly the livestock sanitarian has a very important work to do in aiding his country, when it sorely needs help.

Reports from the chief livestock sanitary officials of a large proportion of the states indicate that there have been no serious outbreaks of disease since we last met, and
on the whole, the livestock of this country and of Canada has probably suffered less
from communicable disease than in the preceding year.

There have been reported outbreaks of anthrax in infected territory and one in
North Carolina which was a previously non-infected district. The outbreaks seem
to have been brought under control by vaccination and the usual sanitary measures.

The wave of encephalomyelitis that has swept over the country during the last few
years seems to have largely subsided. What part of this is due to natural causes is
difficult to determine, but because of the rather general use of vaccine, it would seem
that protective vaccination deserves a good deal of credit.

The Bang's disease program has made good progress. Calfhood vaccination
seems to be gaining in popularity, and evidently is proving to be a real aid to the
Bang's disease program. It is believed worthwhile, at this time, to recall a sugges-
tion made a year ago by President Crossman in his address, which was to the effect
that because of the shortage of milk, some way should be found to save good produc-
ing Bang's disease reactor cows from slaughter until their lactation periods are ended
or the emergency over. I subscribe to President Crossman's suggestion. Since so
much of our wealth and effort must be used to fight the war, it follows that sufficient
funds to continue the Bang's disease work at the rate we have been going, may not
be available. In such an event it would seem best, to direct much of our efforts to-
wards holding the ground already gained rather than in trying to extend it very
much, perhaps with unfortunate results. Possibly it may be desirable, during our
emergency, that some plan be worked out by which as many calves be vaccinated as
is practical under proper supervision, so that large numbers of young heifers will have
sufficient immunity to resist the exposure to which they may be subjected. It
would seem that such a plan would help in controlling Bang's disease during this pe-
riod when there may be a lack of funds for paying indemnities.

Regarding swine diseases which are always with us, hog cholera has caused no
more and perhaps fewer losses than usual. The use of the serum-virus vaccination
by laymen undoubtedly is responsible for a good many outbreaks of this malady.
The need for a more rigid control over live vaccines is very much needed. Swine
erysipelas seems to be slowly spreading to new territory as is also Brucellosis.

The sales yards, cooperative sales and transport by truck are potent factors in
spreading disease unless kept under good sanitary control. States bordering on the
coasts and having seaports need to be especially watchful for the appearance of
foreign communicable animal diseases; and all veterinarians and livestock men
should be alert to the danger. They should familiarize themselves with the nature
and manifestations of these diseases that they may recognize them, should they
appear. Suspicious cases should be reported to the proper officials.

This association has a very great influence over the livestock industry. Livestock
Sanitary officials and owners of all sorts of food and work animals look to it for ad-
vice, and to a great extent, are guided by it. With this influence, goes a great re-
sponsibility, not only to those who work with livestock, but to the people as a whole
who consume animal products. Our responsibility has been great in normal times,
but it is immeasurably greater now.

Members and friends of the Association I welcome all of you and hope that we will
gain much from association and discussion, both in and out of the sessions, that will
help us to fill our places creditably in the hard work that is before us.
REPORT OF THE SECRETARY-TREASURER

FINANCIAL STATEMENT
December 1, 1941, through November 30, 1942

Receipts

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<td>Cash in Prince George's Bank &amp; Trust Company 11/30/41</td>
<td>$2,445.44</td>
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<td>Interest on U. S. Treasury Bonds</td>
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<td>Registration Fees</td>
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<td>Reprints and Proceedings</td>
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Total Receipts ........................................... $5,258.97

Disbursements

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<td>Salary—Secretary-Treasurer</td>
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<td>Clerical Assistance</td>
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<td>Expenses 1941 meeting</td>
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<td>Fred L. Anderson—Typing—1939</td>
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<td>Express charges</td>
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Total Disbursements ..................................... $2,443.93

Cash on hand, Prince George’s Bank and Trust Company 11/30/42... $2,815.04

Assets

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Total Assets ............................................. $7,728.54

Liabilities

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<td>Net Worth—November 30, 1942</td>
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MARK WELSH,
Secretary-Treasurer.
On motion of Doctor Hendricks the report of the Secretary-Treasurer was referred to the Executive Committee and a committee appointed to audit the books.

REPORT OF THE AUDITING COMMITTEE

WILLIAM MOORE, Chairman, Raleigh, North Carolina; C. P. BISHOP, Harrisburg, Pennsylvania; and WILL J. MILLER, Topeka, Kansas

Your special auditing committee has examined the books of the Secretary-Treasurer and found them to be in good shape with all funds accounted for.

It was moved and passed that the report of the Auditing Committee be accepted.
Death has claimed the following members and live stock sanitarians during the past year:

Albert T. Kinsley, Kansas City, Mo., died December 8, 1941.
J. P. Bushong, Los Angeles, Calif., died January 5, 1942.
Charles H. York, Holmesville, Ohio, former B. A. I. field inspector, died April 21, 1942.
Hubert Bunyea, Washington, D. C., veterinarian of the U. S. B. A. I., died May 7, 1942.
C. C. Hall, Omaha, Neb., city veterinarian and responsible for development of city's modern meat and abattoir inspection system, died May 21, 1942.
James B. Way, Cynthiana, Ky., former B. A. I. inspector, died June 18, 1942.
Ralph E. Noyes, St. Louis, Mo., former B. A. I. inspector, died Aug. 9, 1942.
J. Eldorbas Bard, Los Angeles, Calif., former B. A. I. inspector, died Aug. 28, 1942.
Albert Hassell, Bangor, Me., former senior zoologist, U. S. B. A. I., died Sept. 18, 1942.
Walter L. Curtis, Los Angeles, Calif., died Oct. 11, 1942.
lions are sacrificing their comforts, pleasures, families, friends and even their own lives. These sacrifices are being made willingly and with a vigor that we confidently feel will bring us Victory and the preservation of those liberties we deem so vital to our existence.

In the face of this request we are going to pay tribute to them by accepting the small sacrifice requested of us such as a cup of coffee, a little sugar or meat, a pint of blood, 10% of our earned dollars, a Sunday afternoon spin in the country or any of the other sacrifices we at home will be asked to make. Think of the sacrifices of our millions under arms, and we'll never think of our own sacrifices. We will carry on. We will emulate them in terms of the beautiful language of Howard Arnold Walter, reading as follows:

"I would be true, for there are those that trust me;
I would be pure, for there are those that care;
I would be strong, for there is much to suffer;
I would be brave, for there is much to dare.
I would be friend to all, the underprivileged; the friendless;
I would be giving and forget the gift.
I would be humble, for I know my weakness;
I would look up—and laugh—and love—and lift."

To each of them we say, "Aye, Aye, Sir," and pray for the peaceful repose of their souls.
HIGHLIGHTS AND SHADOWS IN TUBERCULOSIS ERADICATION

BY JOHN R. MOHLER

Chief, Bureau of Animal Industry, Agricultural Research Administration,
U. S. Department of Agriculture

A half century ago, back in 1892, Dr. Leonard Pearson, of the Veterinary Department of the University of Pennsylvania, tuberculin-tested a herd of Jersey cattle near Villa Nova, Pa., assisted by one of his students, Charles E. Cotton, who later became Minnesota's State Veterinarian for many years. This was the first tuberculin test of cattle made in the United States. Twenty-five years later, in 1917, the United States Livestock Sanitary Association considered the time ripe to undertake the systematic eradication of bovine tuberculosis on a nation-wide scale with Federal and State cooperation. And now, in 1942, marking the elapse of another 25-year period, we are devoting a portion of our program to an appraisal of results achieved. Thus the record shows 25 years of preparation and 25 years of fulfillment.

My topic "Highlights and Shadows in Tuberculosis Eradication" invites remarks in two general fields: First, those outstanding events that we view with particular interest and satisfaction and, second, the somber side of the work that includes some regrets. A conspicuous highlight has been the testing of all cattle in all herds in all States, with the District of Columbia, Puerto Rico, and the Virgin Islands included for good measure. This achievement fully vindicates the judgment and foresight of those members of our organization who believed the undertaking to be feasible in spite of its magnitude and obvious difficulties. Whether viewed from the standpoint of herds, cattle, or reactors, the figures involved are impressive. Herds tested exceed 20 million; cattle over 242 million; reactors found almost 4 million. In the short time at my disposal many interesting features in connection with this work must necessarily be omitted, but those interested in more details will find abundant information by consulting the veterinary magazines, Department and State publications, Proceedings of this Association, and Dr. J. Arthur Myers' "Man's Greatest Victory over Tuberculosis" available in many libraries.

A TEN-YEAR PROPHECY FULFILLED

It is illuminating to compare some of the opinions advanced back in 1917 when eradication work was undertaken with developments since that time. One of the most practical of our members, yet gifted with remarkable foresight, was Dr. John A. Kiernan. As a member of the committee on diseases, he was a vigorous sponsor of tuberculosis-eradication and he will be remembered also as the veterinarian brought in from tick work in 1917 to become the first chief of the Bureau’s Tuberculosis Eradication Division.

In addressing this association in 1917, Dr. Kiernan said in part, "It is believed that, with such a campaign, an entire State of 50,000 square miles may be cleaned in 10 years." Following favorable action by the U. S. Livestock Sanitary Association and the Bureau of Animal Industry, the field work got under way gradually in
1918 and Congress made the first specific appropriation for tuberculosis eradication on a cooperative basis, including indemnities, on Oct. 1, 1918. Credit must be given ex-Congressman Chas. H. Sloane, now an attorney of Geneva, Nebr., for his introduction of an amendment to appropriate $1,000,000 for this work, but as a compromise the bill was finally passed carrying $500,000.

The record also shows that the first State, North Carolina, to achieve a modified accredited status received this official recognition on October 1, 1928, exactly 10 years to the day after the Congressional authorization mentioned. Incidentally, the State of North Carolina contains 52,426 square miles, slightly more generous in size than the 50,000 square miles mentioned by Dr. Kiernan in his prophetic address.

The association, it seems, had another good prophet at that time in its president, Dr. John G. Wills, who called that memorable session to order at the La Salle Hotel, December 3, 1917. In discussing the accredited herd plan, Dr. Wills declared, "This is considered as offering a solution so far as it relates to bovines and tuberculosis and may be the forerunner of a general system applying to other species and other diseases." Within the last 25 years the suppression of tuberculosis in swine and poultry, as well as cattle, has received a great deal of attention, leading to fruitful results. Moreover, our present campaign against brucellosis in cattle follows somewhat closely the pattern of that used for bovine tuberculosis. These observations confirm Dr. Wills' advanced views, expressed 25 years ago.

Another highlight of the campaign is the momentum it gained when once well under way. The interval between the accreditation of the first State, North Carolina, in 1928, to that of the last State, California, in 1940, was only 12 years. During this time all 48 States attained accreditation, which is another way of saying that they reached this goal at the rate of 4 a year, or 1 every 3 months. This is a remarkable rate for the type of activity involved.

Further evidence of the rate of progress is seen in the statistical records. The fiscal year 1935 witnessed the tuberculin testing of more than 25,000,000 cattle. This is more than 2,000,000 a month, or an average of about 80,000 each working day for the entire year.

CONVINCING EVIDENCE OF VALUE OF COOPERATION

A still further highlight that has added luster to the work is the cooperative spirit that has been evident. The results refute opinions, sometimes expressed, that voluntary cooperation is ineffective, and that, in matters pertaining to the States and Federal Governments, one eventually seeks to dominate the other. On the contrary, the past 25 years of cooperative tuberculosis eradication have proved the soundness and effectiveness of this cooperative enterprise. No one name or group of names has been dominant and there has been ample credit for all.

Various published proceedings of this association show that considerable independent work in accrediting herds as free from tuberculosis had been started in Illinois, Minnesota, Wisconsin, and the District of Columbia before a national uni-

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form campaign was adopted by this organization 25 years ago. Thus the first such certificate was signed by Dr. Melvin on April 28, 1908, for the Jersey herd of Ford and Graham at Garrett Park, Md. This firm owned a restaurant opposite the Treasury Building in Washington and it was frequented at lunch time by a number of Bureau officials. The question of handling milk and cream from a tuberculosis-free herd only and advertising its freedom of tuberculosis when this had been accomplished was discussed with Mr. Ford. He at once realized its publicity value and signed the necessary agreement promptly. After the herd had passed two annual negative tests, the certificate was issued which was framed and hung in the restaurant, to be followed annually by similar certificates until the firm went out of business and the herd dispersed. Later when the uniform plan of eradicating tuberculosis was adopted by this association and put in force through the cooperation of Federal and State agencies, the herd receiving accredited herd certificate No. 1, dated February 6, 1918, was that of the U. S. Soldiers Home, Washington, D. C., which had been under joint Federal and District supervision since 1902. This was a problem herd and reactors were found in every test until the decision was made to raise the heifer calves instead of buying annually one or two carloads of previously tested cows out of infected herds.

Credit, however, should be given to the dauntless pioneer work and ingenuity of the late Dr. O. E. Dyson of Illinois in outlining plans for herds that might be state accredited as free from tuberculosis; also similar work of the late S. H. Ward of Minnesota, O. H. Eliason of Wisconsin, and others who labored so earnestly toward the perfection of this worth-while undertaking.

An associated highlight in cooperation has been the increasing degree of understanding between the veterinary and medical professions. By reason of its vast scope and noteworthy success, the campaign against bovine tuberculosis has received much discussion in medical circles in addition to the active participation of medical authorities in veterinary meetings. Moreover, public mention has already been made of the fact that plans have been developed by the medical officials of Minnesota to establish modified tuberculosis-free areas when the disease among humans has been reduced to less than a certain level.

The public health features of the campaign also soon impressed many municipal officials like Health Officers D. C. Lochead and H. M. Bundesen, with the importance of obtaining milk supplies from tuberculin-tested cattle. In Illinois, which was the fifteenth State to become a modified accredited area, a noteworthy stimulus was the Chicago Milk Ordinance. This became effective in 1926, and required all milk used in Chicago to be from tuberculin-tested herds. The requirement hastened the progress of testing in adjoining States also. The cooperation of the agricultural press led by A. J. Glover, and that of the commissioners of several livestock exchanges, who represented commission men headed by Everett Brown, stockyards by A. G. Leonard, and packing interests by Thos. E. Wilson, and all directed by Prof. H. R. Smith, proved likewise very helpful.

**RECIROCITY WITH CANADA**

An international highlight of the campaign was the reciprocal agreement that enabled the United States to admit cattle from Canada more readily. Effective
August 1, 1935, in the form of B. A. I. Order 352, this agreement was an early example of the good-neighbor policy. Formerly cattle were admissible, without further test, only from accredited herds, but the new order granted them entrance into the United States when they were from an area in which all cattle had been tuberculin-tested and in which the disease was less than one-half of 1 percent. The plan was suggested to the U. S. Department of Agriculture by Dr. George Hilton, then Canadian Veterinary Director General. Not only has it facilitated the movement of healthy breeding cattle in both directions across the United States-Canadian border, but it has further improved the cordial relations that the United States has enjoyed with its northern neighbor for many years.

A financial highlight that proved to be a definite stimulus to tuberculosis eradication was a provision of the Jones-Connally Act of 1934 that provided several million dollars for the work during the depression days. The Act authorized the use of Federal funds for both indemnities and operating expenses when States were not in a position to match the Federal payments. This Act greatly accelerated progress.

Still other highlights that for brevity I shall merely name, have been:
- The improvement of tuberculin by producing it on a synthetic medium.
- The numerous achievement-day celebrations held in various States.
- The integrity with which vast sums of money were handled.
- The increasing evidence, provided by meat-inspection records, that bovine tuberculosis has ceased to cause material losses of meat and related products.
- The courage of veterinary and other leaders to stake their professional judgment
- Favorable court decisions on legal phases of the work.

All the highlights mentioned thus far may be considered, to use an astronomical expression, stars of the first magnitude. There are many others, however, of lesser brilliancy.

SHADOWS OF DEPARTED COLLEAGUES

Now let us turn to some of the shadows that, together with the highlights, add depth and character to a picture. Conspicuous among them has been the loss by death, retirement, or otherwise, of many of our former colleagues. True, the work that they helped to initiate has gone on without them, but it is regrettable that all have not been able to observe the results achieved. Of the state veterinarians or other state leaders in office back in 1917, I believe that Dr. W. J. Butler, of Montana, Dr. E. P. Flower, of Louisiana, Dr. W. H. Lytle, of Oregon, and Hon. Andrew L. Felker, of New Hampshire are the only ones still active in the same capacity in the same state.

In connection with the highlights of early planning I quoted a few portions of addresses optimistic in tone. By way of contrast, here are a few extracts singing the blues. I quote from our printed proceedings:

"In our enthusiasm let us not start with any proposition which is going to make trouble for us. . . . The killing idea has been tried before and it is a failure over a large area where there are a large number of animals involved."

Here is another: "For Heaven's sake, get away from the idea that the tuberculin test is going to show that any cow has tuberculosis . . . . We have been handling cows
long enough to know that the test is not a positive diagnosis no matter how it is interpreted and no matter how administered."

NO-LESION REACTORS AND PROBLEM HERDS

For a good many years shadows of doubt concerning the test persisted. At times they combined to form ugly storm clouds, notably in Iowa where violence flared for a time. But with the help of a courageous governor and the militia, the light finally came through. Fortunately, no fatalities were incurred in line of duty, although certain veterinarians were threatened and roughed-up in some cases. The shadow of no-lesion reactors was one of the most persistent and difficult to disperse.

Still another shadow in the tuberculosis picture has been that of problem herds. Like problem children, these herds do not follow the conventional pattern of behavior. But the number of problem herds has been small and cattle owners have now accepted the problem as being one that they and veterinarians must solve together.

By coincidence perhaps, the titles of the first two motion pictures used in the campaign against tuberculosis accurately sum up the 25-year period we are now reviewing. The first picture was entitled "Out of the Shadows." The second one was "Clean Herds and Hearts." Both titles have become actual realities. We are out of the shadows and we have emerged with both clean herds and clean hearts.

It is significant, also, in this critical period in world affairs that those events have occurred in the United States, the land of freedom. The achievement of freedom from bovine tuberculosis is thus a triumph for the democratic form of government.

In conclusion, I feel that this occasion is a fitting one to comment briefly on prospects for eradication of bovine tuberculosis literally and completely. In a practical sense that goal has been achieved, but we are still finding some residual infection in the course of retesting. Also, a small proportion of carcasses observed in Federal meat inspection show lesions, usually very limited in extent. This, of course, means that adequate provisions must be made by the Federal and State Governments to continue the necessary follow-up activities.

One of the most encouraging developments in recent years occurred in the Virgin Islands where the first testing of all their cattle, more than 13,000 in number, failed to disclose a single reactor. Here in the continental United States the monthly tabulations of testing and retesting are likewise showing thousands of tests without any reactors being found in some States.

In recent months I have observed that as many as 8 to 10 States sometimes have had no reactors among some 20,000 cattle tested. Nor are the States involved consistently the same from month to month. All this means that the infection of bovine tuberculosis is being diligently hunted down and destroyed. Complete eradication can and will be achieved.
VETERINARY ORGANIZATION FOR WARTIME SERVICE

BY J. G. HARDENBERGH

Executive Secretary, American Veterinary Medical Association, Chicago, Ill.

For nearly fifty years the meetings of the United States Livestock Sanitary Association have served as a forum for the discussion of disease control problems in livestock. More important is that fact that the deliberations of this association and the reports of its committees have resulted in action, action which has had far-reaching effects upon livestock welfare, public health and the agricultural prosperity of the nation. Here have gathered veterinarians, livestock sanitarians and control officials, loss prevention workers, breeders, research workers in animal disease, public health officers and the rank and file of those who are devoted to the principle that healthy livestock is the chief cornerstone of American agriculture and the most vital factor for the maintenance of a well-nourished, vigorous people.

At this meeting is being celebrated the twenty-fifth anniversary of the inauguration of a disease-eradication program which has had no previous counterpart in the records of livestock production. Its contribution to the welfare of the country cannot be calculated in terms of dollars saved and human lives protected. We are also meeting at a time when this nation confronts the most serious situation in its history with respect to our resources of critical materials and their utilization; when the distribution and conservation of manpower, especially skilled manpower, is a leading problem; and when the production of foodstuffs of animal origin in vast amounts is essential to our armed forces, to our civilian population and to the well-being and survival of other peoples united with us in a struggle for free existence.

In the short space of a year we have passed from a state of embarrassing surpluses of foods of animal origin to one of scarcity and actual rationing. Rationing has been invoked to provide for the proper distribution of foods that are vital to our military forces, to the civilian population and for lend-lease purposes. The scarcities and consequent rationing have come about in spite of the greatest record in the production of livestock, of milk and dairy products and poultry and poultry products ever made by American farmers.

The part which an effective veterinary service and a well organized system of animal disease control have played in the increased production program cannot be properly evaluated but there can be no question of its importance. It is unfortunate, that day-in and day-out animal disease control is a prosaic job, seldom spectacular, and fails to capture the imagination or generate appreciation of its significance except in a limited way. It is doubtful if the American public is even remotely aware of what our plight would be today in the absence of effective animal disease control conducted by well trained personnel. This in spite of the fact that for the past few years a definite program of educational publicity has been carried on. Even our leaders in agriculture and other fields seem to speak only in terms of increased production, the miracles of productive capacity performed by our livestock economy, and too little of the simple but fundamental necessity of
protecting what we already have and so adding to production by reducing losses due to preventable disease.

This association has operated on the plan of coordinated efforts, efficient utilization of scientific knowledge by trained personnel, and in getting all groups who are interested in livestock sanitation to work together toward a common goal. It is a privilege to appear on this program and to report on the "state of the nation," as it were, with respect to the veterinary profession and its wartime organization.

VETERINARY PERSONNEL ORGANIZATION

In the year since Pearl Harbor the aim has been to gear-up and speed-up every activity essential to the successful prosecution of the war. Insofar as the veterinary and allied professions are concerned, steps had been taken even before Pearl Harbor to survey and mobilize our manpower in view of the evident threat to the nation's security.

On October 30, 1941, the President approved the establishment of the Procurement and Assignment Service for Physicians, Dentists and Veterinarians. Its administration was placed in the Office of Defense Health and Welfare Services and subsequently became a part of the War Manpower Commission. The functions of the agency were stated to be (1) to receive from various governmental and other agencies requests for medical, veterinary and dental personnel, (2) to secure and maintain lists of professional personnel available, showing detailed qualifications of such personnel, and (3) to utilize all suitable means to stimulate voluntary enrollment (in the military forces) having due regard for the overall public health needs of the nation, including those of governmental agencies and civilian institutions.

On November 7, 1941, the service was organized. Various national committees were provided to consult and advise with the Directing Board of the P & A Service. A committee of five was appointed to represent veterinary medicine and the organization was then extended to corps areas and to the individual states. A veterinary member of each corps area advisory committee was appointed.

By early 1942, state veterinary chairmen had been nominated by their respective veterinary associations in the forty-eight states and the District of Columbia. These nominees were officially appointed by the Procurement and Assignment Service and, within a short time thereafter, the personnel of these state veterinary committees had been completed. The structure of these committees was such as to be truly representative of the veterinary elements within each state and of the veterinary activities and agencies therein. Thus, most committees consisted of one or more members representing the following: veterinary practice, veterinary education or the veterinary science department of the state college, the state veterinarian or livestock sanitary official, the federal inspector-in-charge, the state examining board and the state veterinary medical association. This method of organization was designed to assure a representative committee which would function capably and fairly in carrying out the duties assigned.

That these committees have functioned in a most commendable manner is now a matter of record. They have helped to secure complete enrollment of veterinarians within their states; they have surveyed the veterinary manpower of each state with respect to the total number of veterinarians, their fields of service or activity, and
their relationship to the civilian and public health needs in the state; they have also surveyed the essentiality of veterinarians in their present work or their availability for service either in the army or for civilian service elsewhere.

On April 15, 1942, questionnaires and enrollment forms were mailed to nearly 13,000 veterinarians in the United States. These forms were returnable to the National Roster of Scientific and Specialized Personnel in Washington which has collaborated in the record work of the Procurement and Assignment Service. The records thus accumulated have permitted cataloging the education, training, experience and special capabilities of nearly every veterinarian in the United States. The enrollment forms enabled each veterinarian to indicate first, second, third and fourth preferences of the military, governmental, industrial and civil categories that may require his services.

The response of veterinarians to the questionnaire survey and enrollment has been outstanding; the veterinary profession has consistently maintained the highest per cent of returns of any professional or technical group. As a result, there is a record of available personnel ready and willing to accept service, when needed, either with the armed forces or in other capacities.

The data collected from the survey is also useful in studying problems relating to the distribution and utilization of veterinary services, in determining replacement needs of the profession, and so helping to guide educational policies.

**EDUCATIONAL ORGANIZATION**

As a corollary to the foregoing survey and the gearing-up of veterinary manpower to meet the needs of the country at war, our veterinary schools have kept pace by adopting accelerated curriculums. By eliminating summer vacations and adopting a year-round schedule, these educational institutions have voluntarily acted to meet any increased need for trained veterinarians. This enables veterinary students to complete the regular veterinary course (exclusive of pre-veterinary work) in about three years instead of four, or at least a 25 per cent "speed-up." In adopting the program, care has been taken to insure that high educational standards shall be maintained—standards which the schools and the American Veterinary Medical Association have advanced over the years and continue to foster. The courses of instruction and the actual time spent in school work by veterinary students is essentially the same as under the usual curriculums.

It is evident that a very definite obligation exists to the schools and to the students taking the accelerated course, namely an obligation that the speed-up program shall not have been in vain insofar as the utilization of this increased veterinary manpower is concerned. For obvious reasons, all the schools were somewhat reluctant to undertake the acceleration but did so in good faith and with the expectation that the trained personnel graduated would be needed and used in a professional capacity to meet either military or civilian needs.

Recent developments have lent an uncertainty to the situation that must be resolved by the responsible governmental agencies, if the fruits of the accelerated educational program are not to be wasted. There is no sense in stepping up the output of graduate veterinarians unless their training and services are utilized in a professional capacity. There are areas without adequate veterinary service or
entirely lacking in it; there are public health requirements for veterinary personnel which cannot be met; there is needed research in animal diseases which is not being done for want of trained men to do it. This is a problem which must be given utmost consideration by whatever agency is finally charged with the manpower problem in order to crystallize a workable policy for the conservation of trained veterinarians.

ASSOCIATION ACTIVITIES ORGANIZED FOR WARTIME NEEDS

The past year has witnessed developments that are significant not only as wartime projects but also for their potential value to the livestock industry to meet peacetime needs. The future demands upon our flocks and herds to replenish the animal economies of the war-devastated countries will be very large and upon our ability to supply healthy breeding stock will depend rehabilitation of the health and wealth of peoples in several parts of the world.

One such activity is the formation of the Inter-Association Committee representing, at present, five different organizations directly interested in livestock problems. These cooperating associations are the United States Livestock Sanitary Association, American Society of Animal Production, American Dairy Science Association, Poultry Science Association and the American Veterinary Medical Association.

As a result of conferences begun last April, definite plans are taking shape to secure better correlation of animal health factors and production efficiency. The potential value of such inter-association cooperation is evident. It brings to bear upon the problems a coordination of thought and effort that should have far-reaching results. Special committees of the American Veterinary Medical Association have also been appointed to devote attention to the diseases of dairy cattle, beef cattle, sheep, swine, horses and small animals. The immediate thought behind this work is not to develop new knowledge or new methods of animal disease control but to make most effective use of the knowledge we already possess. These committees will put into the hands of veterinarians a summation of proven ways and means that can be used now to aid livestock owners and obtain better health of their herds and flocks. Such information can contribute much by reducing losses in young animals especially and it is obvious that every loss prevented represents an automatic increase in the numbers of animals marketed for food.

The special committees mentioned are in addition to standing committees of the association such as those on nutrition, poultry, brucellosis and others, all of which are actively concerned in work with a definite bearing on improved livestock health and sanitation.

THE FEDERAL AND STATE BUREAUS

Any accounting of veterinary organization to meet wartime needs would be grossly incomplete without mention of the federal and state agencies officially charged with the control of livestock diseases. Before this assembly it would be like carrying coals to Newcastle to recount the relationship of the federal Bureau of Animal Industry and the corresponding state agencies to our present favorable animal health status. Over a period of many years these organizations have func-
tioned faithfully and with great efficiency, but without fanfare, to make America the safest country in the world to raise livestock. In wartimes, the responsibility of these agencies is grave but they have repeatedly demonstrated their alertness to meet any threat.

Working together as they do, the federal and state bureaus of animal industry have shown what cooperative efforts can accomplish in eradicating infectious livestock diseases. Moreover, they have further strengthened the overall ability of veterinary services to cope with animal plagues by utilizing the rank and file of veterinary practitioners to help carry on disease control programs. The wisdom of this part-time use of private veterinarians seems especially plain in wartimes: it has accustomed a large cross-section of the veterinary profession, individually and collectively, to cooperative disease control measures under the guidance of the federal-state agencies. Thus, with a limited number of federal and state veterinarians to serve as the organizing and directing force, several thousand practitioners in the field serve as reserve manpower that can be called upon in an emergency to help stamp out contagious diseases. It would seem that the value of such a reservoir of men, trained and accustomed to the rigorous demands of effective sanitation and control procedures, should not be underestimated and that every opportunity should be taken to extend the participation of veterinary practitioners in programs of disease eradication. Moreover, such training and participation makes the practitioner more conscious of and effective in his role as the “first line of defense” in recognizing and preventing the spread of animal contagions.

THE ARMY VETERINARY CORPS

I have no authority or intent to speak of the work of the Veterinary Corps of the Army other than to call attention to its accomplishments. As this meeting marks a twenty-fifth anniversary celebration in disease control, so does this year mark a twenty-five year anniversary for the veterinary military service as we now know it. Sired and conceived by the necessities of World War I and born after a very brief gestation period, also shortened by necessity, the Army Veterinary Corps struggled as somewhat of an ungainly infant through the “blood, sweat and tears” of that conflict and emerged as a promising adolescent. Since that time, thanks to the calibre of veterinary officers who remained in service through the interlude of peace, the nation today has a mature veterinary military service trained to its job, alert, and staffed by a corps of men who reflect great credit upon veterinary science and its application. The health, efficiency and morale of our armed forces are to a very real degree dependent upon the quality and wholesomeness of the foods of animal origin which are under veterinary supervision from the primary source until issued to the troops.

In conclusion, it may be said that our nation is prepared veterinary-wise for wartime if full utilization is made of the trained personnel available and of the established veterinary agencies. There is a regrettable lack of recognition of what an effective veterinary service can do if its full potential for service is called into action. There are forces at work which, if allowed to exert their full effect, would nullify competent disease control and place it in the hands of untrained persons
whose primary and almost sole interest is monetary gain. As livestock sanitary
officials, legally responsible and charged with protecting livestock health, it would
seem that many of you have a very direct interest in the situation.

The rank and file of veterinarians today stand ready to serve wherever needed.
They are aware of their added responsibilities and ask only a reasonable oppor-
tunity to do the work for which they are trained. As an individual, the veteri-
narian realizes that his reason for existence is not simply to make a living for him-
self but that he and the science he practices are dedicated to livestock welfare. No
better summation of the situation has ever been expressed than by L. A. Merillat
in the January issue of the Journal of the American Veterinary Medical Association:

"The function of the veterinary profession is understandable. The raw material
of human sustenance is the gift of gregarious herds, susceptible kindling for communi-
cable infections, deadly, sweeping, stealthy, insidious, ever present and always ready
to flare. Shelter and food are man's principal needs. It is as suicidal to neglect one
as to unwisely manage the other. Precisely to the same extent that fire departments
prevent man's shelter from being swept away by flame, so does the disciplined vete-
riinary service prevent his food from being abolished by disease."

Today, when threatened food shortages are almost daily front page news, that
statement may well serve as a guiding principle not only for veterinary organiza-
tions everywhere but for those in high places who control the country's destiny.
PERSONAL OBSERVATIONS ON THE IMPORTANCE OF ANIMAL HEALTH IN THE BRITISH WAR EFFORT


Animal Disease Station, U. S. Bureau of Animal Industry, Beltsville Research Center, Beltsville, Maryland

Shortly after the return of Dr. Adolph Eichhorn from England last year, where he had participated in discussions relative to war-time control of livestock diseases, the British Ministry of Agriculture and Fisheries officially requested assistance in establishing facilities for the production of Brucella abortus strain 19 vaccine. It was the desire of the animal health authorities to employ this vaccine for the control of bovine brucellosis, in a manner similar to that followed in the United States during the past several years. As a result of this request, I was privileged to accept a temporary transfer from the Animal Disease Station, Beltsville, Maryland, to the Ministry of Agriculture and Fisheries Veterinary Laboratory, Weybridge, England, to assist in the program.

Through the generous courtesies extended me by the British government, it was possible to observe many of the war-time activities, especially those relative to the conservation and utilization of available food resources. In this connection, there seems to be a universal appreciation of the necessity for reducing shipping tonnage devoted to the importation of food products. This is apparent in the increased efforts on the part of everyone to expand home production to the limit. These undertakings have been and continue to be of a very broad scope, designed for an ultimate goal as near self-sufficiency as possible. In spite of innumerable difficulties associated with such a plan, particularly during emergency periods such as the present, the progress made is truly amazing.

Great accomplishments have been achieved in the program for increased acreage of arable land. Emphasis is also being placed on the necessity of maintaining at present levels a normally limited capacity for meat and milk production. The pre-war dependency on imports for many of the livestock feedstuffs, particularly concentrates, has placed a very heavy burden on these efforts. Furthermore, the relatively small area of the country itself is an important limiting factor in the expansion of the livestock industry. In fact recent programs are being designed more from the standpoint of improving the productivity of stock now on hand, rather than numerical increases in the livestock population as a whole.

The Ministry of Agriculture has made it clear that for the 1943 autumn and winter period, the farmer must expect to feed his cattle, as well as other stock, on what he can raise himself. Here again, we see evidence of the critical shortage existing in reserves of imported concentrates. As a direct result, agricultural campaigns have been inaugurated and are responsible for over 4,000,000 acres being added to the tillage area since war broke out. However, it is considered probable that the maximum tillage area has virtually been reached. In other words, while further considerable areas might be ploughed during coming seasons, others might of necessity be allowed to revert to grass. As a matter of fact, ploughing for improved pastures,
through reseeding, is considered equally important to the increased need for arable land. Large sums of money and considerable effort are being expended in reclaiming derelect land and putting as much acreage back into production as possible. This program is proving to be a good investment, not only for the present emergency, but also for generations to come. The realization has been driven home to the people of Britain that nutrition, important in peace, is vital to a nation at war.

In spite of the necessity for wholesale readjustment and modification of practices followed in the past, it is recognized that the farmers as a whole are rendering excellent service. Farm management, from the standpoint of livestock maintenance, now depends upon the capacity of the individual for growing feeding-stuffs on the farm and has resulted in vast differences between current and pre-war winter feeding standards.

Despite the difficulties of war, the farmers have practically maintained the 1938 level of milk production. Milk produced in 1938, the last year of peace, was approximately 1,076,000,000 gallons. In 1941, production was 1,053,000,000 gallons, but the liquid milk consumed had gone up by some 200,000,000 gallons.

The 1939 record figure of 6,762,000 covering the number of cattle in Great Britain was surpassed in 1941, in spite of the extensive ploughing up of thousands of acres previously devoted to pasture. This total includes an increase in the number of dairy cattle, which in 1939 approximated 3,000,000. Sheep have been fairly well maintained around 18,000,000, and although the pig and poultry populations have been reduced, these reductions have not been so great as was anticipated.

Shortages of farm workers and machinery are two of the more serious handicaps under which British farmers have to work. In order to alleviate this situation to some extent, a women’s land army of some 65,000 has been organized throughout England, Scotland and Wales. In addition, a limited number of Italian prisoners of war have been available for controlled service.

All key farm workers have been given deferment from the draft, and every effort has been made to insure adequate farm labor. County agricultural committees have small labor and machinery pools from which hard-pressed farmers may draw. Incidentally, the number of tractors in Britain has increased from 50,000 before the war to nearly 150,000 at the present time.

It was insistent demands for increased production of meat and milk which led to a serious consideration of animal disease control to compensate, in some measure, for the effects of unusual war-time conditions. In anticipation of such an eventuality, the National Veterinary Medical Association of Great Britain and Ireland, early in the war, sponsored a survey committee delegated to examine the existing animal health situation and to ascertain those methods currently applicable for the rational control of disease. This committee issued a report in November 1940, in which the general livestock position in the country was reviewed and specific recommendations made in regard to the control of selected cattle diseases. It was pointed out in this report that the need for concerted action to prevent disease among livestock is greater at the present time than ever before in the history of the country. The seriousness of the situation is emphasized further in this report by the statement that “Diseases are raging among the livestock of this country, exacting a toll
upon the nation's food at a time when this can ill be spared.” From this beginning, the Ministry of Agriculture and Fisheries in collaboration with the National Farmers Union of England and Wales, and the National Veterinary Medical Association, evolved a program for the control of selected dairy cattle diseases. This group of diseases, including mastitis, contagious abortion, sterility, and Johne's disease, was considered responsible for very great losses to the nation's milk supply. A conservative estimate of these losses has been placed at 50,000,000 gallons annually, which does not take into consideration the reduction in the meat supply accompanying such conditions as abortion and sterility.

MINISTRY OF AGRICULTURE AND FISHERIES SCHEME FOR THE CONTROL OF DISEASES OF DAIRY CATTLE

The Scheme, which came into operation on June 1, 1942, is primarily an agreement between the farmer and his local veterinarian in which certain approved methods will be carried out for the control of mastitis, contagious abortion, sterility and Johne's disease. The control methods adopted were selected and agreed upon by the three cooperating agencies after full discussions in which qualified sanitary and research experts participated. Moreover, the methods advocated had the approval of the British Agricultural Research Council, a body in which responsibility for research pertaining to agricultural problems is vested.

The Ministry of Agriculture provides free laboratory service for necessary diagnostic work, supplies Brucella vaccine free of charge, and sulphonamides at reduced cost.

The veterinary profession, through its national organization, has agreed to a scale of fees which is considered moderate and reasonable for the services rendered. The annual cost to the farmer under the Scheme is as follows:

**Cows**
(a) In herds up to and including 50 cows:
- Each cow up to and including 10 ........................................... $2.50
- Each cow over 10 .................................................................. 2.00
(b) In herds of over 50 cows:
- Each cow ............................................................................ 2.00

**Heifers**

For each heifer from the age of 6 months to day of first calving...... .50

The above fees are subject to a reduction of 10 per cent in the second year and 20 per cent in the third year of the period covered by the undertaking. An additional charge of 50 cents is made for each animal treated with sulphanilamide, and the veterinarian may charge mileage at the rate of 7 cents per mile for travel in excess of 10 miles each way. No agreement is valid for a period of less than one year, and the farmer is encouraged to extend this to cover either two or three years in order to secure the best results. It should be pointed out that the Scheme is entirely voluntary at the present time, and no attempt has been made to force universal adoption of the plan. Aside from a sane and practical educational program of limited extent, the entire effort has been made through local practitioners.

The immediate objective of the Scheme, as set forth by its sponsors, is a short term control policy designed to meet the need for a maximum milk supply. In the
background, of course, a basis is being established for eventual eradication of those diseases covered by the plan. A brief review of these four diseases and recommendations for their control may help to orient the animal health situation in relation to the program.

**Mastitis**

Although several distinct forms of mastitis are recognized in Great Britain, the common chronic streptococcic type due to Streptococcus agalactiae is of widest distribution, having an incidence of approximately 35 per cent of all milking cows. It is recognized as being responsible for more clinical mastitis and loss of milk than all other types. Other forms of mastitis, representing the more acute manifestations, are apparently of minor economic importance. The actual monetary loss due to mastitis has been estimated as approaching the figure of 3,000,000 pounds sterling ($12,000,000) each year. Recommendations for control, as laid down by the Scheme, emphasize the importance of early diagnosis and appropriate segregation of infected animals. Routine clinical examinations by the cooperating veterinarians and bacteriological examinations, where confirmation is required, are the basic elements of the diagnostic procedure employed.

After recognition of the disease, two general lines of treatment are followed. Acute clinical cases receive administrations of sulphonamides, by which it is believed at least 60 per cent of the cases can be cleared up clinically. In the subclinical and chronic cases, treatment consists of irrigation of the udder with solutions of the acridine compounds. The general picture in regard to mastitis is much the same as observed in this country, and the importance of the problem as a whole is demanding increased consideration in both countries.

**Bovine Brucellosis**

The most common cause of infectious abortion in Great Britain is Brucella abortus. The disease has assumed even greater importance in the British Isles than here, due to the high percentage of infection believed to exist throughout the country. Although no comprehensive data are available concerning the actual incidence of the disease, most reliable estimates place the figure at 30 to 40 per cent. This figure is substantiated in part by the fact that a conservative estimate of the number of cows aborting each year has been placed at something over 300,000, roughly 10 per cent of the entire dairy cattle population. An abortion rate of this magnitude would no doubt have to be associated with a very high incidence of infection. The average British dairy farmer is becoming increasingly conscious of the ravages caused by brucellosis and is anxious to cooperate in any program which offers encouraging prospects for controlling the disease. It was interesting to note the great enthusiasm and intelligent spirit of cooperation shown by dairymen in attendance at stock improvement meetings held throughout the heavy milk-producing sections. In most instances, the greatest criticism of the Scheme has been its voluntary aspects. Many farmers seemed to feel that compulsory participation was desirable if the greatest good in the shortest period of time were to be accomplished.

Although a limited amount of testing has been carried out in the past, no con-
certed effort has been made to control the disease on a nation-wide basis. Recent experimental studies carried out by Dr. A. D. McEwen, Advisory Veterinary Officer in the Ministry of Agriculture, has stimulated considerable interest in preventive vaccination throughout Britain. The vaccine endorsed by Dr. McEwen is a living product developed from a strain of Brucella abortus which possesses no agglutino-genic properties. Dr. McEwen's work, however, has not been sufficiently extensive at the present time to permit a true evaluation of the vaccine. Moreover, the admitted necessity of repeated injections, at yearly intervals, suggests a dangerously low potency value. Additional work under supervision of the Agricultural Research Council will be carried out before this product receives unqualified official sanction. The uniformly satisfactory results obtained through calfhood vaccination with strain 19 in the United States encouraged British authorities to believe that an identical program could be adopted with success in Great Britain.

Obviously, eradication through test and slaughter procedures was out of the question. In the first place, such a program would reduce the number of milk cows far below a point that could be safely tolerated, especially when shortages are more critical than ever before. In the second place, the funds necessary for compensation of owners on a scale as large as this, would be extremely difficult to obtain during times of national emergency. It was in consideration of these facts that a request for assistance in establishing facilities for the production of Brucella abortus, strain 19 vaccine was made.

The essence of recommendations incorporated in the Scheme for the control of bovine brucellosis points out the advantages to be gained through the use of living vaccines in herds where infection is known to exist. Strain 19 vaccine will be employed for the vaccination of adult animals as well as calves. In no case will the use of the McEwen vaccine be permitted, except where specifically requested for adult vaccination. Blood testing and segregation of reactors are recommended only in herds which are lightly infected, and where the system of herd management is such that the application of this system has every assurance of success. There will probably be only a small minority of cases suitable for this kind of a program. There is every reason to believe that an extensive vaccination program, carried out in the manner planned, will justify further the growing conviction that this procedure is the logical approach to the control of bovine brucellosis.

**Sterility**

Sterility and temporary infertility are considered to be of sufficient economic importance in Britain for inclusion in the Scheme. The number of animals affected is estimated to be between 25 and 35 per cent each year. Based on this estimation, it is readily apparent that significant losses may well be associated with these conditions, and proper control can be expected to pay worthwhile dividends from the standpoint of increased production. In view of the high incidence of brucellosis, there is every reason to believe that a great number of these cases are sequelae to active abortions, which may be followed by persistent secondary infections of the genital tract. Other causes of sterility are of course recognized; these include contagious granular vaginitis, contagious vesicular vaginitis, and physiological derangements.
Recommendations for the control of sterility stress the need for frequent periodic examinations of all cows and heifers by the veterinary practitioner, in order that remedial measures may be carried out as quickly as possible. Wherever necessary, the use of suitable hormones is encouraged and every effort is being made, through practical demonstration schools, to familiarize the cooperating practitioners with the latest information available on sterility control. It is expected that, as a result of close veterinary supervision, many of these conditions will be diagnosed sufficiently early to minimize the losses that otherwise would assume serious proportions. The interest displayed by the majority of British practitioners in preparing themselves for efficient service along these lines, indicates the widespread prevalence of sterility throughout the country. By qualifying himself, the average veterinarian hopes to be in a position to advise intelligently and administer treatment along lines currently recognized as the latest developments in a previously neglected field.

Johne's Disease

The inclusion of Johne's disease in the control Scheme was justified by accumulated evidence indicating a probable increase in the prevalence of this disease throughout some English counties. No accurate information is available concerning the extent of the infection, although a significant incidence is believed to exist.

The use of Johnin, having an acceptable specificity and proven potency, is recommended as a diagnostic agent in suitable herds. Animals reacting positively to the intradermal test are to be segregated, and the slaughter of clinically infected animals advised. It is considered probable that, by adopting good farm management practices and exercising reasonable care from the standpoint of sanitation and hygiene, satisfactory control of the infection will be possible.

This covers, in a very brief manner, the livestock diseases requiring war-time consideration. It should be pointed out that this selection was predicated on the necessity of controlling those diseases which were accounting for the greatest economic losses. Consideration was also given to the fact that adoption of known methods of control in the case of these four diseases offered considerable prospect of reducing important losses within a reasonable period of time. It is too early to determine the eventual results which may be secured from the program. This will depend to a very large extent upon the reception accorded the plan by the dairymen themselves. However, at the time of my return, late in July 1942, there was every reason to believe that the program was off to an encouraging start. As already pointed out, the primary purpose of my mission to the United Kingdom was to assist in establishing facilities for the production of strain 19 vaccine. In spite of some delay experienced in assembling necessary equipment, some of which was flown to England by bomber from the United States, laboratory arrangements were complete when the Scheme came into operation on July 1, 1943. By the last day of July, Brucella abortus vaccine was being dispatched at a rate rapidly approaching 1,000 doses per day.

A word or two concerning other diseases encountered in Great Britain may be of some interest in their relationship to similar problems existing in the United States. With the exception of foot-and-mouth disease, the affections common to
British livestock are much the same as in this country. The incidence of the more chronic infections, however, is no doubt considerably higher in Britain. This is attributable, in part, to the fact that the livestock industry in Great Britain is centuries older than our own, and also to modern intensification of production schedules that has unfortunately become far too common throughout the world.

The work of the Animal Health Division of the Ministry of Agriculture, under the able leadership of Mr. D. A. E. Cabot, Chief Veterinary Officer, has been most effective in controlling the more acute or so-called "Scheduled Diseases." The organization of this division is quite similar to our own Bureau of Animal Industry and functions through regional field offices located in various sections of the country.

Foot-and Mouth Disease

Considering the proximity of Britain to continental seats of infection and the necessity of heavy importations of meat products, the effectiveness of foot-and-mouth disease control is quite remarkable. The procedures employed for localizing individual outbreaks are necessarily rigid and include prompt establishment of quarantine zones around infected premises. Within these zones, all movements of animals are restricted, and immediate slaughter of all clinical, as well as contact, cases undertaken. Prior to the war, all of these animals were destroyed on the premises by burning as quickly as appraisals could be made. However, at the present time, due to emergency requirements for conservation of food, only the carcasses of clinically affected animals are destroyed. The contacts are slaughtered on the premises by a crew of expert butchers, and the meat salvaged for human consumption. Blackout regulations now in force have made it necessary to carry out destruction of carcasses by deep burying in lime, rather than by burning. It is interesting to note that in spite of current food restrictions, informed farming opinion generally supports the slaughter policy. The extent of the foot-and-mouth disease problem is emphasized by the number of confirmed outbreaks. For the nine months beginning January 1, 1942, 415 confirmations were reported by the Ministry of Agriculture. A high percentage of outbreaks have been in swine, the source of which in many instances has been traced to the feeding of uncooked garbage. In order to minimize this danger, concentrator plants for the treatment of swill are being established near military camps throughout the Southern Command. It is intended to expand these facilities so that eventually all parts of the country will be served. So far, no case of foot-and-mouth disease has been traced to garbage from these concentrator plants.

Activities of the foot-and-mouth disease station at Pirbright have been expanded during the past few years, and research being carried out at the present time gives promise of more effective control measures to come.

Hog Cholera

Hog cholera, the American equivalent of British swine fever, has not assumed the same importance in Britain as it has in this country. There are indications that the incidence is increasing and, therefore, the control of the disease is securing more attention than in the past. Immunization with serum and virus has never been practiced; in fact the use of the simultaneous treatment is prohibited by law.
Quarantine and slaughter measures applied under the Diseases of Animals Acts have been relied upon exclusively to control outbreaks as they have occurred. Although the incidence of cholera is not extremely high, 329 outbreaks having been reported between January 1 and September 15, 1942, the potential danger of uncontrolled epidemics has led to a serious consideration of immunization procedures, employing crystal-violet vaccine. Comprehensive experimental studies of this product completed recently at the Weybridge laboratory have confirmed the favorable results obtained in the United States. The acceptance of this procedure in some form, either to complement existing quarantine and slaughter measures or along even broader lines, appears probable.

_Tuberculosis_

The estimated 40 per cent bovine tuberculosis existing in British cattle presents a difficult problem from the standpoint of control, especially during periods of emergency such as the present. With this degree of infection, methods based on eradication by test and slaughter are quite unacceptable. Such a procedure, undertaken on a wide scale, would deplete the cattle population to such a level that it would be impossible to secure necessary replacements. As a matter of fact, it would mean the probable elimination of 50 per cent of the cattle and could be tolerated only as a gradual process extending over long periods of time. Furthermore, the cost of such a program would be staggering. In normal times, cattle prices are considerably higher in Britain than here. War-time prices for dairy stock have naturally increased during the present emergency to the point where an average grade cow may be worth from 50 to 60 pounds sterling, or roughly $200.00 to $250.00. These prices become correspondingly higher in pure bred lines, depending upon the quality of breeding.

Interference with the effectiveness of the tuberculin test by cross-sensitization with avian strains, also has been a factor responsible for the limited testing carried out in the past. Extensive studies dealing with attempts to increase the specificity of the test through modification of the tuberculin are now in progress. From these, it is hoped that improved methods of differentiation may be developed.

Although past efforts to develop an immunization agent suitable for the control of bovine tuberculosis have been unsuccessful, further research along these lines is being carried out at the Cambridge Institute of Animal Pathology. These studies deal primarily with the use of the attenuated B.C.G. culture and an atypical acid-fast organism which specifically affects the vole, or English field mouse. The progress, while necessarily slow, has been sufficiently encouraging to justify continuation and expansion of the work.

After the war, the United States and the British Empire will be faced with a tremendous responsibility in restoring Europe's livestock. The occupied countries will have been greatly depleted of much of their best stock by the time hostilities cease. Restoration of suitable breeding stock to continental European areas will for the most part have to be supplied from America and British Dominions. This problem is already receiving serious consideration in Britain, although the British position in this regard is far less favorable than our own, from the standpoint of potential numbers of desirable stock available. Moreover, the enviable position
enjoyed by the livestock industry in the United States as regards freedom from disease is unexcelled throughout the world. Therefore, in the near future, livestock sanitary officials of this country may well see a greater justification of their past efforts than anyone has ever had reason to anticipate.

After expecting to find the British on the verge of starvation, it was a pleasant surprise to me to see men, women and children on the streets of London showing no evidence whatsoever of being undernourished. Of course, drastic reductions in the food supply have been necessary, but not to the extent that nutrition has been jeopardized. The Ministry of Food deserves a great deal of credit for the efficient manner in which food distribution has been handled. The English “points” rationing system, based on considerably less food than will be available under rationing in this country, has been entirely adequate. The job has been so equitably carried out that everyone is sure of getting a fair share of essentials at reasonable prices.

No people in the world have ever had more excuse to be sick, disspirited and generally in poor health than the British, after being subjected to indiscriminate bombings. London, Coventry, Bristol and many other ravaged cities have gone without water, gas and other services for days at a time. It has been necessary in many cases to move large population centers to other less exposed sections. In spite of these emergency measures, investigations have shown that the general health level of the British people, after more than three years of war, is better than ever. The most logical explanation of this lies in the fact that rationing has regulated the eating habits of the entire population along dietetically controlled lines. The general state of morale shown by the people is extremely high. Everyone is quite willing to accept the hardships and privations necessary to further the war effort. Under the circumstances, such high morale certainly speaks well for their leadership and the equitable manner in which an extremely critical food situation has been handled.

In conclusion, I might add that I have returned from Britain with renewed faith in the proverbial dogged determination of the British to see this deplorable war through to a victorious finish. The courteous reception and splendid cooperation accorded me during the five months spent in the United Kingdom, confirms my conviction that the two countries have much in common. It was most encouraging to note the interest displayed by scientific groups for developing a closer cooperation between Britain and America. The high regard we in this country have always held for British science and British scientists is similarly held by them for our own accomplishments. The desire for international cooperation, especially in the fields of science and learning, should receive favorable consideration in both countries. And if the exigencies of war will aid in bringing about a closer spirit of cooperation in this respect, we should make every effort to see that post-war complacency is not allowed to interfere with a program that offers so much in the way of mutual benefits.
REPORT OF THE COMMITTEE ON MISCELLANEOUS TRANSMISSIBLE DISEASES

ADOLPH EICHHORN, Chairman, Beltsville, Md.; C. E. Fidler, Springfield, Ill.; L. M. Hurt, Los Angeles, Cal.; Hadleigh Marsh, Bozeman, Mont.; John W. George, Jefferson City, Mo., Sam McCue, Albuquerque, N. Mex.

During the past year no extensive outbreak of any transmissible disease occurred in the United States, which, in consideration of the greater effort now made in the production of livestock, must be recognized as accreditable performance of the livestock sanitary and veterinary profession. The general appeal for concerted effort on maximum production without the necessary preparation in buildings, equipment, etc., for such an effort results in a greater crowding and consequently greater exposure to infection, yet no increase in losses has been reported from infectious diseases.

No striking development in methods of control has occurred during the past year although from all reports it is evident that research in the control of animal infections is proceeding on an intensive scale throughout the country. Your committee will not endeavor to discuss the diseases for which special committees are appointed; however, it is very noteworthy that the incidence of bovine tuberculosis is comparatively negligible and that the control of brucellosis according to the various programs in the different States is making progress.

Equine encephalitis was less prevalent in 1942 than in any year since 1936, according to the reports thus far received by the Bureau. Up to November 1, when the disease was rapidly subsiding or had disappeared in many States, only about 3,200 cases had been reported from the 34 States where the disease was recognized.

The distribution of the disease remained about as in other recent years, except for a notable decrease in incidence in the Southwest, including Texas. Again, however, California reported over 200 cases. Relatively few scattered cases, but with the usual high mortality attending infection with the eastern type virus, occurred in 10 Eastern and Southern States.

A quite limited, but sharp outbreak of the disease with high mortality occurred late in the season in Michigan. Eastern type virus was recovered in the Bureau laboratories from the brain of one representative case. This is a very interesting finding, since western type virus was found in a Michigan case only last year. It emphasizes the desirability of frequent sampling from each outbreak to determine the type of virus operating in the locality.

Exact figures on the extent and results of vaccination are not available, though 74 cases of the disease were officially reported in vaccinated horses. Some, but not all of these, were in farmer-vaccinated animals. Laboratory confirmation of the diagnosis was not obtained in any of these cases, but there is little apparent reason in most instances to doubt the accuracy of classification as bona fide cases of infectious equine encephalomyelitis.

Practitioners and livestock sanitary authorities have in general supported and contributed to the collection by the Bureau of epizootiological data on the disease.
It is believed that this program should be continued with concerted efforts to secure detailed and accurate information.

From accumulated data, it is evident that during the past year only a limited number of infections in human beings due to the virus of equine encephalomyelitis were diagnosed. The low incidence of the disease in horses may account for this reduction of the disease in man.

Concurrent with the demand for a greater production of milk, there has occurred an unusual increase in the incidence of mastitis in dairy cows. Since the number of cows in lactation cannot be expanded immediately, any increase in volume must come from the individual animal. To accomplish this end, heavier feeding must be instituted. It is a recognized fact that this practice is followed almost invariably by a marked increase in udder disease. The strain of additional milk secretion creates a fertile field for the activities of mastitis bacteria. Previously sound udders become more susceptible to invasion by these bacteria and chronically affected udders develop into clinical cases.

Until a few years ago, no treatment for the disease was available. Since that time several chemotherapeutic agents—acriflaxine, Entoson, colloidal silver oxide, and tyrothricin—have been recommended for the treatment of streptococcal mastitis. More recently iodized oil and sulfanilamide in oil have been recommended for the same purpose. A number of reports dealing with the results obtained with these products, particularly the earlier ones, have appeared in the past year. Although these reports in general have been promising, the products have been used on a relatively small scale and on a more or less experimental basis. No conclusion, therefore, can be reached relative to their practical value in the treatment of streptococcal mastitis until such time as these agents have been thoroughly tested in the field by the practicing veterinarian. Pending a final decision in this matter and in view of the current necessity for a greater volume of milk, even more extensive use of strict sanitation and segregation of infected animals would seem advisable.

Recently the occurrence of a serious infection in breeding sheep has been noted especially in the range states. This disease is a specific mastitis, caused by infection with Pasteurella mastitidis. It is so acute that treatment is ineffective. Investigation of methods of prevention and control are being carried on. For the present, the fact that this condition is caused by a specific infection should be recognized, and sanitary measures should be used in its control, until further progress can be made in the investigations.

In the western part of the United States, immunizing agents for two bacterial diseases have proved very encouraging. One of these is bacillary hemoglobinuria (redwater) of cattle, for which there is commercially available a more effective vaccine than was produced a few years ago. A focus of this disease has appeared in a State not previously involved and an attempt is being made to prevent spread from this focus by vaccinating all the cattle in the immediate vicinity. The other is the Clostridium novyi vaccine for the prevention of black disease in sheep. This disease, characterized by sudden death caused by C. novyi toxin, resulting from the development of C. novyi in livers invaded by young liver flukes, causes rather
serious losses in the West Coast States and the intermountain country. It is being successfully combatted by the use of the vaccine, which has recently become commercially available.

The necessity of being on the alert for the introduction of infectious diseases of animals is vividly shown in the recent report by Dr. L. M. Hurt, of the Los Angeles County Live Stock Department, in the suppression of a Southern cattle tick invasion. Ticks were found on cattle which were traced to importations from across the Border. Immediately a control program was started. Cattle of the shipments in question were traced to 31 dairy herds comprising over 5,000 animals which were quarantined. An inspection force was formed; each animal in these herds was searched for ticks; and where found, power spraying with arsenical preparations was done every two weeks. These procedures, together with segregation and the creation of "tick-free" areas on the premises, resulted in the eradication of ticks, and the prompt suppression of what undoubtedly might have been a serious outbreak of piroplasmosis. The methods used in this work were unique due to conditions obtaining in that section and Dr. Hurt deserves the praise of the committee for the excellent manner in which this threat was overcome.

The sulfonamide preparations, which have shown great merit in recent years in human medicine, are being shown to possess remarkable therapeutical properties in certain diseases of animals. It is desired here especially to mention sulfaguanidine which has proved one of the most promising agents in the control of enteric infections. Sulfaguanidine, contrasted with other sulfa-preparations, has a low absorption rate in the gastro-intestinal tract and as a result its concentration in the digestive tract is many times greater than in the blood, thereby lending itself admirably to bacteriostatic action on organisms in the gastro-intestinal tract. The tolerance of animals for sulfaguanidine is high and its toxic dose is considerably above its therapeutic dose.

The use of sulfaguanidine has been reported by Thorp, Shigley, Wise, and Anderson in the treatment of white scours in calves, with clinical symptoms usually subsiding in two to four days. It has been shown by Kernkamp and Roepke to possess exceptional merit as a therapeutic agent for the treatment of infectious enteric complex in swine commonly grouped under such terms as infectious enteritis, necrotic enteritis, etc., and by Levine (in concentrations of as low as 0.5 percent of ration) in the prevention of infection with those species of coccidia that complete their life cycle in the intestine. Studies were conducted by Foster, Christensen, and Haberman on the use of sulfaguanidine for the treatment of coccidiosis in lambs. Their observations that administrations of sulfaguanidine in 2 gram amounts per lamb daily, except Sunday, prevented completely the acquirement of natural coccidial infections in five lambs, and rapidly reduced to insignificant proportions heavy existing subclinical natural infections in four lambs. Observations by Bryan indicated that sulfaguanidine appears to offer the small animal practitioner an effective chemotherapeutic agent for the treatment of enteric infections, particularly watery diarrheas of bacterial origin.

The utilization of sulfaguanidine under field conditions will establish its indications in the many diseases for which it is now suggested and it is hoped that with
its availability the veterinary profession will evaluate it and will carefully note its action and make the information available to the veterinary profession.

In the present emergency, the importance of controlling all livestock diseases prevalent in this country need not only be re-emphasized but your committee also stresses the necessity of the greatest watchfulness to be exerted by veterinarians and livestock sanitarians on any foreign disease which might be introduced into the country. It is generally known that in the wake of wars, the possible introduction of foreign diseases is greater than in peace time and therefore we must be alert and ready to act in any emergency which might occur.
COMMITTEE ON LEGISLATION


Your Committee on Legislation, in attempting to collect information concerning new legislation from the various states pertaining to the control and eradication of contagious, infectious, or communicable diseases, sent out a questionnaire requesting that copies of any new laws or regulations be sent to the Committee and requesting information as to whether an appropriation had been made for the carrying on of a co-operative Bang's disease control and eradication program with the United States Bureau of Animal Industry and requesting information as to whether or not this appropriation was an initial one for this purpose.

Forty-six out of the forty-eight states reported and twenty-seven reported no new laws passed during the past two years. A great many of these, however, reported changes in various regulations.

One state passed a law governing mastitis in cattle and appropriated $25,000.00 for the testing, by the laboratory method, for the detection of this disease and for continuing the study and experimental work now under way at their College of Agriculture.

Two states passed laws governing livestock sales rings. These laws provide for the bonding and licensing of the operators and provide for the proper inspection of all livestock by the livestock sanitary department of the state.

A few states passed adequate laws governing rendering plants.

Most of the changes in the various states have been brought about through regulations made by the livestock sanitary departments.

Many of the new regulations deal with changes in area Bang's testing due to calfhood vaccination being officially recognized.

Other regulations passed govern the sanitary requirements of auction sales, prescribed tests, immunization and dipping of certain classes of livestock.

The increased number of regulations of this type indicate that the majority of livestock sanitarians are fully aware of the danger of these disease-mixing stations to their state's livestock industry and are trying to do something about it.

Thirty-eight states reported that the last legislative session in their state appropriated money for the co-operative Bang's disease-control program with the United States Bureau of Animal Industry. This indicates an increase of two states making such appropriations. From the investigations made by your Committee, it has been found that four states made initial appropriations for this purpose, indicating that, at least, two states that formerly made such appropriations failed to do so at the last legislative session.

A few states have appropriated money for calfhood vaccine and vaccination.

We recommend that all states be urged to provide adequate laws and funds so that an active campaign may be waged against Bang's disease.

Your Committee on Legislation believes that community auction sales are here
to stay and make all other livestock sanitary control work futile unless brought under control.

We recommend that the President of this Association appoint a committee, composed of not less than three leading livestock sanitary authorities, such committee to be known as the Community Auction Sale Committee; the members to meet with an equal number of leading community sale operators, and with a competent livestock marketing authority, and draw up a satisfactory law governing all aspects of community sale operations.

It has been recommended by those who have made a study of the situation that such a committee should prepare and make available blueprints of model sale premises suitable for different parts of the country which would meet minimum sanitary requirements; such blueprints to serve as a guide in remodeling old premises or building new sale barns.

It has been further claimed that if such a model community auction sale law would be available, the sanitary authorities and sales people of the different states could present bills to their respective legislatures with some assurance of fairness, workability and efficiency.

Your Committee on Legislation recommends that all states that have not already done so provide adequate laws and regulations for the proper supervision of sale barns and community sales.
REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES
OF SWINE

F. L. Carr, Chairman, Columbus, Ohio; Frank Breed, Lincoln, Nebr.; L. P. Doyle, Lafayette, Ind.; L. Van Es, Lincoln, Nebr.; E. S. Brashier, Jackson, Miss.; R. Fenstermacher, St. Paul, Minn.

One of the functions of the committee on transmissible diseases of swine seems to be to make a report of the prevalence of disease among swine during the past year.

As has been the custom in the past, your committee sent out questionnaires to the regulatory officials of the principal swine raising states. The statements contained in this report are based largely upon information received from the replies and comments made regarding conditions in swine in their respective sections.

In general, there has been an increase in swine disease the past year: but this increase is probably not as great as would at first seem apparent.

During periods of low prices, owners are prone to pass over lightly the loss of some animals and not seek medical aid unless the losses become large: On the other hand, during times of high prices, greater care is taken of stock and consequently more owners seek veterinary aid. As our summaries are made largely upon reports by veterinarians and regulatory officials, naturally the above facts tend to indicate a greater incidence of disease during a period of high prices such as the present than is the case during a low price period.

In spite of these facts, we are forced to the conclusion that in many sections, the past season has been a period of rather high incidence in some of our swine ailments.

One factor which may account for some increase in swine disease is the tendency for persons not experienced in swine raising to enter the business due to the high price of pork. Also it is perfectly natural that as fat hogs are at a good price and in all probability will continue in good demand, owners are anxious to keep a maximum number on feed at all times and consequently the competition for feeder pigs is great. This results in purchasers being less careful about the quality and health of animals placed in the feed lots. We all know of outbreaks in large herds which are traceable to this condition. The owner states that he purchased a group of pigs that were below par, but he needed some more and as it was hard to find the right kind for sale, he simply took a chance.

Hog cholera continues to be the cause of death of the largest number of swine in most sections and it is noteworthy that in some sections the past year the losses have been very heavy, yet in other sections the incidence of this disease has been below normal.

This same statement applies to our own State of Ohio. In some sections the loss from cholera has been extremely heavy while in other localities the incidence has been below that for most years.

The experience in hog cholera the past year again impresses upon us the fact that there is yet much educational work to be done to convince hog breeders and feeders of the necessity of keeping their swine immunized against this disease at
all times. Also the fact that the best in immunisation is the cheapest and that slipshod methods or bootleg virus are often very expensive.

It seems so useless in times like these when livestock products are so sorely needed as a part of our war program, that thousands of hogs should be lost from cholera when we have a weapon at hand which if properly used according to our best knowledge, would prevent this loss.

Enteric diseases continue to take their toll in many sections and increases in this class of ailments are reported from some sections especially in localities around army camps where garbage feeding is general.

Mange in hogs is spreading in some states and is mentioned in reports from Indiana, Minnesota and others.

Brucellosis is evidently not widespread in swine, but is reported as increasing in many states and is a condition that we feel should be considered in our disease control programs lest it become a serious menace.

Swine Erysipelas: Our reports would indicate that this disease is gradually spreading to new territory, although several states report a decrease in the occurrence of the disease.

As a result of articles in the farm press and other publications, considerable demand has arisen in some states for permission to use the serum virus vaccination as a preventative.

This places the regulatory officials of many states in a peculiar position. In many sections erysipelas is not of general distribution yet there is a demand for this vaccination coming from swine breeders and feeders.

Bearing in mind the nature of this disease as well as the fact that an unattenuated culture of the virulent organism is used it might be questionable to allow its use in sections in which the incidence of erysipelas is low.

Also as this disease is pathogenic to man, it seems that we should not lose sight of the public health angle of this problem. It is a fact that demands are being made upon regulatory officials of states in which it is doubtful if the incidence of the disease is large, for permission to practice this vaccination in their herds.

Many owners can not see why if it is a good thing for one state or section it should not be for their business.

It appears to us that some form of recommendation for these borderline sections should be promulgated possibly by the U. S. B. A. I. or the U. S. Livestock Sanitary Association, as a statement of policy or at least a guide for the state regulatory officials.

Another factor which challenges us as guardians of livestock health in this country is the spread of infection by truck movement of livestock. The principle is the same no matter what the distance, but it is especially dangerous when animals are moved long distances with no inspection or any method to check on origin, destination or health of the transported animals. Certainly it is to the best interests of all that some restrictions be placed upon the operation of long distance trucking of animals whereby they may be regulated and checked as to health status and compelled to operate in compliance with the regulations provided for that class of livestock.

As stated, we sent out a list of questions to various regulatory officials and
practicing veterinarians. As was to be expected, the answers to these questions differed greatly according to section. It is noteworthy that there was one exception to this statement. It matters not whether the answer came from a regulatory official or a practitioner of veterinary medicine, they all agreed on one point. I refer to the part the community auction is playing in the dissemination of disease among swine.

Many report an improvement in this respect as the result of new laws passed and rigid inspection at these auctions, but all agree that the auction market is a real problem and a menace to live stock health, with exception of animals going to market for slaughter.

The problem of proper inspection at these sales has always been a serious question but under war conditions, with the shortage of veterinarians and the consequent increased demand upon the practitioners yet available, it seems well nigh impossible to give adequate inspection of these community auctions. This is especially true in those states which have a large number of these sales.
PROBLEMS IN SWINE PRACTICE

BY T. L. STEENBERSON, VETERINARY PRACTITIONER, WILKINSON, INDIANA

Problems in swine practice cover a wide range of conditions and a variety of diseases. It will be the intent of this paper to point out only the major problems encountered in 18 years of hog-belt practice, supplemented with suggestions for their correction.

Generally, our major problems might well be divided into four headings—(1) breeding, (2) feeding, (3) disease, and (4) dissemination.

Before taking up the individual subjects, it is in order to note that the membership of this organization consists of men, regardless of their personal labors, who have a united interest in the improvement of live stock, and it would seem that any improvement project should take breeding, feeding, disease, and the dissemination of disease into consideration. Such a program, to be successful, must be firmly anchored to veterinary science, and it is indeed very gratifying to note that the practice of veterinary medicine is receiving increased recognition and a deserving place in the field of animal and human health control. Greater recognition brings forth greater responsibilities which veterinarians must accept and faithfully discharge.

BREEDING

The year just closing has brought forth a bumper pig crop. For the coming year, an increase of twenty-five percent has been requested. Too many of our swine producers interpret this as meaning that they should breed twenty-five percent more sows. The average producer breeds too many sows. Available equipment, facilities, feed, and his capacity for work should govern the number of sows to be bred. Over crowding, lack of proper feed, water and care are responsible for many losses of baby pigs and shoats up to four months of age.

The foundation of an effort to increase pork production twenty-five percent should lie in the selection of breeding stock. Our major problem in this connection is our inability to get breeders educated to the fact that they should never breed animals that have previously had enteritis, influenza, or other febrile diseases. Too much attention is given to the appearance of the individuals, and not enough thought given to the history of past production records and disease records. When it is possible to talk to the breeder before he selects his breeding stock, these points are discussed with him, advising him that it applies to both the dams and sires. At the same time, it is suggested that gilts be at least seven months old and boars nine months old before breeding; that males should not be permitted to run with the herd, and that not more than three services in a twenty-four hour period should be permitted.

If these thoughts on the selection of breeding stock can be instilled into the hog breeder, and he complies with them, a big step forward has been accomplished in the raising of larger litters, healthier pigs, and the reduction of baby pig mortality.
FEEDING

The best breeding stock in the world will do little good unless considerable attention is given to the feeding program. Once again, the problem of the practitioner is to find some means of getting his client to come in and discuss his feed problems with him. If the practicing veterinarian will familiarize himself with known and fundamental facts regarding feeds and feeding, as well as the care and management of the dam during pregnancy and at farrowing time, it will not be long until the swine breeders of his community will realize that he can give them some valuable information, and they will regularly seek his advice. This is a responsibility of the veterinarian, and if he fails to perform this mission, he is not measuring up to his duty, either as a veterinarian or a citizen of the United States.

Abnormal conditions exist. New equipment cannot be obtained. Labor is scarce. Many feeds, especially supplement and animal proteins are below par due to glands and other products which they formerly contained, being diverted to other uses. Tankage is no longer the food balancer that it was in the past. Even the grains, due to soil depletion, do not contain the necessary amount of chemical and vitamin units. It is, therefore, important, if possible, to secure these elements from other sources.

In the past many experimental stations, including our own Purdue University have used fish meal, meat scrap, soy bean meal, cotton seed meal and ground alfalfa to good advantage. However, as least some of these ingredients are now off the market and I question if it is advisable for the swine producer to attempt to find substitutes for these.

Commercial supplements, if purchased from reliable firms who have the facilities and personnel for manufacturing good feeds, should be recommended over the feeder's attempt to make his own.

It is believed by many that the hog is much more capable than man in the selection of its body requirements therefore, it might be best to feed all supplements, minerals, etc., free choice,—either in a separate compartment of the self feeder or in a separate feeder. This was brought out quite forcibly this year when herds had access to some of the most lucious alfalfa and clover pastures ever known. In instances where the supplement was fed free choice and the hogs were running on these fine pastures, they ate very little supplement. If they were taken off of the pasture, they would immediately start eating large quantities of the supplement.

At this season of the year, a simple ration for the brood sow is suggested in the form of ground corn and ground oats, in the proportion of one bushel of each to which ten pounds of supplement is added. This can be fed by hand or in feeders. If fed in feeders, it can be improved by addition of ten to twenty pounds of high quality ground alfalfa. If hand fed, alfalfa hay should be placed in racks in dry accessible quarters. Sows should have free access to a mixture of equal parts of calcium carbonate and steamed bone meal, plus ten percent salt and one-fourth percent potassium iodide.

This type of feeding program, allowing the sow suitable range, fresh clean warm water, comfortable quarters and a dry bed should be ample to produce large, strong, healthy litters. Feed is withheld twenty-four hours before and forty-eight hours
following farrowing. After which she is gradually brought back to full feed. The
time required being ten days to two weeks.

Feeding of the dam after farrowing depends upon the type of feed that the pro-
ducer might have on hand. The self feeder can be profitably employed in this class
animal. The diet may consist of sixty percent corn, thirty-three percent oats and
seven percent supplement, plus range and pasture in season, fresh water, and free
choice to the simple mineral mixture being essential.

The pigs, at two weeks of age, should have free access to ground feed consisting
of sixty percent corn, thirty percent wheat, and ten percent supplement which is
fortified with vitamin D. This same formula can be profitably fed until such time
as it is desired to place them on full feed of corn, preferably shelled, via self feeder,
plus free access to a suitable supplement and ample water supply. A mineral
mixture consisting of equal parts of calcium carbonate and steamed bone meal,
plus ten percent salt and one-fourth of one percent potassium iodide, free choice,
will suffice. Pigs handled in this manner should weigh two hundred to two hun-
dred and fifty pounds in six months.

DISEASE

If the dam has been fed and handled as previously suggested, pre-natal scours
will not be a problem.

Post-natal scours is always a problem in swine practice. It is invariably due to
having selected breeding stock that had previously gone through some febrile
disease, improper feeding, sudden changes in temperature, or unsanitary quarters.
Proper management will eliminate most of this trouble.

There is a bacterial infection which frequently affects young pigs, causing heavy
losses unless it is recognized early, when the prompt administration of a Salmonella
cholasuis bacterin will reduce the mortality.

Pig anemia has ceased to be a major problem because of the splendid research
work started at Purdue University by the late Dr. R. A. Craig, and finished by
Dr. L. P. Doyle of the same institution. As you know, it was a condition that
was responsible for tremendous pig losses and many stunted shoats. Its correction
lies in permitting the sow and litter to have access to clean, uncontaminated soil,
providing equipment and weather will permit. Otherwise, blue grass sod collected
from an uncontaminated source should be placed in the pen or farrowing house
where the pigs will have access to it. It is not necessary that the sow have this
sod, although it will do no harm.

Pig pox, frequently overlooked or considered unimportant, is a problem in swine
practice that deserves consideration. It can easily be the cause of a heavy mort-
tality, especially if the herd is subjected to the introduction of serum and virus
during the initial attack. Close observation on the part of the attending veteri-
narian can prevent this loss. In pox infected herds, lime and sulphur dip, both
internally and externally has definite merit. This year pox in my practice
has been very severe and for the first time I have observed it in the ears of pigs, causing
them to carry their head sideways. Sulphurized oil in the ear seems to eliminate
this trouble.

Internal parasites are a problem in that they cause some mortality and the eco-
nomic loss runs into thousands of dollars. Sanitation, if religiously applied will reduce parasitism to a minimum. However, few hog raisers have the equipment and the initiative to carry it through. Promiscuous use of the many nostrums available on the market does not solve the problem and in many instances is responsible for quite heavy losses. Herd treatment is not satisfactory. Treating each individual animal by means of the stomach tube, with a combination of oil of chenepodium, castor oil, and raw linseed oil has proven much more satisfactory than any other method. It is fast, efficient, and highly professional. When used, pigs are fasted for sixteen hours before and twenty-four after the treatment is administered. Sixty hours after treatment, the herd is transferred to clean ground and sleeping quarters.

Swine erysipelas is increasing year by year. Proper diagnosis is the major problem confronting the practitioner. Autopsy findings may be and often are misleading. To make a diagnosis of erysipelas and later to find the virus of hog cholera the active causative agent is a serious and costly error. Laboratory help is highly beneficial, but necessarily slow. History and herd observation is very important. Once properly diagnosed, administration of anti-swine erysipelas serum gives gratifying results. The use of this serum gives only a temporary immunity, and in many instances it is necessary to repeat its use in twenty to thirty days time. Immunization by means of the culture-serum method is not permitted in Indiana, so I am familiar with their results only as I read of them, and not from experience.

Hog cholera becomes a problem only as the swine producer neglects the proper immunization of his herd. The mere mechanics involved is not important. It is highly important, and profitable, to know the physical condition of the herd. Of equal importance is the selection of products of known potency and virulence, and the administration of sufficient quantities to produce active and lasting immunity. Cheating the pig by underdosing should not be tolerated under any circumstances and this day and age when the entire world is looking to us for more pork products it seems advisable to be more liberal than ever with our serum dosage. When normal healthy pigs of suitable age and weight are subjected to a liberal dosage of potent anti-hog cholera serum and virulent hog cholera virus, then ninety-nine percent of such herds are immune to hog cholera.

Pneumonia, uncomplicated, is wide spread and at times very active. Improper feeding, poor housing, and poor management are responsible for this problem. Mortality is not great if these causative factors are corrected. Quite recently, with the advent of sulfathiazole, when administered at the rate of one half grain per pound weight, and given in conjunction with symptomatic treatments, it has proven a near specific in its cure.

Enteric diseases, in their many and varied forms, take an enormous toll throughout the hog belt, and constitute one of the most serious problems that the veterinarian has to face. It is a mistake to draw too fine a line of differentiation between these conditions or to classify them as feed lot infections. Practical experience and observation would indicate that eighty-five percent or more of the enteric diseases of swine can not only be prevented, but can be relieved by proper feeding and management.

The swine producer who will religiously follow the feeding and management
program outlined in this paper and practice reasonable sanitation can eliminate most of this type of swine production problems.

Infectious hemorrhagic dysentery of swine is a separate entity. In years past the mortality rate has been exceptionally high and once it has developed in a community, it has proven an exceptionally serious problem in swine practice. Most men in this audience are familiar with its history, symptoms and post mortem lesions. Some of you may not be familiar with a successful method of treatment. Here, as in most other disease of swine, too much stress cannot be placed upon segregation, observation, feeding and management. They are extremely important.

The animals that die are those that become too weak and prostrated to eat and drink. Such animals, if they are to recover, must be treated by the veterinarian as individual patients. A stomach tube is passed on all such patients once every twenty-four hours, through which is given a quantity of a very highly concentrated saline and alkaline solution. It is a mighty rare occasion to have to do this more than two or three times until such patients are again on their feet.

All animals that are strong enough to eat are fed a diet of finely ground oats, which has been soaked in this same highly concentrated liquid for twelve hours. An ample supply of fresh water, located near the feeding troughs, must be provided. Careful nursing, special feeding and strict sanitation are essential and necessary if recurrences are to be avoided. A mixture of finely ground oats, alfalfa and wheat seems to be a satisfactory diet during convalescence. Corn should be avoided. Alfalfa and clover pastures are preferred. When started back on corn it should be done very gradually and at least thirty days should be consumed in bringing them back to full feed.

Swine brucellosis is not only a problem in swine practice, but it is equally a problem of the swine industry and to the public health authorities, due to its apparent pathogenicity to man. At the present time, research on swine brucellosis is going on in full force at several of the research stations in the hog belt. This is very encouraging, and all veterinarians, as well as swine breeders, should offer these institutions their full co-operation. The agglutination test is being used as a means of detecting the infection. So far this has not proven very satisfactory when it comes to picking out the individual animal infected, but it does have considerable merit in detecting herd infection. No immunizing agent of value has been developed, nor have any chemicals or pharmaceuticals proven of value as a treatment.

Isolation, sanitation, and suggestions that the nearest research group be contacted, seem to be in order pending further developments.

In all of the above disease problems of swine, the paramount thing of importance is correct diagnosis. This is not always easy nor quickly obtained. It requires patience, keen observation, careful and diplomatic inquiry, often more than one call, complete and diligent autopsy, and occasionally laboratory confirmation. Autopsy findings are very often misleading unless they conform to herd history and observations.

It is well to remember that any bacteremia will produce hemorrhages and pathological changes in the animal body. This fact alone should be enough evidence to prove that no greater mistakes can be made than to attempt to make a "long distance" diagnosis of swine diseases by arriving at a diagnosis on one or two animals brought to the office or hospital. This applies to the practicing veterinarian as
well as to the experimental station or commercial house that operates a diagnostic laboratory. Such a procedure is full of errors, is unfair to the herd owner, and too frequently proves very embarrassing to the practitioner.

Throughout the entire hog belt, both State and Federal officials use many employees as consultant veterinarians on swine diseases. Entirely too many such employees are not properly trained on the diagnosis of swine diseases. Apparently most such employees take the course of least resistance and diagnose almost everything they see as hog cholera, regardless of what the true condition might be. This is not sound, scientific, swine disease control.

Laboratories, state experimental stations, federal and state offices should not attempt this disease control work unless they have ample funds to employ a trained, competent consulting veterinarian to visit the herds in question, get a complete history, secure such specimens as seem advisable, return to the laboratory to complete or confirm their field findings, and cooperate fully with the veterinarian who is responsible for the maintenance of the health of his client's herd.

**DISSEMINATION OF DISEASE**

As a practicing veterinarian and one vitally interested in the livestock industry, I feel compelled to say something relative to the extreme lack of any systematic control over the spread of contagious and infectious diseases of live stock, particularly swine, which is the subject involved.

The result of the recent general election indicates, among other things, that in general, the agricultural interests in the swine production states, will have a large representation in the several legislatures. They are, therefore, in a position to at least attempt to correct their live stock disease programs. Any live stock disease program that does not take efficient veterinary service into consideration is doomed to failure. Likewise, most any program of this nature in any state, operating under a lax political enforcement, cannot be effective.

Perhaps laws are not needed. Regulations may be sufficient. We seem to have regulations at the present time governing almost everything that is done with the exception of regulations on the control of disseminating swine (or livestock) diseases.

Never was there a time in history, with the entire world clamoring for more and more food producing animals, a greater need for effective regulations, wisely and fearlessly enforced, governing the sale, transportation and exchange of live animals and poultry. To be successful, live stock health departments of the several states should be placed under civil service. They should be manned by efficient and fearless executives, regardless of their political preferment, provided with ample funds to employ an intelligent and efficient staff who are capable and willing to discharge their duties.

Livestock traders, sales barns, stock yards, and other places used for the common exchange of live stock are primary sources for the dissemination of contagious and infectious diseases. Innocent and unsuspecting persons are often victims of these unsupervised centers. Disease is spread; unwarranted losses occur,—both nullifying the efforts being put forth by the live stock producer, the veterinarian, and the subsidiary interests in their effort to conserve and produce an ample food supply for our war effort.
FORUM ON INFECTIOUS AND TRANSMISSIBLE DISEASES OF SWINE

President McAdory: Now I am going to ask Dr. Frank Breed to come to the platform and preside over the forum on infectious and transmissible diseases of swine. Following the splendid forum we had on Bang's disease last year, we were asked to have a forum on swine diseases. I wish to congratulate the Committee who arranged this program, and thank all in advance for their work.

I will now turn the meeting over to Dr. Breed, who will act as Chairman of the forum on infectious and transmissible diseases of swine. I will ask Dr. Breed to bring his class with him. Those of you in the audience who wish to ask questions, please speak over the microphones near you.

Dr. Frank Breed assumed the Chair.

Chairman Breed: Gentlemen, will the members of the forum please come to the platform.

The following gentlemen were seated on the platform:

H. C. H. Kernkamp University of Minnesota, Saint Paul, Minnesota
E. W. Roberts (For B. H. Edgington), Ohio Agricultural Experiment Station, Reynoldsburg, Ohio
B. W. Fairbanks, University of Illinois, Urbana, Illinois
T. L. Steenerson, Wilkinson, Indiana

Chairman Breed: Mr. President and members of the United States Live Stock Sanitary Association: The program of the question and answer forum, which we are about to present, is the result of requests from the membership since the 1941 meeting. From information gathered by your capable Secretary relative to the two former forums presented before this Association, namely, in poultry diseases and Bang's disease in cattle, it was quite evident that this form of program was desired. Furthermore, there were direct requests made for this type of program on swine diseases.

At a committee meeting held during the A.V.M.A. convention last August, the request for this type of program was presented. The committee members realized that although increased demands had been placed on the swine raisers, even further demands may be made. With this in mind, it was felt that this type of program would make available a great amount of practical and scientific information to the swine raiser, state and federal disease control agencies, and practicing veterinarians.

As master of ceremonies, this opportunity is taken by me to thank all those who so generously responded to the request for questions. There could not be a more appropriate opportunity to extend my sincere thanks and gratitude to those participating in the forum, and I wish to do so at this time.

There are a few questions which will be answered by individuals not selected on the panel. It was felt that certain questions could best be answered by these individuals from the floor.

We appreciate the fact that we will not be able to cover all phases of swine disease
in detail, so the questions which appeared most frequently in the responses have been selected.

This is your program, not ours. We are only putting your wishes into action. At any time one feels the urge and desire to ask a question from the floor, please do not hesitate to do so. We ask that in so doing you arise, state your name and address, then present the question slowly and distinctly. Please present concise and direct-to-the-point questions. Those questions may be directed to one or more individuals on the panel, or to the Chairman, who will direct the question to a panel member. There may be other questions for which there may not be time during this session. If so, they, together with the answers, will be included in the report of the Association.

This program has intentionally been divided into separate and distinct parts. You will note that in certain parts of it one individual may answer a number of questions consecutively. That was due to the fact that we want to keep each section of the program by itself.

We cannot very well have a program on swine diseases without first of all getting the basis of the subject of swine husbandry, so we will start with questions on the subject of swine husbandry.

Dr. Fairbanks, about how many sows are expected to be used for reproductive purposes this coming fall and spring?

DR. FAIRBANKS: The number of sows farrowed in the fall of 1942 is estimated at 6,892,000 head. This is an increase of 1,361,000 or 25% over the record number farrowed in the fall of 1941. As farmers' intentions to breed for spring farrow are not canvassed until December, figures on next spring farrow are not available at this time. But in the spring of 1941 9,819,000 sows were farrowed, which was 26% larger than the number in 1940.

Certainly as many will be farrowed in the spring of 1943, and it is quite conservative to estimate that the number will exceed 10,000,000, as this is a little less than a 5% increase. I am certain we will not have another 25% increase, and even a 10% increase has been regarded as dubious by some.

CHAIRMAN BREED: Dr. Fairbanks, is there reliable data on the number of live pigs farrowed per sow? If so, please give the number.

DR. FAIRBANKS: Technical Bulletin No. 836, United States Department of Agriculture, reports an average of 9.01 pigs per litter. The data include 7,415 litters produced in agricultural college or experiment station herds, and in the government herd at Beltsville, Maryland. I believe this figure of 9.01 pigs per litter includes those born dead. If we estimate the percentage of pigs born dead at 5%, the number of live pigs per litter is 8.56.

CHAIRMAN BREED: Dr. Fairbanks, do you have data on the number of pigs lost between birth and weaning? Give approximate percentage.

DR. FAIRBANKS: Technical Bulletin No. 836, United States Department of Agriculture, reports 5.48 as the average number of pigs weaned per litter. This would be a death loss of 39.19% between farrowing and weaning, based on the average number farrowed per litter, or a death loss of 37.39% based on the estimated number of live pigs farrowed. Smith estimates the loss before weaning at 34.4%. Field surveys frequently indicate 40% to 50% death losses before weaning in some herds.
CHAIRMAN BREED: Dr. Fairbanks again, is the greater death loss in pigs between farrowing and weaning, or between weaning and marketing?

DR. FAIRBANKS: There is no question but that the heavier death loss occurs before weaning. Wilcox, Carroll and Hornung report a 4.2% death loss after weaning for Illinois farms with low after-weaning costs, and a 12.2% death loss after weaning for farms with high after-weaning costs.

CHAIRMAN BREED: Dr. Fairbanks, are the losses between farrowing and weaning greater from nutritional disturbances or infections?

DR. FAIRBANKS: Would you mind reading the rest of the question? I am in enough trouble now. (Laughter)

CHAIRMAN BREED: Continuing the question, are the losses between weaning and marketing greater from nutritional disturbances or infections?

DR. FAIRBANKS: I hope the one who thought up this question feels very proud of himself. (Laughter)

I am going to answer the question from an academic point of view, if I may. These questions imply that all the nutrients required by swine of all ages are known; that the symptoms of a complete lack of each nutrient and combinations of nutrients are recorded in scientific literature; and that border-line deficiencies of single nutrients and combinations of nutrients can be detected. Knowledge has not progressed to such extents.

Any answer to these questions could not be supported by facts. It is well to point out, however, that nutrition should not be ruled out in all cases where specific organisms are identified as the immediate cause of disease. Until all of the information is in, nutrition might be considered as a primary cause or at least a contributing factor. There will be many instances in which nutrition has no part to play, but let cold facts rather than opinions rule out the nutritional concept.

The interplay of nutrition and disease is still virgin territory, and it will not be worked effectively until veterinary medicine and nutrition team up for a long, hard pull. I have often said that a nutritionist is the world's poorest diagnostician, and a veterinarian is not much better as a nutritionist.

I cannot answer the questions. (Laughter)

CHAIRMAN BREED: I want you to know, Doctor, that I did not propound those questions. You have been very lenient with the veterinary profession, and at the same time have acknowledged the value of the nutritionist. Thank you, Dr. Fairbanks.

Now we will turn to the heading of our old friend in swine diseases, hog cholera. The first question will be directed to Dr. Kernkamp:

DR. KERNKAMP: Two of the factors now existing which contribute much toward the spread of hog cholera are: First, the motor truck. Second, community sales pavillons or other similar enterprises.

Events occur in connection with the conduct of these enterprises that afford great opportunities for the dissemination of this highly infectious and contagious disease. For example, in a drove of swine where cholera is present and is beginning to spread, there is often a number of animals that appear sound and healthy. If
these are of marketable size, the owner often elects to send them to market. While most or all of that lot may have appeared sound, yet many may have been in the incubative and preclinical stages of the disease and capable of eliminating virulent virus. The truck can thus become contaminated. If then a load of susceptible pigs is transported in the same vehicle in a day or two, without its having been adequately sterilized, the opportunity for contacting infection is evident.

A similar situation may occur with respect to "feeder pigs" offered for sale in an auction establishment. Thus, pigs in the incubative or preclinical stages of cholera come to the sales barn, where they may or may not be vaccinated, and are taken home by an unsuspecting buyer, unloaded and turned out with his native pigs, which, if susceptible, may soon contract the disease.

CHAIRMAN BREED: Dr. Roberts, if hog cholera appears on a ranch and all infected hogs are double or simultaneously vaccinated, is it essential for that owner to continue to double-treat his hogs indefinitely, or may this disease be eradicated from the premises by proper cleaning and disinfecting?

DR. ROBERTS: Serum-virus treatment in cholera infected herds, in my opinion, does not in itself increase the probability of subsequent infection on the premises.

It is recognized that in some instances, though fortunately they are relatively few in number, serum-virus treated animals develop hog cholera and may become potential factors in spreading the infection. However, it should be remembered that the occurrence of cholera on a farm which formerly has been free of the disease indicates a source of infection to exist which may remain or again recur and which may be entirely independent of any residual infection from the initial outbreak or from subsequent serum-virus treatment. Farms on which cholera has occurred and where serum-virus treatment has been used, have in many instances been restocked with susceptible swine without immediate recurrence of the disease. Unfortunately this is not uniformly true.

It is apparent, therefore, that an over-all "yes" or "no" answer to the question of necessity for continued serum-virus treatment, once the practice has been instituted, is not warranted.

While it is axiomatic that complete protection against hog cholera can be attained only when the swine possess an immunity to the disease, experience indicates that consideration of conditions relative to the individual herd offers a more rational guide to methods of procedure than would the adoption of any single method intended for universal application.

Under favorable conditions, proper cleaning and disinfection of premises on which hog cholera has occurred may eliminate the existing infection, but in regions wherein the disease is of frequent occurrence, the possibility of re-contamination from other outbreaks is an almost constant threat. The necessity of repeated disinfection for protection under such conditions is not considered practical.

CHAIRMAN BREED: Dr. Kernkamp, are pigs, born to a cholera-immuned sow, immune to cholera? If so, for how long a period?

DR. KERNKAMP: Pigs born to a cholera-immune sow are not immune to hog cholera. Pregnant cholera-immune sows do not transmit immunity to their fetuses in utero.

On the other hand, pigs that nurse and obtain milk from a cholera-immune sow
will attain a high degree of passive immunity as long as they obtain such milk. This immunity gradually fades out subsequent to weaning, which, in most instances would be about seven to fourteen days.

**Chairman Breed:** Gentlemen, as I stated in my opening remarks, this is your meeting. The gentlemen up here are expressing their opinions. If you don’t agree with them, do not hesitate to say so.

**Dr. C. L. Campbell (Missouri):** I think I understood Dr. Kernkamp to say that as long as pigs were suckling an immune sow, such pigs were immune to hog cholera. Should we take that relatively or as an actual fact? I know that some degree of immunity is conferred, but didn’t you intend to say that they have relative protection and not immunity? I think I have seen quite a few litters of pigs come down with hog cholera in their suckling stage when suckling an immune mother.

**Dr. Kernkamp:** I do say that it is a passive immunity, but I do not say that they would obtain it as long as they were getting the sow’s milk. That might be greater or less. I can understand that you may observe such a situation arise, yes. I would say, then, relatively that would supply your answer better.

**Dr. Campbell:** Thank you.

**Chairman Breed:** You don’t know what a job it is for me to stand here and remain silent. (Laughter)

**Dr. Kernkamp:** Let’s get the Chairman in on this discussion.

**Dr. Brasier:** I would like to have Dr. Breed answer the question.

**Chairman Breed:** I would say, gentlemen, that Dr. Bert, at the veterinary school at Manhattan, Kansas, a number of years ago, showed quite conclusively that pigs who were originally farrowed by immune sows developed a resistance. Clarence was sort of quibbling over terminology, which may be correct.

Dr. Bert carried those animals through either six or seven different generations, by just the administration of virus to the young suckling pigs, and within a comparatively few days after they were born. So it is quite conclusive from that evidence—at least to me—that these pigs maybe do not procure the resistance to hog cholera virus until they have obtained the colostral milk.

That is the point Dr. Kernkamp also brought out. Maybe that is why the resistance is established. But during the period Dr. Bert was able to administer this hog cholera virus, the young animals resisted the infection, and from then on he built up quite a group of pigs through six or seven generations, which were normally resistant to cholera under that procedure.

I don’t think on the whole, however, that there are very many practicing veterinarians who are acquainted with the work Dr. Bert did. If there are no further questions we will proceed with the program.

**Dr. Roberts:** Does hog cholera immunity play a role in the enteric disease complex of swine?

**Dr. Roberts:** Obviously, immunity to hog cholera is quite important in those instances in which exposure to cholera is concomitant with that of enteric infections. However, this immunity will not protect swine against the latter conditions.

It is possible that the secondary invasion of S. cholerasius associated with hog cholera results in some instances from the baneful effect of the hog cholera virus. Nevertheless, this virus is not essential in infection with the cholerasis organism.
Hog cholera immunity, as well as other aids that tend to maintain a high plane of general resistance of the animal, are desirable even though they may not afford complete protection against enteric infections.

CHAIRMAN BREED: Dr. Roberts, what is the most satisfactory age at which pigs may be vaccinated with serum and virus under normal conditions? How young may they be simultaneously vaccinated with good results?

DR. ROBERTS: The question as to the most suitable age at which pigs may be immunized with serum and virus appears to involve factors of convenience in handling and economy of treatment, rather than those related to the biologic possibility of producing an active immunity.

While in the past reliable investigators have presented somewhat divergent data upon the subject, prevailing opinion appears to be that pigs two to three weeks in age and over can be effectively immunized by serum-virus treatment.

The personal opinion of veterinarians of extensive experience in serum-virus immunization of swine is probably too divergent to permit the dogmatic selection of any particular age at which pigs can be most satisfactorily immunized.

The possibility of cholera exposure and the development of bacterial and parasitic infections that may adversely affect the results of serum-virus treatment are recognized as potential threats to a prolonged delay in immunization.

To minimize this period of hazard, to avoid radical dietary change for the pig at time of treatment, and to take advantage of the added convenience in handling as well as the economy in materials, has prompted many veterinarians to select a period somewhat prior to weaning as being the most desirable for serum-virus immunization.

CHAIRMAN BREED: Dr. Steenerson, what should be done with a drove of swine in which some of the pigs are sick with cholera?

DR. STEENERSON: The ones that are not sick should be given a simultaneous treatment, increasing the serum dose 50%, and the sick ones destroyed.

CHAIRMAN BREED: Dr. Steenerson, what procedure should be followed with respect to the handling of a drove of swine where pigs are sick with cholera and in which enteritis is also a problem?

DR. STEENERSON: Well, Doctor, could I ask you a question first?

CHAIRMAN BREED: If it isn't too difficult! (Laughter)

DR. STEENERSON: We have an enteritis with hog cholera. Do you refer to that one or some other form of enteritis?

CHAIRMAN BREED: That brings up another subject for discussion, doesn't it. We will eliminate the hog cholera enteritis that you speak of.

DR. STEENERSON: All right. The drove should be divided, the apparently sick pigs moved to clean ground. They should all receive a liberal dose of anti-hog cholera serum and an adequate dose of S. cholerasius bacterin, bearing in mind that you are dealing with sick pigs, and increase your dose accordingly. The feeding program should be corrected.

CHAIRMAN BREED: Dr. Kernkamp, is the Boynton method for the diagnosis of hog cholera efficient and practical as a means of diagnosis?

DR. KERNKAMP: Basing my reply on personal experience, I am obliged to say that the cytologic changes described by Boynton as occurring in the cells of the
mucoid glands in the ductal extremity of the gall bladder of cholera-infected swine, has not been too satisfactory.

The technical procedures involved seem to me to belong strictly to a laboratory technician and not suitable to field use or by persons unfamiliar with the practices which must be carried on in most laboratories.

I have been very much interested in this during the past year, and I will have to say that from my experience I cannot correlate these findings with what I have diagnosed as cases of hog cholera. However, I think the procedure has some merit, and I welcome any procedure that will help us to be more specific in the diagnosis of this disease.

But with this method of staining and examining for these bodies, which to me does not appear to stand out too clearly, I would say that for a general practitioner not too familiar with laboratory technic the job is not an easy one.

CHAIRMAN BREED: Now we will proceed to the subject of swine erysipelas, which I hope you will be able to hear completely.

Dr. Grey, how widespread is swine erysipelas in this country, and what type of the disease is most prevalent?

Dr. Grey: We realized swine erysipelas was present in a low-grade form in this country in 1921 when Dr. Creech, of the U. S. Bureau of Animal Industry, isolated the organism from a case of diamond skin disease. However, we did not feel particularly alarmed about the presence of the disease until ten years later, when Dr. Fosterman, a practitioner in South Dakota, told us that swine erysipelas existed in his territory in an acute septicemic form and was causing heavy losses among a large number of swine.

In 1937 Dr. Frank Breed of Lincoln, Nebraska, reported that the swine erysipelas organism had been identified as a cause of swine maladies in 28 of the 46 states reporting. Since that time, based upon surveys and reports made by various members of the veterinary profession, it has been concluded that wherever hogs are raised there we are likely to find the swine erysipelas organism. This does not mean that the disease is a serious menace in all sections of the country. In the states outside of a portion of the corn belt the disease at present is limited to occasional cases.

In general, the disease occurs as a low-grade infection; however, there are areas in certain sections of the corn belt where an acute form of the disease has played havoc with swine production.

CHAIRMAN BREED: Dr. Grey, describe briefly, giving a few of the fastidious characteristics of the swine erysipelas organism.

Dr. Grey: Erysipelothrix rhusiopathiae, the causative organism of erysipelas in swine, is very readily influenced by its environment and is subject to quite sudden changes. Ordinarily the organism occurs in the organs of acutely affected swine as a slender, slightly curved, small rod. It may occur in long filaments in chronic lesions, and tends toward this type on prolonged culturing in artificial media.

It is non-motile, does not form spores, stains quite readily with aniline dyes and is gram-positive. This organism is provided with a waxy coat that may explain its resistance to putrefaction, dessication, and also that in meats it is not destroyed by pickling, smoking, or drying over long periods of time.

In the soil it is capable of growing and multiplying, and is not destroyed by freez-
ing, and because of the depth to which the organisms may grow the sun's rays do not penetrate sufficiently to cause their destruction. Only those on or near the surface may be affected in this manner. Acid media and prolonged exposure to temperatures above those of ordinary refrigeration bring about changes in the morphology of the swine erysipelas organism, with an attending decrease in its virulence.

Pigeons and mice, as a rule, succumb to inoculations with E. rhusiopathiae within two to four days. However, if cultures are maintained on artificial media for some time there may be a gradual lessening of virulence until with some strains it is impossible to bring about the death of these animals.

It is quite difficult to artificially infect swine with swine erysipelas organisms. This has been done with organisms freshly isolated from acute cases of erysipelas. However, we lack definite information concerning the proper care and diet necessary to maintain older cultures so that they regularly infect swine upon artificial inoculation.

CHAIRMAN BREED: Dr. Van Es, of what economic importance to the swine industry is the low-grade type of erysipelas?

DR. VAN ES: Assuming that the question pertains to the chronic forms of the disease, there can be no doubt regarding their damaging character and their economic importance. Such forms of the disease are commonly manifested by the involvement of joints, and as such they constitute a source of loss at terminal markets and processing establishments. The unthriftiness of pigs thus involved often results in their remaining unmarketable, and a waste of feed on farms.

CHAIRMAN BREED: Dr. Grey, what symptoms, if any, aid in arriving at a diagnosis of swine erysipelas?

DR. GREY: There are certain symptoms and manifestations which serve to help in arriving at a diagnosis of swine erysipelas, such as sudden onset of the disease; typical skin discolorations; dehydrated appearance of swine; curled ears; stub tails; evidence of pain on movement; reluctance to move unless forcibly stirred up; clear, active eyes; vigorous squeals; jumping up with considerable activity when disturbed but soon seeking the comfort of reclining positions in the bedding; enlarged joints; scaley eczema; edematous swellings of ears, snouts, legs and elsewhere about the body; high temperature; sloughed ears, and sloughing patches of skin.

CHAIRMAN BREED: Dr. Grey, enumerate the organs most frequently showing pathological changes, and describe briefly the lesions. Also state the tissues most suitable for bacteriological examination, and how they should be prepared for shipment to the laboratory.

DR. GREY: A post-mortem examination of internal organs may reveal some, all, and at times none of the lesions as indicated in the following. However, bear in mind that it is difficult to make a definite diagnosis of swine erysipelas on the basis of lesions alone.

The tonsils, in acute cases, may be normal or may present a cherry-red to bluish-red discoloration. The lymph nodes may be enlarged, edematous and exhibit cherry-red or bluish-red congestion. The heart may present ecchymoses in and under the endocardium, diffuse congestion of the fat at the base of the ventricles, and valvular endocarditis (cauliflower growth on heart valves). The lungs may be swollen, edematous and congested. The liver may be enlarged and dark red or
brownish-red in color. It may be enlarged throughout or only in spots. The mucous membrane of the stomach, particularly of the fundus and pylorus, may be swollen and cherry-red to intensely bluish-red in color. Ecchymoses may be present. The submucosa is edematous and frequently there may be found areas partly covered by a tenacious mucus. Superficial, dry necrotic patches may be found. The small intestines, particularly, are involved and occasionally the large intestines. The mucosa is hyperemic and swollen and may show ecchymoses. Shallow erosions may be observed. The kidneys are dark in color, enlarged, soft and moist upon incision. Punctiform or diffuse hemorrhagic infiltration may be observed. The urinary bladder may exhibit hemorrhages and contain a highly colored urine. The bone marrow exhibits an abnormally red color, is soft and friable of texture.

Examination of the various joints may reveal inflammation of the synovial membranes, reddish, flaky, synovial fluid, formation of granulation tissue and connective tissue proliferation, giving rise to the formation of elongated tags or threads (synovial fringes) either attached to the synovial membrane or freely suspended in the joint fluid. Capsular ligaments become thickened. The articular cartilages may become eroded. As the damage progresses periostitis and ostitis with ankylosis occurs.

The tissues most suitable for bacteriological examination for swine erysipelas are tied-off heart, spleen, kidney, lymph node, and involved joint. If the skin is involved, remove a piece at least 5" square and 1" thick. This will include enough underlying fat to insure a suitable specimen for examination. Do not cut into any of these tissues if they are to be forwarded to the laboratory for bacteriological examination. Wrap the tissues in wax or oil paper or in cheesecloth that has been wrung out of 0.5% phenol. Place in container and cover with borax. Place container and tissues under refrigeration until time to ship. Before shipping, print in large letters on the container, "TISSUES FOR BACTERIOLOGICAL EXAMINATION—PLEASE RUSH." Employ some method, preferably dry ice, to keep the tissues cool if the journey to the laboratory is a long one. Where dry ice is not available, cans or bottles of water may be frozen and packed with the tissue. Anything to keep them in good condition until they may be examined.

CHAIRMAN BREED: Dr. Schoening, should all swine with bony enlargements and lame be considered as being affected with chronic swine erysipelas? If not, how can they be differentiated clinically from bony enlargements due to other causes?

DR. SCHOENING: The answer to this question is "No". It is considered, however, from all available evidence, that the majority of cases of arthritis in swine are due to erysipelas infection. This largely is based on investigational work started in 1938 by the U. S. Bureau of Animal Industry, embracing the examination of arthritis in swine found at post-mortem at slaughtering establishments in various parts of the country.

Since the start of this work over 500 specimens of arthritis were examined bacteriologically, and in more than 75% of the cases the swine erysipelas organism was isolated and definitely identified. It is felt that this number is conservative, since more detailed examination probably would have revealed a larger percentage.
On the other hand, it must be remembered that enlargements of joints and lameness may be produced from other causes. Infections with such organisms as brucella, streptococcus, staphylococcus and Corynebacterium pyogenes may also be the cause of arthritis. In addition, bruises and mineral deficiencies may be responsible for arthritis.

Certainly when arthritis is seen, erysipelas infection should be first suspected. It would be difficult clinically to differentiate swine erysipelas arthritis from other forms, and recourse should be had to the history of the drove and general examination of individuals making up the drove.

If arthritis appears in a number of animals with a number of joints involved, particularly with a previous history of sickness some weeks before, this would be very suggestive of erysipelas infection. On the other hand, arthritis in one or two animals and then involving only one joint, sources of infection other than erysipelas might suggest themselves. The statement, “Where there is arthritis, swine erysipelas should be suspected” is a point to keep well in mind.

CHAIRMAN BREED: Dr. Grey, what diseases are of principal interest in a differential diagnosis of swine erysipelas?

Dr. Grey: The principal disease with which erysipelas may be confused is hog cholera. In swine erysipelas the onset of the attack, as a rule, is more sudden and abrupt and its course is more rapid. Body temperatures are generally higher than those experienced in hog cholera.

A history of lameness and recovery or death of a hog sometimes prior to the outbreak of disease indicates swine erysipelas. During the active outbreak there are usually cases exhibiting stiffness and stilty gaits. In swine erysipelas there is more pain evidenced on handling than in hog cholera. The eyes remain clear and active, while those of swine affected with hog cholera become dull and gummy. The lymph nodes in hog cholera assume a more markedly dark-red discoloration with enhancement of the color at the periphery, while in swine erysipelas there is rather a characteristic cherry-red to violet discoloration. The spleens of uncomplicated hog cholera cases remain normal in size, while those of swine erysipelas exhibit localized or generalized enlargements. In hog cholera intestinal lesions are more commonly found in the large intestine, while in swine erysipelas they are more commonly observed in the small intestine. To make the picture more complicated, it is possible to have swine erysipelas and hog cholera simultaneously present in an animal. Thus caution must be observed in rendering a positive diagnosis until a complete history of the herd has been obtained.

CHAIRMAN BREED: Dr. Grey, is the field agglutination test reliable for diagnosing swine erysipelas? If not, how can this disease be determined under field conditions?

Dr. Grey: The agglutination test requires considerable experience with the disease in order to properly interpret results obtained when testing swine serum or blood. At present, under our methods of antigen production, it is best to consider the field agglutination test merely as an aid to diagnosis, not a diagnostic entity.

If erysipelas organisms are present anywhere in the body of swine we are likely to get a positive reaction on testing their blood or serum. Such a reaction does not necessarily mean that the swine are suffering from the presence of these organisms. We know that apparently normal swine may carry erysipelas organisms in their
tonsils and ileo cecal valves. We also know that swine vaccinated with erysipelas culture and serum, or with serum alone, will react for a number of weeks and even months when tested with this antigen. In addition we have seen cases where swine harbouring the swine erysipelas organism have actually been dying of hog cholera or other disease. Considerable sums have been expended in the purchase and use of anti-swine-erysipelas serum in these cases when other treatment was in order, all because of misinterpretation or more likely because of an overblown confidence in a test.

The main building blocks in a foundation upon which to base a diagnosis of swine erysipelas are clinical observations combined with complete histories and post-mortem examinations of a number of individuals. Laboratory examinations help in arriving at a diagnosis, and the agglutination test should only be looked upon as an aid.

CHAIRMAN BREED: Gentlemen, I would like to introduce to you Dr. J. E. Peterman of Nebraska. (Applause)

Dr. Peterman, how effective is anti-erysipelas serum alone in the prevention and treatment of erysipelas? Also give dosage.

DR. PETERMAN: Serum alone is not indicated in the prevention of erysipelas on healthy hogs. If it is used the swine are usually protected against the disease from fifteen to thirty days.

Serum alone, administered as a treatment in the acute stages of erysipelas, is usually a specific in arresting the development of the disease for a short duration. However, do not expect every affected animal to recover or all the damage in the herd to be repaired.

Serum alone, used in the chronic stages of the disease, does not produce very favorable results.

The dose of serum largely depends upon the circumstances prevailing in the herd, and the stage of the disease during which the serum is administered. In many cases serum is wasted in treating sick herds. If the entire herd has been affected with acute erysipelas for two or three days or more, considerable damage has already taken place. A large dose of serum is of no more value than a small dose.

It is very difficult to determine when to use a large or small dose. It is only through experience that one does become qualified to arrive at any definite conclusion as to the adequate dosage.

Based upon several years of observation and experience, I would recommend the following dosage under average conditions: For suckling pigs, 5 cc; 100 lb. shotes, 10 cc; 150 lb. shotes, 15 cc; mature hogs, 20 cc.

CHAIRMAN BREED: Just a moment, Dr. Peterman, please. Those are prophylactic doses?

DR. PETERMAN: That is in treating sick herds.

CHAIRMAN BREED: Treating sick animals or normal animals? Those not showing physical sickness?

DR. PETERMAN: That would be the entire herd. If they are all sick or part of them sick, this is for average conditions and is about what I would recommend.

CHAIRMAN BREED: Dr. Schoening, what attempt is being made in this country to actively immunize swine against erysipelas?

DR. SCHEINING: At the present time a large-scale experimental project is in
effect to study the efficacy of the active immunization in swine against erysipelas by use of the live culture and serum method. This project was inaugurated in 1938 on a small scale in the State of Nebraska through cooperative efforts of the University of Nebraska, the office of the State Veterinarian, and the U. S. Bureau of Animal Industry, together with a group of practicing veterinarians in sections of the State in which swine erysipelas control was a big problem.

The work was begun in a limited way. The culture was prepared by Dr. Van Es of the University of Nebraska, and data were collected by the State Veterinarian’s office and the Federal Bureau of Animal Industry. In March 1940 the work of preparing the culture was taken over by the U. S. Bureau of Animal Industry through a laboratory established for this purpose in Lincoln, Nebraska. The work was extended in Nebraska, and work was also undertaken in Iowa and South Dakota, where the disease was of considerable economic importance. Results were quite encouraging.

On account of increased pork production, the demand for vaccine reached such proportions late in 1941 that the small laboratory of the Bureau at Lincoln was unable to supply the demand. Arrangements were made, therefore, which became effective April 1, 1942, for the vaccine to be prepared by commercial houses operating under a limited license issued by the U. S. Bureau of Animal Industry.

The work was continued on the original experimental basis in those states in which the disease occasioned heavy losses and which were in a position to cooperate in the project. Limited licenses were issued to biological houses to prepare the culture, to be known as Erysipelothrix rhusiopathiae vaccine. A memorandum of understanding between the U. S. Bureau of Animal Industry and the office of the State Veterinarians of Nebraska, Iowa, South Dakota, Illinois and Missouri (States in which the disease was prevalent and which were in a position to cooperate) was drawn up whereby the vaccine would be prepared by commercial houses holding limited licenses and distributed to authorized veterinarians upon authorization from the state veterinarian having the memorandum of understanding with the Bureau. Records are kept by the state veterinarian’s offices and by the practicing veterinarians on the use of the product and the results obtained from its use. These are being tabulated throughout the state by veterinarians, and the inspectors in charge of the U. S. Bureau of Animal Industry in the respective states.

Dr. J. E. Peterman of the U. S. Bureau of Animal Industry at Lincoln in September 1942 was appointed to be in charge of field investigations of swine erysipelas for the Bureau, and is coordinating the collection, assembling and evaluation of the results. The project is considered to be on an experimental basis until such time as sufficient data have been collected to permit an evaluation of the method.

This method has been in use in some European countries for a number of years with apparently satisfactory results, although it should be recorded that the disease has not been eradicated in those countries where vaccination is being used. Since conditions vary in different countries, it is of extreme importance that before a method is adopted in a new country that it be studied in relation to conditions prevailing in that country. It is for this purpose that the work is carried out on an experimental basis at the present time.

The veterinary profession as a whole has a grave responsibility in the proper de-
development of this experimental project in order that all phases of the project be
given proper evaluation for the future benefit of the swine industry.

Chairman Breed: Dr. Van Es, in the prophylactic immunization of swine against
erysipelas, should the second injection of E. rhusiopathiae vaccine be given, and if
so, why?

Dr. Van Es: A second injection of the culture of the swine erysipelas bacillus is
indicated whenever and wherever the immunity of duration of more than the
average of six months is desirable. The second inoculation tends to prolong the
resistance induced by the first vaccination.

Chairman Breed: Dr. Peterman, in herds actively infected with swine erysipelas,
should the vaccine be used with serum at the onset, or should the serum be used
alone and in ten to fourteen days the simultaneous treatment inaugurated?

Dr. Peterman: Serum and vaccine can be used with safety in actively infected
herds and should be used if vaccine is immediately available. However, under the
experimental set-up several days elapse between the request for and the receipt of
the vaccine; therefore, it is desirable to use the serum alone promptly, then about
twenty-one days later administer serum and vaccine. Instead of fourteen days
it should be about twenty-one days.

Chairman Breed: Dr. Van Es, what is the danger (if any) in the use of living
culture with serum on farms not infected with erysipelas?

Dr. Van Es: Although there is little dependable evidence which points to the
procedure tending to be particularly hazardous, the use of culture should be con-
fined to farms where the disease has made its appearance, or on which pigs of un-
known origin are introduced. However, in certain definite erysipelas areas the
omission of vaccination probably constitutes the greater risk.

Chairman Breed: Dr. Schoening, what (if any) are the advantages and disad-
vantages of using swine erysipelas vaccine in a state where the disease is not
widespread?

Dr. Schoening: There may be distinct disadvantages in the use of swine ery-
sipelas vaccine in a state where the disease is not widespread. The use of the
vaccine is predicated on definite evidence that erysipelas infection exists in certain
herds. When this infection is actually found, there can be no harm resulting from
the use of the live culture method of immunization.

However, in areas where the disease is not present or is of minor importance, the
use of the live culture might possibly set up centers of infection that did not already
exist. This is more particularly true in cases of mistaken diagnoses, and while,
generally speaking, no untoward results have occurred following the use of the
vaccine, there have been instances where apparently the disease has been set up
by vaccination procedures. If such happenings occurred in areas where the disease
did not exist, it is well within the realm of possibility that new centers of infection
might actually be established by vaccination procedures over a period of time. It
is felt, therefore, that extreme care should be used in considering the simultaneous
vaccination against swine erysipelas.

Chairman Breed: Dr. Grey, does swine erysipelas infection ever cause posterior
paralysis with heavy losses in young hogs?

Dr. Grey: No! We do not have evidence to show that swine erysipelas organisms
are responsible for posterior paralyses except in very occasional cases in which local vertebral lesions have caused dropping down in the back and even complete loss of use of the hindquarters.

Chairman Breed: Dr. Grey, how would you control swine erysipelas on a farm that has sustained heavy losses from this infection in the past, located within a state where it is impossible to use the serovaccination?

Dr. Grey: In attempting to control swine erysipelas on a farm of that type, administer large doses of anti-swine-erysipelas serum to all the swine. Remove the apparently normal swine to clean ground. Confine all visibly sick animals. When the disease has subsided eliminate all swine showing effects of the disease. This will include those left lame and those that are not doing well. Sick swine are not profitable for the farmer to keep, and they may act as spreaders of erysipelas or as sources of future outbreaks of the disease.

The next step, after administration of the serum, would be to clean, scrub and disinfect all houses and equipment with which the herd has been in contact. A hot lye solution is probably as good as any disinfectant for this purpose. Do not return the herd to the old lots until it is absolutely necessary, and then not under a year. Plow up the old lots, work them over and let the sunshine do what it can to lower the concentration of swine erysipelas organisms in that soil.

Follow the so-called McClain County system. Although the swine sanitary system as practiced may not eliminate erysipelas organisms from the soil, yet if by virtue of the system the hogs are kept reasonably free of parasites and perhaps the danger of infection with filth-borne diseases is minimized, the result may be hogs that are more resistant to swine erysipelas infection. A healthy hog is harder to infect than is one already exhausted by its battle against other causes which may be eliminated by sanitary measures.

Observe the herd regularly and remove any swine showing evidence of infection. Burn all hogs dead of this disease. In addition, the following has proved to be of benefit in some herds, particularly those affected with a low-grade type of this disease: At the time pigs are born administer 5 cc. of anti-swine-erysipelas serum to each in the inter-axillary space. Return at the end of thirty days and repeat the dose of serum if it is thought desirable.

Chairman Breed: Dr. Peterman, to what extent do healthy swine inoculated with E. rhusiopathiae vaccine develop symptoms of chronic swine erysipelas following vaccination, and what steps (if any) may be taken to prevent such occurrences?

Dr. Peterman: Reports have been received that indicate that occasional cases of chronic erysipelas have appeared following vaccination. In some instances these were interpreted to be due to lack of protection following vaccination, and in others as being induced by the vaccination. The incidence is very low. At this time, of course, we are still in the experimental stage of this vaccination, and we are not quoting any figures as yet. There is nothing much that you can do about it that I know of.

Chairman Breed: Probably that is what the fellow thought who asked the question. Thank you.
Dr. Grey, do swine showing symptoms of chronic swine erysipelas continue to eliminate the causative organism after the acute symptoms have subsided?

Dr. Grey: This brings up the question of a possibility of carriers of swine erysipelas.

Erysipelas organisms have been demonstrated in various tissues within the bodies of swine apparently recovered from various forms of the disease. Presence of the organisms in these swine is a potential threat from the standpoint of future infection in the herds of origin, or in any herd into which such swine may be introduced.

Hayes and Harrington, as noted by Dr. Van Es on page 11 of his bulletin on swine erysipelas (Research Bulletin 84, College of Agriculture, University of Nebraska), report "... that a number of pigs which displayed chronic manifestation of the disorder were segregated on a farm where erysipelas had not previously occurred. Later on these animals were turned into the common hog lot, after which the original inhabitants then promptly sickened with acute erysipelas."

Another report of interest is taken from page 688 of the 1942 Yearbook of Agriculture: "Several years ago, for example, two healthy hogs were placed in contact with two hogs affected with a chronic form of swine erysipelas. The four animals were housed in a small enclosure on a concrete floor. After almost three months the normal animals remained healthy. Soil was then placed on the concrete floor. About two and a half months later both the normal hogs developed the disease and died within a week of each other. E. rhusiopathiae was recovered from the organs of the dead animals."

We are also faced with the problem of healthy carriers of the disease. It is not uncommon to find erysipelas organisms in the tonsils, ileo cecal valves and elsewhere in the intestinal tracts of apparently healthy swine. Such animals may possibly be dangerous to others, or they may subsequently develop the disease themselves.

Chairman Breed: Gentlemen, this concludes the questions we have on the subject of swine erysipelas. We shall turn now to another phase known as enteric disturbances.

Dr. Kernkamp, please enumerate the different factors, transmissible and otherwise, which may cause symptoms of an acute or chronic gastroenteritis.

Dr. Kernkamp: The causes of gastro-intestinal inflammatory disturbances are many and varied. Of the bacterial agencies we have Salmonella cholera suis (supestifer), S. enteritidis, S. aertricke, S. schottmulleri, Escherichia coli, and Actinomyces necrophorus.

The protozoan vectors include Trichomonas suis, Eimeria debliecke, Isospora suis, Ameba intestinalis, Balantidium coli and B. suis.

The chemical agents include acids, alkalis, ptomaines, staphylotoxin.

Dietetic factors embrace overloading or engorgement, ingestion of unwholesome or spoiled food, possibly a deficiency of specific food factors such as nicotinic acid and others.

Climatic influences: Sudden atmospheric changes, especially when turning cold and damp after a more temperate period.

Specific infectious diseases: Certain infectious diseases are marked by gastro-intestinal disorder; a.e., hog cholera, swine erysipelas.
Parasitic: The common round worm, Ascaris suis, may at times cause inflammatory disease of the gastro-intestinal tract.

Chairman Breed: Dr. Kernkamp, state in the order of frequency or economic importance the enteric disturbances of swine.

Dr. Kernkamp: I would say the order of frequency and economic importance of enteric disturbances in swine would be, first, the infectious enteritis complex, including, as Dr. Steenerson reported in his paper, the bloody dysenteric type. I would include that in the enteric complex. Then I think the parasitic infestations should be second. Possibly after that would come chemical factors, the ingestion of foodstuffs, too acid or too alkaline, or something of that nature.

Dr. Quinn: Dr. Kernkamp, did you intentionally or by an oversight omit the deficiency factors?

Dr. Kernkamp: Yes, that was an oversight. Thank you, Dr. Quinn.

Chairman Breed: Dr. Roberts, in your opinion, in acute infectious enteritis, is the causative factor due to S. cholerasuis (B. Suspestifer)?

Dr. Roberts: Acute enteritis in swine has been repeatedly, though not regularly, produced by oral administration of cultures of S. cholerasuis and in a limited number of trials the infection has occurred in pigs directly in contact with the orally infected animals. However, I am of the opinion that not all cases of acute infectious enteritis of swine are due to the S. cholerasuis organism.

Chairman Breed: Dr. Steenerson, on premises where S. cholerasuis infection is known to exist, does the use of an S. cholerasuis bacterin—used before, at the time of, or following the simultaneous vaccination for cholera—help in any degree to lessen the occurrence of post-vaccinational enteritis?

Dr. Steenerson: Yes, preferably used when pigs are three weeks of age and then simultaneously vaccinated at seven weeks of age.

Chairman Breed: Dr. Steenerson, is the so-called "salt treatment" still looked upon with favor? If so, give in detail the method of handling affected herds, together with the necessary precautions, which will eliminate the possibilities of disastrous results.

Dr. Steenerson: In my opinion it is the best treatment available. Affected herds are placed on a diet of ground oats which have been soaked in a highly concentrated saline and alkaline solution for twelve hours. This is fed to capacity, being definitely sure that an ample water supply is provided. Animals that are too sick to eat or drink are given a quantity of a highly concentrated saline and alkaline solution by means of the stomach tube.

Chairman Breed: Now we will pass to another phase, the subject of nutrition.

Dr. Fairbanks, under the heading of vitamins, will you enumerate the various vitamins which are essential in growing healthy swine? Also name the conditions which may or will develop when these individual vitamins are lacking.

Dr. Fairbanks: Vitamin A is associated with growth, normal reproduction, the integrity of the nervous system, and the normal function and structure of epithelial tissue. Rations too low in Vitamin A predispose incoordination and disturbances in locomotion which may vary from a slight weaving gait of the hind legs to a complete posterior paralysis. At times all four legs are involved. Such syndromes may be accompanied by night blindness and diarrhea, according to one review.
As Vitamin A is identified with the normal function and structure of epithelial tissue, it might be postulated that this vitamin is of importance in the prevention of infections, as of the respiratory tract. In swine literature conclusive evidence is wanting, while with other species there are some indications that the vitamin has anti-infective properties.

Vitamin D or the antirachitic vitamin, affects growth and the economy of food consumption. It is better known as a necessity in the proper metabolism of calcium and phosphorus. It is needed even when calcium and phosphorus are adequately supplied and when the Ca:P ratio is correct, but when Vitamin D is present the Ca:P ratio may vary widely.

In the absence of Vitamin D there is faulty mineralization of the bones, pains in leg muscles, bones and joints, stilted lame gaits, enlarged joints, deformed legs, and low inorganic phosphorus in the blood. Early symptoms are digestive disturbances, loss of appetite, bloating, weakness, and depraved appetites, and finally marked loss of weight.

Senior has shown that when Vitamin D is in the ration of pregnant and lactating sows, there is a delay in the manifestation of rickets when their pigs are raised on a Vitamin-D-free ration.

Vitamin E and its need in swine nutrition is still in need of conclusive evidence. Natural feeds may supply enough Vitamin E, but it is well to take cognizance of the many field cases in which benefits have been reported from the administration of Vitamin E in the form of wheat germ oil.

Vitamin B₁ or thiamin is necessary for the normal health and well-being of swine. Symptoms of a thiamin deficiency may be enumerated as anorexia, cessation of growth, multiple peripheral neuritis, emaciation, posterior paralysis, muscular incoordination and bradycardia.

Riboflavin has been shown to be of practical importance in swine nutrition. Pigs fed rations inadequate in riboflavin manifest retarded growth, diarrhea and a general appearance of unthriftiness.

It has been demonstrated that pantothenic acid is necessary for normal growth and well-being in swine. Symptoms of deficiency may be enumerated as rough, dry coats, and disturbances in the digestive tract, particularly in the stomach and large intestines. In these areas may be found congestion, hemorrhages and ulcers. Spinal cord lesions have been reported as well as a very characteristic gait described as the "goose step".

Nicotinic acid or niacin is required in the normal nutrition of swine. Reported symptoms of a niacin deficiency are emaciation, dermatitis, diarrhea, and lowered resistance to necrotic enteritis. The last point needs further study and investigation.

Vitamin B₆ or pyridoxine is required by the pig. The symptoms of a pyridoxine deficiency are convulsions and fits, a severe microcytic hypochromatic anemia, poor appetites, loss of weight and unsteady gaits.

CHAIRMAN BREED: Dr. Fairbanks, what is this so-called "baby pig disease," commonly referred to as "shivers" or "shakes," and give prevention and treatment, if possible?

DR. FAIRBANKS: This is a disease of young nursing pigs, and occurs generally
before they are two to three weeks of age. The pigs are normal and healthy at birth, and nurse normally until affected. The pigs become lifeless and weak, burrow into the straw, have a peculiar squeal which has been described as “graveyard squeal”. They shiver and are cold to the touch, and the hair frequently stands on end. They soon pass into a coma and death comes soon afterward.

The Illinois station has reported that the sugar in the blood of affected pigs is lower than in normal pigs of like age. The workers at this station refer to the disease as acute hypoglycemia. Pigs in the early stages of the disease have responded to glucose therapy, while in the terminal stages such therapy may be ineffective.

The cause for this acute hypoglycemia has not been definitely determined. I have the opinion that it is a disturbance of carbohydrate metabolism, and the disease could be studied from this point of view.

CHAIRMAN BREED: Thank you.

DR. KERNKAMP: Mr. Chairman, may I ask a question? The question asks, “What is this so-called “baby pig disease” commonly referred to as “shivers” and “shakes”?

I connect the latter two appellations to another syndrome, admitting, of course, that these little pigs that Dr. Fairbanks just discussed, having hypoglycemia, do shiver. But I think there is another syndrome, and I don’t believe it is the same condition of which the shivers and shakes are manifest symptoms.

CHAIRMAN BREED: Tell us what the disease is.

DR. FAIRBANKS: I think Dr. Kernkamp is right.

DR. EJZRNKAMP: I don’t know. (Laughter)

DR. FAIRBANKS: I think Dr. Kernkamp is right.

CHAIRMAN BREED: Are you satisfied, Dr. Kernkamp?

DR. KERNKAMP: I am not satisfied, but I have said all I can about it.

CHAIRMAN BREED: I guess that rounds out the question.

DR. FAIRBANKS: Is there evidence to show that a young growing pig, receiving a food intake deficient in one or more mineral elements, develops a greater susceptibility to infectious disease?

DR. FAIRBANKS: As a layman I might be misinterpreting the words “infectious disease”, but if my interpretation is correct I know of no experiment that would support the conclusion that any mineral element is associated with a greater susceptibility to infectious disease in swine.

CHAIRMAN BREED: Dr. Fairbanks, is there evidence that the lack of certain vitamins in the diet of the young growing pig increases its susceptibility to infectious diseases?

DR. FAIRBANKS: Davis, Freeman and Madsen, and Davis and Freeman showed that swine exposed to necrotic enteritis either naturally or artificially, appeared to be more resistant to the infection when nicotinic acid or feeds containing this vita-
min were given. Beneficial effects have been attributed to the vitamin’s ability to maintain the integrity of the intestinal mucosa, rather than to a specific action against the invading organism. Edgington was unable to confirm these results.

CHAIRMAN BREED: Now we will proceed to brucellosis in swine.

Dr. Kernkamp, how much of a factor is brucellosis as a disease entity in swine?

DR. KERNKAMP: I do not believe that brucellosis, as a disease entity in swine, is very prevalent. On the other hand, in droves where the disease exists it usually is quite serious, since the losses due to abortion are often very great.

DR. QUINN (Iowa): Dr. Kernkamp, do you refer to the dairy district around St. Paul or the hog raising sections of the United States? (Laughter)

DR. KERNKAMP: I’ll tell you, Dr. Quinn: I think I have to base some of this upon an examination of 3,500 blood samples from swine brought to a central market. They probably came from the swine growing district of the State and not the dairy district. (Laughter)

DR. QUINN: I cannot help but feel that the answer needs some discussion. Is there anyone here—Dr. Robert Graham or some of the men from the University of Illinois—who would coincide with that opinion?

DR. MORRILL: I should say that I haven’t any figures with me, of course, but offhand our testing in Illinois would indicate that it is quite prevalent in Illinois swine.

CHAIRMAN BREED: What do you mean by “quite prevalent”?

DR. MORRILL: I mean a relatively high percentage of swine herds may show infection, and do show infection.

CHAIRMAN BREED: 10, 15, 20 per cent?

DR. MORRILL: Probably. (Laughter) And some fellows who start out to find herd sires have likewise found that it is pretty difficult at times, if you want a certain type of hog, to find one free of brucellosis, or in a herd free of brucellosis.

DR. KERNKAMP: In answer to Dr. Quinn, I will say I believe it is on an increase, that the prevalence is increasing; I will admit that. I heard much more about brucellosis in swine in the last few years than I did previous to that, but I still maintain that the incidence is not too great.

CHAIRMAN BREED: You mean in comparison with other swine diseases?

DR. KERNKAMP: Yes.

DR. QUINN: In view of your comment at the end of your sentence, “in comparison with other swine diseases”, I believe Dr. Jordan of our Iowa Board of Health is in the audience. Not many years ago we found in Iowa that the incidence of brucellosis in swine on farms where undulant fever occurred was four times that of the incidence of brucellosis in swine.

DR. JORDAN: I am afraid I don’t have all the information desirable on the incidence of brucellosis among swine. I wish Dr. McNutt were here. I think he found it necessary to go back to his work this afternoon.

In Iowa for the last several years our impression has been that brucellosis in swine is a disease of considerable proportions, and if you will look at the number of charts that have been brought along, which are based on data contained in Boards in Iowa, you will see that the great majority of brucella strains that have been isolated from the blood are brucella-suis. Perhaps 80 per cent of all the strains were strains of brucella, and a much smaller percentage of brucella were brucella abortus.
I realize it is very difficult to isolate brucella abortus, and I wish Dr. Morton had found it possible to attend this meeting. We hoped he would be here to speak about the bacteriologic phases of the brucella organisms.

It is Dr. Morton's feeling that the cultures are not incubated over long periods of time. Sometimes it is necessary to incubate and transfer the organism from the blood culture bottle to plates containing the necessary media, and to transfer over a period of two or three weeks; in some instances, the blood cultures had to be incubated for a period of a month or more before Dr. Borts succeeded in isolating brucella.

Brucella abortus requires an atmosphere containing carbon dioxide and for that reason it is much more difficult to isolate brucella abortus than brucella-suis. The latter ordinarily will grow under atmospheric conditions and may appear in the blood culture several days after the culture is taken.

We believe this difficulty in isolating brucella abortus as compared to brucella-suis accounts for the fact that many more strains of suis have been isolated than abortus.

Then again, patients who suffer from the disease due to brucella abortus are probably not as sick, and are sick over a shorter period of time, and it is not easy to get blood cultures on such patients. It is desirable that as many patients as possible have a blood culture taken during the active virile stage of the disease. That is another reason why more suis strains have been isolated than abortus.

I think we have to depend upon veterinary research workers. Dr. Murray is here from Iowa State College. Some years ago, when the study of undulant fever began in Iowa, Dr. Murray played a very active part in arranging agglutination tests on specimens of animals. We feel that swine do play an important part, especially in Iowa, where we have so many hogs.

I talked with a number of veterinarians, and, as has been mentioned today, it seems to be the prominent opinion among some of the veterinarians that this infection in swine is on the increase. We are dependent very much upon veterinarians for the collection of blood specimens. It is necessary for that work, of course, to be done by the veterinarian, and on farms particularly we should not be satisfied with taking blood specimens from dairy cows. If we stop there we are going to miss the source of infection in quite a number of cases.

It is highly desirable that the blood specimens be taken from a number of brood sows as well as other sows in order to get complete information and throw proper light on the sources of probable human infection.

Chairman Breed: Thank you, Dr. Jordan.

Dr. Kernkamp, is Bang's disease of cattle transmissible to swine?

Dr. Kernkamp: No. The evidence, experimental and otherwise, indicates that the diseases in cattle and swine are not cross-infective.

Chairman Breed: Dr. Kernkamp, how is brucellosis in swine spread?

Dr. Kernkamp: The answer to this must be delayed. Sufficient information is not yet available to give a definite and complete reply. However, we look upon an infected intact male as an important factor in the spread of this disease, but by no means is it the only one nor it is not likely to be the most important one.

I would consider that the ingestion of infective material is a very significant way
in which animals become infected. Aborted fetuses and placenta of infected animals is dangerous infective material.

**CHAIRMAN BREED:** Dr. Kernkamp, is the agglutination test for this disease in swine as reliable as in cattle? What dilution or titre would you consider as positive evidence of infection?

**DR. KERNKAMP:** Here comes the point which Dr. Quinn is interested in and on which he has raised some question. On the brucellosis program tomorrow afternoon we will try to answer this question.

I think the agglutination test for brucellosis in swine is as reliable as is the agglutination test for this disease in the bovine. The dilution titre which I would consider as representing evidence of infection would be somewhere in the vicinity of 1:100.

Tomorrow morning in our program this same question will come up, and I would like to delay it until that time.

**CHAIRMAN BREED:** Dr. Eichhorn, is it possible to immunize swine against brucella infection with Strain 19, abortus vaccine?

**DR. EICHHORN:** About a year and a half ago we arranged for a project on this very same question. Untold numbers of experiments were conducted, and in each group about 25 animals were included. They were naturally challenged during pregnancy, and at that time we found that about the same number of vaccinated animals aborted as in the controls.

From all indications, and from the limited experiments, we can conclude that Strain 19 is not adopted for immunization against swine brucellosis.

May I just add one more point, that at the present time we are working with a suis strain of reduced virulence, and we are not as yet ready to give you an answer on the results.

**CHAIRMAN BREED:** Thank you, Dr. Eichhorn.

**DR. ROBERTS:** Swine abortions of an infectious character are probably most frequently the result of brucella suis infection; however, some may be the result of other causes.

Abortion is occasionally associated with hog cholera and other systemic diseases of swine. Rough handling and transportation of sows in advanced pregnancy, toxic feed and possibly dietary deficiencies, may account for other abortions.

**CHAIRMAN BREED:** Dr. Fairbanks, what procedures would you recommend for the eradication of brucellosis infection from a valuable pure bred herd of swine?

**DR. FAIRBANKS:** My procedure is simple but effective. At times it appears the hard way, expensive, ruinous and impractical, but in the end it is the cheapest procedure. Test the herd regularly. Sell all animals that react positively to the agglutination test. Bring no animals into the herd unless they have reacted negatively to the test. I know you will not like that answer.

I have consented to attempt to answer this question because the breeder of pure bred swine is involved, and certainly is implied in the question. Furthermore, I have had two unfortunate experiences with this disease. The first occurred 25 years ago in Colorado, and at the present time the herd that I am managing consists
of 100 sows, and at one time it had been reduced to one Chester White sow, due to this disease.

Dr. Kernkamp: I think your answer to the question is a good one. (Laughter)

Chairman Breed: We have four more questions under the heading of general subjects pertaining to swine diseases.

Dr. Kernkamp, will you give your opinion why swine flu is so seasonal, taking into consideration the findings of Shope, which show that the lung worm larvae are capable of harboring and transmitting the virus?

Dr. Kernkamp: In the first place, I would agree with the statement contained in the question, that the disease of swine flu is a seasonal one. The season is principally the fall and winter months.

To relate this seasonal occurrence with the transmission of the disease through the larvae of the lung worms in swine is more difficult. I really cannot answer that. It is my opinion that there is no relationship between the seasonal occurrence of swine flu and the transmission by the larvae of the lung worm.

For example, one finds many things in the summer time—heavily parasitized with lung worms, but no evidence of swine flu is found. I think it is Dr. Shope’s idea that the larvae harbor the virus, carry the virus, and therefore it is contained within the larvae, but some factor has to come into play in order to release it. I don’t think Dr. Shope tried to tell us what that factor is. I don’t know what the factor is that makes this disease seasonal. Since it occurs at those times of the year when climatic conditions are least favorable, with the weather cold and damp, I think that is a factor in the development of this disease.

Chairman Breed: Dr. Kernkamp, it has been reported that the organism, \( E. \) \textit{Buiseptica}, is capable of activating the virus of swine flu. Are you able to affirm this finding? If so, point out some gross differences noted in the affected lungs, and compare the mortality with flu caused by Hemophilus suis and the virus.

Dr. Kernkamp: Mr. Chairman, I should not even attempt to answer this question. I haven’t had any experience in an experimental way in the study of this disease, especially with reference to its transmission. But I will say that the swine flu due to the synergistic activity of the virus and the hemophilus suis organism which is associated with it is not a serious disease, at least not serious from the standpoint of high mortality.

It does have a high morbidity. Many animals in the group may be affected, but the death rate is very small, and many times inconsequential, and many times no animals die at all. On the other hand, if there is an association of pasturella suiseptica, this brings on something else; then the mortality increases.

You ask whether or not that activates the virus. That I do not know. I would think it is an association between this virus and the organism. The virus may not have been activated at all.

Another thing: I would say that as far as the lesions are concerned, it is very seldom that we have a pig die from swine flu due to the synergistic activity of the virus and the hemophilus suis, and therefore we do not have much of an opportunity to examine the lungs. One would have to destroy an animal in the height of the disease to know what occurs then. On the other hand, these cases where such organisms as the suisepctica have been observed, those lungs have showed a marked and extensive bronchopneumonia.
CHAIRMAN BREED: Dr. Scott of Pennsylvania, do you agree with everything Dr. Kernkamp has said?

DR. SCOTT (Pennsylvania): I think I agree fully with what Dr. Kernkamp has said on this subject. I might add that the lesions after a pig is killed, after being infected with the virus and hemophilus suis, are one of atelectasis of the cardiac and apical lobes, and that is about the only lesion there is. It affects the entire cardiac and apical lobes, and occasionally some of the adjacent portions of the posterior lobes. If pasturella suiseptica is added to swine flu virus, the disease is extremely severe, and I think 100 per cent of the animals infected with this mixture will die.

From experimental infection with the hemophilus suiseptica and virus of, say, 100 animals, I believe we have had no deaths at all. It is an uncomplicated infection.

CHAIRMAN BREED: While we are on the subject of virus, here is a question from the floor: What causes abortion in swine following an outbreak of swine flu virus? Who desires to volunteer to answer the question?

DR. SCOTT: We have not had any experimental work in connection with abortions during swine flu infections, and in Pennsylvania we have very little swine flu in the State, so we have not had any sows infected with the disease when they might possibly abort. Theoretically, I suppose, the disease would perhaps increase the chances for abortion.

DR. KERNKAMP: May I ask you a question, Dr. Scott? How often have you observed swine flu in breeding sows—sows that are 18 months old or so?

DR. SCOTT: We have not observed it in any animals of that age. We have had only three field outbreaks of the disease in the State during the past six years.

DR. KERNKAMP: Does it occur in young pigs, 3 months of age, or up to 3 months of age?

DR. SCOTT: Yes, we have had it in pigs about 2 months of age, and some were about 6 months of age. In the latter case it was associated with hog cholera.

I think perhaps Dr. Steenerson has had experience with the disease in the field, in which abortions may have occurred for which the condition occurred in older animals than we have noticed in Pennsylvania.

DR. STEENWON: Maybe I don’t know swine flu when I see it, but we have got something in Indiana that fits into the reasonable picture that describes swine flu, and I think I have seen gilts—I wouldn’t say sows, but I think I have seen quite a number of gilts that would abort their pigs shortly after they had gone through this spell of sickness.

DR. SCOTT: Possibly just the clinical manifestation of increased respiratory action might give almost a mechanical abortion there, without much action from the flu virus.

DR. STEENWON: I can’t answer that; I am not going to attempt it. It is out of my line.

CHAIRMAN BREED: Let us ask Dr. J. S. Koen, the daddy of swine flu, if he has anything to add to this discussion on the matter of flu virus or flu occurring in a herd of bred gilts or sows, causing abortion.

DR. KOEN: I have observed a number of gilts that have aborted after having gone through an outbreak of flu previously. They don’t have to have the flu soon,
nor will they abort soon after having an attack of flu. It can be a couple of months later, and the owners could not connect the presence of flu two months before with abortion that the gilts show. Practitioners here in Illinois, when I was living here, were observing this condition very frequently, and I believe it was Dr. Hastings of Williamsville who gave quite an elaborate report on flu that causes abortion in gilts.

As to your laboratory investigations, of course I know nothing about that. Thank you.

CHAIRMAN BREED: Thank you, Dr. Koen. Does anyone else wish to say anything about this flu virus and the relation to abortions of sows or gilts?

DR. STEENERSON: May I ask a question of some of the laymen in the audience? Could a high temperature during this attack of flu have something to do with abortion, if the gilts were pregnant?

DR. ROBERTS: It has been my understanding that almost any febrile condition would predispose to abortion during certain stages.

CHAIRMAN BREED: I don’t believe we can get into an argument over this matter. We will proceed to the next question.

Dr. Grey, swine pox is an outstanding problem among small pigs in certain areas. Is this condition always caused by one specific virus, or may there be more than one virus producing identical lesions? Give the viruses involved, and best method for handling.

DR. GREY: Swine pox is now known to be caused by two types of virus. One type is immunologically similar to that of vaccinia, and the use of vaccinia virus for immunization against this type has been successful. The second type is not immunologically similar to the vaccinia virus; however, the lesions produced by these two viruses are similar. Swine recovered from one type of the virus are immune to that particular type but are still susceptible to the second type. Shope and other investigators have observed that pox is transmitted by lice carrying the virus from animal to animal and not by contact of healthy and affected swine. Therefore, in order to prevent swine pox, eradicate hog lice.

CHAIRMAN BREED: Dr. Grey, is it advisable to vaccinate young pigs with serum and virus during an outbreak of acute swine pox?

DR. GREY: It is not considered advisable to introduce hog-cholera virus into pigs during an outbreak of acute swine pox. Some advise the administration of anti-hog-cholera serum alone in these cases just for the “lift” it gives the pigs. Of course, if there happens to be an outbreak of hog cholera in the neighborhood, the administration of anti-serum is advisable and serves a double purpose.

CHAIRMAN BREED: Gentlemen, that concludes our program as far as this forum is concerned. We have asked all the questions we felt would give you what might be termed a short course in the subject of swine diseases in a two-hour period in one afternoon.

I want to take this opportunity to thank those who have participated in the program, those here at the table and those on the convention floor. I feel the information given here is probably the latest available information on all the subjects presented. I can assure you that you have been a very fine audience. It has been a pleasure on my part, and I believe I speak for the members of the panel.

We thank you and turn the meeting back to your President. (Applause)

PRESIDENT McADORY: The meeting is adjourned.

The meeting adjourned at 5 o’clock.
FEDERAL MEAT INSPECTION IN WARTIME

By O. W. Seher

Inspector in Charge, St. Louis, Missouri

Members of the U. S. Livestock Sanitary Association: It is a distinct honor and pleasure to be invited to speak to you on the subject of Federal inspection of meats. Because of your general familiarity with it, as conducted under normal conditions, I shall deal principally with developments of the last year.

Largely for the same reasons that business cannot be conducted as usual during a war of global scope, Federal meat inspection cannot be conducted without material adjustments. These concern the increased volume of the work, new legislation and regulations, personnel problems, substitutes for critical materials, and control of inspection data of possible value to the enemy. Let us consider some of these points briefly.

Following the entrance of the United States into the present World War, there was much discussion on means of providing the necessary quantity of federally inspected meats for customary needs and, at the same time, of complying with the increasing needs of Federal agencies. These agencies included those that were placing orders for Lend-Lease purposes as well as those seeking to procure meat for our armed forces.

SCOPE OF INSPECTION EXTENDED

On June 10, 1942, Public Law 602 was approved by the President after its passage by Congress. Its purpose, as given in the introductory statement, was as follows: (I quote) "To authorize the Secretary of Agriculture to provide Federal meat inspection during the present war emergency in respect of meat-packing establishments engaged in intrastate commerce only, in order to facilitate the purchase of meat and meat food products by Federal agencies, and for other purposes." (End of quote.)

The law authorizes the Secretary of Agriculture to make the same or similar examinations and inspections for establishments conducting only intrastate business as would be made if meat and meat food products from such establishments were to be used, transported, or sold in interstate or foreign commerce. The provisions of the law apply to any slaughtering, meat canning, salting, packing, rendering, or similar establishment.

Although the legislation materially increased the scope of the meat-inspection service, no change in its existing regulations was necessary, with the exception of one paragraph that was added to B.A.I. Order 211 (Revised as Amendment 16). This B.A.I. Order, together with the amendment, constitutes the operating basis for the Federal meat-inspection service. One of the reasons why Federal inspection has been able to meet new developments was the wisdom of the framers of the meat-inspection laws in establishing broad principles and objectives, but at the same
time authorizing the Department of Agriculture to make such rules and regulations as might be necessary for carrying out the provisions of the laws.

The new amendment covered the following points: The establishments that seek inspection under the new law should be prepared to furnish substantial quantities of meat or meat food products for purchase by Federal agencies. The construction, equipment, facilities, and sanitation of such establishments are to be acceptable to the Secretary of Agriculture for the conduct and maintenance of the inspection. The law and amendment are both effective for the duration of the present war and not exceeding 6 months after its termination. The new legislation is such that the requirements of Federal meat inspection apply with equal force to all inspected establishments and cover all features of the work, including marking and labeling. The products of establishments inspected under the new law and regulations are eligible for interstate and foreign commerce to the same extent as all other federally inspected meats.

INSPECTORS GIVEN BROAD AUTHORITY

To expedite the granting of inspection and to keep pace with the tempo of wartime activities, after the approval of the Act of June 10, 1942, the Bureau promptly designated traveling inspectors at strategic field stations to examine the plants and premises of applicants for inspection. The inspectors were instructed to inform the management in each case of any necessary changes and corrections. These employees, of whom there are now 12, were selected because of their extensive experience with the planning and conduct of Federal meat inspection operations. They are given broad authority to reach understandings with plant managements regarding the most practicable means of providing necessary facilities. In this work economy of critical metals and other materials needed in the war effort is kept constantly in mind and all possible assistance is furnished applicants in planning for inspection. This principle is followed whether a plant has only recently applied for inspection or is already operating under it but is contemplating changes.

Since the passage of the new Act, approximately 300 concerns have applied for inspection and their plants have been examined accordingly. Inspection has been granted thus far at more than 80 of these establishments, with prospects that most of the remainder will eventually prepare to operate under the same supervision.

MEAT INSPECTION LEGISLATION FANNED BY PUBLIC SENTIMENT

To understand fully the scope of present authority for Federal inspection of meats, let us review briefly the legislation covering this field. The original meat-inspection law was enacted in August 1890, but was soon superseded by an Act of March 3, 1891. Those laws dealt principally with inspection of meat for export in order to make meat from the United States acceptable to foreign governments. Time and experience soon showed the inadequacy of this limited legislation, especially in connection with the welfare of consumers in the United States. There followed the Act of June 30, 1906, which was re-enacted March 4, 1907, with a slight change, and is now officially known as the Federal Meat Inspection Act. This formed the basis of our present comprehensive meat-inspection system, which has received world-wide acceptance. It is noteworthy that this Act was the result
of public sentiment occasioned in part by unsatisfactory conditions surrounding the meat supply of the United States Army during the Spanish-American War in 1898. Theodore Roosevelt, who participated in that war, was intensely interested in supervision of the meat supply, and his influence, after he became President, was largely instrumental in the passage of the Act of 1906.

The next meat-inspection legislation was in 1913 under the provisions of the Tariff Act, which was thereby broadened to include inspection of imported meat. Each succeeding Tariff Act has contained provision for the inspection of foreign meats offered for importation. Six years later, in 1919, Congress passed the so-called Horse-Meat Act, which was approved June 24 of that year. This Act served a useful purpose in livestock production in addition to providing for the actual inspection of horse meat. Especially on ranges of the Western States, wild horses had been increasing in number and they consumed much pasturage that was desired by ranchmen for cattle and sheep.

One effect of the Horse-Meat Act was to provide an export market for the meat of these surplus horses. The same Act made possible the utilization, after proper inspection, of the meat of horses, in general, that have outlived their usefulness. Besides the export market there were additional outlets for horse meat for animals in zoological parks, fur farms, kennels, and similar uses. However, the inspection of horse meat has constituted a very small proportion of the operations of the Federal meat-inspection service.

In accordance with the policy of the service to have inspected products clearly and accurately labeled for the information of consumers, all horsemeat is marked with a distinguishing stamp. This stamp is hexagonal and the marking fluid is green in color, whereas the stamp used on all other inspected meat is round and the marking fluid is purple.

MEAT PRODUCTION AND INSPECTION SURGE UPWARD

The next and last meat-inspection legislation was the Act of June 10, 1942, already mentioned, which is expected to be highly useful. Whereas, in the past, about 66 percent of the Nation's meat supply has received Federal inspection, prospects are that during the present fiscal year the proportion may rise well above 75 percent. The increased percentage, when applied to the volume of expected slaughter, appears certain to result, this year, in a total figure for animals inspected that will eclipse all previous records. During the last fiscal year, which ended June 30, 1942, the inspection of food animals exceeded 86 million head, as compared with approximately 70 million under normal peace-time conditions. But the figure, 86 million, includes only a few of the many million pigs farrowed in the spring of 1942. Their slaughter will be recorded chiefly in the fiscal year 1943, when the inspected kill of food animals will undoubtedly reach a much higher total, due largely to the greatly increased production of hogs.

AIDS IN CONSERVING CRITICAL MATERIALS

Another development in the meat-inspection service has been its cooperation with other Federal agencies in their conservation programs. As a contribution to sugar saving, the Bureau in February notified the operators and owners of inspected
establishments of opportunities for using sugar substitutes that previous investigations had shown to be satisfactory in curing meats. These substitutes included honey, maple syrup, corn syrup, refiner’s syrup, partially refined corn sugar, and several other sweetening substances. The reaction to the suggestions was favorable.

In still other respects the meat-inspection service has sought to help establishments gear themselves to wartime policies and requirements while, at the same time, maintaining high standards for meat hygiene and the quality of the product prepared. As already mentioned briefly in connection with the new inspection work, Bureau employees have endeavored to see that critical materials such as iron, steel, copper, and cork, have been kept at a minimum as regards both new construction and replacements. This effort has resulted in a material saving of these materials.

FORGING THE POWERFUL WEAPON—FOOD

Necessarily, the increased volume of work has added administrative responsibilities. One of the greatest has been that of obtaining adequate personnel with proper training and experience, in the face of a national labor shortage. There has been need, also, to comply with wartime requirements involving the publication and other release of information. Detailed figures on imports and exports, while still being compiled, are no longer being published because of their possible value to the enemy or subversive elements. Meat inspection must be adapted also to new developments in the preparation and packaging of new products, of which dehydrated meat is a typical example. The service has been and must continue to be adaptable in such fields.

In behalf of my associates, let me state in conclusion that although carrying added duties, we take pride in maintaining the customary high professional standards and integrity of Federal meat inspection. This is a war in which technical knowledge and experience have far-reaching effects in improving the striking power of our armed forces. In the meat-inspection service we are striving to help forge one of the most effective of all weapons—food.
Epidemiology is not the simple investigation of common infections that it was formerly. Today epidemiology has become a more complex investigation than it was even five years ago. With the passing of our common water-borne epidemics of the 19th and early 20th century, attention was turned to the epidemiology of respiratory infections. This has occupied the attention of most medical investigators up to the present day. In stating that respiratory diseases have received the larger amount of medical researchers’ time, I would not infer that our enteric diseases are assumed to be successfully controlled. But we can say that by far the larger part of our population live in communities where adequate water and sewage sanitation are part of the community. The sanitary engineer still has a large task before him in developing desirable sanitary facilities in thousands of small communities ranging in size from 500 to 5,000 population and there are many larger communities that need additional or supplementary sanitary programs.

Our next step in control of enteric diseases is control of food sanitation. In this food category we shall include all edibles—meat, fish, fowl, milk, dairy products, fruit, vegetables and staples. The containers and utensils used in dispensing are so closely related that they are a direct part of the cause in many incidents. The third part is the human factor which is the most important in the opinion of many health officials.

The time honored investigation of epidemics has been to find the common denominators of those who are ill and rest the case there. But today, epidemiological procedures include bacterial investigation; that is, attempts to isolate the organism and study it further in the health units laboratory—usually a state laboratory except in the case of large cities. From this point the data is accumulated until sufficient is available to do a statistical analysis of what we know so we may get an idea of what to expect. With respiratory and communicable diseases this has worked very satisfactorily. But with enteric diseases that are sporadic or endemic it is difficult to get an over all picture because too small a number of cases are reported to health authorities to be investigated thoroughly. Too often they are passed off as summer flu—upset stomach—and truly they usually are of minor importance as to mortality data; but as for morbidity, it is difficult to hazard an estimate except to rationalize from figures that are available of the severer cases.

Recently the U. S. Public Health Bulletin reported data applying to causes for industrial absenteeism. The survey included 120,000 workers. The following figures were quoted:

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Analyzing those figures we realize there were 8.8 days lost in 1941 per 1,000 employees, but in 1942 this rose to 12 days per 1,000 employees. For the purpose
of speculation let us assume there are 55,000,000 wage earners—20,000,000 employed industrially today. That would give us 480,000 man days lost from our war effort in 1942. Fifty percent of this can be safely attributed to food borne diseases. The above cases are those that are severe enough to cause absence from work for eight days or more. How many may we assume are less severe than this—a problem that staggers our imagination. Recent investigational work by Dr. Albert Krueger and his naval influenza research unit have proven that influenza can be easily transmitted by restaurant eating ware, indicating that our food control sanitation may enter the respiratory disease control picture.

The past few months in Ohio we have had some interesting epidemics in local areas. Early this summer there was an outbreak of 13 typhoid cases and 20 or more severe enteritis cases. The first case occurred on a grade A milk producer who was distributing raw milk. The farm was under the supervision of the local health department and no previous illnesses had occurred on the premises. The history was that the father and son had become ill a few weeks after a relative had visited them a few days. The owner and son continued to work realizing that the business depended on their efforts. Finally they were forced to bed with a diagnosis of typhoid fever. Following their confinement, 13 typhoid and 20 enteritis cases developed on their milk route among 36 families where they delivered milk.

The above epidemic is an illustration of a well supervised raw milk dairy where the physical plant was well developed and all due precautions were exercised except pasteurization of the milk—and in this case we may not be certain that pasteurization would have prevented the outbreak. The factor that should have been emphasized in milk sanitation was the human factor—the owners did not realize or overlooked, because of the economic factor, the fact that they can be the cause of infecting milk handled in the best prescribed methods. Our position in all sanitation work should be in developing this thought in the person handling food products—"Am I possibly contaminating this product because of illness or poor personal hygiene?" We can control sources of food, general sanitary procedure and type of equipment used, but we can't check each food handler everyday—we are fortunate if we can have a thorough physical check-up when they start in working for or operating food handling establishments.

To describe an epidemic of opposite circumstances—late this summer I was called to see a dairy (jug distributor) where a boy had been seriously ill. The owner of the farm rented to a family whose boy became very ill. The owner continued to operate a small dairy herd on this farm processing the milk on the back porch of the farm house. At first the boy was thought to have had polio and after he was sent to the hospital a tentative diagnosis of subacute meningitis was made. But by the end of the week the hospital had diagnosed the case as Shigella dysentery of the Sonne type which was controlled by sulfasuxidine.

During the interval we began an investigation of the owner who was distributing milk. He was in an area where the U. S. Public Health Milk Code was in force but he had evaded supervision by operating without a permit—bootlegging milk. He had no suitable dairy barn or milk house for his processing. Most of his milk was distributed in gallon bottles and a few quarts. The surprising thing was that he had a fairly intelligent group of families to whom he distributed milk. It is
difficult to understand the reasoning of laity who spend money for vitamins and health-giving compounds but will jeopardize their health to save a few cents buying cheap milk.

On the porch where the milk was processed the bedding from the ill boy's bed had been placed, while the milk was bottled on the other side of the porch. On investigation of the 12 households we found 9 cases of enteritis had occurred in these families. Two of these cases were military men who had been ill, but had returned to their bases. The county health officer immediately notified their bases and these men were isolated until the final diagnosis was made.

This case illustrates the opposite of the first case in that there were no physical facilities for handling milk properly. They were attempting to evade the law and can be said to be criminally negligent. There are numerous civil suits where damages have been collected—when word of this got around the community's five other bootleggers of milk quit business.

Recently public health authorities have become cognizant of animal diseases being a greater source of human disease than was formerly thought. Tuberculosis, trichinosis, undulant fever, septic sore throat and encephalitis have received much attention as diseases of animal origin. But the enteric infections are now moving up into this group of diseases. In a recent Army medical bulletin attention was called to the fact that physicians may often be able to predict the occurrences of disease by finding out what diseases are occurring in animals. The medical literature has called attention to this editorially by saying that physicians should have close professional relationship to veterinarians in the community so they may know what epizootics or enzootics are occurring. In Ohio we are developing this relationship in pointing out to local health officers to contact veterinarians for information about animal diseases. By having the local veterinarians participate in health programs we may even develop to the point where the health authorities can predict enteric disease outbreaks. For example hog cholera occurs in the community and the health officer is notified. He may know from experience that some ill hogs will be slaughtered and offered for sale with ensuing enteritis. The possibilities of improved public health procedures by closer relations between the veterinary profession and health authorities are immense.

In recommending a local health program for the control of food-borne diseases the adoptions of the U. S. Public Health Milk, Restaurant and Frozen Desserts Codes and the Bureau of Animal Industry meat regulations—the latter modified to suit local necessity. Through this program all food except canned goods come under adequate supervision but mechanical compliances will not control the problem. Education and developing a public health responsibility of those in the food industry are important for Better Health to make for Better Living.

Epidemiology of enteric diseases of the milder types have not developed as rapidly as other diseases as few cases are reported and mortality is low. To develop this field of epidemiology better reporting of diseases must follow closer cooperation between health officials and local veterinarians so that the health officer will be acquainted with animal disease outbreaks. A program of milk, dairy products, restaurant sanitation and meat inspection regulation must be adopted by health districts to maintain high standards of sanitation and hygiene.
REPORT OF THE COMMITTEE ON MEAT AND MILK HYGIENE

A. F. Schalk, Chairman, Columbus, Ohio; T. B. Jones, Phoenix, Ariz.; Warren P. S. Hall, Toledo, Ohio; J. S. Koen, Storm Lake, Iowa; C. C. Franks, Des Moines, Iowa; W. H. Lytle, Salem, Ore.

Your committee desires to report further progress in this important health work. All states engaging in the work have improved their operations and are getting closer together on a really safe and firm foundation for this service. California is still far ahead of other states in the matter of meat inspection and deserves great credit for the example it has set. Connecticut, Pennsylvania, Montana and most of the Southern states are forging ahead and making satisfactory progress.

Missouri has taken great forward steps at Kansas City where a system of meat inspection under veterinary supervision has been inaugurated. St. Louis has voted to put it's Health Department on a real civil service or merit system.

Milk inspection still remains a city proposition as a rule, yet several states have improved legislation now in force in this respect. All cities and states are approaching a single standard for milk and it's inspection which is indeed a hopeful sign of progress.
BOVINE TUBERCULOSIS IN HUMANS

BY D. C. LOCKEAD

City Health Dept., Rochester, Minn.

It is hardly apropos to discuss bovine tuberculosis in humans twenty-five years after your inauguration of the accredited herd plan soon to be followed by the area eradication method which has resulted in the control of bovine tuberculosis throughout the country.

There seems little to say except to remind you that you have not eradicated bovine tuberculosis. As long as one cow reacts to tuberculin there is danger of a flareup if you relax your activities.

Tuberculosis is tuberculosis, so I should remind you of swine and fowl potentialities, and it might be profitable to consider the danger to cattle of human tuberculosis. In the past from a control standpoint too much attention was paid to types. My late respected chief, Dr. C. H. Mayo, always insisted that different types of tubercle bacilli are more a matter of soil than of seed.

By typing tubercle bacilli from human lesions we used to conservatively say that twenty-five per cent of all human tuberculosis and one-half of one per cent of pulmonary cases were bovine tuberculosis. Later European surveys indicated five or six per cent of human pulmonary tuberculosis were bovine cases. I still think we underestimated the danger of bovine tuberculosis to humans. It used to be that many children got unpasteurized milk from tuberculous cows. They must have received infection and many years later when tuberculosis occurred the tubercle bacilli found would show human type. I cannot see any reason why the bovine organism ingested in infancy after millions of generations of germ life in the human environment should not have taken on the characteristics and even virulence of the human type.

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. I wish I had had more time to gather figures to substantiate that statement. When the Minnesota Gillette Hospital for crippled children at St. Paul was opened in 1897, about ninety per cent of the patients had bone and joint tuberculosis. Today, a case of this kind rarely appears there.

Tuberculosis in human has been gradually and enormously reduced in recent years all over the country. Several years ago, Prof. H. R. Smith compiled figures which indicated that in states where the most tuberculin testing of cattle was done, the human death rate was reduced more and faster than in states where bovine testing was neglected. In Minnesota, the death rate in 1911 was 119 for every 100,000 population. In 1941, it was 26.6—a reduction of seventy-eight per cent. Several unmeasurable factors have operated to cause this reduction. One of the
big factors has been the decreased amount of tuberculosis in cattle, with resulting lessening of human infection. That is a generally accepted opinion, but figures will bear out the correctness of the opinion. Prof. Smith has furnished me with a tabulation of figures for the whole United States which show that since 1917 to 1938, there has been a decrease in the human non respiratory tuberculosis death rate from 22.5 to 4.6 (79%) as compared with a decrease of sixty per cent in the death rate from respiratory tuberculosis during the same period.

In Minnesota, the figures are almost the same. Since 1918 to 1941, there has been a decrease in the human non respiratory tuberculosis death rate from 18 to 2.74 (85%) as compared with a decrease of seventy-three per cent in the death rate from respiratory tuberculosis during the same period. But reduced death rates do not tell the whole story in regard to bovine tuberculosis. The large majority of cases of bovine tuberculosis in humans are not found in mortality lists—they do not result in death. They result in suffering, incapacitation, and crippling to which death might be preferable. So to properly appraise the benefits to humans of your controlling of bovine tuberculosis, we might well consider evidence that there are fewer cases of bovine tuberculosis in humans with, of course, much reduction in after effects.

In 1917, 3.4 per cent of the patients who came to the Mayo Clinic had tuberculosis. In 1941, only 1.2 per cent, a reduction of sixty-five per cent. Remember this was not a decrease among the normal population, but among sick people. In 1917, 864 cases were of the respiratory system, while 737, or forty-six per cent nearly half were other forms, among which we expect to find bovine cases. In regard to the figures which follow, I would draw your attention to the fact that the number of cases mentioned are from a considerably increased total of persons seen (maybe double the number) due to the gradually increasing number coming to the clinic. In 1941, 683 cases were of the respiratory system, while only 375 were other forms, 35%, which means about half as many non respiratory cases in about twice the number of patients seen. The respiratory cases were reduced only 20%, while the non respiratory cases were reduced 51%, since you began working. Bone and joint and cervical and other lymph node cases, which are more usually of the bovine type, show a reduction of fifty-three per cent. Obviously, the number of cases of bovine tuberculosis coming to the Mayo Clinic has been very considerably reduced due to your control of the amount of tuberculosis in cattle.

Most of you will remember Dr. J. A. Myers of Minneapolis. He appeared on your program last year. He is Professor of Medicine and Preventive Medicine and Public Health in the University of Minnesota. He is the author of a book which you should have. It costs $5.00 and was published by Chas. C. Thomas, Springfield, Illinois, and Baltimore, Maryland. It can be obtained by writing to the Minnesota Public Health Association, 11 West Summit Avenue, St. Paul, Minnesota. It is named "Man's Greatest Victory Over Tuberculosis" and is a worthy and deserved tribute to the ability and foresight of American veterinarians in their untiring efforts to control bovine tuberculosis.

In accomplishing "Man's Greatest Victory Over Tuberculosis", as Dr. J. A. Myers calls your great achievement, the veterinarians stood and fought almost alone. You had in mind two objectives or aims, (1) to reduce the rapidly mounting eco-
nomic loss to farmers, (2) to protect humans from invasion with the disease which caused more deaths than any other disease. In the objective of reducing economic loss to farmers, you did not have the proper support of farmers and stockmen. Often you had their open and active opposition, as in the Iowa war where it was necessary to call out the Militia. You must not blame the farmers too much. If they had been left alone they most likely would have fallen in line with your great endeavor. You must not ever forget the evil influence of the selfish organization with the high sounding title "The American Medical Liberty League" which would sneak its money into an area, employ the loudest talking attorney and proceed to stir up the farmers with arguments based always on the background of the pitifully mistaken and discredited Koch. The only assistance you had in your economic objective was from Prof. H. R. Smith, and the packers.

In your objective of preventing tuberculosis in humans the story is much more pitiful and deplorable. Here again, only more so, the sombre shadow of Koch's opinion hung as a pall over the situation. "Humans didn't have bovine tuberculosis, therefore it was not necessary to waste time trying to prevent it," authority had spoken.

The great National Tuberculosis Association financed by the annual Christmas Seal Sale to fight tuberculosis quite early in its existence decided that it was not concerned about bovine tuberculosis, and as late as 1927, Dr. Jacobs, one of its officers practically boasted that they had not wasted any of the Seal Sale money in the fight against bovine tuberculosis. For goodness sake, don't decide not to buy Christmas Seals. They have accomplished wonderful results and there is more need than ever for your support. Blame Koch and buy Christmas Seals.

Neither did you receive the support you should have had from the medical profession. Not even those especially engaged in preventing disease. Didn't we have pasteurization to prevent transference of infection by milk? I have to confess myself in that category until 1926, when Dr. Mayo suggested my going to the Omaha Conference in his stead, did I see the light. Knowing his decided opinions on the question, I spent much time reading authoritative information and opinions, and I gave them expression. I think I did a good job. No one doubted where Dr. Mayo stood then, and if I didn't convince anyone else of the menace of bovine tuberculosis to humans, and the correctness of attacking it at its source, I sure convinced myself, and from then on no one could accuse me of indifference on the question.

But physicians generally were indifferent. Cases didn't come to them labelled bovine and there were no distinguishing symptoms. Besides, hadn't one of the greats spoken? Koch, who had discovered the causative organism, and had given them tuberculin.

Your worked on the premise that a positive reactor was dangerous or potentially dangerous and should be put out of the way by slaughter. Of course, the medical profession couldn't slaughter reactors, but they could put them out of the way by isolation, or even quarantine. But they don't. They make a distinction between infection and disease, where you made none. A positive reactor is considered as an individual who has been infected and if the x-ray of the chest shows no signs of active tuberculosis the individual is considered to have been infected some time in
the past and not to have tuberculosis regardless of the fact that only the chest has been x-rayed, and that tuberculosis can exist without symptoms.

"Human medicine is forty years behind veterinary medicine in the tuberculosis control program. The views and activities of the former in 1940 are the same as the veterinarians' in 1900."

It is only in recent years that much tuberculin testing has been done in humans, and not yet to any extent in many places on a comprehensive scale. I am proud that Minnesota is in the front rank. Minneapolis in 1894 was the first city to require dairy products from tested cattle. For years we have had much group testing of high school pupils throughout the state sponsored and organized by our Christmas Seal organization. A couple of years ago, together with the State Medical Association, and the State Department of Health, they established a system of accrediting counties for human tuberculosis. Our own county Olmsted was the second to be accredited and there now are four. It requires a death rate from tuberculosis of under 10 per 100,000 population, and (don't laugh) a positive reaction of less than fifteen per cent among the High School students who have voluntarily submitted to the test. We also have one county where the Medical Association is testing, free of charge, all who will submit to the test. Already well over fifty per cent have been tested and several unknown cases have been discovered. Quite different from your procedure; but we hope to find and prove some things and though we are forty years behind you, we may catch up and succeed in controlling tuberculosis in humans as you have in cattle.
MARKET LOSSES FROM TUBERCULOSIS TODAY AS COMPARED WITH TWENTY-FIVE YEARS AGO

ADDRESS BY H. R. SMITH

General Manager, National Live Stock Loss Prevention Board

Practically all of us here have participated in some way in the great campaign to eradicate tuberculosis in live stock. Its success to date must give everyone in the nation a keen sense of pride in what has been accomplished to reduce to such a large extent the waste in meat and dairy products caused by this disease, and the lowering of the death rate in the human family, particularly the non-respiratory types of tuberculosis, as a result. The recognition on this program of the 25th anniversary of the campaign seems most appropriate.

As you all know, the United States government has what is probably the most exacting system of meat inspection of any country in the world, primarily as a safeguard to public health. Incidentally, the careful records kept by the Division of Meat Inspection on the number of each class of live stock found diseased gives us an accurate picture from year to year of the prevalence of tuberculosis, and the losses caused by it. These records show that the percentage of cattle retained for this disease in the United States increased from .9% in 1907 to 2.1% in 1917. It therefore more than doubled during this ten-year period. If nothing had been done to combat it, and if it had continued at the same rate of increase after 1917, by now 13% of the total slaughter would be retained. The incidence of infection would be still higher because many animals have the disease in such an incipient stage that the lesions are not visible on postmortem inspection. In 1917 there were a total of 40,746 beef carcasses condemned for tuberculosis under federal inspection in the United States.

Tuberculosis in swine increased from 2% retained in 1907 to 9.8% in 1917. We know now that a large part of this increase in swine retentions was caused by the increase in the prevalence of tuberculosis in poultry. However, there were 76,807 hog carcasses condemned for tuberculosis in 1917 or approximately 2% of the total slaughter that year, nearly all of which came from infected cows' milk and cattle droppings. There were in addition 91,543 hog carcasses sterilized which sold for about half-price as such.

Tuberculosis in cattle slaughtered under federal inspection at the Chicago market increased from 1.5% retained in 1907 to 4.3% in 1917, or nearly three times as great. The number of cattle condemned for tuberculosis at Chicago in 1917 was 20,293.

Tuberculosis in swine slaughtered at Chicago increased from 3.7% retained in 1907 to 16.3% in 1917. There were a total of 25,791 hog carcasses condemned and 51,274 sterilized for tuberculosis at Chicago in 1917.

Conditions were such that the future of both the cattle and swine industries was seriously threatened. The packing companies had firsthand information about this increase and it was the vision of Thomas E. Wilson, A. G. Leonard—both still
serving on our Sanitary Committee—and others at our live stock markets including G. F. Swift, Edward Morris, the late E. C. Gentry and Everett C. Brown that caused a fund to be subscribed by the various live stock market interests in 1916 for the purpose of initiating an-educational campaign to inform producers and legislative bodies of the need of concerted effort to cope with this situation. Twenty-five years ago many said it could not be eradicated. I recall a statement made by Henry Wallace, Sr., at that time when I visited him to secure the cooperation of Wallace's Farmer in publicity: "Smith, don't you think it is an impossible undertaking?"

Twenty-five years ago a bill providing for an appropriation of $100,000 for tuberculosis eradication was passed by the Iowa Senate, but defeated in the House. After its defeat, I asked the leader of the opposition why he was opposed. He said: "It's too big an undertaking. The Federal government should do this."

In 1916, E. Z. Russell, a breeder of Duroc-Jersey swine in eastern Nebraska, and a writer for the Twentieth Century Farmer published in Omaha, prepared an excellent series of articles on tuberculosis in cattle and swine. This, with other material furnished Congressman Charles H. Sloan of Geneva, Nebraska, caused him to introduce a bill in Congress calling for an appropriation of $1,000,000 for tuberculosis eradication. The original draft did not provide for federal indemnity.

Upon the invitation of Congressman Sloan to attend the first hearing before a congressional committee January 14, 1918, the writer stated that satisfactory progress could not be made without reimbursing farmers for a part of the loss sustained in the slaughter of reactors. When this was proposed, one of the members said: "Why should the Federal government pay farmers for their sick cows?" It was explained to the committee that this disease came originally from foreign importations of breeding cattle and in practically all instances the purchasers were unaware of the existence of the disease in these cattle; that a large number of herds were so badly infected that without indemnity, the owners would be put out of business. It was stated further that our leading medical authorities asserted that tuberculosis in cattle is readily communicated to people, to make it a public health measure and, therefore, every taxpayer should be willing to pay a certain share of the cost of eradication. We suggested that the loss on reacting cattle be shared equally by the Federal government, the state and the owner.

The plan of paying federal indemnity was accepted and this was incorporated in the Agricultural Appropriation Bill. Congressman McLaughlin of Muskegan, Michigan, worded the clause which provided that the Federal government would pay one-third of the difference between the salvage value of the meat and the breeding or dairy value of the reactors if the state or county would pay at least as much with a limitation of Federal indemnity to $25.00 on grades and $50.00 on registered purebreds.

At this first hearing a member of the committee asked a representative of Mr. Houston, secretary of agriculture, what, in his opinion, would be needed as a federal appropriation and he replied: "$250,000." This was before provision had been made for the payment of indemnity and with this clause inserted, the department was agreeable to a larger sum. However, the committee recommended $250,000 and the effort to get it increased on the floor of the House failed. Then resolutions urging a larger appropriation were sent to Senate members from farm organizations
MARKET LOSSES FROM TUBERCULOSIS

in many states, and the Senate increased the appropriation to $500,000. It was then sent to the conference committee and we asked for a hearing before the House conference in the hope of securing their consent to the Senate appropriation. Those who attended this hearing were as follows:

- W. S. Moscrip, representing the Minnesota Live Stock Sanitary Board
- Charles Bellows, representing the Missouri State Board of Agriculture and the American Shorthorn Breeders' Association
- W. W. Wright, superintendent of Animal Husbandry, Illinois Department of Agriculture
- Prof. W. A. Cochel of the Kansas Agricultural College
- Prof. W. W. Wing of the New York State College of Agriculture
- Pres. A. F. Woods and Dr. Reed of the Maryland Agriculture College
- E. Z. Russel, Omaha, Nebraska, secretary of the National Swine Growers' Association
- Dr. George Dunphy of the Michigan Live Stock Sanitary Commission
- Dr. J. I. Gibson of the Iowa Animal Health Commission
- Dr. Musselman, State Veterinarian of Kentucky
- Dr. L. E. Northrup, State Veterinarian of Indiana
- Everett C. Brown and H. R. Smith, representing the Chicago Live Stock Exchange

With the need of a larger fund as urged by this representative group, the House conferees accepted the Senate appropriation and the item of $500,000 in the agricultural bill was approved and signed by the President in October, 1918.

Each year thereafter, a number of representatives of farm organizations, state commissioners of agriculture and farm journals appeared at these hearings before House and Senate committees to report on the progress of the campaign in the various states and to urge larger funds for expanding the program. At one of these hearings, we delegated A. J. Glover, editor of Hoard's Dairyman to confer with President Coolidge who also asked why the Federal government should pay anything on reactors. Mr. Glover cited the general welfare section of the Federal Constitution. By 1930, the congressional appropriation reached $6,361,040, and hearings were no longer needed. Shortly after the federal law was passed, the states enacted similar legislation and made appropriations to meet the conditions of the Federal law. These also were gradually increased at each session. In many of the states County Boards made appropriations to supplement Federal and State funds and by 1930, the total state and county appropriations amounted to $12,154,226. This, with Federal funds, gave a total in excess of $18,000,000 for tuberculosis eradication for the year. By that time such a large volume of cattle had been tuberculin tested that the percentage reacting in the entire country had been reduced from 4.9% in 1917 to 1.6% in 1930. The LaFolette amendment to the Jones-Connelly Act passed in 1934 increased the Federal appropriation about 50% and the volume of testing was greatly increased, so much so that by 1940 all states had been officially accredited as being practically free from bovine tuberculosis.

That the Federal, State and local veterinarians in this country did a thorough job in the application of the tuberculin test to all breeding and dairy cattle in this
great campaign is indicated by the relatively low losses from tuberculosis now found in all market cattle at all packing plants in the United States. Instead of having 40,746 cattle condemned under Federal Inspection as in 1917, or .43% of the total slaughter, there were only 1,593 condemned or .013% in the fiscal year ended June 30, 1942. The percentage retained decreased from 2.10% in 1917 to .061% in 1942. It is significant that the number of cattle retained, in proportion to number slaughtered in 1942 was only 3% of the number retained in proportion to the number slaughtered in 1917, and that the number condemned in 1942 was only 3% of the number condemned in proportion to slaughter in 1917. This would indicate that the prevalence of tuberculosis in poultry has not affected the decline in retentions in cattle as it has in swine. No doubt some cattle are sensitized by tuberculosis in poultry, but apparently this type of the disease does not give visible lesions in cattle as in swine.

Instead of having 20,293 cattle condemned at Chicago in 1917, or .94% of the total kill, there were only 163 or .010% in 1942 at all plants under Federal inspection at this market, and instead of having 93,896 or 4.34% of the cattle retained at Chicago as in 1917, there were only 566 or .036% retained in 1942.

There is not time to discuss the reduction in losses at other markets which are similar, but I do wish to call attention to the fact that Omaha and Sious City show the smallest percentage of cattle retained and condemned for tuberculosis of any of the primary markets. Am of the opinion that the wide use of the 11-C reports of the Federal government in tracing diseased shipments from these markets back to the point of origin where the cattle on the farms are again tested, is quite largely responsible for this.

In hog losses there is quite a different situation. There has been a marked decrease in the number condemned, but not nearly as much as in cattle as a result of the prevalence of tuberculosis in poultry in the north-central states. Instead of having 76,807 hogs condemned in the United States as in 1917, or .19%, there were only 13,357 or .026% condemned in 1942. The hogs retained for tuberculosis increased from 9.89% in 1917 to 13.54% in 1927 and since then has decreased to 7.96% in 1942.

Bovine tuberculosis is now so nearly eradicated that whatever decrease in swine losses takes place in the future will result largely from the elimination of the disease in poultry. Much effort has been given to this problem in recent years and the decrease in hog retentions is indicative of some results. However, there is yet a great deal to be done along this line.

Government records show that the highest percentage of hogs retained for tuberculosis are in those states where the least work has been done to eliminate tuberculosis in poultry. Michigan, Indiana and Ohio have done extensive work in testing hatchery flocks, as have certain other states in the middlewest—Kansas, Nebraska and the Dakotas. Iowa and Illinois, through various organizations, have also done much to reduce the prevalence of this disease in poultry and swine, and the records show a substantial reduction in hog retentions in those states.

The lack of veterinarians due to the war is interfering somewhat with the progress of the testing which makes it all the more necessary to intensify our educational work to induce farmers to dispose of their entire flock at the end of the first laying
year which we know from experience will gradually eliminate the disease in both poultry and swine.

It would seem that even with the present shortage of veterinarians, county area work to eliminate tuberculosis in poultry and swine could be undertaken by testing only the more valuable purebred flocks of poultry constituting less than 10% of the total, securing the consent of all others to keep only young birds. This plan recently started in South Dakota and Nebraska is a real conservation movement so needed in this emergency, not only because it reduces disease in poultry and swine but at the same time increases egg production. Trap nest records in many states show that on the average hens lay 30% more eggs the first laying year than the succeeding year. Dr. Van Es calls attention to the possibility that in future years, in the absence of exposure with the bovine bacillus, cattle may become more susceptible to exposure from the avian type. It is reasonable to predict that veterinarians and others who have succeeded so well in the elimination of bovine tuberculosis, will be equally successful in ridding the nation of avian tuberculosis.
CHEMOTHERAPY IN TUBERCULOSIS—AN APPRAISAL OF PRESENT EVIDENCE AND OF FUTURE POSSIBILITIES

BY WILLIAM H. FEIDMAN

Division of Experimental Medicine, Mayo Foundation

H. CORWIN HINSHAW

Division of Medicine, Mayo Clinic

AND

FRANK C. MANN

Division of Experimental Medicine, Mayo Foundation, Rochester, Minnesota

The hard fought victory over bovine tuberculosis which we are celebrating enthusiastically at this time was achieved by methods that were applicable to the enormousness of the problem. The methods, while necessarily ruthless, were practical and as a consequence of the vision and the persistence of the veterinary profession we now have a healthier America and a more profitable agriculture. Whether or not comparable results might have been obtained by other methods must remain in the realm of speculation. It would, however, be injudicious to state that any form of therapy could have solved the problem. In combating tuberculosis, detection of the infection and destruction of the infected have the important virtue of the immediate and final extermination of tubercle bacilli. Since every case of tuberculosis comes from another this is of the utmost importance. The fact that all infected animals were killed, whether the disease was minimal in extent or in an aggravated or an advanced state, accounts for the remarkable and satisfactory results of the eradication program. To expect as much from any form of therapy would be to reveal a lack of understanding of certain essential and simple truths about tuberculosis. The tubercle bacillus is a microbial gangster that makes its own rules and gives no quarter. Methods that will provide for its sure and complete destruction must be applied whenever possible if this organism and the disease it produces are to be satisfactorily combated.

When considering the control and eradication of tuberculosis of cattle one must not be unmindful of the fact that tuberculosis remains one of the greatest killers of mankind. It is startling indeed to know that this disease kills 160 persons every day in the United States. This represents one death every nine minutes. As one example of what tuberculosis means in dollars and cents we need only mention that the compensation, vocational training, insurance and hospitalization as a consequence of this disease among our soldiers during and after the first World War have cost approximately $1,000,000,000. This is only part of the picture. No one can translate into dollars and cents or words the tragedy of broken homes, the calamity and disappointments of interrupted careers and the years of suffering that

1 Read before the annual meeting of the United States Livestock Sanitary Association, Chicago, Illinois, December 2 to 4, 1942.
must be endured before death comes as a welcome release. While tuberculosis is truly preventable, it kills more people between the ages of fifteen and forty-five than any other disease. Only by a continuous and relentless attack can mankind hope eventually to reduce to a minimum this insidious and ubiquitous disease.

If our modern civilization would permit of the ruthless disposal of all human beings affected with tuberculosis the disease in man would in time very probably diminish exactly as it has in cattle. Since such a procedure is too abhorrent even to contemplate, the problem of tuberculosis of human beings must be approached differently. There must be early detection of the infection, segregation of the actively infected from the noninfected and treatment rather than destruction of those affected.

Search for a chemotherapeutic substance that will be effective against the tubercle bacillus is motivated by the hope that eventually some agent will be found that will materially assist in restoring the tuberculous patient to a life of usefulness. It would probably be fantastic to believe that modern chemistry will some day produce a drug that will provide a practical means of treating tuberculosis of cattle, swine or chickens. One should, however, be cautious in voicing negativistic predictions. The tremendous advances made in chemotherapy since the therapeutic properties of prontosil were announced in 1935 suggest the possibility that most if not all infectious diseases may eventually be combated successfully by products supplied by the wizardry of modern chemistry. Already, notable results have been achieved in a variety of infections such as pneumonia, streptococcal septicemia, Neisserian infections and several others. New products are being made available continuously, attesting to the considerable imprint recent chemotherapeutic procedures have had on modern medical practice.

Since the time of Koch a chemotherapeutic agent that could be used effectively against the tubercle bacillus has been the dream of countless investigators. It would be inappropriate at this time to review the reports of the many workers who have explored the possibilities of such substances as fat soluble antiseptics, guaiacol, creosote, chaulmoogra oil, the arsenicals, copper, the mercurials, gold and other metallic elements. Wells in 1932 (1) published the results of a critical review of the work done previously on the above mentioned substances and concluded as follows: "A specific chemotherapy of tuberculosis has not been found, and it may be a long time in coming because of the inherent difficulties of the problem." Wells closed his admirable review with the following statement, "Probably some new success with some other bacterial infection will be needed to stimulate a new attack on the more difficult problem offered by tuberculosis."

How prophetic Wells' suggestion has proved to be! With the appearance of the reports indicating the favorable results of the earlier sulfonamide compounds such as sulfanilamide and sulfapyridine in certain acute infectious diseases, investigators were soon to see the possible application of the new chemotherapy to infections induced by the tubercle bacillus. Properly the problem was approached by determining whether or not these newer agents could exert a favorable influence on the expected course of tuberculosis produced experimentally. The first to report their findings were Rich and Follis (2). Their experiment, which was reported in 1938, showed quite definitely that sulfanilamide, in adequate doses given at frequent
intervals so as to maintain an effective concentration in the blood, inhibited slightly the development of tuberculosis in the guinea-pig. While the work of Rich and Follis did not indicate that sulfanilamide was a tuberculotherapeutic agent of high efficacy their report was of the utmost importance in suggesting that one of the toughest of the drug resistant diseases might possibly yield to a specific chemical substance. The problem is to find the right substance. Without wishing to over-emphasize the importance of our own observations we firmly believe this is possible of achievement.

**CRITICAL FACTORS IN EXPERIMENTAL PROCEDURE**

Tuberculosis is so dissimilar to most other infectious diseases as to require that the most careful consideration be given to the many factors that are involved in any experimental study of this disease. Especially is this true in studies pertaining to chemotherapy. The method should be as simple as can be devised, yet adequate to offer a reasonable possibility that definite, clean-cut evidence will be obtained.

Of first consideration is the animal chosen for test purposes. Many species of animals are susceptible to tubercle bacilli but none respond to an experimental inoculation in a manner exactly like that of human beings who are infected naturally. With full cognizance of this limitation we have used guinea-pigs in most of our work. Guinea-pigs have a high susceptibility to virulent tubercle bacilli of the human type and it would seem logical to assume that favorable effects obtained from the administration of a chemotherapeutic agent to tuberculous guinea-pigs would be more impressive than similar results obtained from the same drug in an animal possessing a more formidable natural resistance. It is obvious, of course, that the number of animals used in any one experiment should be sufficient to make clearly evident the exact character of the results. Experiments on five or six guinea-pigs are little more than "fishing expeditions" and cannot be expected to provide more than suggestive evidence. We feel that the size and age of the guinea-pigs selected for work in chemotherapy are also of importance. We prefer young adults weighing not less than 450 gm. Such animals in our experience are less subject to factors that lead to premature deaths.

The infective organism should be one of satisfactory virulence and, when possible, a strain of tubercle bacilli whose history and pathogenicity are well known. Such a strain is H37RV which we have used in most of our work. We consider a strain of tubercle bacilli satisfactorily virulent when medium to small doses injected into guinea-pigs produce in all instances typically progressive and eventually fatal tuberculosis. In no other experimental procedure does the behavior of the infection in the untreated or control animals assume such importance. It is true that individual guinea-pigs, like individual human beings, differ somewhat in their susceptibility to even highly virulent tubercle bacilli. For this reason one may expect to observe differences in the magnitude of the morbid changes and in the duration of life even though all animals in any given experiment died as a consequence of a tuberculous infection.

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These factors are considered in greater detail in a recent paper by Feldman (3). Important details concerning the origin and characteristics of this strain of tubercle bacilli will be found in the report by Oatway and Steenken (4).
Also of importance in tests of tuberculochemotherapy in vivo is the relation of the beginning of treatment to the time of infection. In preliminary tests it is probably justifiable to start the administration of the drug a few days before or at the same time the animals are inoculated with tubercle bacilli. However, when the therapeutic rather than the prophylactic effect of the drug is to be determined, treatment must necessarily begin after the disease has become established. Our procedure in critical experiments has been to delay the beginning of treatment for a period of six weeks after infection. At that time well formed lesions that are recognizable microscopically are usually present in the spleen and liver. It would appear reasonable to presume that unless a chemotherapeutic substance can act effectively against an experimental tuberculous process that is morphologically recognizable when therapy is started, the possibilities for the clinical use of such a drug are unimpressive.

That one may be reasonably sure that every animal in the experiment has actually become infected it is important that each animal be tested with tuberculin or if more convincing evidence is desired the animals should be subjected to laparotomy six weeks after inoculation with tubercle bacilli so that biopsy specimens may be obtained.

Evidence of therapeutic effect consists of the following: (1) the treated animals should live longer than those not treated, (2) there should be convincingly less tuberculosis in the principal organs of predilection of the animals that received treatment than in those not treated and (3) the residual tuberculosis in the organs and tissues of the treated animals should show signs of nonprogression or of resolution. These signs consist principally of peripheral encapsulation without "daughter" tubercles, the presence of noncaseating or "hard" tubercles, the transition of epithelioid cells to fibroblastic elements and calcification. Although each of the previously mentioned factors constitutes evidence that a therapeutic effect has been obtained, it must be emphasized that in experiments in which the disease was present when the administration of the drug was started and in which treatment was continued for approximately six months, the character of the lesions, rather than their extent or number, is of most importance. In our experience, however, compounds that have exerted the most favorable influence on the character of the tuberculous lesions have also been those in which the average survival time of the treated animals greatly exceeded that of the controls and in which the total amount of disease was definitely less than was true in the untreated animals.

Another factor that must be recognized in appraising the apparently favorable results of a tuberculochemotherapeutic agent is the permanence of the therapeutic effect. This cannot be adequately determined with experiments of short duration. One should be aware of the effect that may be ascribed to a bacteriostatic action in which the bacteria, while unable to multiply in the presence of the drug, nevertheless remain viable and potentially capable of producing tuberculosis when the administration of the drug is discontinued. A more desirable therapeutic effect is obtained when a drug is bactericidal or capable of exerting a killing action on the infective agent. Information at hand fails to supply a satisfactory explanation concerning the nature of the mechanism by which the tuberculotherapeutic effect of certain compounds belonging to the sulfone series is obtained. There is indirect
evidence that the effect occurs as a consequence of a limited bactericidal action plus the influence of the immune mechanism that is stimulated to effective action as a consequence of the initial infecting power of the tubercle bacillus. In other words, the tubercle bacillus in the presence in vivo of an effective therapeutic agent is still capable in the earlier phases of its pathogenesis of provoking a limited reaction on the part of the host. Perhaps the continuous presence of the drug inhibits the infective power of the bacteria sufficiently to provide the necessary assistance to enable the animal to produce effective immunizing substances that not only deter the progression of the disease but also enable the protective substances to gain the supremacy and resolve the lesions.

One should be cautious in claiming permanence for the effect of any chemotherapeutic agent, especially in tuberculosis. To say that any chronic infectious disease of such formidable characteristics as tuberculosis is "cured" should always imply reservations. There is no method known by which one can definitely determine whether or not a previously infected animal has been rid of every single tubercle bacillus. One may insist with good evidence that lesions can no longer be demonstrated or that they appear to be healed but one should avoid the implication in such instances that all tubercle bacilli have been eliminated.

RÉSUMÉ OF PRESENT EVIDENCE

Since, as was mentioned previously, none of the various substances studied for their possible tuberculochemotherapeutic effect before the advent of the sulfonamide and sulfone compounds proved capable of exerting a convincing curative or deterrent effect on an experimental tuberculous infection, we may now examine briefly the results obtained from these newer and markedly different drugs. The drugs that have offered the most interesting possibilities in the chemotherapeutic attack on tuberculosis can be conveniently placed in two groups: the sulfonamides and the sulfones.

Sulfapyridine, sulfathiazole, sulfadiazine, sulfaguanidine and similar much used chemotherapeutic compounds are all derivatives of sulfanilamide and consist of the sulfanilamide nucleus with various side chains added. These added radicals appear to affect profoundly the specificity of action and the toxic properties of the parent substance. A different group of compounds commonly referred to as "sulfones" has been developed with 4,4'-diaminodiphenylsulfone as the nucleus to which various side chains may be added to either or both ends of the symmetrical molecule. These added radicals affect the physical and chemical properties of the substance to a marked degree. Unquestionably the therapeutic efficacy of these drugs against the tubercle bacillus is likewise affected by such chemical alterations. However, it has not been determined whether these sulfone derivatives, given orally, act as complete molecules or whether they are broken down in the gastro-intestinal tract to some compound resembling the parent 4,4'-diaminodiphenylsulfone. A similar uncertainty existed early in the development of the sulfonamide derivatives, when it was thought by some that a compound such as sulfapyridine exerted its effect only by virtue of its sulfanilamide content. Further work will be required before we can know if it is possible to alter 4,4'-diaminodiphenylsulfone in such a
manner as to increase its tuberculotherapeutic action and at the same time decrease its toxicity for the human subject.

The sulphonamides. Without examining in detail the many experiments that have been reported concerning the effect on the tubercle bacillus of many of the sulphonamide compounds it will suffice to state in a few words what value, if any, the compounds that have been tried may have (5). In vitro studies have been reported indicating that certain of these compounds have bacteriostatic qualities against the tubercle bacillus (6). However, results of tests in vitro are of doubtful value as dependable criteria in predicting what the results in vivo will be.

A review of the many reports in which the efficacy of sulphonamides was tested in infected animals reveals a certain amount of data that are confusing. While some workers such as Rich and Follis recorded, conservatively, that sulfanilamide had exerted a slight inhibitory action against experimental tuberculosis in guinea-pigs, others have recorded failures with this drug (5). The same may be said concerning sulfapyridine. Our own work (7) with this compound indicated quite definitely that sulfapyridine under the conditions imposed had exerted a definite modification and retardation of the expected course and character of a tuberculous disease in guinea-pigs; yet others have reported different results under different experimental conditions.

The explanation for the different results obtained by different investigators is not always apparent. However, it must be emphasized that different workers almost invariably use different experimental methods. While one worker may inoculate the experimental animal with a small dose of tubercle bacilli subcutaneously and administer the drug in such a manner as to insure a relatively continuous and adequate concentration in the blood for a sufficient period to give the drug ample opportunity to exert a favorable effect, others in an attempt to confirm the results of the first worker will follow a widely divergent procedure. They may inoculate the animals with a large dose of tubercle bacilli intravenously or intraperitoneally and administer the drug parenterally in inadequate doses or for too short a period or at intervals too long to provide a proper concentration in the blood. Unless an experiment planned for confirmatory reasons follows in every detail the original work, one is not justified in concluding that divergent results indicate that the original experiment could not be confirmed.

When the importance of the experimental method in chemotherapy of experimental tuberculosis is recognized one may conclude that much of the disagreement in the results obtained in testing the effects in vivo of certain sulphonamide compounds is due to critical differences in the experimental methods employed. However, when one considers carefully the evidence that has accumulated it appears that at least some of the sulphonamides have a limited but definite deterrent effect on the course of experimental tuberculosis. This effect is perhaps only relative and not of sufficient magnitude to generate any great enthusiasm concerning the possibilities of this group of compounds in the clinical treatment of tuberculosis.

The sulfone compounds. Of the many substances tested for their tuberculothera-
peutic action the most promising up to now have been compounds containing a
diphenylsulfone nucleus. We have studied in vivo the therapeutic efficacy of a con-
siderable number of such compounds and others have done likewise (8). The drugs
have all been derivatives of 4,4'-diaminodiphenylsulfone. This parent compound,
as we shall show later, has a high tuberculotherapeutic efficacy but unfortunately is
highly toxic. Whether or not it could be administered to human beings in what
might be effective therapeutic doses is as yet uncertain. Consequently in further
exploring the subject of chemotherapy in tuberculosis the objective of the chemist
should be a compound having the high specificity of 4,4'-diaminodiphenylsulfone
but with less of the undesirable toxic properties of this compound. The possible
derivatives of 4,4'-diaminodiphenylsulfone seem to be limited only by the imagina-
tion of the research chemist. By subjecting the compounds which can be produced
to proper tests in vivo the possibilities of eventually discovering a reasonably safe
and highly specific drug are promising.

Evidence of therapeutic effects with 4,4'-diaminodiphenylsulfone and its derivates.
We have up to now completed experimental observations with 4,4'-diaminodi-
phenylsulfone and with ten derivatives of this compound. Among these eleven
drugs were five that had very little if any therapeutic effect, while all of the remain-
ing six compounds had a moderate to a striking therapeutic effect.

In each of the aforementioned experiments the same general procedure has been
followed. The animals used were guinea-pigs; the infective agent was a human
strain of tubercle bacilli, the virulent variant of H37 (H37RV); the inoculations
were made subcutaneously; the respective drugs were given orally with the feed; the
beginning of treatment was delayed until six weeks had elapsed after the animals had
been infected, and treatment was continued either until all of the untreated controls
had died or until the animals had received treatment for approximately six months.

As mentioned previously, the six compounds that exerted a definitely recogniz-
able deterrent effect on experimental tuberculosis were not equally effective; three
were superior to the rest in the doses employed. These were 4,4'-diaminodiphenyl-
sulfone, sodium p,p'-diaminodiphenylsulfone-N,N'-didextrose sulfonate (promin)
and disodium formaldehyde sulfoxylate diaminodiphenylsulfone.

We shall now present briefly the results of a few typical experiments in which evi-
dence indicative of the therapeutic action of the three compounds just mentioned
may be noted.

Sodium p,p'-diaminodiphenylsulfone-N,N'-didextrose sulfonate (promin). 5 This
was the first compound containing a diphenylsulfone nucleus that we studied. The
results appeared so promising that we felt justified in extending our investigation
not only with promin but with other related compounds.

A preliminary experiment with promin had indicated that, when the administra-
tion of this drug to guinea-pigs was started a few days before the animals were inoccu-
lated with tubercle bacilli, the expected course of the infection was strikingly
altered. Not only did the treated animals live longer than the untreated ones; they
also had a lesser amount of tuberculosis which was for the most part nonprogressive.

These preliminary observations made it desirable to extend our study of this drug.

5 Detailed accounts of the effects of promin in experimental tuberculosis have
been published previously (9, 10).
We therefore conducted a second study to determine primarily if promin would have a therapeutic effect on a tuberculous infection definitely established before treatment was started. For this study eighty guinea-pigs divided into eight groups were used. One group was untreated and served as controls while the other seven groups were treated with promin. The relation of the beginning of therapy to the time of inoculation with tubercle bacilli varied from two days before for one group to as long as six weeks after for another. At the end of six months all of the untreated animals had died, presumably as a consequence of the severe and widespread tuberculous infection noted at necropsy. During the same period only eleven, or 16 per cent, of the treated animals had died. Of thirty-nine, or 57 per cent, of the sixty-eight animals that had received promin, lesions of tuberculosis could not be found grossly or microscopically in the liver, spleen or lungs. The definite and dramatic influence that promin had apparently exerted on a tuberculous infection which had been responsible for the death of all the untreated animals provided reason for believing that this drug has a relatively high tuberculo-therapeutic efficacy as the disease occurs in the experimentally infected guinea-pigs. However, of much interest and significance was the fact that a favorable therapeutic effect was obtained regardless of whether treatment was started before, at the same time as, or as long as six weeks after, the animals had received tubercle bacilli.

The evidence that promin was capable of reversing a potentially lethal tuberculous infection to one that was regressive or arrested was necessarily, under the conditions of the experiment just reviewed, presumptive. That more definitely tangible data be secured that would prove beyond any reasonable doubt that the results obtained were in reality due to the effects of the drug that had been given with therapeutic intent, another experiment was done (10). The salient feature of the procedure followed was the securing of specimens for biopsy from the liver of tuberculous guinea-pigs some weeks after infection and at about the time treatment with promin was started. In this manner we hoped to obtain data on specific tissues containing lesions of tuberculosis when therapy began; such tissues to be available for direct comparison with tissues from the same organ at the end of the period of treatment.

Fifty-one guinea-pigs were each inoculated with tubercle bacilli. All were tuberculin positive forty-two days later when the animals were divided into two groups. Group 1 consisted of thirty-one animals. These were not treated and were considered as controls. Group 2 consisted of twenty animals that received promin daily with the feed, starting on the forty-second day. One week later (forty-nine days after infection) specimens for biopsy were obtained from the livers of all animals in group 2 and from twelve animals in the untreated or control group. Five animals died as a consequence of the laparotomy necessary to obtain the specimens from the liver; one in the control group and four in the group that was being treated. Microscopic examination of the specimens of liver obtained for biopsy indicated definitely that tuberculosis was present in the livers of both the treated and the untreated group of animals at the time treatment was begun. The experiment continued until all of the untreated guinea-pigs had died; this was 224 days after the animals had been inoculated with tubercle bacilli. At that time all of the untreated animals were dead; thirteen, or 81 per cent, of those that had been treated with promin were still alive. When the specimens obtained for biopsy from the liver
when treatment began were compared with specimens taken from the same respective livers at the end of the period of treatment (184 days) unmistakable proof of the favorable effects of promin was readily discernible. In most instances not only did the disease fail to progress under the influence of promin but instead regression and ultimately resolution took place. This was in marked contrast to the situation that obtained in the untreated animals. In practically all of the latter tuberculosis was present in sufficient severity to have accounted for the animal's death.

This experiment provided acceptable morphologic evidence that a tuberculous process induced experimentally and characterized at the time treatment began by cellular foci consisting of histiocytes, epithelioid cells and lymphocytes can be resolved under the influence of a drug containing a diphenylsulfone nucleus.

\[4,4'-\text{diaminodiphenylsulfone}.\] As mentioned previously, this is the parent compound from which promin is derived. In testing the tuberculotherapeutic efficacy of this drug, which was kindly supplied by Dr. E. H. Sharp, Parke, Davis and Company, Detroit, Michigan, we also tested concurrently several derivatives of this drug including disodium formaldehyde sulfoxylate dianaminodiphenylsulfone. By this procedure it was possible to utilize the same group of twenty-eight untreated animals as controls for each of the respective drugs tested.

The group treated with \(4,4'-\text{diaminodiphenylsulfone}\) consisted of fourteen guinea-pigs each of which had been inoculated with tubercle bacilli forty-two days prior to the time that treatment was started. The experiment was terminated 228 days postinfection after a period of treatment of 186 days. At the time the experiment ended, 71 per cent of the untreated animals had died while of the original fourteen animals in the treated group ten, or 71 per cent, were still living. Although the amount of tuberculosis in the untreated controls was impressively severe, with an index of infection of 8.1 on the basis of a maximum of 10, the amount of disease in the animals that had received treatment was extremely small. The index of infection in the treated group based on a maximum of 10 was 1.5. Furthermore, the morphologic character of the residual lesions that were found in animals that had been treated revealed, clearly, the regressive tendencies of the disease processes.

The results provide evidence of the marked ability of \(4,4'-\text{diaminodiphenylsulfone}\) to combat with considerable success a tuberculous infection in guinea-pigs established experimentally six weeks before treatment began. The results also lend support to the belief that future search for an effective chemotherapeutic agent that can be used with reasonable safety in the treatment of clinical tuberculosis should be directed to compounds derived from \(4,4'-\text{diaminodiphenylsulfone}\). The objective should be a drug having the high tuberculotherapeutic ability of this substance but without its more objectionable toxic properties. Such a drug would be worthy of serious consideration in the treatment of tuberculosis in human beings.

\[\text{Disodium formaldehyde sulfoxylate dianaminodiphenylsulfone}.\] As in the previous experiment, fourteen tuberculous guinea-pigs were used to determine the possible

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6 The tuberculotherapeutic effect of this drug has been reported previously by Smith, Emmart and Westfall.
7 A report by Callomon on the effect of this compound in experimental tuberculosis in guinea pigs was published recently (11)
therapeutic value of this compound, which was supplied through the courtesy of Dr. George W. Raiziss, Dermatological Research Laboratory, Division of Abbott Laboratories, Philadelphia, Pennsylvania. As in the previously mentioned experiments, the administration of the drug was delayed for six weeks after the animals had been inoculated with tubercle bacilli. This drug appeared to be well tolerated in the dosage used. In fact it is our impression that this compound was the least toxic of any of the sulfones, of comparable efficacy, that we have studied. The experiment was terminated 228 days after infection and although 71 per cent of the control or untreated animals were dead at that time only two, or 14.3 per cent, of the fourteen animals in the treated group had died. The amount of tuberculosis in the twenty-eight untreated animals expressed numerically was 8.1 based on a maximal figure of 10, while on the same basis the average severity of the disease in the animals that were treated, expressed numerically, was 2.9. While it was apparent that the drug was not equally effective in all of the guinea-pigs one very significant fact was observed. This was the conspicuous tendency of the residual lesions toward healing in all guinea-pigs that received this drug. Not only did most of the lesions appear to be arrested in their progression but in addition many lesions were observed in which most if not all epithelioid cells had been replaced by a fibrous connective tissue process.

Taken in all, the results obtained from this one, and by no means comprehensive, experiment with disodium formaldehyde sulfoxylate diaminodiphenylsulfone provide reasons for believing that this compound is worthy of additional study. Although perhaps somewhat less dramatic in its ability to resolve relatively young tuberculous lesions than the parent substance from which it is derived (4,4'-diaminodiphenylsulfone) it appears to have the desirable virtue of being less toxic than the parent compound.

From the experimental observations briefly recounted in the foregoing paragraphs, certain facts emerge which indicate clearly the tuberculotherapeutic capacity of certain complex chemical substances. These facts are as follows: 1. Although all animals in the respective experiments were inoculated with human tubercle bacilli sufficiently virulent in relatively small doses to initiate a progressively severe, fatal tuberculosis, the average survival time of the treated animals was significantly longer than the survival time of those not treated. 2. The favorable results of the treatment were observed even though the animals had been inoculated with tubercle bacilli six weeks prior to the time treatment began. 3. Morphologically it was observed that many animals at necropsy were apparently rid of all recognizable signs of tuberculosis, although definite lesions of tuberculosis had been demonstrated previously in biopsy specimens obtained when treatment began. 4. In the untreated animals the morbid changes were complex, progressive and destructive while in the animals that had been treated, the morbid changes were simple and usually regressive or static. Many convincing signs of healing were the dominant feature.

FUTURE POSSIBILITIES

To predict future possibilities in the development of any form of therapy is both difficult and unwise. This is especially true in clinical tuberculosis where the lessons
of past disappointments should provide ample reason for caution. Even though the results of animal experimentation may be most impressive and convincing one is not justified in assuming that the same favorable results will be obtained when the same therapeutic procedure is applied to tuberculosis as it occurs in human beings. However, a drug that gives consistently favorable results in tuberculosis of guinea-pigs merits serious consideration for trial in tuberculosis of human beings if such a drug can be administered with reasonable safety.

As mentioned previously, the objective of chemotherapy in tuberculosis is to obtain a drug that can be given with reasonable safety to patients in sufficient doses to bring about a progressive and measurable improvement leading to the ultimate restoration of the patient to a useful life. The results should be more rapid than those obtained by the usual sanatorium care. The disease should be "cured" in the sense that it is no longer active and will not become so even though alterations of tissue indicative of a previously active or progressive process may persist.

Nearly all existing treatises on clinical tuberculosis make mention of the many ineffective attempts at chemotherapy in either experimental or human tuberculosis. The time has now come when this point of view must be radically revised so far as experimental tuberculosis is concerned. It may be said that the chemotherapeutic effectiveness of some drugs of the sulfone series in experimental tuberculosis is comparable to the effectiveness of some of the early drugs of the sulfonamide series in the treatment of pneumococcus and streptococcus infections of experimental animals. It will require considerable time before a large series of sulfone compounds can be explored either in experimental or in clinical studies because of the slow manner in which tuberculosis usually develops in both men and animals. Preliminary results of experiments in clinical tuberculosis suggest that a true therapeutic effect is being observed, if one takes into consideration the character of the lesions treated and the relative dosages employed. Unfortunately, existing drugs are sufficiently toxic to make it appear improbable that these preparations can be safely used under average conditions.

A widespread and lively interest in the topic has been aroused in recent months and observations are being made in many institutions. Progress is unquestionably being delayed because of competing demands of the war effort which interfere with the program of synthetic chemists, biological experimenters and clinical observers alike. Viewed from the standpoint of the optimist, it may be stated that successful clinical chemotherapy in tuberculosis does not appear to be as far away today as did successful chemotherapy of pneumonia when sulfanilamide was the only drug known in the sulfonamide series.

Definitely, some progress has been made and future developments will depend largely on what use is made of the more recent information and on the acceptance of the fact that chemotherapy in tuberculosis is not a futile field but one where there exist enormous possibilities for the investigator who has energy, imagination, patience and enthusiasm.

REFERENCES


PROSPECTIVE RETROSPECT

BY R. W. SMITH

State Veterinarian, Concord, New Hampshire

Dr. Smith: Dr. Faulder called me on the phone last Friday evening and asked me if I would substitute for Dr. Duckworth on this program. It was not until I was on my way to Chicago that I read the title, “Prospective Retrospect.” Not having a dictionary with me, I spent no little time wondering what my good friend Dr. Duckworth would have said had he been here. Since arriving in Chicago I have learned that “prospective” means looking into the future, and that “retrospect” means looking into the past.

Knowing Dr. Duckworth as I do, I am inclined to believe that were he here he would endeavor to place himself in the future some ten or fifteen years, and then he would look back over this 25-year program that has been carried out so successfully in the United States, and that would be his retrospect.

I am not going to attempt to give you what Dr. Duckworth might have given you were he here; I can only hope to be a poor substitute. But I am wondering what the personnel will be fifteen or twenty years from now, and who will look after the health of the livestock of our country. In the main they will be young men, and in some cases women, who have graduated from our veterinary colleges and our agricultural colleges during the last few years, and who will graduate during the next decade or so.

These young men and women will not have had the privilege of visiting our slaughter houses and seeing cases of tuberculosis posted on the floor. They will not have had the privilege—as many of us have had—of going into barns, putting on an intradermic tuberculin test, returning three days later and seeing the typical reactions on 50, 75 and in some cases 100 per cent of the animals previously injected. They will not have had the privilege of following those reactor animals to the slaughterhouse and seeing the postmortems as we have seen.

They will possess all modern scientific knowledge that our colleges can give them, but they will not have had the privilege of seeing postmortems, neither will they have had the privilege of going out onto the farms and condemning animals by a physical test only.

So, I am wondering just how they will look upon this program that has been carried on during the past 25 years, when practically the only knowledge they will have of it is what they glean out of the reports and by word of mouth of some of the old-timers such as we will be at that time.

Dr. Duckworth is a man of courage. Any man who will attempt to look into the future or predict what is going to happen in the future is not only a man of wisdom and courage but also a man who has that thing under his belt called guts.

We have had an experience of that kind, and when any of us attempt to do it we only want to go back about 15 years and recall to mind the experience of that man they called, Billy Mitchell. You know the rest. And yet in our own field of work.
25 years ago today there were gathered in this hotel, men under the peerless leadership of John R. Mohler, John R. Kernin and others who many of us know. They had the courage and the vision to outline and set up the machinery for a program which at that time they admitted would require from 10 to 25 years to complete. Don't forget we were in the midst of a great war then, just as we are today. It should give us courage when we think of them and when we go back home and hear organizations and leaders in other lines of the war effort say to us, "You should stop your disease eradication program at this time, when there is need for so much meat and milk." "You should call an armistice on your disease program until this war is over."

Gentlemen, there is no easy road to success, and there can be no armistice declared in this disease eradication program that we are now engaged in today. You have only to recall the statements made by Dr. Mingle yesterday, and analyze the predicament in which Britain finds herself, with a shortage of milk and meat because she did not have the courage or the will (whatever you might call it) to start 25 years ago cleaning house as far as disease is concerned.

We are engaged in a great war. On June 21, 154 years ago, the citizens of my State signed the ratification of the Constitution of the United States of America, and by that act they made it possible for that great document to be put into operation at a later date. Under our Flag our forefathers of '76 won for us our independence. By that independence and our Constitution, which was adopted more than 100 years ago, we have enjoyed certain privileges, ideals and principles that no people on earth other than those in this country have had.

Down through the years our armed forces have fought many wars under this Flag, and the Stars and Stripes have never rippled in an unworthy cause, and there has never been a spot of dishonor on them. In '76 they won our independence; in 1812 they won the right for our sailors to sail the seven seas without being molested. In 1846 they made a good neighbor out of Mexico. Again in 1860 they united this nation, never to be separated again. In 1898 they freed Cuba, and in 1918 our Flag was victorious at Chateau Thierry and the Argonne.

Under the American Flag today there are banded together millions of our boys fighting for those rights and privileges given to us by the Constitution of the United States of America. They have received a challenge, and they are meeting that challenge, and you and I as sanitary officers have been given a challenge. If we expect our boys to fight our battles at the front, we must fight the battles of disease at home. Secretary Wickard has said that food will win the war and write the peace. I am not so sure, but I am sure of this: Without food the war will not be won, and without food there can be no peace.

Gentlemen, PROSPECTIVE RETROSPECT—think it over. Thank you.
REPORT OF THE COMMITTEE ON TUBERCULOSIS


Your Committee on Tuberculosis this year has contacted Live Stock Sanitary Officials of all states, offering them the opportunity to submit to the Committee any problems relating to tuberculosis needing attention. All recommendations received have been carefully considered by your Committee. Uniform methods and rules for the establishment and maintenance of tuberculosis-free accredited herds of cattle in modified areas now in effect have been carefully scrutinized and your Committee believes that these rules are adequate to keep bovine tuberculosis under control in all states.

Your Committee strongly urges all Livestock Sanitary Officials to make plans and carry them into execution, providing for the periodic retesting of all accredited herds of cattle in modified accredited areas—providing for special attention to be given infected herds and herds classified as problem herds. All Livestock Sanitary Officials are urged to make plans, and improve plans now in operation, providing for all slaughtering establishments to keep a record of slaughtered cattle showing lesions of tuberculosis and to provide Livestock Sanitary Officials with this information in all cases possible, so that infected premises and the owners of same can be located.

It is the further recommendation of your Committee that all Livestock Sanitary Officials and others connected with the livestock industry, as well as all veterinarians, in addition to the tuberculin testing of cattle to the greatest extent and the blood testing of cattle for the control of Bang's abortion disease to the greatest extent, be on the watch at all times for outbreaks of infectious and contagious diseases, to the end that such diseases may be kept under control. This will aid the livestock industry to meet the demands for more meat producing animals, more meat and meat food products, more poultry and poultry products. Furthermore the need for disease-free and especially tuberculosis-free cattle for the purpose of restocking and reestablishing herds that have been destroyed as a consequence of the war makes it imperative that American herds be maintained in condition to supply this anticipated post-war demand.
EXTENT OF TUBERCULOSIS IN CATTLE
BASED ON FEDERAL MEAT INSPECTION RECORDS
NOT INCLUDING REACTORS TO TUBERCULIN TEST

Note: In 1917 about 1 animal in 48 slaughtered showed lesions of the disease, in 1942 about 1 in 1,600.

Bureau of Animal Industry, Agricultural Research Administration, U. S. D. A.

EXTENT OF TUBERCULOSIS IN SWINE
BASED ON FEDERAL MEAT INSPECTION RECORDS

Note: In 1922 about 1 animal in 7 slaughtered showed lesions of the disease, in 1942 about 1 in 13.

Bureau of Animal Industry, Agricultural Research Administration, U. S. D. A.
TREND IN PERCENTAGE OF REACTORS IN FEDERAL-STATE BOVINE TUBERCULOSIS ERADICATION WORK 1917–42

NOTE: total number of cattle tested ........................................ 252,926,608

reactors ........................................ 3,836,911

Bureau of Animal Industry, Agricultural Research Administration, U. S. D. A

MODIFIED TUBERCULOSIS-FREE COUNTIES IN THE UNITED STATES 1924–41 (fiscal year)

NOTE: First county in United States was officially accredited July 23, 1923 and the last county Nov. 1, 1940.

Bureau of Animal Industry, Agricultural Research Administration, U. S. D. A.
INTRODUCTION OF THOSE INITIATING THE TUBERCULOSIS
ACCREDITED HERD PLAN

DOCTOR McADORY: I will now turn the meeting over to Doctor E. T. Faulder and Doctor A. E. Wight as Co-Chairmen of the next part of our program.

CHAIRMAN FAULDER: This meeting of the United States Live Stock Sanitary Association marks the twenty-fifth anniversary of the inauguration of the Tuberculosis Accredited Herd Plan which we all know has produced the anticipated results. We have in this audience many individuals who met in Chicago twenty-five years ago and, after much study and deliberation, formulated what we now know as the "Accredited Herd Plan". I have before me the names of many of those here present who took part in this important work twenty-five years ago and in a few moments we would like to have them come forward to be recognized. Unfortunately, many of those who labored and worked with us so long ago have passed away and left the continuance of their well-started work to us who remain. Many of these were our close personal friends as well as our associates and I am sure you will all join with me for a moment of silent prayer in their memory.

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I will now read the following names of those who were with us twenty-five years ago, some of whom have passed on to their reward, but we are fortunate in having many of them spared who are with us today.

Dr. J. S. Anderson, Lincoln, Nebraska
Dr. J. A. Barger, Des Moines, Iowa
Dr. W. J. Butler, Helena, Montana
Dr. Edward A. Cahill, Indianapolis, Indiana
Dr. C. A. Cary, Auburn, Alabama
Mr. A. B. Cook, Helena, Montana
Dr. Chas. E. Cotton, Minneapolis, Minnesota
Dr. W. F. Crewe, Bismarck, North Dakota
Mr. J. K. Dering, Lake Villa, Illinois
Dr. R. J. Donohue, Olympia, Washington
Dr. O. E. Dyson, Chicago, Illinois
Dr. O. H. Eliason, Madison, Wisconsin
Mr. Charles Escher, Botna, Iowa
Dr. E. T. Faulder, Albany, New York
Mr. Andrew Felker, Concord, New Hampshire
Dr. W. J. Fretz, Saint Paul, Minnesota
Dr. J. I. Gibson, Des Moines, Iowa
Mr. A. J. Glover, Fort Atkinson, Wisconsin
Dr. R. M. Gow, Denver, Colorado
Dr. Preston Hoskins, Chicago, Illinois
Dr. M. Jacob, Knoxville, Tennessee
Dr. J. A. Kiernan, Washington, D. C.
Dr. Nelson S. Mayo, Chicago, Illinois
Dr. I. S. McAdory, Auburn, Alabama
Dr. J. R. Mohler, Washington, D. C.
Dr. V. A. Moore, Ithaca, New York
It is possible that in searching the records of twenty-five years ago we may inadvertently have omitted someone and, if such is the case, we regret it for there is honor enough for all in this great achievement. I will now ask Doctor Wight, my Co-Chairman, to introduce to you those who are present today as they were twenty-five years ago.

CHAIRMAN WIGHT: Ladies and Gentlemen: It has been a pleasure to take part in this program today and as we would like to have a photograph of the men here who initiated the Tuberculosis Accredited Herd Plan, we will try to be as brief as possible.

I would first like to call upon Doctor J. R. Mohler, Chief of the United States Bureau of Animal Industry, whose name has been continuously identified with the initiation and conduct of this work. He carried to completion the work which was contemplated by his predecessors Doctor D. E. Salmon and Doctor A. D. Melvin. Doctor Mohler was first ably assisted during the campaign by my friend, Doctor John A. Kiernan, and since then by myself.

I would next like to introduce Mr. A. J. Glover. (Mr. Glover indicated the great benefits now enjoyed by the live stock industry through the eradication of bovine tuberculosis.—Ed.)

(Chairman Wight introduced several others some of whom spoke briefly and whose picture appears on the opposite page.—Ed.)

CHAIRMAN WIGHT: I regret that we are running considerably behind schedule and I am sure we would like to hear from many others who have not had an opportunity to speak and much more from those who have spoken all too briefly. We are, however, greatly honored and pleased to have with us the Honorable Charles H. Sloan who was much interested in having federal funds appropriated to initiate the tuberculosis eradication campaign as a member of Congress from Nebraska. Mr. Sloan will you please come to the microphone?

MR. SLOAN: Mr. President, Officers, and Members of the United States Live Stock Sanitary Association, and Friends:

Many of you I met and collaborated with in Washington a quarter of a century ago in preparedness for a greater world conflict then being waged and which was then being carried on in the European continent.

The winning of that war was not entirely due to the American factor. But we,
Seated left to right: Dr. E. T. Faulder, Dr. W. J. Fretz, Dr. John R. Mohler, Hon. Charles Sloan, Mr. A. J. Glover, Dr. L. Van Es, Mr. H. R. Smith. Standing left to right: Dr. I. S. McAdory, Dr. Preston Hoskins, Dr. A. E. Wight, Dr. William Moore, Dr. M. Jacob, Dr. O. H. Eliason, Dr. J. A. Barger, Dr. Cassius Way.
less modest, but fully just, assert that the intrepid sons of America ended that war. And in the present global conflict American sense, backed by the forces, resources, and genius of the great Republic, will be victory's premium factor. Was it not the deliberate statement of Napoleon, Europe’s greatest continental warrior, who said “Armies march, fight, and win on their bellies”?

So believed America’s superb commander on that continent, John J. Pershing, inspired by Washington, Jackson, and Grant. He, Pershing, crystallized that statement into concrete action.

I won the honor of this place on your program by my accredited, congressional activities in mildly raiding the National Treasury to aid the great American mortgage lifter, Sir Porcine, and to furnish more red beef and other preferred flesh and to give to babies and adults milk, that primary food of man, unpoisoned at its source.

Remember, I am not abrogating to myself the fulsome praises given to me on the floor of the House of Representatives and made a part of its record. (Congressional Record beginning on page 2,449 bearing the date of January 30, 1919.)

The mechanics of each of the procedures was the introduction of a simple bill for an appropriation adequate for the undertaking proposed. In each case the bills were referred to the great agricultural committee of the House, and each, after a rebuff and rejection, was realized and incorporated in the appropriations bill. It was then considered by that great committee, debated, and received some encouragement by a rather limited sum for the first and trial years, and thereafter in each case some six years apart to obtain the generous appropriation which would be managed by and through the Bureau of Animal Industry, and from which the great campaigns were organized: first, for the eradication of hog cholera, that disease which was the spectre to the farmers of the United States who saw by its absence prosperity and by its occurrence not only adversity, but often complete bankruptcy, and second, for the eradication of tuberculosis in food producing animals, which include especially beef and dairy cattle, and also in hogs and poultry.

In the nineteenth century, succeeding the close of the Civil War, Ohio, Indiana, Illinois, Iowa, and Nebraska, occupying the same latitude, together with flanking Michigan, Wisconsin, Minnesota, Kentucky, Missouri, and Kansas, bent their energies toward mass production of cereals and food-producing animals. To these were gradually added dairy and creamery interests. The grains and dairies met the farm's running expenses and home living. Cattle breeding and marketing often laid the foundation for land purchase and barn building as well as obtaining credit, while hogs became the interest payer and mortgage lifter.

With multiplied production, marketing at a distance, and interchange of breeding came the spreading of diseases, followed by great financial losses. There came a time when land grant colleges, through farm husbandry courses, stimulated interest by the United States Government in preserving as well as producing food for our own consumption and export. Hog cholera and tuberculosis in live stock and poultry became the two dreaded economic diseases periodically sweeping away the farmer's earnings.

At this time, the veterinary profession was called to combat these losses. In the early eighties, as a student at Iowa State College, and editor of the college paper, I
took up cudgels in defense of the veterinary course against the aspersions of the public that did not like "hoss doctors". That sentiment has long since died out. The concern for the equine has centered in the bovine and spread to include swine, sheep and poultry, but more especially for their protection and prevention of diseases transmissible to man.

Research, investigation, experimentation with industry and zeal of scientists revealed much to encourage cooperation by state and national governments until early in this century and many forward-looking citizens in both public and private life were demanding effective action in the interest of man and his beasts.

The center of activity in this phase of the subject was in the Department of Agriculture in Washington during the latter part of the sixteen-year service of Secretary James Wilson, a friend of my father. Under him were Doctors A. D. Melvin, Chief of the Bureau of Animal Industry, John R. Mohler, his assistant and later his successor, and John A. Kiernan. These led with the spirit of Crusaders the nation-wide project of eradication of hog cholera and bovine tuberculosis.

About this time, 1911, my neighbors in eleven counties constituting the old First Nebraska District, had sent me to Congress. I took pride in saying that there was more good land and less waste land in that district than any other in the United States. That statement stands unamended. With the organization of the House, I was assigned to the tail end of a minor committee, "expenditures in the Department of Agriculture". There had been organized a movement to get the Secretary's "hide" on some charges Doctor Wiley and others had made. After many extended hearings the Secretary was given a substantial bill of official health. There was some mild criticism, but more commendation. The only severe criticism came from the "Washington Times" against Chairman Moss of Indiana for permitting a young, western congressman to perform the feat of the "tail wagging the dog".

The Secretary at this time told me his career was closing but regretted that he could not finish two great enterprises in which considerable preliminary progress had been made. He deplored the fact that he had been unable to gain consent of any congressman to press the legislative part to a successful conclusion. Perhaps immediately the suggestion came that his canvass had not been completed. He said, "Charlie, would you undertake it?" I did not complain of its being "so sudden". This seemed to be a boon to American farmers, but I did not vision the vast fulfillment by officials and professional men in preparing to meet in a large part our battling nation's largest demand.

That started the two legislative movements, which after a lapse of twenty-five years, promoted officials to observe the anniversary of the beginning of the major comprehensive campaign to eradicate tuberculosis in the United States. The pioneers of the movement, who engaged in that successful campaign, builded better than they knew. They believed that their work would aid in the economics of producer and consumer. They saw great possibilities of saving human life by clearing the milk used for nourishment of child and men. For many have forecast the greatest war of all time, rivaling terror, depicted in Dante's "Inferno" or Milton's "Paradise Lost", or a world-wide cry for strong men and plenty of pure food for active and potential armed forces. The work of those pioneers and those who followed has outclassed any government-aid project within the last half century.
In the matter of hog cholera, it has been reduced to the irreducible minimum. Like smallpox in the human, there will be periodic outbreaks, but in scope and virulence, they are quite limited. In mortality of human beings from tuberculosis, there has been between 1900 and 1940, a marvelous decrease. In 1900 there were 202 deaths for every 100,000 people, while in 1940 only 45 deaths occurred from this disease for the same basic number, a decrease of nearly 80%. In that two score years every year showed a decrease.

Upon the economic side there has been equal progress. The goal set early in this campaign was to reduce the reactors to 0.5% or less in every area in the United States and its possessions. At the present time the goal has been reached, some areas being much less than 0.5% and some entirely clear. According to the records 0.26% would cover the United States as a whole.

When we reflect that twenty-five years ago there were areas where the reacting cows in many herds were more than 50%, and considering the hazard of life to children supplied therefrom, we wonder what would have been our situation and condition now to meet the demand for milk and meat during the emergency had not this been done.

I have before me the figures furnished by Doctor Mohler, "Noblest Roman of them all", showing death rates for human beings from tuberculosis beginning 1900 to 1940. These will be divided into two parts; first, 1900 to 1918, the latter being the year in which the eradication movement began in earnest with an adequate appropriation made by Congress.

The estimated rate of human beings dying from tuberculosis in 1900 was 202 per 100,000, in continental United States. In 1918, through the efforts of great sanitoriums, medical institutions, and other scientific and benevolent organizations, and the efforts of the general public, the rate was reduced to 150 per 100,000. In 1940 the death rate from all forms of tuberculosis was only 45 per 100,000. This shows a reduction for 1900 to 1918 of 25% while from 1918 to 1940 a reduction of 70% or three times the reduction rate in the period in which the Bureau of Animal Industry and the cooperating states actively engaged in eradicating the disease in live stock.

Specializing in mass production, for which there is such an imperative call, we may consider this as a case of "Mass Reduction" when effort has been applied at the principal source.

When you take into account the achievements through the government's efforts directed and carried out by you, and consider the imperative and almost important demand of your country for red meat furnished by healthy cattle, and the dairy products in such serious demand for our soldiers and our allies in the far-flung areas of war, and when you further consider the man-power which has been built up ready for action making our sons the cyno­eurs of all the world in the first world war, where, up-standing health, vigor, vision, and efficiency measure something of the humanity of economic preparedness for which you have been great factors,—think of it.

In the first world war, which lasted from April 1917 to the settling of peace in June, 1919, although, of course, an armistice was arranged in much less time, we find the statistics show a saving of 105 American lives for every 100,000 of the
population which amounted in the United States to 147,000, just about 23,000 in one year more than the total deaths of our armed forces during the first world war, and more than half of all the casualties in the war except from death. That is more than $\frac{1}{3}$ of all casualties including dead, wounded, and missing in our armed forces during the war.

The official statement of the deaths in our military forces throughout that war was only 124,000 as compared with 147,000 that presumably would have perished here in America from this dread disease. When all the casualties aside from death amounted to only 236,000, you can see the relationship between a great force of American people led by these and others including Secretary Wilson, Doctors Melvin, Mohler, Kiernan, Spencer, Wight, and many others. The magnitude of your achievement and the glory of your victory, will be outstanding in the estimate of the world as the centuries come and go. Well has it been said that “Peace hath its victories no less renowned than war”. Peace hath its victories more valuable and hence should be renowned far beyond the victories of the battlefields.

You, gentlemen of this convention, official, scientific, and professional who have in the last quarter of a century contributed to this humane enterprise, are entitled to be thanked, congratulated, and remembered for what you have done, and inspired to wait and watch for the good you yet may do.

I trust that you

“May live for those who love you,
For those that know you true,
For the heaven that smiles above you
And awaits your spirits too.

And live to hail that season
By gifted minds foretold
When men shall live by reason
And not alone by gold.

For all human ties that bind you
For the task that God assigned you,
For the bright hopes left behind you
And the good you yet may do.”
REPORT OF THE ADVISORY COMMITTEE ON LAWS AND REGULATIONS


Your committee has endeavored to approach this subject as one that has been repeatedly reported on in the hope of obtaining more uniformity between the respective states. It recognizes that the authority it possesses is limited to one of advice and cannot expect end results only as their recommendations meet with favor by those vested with legislative authority.

It appears we are always ready to proclaim, "The Union, now and forever, one and inseparable," only to have our actions belie our words, by continuing a system of provincialism, in many instances unwarranted, unjustified, and frankly savoring of "Holier than thou," but unmindful of the admonition, "Let him, who is without sin, cast the first stone."

Your committee is definitely cognizant of this being a complex proposition, and realizes it is an extremely difficult matter without taking specific examples on each set of regulations.

We are of the opinion that the Federal laws, rules and regulations which are provided for the protection of the country as a whole could be used as a foundation or basis for each state. Certainly forty-eight uniform units could be constructed on so safe a foundation.

If the United States is to retain its status and recognition relative to animal health and disease prevention and control, it becomes instantly obvious that such a status can be retained only by the uniform diligence of the respective states.

Thus our duty is co-operative, based on the principle of "one for all and all for one." Hog cholera, brucellosis, tuberculosis, cattle and sheep scabies, surely they are no respector of flocks or states; still we are at variance among the states relative to their importation. Further examples will only add ignominy to the whole situation. We are aware that it is difficult to obtain uniformity promptly, due to the very nature of our states government.

We have a two party system of Government, and the changes in those in authority creates a situation flowing and ebbing that handicaps progress in uniformity unless and except following and during livestock epidemics.

We believe the Honorable Claude Wickard, Secretary of Agriculture, created and stated a new axiom, when he said, "Food will win the War and write the Peace." We want every person in the armed service of this country to have his sixteen ounces of meat per day. We believe during peace or war, a prime steak, a rasher of bacon, a leg of lamb, a baked hen or a roast turkey is comparatively wholesome whether originating in Maine or Minnesota, Florida or Fon-de-lac, Indiana or Idaho.

In view of these facts and opinions, your committee recommends that the President of the United States Live Stock Sanitary Association at an early date in 1943, after careful thought and diligent search, appoint a committee of five members—
two representing state sanitary service, one representing the Bureau of Animal Industry and two laymen, who are members of the Association.

The chairman of the committee shall be designated by the President, and said Committee shall be paid its actual, necessary expenses incurred, which amount shall be subjected to the approval by the Executive Committee, with instructions to each committee member that by correspondence they are to draft a set of uniform state regulations covering all classes of live stock and poultry, and when said uniform regulations are drafted in final form that said uniform regulations be submitted to the 1943 meeting of the United States Live Stock Sanitary Association for consideration. If said regulations be approved by the Association, then said Association shall have a sufficient number printed to mail copies to Governors of states, chief sanitary officials, commissioners of agriculture, and any others of influence interested in the interstate movement of live stock and the control of diseases within the respective states, that the information contained might be used in the passage of all laws, rules and regulations.
REPORT OF THE COMMITTEE ON RESOLUTIONS


WHEREAS: Through the highly efficient efforts of the Bureau of Animal Industry and of the sanitary officials from the various states, working in close cooperation with live stock producers, our country has been placed in a most enviable position with regard to the health and condition of our live stock herds and flocks; and

WHEREAS: This condition has been made possible only at great sacrifice to live stock producers and at great cost to both state and federal government; and

WHEREAS: The greatest contribution that the live stock industry of this country can make to the war effort is to insure a continuing, ample supply of meat, meat products and dairy products for our armed forces and our civilian population; and

WHEREAS: Any step lessening the safeguards applying to imports of live animals or dressed meats from the countries where foot-and-mouth disease exists would constitute a grave hazard to our live stock industry and to our present and future food supply; therefore be it

RESOLVED: That we again register our opposition to any change in the embargo provisions of the present law.

RESOLVED: That the regulatory live stock officials of each state report monthly to the B. A. I. the extent of contagious and infectious diseases of domestic animals, within their respective states, and be it further resolved that the B. A. I. maintain an office of Statistics, compile said reports and mail a copy of same to all state regulatory officials.

RESOLVED: That it is the sense of this association that the best interest of the live stock industry of our country would be served if each state would establish and maintain a diagnostic laboratory under the direct supervision of the state regulatory official of the respective states.

WHEREAS: Cattle grubs cause an annual cut out loss in the best section of some 6,700,000 cattle hides, together with the condemnation of at least 11,500,000 lbs. of beef, be it

RESOLVED: That this association approve and encourage the cattle grub control program in each state,

And request the War Production Board to release sufficient rotenone bearing powders for effective cattle grub control.

WHEREAS: On account of the extreme necessity of protecting our food animals from becoming infected with contagious and infectious disease which is transmitted from one state to another through the media of feeder, dairy and breeding stock being transported from one state to another state,

Attention of the Office of Defense Transportation is hereby called to the fact that the absence of uniform waybills and live stock contracts in the major portion of our truck shipments of live stock prevents sanitary officials and other qualified peace
RESOLUTIONS

officers from being able to verify the origin and destination of live stock shipments that may pass through or be delivered in areas under their jurisdiction.

Therefore Be It Resolved: By the U. S. Livestock Sanitary Association, that the Office of Defense Transportation be urged to establish some form of uniform waybill or live stock contract in truck shipment of live stock by common, contract and private carrier, so that State and Federal officials will have some method of policing the sanitary laws that are in force.

Whereas: Twenty-five per cent of sheep intestines in the United States are unusable for making surgical sutures so much needed in the war effort, and

Whereas: Nodular worms produce a serious loss of wool and mutton, and

Whereas: Phenothiazine is the only effective remedy for the removal of nodular worms,

Be It Resolved: That the United States Live Stock Sanitary Association urge the War Production Board to make available enough diphenylamine to supply the essential needs of the states of phenothiazine, and be it further resolved that the United States Live Stock Sanitary Association urge the Livestock Sanitary officials of each state where this disease is prevalent to organize an effective campaign for the control of nodular disease in sheep.

Resolved: That this association and the members thereof as individuals, again commend the Bureau of Animal Industry for the development of brucellosis vaccine from “Strain 19” and for standardization of brucella antigen; both achievements having, in our opinion, contributed greatly to the control of brucellosis in cattle.

Resolved: That we extend to the manager and other employees of the Hotel LaSalle our appreciation and thanks for the satisfactory manner in which they have provided for this convention and for the uniform courtesy and efficiency with which they have accommodated our members and visitors during the period of our meeting.

Resolved: That the president and secretary-treasurer of this association be and hereby are authorized to supply copies of the foregoing resolutions to the appropriate persons and by letter direct their attention to these resolutions.
SANITARY SCIENCE IN THE PRACTICAL SHIPPING OF LIVE STOCK

BY EARLE G. REED

General Live Stock Agent, Union Pacific Railroad, Omaha, Nebraska

Sanitary science in the prevention of animal diseases and infections has closely paralleled the progress made in the last few years in animal nutrition for building up resistance to diseases and infections. Building a strong animal bone framework likewise builds disease resistance. Greater interest of the industry lies in preventive measures rather than cures.

Changing systems and methods of marketing live stock that have taken place in the last few years have produced new and more hazards, new and more problems of sanitation. These new conditions have made quite vulnerable some of the previous practices that were generally considered adequate to handle difficulties with which the rancher, farmer-feeder, market stockyard, the railroad and the meat packer were faced in the past. Increases in shipping fever, pneumonia, septicemia, erysipelas, etc., is evidence of effect of changed conditions.

The ever prevalent demand for speed and more speed in feeding, fattening and finishing live stock; more rapid transfer from feedlot to market and packing plant; longer and faster runs by trains handling live stock with longer time on cars and shorter periods for feed, water and rest; more speed for truck shipments with less attention to careful handling and driving or to adequate and proper bedding or footing; all contribute to the hazards to live stock and to the losses enroute to market. Recently the trend in rail shipments has been to slow down, with more frequent stops for feed, water and rest—a war necessity due to heavy military traffic.

Insufficient amounts of feed at feeding yards and in the case of long distance truck hauling no stops at all for feed, water and rest produces a degree of malnutrition often bordering on emaciation and starvation or just plain "empty belly" that so frequently results in reduced vitality. Were it not for reasonably good sanitary practices the losses resulting would be staggering. B.A.I. feed requirements in railroad tariffs are based on 36-ft. cars and on minimum time at feed stops. Too often insufficient, inadequate or the wrong kind of feed is furnished. Malnutrition and emaciation is too frequent in young stock—lambs and calves. There are no B.A.I. requirements on truck shipments.

Such practices in the shipping of livestock as the use of unsuitable and inadequate bedding or footing in the cars and trucks; forced feeding of salt or starvation rations just before shipping in order to produce a big fill and an artificial weight; rushing live stock to market when it is evident that some disease or infection has obtained a start in the herd or flock; holding cattle or sheep too long on an inadequate range or pasture or where water is scarce and of such poor quality that animals will not drink normally; and many other such questionable practices are of

1 Given at the annual meeting of the United States Live Stock Sanitary Association in Chicago, Illinois, December 3, 1942.
extreme concern to the sanitarian and the veterinarian. Only sound common sense coupled with good animal husbandry can bring about the necessary corrections of such conditions. Sanitary boards are also concerned with prevention practices, not cures. They are the underwriters of live stock health.

Improved methods instituted by the railroads in connection with the construction of stock cars, pens, alleys, chutes and the employment of full time or part time veterinarians together with a great deal of educational work with railroad employees as well as shippers are producing favorable results. The use of practical methods based on strict sanitary science and common sense in handling live stock along with the full cooperation and assistance that we are receiving and giving to the state live stock sanitary boards has been most effective and helpful to the railroads. Those things that are of proven value to the railroads and the live stock industry must be extended to live stock trucking and to all forms of transportation alike, and to all types of markets, large and small. Each is affected by the sanitary practices or the lack of them of the other. We can't go half clean and half dirty—we will soon be all dirty.

With all due respect, commendation and complements to their past performance, the state live stock sanitary boards and the state veterinarians still face problems that have not been solved. There is still much to do in new sanitary science investigations and research, practices and controls that will be very beneficial to the live stock producer, the stock yard, the railroad and the meat packer. There will be greater achievements in sanitary science in the future with corresponding advances in the practical application of veterinary and nutritional science. These things when accepted and applied by practical men will eliminate many of our present losses and troubles in shipping live stock.

The best way to understand and appreciate the problems of live stock sanitation in shipping is to actually get out in the country, in the stock yards and on the railroad.
At the annual meeting of this Association in 1925 we reported the release from the cattle tick quarantine of the remaining seven counties in North Carolina and thereby the completion of cattle tick eradication in the state started some twenty years prior to that date and involving 75 of the counties of the state. At the annual meeting in 1928, I had the privilege of appearing on the program and reporting the completion of the area tuberculin testing of all cattle in all of the counties in North Carolina, reducing the infection to less than one-half of one percent and thus making North Carolina the first state to be placed in the T.B. modified accredited area and completing a program started some ten years previously.

Today it gives me pleasure to report to you that on July 1, 1942, the remaining ten counties in North Carolina were placed in the Bang's modified accredited area and North Carolina became the first state to be accredited for Bang's disease, completing a project begun some fifteen years ago. I mention the completion of tick eradication and T.B. eradication at this time for the reason—especially in connection with tick eradication—that there were certain fundamental principles established as a result of these campaigns that have general application to animal disease eradication on any large scale and demonstrates how research may be practically applied. The details, of course, are different but the fundamentals are the same.

I will not burden you with a detailed account of our Bang's program but I do wish to give you briefly a summary of this work with a few statistics. I submit for publication with this paper a detailed account of the work by counties. The completion of this work was made possible by the splendid cooperation and financial assistance of the U. S. Bureau of Animal Industry. Our Bang's program began in 1927, at which time we entered into a project with our Experiment Station, selecting a number of representative herds—about 25—throughout the state, to determine the extent of the infection, the best method of control and eradication, and such other information as might be obtained by working with such a number of herds representing a cross section of the herds of the state. Some owners agreed to slaughter reactors, others to isolate them, and a few failed to do anything about them. This work was carried on for more than five years and the results clearly indicated that under existing conditions, it was possible and practical to eliminate Bang's disease from our herds and in most instances, with the proper cooperation of the owner, to keep such herds free. Following this experimental project, the same work was extended as rapidly as funds and personnel would permit and the demand for the work grew rapidly. As a result of this preliminary work, we perfected an organization and our cattle owners were ready for a Bang's eradication campaign when Federal funds were made available July 1, 1934. However, we were not able to start promptly on account of our receiving more than 100,000 drought relief cattle about that time that had to be tested. Our testing program in cooperation with the U. S.
### Table 1.—Summary of Bang's disease area testing in North Carolina

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<th>COUNTY</th>
<th>HERDS</th>
<th>CATTLE</th>
<th>REACTORS</th>
<th>REACTOR HERDS</th>
<th>DATE STARTED</th>
<th>DATE FINISHED</th>
<th>% CATTLE INFECTION</th>
<th>% HERD INFECTION</th>
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<td>1.37</td>
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<td>4-3-40</td>
<td>.17</td>
<td>.34</td>
<td>7-1-40</td>
</tr>
</tbody>
</table>
116

WILLIAM MOORE

TABLE
l-continued
COUNTY

ERDS CATTLE BEAC-

Tom

susPECTS

BEACTOR
HERDS

DATE
STARTED

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9%

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DATE

CATTLE

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DATE

FINISHED

INFEC-

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Duplin .........
Cherokee.......
Surry ..........
Cleveland......
Jones ..........

2483

Richmond ......
Columbus......
Bertie ..........
Alamance ......
Washington....
Onslow.........
Lee ............
Madison........
Rutherford .....
Alexander......
Pitt ............
Hertf ord .......
Pender .........
Nash ...........
Vance ..........
Northampton . .
Polk ...........
Rockingham ...
Randolph ......
Harnett ........
Montgomery ...
Ashe ...........
Perquimans ....
Watauga ......
Chatham .......
Yancey.........
Tyrrell .........
Transylvania . .

1635 3304
1785 424:
1154 2384
3323 887t
691 214
953 2464
1458 308(
3838 10276
4451 8661
2108 459t
1765 43M
869 1701
1177 2794
2401 4641
2221 407:
1977 340E
1414 3151
4503 854(
4343 1086t
3079 584t
1502 332:
4347 1392<
651 191i
2917 7891
3291 841I
2952 669t
513 88!
1080 275;

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2145 4734
4982 92ot
5367 1151f

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647 1424 14
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21 9-21-39
1 9-16-39
23 5- 1-39
39 5- 1-39
13 4-17-40

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5-29-40

10-23-39 6- 1-40
11-16-39 6- M a
4 - 1 4 8-3-40

.44
.32
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.98
.97
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.73

6- 7-39 8- 6 4
6-18-40 8-10-44 .88
11 4- 1-40 8-15-43 .52
16 6 - 1 4 9-104 .58
19 7-24-39 9-3(3-40 .27
16 10-24-39 10- 9-40 .45
14 6-17-40 10-25-4[1 .30
19 6-22-40 11-21-4
.88
5 10-17-40 12-144 .29
7 8-16-40 1-14-41 .32
25 8-14-40 1-3141 .66
0 10-21-40 2-7-41 none
11 8-26-40 2-19-41
.35
- 7 10-9-40 2-22-41 .28
12 10-16-39 3-13-41 .14
24 4-1-40 3-20-41
.36
7 4-11-40 4-9-41 .12
6 11-18-40 4- 9-41 .18
20 11- 1-39 5- 1-41 .18
4 2-!20-41 5-12-41 .21
7 8-26-40 5-2141
09
14 9-9-40 5-23-41 .23
10 10-26-40 6-8-41
.15
5 5-13-41 6-21-41 .56
7 4-10-41 7-5-41 .25

12
9 28
12 83
39 192
7 47
6 46
25 51
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4-16-40
3-22-40
3-23-40
3-28-44)

48

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7 54
19 170
10 43
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7 12

Wilson ......... 1507 393t
Scotland ....... 1097 202!
Camden........ 613 1911
Pasquotank ....
Caswell........
Dare ...........
Buncombe
-1st Test .....
-2nd Tee$....

787 3194
2691 488t
72 27t

.84
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7-1-40
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7-1-40
2.00 7-1-40

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.73
1.21
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2.46
1.15
1.09
.49
.36
.66
1.07
.57
.59
1.04
none
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.64 9 - 2 4
2.29 9-2-41
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18 3-10-41 7-31-41
9 3-13-41 8-9-41
1 8-11-41 8-22-41

.91 2.29
.20 .33

.36

9-2-41
9-2-41

1.39 61-42

6276 1982t 784 548 170 7- 1-38 l(t31-40 3.95 2.70
6235 175U 134 428 35 11- 1-40 8-31-41 .76
56 4-1-42

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I


While our infection began by a result of the herds and the herds where we believed the infection existed, we commenced our work in September, 1934. As a result of the work previously done, we had the support and cooperation of the veterinarians, the Extension Service, pure bred cattle associations, Health Departments, press, and other influential organizations and the demand for testing grew rapidly. We began by testing the pure bred herds from which replacements came; the commercial dairy herds and the herds where we believed the infection existed. While our infection

NORTH CAROLINA AND BANG'S DISEASE

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>HERDS</th>
<th>CATTLE</th>
<th>REAC-TORS</th>
<th>SUBJECTS</th>
<th>REAC-TOR HERDS</th>
<th>DATE STARTED</th>
<th>DATE FINISHED</th>
<th>% CATTLE INFECTION</th>
<th>% HERD INFECTION</th>
<th>DATE AC-CREDITED</th>
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<tbody>
<tr>
<td>Martin</td>
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<td>18</td>
<td>14</td>
<td>6-3-41</td>
<td>8-31-41</td>
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<td>Greene</td>
<td>1039</td>
<td>1846</td>
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<td>11</td>
<td>14</td>
<td>6-23-41</td>
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<td>14</td>
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<td>10-2-41</td>
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<td>10-7-41</td>
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<td>11-6-41</td>
<td>.20</td>
<td>.32</td>
<td>4-1-42</td>
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<th>CATTLE</th>
<th>REAC-TORS</th>
<th>SUBJECTS</th>
<th>REAC-TOR HERDS</th>
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<td>6</td>
<td>5</td>
<td>15.76</td>
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<td>Henderson</td>
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<td>6687</td>
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<td>55</td>
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<td>Robeson</td>
<td>3946</td>
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<td>80</td>
<td>18</td>
<td>6-10-40</td>
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<td>19</td>
<td>7-17-41</td>
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<td>4</td>
<td>1</td>
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<td>58</td>
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<td>4</td>
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<td>1956</td>
<td>6</td>
<td>2</td>
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</table>

CATTLE INFECTED 3 individual-cow reactor herds

<table>
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<tr>
<th>COUNTRY</th>
<th>HERDS</th>
<th>CATTLE</th>
<th>REAC-TORS</th>
<th>SUBJECTS</th>
<th>REAC-TOR HERDS</th>
<th>DATE STARTED</th>
<th>DATE FINISHED</th>
<th>% CATTLE INFECTION</th>
<th>% HERD INFECTION</th>
<th>DATE AC-CREDITED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenoir</td>
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<td>7069</td>
<td>84</td>
<td>203</td>
<td>27</td>
<td>6-10-40</td>
<td>4-16-42</td>
<td>.97</td>
<td>.18</td>
<td>7-1-42</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>HERDS</th>
<th>CATTLE</th>
<th>REAC-TORS</th>
<th>SUBJECTS</th>
<th>REAC-TOR HERDS</th>
<th>DATE STARTED</th>
<th>DATE FINISHED</th>
<th>% CATTLE INFECTION</th>
<th>% HERD INFECTION</th>
<th>DATE AC-CREDITED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyde</td>
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<td>2750</td>
<td>41</td>
<td>51</td>
<td>31</td>
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<td>4-23-42</td>
<td>.94</td>
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</table>

**Table 1—Concluded**

(14 individual-cow reactor herds)

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<th>COUNTRY</th>
<th>HERDS</th>
<th>CATTLE</th>
<th>REAC-TORS</th>
<th>SUBJECTS</th>
<th>REAC-TOR HERDS</th>
<th>DATE STARTED</th>
<th>DATE FINISHED</th>
<th>% CATTLE INFECTION</th>
<th>% HERD INFECTION</th>
<th>DATE AC-CREDITED</th>
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<tbody>
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<td>210</td>
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<td>.92</td>
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<td>4-27-42</td>
<td>.11</td>
<td>.28</td>
<td>7-1-42</td>
</tr>
<tr>
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<td>881</td>
<td>330</td>
<td>6</td>
<td>16-37</td>
<td>1-19-42</td>
<td>12.43</td>
<td>13.27</td>
<td>7-1-42</td>
</tr>
<tr>
<td>2nd Test</td>
<td>3765</td>
<td>14169</td>
<td>65</td>
<td>96</td>
<td>10</td>
<td>10-13-41</td>
<td>5-15-42</td>
<td>.46</td>
<td>.48</td>
<td>7-1-42</td>
</tr>
<tr>
<td>Mecklenburg</td>
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<td>10737</td>
<td>296</td>
<td>244</td>
<td>118</td>
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<td>1-19-39</td>
<td>2.76</td>
<td>3.44</td>
<td>7-1-42</td>
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<tr>
<td>1st Test</td>
<td>3589</td>
<td>14210</td>
<td>112</td>
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<td>44</td>
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<td>5-16-42</td>
<td>.79</td>
<td>1.22</td>
<td>7-1-42</td>
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<tr>
<td>Haywood</td>
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<td>11953</td>
<td>23</td>
<td>46</td>
<td>19</td>
<td>5-1-41</td>
<td>5-23-42</td>
<td>.19</td>
<td>.35</td>
<td>7-1-42</td>
</tr>
</tbody>
</table>

**Bureau of Animal Industry began in September, 1934. As a result of the work previously done, we had the support and cooperation of the veterinarians, the Extension Service, pure bred cattle associations, Health Departments, press, and other influential organizations and the demand for testing grew rapidly. We began by testing the pure bred herds from which replacements came; the commercial dairy herds and the herds where we believed the infection existed. While our infection**
WILLIAM MOORE

on the whole was light, we did have rather heavy infection in some pure bred herds and in the older dairy sections. By following this plan for a couple of years, we were able to clean up many herds and to enlist the support of influential herd owners in a campaign to bring about county wide testing, with the result that our State Legislature of 1937 enacted a law which became effective July 1, 1937, providing for cooperation by the Boards of County Commissioners and the testing of all cattle on a county-wide basis. Upon the passage of this act, we solicited the cooperation of the County Commissioners of the counties which we knew to be most interested and obtained agreements for the work. Others followed in rapid succession and we were able to keep enough counties signed up to continue the work and progress as rapidly as our personnel would permit. Little difficulty was experienced in inducing Board of County Commissioners to cooperate, with the exception of the last ten or twelve counties. Indemnity was paid on reacting animals with Federal funds from July 1, 1934, to May 1, 1939. On the latter date the state began the payment of indemnity by an Act of the 1939 Legislature. Payments are on the basis of $25.00 for grades and $50.00 for pure breeds, total payment.

During the eight years covered by this report, we made a total of 1,255,648 tests in 286,364 herds. Of this number 8,836 herds of 238,884 cattle disclosed a total of 20,506 reactors. During this period there were 249,084 herds of 601,149 cattle under supervision. Having attained the status of a modified accredited state, we are naturally concerned over maintaining this status. We realize that this is difficult in the present war emergency. The demand for milk and beef in our state is beyond anything that we might have anticipated and the consequent importation of cattle presents a serious disease problem. In an attempt to protect our investment in our Bang's program, we amended our Bang's regulations on October 13, 1942 as to the requirements on cattle shipped into North Carolina, of which you have received notice. Briefly, this regulation requires that such cattle come from (1) a Bang's accredited herd or (2) a herd not under quarantine in a modified accredited county or (3) a herd under State and Federal supervision for Bang's disease that has passed a clean test within the past twelve months—all cattle to pass a test within thirty days of shipment. We solicit the cooperation of the officials of the states from which we import cattle in the observance of this regulation.

I take pleasure in acknowledging our thanks for the splendid cooperation received from the many organizations and other agencies who so greatly helped in making this campaign a success. The cooperation of our practicing veterinarians was especially helpful and we solicit their continued support which is so necessary for keeping this disease under control. I also acknowledge with thanks the wide publicity given to the completion of this program.

Now a word about vaccination. We recognize the value of calfhood vaccination, under proper supervision, for the control and eradication of Bang's disease where conditions warrant its use. Such conditions did not and do not now exist to any great extent in North Carolina and we feel that we were fully justified in adopting the test and slaughter method of eradicating this disease. I would remind those of you who select the vaccination method of eradication, of two very important facts: 1. In adopting the vaccination method you elect to live with the disease for many years in the future, depending upon circumstances, and in doing so, you will expose
the owner and those who care for his animals and others to a dangerous and serious human disease hazard. Contact infection should not be overlooked. Research work that is now in progress may show that this is a more serious situation than we realize.

2. I think we all agree that if vaccination is to be successful, it must be done under proper supervision. Basing my opinion on observation and experience, I don't believe that vaccination can be kept under supervision under present conditions. Unless the Secretary of Agriculture adopts Amendment 15 to B. A. I. Order 276, or a similar requirement, I am of the opinion that you cannot properly supervise vaccination in your state—in fact, you may find yourself paying indemnity on animals that react as a result of vaccination with this uncontrolled product. I might add that we have encountered our share of so-called "problem herds," and in some instances the owners, with little knowledge of Bang's vaccination, insisted that this method be adopted for their relief. A careful investigation of these cases revealed, in most instances, that such a procedure was not advisable. As previously stated we adopted the test and slaughter method of eradicating Bang's disease as being the best method under conditions as they existed in North Carolina, realizing that under different conditions, it might be advisable to use other methods.
CALFHOOD VACCINATION IN NEW YORK

By E. T. Faulder
State Veterinarian, Albany, N. Y.

For many years the cattle owners in New York State, and in fact in all states, have been confronted with the problem of controlling Bang's abortion disease in their herds. Many remedial measures were recommended and tried without success. Then research workers developed the agglutination test, by which it is possible to locate infected animals. The next step is to segregate the infected animals, thus preventing unnecessary spread of the disease.

In 1932 the Recorded and Approved Plan for Bang's disease control was created in New York. Under this plan no indemnities were paid and the cattle owner compensated his veterinarian for conducting the blood test. Reacting animals were properly segregated and were sold into infected herds, or slaughtered.

In 1934 considerable blood testing was done under the Federal Plan, with the payment of Federal indemnities only. This plan was discontinued in 1937, at which time the first State appropriation was made for Bang's disease indemnities, and a Federal-State cooperative plan created. Under this plan, 3100 herds have been given attention, and from 1937 to the present time $1,750,000 of State money has been expended. No new herds have been taken on under the test-slaughter-and-indemnity plan since August 1940, and the number of herds operating under this plan has been reduced from 3100 to approximately 1400. One-half of the herds still operating under the test-slaughter-and-indemnity plan have either passed one or two successful tests, or have improved. Owners of herds under this plan are given the opportunity to transfer their herds to the new plan, inaugurated September 1941, involving blood test and calfhood vaccination—with no indemnities, either State or Federal. Herds failing to show improvement in the control of Bang's abortion disease under the test-slaughter-and-indemnity plan are dropped from supervision, and in most cases the owners of such herds welcome the privilege of placing their herds under the new plan involving calfhood vaccination.

Under the new plan involving blood test and calfhood vaccination, a blood test is first applied to the herd before any calves are officially vaccinated. A blood test on record, made within a period of six months and covering all animals six months of age or over, is acceptable. This condition exists when a herd has previously been blood tested under either the Recorded-and-Approved Plan or the Test-Slaughter-and-Indemnity Plan. In herds acceptable under the new plan and not previously blood tested, all animals six months or over, including calves of vaccinal age, must be blood tested. An annual blood test is required on all herds operating under the new plan, with more frequent tests being desirable. No indemnities are paid, either State or Federal, and the herd owner is required to properly segregate reacting animals, disposing of them at his convenience—preferably by slaughter. Some of these reacting animals may find their way into known infected herds.

Blood tests upon herds operating under the new plan are conducted by regularly
employed state, federal, county and accredited veterinarians. When the services of these veterinarians are not available (and these cases are infrequent) or operating funds become exhausted, the owner of a herd may employ his accredited veterinarian to apply the blood test at his expense—funds being held in reserve for the official vaccination of calves as they become of vaccinal age.

At the present time approximately 200 accredited veterinarians already assigned to zones in the vicinity where they practice and in which they retest accredited herds at State expense are participating in the drawing of blood samples from herds operating under the new plan including the official vaccination of calves. These accredited veterinarians work under blanket authorizations and are compensated for the drawing of blood samples at the rate of $2.50 for making the visit to the farm and 20¢ for each blood sample drawn. Their compensation for officially vaccinating calves is $2.50 for making the visit to the farm and 25¢ for each calf vaccinated, ear-tagged and recorded.

When the qualifying or initial blood test is applied to a herd acceptable under the new plan and calves of vaccinal age are vaccinated at the same time the blood samples are drawn only one herd charge is made. When a return trip is made to a farm to vaccinate additional calves of vaccinal age, the veterinarian is paid the herd charge and also the per-head charge. In most instances, two trips to a farm during a period of twelve months is sufficient to vaccinate all calves of vaccinal age; but not more than three trips is permissible during the year.

The vaccination of calves is restricted to calves between the ages of 4 to 8 months, preferably at 6 months, and officially marked vaccination tags are furnished free by the state. The Brucella Abortus, Strain 19, vaccine used is prepared under federal supervision, is distributed in 6 cc vials, and must be used before the expiration date, which is six months from the date of manufacture. None of this product is in the possession of our Department longer than two weeks. This means that a potent vaccine is being administered.

The vaccine is distributed to federal, state, county and accredited veterinarians authorized to use it officially. It is shipped to them by first-class mail, and shipment is so timed that the package will not lie in the post-office over Saturday and Sunday. Just enough is shipped to the veterinarians at a time to take care of their needs for a period of not longer than a week. This vaccine is kept under refrigeration in the Bureau of Animal Industry and all veterinarians are required to keep it under refrigeration in their homes. It is carried to the farms where it is to be used in vaccine thermos jugs at least one gallon in size. At the present time more than 200 of these jugs are in use.

Instructions are given to all veterinarians engaged in the drawing of blood samples and the official vaccination of calves. The technic of vaccinating calves consists of having proper equipment, including disinfectant for the seat of injection, and alcohol and cotton for cleaning the needles between each injection. The empty vaccine vials and rubber stoppers are to be returned to the Albany office.

The vaccine is injected on the side of the neck a few inches in front of the scapula and in the underlying fascia. This prevents indurations, and the cleaning of the seat of injection and the cleaning of the needle between injections prevents any possibilities of abscesses. The syringe is cleaned by immersion in boiling water.
Official, non-replaceable calfhood vaccination tags are furnished free by the Department, and are marked N.Y.U.S. B.A.I. Vac. (meaning vaccination) with the fiscal year. This data is entered upon the records at Albany and in the various county offices for the benefit of veterinarians, county agents, cattle owners and other interested persons. These records show all information relative to the calves vaccinated, dates of blood tests, etc. Under this plan the Department is always in a position to tell just when each calf was officially vaccinated and the serial number of the vaccine used.

The goal of the Department in promoting the new plan of controlling Bang's abortion disease through blood test and calfhood vaccination is eventually to have sufficient available funds to make an annual blood test upon all the cattle in the state and officially vaccinate all calves which are raised, approximately 300,000. This will eventually mean the employment of all the accredited veterinarians now assigned to zones, numbering approximately 380. This will place upon the shoulders of this large group of veterinarians the responsibility for blood testing annually all of the cattle in the zones assigned to them and for officially vaccinating all calves of vaccinal age which are to be raised. The size of the zones assigned to accredited veterinarians is so arranged that it is possible for an active accredited veterinarian to look after his practice, to do the retesting of accredited herds in his zone, and also take care of the blood testing and the vaccination of calves. In addition to the blood testing and calfhood vaccination being done by accredited veterinarians, state, federal and county veterinarians will participate in this work to the fullest extent.

In one county made up of thirteen townships and having a cattle population of 19,000, all cattle have been blood tested and calves of vaccinal age vaccinated in six townships. This work will be completed within the next few weeks in the remaining seven townships.

Since the new plan was inaugurated September 12, 1941, applications have been received from approximately 4500 cattle owners, all of whom have been given service. The herds of these owners are distributed throughout the 62 counties, and approximately 23,000 calves have been officially vaccinated and ear-tagged. Increasing numbers of applications are being received due to cattle owners becoming familiar with the new plan through information provided by the Farm Bureaus, by members of county disease-control committees, township meetings, articles appearing in agricultural papers, and the press. The Department proposes soon to issue a pamphlet entitled "Help Eradicate Bang's Abortion Disease," which will be placed in the hands of cattle owners.

In addition to state funds provided for the compensation of veterinarians for the drawing of blood samples, for the vaccination of calves, and for the purchase of vaccine, ear tags and other supplies, as well as limited personnel, county funds are available for the employment of county veterinarians, and in many cases accredited veterinarians working in the capacity of assistant county veterinarians.

During the fiscal year 1941, $50,000 of state funds and $60,000 of county funds were used in promoting the new plan.

For the fiscal year 1942, $100,000 has been appropriated by the state for the same purpose, with an increase being made in county funds.
Calfhood Vaccination in New York

For the fiscal year 1943, it is anticipated that increased state and county funds will be available.

This is an opportune time for owners to control and eventually to eradicate Bang's disease from their herds. Every food-producing animal must be saved. Sacrifice of cattle by the test-and-slaughter method should be discouraged. Bang's abortion disease should be controlled by more economical methods, and this is being done under the New York plan involving blood test and calfhood vaccination. Under the new plan of calfhood vaccination, within a period of approximately six years owners will have rid their herds of all the original members, and be in possession of a new herd made up of animals which were all officially vaccinated as calves. It should be the goal of all cattle owners operating under the new plan eventually to own an approved vaccinated herd, and the definition of an approved vaccinated herd is: "A herd under the vaccinal plan may be certified as a herd free of brucellosis for a period of one year when all animals in the herd over two years of age reveal at least two negative reactions to official blood agglutination tests properly spaced, when non-vaccinated heifers under two years shall similarly be proved negative to the test, and when vaccinated heifers under two years either show a satisfactory decline in titer or are removed for slaughter."

All of this has been accomplished without the expenditure of indemnities, the total cost being represented by the amount expended in the drawing of blood samples, the cost of vaccinating, the purchase of vaccine, ear tags, and other supplies, and the cost of administration. The owner has been caused no inconvenience or loss of revenue as he would under the slaughter plan, which in many cases has destroyed valuable blood lines and temporarily or permanently impaired his income. Under the present conditions, it seems inadvisable to slaughter large numbers of good producing animals simply because they have reacted to the blood test.

Cattle owners wise enough to place their herds under the new plan will have a foreign post-war replacement market for animals free from tuberculosis and negative to the blood test for Bang's disease, and will have for sale animals negative to the blood test which were officially vaccinated. Under present and post-war conditions, he should also have a good market for positive cows which have served their usefulness.
INCIDENCE OF BRUCELLOSIS IN SWINE¹, ²

W. L. BOYD, H. C. H. KERNKAMP, M. H. ROEPKE AND C. E. BLYE

Division of Veterinary Medicine, University Farm, St. Paul, Minnesota

Information on the prevalence of brucellosis in swine trails far behind that of brucellosis in cattle. On the basis of the agglutination test for brucellosis, the prevalence of this disease has been determined for the entire cattle population (cattle six months of age and over) in the state of North Carolina. Similar information is available for large portions of other states and in still others, the extent of the disease in this class of livestock is known for areas of the magnitude of counties and townships. Nothing comparable to this is available for swine.

The application of the agglutination test for the detection of brucellosis in swine has been in use for many years. The interpretation of the results of the test on the other hand, has not been as generally agreed upon as in the case with cattle. In general, the tendency has been to consider agglutination in the 1:50 dilution as an indication of the possibility of infection or an undesirable animal to leave in the drove. Whether or not agglutination in the 1:50 dilution should be considered as representing the significant titer or "reactor" titer is a matter in which we have become interested in the past few years.

From time to time during the past 20 years investigators have conducted survey agglutination tests for brucellosis in swine slaughtered in abattoirs in different parts of the country. To a large extent, these studies had for their objective a desire to obtain information on the prevalence of the disease in what might be considered a fair sampling of a general swine population. A summary of these studies is shown in Table I. The data summarized in this table should probably not be considered strictly comparable because the strains of Brucella organisms used in the preparation of the antigens, the density of the antigens and the technic of conducting the tests would vary considerably. These variations might account for differences in the results. However, when taking into consideration the possibility of such variations, the results indicate a fair agreement in the per cent of cases falling in the different titer classifications. The percentages shown in the first column on dilutions (1:40-1:60) includes also those animals with agglutination titers above this range. It is obvious from the data that the per cent of animals showing titers of the order of 1:80 and higher is considerably less.

An important question which arises in connection with the interpretation of the results obtained by the several investigators is: What should be considered a significant titer or "reactor" titer for the animals tested? If a titer in the 1:40-1:60 range and higher is to be considered a reactor, then the incidence of brucellosis appears to be appreciably greater than if one considers only titers in the 1:80-1:100 range and higher.

¹ Paper No. 2053, Scientific Journal Series, Minnesota Agricultural Experiment Station.
² The investigation herein reported was in part made possible through support granted by the Bureau of Animal Industry, United States Department of Agriculture.
In an attempt to obtain some information on the incidence of brucellosis in swine in the South St. Paul market area we are presenting the results of a study that has been in progress during the past 18 months. It is based on material derived from

**Table I.—Brucella agglutination tests on swine**

Results of different investigators

<table>
<thead>
<tr>
<th>NUMBERS OF SWINE TESTED</th>
<th>PER CENT OF CASES HAVING AGGLUTINATION TITERS INCOMPLETE OR COMPLETE IN DILUTIONS OF</th>
<th>AUTHORS AND YEAR</th>
<th>SAMPLES COLLECTED AT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1:40-1:60 and higher</td>
<td>1:80-1:100 and higher</td>
<td></td>
</tr>
<tr>
<td>435 (sows)</td>
<td>14.7</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>190 (barrows)</td>
<td>5.3</td>
<td>2.6</td>
<td>Weeter (1923)</td>
</tr>
<tr>
<td>4,014</td>
<td>1.5</td>
<td></td>
<td>Boak &amp; Carpenter (1930)</td>
</tr>
<tr>
<td>490 (gilts)</td>
<td>2.8</td>
<td></td>
<td>McNutt, Murray &amp; Purwin (1931)</td>
</tr>
<tr>
<td>188 (sows)</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>548 (barrows)</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52 (stags)</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>501</td>
<td>1.2</td>
<td>0.6</td>
<td>Gwatkin (1931)</td>
</tr>
<tr>
<td>3,975</td>
<td>7.7*</td>
<td></td>
<td>Huddleson &amp; Johnson (1933)</td>
</tr>
<tr>
<td>1,316</td>
<td>26.9**</td>
<td>3.2</td>
<td>Starr (1933)</td>
</tr>
<tr>
<td>1,011 (sows)</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,034 (barrows)</td>
<td>3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,285 (gilts &amp; sows)</td>
<td>10.1</td>
<td>2.1</td>
<td>Boyd, Kernkamp, Roepke, &amp; Blye (1942)</td>
</tr>
<tr>
<td>1,276 (barrows)</td>
<td>10.1</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

* Rapid whole blood test.
** Dilutions of 1:25 and higher.

three different sources: (a) Blood samples of swine slaughtered in one of the packing plants in South St. Paul, (b) Sample collected from swine in 12 brucellosis negative droves, (c) Samples collected from swine in four brucellosis positive droves.
The samples collected at the abattoir were obtained in lots of about 250, one to three times a month over a ten-month period. Blood was collected from every third or fourth pig as it passed the "sticker" so that the sampling represented approximately three to four times the number of animals actually tested. The swine in the brucellosis negative and positive groups consist largely of droves kept by experiment stations and state institutions. The status of those droves with respect to brucellosis is familiar to us both from the standpoint of past history and performance and the results of previous agglutination tests. The antigens used and the technics employed in conducting the tube and plate tests were the standard Brucella antigens and technics regularly employed for conducting agglutination tests for brucellosis in cattle. Table II and Figure I summarizes the results of the agglutination test conducted on these samples.

These data show that the results of the tests on the market swine (swine slaughtered at South St. Paul) agree very closely with the tests on swine in the negative droves in the lower dilutions (1:50 and below). It is only in the higher dilutions (1:100 and above) that significant differences occur.

When comparing the results on the market swine and those in negative droves with the results obtained in the positive droves, the differences are most marked in the higher dilutions. This indicates that the majority of infected swine show high titers.

In regard to the agglutination tests on the swine comprising the South St. Paul group and the negative droves, an important question arises as to what titer should be considered as indicative of infection in order to determine the incidence of the
disease in the swine population tested. It is realized that the negative group represents a relatively small number of droves and only many more extensive studies of this kind will help to establish more exactly a cross-section of the agglutination titers or titer profiles in negative droves. However, if the results obtained in these studies on what we believe are negative droves represent negative droves in general, then one should not consider all animals showing a titer in the 1:50 range as infected. Of the South St. Paul group, 10.14 per cent of the animals tested showed agglutination in the 1:50 dilution or higher according to the tube test and of the negative droves, 7.0 per cent of the animals showed agglutination in the 1:50 dilution or higher, or a difference of 3.14 per cent. Similarly, 3.24 per cent of the South St. Paul group showed agglutination in the 1:100 dilution or higher and 1.3 per cent of the animals in the negative droves showed agglutination in this titer range, or a difference of 1.0 per cent. Thus it would appear that these preliminary data suggest the incidence of brucellosis in the South St. Paul market swine to be of the order of one to three per cent depending upon the titer considered to be indicative of infection in a survey of this nature on random samples of market swine.

In conclusion we wish to emphasize that our data, especially on the negative and
positive droves, is rather limited and therefore the interpretations discussed above should be considered only as suggestions. More conclusive interpretations must await more extensive studies of the type presented.

REFERENCES


The success of vaccination against bovine brucellosis with Strain 19 vaccine has been proved by laboratory and field experiments involving large numbers of cattle. However, there are certain problems which still need clarification and should be investigated, two of which are dealt with in this paper.

There is at present no serological method whereby immunity produced in vaccinated animals can be determined. While the agglutination titer in most instances disappears within one year following vaccination, experimental evidence shows that the animals remain immune for a considerably longer period. At the present time the only satisfactory test for immunity is animal exposure, which of necessity is time-consuming and costly.

A review of the literature pertaining to brucellosis reveals that for some time a routine test found to be useful in the diagnosis of the disease in man has been the opsonocytophagic test. This test is an approximate measure of the opsonins which are specific immune bodies present in the blood stream that render bacteria more susceptible to phagocytosis. In human brucellosis the opsonocytophagic test is used as a measure of the phagocytic power of the blood against Brucella and aids in determining, in conjunction with other tests, whether the patient is susceptible, infected, or immune.

In 1936 the opsonocytophagic test was adapted by Huddleson for use in cattle, and this work is described in one of the few papers published on this subject. It is interesting to note the following statement which he makes concerning the usefulness of the opsonocytophagic method: “The test, when properly conducted, serves not only as a means of detecting the immune, but in determining the degree of immunity. Further, it may be used as a means of determining the immunizing value of vaccines.”

The test has not been used extensively in Bang’s disease in animals as the agglutination test has always been relied on as a good index of infection. Besides, the technique of the opsonocytophagic test is more difficult than that of the agglutination test. However, once the laboratory worker becomes familiar with the method, it offers few difficulties.

TECHNIQUE

The technique for the test is described completely by Huddleson in his book, Brucellosis in Man and Animals. Briefly stated it is as follows: 0.1 cc. of citrated blood is mixed in a small test tube with 0.1 cc. of a suspension of virulent Brucella and incubated for 30 minutes. A drop of this mixture is then smeared on a clean slide and stained with toluidine blue. Twenty-five polymorphonuclear leucocytes
are examined and the number of ingested bacteria in each is counted. The results are tabulated as follows:

- **Marked** .............. 40 or more bacteria per leucocyte (fig. 1)
- **Moderate** ............. 21 to 40 bacteria per leucocyte (fig. 2)
- **Slight** ................ 1 to 20 bacteria per leucocyte (fig. 3)
- **Negative** ............. No bacteria per leucocyte (fig. 4)

We have considered as does Huddleson, that considerable immunity is probably present when 15 (60%) or more of the 25 cells counted show marked phagocytosis.

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**EXPERIMENTAL DATA**

The work to be reported consists of approximately 2200 opsonocytophagic and agglutination tests on 438 animals and is divided as follows:

1. Newly vaccinated calves
2. Animals vaccinated during the period extending from 1935 to 1941
3. Negative animals from accredited herds
4. Animals which had become positive to the agglutination test following exposure to natural infection.
Opsonocytophagic and agglutination tests were made on a group of 96 calves prior to vaccination. Of these, 85 per cent showed low opsonocytophagic activity, probably indicating susceptibility. The remaining 15 per cent were found to have a high degree of opsonocytophagic activity and might be considered immune. All of these calves came from infected herds and many had nursed positive dams. All 96 animals were completely negative to the agglutination test in dilutions of 1:25 through 1:2000. Table 1 shows five typical pre- and post-vaccination titers and opsonocytophagic reactions in this group.

Following vaccination it was found that the opsonocytophagic activity reached its peak about the fifth day with most of the animals showing over 80 per cent marked cells and has remained high for five months, which brings the experiment up to the present date. The agglutinins did not reach their peak until the ninth day after which they gradually disappeared and at present all of the calves show a negative agglutination titer. Table 2 shows graphically a comparison of opsonocytophagic reactions with agglutination titers in vaccinated calves. Five of the calves developed no measurable agglutinins following vaccination, but all five came from positive dams and three of these calves showed opsonocytophagic activity indicative of immunity before vaccination.

### Table 1.—Typical pre- and post-vaccination titers and opsonocytophagic reactions in newly vaccinated calves

<table>
<thead>
<tr>
<th>Blood titer</th>
<th>Opsonocytophagic tests</th>
<th>Blood titer</th>
<th>Opsonocytophagic tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ma* Mo Si N</td>
<td></td>
<td>Ma* Mo Si N</td>
</tr>
<tr>
<td>1</td>
<td>— — — — —</td>
<td>++++++++</td>
<td>22 3 0 0</td>
</tr>
<tr>
<td>2</td>
<td>0 2 18 3</td>
<td>++++++</td>
<td>25 0 0 0</td>
</tr>
<tr>
<td>3</td>
<td>0 8 15 2</td>
<td>+++++</td>
<td>25 0 0 0</td>
</tr>
<tr>
<td>4</td>
<td>1 4 18 2</td>
<td>+++++</td>
<td>23 1 1 0</td>
</tr>
<tr>
<td>5</td>
<td>0 1 12 13</td>
<td>+++++</td>
<td>25 0 0 0</td>
</tr>
</tbody>
</table>


Opsonocytophagic test:* Ma, marked; Mo, moderate; Si, slight; N, negative.

2. Animals vaccinated as calves during the period extending from 1935 to 1941

Tests were made on 178 animals which had been vaccinated during the years 1935 through 1941. As shown in table 3, the opsonocytophagic reaction remained constant at a level slightly above 60% marked cells in those animals vaccinated within the period from 1938 to 1941. There was a sharp drop to 40% marked cells in 1937, and a further decrease to 16% marked cells in 1935.

The opsonocytophagic tests show, therefore, that the immune level was maintained approximately four years after vaccination, as indicated in Table 4.
Table 2.—Comparative study of average agglutination and opsonocytophagic tests
3. Negative animals from accredited herds

Opsonocytophagic tests were made on blood of 134 negative animals in two accredited herds. Of these, 126 showed little or no opsonic activity (table 5) and

**Table 3: Average opsonocytophagic reaction for animals vaccinated 1935-1941**

<table>
<thead>
<tr>
<th>YEAR VACCINATED</th>
<th>NUMBER OF ANIMALS</th>
<th>AVERAGE OPSONOCYTOPHAGIC TESTS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ma*</td>
<td>Mo</td>
<td>Sl</td>
<td>N</td>
</tr>
<tr>
<td>1935</td>
<td>5</td>
<td>4.3</td>
<td>6.7</td>
<td>11.6</td>
<td>2.4</td>
</tr>
<tr>
<td>1936</td>
<td>7</td>
<td>8.2</td>
<td>6.2</td>
<td>8.4</td>
<td>2.2</td>
</tr>
<tr>
<td>1937</td>
<td>6</td>
<td>10.2</td>
<td>5.8</td>
<td>7.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1938</td>
<td>9</td>
<td>15.7</td>
<td>4.6</td>
<td>4.3</td>
<td>0.4</td>
</tr>
<tr>
<td>1939</td>
<td>53</td>
<td>15.8</td>
<td>4.7</td>
<td>4.2</td>
<td>0.3</td>
</tr>
<tr>
<td>1940</td>
<td>80</td>
<td>15.9</td>
<td>4.4</td>
<td>4.3</td>
<td>0.4</td>
</tr>
<tr>
<td>1941</td>
<td>18</td>
<td>15.8</td>
<td>3.6</td>
<td>4.5</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Opsonocytophagic test:* Ma, marked; Mo, moderate; Sl, slight; N, negative.

**Table 4: Average opsonocytophagic reaction for animals vaccinated 1935-1941**

were considered susceptible. The remaining 13 showed a high opsonocytophagic reaction possibly indicative of immunity. Seven of these thirteen animals were among those in a herd in which there was a severe outbreak of brucellosis in 1938,
and it is quite possible that they acquired a substantial degree of immunity without actually becoming clinically infected, since they have never shown either a suspicious or positive blood titer.

4. Positive animals which had become positive to the agglutination test following exposure to natural infection

Thirty-five reactors in recently infected herds were tested, and it was found that without exception all the animals showed high opsonic activity, with an average of over 80% marked cells.

Table 5.—Typical opsonocytophagic reactions in negative unvaccinated animals in accredited herds

<table>
<thead>
<tr>
<th>AGGLUTINATION TESTS</th>
<th>OPSONOCYTOPHAGIC TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ma*</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
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</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>


Opsonocytophagic tests: *Ma, marked; Mo, moderate; Sl, slight; N, negative.

INTRADERMIC VACCINATION

It is true that in calves the post-vaccination titer usually disappears within 10 months following vaccination, nevertheless, there are a number of vaccinated animals that fail to return to a negative status. In Maryland, five per cent of the vaccinated animals are still found to be positive 18 months after vaccination. The disposition of these animals is a vexing problem where the test and slaughter program is being conducted in conjunction with calfhood vaccination.

We have attacked this problem by attempting to modify the dosage and method of administration in such a way as to reduce the time required for the post-vaccination titer to disappear, but still to confer immunity.

The skin, rich in reticulo-endothelial tissue, appears to play an important part in the formation of antibodies and, therefore; is intimately concerned with immunity. For this reason the skin has been used by many workers as the site of injection of vaccines in preference to the subcutaneous or intramuscular routes.

The only record of Brucella vaccine being used intradermically was reported by Cotton, Buck and Smith in 1933. However, their work was based on an insufficient number of animals to be conclusive.
Our work on intradermic vaccination was begun on adult cows in heavily infected herds. The herds were divided into two groups. One group received 5 cc. of the vaccine subcutaneously and the other received 0.2 cc. of the same vaccine intradermically. This work will be reported in detail at a later date when exposure tests are completed, but for the purposes of the present paper one of the results will be mentioned. Animals vaccinated intradermically with 0.2 cc. of vaccine produced as high a titer as those vaccinated subcutaneously with 5 cc. of the same vaccine.

The other phase of our work on intradermic vaccination consists in a comparison of the height of titer and opsonocytophagic activity in calves vaccinated intradermically and those vaccinated subcutaneously.

Our experiment included 29 calves which were vaccinated intradermically with 0.2 cc. of vaccine in the caudal fold and 12 animals vaccinated subcutaneously with the usual 5 cc. dose. They were tested daily for 10 days and then monthly until the titers had completely disappeared. The tests included a white cell count, differential count, agglutination test, opsonocytophagic test and temperature readings. For the purpose of easier summarization only the results of the agglutination and opsonocytophagic tests are given at this time.

Sixty-nine calves, vaccinated subcutaneously, were tested at intervals for six months and also compared with the intradermic group. Two weeks following vaccination the agglutination titers and opsonocytophagic reactions were of equal height in all three groups. At the end of three months all intradermically vaccinated calves still showed a high opsonocytophagic reaction, but were completely negative to the agglutination test in all dilutions. In the subcutaneous group at the end of three months, although all the calves showed high opsonocytophagic reactions, there were still 50% showing a positive or suspicious titer.

SUMMARY AND CONCLUSIONS

I. Immunity tests

1. Before vaccination most calves show a low opsonocytophagic reaction, but within five days following vaccination the test indicates great opsonocytophagic activity. The agglutination titer appears to reach its peak about the ninth day after vaccination and begins to decline at once, but complete loss of titer does not occur for some months.

2. Some calves, usually coming from positive herds, show a high opsonocytophagic reaction before vaccination, possibly indicating that some immunity is present. This may account for animals which do not show any agglutination titer after vaccination.

3. The opsonocytophagic reaction of negative unvaccinated cows raised in accredited herds is very low.

4. Strain 19 Brucella abortus vaccine produces opsonins which are measurable four years after vaccination and the degree of the opsonocytophagic activity is about the same as that found immediately following vaccination. By the seventh year, however, the opsonocytophagic reaction is about the same as that of normal unvaccinated calves.
5. A high opsonocytophagic reaction is present in animals showing a positive agglutination test that originate in infected herds.

6. Controlled exposure tests on vaccinated and unvaccinated animals, showing both low and high opnonocytophagic reactions are needed to confirm the belief that a high reaction is indicative of immunity and a low one indicative of susceptibility.

7. The agglutination test is generally considered to be a measure of infection. While the work here presented is not conclusive and is being continued, it would seem to indicate that the opsonocytophagic test may be a measure of immunity. Should this be true, it would be an invaluable aid in Bang’s disease control work in determining susceptibility or resistance in individuals or in herds.

II. Intradermic vaccination

1. Cows vaccinated intradermically with 0.2 cc. Strain 19 vaccine showed as high an agglutination titer as cows given 5 cc. subcutaneously.

2. The agglutinin and opsonin response in calves vaccinated intradermically with 0.2 cc. of the vaccine was equal to those vaccinated subcutaneously with 5 cc.

3. At the end of three months the calves vaccinated intradermically were completely negative, whereas 50% of those vaccinated subcutaneously still showed positive or suspicious titers.

4. While there is nothing conclusive about this information, it does indicate that intradermic vaccination probably produced a substantial degree of immunity, as shown by a high opsonic reaction, together with a high agglutination titer which disappears within three months after vaccination. How solid this immunity will be, only future exposure to infection will tell.

REFERENCES


UNDULANT FEVER IN IOWA

BY CARL F. JORDAN, M.D., M.P.H.

Director, Division of Preventable Diseases and Epidemiologist, Iowa State Department of Health, Des Moines, Iowa

FIRST CASE IN IOWA

Some years ago, an Iowa butter maker, age 49, complained of fever, profuse sweats, severe headache, chills, pain between the shoulders and back of head and neck. He went to see his doctor. The attending physician listened to the patient's story and made a thorough physical examination. The doctor had recently attended a medical meeting in Chicago where he heard a discussion of undulant or Malta fever, a condition then little known in America. Confident that his patient was suffering from no other disease, the attending physician, L. R. Woodward, M.D., of Mason City, made a clinical diagnosis of undulant fever, the first case of its kind to be reported in Iowa (1). This was in December, 1926.

To make sure of the nature of the disease, Dr. Woodward sent a blood specimen to the state laboratory. The agglutination test, which proved positive, was carried out by A. V. Hardy, M.D. (2), then Acting-Director of the State Hygienic Laboratory; positive agglutination was confirmed by the National Institute of Health of the United States Public Health Service, Washington, D. C.

REPORTED PREVALENCE

After accurate diagnosis of the first case, many additional cases of undulant fever were recognized during subsequent years. In 1929, Walter L. Bierring, M.D. (3), for the past ten years Health Commissioner, Iowa State Department of Health, presented a clinical analysis of 150 cases which were reported in 1927, 1928 and the first six months of 1929.

During the 16 year period 1926-1941, there were notified officially in Iowa 2229 cases of undulant fever. For the period 1930-1941, cases in Iowa numbered 1883, an average annual rate of 6.25 per 100,000 population. During the same 12 year period, the 48 states reported 29,596 cases, an average annual rate of 1.87 per 100,000.

SYMPTOMS

Case records, completed by Iowa physicians and returned to the State Department of Health, mention symptoms of which the patients complain. In a series of 1011 undulant fever case reports covering the 7-year period, 1935-1941, the ten chief symptoms, listed in the order of their frequency of occurrence were: fever, chills, sweating, weakness, malaise, headache, muscle or joint pains, backache, loss of appetite and loss of weight. Other symptoms included cough, abdominal discomfort, irritability, dizziness, diarrhea.
METHODS OF SPREAD FROM ANIMALS TO MAN

Brucellosis, caused by bovine, porcine or caprine strains of brucella, is transmissible from animals to man. Cows and hogs are the usual sources of undulant fever in Iowa, apparently also in many other states. Although goats were found to be the source of undulant (Malta) fever in the Mediterranean region, in Texas and other southwestern states, these animals have not thus far been incriminated as the source of endemic human infection in Iowa.

People usually acquire the disease 1) as the result of direct contact with infected animals or 2) following the use of raw dairy products from infected dairy cows. When the disease is due to contact with infected animals or their tissues, the germ gains entrance to the human body through the skin.

Persons who live on farms are more subject to undulant fever than those who live in cities. On farms, the disease affects more male workers than females due to the fact that men on the farm come in contact with hogs and cows to a much greater extent than do women.

Urban residents, with the notable exception of packing house workers, have little or no occasion for direct contact with infected animals. Undulant fever acquired in city or town is due, as a rule, to the use of raw milk, cream and butter, from dairy cows infected with Bang's disease.

EPIDEMIOLOGIC FACTORS

Age and sex

Analysis has been made of the age and sex of 1148 undulant fever patients, reported to the Iowa State Department of Health during the period 1933–1941. Distribution of the cases according to age and sex is shown in table 1.

It is of interest to note that in the first decade of life, females suffer from this disease quite as frequently as males; this statement applies also to people 70 years of age and over. In all probability use of raw dairy products from infected dairy cows accounts for a high percentage of the cases which occur in the extremes of life. When persons are exposed to contaminated raw dairy products and give no
UNDULANT FEVER IN IOWA

history of direct contact with animals, males and females are equally susceptible to undulant fever.

The preponderance of cases among males of teen-age and throughout the decades of active adult life, emphasizes the major part played by direct contact in accounting for the difference in attack rate in the two sexes. Among undulant fever patients of all ages, as noted in table 1, nearly 80 percent were males, a little over 20 percent females.

Seasonal prevalence

Table 2, based on a series of 1043 cases of brucellosis of man or undulant fever as reported in Iowa for the 13-year period 1930–1942, shows the time of onset of illness according to months of the year:

Undulant fever occurs throughout the year; it is evident however, that more patients develop first symptoms of illness in June, July and August than in any other three-month period of the year. As noted in the above table, 61 percent of the patients began to complain during the 6-month period from April through September, compared with 39 percent for the months from October through March.

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NO. OF CASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>52</td>
</tr>
<tr>
<td>February</td>
<td>65</td>
</tr>
<tr>
<td>March</td>
<td>66</td>
</tr>
<tr>
<td>April</td>
<td>77</td>
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<tr>
<td>May</td>
<td>99</td>
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<td>June</td>
<td>114</td>
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<td>July</td>
<td>132</td>
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<td>August</td>
<td>130</td>
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<tr>
<td>September</td>
<td>89</td>
</tr>
<tr>
<td>October</td>
<td>78</td>
</tr>
<tr>
<td>November</td>
<td>77</td>
</tr>
<tr>
<td>December</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>1043</td>
</tr>
</tbody>
</table>

Role of occupation, contact and raw milk

Conclusions with reference to the probable part played by contact and by raw dairy products in the spread of undulant fever may be drawn from table 3.

Attention is directed to column seven at the extreme right of the table, which shows the calculated average annual morbidity rate per 100,000 population in various occupational groups. It will be noted that the hazard of exposure to brucella infection is greatest in the group of packing house employees, second greatest among male farm workers, with a far smaller relative hazard among children, housewives and merchant professional groups.

Among 118 packing house workers who acquired undulant fever during the 6-year period 1936–1941 (see table 3), 98 percent gave the history of direct contact
with live stock; only 20 percent of this group used raw dairy products during the period preceding onset of illness. The importance of brucella infection of swine in packing houses is emphasized in a study reported by McNutt (4), who tested 1547 hogs by the rapid agglutination method and reported that 3 percent of all animals slaughtered showed a positive agglutination reaction of 1:25 or above and 2.3 percent in titers of 1:50 or higher. McNutt succeeded in isolating the porcine species of brucella (Brucella suis) from 41 percent of 34 reacting animals, organs of which were cultured bacteriologically.

Four Veterinarians of Iowa were reported as having undulant fever during the 5-year period 1936-1940. Whether infection was caused by brucella of bovine or of porcine type, is not known.

Table 3.—Information regarding direct contact, dairy products and morbidity rates in relation to occupation

<table>
<thead>
<tr>
<th>OCCUPATION</th>
<th>AREA</th>
<th>PERCENT CONTACT WITH LIVESTOCK</th>
<th>PERCENT USING RAW MILK</th>
<th>CASES, 1936-1941</th>
<th>POPULATION IN GROUP</th>
<th>ANNUAL RATE PER 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td>Rural</td>
<td>60</td>
<td>85</td>
<td>47</td>
<td>1,454,037</td>
<td>0.5</td>
</tr>
<tr>
<td>Farm wife</td>
<td>Rural</td>
<td>40</td>
<td>100</td>
<td>81</td>
<td>1,454,037</td>
<td>0.9</td>
</tr>
<tr>
<td>Farm worker (male)</td>
<td>Rural</td>
<td>100</td>
<td>100</td>
<td>320</td>
<td>311,776</td>
<td>17.1</td>
</tr>
<tr>
<td>Child and teen age</td>
<td>Urban</td>
<td>23</td>
<td>77</td>
<td>26</td>
<td>1,084,231</td>
<td>0.4</td>
</tr>
<tr>
<td>Housewife</td>
<td>Urban</td>
<td>3</td>
<td>92</td>
<td>36</td>
<td>1,084,231</td>
<td>0.6</td>
</tr>
<tr>
<td>Merchant prof.</td>
<td>Urban</td>
<td>25</td>
<td>84</td>
<td>154</td>
<td>1,621,500</td>
<td>1.6</td>
</tr>
<tr>
<td>Packing house worker</td>
<td>Urban</td>
<td>98</td>
<td>20</td>
<td>118</td>
<td>15,000</td>
<td>131.1</td>
</tr>
<tr>
<td>Total</td>
<td>Urban</td>
<td></td>
<td></td>
<td>782</td>
<td>2,538,263</td>
<td>5.1</td>
</tr>
</tbody>
</table>

BOVINE AND PORCINE SPECIES OF BRUCELLA IN IOWA

Throughout the 16 year period during which undulant fever cases have been reported in Iowa, all blood cultures of patients have been studied under personal direction of I. H. Borts, M.D., Associate Director, State Hygienic Laboratory. Among 205 brucella strains isolated in Iowa during the 15-year period 1927-1941: 147 (71.7%) were porcine (Brucella suis), 57 (27.8%) were bovine (Brucella abortus), and 1 (0.5%) was caprine (Brucella melitensis).

UNDULANT FEVER USUALLY SPORADIC

Undulant fever resulting from direct contact, whether with infected hogs or cows, is usually of sporadic nature. It is not anticipated that more than a few cases will be reported from an entire county during the course of a year. In the aggregate, cases of the disease resulting from contact probably exceed in number those traceable to contaminated dairy products. Undulant fever of milk-borne character is apt to be of sporadic occurrence whenever the bovine type of brucella (Brucella abortus) is the causative organism.
MILK-BORNE EPIDEMICS OF BRUCELLOSIS IN IOWA

Unlike the bovine strain of brucella, when the porcine species (Brucella suis) gains access to the udder of one or more dairy cows to contaminate a raw milk supply, an epidemic of undulant fever may be fully expected. This is apparently due to the fact that Brucella suis is more virulent and more invasive than Brucella abortus. Two milk-borne epidemics of brucellosis caused by the porcine type of brucella have occurred in Iowa in past years. The first outbreak in Council Bluffs, Pottawattamie County, comprised 30 known cases of human illness (5), while the second epidemic occurred in Marcus, Cherokee County, during the late months of 1941 (6).

In the Marcus outbreak, 77 persons, children and adults, gave strongly positive agglutination tests for brucellosis or undulant fever.* Brucella was isolated from the blood of 14 patients. The disease was mild in some, severe in other instances; subclinical, asymptomatic infection was also observed (6, 7). Nearly all of the patients lived in town, with no opportunity for direct contact with farm animals. However, all shared a common factor in use of milk or cream from the W-H dairy which supplied about 60 families and was one of four producers of raw milk in the community. All blood cultures from patients yielded Brucella of porcine type. Brucella suis was isolated from the cream of several dairy cows which reacted to the test for Bang's disease. Of 24 sows that had been allowed to occupy the same lot with dairy cows, 10 showed positive and 3, suspicious reactions in the agglutination test.

COOPERATIVE CONTROL MEASURES

For several years following report of the first case of undulant fever in Iowa, special effort was made through field investigation and experimental studies to throw light on the epidemiology of the disease and to establish the source of infection. This work was carried out under direction of A. V. Hardy, M.D., with financial aid from the United States Public Health Service. During those years, Charles Murray, D.V.M., then Professor of Veterinary Research at Iowa State College, made possible the discovery of infected animal sources by giving time and effort to supervision of agglutination tests on blood specimens from cows and hogs involved in cases of brucellosis of man.

In recent years significant data pertaining to sources of infection have been gathered through cooperation between the Iowa State Department of Health, the Federal Bureau of Animal Industry and the State Department of Agriculture. Acknowledgement is made in particular of the important part which J. A. Barger, D.V.M., Inspector in Charge of the Bureau of Animal Industry, and C. C. Franks, D.V.M., State Veterinarian, have taken in this activity. During 1941 and the first 10 months of 1942, agglutination tests were carried out on serum specimens of 117 herds of cows and hogs suspected as the probable source of infection of undulant fever cases.

* Skin tests with brucellergen were performed on a group of 266 persons in the community. Brucellergen, made separately from Brucella abortus and Brucella suis, was furnished through the courtesy of I. Forest Huddleson, D.V.M., Ph.D., Research Professor in Bacteriology, Michigan State College.
The plan works as follows: An excerpt of each undulant fever case and a request for examination of livestock signed by the owner or dairyman, are forwarded to the offices of the Bureau of Animal Industry and the State Department of Agriculture. An assistant state veterinarian or private practitioner is authorized to collect blood specimens from cows and brood sows on farms, or from a herd of dairy cows. All specimens are forwarded for agglutination tests to the Veterinary Laboratory of Iowa State College.

A few instances may be cited of the findings which result. An Iowa farmer, A. C., 49 years old, (Case Report No. 14) developed undulant fever early in 1942. Agglutination tests revealed no reactors among 16 cows; however, 5 of 17 sows were tested at the same time, three showing positive and two, negative reactions. In another county, J. C. (Case No. 28) a farm boy of 17, acquired the disease. In April 1942, of 34 cows tested on the farm concerned, 23 passed the test, 9 showed positive and two, incomplete reactions to the agglutination test. Four sows were tested but all were negative. On another farm W.R., 47, and a son, age 16 (Case reports Nos. 155 and 156) became ill at about the same time. Both patients had handled pigs of aborting sows prior to onset of symptoms; both proved to have undulant fever. Sixteen cows on this farm passed the agglutination test but 3 sows showed a positive and a fourth a suspicious reaction.

CONCLUSIONS

1. Careful pasteurization of all dairy products is an essential safeguard against milk-borne brucellosis of man or undulant fever.
2. Since contact with infected animals evidently accounts for most of the cases of undulant fever on farms and for practically all of the cases among packing house workers, special precautions need to be exercised to reduce the hazard of direct contact to a minimum.
3. Discovery of sources of human infection are successful in a high percentage of instances when agglutination testing of farm animals includes brood sows as well as dairy cows.
4. Hogs must not be permitted to run on the same lot with dairy cows.
5. Further reduction in the prevalence of brucella infection as a hazard to human health necessitates a continuing program and effective measures for the eradication of infectious abortion in farm animals.
6. Carrying out of control and preventive measures against brucellosis is dependent upon financial support of federal and state agencies and upon unwavering interest of members of the veterinary medical profession.

REFERENCES


THE CONTROL OF BANG'S DISEASE IN RELATION TO THE
CONSERVATION OF MEAT AND DAIRY PRODUCTS

By H. R. Smith

General Manager, National Live Stock Loss Prevention Board, Chicago, Illinois

Our educational work for the live stock markets and related industries during the past twenty-six years has been largely confined to the elimination of hidden losses—those not observable until after slaughter. Under this classification are the losses from such diseases as tuberculosis, condemnations for pericarditis, beef liver condemnations, nodular disease in sheep, and injuries from bruising. We are also endeavoring to reduce losses in transit on deads and cripples and hide damage by warbles. In other words, we are engaged in the elimination of waste in meat and byproducts which we hope will benefit the entire live stock industry.

We have given less attention to brucellosis, commonly called Bang's disease, because all who have it in their cattle are in a position to see for themselves the heavy losses that occur from premature births, lower milk production, and often sterility. This obvious and direct loss to farmers and ranchmen, great as it is, in my opinion requires less educational work for active cooperation among producers than the hidden and indirect losses. I do not wish to infer that educational work is not needed in the control of bovine brucellosis, but this will explain why the National Live Stock Loss Prevention Board has not been an active participant.

Now we are at war and there is the greatest possible need of conserving meat and dairy products as well as increased production to supply the absolute needs of our rapidly growing armed forces—each man with 18 oz. of meat per day or nearly three times average consumption; some to our allies, to our civilians and more liberally, if available, to those engaged in heavy work such as manufacturing war equipment. The need for more meat and dairy products was never greater. How fortunate that tuberculosis in cattle and hogs, which twenty-five years ago caused such a great loss to the nation, is today a minor loss, thanks to the support of legislative bodies and to the efforts of veterinarians, producers and other cooperating groups.

In more recent years, great progress has been made, and is continuing, in the control of bovine brucellosis, perhaps equal in its economic importance and likewise a menace to public health. The test and slaughter method, when we had less demand for meat and dairy products, was entirely logical and the only means available then, but now when the need for more meat and dairy products is so great, will it not be possible to make still greater use of the immunization method to save from slaughter the more valuable animals that they may continue as food producers with proper supervision, if the milk can be pasteurized? No one can deny that in sending to slaughter commonplace reacting dairy cattle, to be replaced by healthy individuals, the gains in milk production, greater regularity in breeding and the removal of centers of contagion, much more than offset a small slaughter sacrifice. But if there is some way to lessen the waste of good breeding
tattle still going on though to much less extent than formerly, without postponing too long the eventual eradication of the disease, it will help in this emergency. It seems to me the answer is the much more general use of Brucella abortus vaccine strain 19, developed by the United States Bureau of Animal Industry and standardized to a degree that is giving excellent results in many states. What a pity that our good friend the late Dr. John M. Buck who worked so diligently to develop this vaccine could not have lived to see it used so successfully in many states. Here is something that should lessen the slaughtering of good producers to make brucellosis control a still greater conservation project.

Calf vaccination is now extensively undertaken in California, New York, Vermont, and a good start has been made in Michigan, Illinois, Washington, Louisiana, Maryland and other states.

During the last half of October and nearly all of November, I visited a number of feed lots and ranches in California observing cattle feeding methods to learn, if possible, why three times as many beef livers are condemned for abscess in California and other western states than elsewhere in this country. Incidentally, I had the pleasure of observing the excellent progress being made in California in the control of brucellosis by the immunization method. There has been full justification for this program in California even before the war.

As you know, California was later than the other states in undertaking the eradication of tuberculosis in cattle. Preceding 1930, it was thought to be illegal to pay state indemnity. Then the State Supreme Court rendered a decision that it was legal.

There was such a heavy infection of tuberculosis in the dairy herds of California and the opposition of the Portuguese farmers was so strong that the work was delayed considerably. Five years ago, upon the invitation of the State Department of Agriculture, I attended a hearing before a joint session of the California Legislature in behalf of a bill providing for an appropriation of $2,500,000 for tuberculosis eradication. The bill was passed but Governor Olson cut out $1,000,000. There were approximately 100 Portuguese dairy farmers in attendance to oppose this measure and it gave me firsthand information as to the antagonism of these people. Therefore, when other states were over the top in the eradication of tuberculosis and were undertaking the elimination of brucellosis on an extensive scale, California was still in the midst of tuberculosis eradication.

The slaughter of reactors in California was so large that it was not thought advisable to adopt the test and slaughter program in brucellosis control because of the great need of more dairy cattle in that state. As you all know, California has been importing dairy cattle from other states for many years. There are approximately 100,000,000 acres of land in California, but only 22,000,000 of these are suitable for food production, and of this, 5,000,000 acres are under irrigation. California has many large centers of population and more milk is needed than can be supplied by dairy cattle produced in that state.

Dr. L. M. Hurt informed me that there are approximately 3,000,000 people in Los Angeles County and this county imported during the fiscal year ended June 30, 1942—38,022 dairy cattle to meet fluid milk requirements. For obvious reasons these must be cows much above average production.
At Los Angeles I visited the certified dairy of the Adohr Milk Farms Company, said to be the largest purebred herd of Guernsey cattle in the country. I have never seen before so many fine looking cows on one farm. You will recall that its manager, Dr. Maynard Rosenberger at the December 1940 meeting of the U. S. Live Stock Sanitary Association described results from the use of strain 19 vaccine in his certified and raw milk herds of over 2,000 head. He predicted then that the gradual addition of vaccinated heifers would stop the spread of brucellosis. I was informed at the dairy that this is now an accomplished fact.

The California State Division of Animal Industry cooperates with cattle owners who agree to follow one of the following four methods:

1. Immediate disposal of positive animals.
2. Segregation of positive animals on the premises.
3. Disposal or segregation of positive animals and vaccination of calves.
4. Segregation of offspring.

All of the above methods are contingent on the employment of a veterinarian to supervise the herd. Blood samples collected by him are tested free by the State.

I was informed by University veterinarians that a large number of so-called experimental herds are being operated in cooperation with the University under methods not included in the above list. In general, the experimental herds are of two kinds.

a—Herd proved to be free of brucellosis where calfhood vaccination is used as an insurance against loss from possible introduction of the disease.

b—Infected herds in which no reactors are being removed or even segregated and in which the adult non-pregnant cows as well as calves have been vaccinated in order to quickly stop losses from abortion.

Dr. Rosenberger has reported to this association success of this latter method in his segregated infected herd. I visited several herds of this type and the owners and veterinarians in charge expressed satisfaction.

An outstanding example of the complete eradication through a combination of adult heifer and calfhood vaccination is the San Quentin Prison dairy where strain 19 was used on 17 unbred heifers between twelve and thirty-two months of age. This herd of fifty cows, although badly infected at the time, is now free from brucella infection. According to Drs. Haring and Traum, if the vaccinations had been limited to the calves between four and eight months of age, a relatively large group of highly susceptible older heifers would have been left unvaccinated. It seems obvious that failure to vaccinate the older heifers would have delayed the eradication. Under the circumstances it might even have resulted in complete failure of the project.

I visited this prison dairy where the reactors have been allowed to remain in the herd and no segregation was practiced. The milk, of course, is pasteurized. I was told that by 1939 brucella infection had completely disappeared from the herd by (1) the addition of mature healthy vaccinated heifers, and by (2) the gradual elimination of reacting cows as they became sterile or otherwise unproductive.

The herd is under the supervision of University of California veterinarians and in order to determine if it would be safe to stop vaccination, all heifer calves born between February 1938 and February 1941 were left unvaccinated. Thirty-two of these have now matured and are in the milking strings with the vaccinated ani-
I was told that none has shown even a suspicious reaction to the agglutination test. Calfhood vaccination was resumed because University of California veterinarians now recommend calfhood vaccination even in herds that are free from infection. During the nine years that this experiment has been in progress at San Quentin, the average milk and butterfat production per cow has increased 30 and 21 per cent respectively. This increase is attributed in part at least to the brucellosis control program.

Under the direction of Dr. K. G. McKay, University Agricultural Extension Service Veterinarian, considerable progress is being made in preventing the misuse of strain 19 vaccine. In the past, peddlers traveled from farm to farm carrying the vaccine without refrigeration and, unfortunately, induced some farmers to buy and use such products, often with disappointing results. Under the leadership of Dr. McKay voluntary projects are now under way in twenty important dairy counties whereby the local representative of the Extension Service arranges with farmers throughout the county to have the calves of the proper age corralled and ready for vaccination at a given date. The county veterinarian selects the brand of vaccine to be used and a sample is tested at the University to determine if it is still up to the Bureau of Animal Industry standard. Local veterinary practitioners are assigned to respective areas and are able to treat a large number of calves in a short time. The farmers are assured of a reliable product properly administered and the combined cost of vaccine and veterinary service is approximately the drug store or peddler price to the farmer of the vaccine alone. I talked with many veterinary practitioners, farm advisers and also with farmers in the San Joaquin Valley. All expressed full approval and want the project continued.

In discussing the California situation, Dr. Haring said: "For several years I have advised dairymen who are fortunate enough to own herds that are free from brucella infection, to use calfhood vaccination in order to build up resistant herds. In no instance have I had reason to regret such advice. On the other hand, had I refrained from giving such opinions, I would now be on the spot for neglecting to tell how they might have insured against loss from the disease."

With respect to the vaccination of adult cattle, Dr. Tramm said: "Under the conditions existing at present in California where the test-and-slaughter method is not being generally followed, there seems to be no good reason for a veterinarian to refuse to extend the vaccination program in badly infected herds to include non-reacting, non-pregnant cows. No apparent good has been observed in vaccinating reacting cows."

Dr. C. U. Duckworth, State Veterinarian, advised me that he is satisfied with the vaccination program in controlling Bang's disease as it is being carried out in California. He stated: "In the light of developments, I have no reason to regret the stand that I took before the U. S. Live Stock Sanitary Association in 1937 when I said that California in all probability would not adopt a test and slaughter program, but would instead concentrate its efforts in handling the disease by vaccination."

Because of the wide-spread high incidence of bovine brucellosis in California, the use of strain 19 vaccine is said to be entirely justifiable. In states where the dairy herds are smaller, the individual value of milk cows lower, where pasteurization is not generally required, and the shortage of dairy products not alarming, a con-
tinuation of programs of blood test and slaughter with federal and state indemnity for reactors is no doubt advisable.

It would be presumptuous for me to suggest what plan should be followed in the various states. You who are in charge know what the conditions are and what plan is best under existing conditions. I have stated as briefly as possible the experiences of California veterinarians and dairymen with the immunization method for what it may be worth to others.

As a timely procedure in the war effort, strain 19 vaccine is playing an important conservation role in many sections of this country. Approval of its use appears to be growing in veterinary and public health circles as well as by dairymen and beef cattle owners who have experienced the benefits of its use. It is certainly a means of conserving meat and dairy products which we all realize is so essential in this emergency.

In anticipation of the question being raised as to why the need of this conservation of dairy cattle, when we read of many auction sales of dairy cattle in Wisconsin, Michigan and other states where it is said labor conditions on farms have made this necessary. The facts are that most of these cattle sold have gone to other farms where more labor is available. I have written to some of the more important cow markets to get information as to the receipts of dairy cattle in the past four months as compared with previously. All of this information including Chicago records shows that the slaughter of dairy cows has not been out of proportion with increased production.

Mr. C. F. Topping, president of the St. Paul Stock Yards Company writes under date of November 30, 1942: "... we do not believe that there has been any great influx of cows fit for dairy purposes to be slaughtered. In other words, it is our belief that while the labor shortage may have an effect on milk production, yet there hasn't been any great evidence on our market of slaughter marketing of cows that should be kept for dairy purposes."

Mr. J. E. McGillivray, president of the Milwaukee Stock Yards Company writes under date of November 27, 1942: "Most observers point to the increasing number of farm auctions as evidence of liquidation due to labor shortage. We believe that this is being overemphasized, and that the most important factor having to do with overemphasis is the fact that most of these auctions are being handled by auction companies and are being given wide publicity by means of flyers, newspaper advertisements and radio."

Mr. Otto V. Moesch of the Buffalo Stock Yards Company, writes; under date of November 27, 1942: "Judging by our receipts of truck cattle, a large portion of which are cows from New York State, our figures show less receipts for the past four months as compared with a similar period in 1941."

This is a fortunate situation. In my opinion, every effort should be made to conserve breeding and dairy cattle in the brucellosis program not only because of present needs but because of the probably continuance of these needs after the war. You will recall that Dr. Mingle in his statement yesterday told about the destruction of breeding and dairy herds in Europe and the probable dependence upon us for food products long after the war. It is not unreasonable to anticipate we may even be called upon to furnish Europe with breeding stock for rehabilitation.
REPORT OF COOPERATIVE BOVINE BRUCELLOSIS WORK IN THE UNITED STATES

By A. E. Wight

Principal Veterinarian In Charge, Tuberculosis Eradication Division, United States Bureau of Animal Industry, Washington, D. C.

At the 1940 and 1941 meetings of this Association the report on the cooperative bovine brucellosis work in the United States was contained in a paper presented on each occasion by Dr. John R. Mohler, Chief of the Bureau of Animal Industry, and it included a section on calfhood vaccination. This year it is my privilege to present a similar report. Due to many unusual conditions brought about by the war, there has been a considerable reduction in the volume of the work in connection with activities in brucellosis among cattle. The most outstanding interference was caused by the reduction in the number of veterinarians because so many of them have joined the armed forces.

CONTINUED TESTING; MORE ACCREDITED COUNTIES

During the fiscal year ended June 30, 1942, blood agglutination tests for brucellosis, many of which were retests, were applied to approximately 6,891,000 cattle, located in about 592,000 herds. The tests disclosed about 209,000 reactors, or 3 percent of the total cattle tested. This percentage is 0.6 of 1 percent higher than reported the previous fiscal year, but the increase is accounted for by the large number of tests made in localities where the degree of infection was very high and where reactors are being retained in the herds and calfhood vaccination is being taken up. Otherwise the percentage of infection would have been about the same as in the previous year. During the fiscal year 1942 approximately 39,600 reacting cattle were retained in herds where calfhood vaccination is being conducted under the deferred slaughter plan without indemnity. About one half of the testing was conducted in connection with the circumscribed area work, which provides for the testing of all dairy and breeding cattle 6 months of age or over under State laws and regulations, and the remainder was carried on under the voluntary individual-herd plan. The number of tests, now averaging approximately 425,000 a month, is about two-thirds the number of tests conducted monthly by the cooperating forces one year ago.

There are now 560 counties, in 24 States, in the modified accredited Bang's disease-free area, as provided for in regulations adopted by this Association in 1939 and approved by the United States Bureau of Animal Industry the same year. Since our meeting last year, 114 counties have been so classified. These are located in 21 States. In the 560 modified accredited counties, there are approximately 5,173,000 dairy and breeding cattle over 6 months of age. All the counties in North Carolina are now in the modified accredited Bang's disease-free area, and I wish to congratulate the cattle owners, officials, and all others who assisted in the great accomplishment in that State. Work is being conducted on an area
basis in about 140 additional counties in States already having modified counties and in 10 counties in a State which has none accredited.

Since December 1, 1941, a sufficient number of retests of herds of cattle in modified accredited areas were conducted in 24 counties to reaccredit them for a period of 3 years. The results of retests in these areas indicate that the disease is well under control and a very low degree of infection remains. A considerable number of cattle reacting to the test are in previously negative herds, but in most of these cases there is a history indicating that cattle have been added.

**ACCREDITED HERDS**

In almost all the States there are some individual herds of cattle that have been certified by the State officials as being free from brucellosis. On November 1, 1942, there were 78,494 accredited herds, containing approximately 1,634,000 cattle, located in 42 States. This is a very good increase over the number of herds reported to be in that status one year ago.

There are now approximately 15,775,000 cattle, contained in about 2,141,700 herds, under supervision in the cooperative brucellosis project. Reports received from field stations show that the owners of large numbers of cattle have indicated that they wish their herds placed under official supervision. There would be an opportunity to conduct work on an area basis in many counties located in various parts of the United States if it were possible to obtain the services of a sufficient number of qualified veterinarians.

**INCIDENCE OF THE DISEASE**

It is estimated that the approximate extent of brucellosis among dairy and breeding cattle 6 months of age and over in this country is about 5 percent, which is higher than is shown by the results of official testing because the 5 percent figure includes many cattle in areas where little or no brucellosis eradication work has been done. Further, the lower percentage previously mentioned, namely, 3 percent, for all testing for the year includes a considerable number of retests. It will be recalled that in 1934 the estimated incidence of brucellosis in cattle was 10 percent.

On the map of the United States which will accompany this paper in the official report, it will be noted that there are 2,423 counties, or more than two-thirds of the total of 3,070 counties, in which the incidence of brucellosis in cattle is estimated to be not more than 6 percent. Of this number the degree of infection does not exceed 2 percent in 1,361 counties. The map plainly indicates the approximate degree of infection of brucellosis in cattle in the various States of the United States, and it can be appreciated that the handling of the disease will necessarily vary in different parts of the country. It is of special interest to note the wide distribution of the counties that are in the modified accredited status.

**FINANCING THE PROGRAM**

State funds available for indemnity in this work during the past year amounted to about $3,000,000, and Federal funds for the same purpose were about $2,340,000. The average appraisal of cattle slaughtered for brucellosis during that period was
$99.19; average salvage, $52.06; average Federal indemnity, $15.83; and average State indemnity, $17.71. The average loss to the farmer was $13.59. Of the reactors slaughtered, 9 percent were registered purebred cattle. There is now a provision for indemnity payments in this work in all States except California, Colorado, Indiana, Massachusetts, Nevada, Oklahoma, and Texas. Provision for indemnity payments has also been made in Puerto Rico. The combined Federal and State operating expenses for the last fiscal year amounted to approximately $3,000,000, about two-thirds of this amount being provided by the Federal Government.

EDUCATIONAL LITERATURE HELPFUL

Much assistance is rendered to the program of handling brucellosis in livestock through the publication of reliable information in the form of press articles, especially those that reach the people engaged in agriculture. The State officials in charge of this work have literature on the subject available, and the Federal Government has distributed large numbers of copies of Farmers' Bulletin No. 1871, which covers the subject of brucellosis in cattle. The 1942 Yearbook of the Department of Agriculture entitled "Keeping Livestock Healthy" contains timely information on brucellosis.

The Department has also made available a film strip which may be used in connection with discussions on this subject. Copies can be obtained for a very small sum on application through the inspector in charge of this work for the Bureau of Animal Industry or through the county agricultural agents. Distribution of the film strip is handled by a commercial contractor, designated by the Department. Radio talks including reference to the proper handling of cattle so that they will be free from this disease, have also been helpful in the advancement of the work.

USE OF CALFHOOD VACCINATION

Since January 1, 1941, about 200,000 calves have been vaccinated against brucellosis in 45 States under the official cooperative plan. This is an increase of 127,500 over the number of calves that had been vaccinated up to the first of January of this year. The largest number in any one month thus far were vaccinated in October of this year, the total being about 17,000.

As indicated in the paper presented here last year on this subject, the plans are often referred to as B and C. These projects provide for the vaccination of all calves between the ages of 4 and 8 months when they are to become adult cattle. Under plan B, the nonvaccinated reactors are removed for slaughter in the usual manner and the owner receives indemnity for them. Under plan C, the nonvaccinated reactors are retained in the herd for an indefinite period and the owner does not receive indemnity for those reactors. There are about 23,000 herds under both plans. About the same number of herd owners are operating under each of the plans but the number of calves vaccinated under plan C is about 20 percent more than under plan B.

The Bureau has emphasized the proper handling of the Brucella abortus vaccine by veterinarians in the field in order that it may retain its proper potency. Veterinarians are instructed to be very careful not to allow the temperature of this material to exceed 45°F. or to go below 35°F. After very careful review of the re-
sults obtained in the field work in connection with calfhood vaccination, it was
decided on November 16, 1942, by the Bureau of Animal Industry to discontinue
the practice of requiring the testing of the calves to be vaccinated. This will, of
course, reduce work and travel. All the _Brucella_ vaccine prepared by commercial
concerns is tested at the Animal Disease Station at Beltsville, Maryland, and it is
not released for use unless it passes the required test. One-dose bottles are used
exclusively in handling this product.

**REPORT ON THE CALFHOOD VACCINATION STUDY UNDER FIELD CONDITIONS**

The study of calfhood vaccination under field conditions was taken up in Jan-
uary 1936 and continued until January 1, 1942. Reports of results were presented
to this Association in 1940 and 1941. At the beginning of the study, there were
260 herds consisting of 18,912 cattle, located in 24 States. Of these cattle, 11,788,
or 62.4 percent, were negative to the blood agglutination test; 1,593, or 8.4 percent,
were suspicious, and 5,531, or 29.2 percent, positive, at the first test in these herds.

When the field study ended last January, 241 of the 260 herds were still operating

| Table 1 |
|-----------------|-------|
| Total number of calvings | 3,328 |
| Normal calvings | 3,252 | 97.8 |
| Negative to post-calving test | 2,956 | 91. |
| Positive to post-calving test | 108 | 3.3 |
| Suspicious to post-calving test | 188 | 5.7 |
| Abortions | 76 | 2.2 |
| Aborters negative to test | 59 | 77.7 |
| Aborters positive to test | 9 | 11.8 |
| Aborters suspicious to test | 8 | 10.5 |

under the plan. There were 718, or 12.9 percent, of the original reactors and 189,
or 11.8 percent, of the original suspects remaining in these herds at that time.
During the latter part of the calendar year 1941 when the last test of these herds
was conducted in connection with the study, there were 343 of the positive non-
vaccinated animals in the original test that were found negative, and 1,284 of the
nonvaccinated negative animals on the original test were still negative. During
the calendar year 1941, 199 cows that were nonvaccinated and held in the herds
since January 1936, had aborted.

There were 17,327 animals vaccinated as calves that were still in these herds,
but the total number vaccinated since January 1936 was 21,005. This is explained
by the fact that some of the vaccinated animals had been dispose of for various
reasons.

**TOTAL OF THE NINE SEMIANNUAL REPORTS OVER THE ENTIRE PERIOD JANUARY 1, 1936, TO JANUARY 1, 1942**

Among the cattle vaccinated as calves up to January 1, 1942, 17,608 calvings
occurred, involving 6 pregnancies. Of these 9,526 were first calvings; 4,993 were
**TABLE 2.—Tabulation by calvings.**

<table>
<thead>
<tr>
<th>Calving</th>
<th>Total</th>
<th>Normal Calvings</th>
<th>Negative to Post-Calving Test</th>
<th>Positive to Post-Calving Test</th>
<th>Suspicious to Post-Calving Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First calving</strong></td>
<td>1,242</td>
<td>1,218</td>
<td>1,094</td>
<td>50</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>98.1%</td>
<td>89.8%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Abortions</td>
<td>24</td>
<td>20</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.9%</td>
<td>83.4%</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second calving</strong></td>
<td>926</td>
<td>897</td>
<td>841</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>96.9%</td>
<td>93.8%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Abortions</td>
<td>29</td>
<td>23</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.1%</td>
<td>79.3%</td>
<td>6.9%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Third calving</strong></td>
<td>742</td>
<td>731</td>
<td>657</td>
<td>23</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>98.5%</td>
<td>89.9%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Abortions</td>
<td>11</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5%</td>
<td>90.9%</td>
<td>9.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fourth calving</strong></td>
<td>334</td>
<td>327</td>
<td>296</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>97.9%</td>
<td>90.5%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Abortions</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.1%</td>
<td>28.6%</td>
<td>42.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fifth and sixth calvings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There were 80 cows that produced their fifth calf during the same period. Abortions occurred in only 5 of the 80 but 4 of them were negative to the test. There were 4 cows that produced their sixth calf, with no abortions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
second; 2,279 were third; 688 were fourth; 118 were fifth; and 4 were sixth. There were 17,056, or 96.9 percent of the total, that were normal calvings. Of these normal calvings, 14,757, or 86.6 percent, were negative to the test after calving; 677, or 3.9 percent, were positive; and 1,622, or 9.5 percent, were classed as suspicious. Therefore 13.4 percent of the cattle that calved normally were classified as either positive or suspicious at the time of parturition or soon after. On the other hand, there were 552 abortions, or 3.1 percent of the total among the cattle that calved during that period. Of this number, 357, or 64.7 percent, were negative to the test; 151, or 27.4 percent, were positive; and 44, or 7.9 percent, were classified as suspicious. Therefore, on the basis of the blood agglutination test, only 195 abortions, or 1.1 percent of the total calvings, could be attributed to brucellosis.

Tables 1 and 2 show the results of the ninth semiannual report on these studies, which covers the period from July 1, 1941, to January 1, 1942:

There were 76 abortions out of 3,328 calvings, but only 17, or 0.5 percent of the total calvings, showed either a positive or suspicious reaction to the test after calving.

**CONCLUSION**

It has been as usual a great pleasure to appear on this program today and be so well greeted by an audience keenly interested in the subject under discussion. It will be recalled that last year we had a forum on brucellosis which brought out many very interesting and important phases of this problem. I would like at this time to suggest that arrangements be made for a similar forum next year.
REPORT OF THE COMMITTEE ON BANG'S DISEASE


Your Committee wishes to report continued progress in the control and eradication of brucellosis in cattle during the past year. On October 1, 1942, approximately 2,218,500 herds, comprising about 15,683,000 cattle, were under official supervision. On the same date there were about 78,000 herds containing approximately 1,628,860 cattle fully accredited as free from this disease. These herds were in 42 states.

The area plan of control was extended to 114 additional counties during the year making a total of 560 counties that are qualified as modified accredited Bang's disease free areas. These counties are in 24 states. Area work is being conducted in about 150 additional counties. Thus we find the area plan of control in operation in 710 or 23% of the total of 3,071 counties in the United States. North Carolina is the first state to be officially designated as a modified Bang's disease free area. This state was also the first in which all counties were declared practically free from bovine tuberculosis, in 1928. Funds for state indemnity in Bang's disease work are available in all states except California, Colorado, Indiana, Massachusetts, Nevada, Oklahoma and Texas. Provision for such indemnity funds has now been made in Puerto Rico.

During the past year all of the antigen used in making the agglutination blood tests in the official cooperative Bang's disease work has been furnished by the Federal Bureau of Animal Industry from its Laboratory at Beltsville, Maryland. In addition, this Bureau continues to test samples of all Brucella vaccines prepared by commercial firms licensed by the Bureau and thus assures the purchaser that such vaccine has been found satisfactory before it is released for sale and distribution. Your Committee wishes to express its approval of these services and recommends that they be continued.

Calfhood vaccination was made a part of the Bang's disease control program in December, 1940. Since that time arrangements have been made to incorporate calfhood vaccination in the official program for the control of Bang's disease in 39 states. Calfhood vaccination is fitting into the program in many states especially in herds where there is considerable infection. In certain states, in herds where the hazards of infection are great, vaccination of calves in non-infected herds is being undertaken. There is, however, a tendency on the part of many veterinarians and cattle owners to use calfhood vaccination as a substitute for other control procedures rather than as recommended by the United States Department of Agriculture Bureau of Animal Industry as an aid to control.

The methods and procedures in use vary in different sections of the country and
in accordance with the conditions and needs of the individual herds. It does no, seem feasible for your Committee to attempt to outline procedures in detail because such procedures cannot be applied uniformly.

Your Committee recommends the following broad principles for use during the period of the war:

1. That control and eradication efforts based on the agglutination blood test be continued with emphasis on the elimination of reacting unprofitable animals. During the present emergency, the judicious retention of reacting animals may be advisable in certain infected herds provided they are high producers or represent valuable blood lines and further provided that the retention of such reacting animals does not grossly jeopardize the total productive capacity of such herds by infecting clean cattle.

2. That more emphasis be placed on appropriate herd management and sanitation practices which have been repeatedly demonstrated to have much value for increasing production efficiency in infected herds by decreasing the spread of the disease within the infected herds.

3. That the area plan of control be continued and expanded to areas where it is feasible.

4. That we approve and encourage calfhood vaccination as recommended as an aid to control efforts and discourage its use as a substitute for good herd management and proper sanitary practices. The ultimate objective in all cases should be a clean, non-infected herd in which the mature animals are negative to the agglutination blood test for Bang's disease.

5. That the regulations providing for modified accredited Bang's disease free areas should be amended to permit not to exceed one per cent of the total number of herds in the area to be maintained as infected herds under strict quarantine with positive reacting animals permanently and conspicuously identified, providing such infected herds employ calfhood vaccination.

During the year there has developed more tangible official recognition of the fact that Brucella infections cause disease in a variety of species of animals and man; and that these diseases in the different species are not unrelated. The Congress of the United States, at the request of Honorable Claude Wickard, Secretary of Agriculture, appropriated a fund of money for research with brucellosis in swine.

Your committee recommends that, temporarily, both the term Bang's disease and brucellosis be recognized as the official nomenclature for Brucella infections in cattle with the view that eventually brucellosis be accepted as the only official designation for this disease in cattle. The term Bang's disease should not be discarded promptly because of legal considerations in some states and the familiarity of livestock owners with it. The term brucellosis, referring to Brucella infections in all species, is rapidly gaining favor with various interested groups of scientists and others and therefore should receive official recognition by this Association at this time. It is recommended that in the future this committee be known as "Special Committee on Brucellosis". Thus the committee would officially concern itself with Brucella infections in various species of animals and not be limited to considerations in the disease in cattle.
The official recognition in December, 1940, of calfhood vaccination as an aid to the control of Bang's disease seems to have been followed by an appreciable decrease in the amount of research being conducted with this disease in this country. This is regrettable. Your Committee considers it timely to warn against a growing tendency on the part of many veterinarians and cattle owners to consider the problem of Brucella infections as satisfactorily solved and recommends that further research is necessary on all phases of the problem.
REPORT OF THE VETERINARY COMMITTEE ON BIOLOGICS


It would seem advisable that the report of your committee on Veterinary Biologics review briefly the history of the past few months with regard to the subject matter that is pertinent to this committee.

It will be recalled that at the insistence of members of this association those in charge of the administration of the Federal Virus Serum Toxin Law approved March 4, 1913 (37 Stat. 832) were requested to inform us as to wherein the Virus Serum Toxin Law is inadequate for the proper control of the distribution of veterinary biologics and what we as a group can do to provide for adequate control of these products in our respective states.

Veterinary literature of the past decade is replete with resolutions both of this association and of the American Veterinary Medical Association as well as of several state live stock associations all dealing directly with this matter.

On June 16, 1941 the present secretary of agriculture promulgated amendment 15 to B.A.I. order 276, which was to become effective January 1, 1942. This amendment did not prohibit the sale and distribution of any biological product but did make it mandatory that the producers and purveyors of viable biological products make a report to the Chief of the Federal Bureau of Animal Industry and to the Chief Live Stock Sanitary Official of the respective state whenever any of these viable products were consigned to residents within the state.

This amendment immediately drew the fire and opposition of those who felt that their personal interests might in some manner be affected.

In what manner legitimate business could be adversely affected by the amendment which simply and solely provided information to disease control officials regarding the name and address of the final recipient of such products as Hog Cholera Virus, Sheep Ecthyma Virus, Laryngotracheitis Virus, Fowl Pox Virus, Brucella Vaccine, Anthrax Vaccine, Blackleg Vaccine, Canine Distemper Virus, is not clear.

To refuse live stock sanitary officials knowledge regarding the sale and distribution in our respective states of the manufactured living agents of infectious diseases and at the same time look to these same live stock control agencies to protect the live stock from the ravages of these diseases is inconsistent and adverse to the best interests of the livestock industry.

Your committee exerted every effort to place before the Honorable Secretary of Agriculture, Claude R. Wickard, clearly the facts concerning the amendment. This body at its meeting last year, having been informed that pressure groups were endeavoring to prevail upon Mr. Wickard to rescind amendment 15, appointed a special committee to wait upon the secretary and personally delineate to him the sound reasoning behind our request for the provisions of the amendment.

Even before the 1941 meeting of the U. S. Live Stock Sanitary Association an
endeavor was made by certain members of this committee to provide them with information relative to any possible change in attitude of the Secretary of Agriculture with regard to the carrying out of the proposed amendment.

The first intimation that the amendment was not to be enforced came in the following letter of January 7, from Dr. D. I. Skidmore.

Dr. R. A. Hendershott
Secy. National Assembly of
Chief Livestock Sanitary Officials
Trenton, N. J.

Dear Dr. Hendershott:
This will acknowledge receipt of your telegram of December 3 addressed to the Secretary regarding Amendment 15 to B. A. I. Order 276. Receipt also is acknowledged of your letter of December 8 addressed to the Secretary regarding Amendment 15 and with which you transmitted a report of the Committee on Veterinary Biologics adopted by the United States Livestock Sanitary Association in convention in Chicago the week of December 1, 1941. Both of these communications were duly received and referred to the Bureau for its attention.

Of course, you know now of the action taken by the Secretary on December 24 when an order was issued amending Part III, Chapter I, Title 9, Code of Federal Regulations (Amendment 15 to B. A. I. Order 276). The effect of the later order is to revoke that part of Amendment 15 which required notices of shipments to be issued to the Bureau and to the state of destination.

I am enclosing for your files, a copy of Amendment 15 and the amending order of December 24.

Very truly yours,

(signed) D. I. SKIDMORE
Chief, Division, Virus-Serum Control

On January 10, a copy of this letter and comment was sent to each livestock sanitary official and immediately Dr. Mark Welsh as a member of the special committee sought an interview for the committee with Mr. Wickard. An interview with Mr. Grover B. Hill, Assistant Secretary of Agriculture for February 6, was granted.

On February 6, 1942 Drs. J. L. Axby of Indiana, C. P. Bishop of Pa., William Moore of N. C., Mark Welsh of Maryland and R. A. Hendershott of New Jersey, personally appeared before Mr. Hill and presented to him reasons why amendment 15 should be reinstated. Following this meeting it was thought desirable that a clear statement in writing should be sent directly to the Honorable Claude R. Wickard. Consequently on February 17, 1942 the following letter was sent.

The Honorable Claude Wickard
Secretary of Agriculture
Washington, D. C.

Dear Mr. Wickard:
We regret the necessity of addressing this letter to your home but there seemed to be no other means by which we would be certain that the information would come to your attention. We feel that should the complete facts concerning the effects of the rescinding of Amendment 15 be brought to your attention, the question could at
least be reopened and more favorable action taken. We would like to state these as clearly and briefly as possible.

1. The Chief Live Stock Sanitary Official in each state is charged with the responsibility of the control and eradication of the diseases of live stock and poultry. Appropriate rules and regulations govern these activities within a state. Both State and Federal laws or regulations prohibit the interstate movement of diseased animals or those that have recently been exposed and the need for these is obvious.

2. Manufacturers of biologics must secure a permit through your office to conduct an interstate business. There are some eight live viruses and vaccines at present shipped interstate which are capable of setting up new centers of infection and endangering live stock or poultry in the communities where they are used. There is no fundamental difference between the shipment of a diseased animal into a community and the shipment of the living causative agent of the disease in a bottle.

3. With two exceptions, the Federal Government does not test these products for potency, contaminants or otherwise have close supervision over products for which they have issued a license yet the manufacturers are at liberty to send their products into any state frequently in violation of State laws; in contradiction of accepted disease control practices and in violation of plain common sense. Neither the State nor the Federal officials are informed as to where these disease producing viruses and vaccines are shipped and used. If the Federal Government assumes the privilege of licensing a manufacturer to sell dangerous products, it seems reasonable that they should not evade the responsibility for their proper use at the point of destination. It is still less understandable why State and Federal officials who are charged with the responsibility of controlling and eradicating animal diseases should be denied knowledge as to where a disease center is established, whether it be imported in a sick animal or through infection imported in a bottle.

4. Many states and the Federal Government are paying indemnity on animals that react to the agglutination test for Bang's disease. The unrestricted sale and use of Bang vaccines jeopardizes the program for the control and eradication of this costly disease. It may also be fraudently employed to collect indemnities as diagnostic tests do not differentiate between an animal that reacts as a result of vaccination and one having active infection. Even in cases of suspected fraud, officials are powerless to act as the manufacturer can refuse to report the sale of the vaccine. It seems unfair and unjust that State and Federal officials should be forced into a position where funds entrusted to them may be improperly or fraudulently used.

5. The unrestricted sale and distribution of live viruses and vaccines results in unconscious sabotage of our live stock industry by our own people. The case of vicious sabotage by foreign agents distributing the virus of foot and mouth disease, rinderpest, fowl pest and others through the unrestricted and unreported sales of biologics is obvious. Yet, no agency of the Federal Government stands guard over this situation and the states are denied knowledge by which they may protect their live stock and poultry industry.

6. We are informed that at the hearing held on Amendment 15 it was alleged that the Chief Live Stock Sanitary Officials of two or three states were directly or indirectly engaged in the sale of biologics and would personally profit should the sale of these products within their state be known to them. This is obviously a regrettable situation and certainly one that would be adjusted should Amendment 15 be put into effect. It is our understanding that many of those so testifying
before you were directly engaged in the sale or manufacture of biological products and they had personal reasons for not wanting to comply with your Order. Granting that the situation in two states wherein an official might profit by the knowledge of the sales within his state may be undesirable, it seems unfair that the remaining states should be denied information as to where dangerous disease-inciting vaccines and viruses are being used.

7. It is a matter of record that for years the Chief Live Stock Sanitary Officials of the various states have repeatedly asked for this information and are willing to assume the responsibility for the proper use of such products within their states and in accordance with their state laws and regulations. Your Amendment to Order 15 does not in any way change the Federal or State laws but merely gives the responsible officials information through which they may intelligently act. Your Order was rescinded before hearing the testimony of the various state officials who are most deeply concerned. We respectfully ask, therefore, that you seriously consider the points which we have raised as our only objective is to more adequately protect the live stock and poultry industries of this country. There are grave duties resting upon all of us engaged in this work and we cannot lightly dismiss our responsibilities for our failure to adequately supervise and control the distribution of potential disease producing biologics. We would welcome an opportunity to meet with you and submit evidence to convince you that your Amendment to Order 15 should be immediately put into effect. Thanking you for your consideration, we are

Very truly yours,
MARK WELSH, Secretary-Treasurer
J. L. AXBY, Indianapolis, Indiana
R. A. HENDERSHOTT, Trenton, N. J.
C. P. BISHOP, Harrisburg, Pennsylvania
WM. MOORE, Raleigh, N. C.

To this letter on March 7, Dr. Welsh received the following reply:

Dr. Mark Welsh
Secretary-Treasurer
United States Live Stock Association
College Park, Maryland

Dear Dr. Welsh:

Your letter of February 19, to Secretary Wickard was received by him personally and given thorough consideration. He has referred it to me and has asked me to answer it.

Secretary Wickard has given a great deal of attention and study to this matter, and is thoroughly familiar with it. His views coincide with the ones expressed by me at the time you gentlemen presented your side of the controversy here in the office, and as I read your letter, it contains nothing different from the views expressed at that meeting. It is the studied opinion and decision of the Department that no substantial results or benefits could be effectuated by Amendment 15, and we are therefore standing on our original decision.

Sincerely yours,
(Signed) GROVER B. HILL
Assistant Secretary
It has become apparent, and brought to the attention of the Committee, that the distribution and sales policies of some of our largest manufacturers of biologics have been influenced and changed because of the failure of adequate legislation whereby all manufacturers of such products, insofar as distribution is concerned, be placed upon an equitable basis.

It is also the opinion of your committee that more stringent control and testing of biologic products should be encouraged to the end that those products offered for sale shall have been found to possess sufficient value to warrant their use.

It is the recommendation of your committee that because the importance to the health of the nation's live stock at all times, but more particularly during the present emergency when the loss of meat producing animals mean so much to our nation and to our allies, that every effort be expended to make opponents see the danger of the present method of distribution of these products and enlist their cooperation to have amendment 15 to B. A. I. order 276 put into force.

We are sincerely interested in making it possible for "Food to win the war and write the peace" and believe that the rescinding of amendment 15 is directly opposed to this policy.
REPORT OF THE COMMITTEE ON PARASITIC DISEASES

JAMES E. ACKERT, Chairman, Manhattan, Kans.; W. R. HINSHAW, Davis, Cal.;
D. H. RICKS, Oklahoma City, Okla.; A. P. SCHNEIDER, Boise, Idaho; GEO. E.
DANIEL, College Park, Md.; B. T. SIMMS, Auburn, Ala.; BENJAMIN SCHWARTZ,
Washington, D. C.

IMPORTANT INTERNAL PARASITES OF FOOD-PRODUCING
ANIMALS IN THE UNITED STATES

The immense problem of feeding the armed forces of the United States and the
civil population, together with aiding in supplying meat to other members of the
United Nations, calls for the most effective means possible for the production of
food animals. One of the hindrances to an ample meat supply is the presence and
effects of animal parasites which appear to be more prevalent this year. Contribut-
ing factors to this condition are heavier rainfall in many regions, overcrowding of
smaller pastures and feeding lots to increase the amount of livestock, and the
reduced control service due to the entrance into the armed service of many practic-
ing veterinarians and other personnel engaged in combatting parasites of livestock.
As an aid in removing as far as possible the parasite hindrance to meat production
the committee on parasitic diseases has made a nation wide inquiry upon the most
important parasites of the food-producing animals in the last two or three years and
the best means of combatting them.

Information has been obtained from recent literature, from experiences of the
members of the committee on parasitic diseases, and from records of colleagues
in veterinary schools, departments of veterinary science, and regional animal dis-
ease laboratories as shown below. Due to the breadth of the subject and to the
necessarily restricted publication space, the food-producing animals considered
will be limited to cattle, sheep, swine and poultry.

1 Contribution No. 234 from the Department of Zoology, Agricultural Experi-
ment Station, Kansas State College of Agriculture and Applied Science, Man-
hattan, Kansas.

* Dr. E. A. Benbrook, Ames, Iowa; Dr. D. W. Baker, Ithaca, New York; Dr. W. L.
Boyd, St. Paul, Minnesota; Dr. J. W. Britton, Davis, California; Drs. L. D. Bushnell
and J. H. Whitlock, Manhattan, Kansas; Dr. C. R. Donham, Lafayette, Indiana;
Dr. Cecil Elder, Columbia, Missouri; Dr. Robert Graham, Urbana, Illinois; Drs.
A. H. Groth and R. L. Mayhew, Baton Rouge, Louisiana; Dr. P. A. Hawkins, East
Lansing, Michigan; Drs. C. A. Herrick and Banner Bill Morgan, Madison, Wisconsin;
Dean M. Jacob, Knoxville, Tennessee; Dr. Erwin Jungherr, Storrs, Connecticut;
Dr. C. H. McElroy, Stillwater, Oklahoma; Dr. Wm. Moore, Raleigh, North Carolina;
Dean I. E. Newsom, Fort Collins, Colorado; Dr. R. E. Rebrassier, Columbus, Ohio;
Dr. J. N. Shaw, Corvallis, Oregon; Dr. Louis V. Skidmore, Lincoln, Nebraska;
Dr. M. A. Stewart, Berkeley, California; Dr. E. L. Stubbs, Philadelphia, Pennsyl-
vania; Dr. H. L. Van Volkenberg, College Station, Texas, and Dr. E. S. Winters,
Auburn, Alabama.
PROTOZOAN DISEASES

Trichomoniasis. Trichomoniasis, caused by *Trichomonas foetus*, is a sporadic but increasingly important parasitic disease of cattle affecting the genitalia of both males and females. It is reported from all sections of the United States. Abortions, delayed conceptions and loss of income from sale of pedigreed stock cause the greatest economic loss, but beef production is inhibited in all grades of cattle. No satisfactory treatment has been developed. Artificial insemination is recommended in valuable herds.

In poultry, trichomoniasis of the upper digestive tract causes considerable mortality, especially in turkeys and pigeons. Recent investigations by Stabler (1938) and by Levine, Boley and Hester (1941) indicate that the various causative organisms described represent but a single species. Stabler has shown that *Trichomonas gallinae* has priority over all other specific names for this parasite. It should not be confused with *T. gallinarum*, a separate and harmless species inhabiting the lower intestines of fowls. No satisfactory treatment is known. Strict sanitation which includes drainage of all overflowing ditches, pools of standing water and removal of excess refuse is recommended. The use of 1–2000 dilution of copper sulfate as a substitute for drinking water is suggested by some disease control laboratories.

Hexamitiasis. This disease, now widespread in turkey growing areas, is caused by *Hexamita meleagridis*, a new species described by McNeil, Hinshaw and Kofoid (1941). It is characterized by catarrhal enteritis, causing severe mortality in young poultis. Diagnosis of *Hexamitiasis* should be based on the finding of the parasites in the upper intestine. The most important means of transmission is the carrier; prevention consists in eliminating contact of young poultis with carriers. Sanitation plays an important role in prevention and control.

Coccidiosis. Considerable losses from coccidiosis in cattle are reported from the west coast especially in animals on permanent irrigated pastures; however, no part of the country is free from attacks of bovine *Eimeria* at least three species of which are known to be highly pathogenic. Transmission is by means of resistant oocysts passed in the feces. Severe scouring and hemorrhage occur in the young animals resulting in extensive debilitation and frequently death. Some losses are also reported in lambs, and these are very severe, at times. Isolation of infected stock, daily change of bedding, soft, nutritious foods, and quiet conditions are recommended; also the segregation of calves by three age groups: calves up to three weeks old, three to six weeks, and six weeks to three months of age. No curative treatment is known. Sulphur or copper sulphate solution has been recommended in a few cases.

Coccidiosis in chickens is doubtless the most important parasitic disease of birds in the United States. In some sections, at least 50 percent of the flocks are infected and the losses are heavy. Much experimentation has been carried out in recent years to find a curative drug, but without much success thus far.

Several laboratories have investigated sulphur as a treatment for fowl coccidiosis with varying results. There is general agreement that flowers of sulphur inhibits the development of the disease in the fowls, but at the same time, it retards growth and may induce rickets. The administration of a vitamin K product (Klotogen)
PARASITIC DISEASES

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to chicks heavily infected with *Eimeria tenella* gave marked protection, according to Baldwin, Wiswell and Jankiewicz (1941), who obtained a ten percent mortality in the treated group as compared with a 70 percent mortality in the unprotected group. Farr and Allen (1942) obtained encouraging results from feeding two percent sulfaguanidine in the mash before and after inoculation with the coccidial cysts.

Some workers find that the most potent factor in coccidiosis control is dryness. In infested houses that were kept dry, no coccidiosis developed in the young chicks. Later when the floors of these houses became wet, severe coccidiosis developed. Many workers agree that if the houses cannot be kept dry and if sanitation is nearly impossible, the feeding of flowers of sulphur may well be undertaken. Further experimentation with sulphur, Klotogen and sulfaguanidine may yield important results.

On the other hand the stand is taken by Dickinson (1942) that the best means of controlling coccidiosis is by so managing sanitation as to permit the young chickens to have light infections of coccidia and thereby develop in the birds an acquired resistance (or immunity) to subsequent infections. As evidence for this, Dickinson stated "It has been well established that chickens that have survived repeated mild coccidial infections or a severe infection of a given species of coccidia are usually highly resistant to further attempts to cause clinical coccidiosis with the same species". Dickinson has recommended more careful cleaning of the brooder houses between the fourth and sixth weeks of brooding with a view of allowing for mild infections but preventing massive ingestions of coccidia cysts.

For all situations regarding fowl coccidiosis, body vigor and high resistance should be sought by feeding balanced diets adequate in proteins, including milk products and proper vitamin and mineral supply. This along with careful sanitation and dry runs wherever possible will aid in suppressing fowl coccidiosis.

*Leucocytozoon infections.* In certain areas, principally in the South, large numbers of turkeys succumb each year to an acute disease caused by a *Leucocytozoon* species. This disease has been thoroughly investigated in recent years, principally by Johnson, Underhill, Cox and Threlkeld (1938). It affects poult under 12 weeks of age and is characterized by loss of appetite and listlessness. At least three species of simuliids (black flies) are known to transmit the disease. Confinement rearing of poult in houses screened against simuliids until they are several weeks old is recommended. Complete segregation of breeding and brooding operations is also recommended to prevent transmission from adult carriers to poult.

*Anaplasmosis.* Although anaplasmosis was reported by but one of the present contributors as an important disease of cattle, Stiles (1942) has stated that this malady is known to exist in 23 states in most parts of the country except the northern and eastern sections. Well kept herds appear to be as subject to attack as others. Heavy infections of the parasite, *Anaplasma marginale* which destroys red blood cells, result in severe anemia, acute debility and, in some cases, heavy death losses. Transmission is mainly by ticks and tabanid flies, 18 species of ticks and several species of the flies having been shown by experiments to be capable of transmitting the disease. As a control measure all animals harboring ticks should be dipped when practicable. Great care is needed in diagnosing the disease, the symptoms of which resemble those of piroplasmosis, anthrax and hemorrhagic
septicemia. Several studies have been made on methods of treatment. Isolation, suitable prophylaxis and intravenous injection of such drugs as sodium cacodylate, and 2 to 4 percent mercurochrome, or of quantities of whole citrated blood from healthy bovines have been recommended.

HELMINTHIASIS

Trematoda

Fascioliasis. Fluke disease caused principally by Fasciola hepatica was reported from the west coast where heavy losses resulted from the condemnation of livers of cattle and sheep. In the vicinity of Boise, Idaho, inspectors reported that at times 50 percent of the livers were condemned because of fluke infection. The gulf coast of Texas is another region of heavy fluke infection, as are other portions of the South and East. The flukes which live in the bile ducts of cattle and sheep are blood suckers throughout their adult life. As several species of snails harbor the larval stages (cercariae), snail control should be undertaken wherever practicable. Extremely dilute solutions of copper sulphate introduced into ponds or streams will kill snails. For the treatment of the host, a mixture of 10 gm. of hexachlorethane and 1.75 gm. of kamala extract for each 70 pounds of live weight has been recommended for cattle with liver fluke infections; for sheep (not for cattle) 1 cc. of carbon tetrachloride is recommended.

Cestodes

Taeniasis. In the larger domestic animals taeniasis appears to be most important in sheep. The large Moniezia was reported in two northern states as causing heavy losses in August. The sheep manifested "a severe diarrhea, with loss of condition, weakness and in some bands a rather serious mortality. A small percentage of the lambs show a peculiar stiffness, as the sheepmen described the condition. This condition appears to be due to muscular fatigue, as the lambs, after moving a short distance, arch their backs, move with short stiff steps, and collapse. After resting, they will get up and move off again".

Results from critical tests of effects of tapeworms on chickens have been conflicting, some tests showing retarded growth and interference with metabolism while other tests failed to show significant differences in growth rate or blood sugar level between experimentally infected chickens and the controls that were free from the tapeworms.

In food-producing animals the control of tapeworms (all of which require an intermediate host) involves avoidance of short pasturing to preclude swallowing of certain grass mites which are the intermediate host of cattle and sheep tapeworms and the removal from poultry yards of debris which protect species of ground beetles that are intermediate hosts of fowl tapeworms. A single beetle after devouring two or three tapeworm segments will develop several hundred larvae that are infective to fowls.

No drug treatment is known for the complete expulsion of tapeworms of food-producing animals. For the removal of tapeworms from chickens, the field that is most exploited, results of recent experiments (Reid, 1942) have shown that a
starvation period of 20 hours will cause a chicken to lose all of the tapeworm segments except the head or scolex which after a few days will regenerate a whole new worm. This expulsion of the tapeworm bodies (strobilae) merely from starvation is the kind of results that are obtained from the administration of various commercial drug treatments which prescribe a 24 hour starvation period. The failure of such treatments to remove tapeworm heads makes it quite evident that individual fowl tapeworm treatments such as are practiced over much of the country are practically useless, to say nothing of the harmful effects of the drugs upon the fowls and the high labor and medicinal (pill) costs to the producers. As suggested by one of the present contributors, poultrymen probably should cease giving individual drug treatments to chickens. Sanitation, clearance of debris from poultry yards and rations high in proteins and adequate in other respects are recommended for the control of fowl taeniasis.

_Nematoda_

_Strongylosis._ Judging from the reports of colleagues from various parts of the country, the greatest hindrance to an ample meat supply is the quantity of strongyles, mostly of the gastrointestinal group, that sap the energy and resistance of the hosts thereby predisposing the animal to fatal attacks by other organisms and forcing the carcasses to lower classifications. Chief among these gastrointestinal nematodes are _Haemonchus, Ostertagia, Trichostrongylus, Bunostomum, Cooperia_ and _Nematodirus_ Spp. Almost equally harmful are lungworms of cattle and sheep (Dictyocaulus) whose effects are more acute. Most of the intestinal forms are equipped with such mouthparts as cutting plates, lancets or teeth thus making them potential blood suckers, some of which may take blood in excess of the amount needed for worm nutrition; so that in heavy infections, especially of _Bunostomum_, the host animals lose large quantities of blood.

Following are some excerpts from the reports: “Stomach worms (_Haemonchus_) are the most common parasites of sheep in Minnesota, and of great economic importance.” “Sheep infected with _Haemonchus_ on abbatoir examination showed gastritis, anemia and edema.”

Heavy losses in deaths or poor condition of lambs and sheep due to gastrointestinal nematodes are reported throughout the middle west. In some states almost every herd is infected.

High losses in lambs due to strongyles occurred in 1941 and 1942 in two northern states where in the flocks of 14 owners, 1476 lambs died with diarrhea and weakness, a death loss of about nine percent. Post-mortem examinations of several lambs from each flock showed heavy infections of intestinal strongyles. Moreover, some 4,000 surviving lambs in these flocks were in poor or unthrifty condition. “These worms (gastrointestinal) are especially destructive when young cattle are being wintered principally on low grade roughage or when pasture gets short in the fall.”

Extensive trips over states brought such observations as the following: “Stomach worms and nodular worms are perhaps causing the most damage in this particular section but other gastrointestinal nematodes and lungworms are causing serious damage in some herds.” “In a well bred herd of Hereford cattle, 40 yearlings valued at $50.00 each died from heavy lungworm infections.” “During the past
year, several severe outbreaks of lungworms have caused heavy losses in both deaths and debilitation." "Serious losses have also resulted from massive infections of gastrointestinal worms." "Post-mortem examinations were made of several calves six to 12 months old which died from severe Nematodirus infections." Some of the eastern workers report increases of gastrointestinal worms due to importation of southern steers for feeding out native grown hay and grain. Nearly all sections of the country complain of Haemonchus contortus except the west coast which seems to be relatively free of these stomach worms and of nodular worms. In that section Ostertagia and Trichostrongylus Spp. have increased markedly due to irrigated pastures as have also lungworms, these worms causing pneumonitis that leads to great debilitation and very high death losses. The Rocky Mountain region has perhaps witnessed one of its first extensive outbreaks of haemonchosis in cattle, whereas these stomach worms have been prevalent in sheep for several years. It is thus clear that an immense toll in quantity and quality of meat is exacted annually by these gastrointestinal helminths.

Nematodes of especial importance in the sheep and swine industries are the "nodular worms" (Oesophagostomum spp.). Development is direct. The young worms hatch in moist feces and soil and soon become infective. They are taken up with contaminated food and settle on the walls of the large intestine where they cause lesions which develop into nodules raised above the surface of the intestinal lining. When such nodules are numerous, as they frequently are, serious consequences may follow. Some workers report dysentery, interference with digestion and absorption, and emaciation. Other symptoms of sheep heavily infected with O. columbianum include stunting, dry yellowish wool, loss of weight and general unthriftness. To the packer the most serious loss is in casings and surgical sutures. The margin between cost and retail of carcasses handled by the packers is so narrow that the packer can ill afford this unpredictable loss.

Lungworms in swine are of very common occurrence over much of the United States except the west coast. The infection known as verminous bronchitis is caused by the larvae of Metastrongylus and Choerostrongylus Spp. which develop to the infective stage in various earthworms. Some States report infections of swine up to 35 percent of those examined at diagnostic laboratories. Nearly all midwestern contributors consider lungworms of importance in swine while some of the eastern and southern workers report that such infections are comparatively rare and of little economic importance. It appears that in the large midwestern areas, considerable damage may result from lungworm disease especially in shoats which may show symptoms such as coughing, rapid respiration and emaciation, and which may occasionally succumb to this parasitic infection. Pigs appear to suffer somewhat less from lungworm infection than do the ruminants.

Ascarids and other worms. Of the other nematodes of swine, ascarids, kidney worms, and thorn-headed worms were mentioned by most of the contributors. Of these Ascaris suum is by far the most widespread and important. In cases where the McLean County ascaris control system cannot be applied, serious losses occur in young swine. Kidney worms (Stephanurus dentatus) appear to cause economic losses only in swine raised in the southern states. Discoloration of the perirenal fat and perforations of the pelvis of the kidney lead to considerable losses in the
swine industry. Thorn-headed worms which use May beetles as intermediate hosts also seem to find life history conditions more favorable in warmer climates. The west coast appears to be almost free of this intestine damaging parasite.

Trichinosis is known to be of rather common occurrence in swine. It is caused by the small microscopic nematode Trinichellina spiralis. Hogs become infected by eating raw pork scraps, dead rats and other small animals which have the larvae encysted in their muscles. Similarly man may become infected by consuming uncooked pork infected with trichinae. If the pork infection is heavy, fatal cases are likely to occur in man. Not so much is known about effects of trichinae on swine. The subject has been reviewed recently by Schwartz (1942) who found from investigations made by artificially digesting diaphrams of hogs at packing establishments that farm raised hogs were much freer from trichinae than were hogs from either the Atlantic or the Pacific coast states that were fed on raw garbage. Farm raised swine showed 0.95 percent of infection as compared with percentages of 6.11 percent, 3.55 percent and 10.5 percent infection from garbage fed hogs in coastal regions, an average of about 6 percent. In a test of hogs fed only cooked garbage only 0.5 percent were infected with trichinae. It, therefore, appears that cooking or steaming of garbage will go a long way toward controlling this important nematode disease. Other precautions for control of swine trichinosis as given by Schwartz are: "(1) Do not feed offal, kitchen scraps containing raw pork, or the contents of the slop barrel to swine; (2) do not throw dead rats and mice into the hog pens; (3) bury deeply in quicklime or burn the carcasses of hogs and other animals that died on the farm".

Poultry nematodes

Reports on nematodes of poultry were confined largely to ascaridia and cecal worms of chickens. Infections of both of these are general throughout the country with percentages of cecal worms up to 75 percent of the flocks. Moderate pathological effects were reported for heavy infections of Ascaridia in young birds and for the frequent transmitting of the blackhead organism to turkeys by the cecal worms (Heterakis). In the middle west, Capillaria, stomach and gizzard worms were reported as fairly common and causing considerable injury and emaciation in the infected fowls. Recommendations for control of Ascaridia in poultry included tobacco dust in mash alternated with copper sulphate in drinking water, standard black leaf 40 treatment, and the iodine vermicide treatment. For the cecal worm, phenothiazine; for Capillaria, stomach and gizzard worms 1 cc of carbon tetrachloride or tetrachlorethylene. Sanitation was stressed for the control of all species of poultry nematodes.

Control of nematodes of livestock

To control and so far as possible prevent nematode infections of livestock most of the contributors stressed sanitation and rotation of pastures and lots where feasible. To accompany these prophylactic measures, host treatment with one or more drugs usually was advocated. For the removal of the gastrointestinal strongyles of cattle and sheep, there were 26 recommendations of phenothiazine, 11 of copper sulphate, three of tetrachlorethylene, three of cunic mixtures and one of oil
of chenopodium. For removal of intestinal worms of swine there were six recommendations of oil of chenopodium and four of phenothiazine.

The newest of these drugs is phenothiazine. Its position as an anthelmintic was reviewed recently by Davey and Innes (1942) who examined the results of 97 published papers on the subject. After considering methods of administration, evaluation of results, anthelmintic action and the toxicity of phenothiazine, the reviewers concluded that while there were many reports of its toxic action, the number was low in comparison with the wide use of the drug in recent years. With an anthelmintic dose of 30 gm of phenothiazine per sheep, the chances of adverse effects are negligible, according to the reviewers, as are also doses of this size for adult cattle and swine. More care is necessary in treating the young of these animals; and in all cases only the minimum anthelmintic dose should be given. In more recent work, Habermann, Foster and Hummon (1942) have reported the successful treating of pregnant ewes with phenothiazine, apparently without affecting parturition.

Copper sulphate solution for the removal of gastrointestinal strongyles is evidently favored by a good minority owing in part to its lower cost and general efficacy. However, some of these contributors favored phenothiazine for Haemonchus and Trichostrongylius.

Other recommendations by contributors included the isolation of animals obviously suffering with helminthiasis, frequent change of bedding and giving soft, nutritious feed. Quiet conditions were stressed for diarrheic cases especially those showing some hemorrhage.

A point to be emphasized in the removal and control of intestinal nematodes is that the adult female worms when removed by drugs carry to the exterior thousands of eggs capable of developing to infective stages in the soil so that all fecal wastes should be carefully cleaned up for two or three days after the drug is administered, such manure to be spread out in areas not traversed by either the old or young host animals.

A factor in helminth control in livestock is possible acquired resistance (or immunity) from previous worm infections. Many species of gastrointestinal strongyles take blood or lymph from the host. Evidence has been obtained by Stoll (1929) and others that host animals are capable of developing some protection against clinical effects of the helminths. This field needs more study. Closely linked with acquired resistance (or immunity) is natural resistance, that is, resistance due to age, nutrition, breed and strain adaptability and conformation. Good stock capable of attaining high development under favorable conditions is an important factor. Aid in this field as well as on the nutritive phases may be obtained from extension and other workers in agriculture. The field of natural resistance to helminthic infections was reviewed recently by Ackert (1942) who found that the natural resistance of a host to its helminth parasites is dependent largely upon its diet, its genetic constitution and its age.

EXTERNAL PARASITES

Producers and disease control workers are urged to watch carefully for such external parasites as ticks, mange mites, lice, warbles, sheep bots, screw worm fly
larvae, and biting flies all of which are very detrimental to livestock. Control measures for these parasites are available in various publications, including many U. S. farmer’s bulletins, Herms (1939), Dykstra (1942), and the 1942 yearbook of the United States Department of Agriculture.

**SUMMARY**

1. A nation wide inquiry has been made of the occurrence and control of important parasites of food-producing animals as an aid in the production of more meat for the armed forces, the civilian population, and the United Nations as a whole.

2. Parasites of cattle, sheep, swine and poultry were considered.

3. Several genera of protozoa cause economic losses in food-producing animals. *Trichomonas foetus* causes abortions in cows and reduces replacements of cattle in all grades. *Trichomonas gallinae* is the cause of necrotic ulcerations in the upper digestive tracts of chickens and turkeys. *Hexamita meleagris* causes severe losses from enteritis in young turkeys. *Leucocytozoon smithi*, a blood parasite transmitted by black flies (*Simulium* Spp.), causes severe losses in turkeys. *Coccidia* (*Eimeria* Spp.) are the most devastating of the chicken parasites. Other species of *Eimeria* are extremely harmful to cattle. Another bovine parasite, *Anaplasma marginale* which is transmitted by various species of ticks and of tabanid flies, occurs in 23 states, often in valuable herds.

4. Heavy condemnations of cattle and sheep livers result from infections of flukes (*Fasciola hepatica*), especially in irrigation areas of western United States.

5. Losses due to tapeworms occurred mostly in sheep. Young animals heavily infected with the large *Moniezia* in two northern states in August caused a severe diarrhea, loss of condition, weakness and considerable mortality. In poultry, attention is called to economic losses in labor and medicine (pills) in administering drugs to individual chickens for tapeworm removal, as recent researches show that 20 hours of host (flock) starvation will accomplish the same results, namely, removal of all tapeworm segments except the head.

6. Of the nematodes of the livestock, the lungworms (*Dictyocaulus*, *Metastrongyulus*, *Choerostomum*) and nodular worms (*Oesophagostomum* Spp.) cause considerable loss from verminous bronchitis and pneumonitis, but the heaviest losses in quality and quantity of meat result from the gastrointestinal strongyles (*Hemonchus*, *Ostertagia*, *Trichostrongylus*, *Bunostomum*, *Cooperia* and *Nematodirus* Spp.) most of which sap the energy and lower the resistance of the hosts by taking quantities of blood.

7. Other important nematodes, especially of swine, include the ascarids, kidney worms, thorn-headed worms and trichinae, the last of which (*Trichinella spiralis*) has recently come into prominence again, as it was found to occur in from 3.5 to 10.5 percent of garbage fed hogs as compared with 0.95 percent in farm raised swine. Cooking or steaming of garbage is urged.

8. Control measures for nematodes include sanitation, rotation of pastures and lots when practicable, isolation of sick animals, and treatment with phenothiazine, copper sulphate solution, tetrachlorethylene, or oil of chenopodium.

9. Other means of controlling nematodes and inhibiting their effects include
selection of good stock and providing good nutrition to develop high natural resistance.

LITERATURE CITED

CATTLE GRUBS AND HOW TO CONTROL THEM

BY BENJAMIN SCHWARTZ

Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture

It is well known to livestock producers, tanners, dairymen, butchers, and others concerned with the cattle industry, that cattle grubs also known as ox warbles and "wolves"—the larvae of heel flies—are among the most injurious pests of bovines. Various estimates have been made from time to time as to the financial losses sustained in this country from the ravages of these pests, the minimum figure given in the 1942 Yearbook of Agriculture being $50,000,000 annually. Precise information on the actual losses from cattle grubs is difficult to obtain, except in the case of those that result from the trimming of affected parts in meat packing establishments and the loss or partial loss of the thickest portion of the hide in which holes or lesser injuries have been produced by the activities of the grubs. The loss of condition in cattle resulting from the annoyance by the flies, the injuries resulting from the penetration of the grubs into the skin and their subsequent migration within the body, and the effects of these parasites on beef and milk production, are too imperfectly known to warrant more than a rough estimate of the damage that they entail. That these and the other injuries are considerable, however, is evident from the fact that several foreign countries that do not enjoy the economy of abundance in livestock production to which we are accustomed in normal times, have adopted and enforced over a period of years rather rigid measures for holding these pests in check, if not eradicating them altogether. Although sporadic efforts have been made here and there in this country to effect control or eradication of cattle grubs in some areas, no sustained effort has been made to get rid of these pests on a significant scale.

In normal times the control of livestock maladies and pests—except those that are of special national concern because of their transmissibility to man or other important reason—is left largely to the initiative of farmers and stockmen. Depending on whether the owners of livestock are alert or indifferent, they take precautions to protect their animals from the ravages of diseases and parasites, or let nature take her course, accepting their losses with concern or with the fatalistic attitude that such things are more or less inevitable hazards in livestock operations. In times of great national emergency, however, when the nation's vital industries are harnessed to the war effort, and geared to produce at top speed to meet goals that have been set, waste and inefficiency in production become the concern of everybody. Considering the importance of animal foods and byproducts in a war economy, the losses produced by grubs acquire a significance beyond the monetary losses sustained by the industries concerned. In these critical times livestock producers must exert every effort to avoid losses of the kinds mentioned through preventive and remedial measures already available as a result of investigations conducted over a period of years, for the most part with funds from the public treasury.
There are two species of heel flies, the common species (*Hypoderma lineatum*) occurring in all States, and the northern heel fly (*Hypoderma bovis*) occurring only in the Northern States. In the life history of these flies there are four principal stages as follows: (1) the egg, (2) the larva or grub, (3) the pupa, and (4) the adult fly. The first two stages are parasitic, the pupa and adult being free-living.

The eggs of the common heel fly are deposited in the first sunny days of spring. In the extreme southern part of the United States the flies begin to emerge on warm days during the winter, their emergence becoming progressively delayed as one goes northward, and taking place as late as June along the Canadian border. Several eggs in a row are attached to a single hair of the heels, rather close to the skin, or to the hairs elsewhere on the body when the animal happens to be lying down. The northern heel fly deposits its eggs—even in cloudy days—on the hairs of the lower and upper legs, one egg being attached to a single hair. In any event, the eggs incubate and hatch at the site of attachment in the course of 3 or 4 days, and the newly hatched maggots or grubs move down the hair to the skin and penetrate it. The young grubs work their way upward between the muscles and a few months later they are present in the abdominal and thoracic cavities. They continue their migrations during the following months, burrowing along the surface of the paunch, intestine, spleen, and other organs. The common grub occurs in rather large numbers at times in the wall of the esophagus. In the fall and winter the grubs migrate to the back and finally come to lie under the skin. In the course of their journey some grubs get into the spinal canal and set up inflammation along the spinal cord. The grubs that reach the backs of cattle under the skin cut a hole through to the surface. This permits the entrance of air that has now become necessary to the parasites' continued existence, and later affords an avenue for their escape from the host. In the back, the grub molts and gradually become isolated from the host's tissue by the formation of a cyst around it. Following a second molt, about 25 days after the first one, the color of the larva gradually darkens, the skin opening becomes enlarged, the grub—now an inch long by one-third inch thick—finally working its way out through the opening, and falling to the ground. In the case of the common grub, the sojourn underneath the skin of the back lasts from 35 to 89 days whereas that of the northern grub lasts from 50 to about 100 days.

Once on the ground the grub crawls into loose earth or seeks the protection of any other available debris; the northern grub is capable also of burrowing into the soil to a depth of about ½ inch where it pupates. The seeking of protection is preparatory to actual pupation, which consists at first in the hardening of the grub's outer skin to form a protective case. Inside this case the transformation of the grub to the heel fly takes place, the rate of the metamorphosis being conditioned by temperature, and lasting from 18 to 77 days in the case of the common grub, and from 15 to 25 days in the case of the northern grub. Within about one-half hour after the fly has escaped from the pupal case it is ready to mate, and egg laying may commence as early as about 20 minutes or so after mating.

It is evident from the account just given that the larval development of the
CATTLE GRUBS

Cattle grubs is slow and prolonged; the span of life of the adult fly is very short, however, lasting only a week or so, the sole function of the fly being reproduction. In fact, of the entire life cycle, which takes about a year, 9 months or more are taken up by the parasitic development of the grub in cattle.

Although the essential facts in the life history of heel flies can be stated in a few minutes, the research effort that led to their discovery involved the combined labors of numerous investigators working in different parts of the world, each contributing one or more bits of information at a time. Some of the observations made by the early investigators were confirmed by later research, whereas other observations proved to be erroneous. Although there can be but little doubt that parasites as large as cattle grubs, forming conspicuous lumps along the backs of their hosts, have been observed by cattlemen from time immemorial, it was not until the early years of the eighteenth century that scientific observations on them began to be recorded. Many of the early observations were made by naturalists, veterinarians and zoologists. The detailed work on the life history and the organization and integration of the scattered information that had accumulated over many decades was the result of systematic investigations made by professional entomologists and parasitologists, much of this research having been done by workers in the Federal Bureau of Entomology and Plant Quarantine.

The observations made by Curtice in the Federal Bureau of Animal Industry in 1890 are of special importance from both scientific and historical standpoints. Curtice reported finding the grubs in the wall of the esophagus, in the pleura near the 11th rib, in the subcutaneous tissue of the back, and in subcutaneous tumors, each of which had an opening through the skin. Curtice postulated, moreover, that the eggs or the newly-hatched larvae were taken into the mouth by the cattle licking their skin, and he assumed that this hypothesis would readily account for the grubs' getting into the wall of the esophagus first, and by later migration through the back into a position under the skin. This hypothesis was accepted for a long time by many competent authorities, but proved to be erroneous in the final analysis. As a result of investigations conducted in Europe and later confirmed in Canada and the United States, it was definitely established that the newly-hatched grubs penetrate the skin, and that their subsequent occurrence in the gullet and elsewhere in the body results from their active migrations that have already been discussed.

INJURIES PRODUCED

The unraveling of the rather complicated and bizarre life history of cattle grubs—a truly remarkable triumph of biological research—has placed these insects in the category of perpetrators of serious injury to the host that they invade. Although the adult fly does not bite or sting, it produces great fear in, and annoyance to cattle, which are believed to curtail milk production; to interfere seriously with proper finishing of steers for market; and to result in injuries of various kinds, especially on the range, from the frantic attempts of cattle to escape from the flies. The penetration of the newly hatched grubs into the skin results in a flow of serum that mats the hair around the injured area and results at times in the loss of hair, the lesions produced resembling a scaby condition. That the penetration of the grubs
into the skin produces marked irritation is evident from the fact that affected cattle lick their heels and other areas where the maggots enter, and stamp and kick their feet. The migration of the spiny grubs through the various tissues and organs, as previously outlined, must certainly produce more or less irritation, and their sojourn in the back is known to produce swelling and tenderness accompanied with pus formation.

The loss of meat resulting from trimming to remove affected parts has been estimated at various times to amount on the average to two pounds per carcass. Moreover, the parts adjacent to those that have been trimmed are rather unattractive and, hence, regarded as inferior in quality. Some estimates place the devaluation of loins and ribs that have been trimmed because of grub infestation as amounting to two cents per pound. According to an article appearing in the June 1942 issue of the Coastal Cattleman, 11,500,000 pounds of beef were lost in 1941 because of grub infestation. This figure is based on the actual findings in about 35 percent of the 16,500,000 cattle and calves slaughtered under Federal inspection. Meat losses of the kinds mentioned are significant and costly at all times, and are doubly significant now when the rationing of meat must be resorted to because supplies for the domestic market are below the demand.

The loss of leather, perhaps of greatest importance at this time because of increased needs in connection with the war effort and apparent difficulties of securing supplies from abroad, is the best known damage that results from cattle grubs. The losses arise from holes produced by the grubs and the scar tissue resulting from the repair of these injuries. Unfortunately, the holes appear along the backs, the part of the hide from which the thickest leather is cut. It is important to remember that shoe soles for soldiers, scabbards, belts for machines, harness and other important leather articles are made from the thickest part of the hide.

Various estimates have been made as regards the proportion of grubby cattle hides bought in the United States—hides being classed as grubby when they have 5 or more holes. It has been estimated recently that 35 percent of all domestic hides are classed as grubby and that the loss from this alone amounts to about $2,500,000 a year. Considering the fact that the hide constitutes approximately 7 percent of the live weight and about 11 percent of the value of the average steer, this figure is quite conservative.

CONTROL AND ERADICATION MEASURES

In view of the facts that a single female heel fly is capable of depositing about 500 eggs, that the eggs incubate in a sheltered situation on the hosts' hair coat where they escape environmental hazards, for the most part, and that the newly hatched grubs have but a short distance to traverse to penetrate the skin, it becomes obvious that unless effective and persistent efforts are made by cattlemen to cut a link in the chain that constitutes the life cycle of heel flies, there is no hope of reducing the ravages produced by the grubs. From the account of the life history that already has been given, it is quite evident that the stage in the life of the fly that can be most readily reached and destroyed is the grub in the sack that communicates with the outside through an opening in the skin.

The methods that have been advocated and practiced with considerable success
in various places for the destruction of cattle grubs, fall into two main categories, namely, (1) mechanical extraction and (2) destruction by chemicals. Regardless of the method adopted for the destruction of grubs, it must be carried out thoroughly and systematically, not once a season but about every 30 days during the entire grub season in the fall, winter, and early spring, depending upon the locality. Haphazard extraction of grubs or occasional treatment with chemicals will not accomplish much in the way of effective results and, hence will make but a slight dent on the heel fly population that starts the vicious cycle year in and year out.

Extraction of grubs under governmental regulation has been practiced in a number of European countries for many years with very good results. The grubs can be removed by hand with or without the aid of forceps. Although objections of various kinds have been made to hand extraction, experience has shown that persons that are sufficiently patient and persistent acquire skill in procedure and become remarkably adept in squeezing the grubs out of the cysts without injuring the host or crushing the grubs while squeezing them out. Crushing the grubs in the sacks may produce a severe anaphylactic reaction. Skillful operators can remove as many as 125 grubs per hour from cattle which offer no serious difficulties to the extraction process. In general, extraction by hand is more adaptable to dairy and relatively small beef herds than to large herds and cattle on the range. For the latter, chemical treatment appears to be more practical.

Of the medicaments that have been advocated from time to time for the destruction of grubs in the backs of cattle, those containing rotenone—principally derris powder and cube powder—are the most effective. Rotenone-containing substances may be applied in the form of a spray, dust, or wash. The spraying method is especially useful in treatment of range cattle and must be applied with a power sprayer capable of developing about 250 pounds of pressure. The Federal Bureau of Entomology and Plant Quarantine recommends the following mixture for use as a spray: derris powder or cube powder (5 percent rotenone content) 5 pounds; wettable sulphur, 10 pounds; water, 100 gallons. The mixture so made up is adequate for treating about 200 head of cattle. Powders containing equal parts of derris or cube (5 percent rotenone content) and wettable sulphur may be dusted from a shaker can on the backs of cattle with one hand and worked into the hair with the other hand. When so used, these powders are very efficient larvacides, and one pound of the mixture is sufficient for 36 animals. A wash made up by adding 12 ounces of derris powder or cube powder (4 to 5 percent rotenone content) and 2 to 4 ounces of neutral soap to each gallon of water, is a reliable treatment when applied with a sponge, cloth, or brush. According to the Federal Bureau of Entomology and Plant Quarantine, 6 ounces of wettable sulphur may be substituted for the soap in the above formula. A more convenient way to apply the wash is with a home-made sprinkler which consists of a fruit jar with holes punched in the metal lid. As the liquid flows from the jar it is spread with a stiff, fiber scrub brush onto the haircoat and skin of the back and upper sides of the animal. At the present time the wash is not recommended for destroying the grubs because it requires considerable labor and too much of the insecticide per animal.

Since rotenone-containing powders are among the critical materials at this time, and may not be available, therefore, in sufficient amounts to meet the demand, the
Federal Bureau of Entomology and Plant Quarantine recommends an alternative treatment, namely, the injection of benzol into each grub hole with a small oil can.

To secure effective results, grub destruction campaigns should be organized on an area basis and wherever possible on a county-wide or State-wide basis. It is essential that all cattle owners in the areas selected for such campaigns participate to the fullest extent. A few non-cooperators can largely nullify the good that is accomplished by the labors of many.

It is true that past experience has shown that cattle owners do not, as a general rule, practice cattle grub eradication voluntarily. In certain European countries farmers and stockmen have been obliged to resort to grub-eradication practices to comply with live stock sanitary regulations. American farmers and stockmen now face the challenge of doing voluntarily that which livestock producers in some foreign countries must do under compulsion. Livestock sanitary officials of this country as well as our livestock producers should accept this challenge in the interest of the war effort.
WARTIME NUTRITIONAL PROBLEMS CONFRONTING
THE VETERINARIAN

BY MARK L. MORRIS

Executive Secretary, Joint Committee on Foods, American Veterinary Medical and
Animal Hospital Associations, New Brunswick, N. J.

On Wednesday at a luncheon meeting, Sir John Orr, of the Rowette Institute,
Aberdeen, Scotland, and Dr. Frank G. Boudreau, Chairman Food and Nutrition
Board, National Research Council, Washington, D. C. outlined for us some of the
plan of the Allied Nations for using food as a weapon for Victory, and to influence
writing the peace. If this plan is to be placed in operation, America has an impor-
tant obligation confronting our entire population. Enormous quantities of the pro-
tective foods will be needed. If agriculture is to meet this challenge, then the veter-
ianarian who’s job is to keep live stock healthy is facing a real responsibility now and
also during the post war reconstruction period.

Are we prepared to do this job? Let us examine our present status. Can we
produce enough food to feed our Army, Navy and Civilian population? It seems
that should be our first consideration.

The shortage of certain essential feed ingredients is now acute. The serious lack
of protein concentrates has already caused some feed mills to close down part time
and as a result, feed manufacturers, jobbers, and brokers are seeking protein in-
gredients with all the energy of a ship builder looking for materials. The necessity
for part-time shut down of some mills is causing alarm because animal feed must
be produced constantly if the food production program is to be kept on the move.
There has been a serious shortage of meat and fish by-products for several months
which has placed a severe strain on other products used as substitutes. The Octo-
ber 31st issue of “Feedstuffs” reports that soybean meal is unobtainable; linseed
meal is climbing rapidly and getting very scarce; cotton seed meal is hard to get;
meat scraps are not offered at all; tankage is practically off the market; alfalfa
meal is not being quoted; and fish meal is almost unobtainable. In the face of this
critical situation the jobbers are releasing some supplies to try to satisfy their in-
sistent buyers. Any of these ingredients which make their appearance are quickly
snapped up. Feed mills which can get all the needed supplies are running well
but smaller buyers are running dry, as the nation-wide demand continues to in-
crease. What effect is this shortage of feedstuffs going to have on the livestock of
this country? How will it involve the veterinarian, his relations with his clients
and the job of producing the necessary food to “win the war and write the peace”? It
is on these points, and particularly the veterinarian’s responsibility to the live-
stock industry that I wish to devote the few minutes allotted to me.

First let us examine the situation among the rank and file of practicing veteri-

1 I wish to acknowledge the assistance of Dr. M. W. Taylor of the New Jersey
Agricultural Experiment Station for his efforts in checking on some of the scientific
and technical statements.
narians with respect to their knowledge of nutrition. This is important because these are the men who are going to be called upon when livestock are sick as a result of nutritional or infectious diseases. Since we are rapidly approaching the time when the services of the veterinarian will be employed more and more in an advisory and diagnostic capacity, therefore it is imperative that the nutritional education of the veterinary practitioner keep pace with the developments in the field of biochemistry and nutrition. For many years the trial and error method was the general practice. Animals were fed largely on what happened to be available and when livestock became sick a golden opportunity was presented to the vendor of nostrum mixtures and quack remedies. In many instances such mixtures contained nothing more than some slacked lime with sodium chloride or sodium bicarbonate and, of course, fenugreek. If the condition happened to be a mineral deficiency, the additional lime sometimes offered temporary relief. In many instances, however, it became necessary to move the animals to new pastures or purchase feeds grown in other sections of the country to correct the mal-nutrition.

This empirical era was followed by the establishment of the federal and state experiment stations and with their growth, the study of feeds and feeding became a more scientific subject. Henry and Morrison wrote their classical work on "Feeds and Feeding," which has become a standard text in our colleges and is a part of the library of most veterinarians and livestock men graduating in the last forty years. Much of the work done during this era was a comparison of feeding stuffs. For example, how many pounds of oats were required when added to a diet of corn and barley to produce superior gains in fattening lambs or swine. Veterinarians receiving instructions in this era learned that feeding stuffs contained protein, fat, fiber, carbohydrates and minerals and were taught to compute feeding values of certain diets. Most of the veterinary students took a nutrition course only because it was a required subject. Few of them realized how direct a bearing this study would have on keeping livestock healthy. During the same period some attention was given to mineral deficiencies, particularly calcium, phosphorus and iodine. Nutritional workers also became aware that rations contained certain vital ingredients which they were unable to identify by any available chemical methods. Since these substances were suspected of being organic "amines" in character they became known as vital amines, later contracted to the word "vitamin." As you are well aware, the discovery and isolation of the vitamins has exerted a powerful influence on the science of nutrition. A number of these essential substances have now been segregated, identified and prepared synthetically and as the result the field of biochemistry and nutrition has expanded very rapidly. Additional biochemistry, physiology and nutrition are now part of the regular veterinary curriculum.

In order to work intelligently with vitamins it is necessary to know the exact requirement of the different species for these substances. However, although we have studied feeds and feeding for many years, the exact requirements of many species of domesticated animals not only for the vitamins but also for specific nutrients such as the amino acids, minerals, trace minerals and fatty acids still remain largely unknown. Much work now in progress is designed to provide further information on these important points, but such studies require much time
and money so that the results will come slowly. Although chemical methods have been widely used to analyze feedstuffs, nevertheless, these methods are still being improved and new methods are being introduced for the determination of additional substances, such as vitamins and amino acids. In fact, it is the development of new methods which makes possible the work on exact nutritive requirements. Chemical methods, however, have serious shortcomings in that the results obtained are quantitative, not qualitative. That is, it is possible to determine the amount of protein, fat, fiber, carbohydrates, minerals, moisture, caloric energy and some of the vitamins, but it is never possible to determine by chemical means the biological efficiency of these substances. For example, two products can contain exactly the same amount of crude protein but one may have 50 to 100% higher biological value than the other. To supplement chemical tests and to provide more detailed information on the nutritive value of feedstuffs, biological methods employing laboratory animals have been developed and their use in testing animal feeds is increasing.

A problem in using biological tests is that such tests conducted on rats or other laboratory animals must be interpreted, insofar as possible, so that they apply to the animals fed the product. This is difficult. It requires specialized training and experience and in most instances the results should be confirmed on the animals for which a product has been prepared. The application of these new principles to animal feeding are rapidly taking hold throughout the country. Feed service men are in the field to aid with the education of the farmer and livestock owner and at the same time to sell their products. County agents, short courses, radio, and numerous other means for dissemination of information all contribute. However, the busy practitioner with limited library facilities must depend on current veterinary literature and meetings to keep himself informed.

Last year, foreseeing the difficulties ahead, Dr. H. W. Jakeman of Boston, president of the A.V.M.A., appointed a special committee on Nutrition. To this committee was delegated the task of organizing a program to disseminate information to the veterinary practitioners on recent developments in nutrition. Dr. H. J. Metzger of the N. J. Agricultural Experiment Station, is now the chairman of this committee. This new committee is outlining a basic program for making available to practitioners some of these developments. I wish, therefore, to transmit a message from this committee to members of the veterinary profession in attendance at this meeting.

The need for the dissemination of knowledge regarding the prevention and cure of deficiency diseases in animals under the care of veterinarians was recognized by the A.V.M.A. by the appointment of the Committee on Nutrition. This committee is still engaged in the process of developing a program which should carry the gospel of better animal nutrition to the profession. But—this committee is composed of only 5 men, living in four different states. It is impossible for them to anticipate questions which may need to be answered in all 48 states. We need 48 listening posts. Each of you are in a position which enables you to keep in close touch with the veterinarians in your respective states. It will be rendering a valuable service to this committee if you will inform them of any unusual nutritional problems coming to your attention so that they can pass this information on to the profession.
If these suggestions made by the Chairman of the Committee on Nutrition can be put into operation this winter, it will certainly assist in arousing the further interest of the practitioner in the importance of nutrition and its relation to livestock diseases.

As critical ingredients such as meat scraps, tankage, and milk by-products become harder to obtain as a result of the war, more and more effort will be made to substitute vegetable proteins such as soybean, linseed and cotton seed meals. Some animals can survive very well on an exclusive diet of vegetable protein, but as in animal proteins, the quality is extremely important. It is possible that work now in progress will show why animal proteins are of superior nutritive quality. We may then be able to supplement vegetable proteins with essential vitamins, minerals and amino acids and thus enhance their biological value to more nearly equal that of meat. At present we can substitute vegetable for animal proteins to a limited degree only but as a result of ingredient restrictions this is already being done on a large scale. What is going to happen when feeds deficient in some of these vital ingredients are fed to livestock? Nutritional deficiencies will develop. (See chart entitled "Influence of Some Ingredient Restrictions on Six Species"). If animals become ill as a result of being fed a diet of poor quality protein obviously the way to treat such a condition is to supply the quality proteins which contain the essential amino acids lacking in the diet. Drugs and biologics may be useful aids in controlling secondary infections but unless the primary causative factor is properly diagnosed and the necessary dietary corrections made, unsatisfactory results must be expected. When the lightning strikes in the form of disease the veterinarian is going to be called to diagnose the complicated situation and try to prescribe intelligently for the sick animals. If the practicing veterinarian is to make an accurate clinical diagnosis, it is essential that some of the modern developments in the medical sciences be applied to veterinary practice. To do this the assistance of well staffed diagnostic laboratories must be available. When an accurate diagnosis, based on clinical and laboratory findings has been made, only a few specific drugs or biologics are required. In many instances the application of sound principles of nutrition and hygiene is all that is necessary. Although drugs and biologics have their place in the armamentarium of the veterinarian, to bear too heavily or depend too much on the assistance of these agents will prove disappointing.

As a result of developments in the field of canine nutrition the veterinary profession goes into this war armed with reasonably valid information regarding the feeding of dogs. The same applies to the feeding of poultry, the requirements of chickens and turkeys having been explored rather well. The result is that we should be able to expand greatly and at the same time to produce more efficiently the huge quantities of poultry products that will be required, provided the necessary feed can be obtained. The nutritive requirements of sheep and cattle is on a more empirical basis, the exact vitamin requirements being very poorly worked out for these species. The ruminants, because of their physiological makeup, probably are much less critical in their protein and vitamin requirements than are swine, poultry or dogs, and will do well on grain, vegetable proteins, and good quality hay
and silage. Man power is probably the limiting factor in the production of beef and dairy products.

Swine present a somewhat more difficult problem. Although the hog produces meat from feed very efficiently, the feed must be of high quality and wartime limitations may cause difficulties. The hog requires most of the known vitamins as well as good quality protein and some of these may be lacking in restricted diets.

What about the equine species? Only very limited progress has been made in this direction. Unfortunately the horse and mule has been the most neglected in nutritional research of all our domesticated animals. Perhaps this is due to the fact that these animals are beasts of burden while cattle, sheep, hogs and poultry are the main food producing species that supply the proteins, fats and vitamins that help to make up a complete diet for the human race.

| Table 1.—Influence of some ingredient restrictions on six species |
|-------------------|------------------|---------|--------|--------|--------|
|                   | HORSES | CATTLE | SHEEP | SWINE | POULTRY | DOGS |
| Protein           |        | *      | *     | +     | +       | +    |
| Fat               |        |        |       |       |         | +    |
| Vitamins          |        |        |       |       |         |      |
| A                 |        | *      | +     | +     | +       | +    |
| B                 |        |        |       |       |         |      |
| Thiamin           |        |        |       |       |         | +    |
| Niacin            |        |        |       | +     | +       | +    |
| Riboflavin        |        |        |       |       |         | *    |
| D                 |        | *      | *     | *     | *       | +    |
| Minerals          |        |        |       |       |         |      |

Blank space affected very little; * = affected to some degree; + = seriously affected.

With the mud clogging the wheels of Mr. Hitler's airplanes and tanks on the steppes of Russia and with the opening of new theatres of war, day by day we can see the continued necessity for an efficient animal transportation system. How are these animals to be fed? Feeding stuffs are perhaps just as critical as petroleum. We cannot afford to ship quantities of roughages or poorly prepared horse and mule feeds all over the world. When horse feed is manufactured and shipped out with our troops as nourishment for transport animals it must be capable of doing the job when the demand arises. If this is to be accomplished efficiently then it is necessary that we apply modern knowledge to the problem. We can depend on our Veterinary Corps to see that this is done. The Corps is handicapped, however, by the lack of nutritional research which has been done on horses and mules during the last twenty years. Who could have anticipated five years ago that it would be sound business to make an investment in equine nutritional research. For hundreds of years it has been customary to attempt to cure with the firing iron skeletal diseases that had better be treated through the digestive tract by means of proper nutrition. It is up to the veterinarians and our biochemical
colleagues to think these problems through cooperatively and I am sure that out of it will come a better understanding of animal nutrition. To illustrate some of the influences of ingredient restrictions which may be encountered in feeding livestock and pet animals, see table 1.

If the veterinarian is to determine the cause of deficiency diseases, certain procedures are mandatory. In taking case histories more must be done than to inquire into what is being fed. It will be necessary to make a complete list of the ingredients in the ration which has been or is being fed to the sick animals. Very frequently when animals become ill the farmer promptly changes the diet. It will be necessary, therefore, to check back for several weeks and determine the average composition of the diet prior to the illness. In addition to obtaining thorough and careful information on the composition of the feed, he must also be aware of present shortages in critical ingredients in order to supplement deficient rations with available ingredients. This is not an easy assignment and will require study and experience. To further improve the work of the practitioner additional diagnostic laboratory services should be made available. Such laboratories properly equipped with facilities and personnel for the analysis of blood, urine and feces, bacteriological examinations, animal inoculations, examination of pathological specimens, etc., could render the veterinarian and the livestock owner a most valued service. If our State Veterinarians could assist with this type of service and it could be coordinated with the work of the practitioner, a superior type of professional service could be made available to the livestock industry. This is a sizeable undertaking, it will take time to work it out, but such a plan should be devised if we are to meet the food demands of lend-lease, and of our armed forces, and if we are to use food as a weapon for victory, and as a powerful influence in writing the peace. This constitutes a real challenge to the veterinary profession but we have a membership capable of meeting it. The services rendered by the veterinary profession of America are the finest in the world but they can and will be improved.

In conclusion I should like to offer for your consideration a few suggestions which might aid in advancing the program.

1—Our chief livestock sanitary officials might well consider making available for the benefit of the livestock industry thru practicing veterinarians facilities for the diagnosis of nutritional and infectious diseases of livestock.

2—The program committee of every state association should write to Dr. H. J. Metzger, chairman Committee on Nutrition, A.V.M.A., New Brunswick, N. J., and solicit the cooperation of this committee as well as the cooperation of the American Veterinary Medical Association to aid in formulating an educational program for the practitioner designed to aid him with the diagnosis and treatment of nutritional deficiency diseases of livestock.

3—The United States Livestock Sanitary Association, through its representative on the Inter-Association Committee, should make every effort to aid with and foster the plan of this committee which has been organized and is now developing a program to increase animal production and improve breeding efficiency so vitally necessary at this time.
THE VETERINARIAN'S RESPONSIBILITY IN THE
POULTRY WAR EFFORT

BY CLIFF D. CARPENTER

Allied Mills, Inc., Fort Wayne, Indiana

Just a year ago Japan sneaked into Pearl Harbor in an attempt to annihilate our Pacific defenses. This vicious attack forced our war production effort into high gear overnight.

To meet the necessary increases in food requirements for our Allies and our armed forces, farmers were given new high goals for 1942. These goals have been met, and the recently announced food production requirements for 1943, of necessity, are even greater. Because food is as important a supply item for our armed forces as ammunition, these goals must be met, even in the face of an acute farm labor shortage. Since mortality seriously threatens our egg and poultry output, the veterinarian is challenged anew to render a more complete service to poultry flock owners.

By the time the poultry farmer calls the practitioner, it is an assured fact that the disease has gained a definite foothold. The farmer is already losing either chickens or eggs or both, and his only concern is to have the flock "cured."

The first important principle in conducting a poultry practice is to impress the farmer that it is much more economical to avoid the conditions which bring about losses in egg production and birds, than to effect a cure.

Since the veterinarian has but few poultry specifics in his kit, he should impress the client with the necessity of correcting mismanagement factors before he may expect his birds to return to normal. Many times recovery is delayed because of failure to correct faulty management practices.

Thus the veterinarian must familiarize himself with fundamental management factors such as requirements per bird for floor space, mash and grain hopper space, water space, depth and absorption qualities of litter, nest space, light, and ventilation.

Lack of adequate floor space per bird presents a serious problem under present crowded conditions. It is an acknowledged fact that as floor space per bird decreases, mortality increases and egg production decreases. Farmers have housed more than 400,000,000 layers this fall—an all-time high in flock inventories. Since few new buildings for poultry have been constructed during the past year, the untenable conditions in many houses present a potential disease problem never before encountered in the history of the poultry industry.

The U. S. Department of Agriculture recently showed that the poultry mortality rate for the first 6 months of 1942 showed a sharp increase over the same period for 1941—and this year about 10% more layers will be housed than last, and virtually with the same housing capacity.

Fortunately the ill effects of crowding can be overcome to some extent by improving conditions within the house. Hopper space, water space, nests, and ventilation should be increased.
A highly absorbent litter, 5 to 8 inches in depth, should be used. Contrary to earlier belief, it is not necessary to change litter at frequent intervals. In fact, many successful poultrymen throughout the country now use an extremely deep litter, keep it well stirred, add new litter at frequent intervals, and, in the absence of a serious infectious disease, do not change the litter all winter. If part of the grain is hand fed in the litter daily, the birds will do the necessary stirring. This deep litter not only provides greater floor warmth but helps absorb the excessive moisture resulting from crowding. In spite of the impression that this practice seems unsanitary, it does not increase rate of mortality.

When aiding the farmer with a disease problem in the laying house, the veterinarian must know the total daily feed intake and the percentage of protein. The total daily feed intake and total daily protein intake must be sufficient to maintain body weight, keep the birds gaining in weight, and “manufacture” eggs. Many laying flocks reach a satisfactory production of 50 to 60 percent during October, only to slump seriously in November and December and not return to profitable production until late February or March. The veterinarian should remind the owner that fall and winter production is “out of season” production, and unless the birds are fed adequately, they will lay some eggs at the expense of their body weight. Nature, however, provides a check on production of this sort, and, when the body weight is reduced just so much, laying ceases, often followed by an expensive molt. In most cases these losses in egg production and the molt which is likely to follow these drops, can be avoided.

When body weight is lost, disease resistance is lowered, and when disease strikes under these conditions, the resulting mortality may be serious.

One hundred Leghorn pullets laying from 50 to 70% production should consume daily a minimum of 30 pounds of feed; 100 heavies laying at the same rate should consume daily 35 pounds of feed. The total ration should contain about 16 percent protein. If the birds are eating equal parts of a 20 percent mash and a 10 percent grain ration, it can be seen that this level is only 15 percent protein. When pullets are laying heavily in the fall and winter, often this amount of protein is inadequate, and a protein supplement is required as a “noon lunch,” or else the grain ration must be so controlled by hand feeding or covering the grain hoppers part of the day, that the birds are eating about 60 percent mash and 40 percent grain, to maintain the daily protein requirements.

Quality of ingredients is an essential consideration in any poultry ration. Many bright green colored alfalfas contain only 30,000 to 50,000 units of vitamin A per pound, in contrast to others less green in color, which may contain 3 to 4 times this amount.

Milk products, animal liver meal, fish meal, and alfalfa may be high or low in riboflavin. Again, certain fish oils may be high or low in vitamin D content.

These three vitamins must be provided in adequate amounts to assure normal body weight, high egg production, and to maintain normal resistance against disease. It is essential that the veterinarian advise the farmer that the only means of guaranteeing high vitamin content mashes is to rely upon a feed in which the ingredients have been biologically, as well as chemically, tested.

Quality of protein in the mash is just as important as the vitamin content. The
A veterinarian may explain to the feeder that the leather in the shoes he is wearing contains a definite amount of protein, almost all of which would be worthless if ground and fed to a chicken or turkey. A guarantee of the amount of crude protein on the feed tag is not a guarantee of its quality.

Light is of extreme importance in the laying house. In the absence of olfactory bulbs, chickens depend upon their keen vision in selecting their food. Mash hoppers should be placed parallel to the incoming light, so that both sides of the hopper will be equally well lighted. Artificial lights should be used during the fall and winter months to give the layers a 13-14 hour day. This is necessary not only to permit greater feed consumption to support “out-of-season” egg production, but, since the rate of ovulation is determined by the intensity of light, a definite wattage per hundred square feet of floor space is necessary. To stimulate high egg production, one watt of light should be provided for each 5 square feet of floor space. Each light should be provided with a reflector so that all of the light rays will be shed downward.

The welfare of the flock, rather than that of the individual, must be taken into first account. Individual sick birds should be isolated from the flock, and those with little chance of making a profitable recovery should be destroyed.

Few poultry diseases respond to medication alone. If, however, medication is indicated, the veterinarian should point out to the owner that proper feed and care are of equal or superior importance. Just as the veterinarian prescribes diet and suitable environment for sick animals, he likewise must apply sound husbandry knowledge to the poultry house, else all his medical skill will avail him but little in the control of poultry diseases. The urgency for conserving every chicken and every egg magnifies this responsibility during these critical times. The physician relies upon the nurse and not the patient to supervise the environment and diet of the sick; thus, the flock owner should be advised of these necessary nursing measures if results are to be obtained.

A disinfectant may be added to the drinking water, particularly when the disease is one of a respiratory nature. It is essential, however, that one of the sodium hypochlorites be used so that the color of the drinking water will not be changed. It has been shown that when the appearance of the drinking water suddenly is altered, water intake is lowered, thus impeding recovery.

The Poultry Committee of the American Veterinary Medical Association recently concluded a year of stepped-up activity dedicated to increasing the nation’s egg production by improving livability, especially in laying flocks. Early in the year they submitted to the Bureau of Animal Industry a plan and a definite program which later was officially approved. The plan incorporated 4 major measures, namely improved breeding, improved nutrition, improved management and specific disease control. They pointed out that the rate of mortality in adult fowl already is the limiting factor in the poultryman's annual production; that the poultry industry suffers the greatest annual loss of any livestock pursuit.

The Committee contended that no new research is necessary to bring about a huge reduction in mortality—that if known methods of disease prevention and control were applied to the industry as a whole, mortality could be reduced 50 percent in one year.
In the face of a 4,000,000,000 pound shortage of meat for our 1943 military and civilian requirements, the production of poultry meat and eggs must not be slackened by a lack of veterinary assistance.

For several years veterinary leaders in poultry work throughout the country have stressed the importance of providing adequate veterinary service to the poultry farmer and their efforts have produced a measure of results. Much improvement has been noted, particularly in the Midwest, where the poultry disease problem on the general farm is most acute.

Under the sponsorship of the Poultry Committee of the American Veterinary Medical Association, a full program of poultry aids for the practitioner was presented at the 1942 annual meeting. Two hundred and fifty veterinarians observed demonstrations and listened to practical talks by poultry pathologists and practitioners. Since this meeting was labeled "an experiment," the attendance and interest were highly gratifying. A unanimous vote by those present to request similar conferences at future annual meetings, indicated not only that this type of poultry meeting is helpful, but that the average general practitioner is ambitious to better serve the poultry interests of his clientele.

Further, it can be said that the industry now is especially aware of the need for trained, competent assistance in the control of disease, and will look more to the veterinarian for guidance in protecting the health of their flocks.

Veterinary extension schools, local and state association clinics, and short courses sponsored by state colleges and universities, have contributed much toward an improved veterinary poultry service.

Finally, when veterinary colleges have incorporated in their curricula required courses in poultry nutrition and management, along with more intensive training in clinical poultry medicine, then and only then can we expect the wasteful mortality experienced by the poultry industry to recede to a reasonable point.

This closer relationship which should result from urgent wartime needs will remain of mutual permanent value in the years to come.
SALMONELLA INFECTIONS COMMON TO MAN, ANIMALS, AND BIRDS

By C. W. Darby and H. J. Staffeth

Because of the complex interrelationships of Salmonella infections in man and animals, this genus has been of interest to a large group of scientific workers. Clinicians, research workers, and sanitarians in both human and veterinary medicine have been vitally concerned in the study of this group of organisms. As the efforts of this varied group of workers are compiled from year to year, the interrelationship between infections of man and animals and between species of animals becomes more apparent and complex.

It is the purpose of this paper to review the recorded species incidence of members of the genus Salmonella in farm poultry (mainly chickens and turkeys) in the United States. After tabulation of this material, we will endeavor to point out the incidence of these organisms in man and domestic animals with some of the complicating public health problems.

Because of the numerous references to paratyphoid (paratyphoid is used in this paper to include all motile members of the genus Salmonella thus excluding S. pullorum and S. gallinarum) organisms in the literature we will endeavor to cite only the essential material needed for reference and draw freely on cited literature reviews.

Although numerous references have appeared in the literature concerning Salmonella species affecting, or found in poultry, Edwards (16) in 1939 has recorded a most impressive list of organisms. His work covered the identification of 223 cultures from 100 different outbreaks from chickens, turkeys, ducks, pigeons, pheasants, quail, and canaries. He listed them in the order of frequency of occurrence as follows: S. typhi murium, S. anatum, S. newington, S. senftenberg, (26) S. derby, S. bareilly, S. newport, S. oranienberg, S. kentucky, S. montevideo, S. bredeney, S. worthington, S. london, S. muenchen, S. minnesota, and S. newbrunswick. In this list S. pullorum and S. gallinarum have not been included. Edwards also discusses the advantages of serological typing and the public health aspects of these paratyphoid organisms.

In 1939 Edwards and Bruner (17) reported four additional Salmonella species: S. enteritidis, S. california (27, S. typhi murium var. copenhagen and S. give.

1 Journal Article No. 618 (n.s.) from the Michigan Agricultural Experiment Station.
Mallmann, Ryff and Matthews (18) reported isolations from chickens which add *S. paratyphi* B, *S. urbana*, *S. aberdeen*, and *S. hvittingfoss*.

Jungherr and Clancy (19) added *S. typhi muriurn* var. *bivins* and Jungherr and Borden (20) described *S. typhi muriurn* var. *storris* infection of chicks.

Pomeroy and Fenstermacher (21), in a discussion of paratyphoid infection in turkeys, added *S. vichia*, *S. eastbourne*, *S. chester*, *S. meleagridis* (28) and *S. saint paul*.

Edwards and Bruner (22) reported *S. illinois*, found in hogs in Illinois, Hungarian partridges in Michigan and turkeys in Minnesota. They (23) described two additional species *S. oregon* (from hogs and turkeys) and *S. manhattan* (from chickens and turkeys). *S. litchfield* and *S. saint paul* (previously mentioned) were described by Edwards and Bruner (24) in 1940.

From the report of Bruner and Edwards (25) *S. cholerae suis* incidence is quite rare in fowls. They have found it only once from fowls and once from a canary.

Jungherr (30) in 1940 published an excellent discussion of paratyphoid infections in birds; this includes a discussion of the Kauffmann-White classification, occurrence, symptoms and lesions of paratyphoid infections, public health importance and control. He has stated that *S. enteritidis* var. *essen*; *S. enteritidis* var. *dublin*, now *S. dublin* (11); and *S. amersfoort* are found in poultry. To date these have not appeared in the literature occurring in poultry in the United States.

Since *S. typhi muriurn* var. *copenhagen*, *storrs* and *bivins* are not recognized by the Sub-committee on Nomenclature as separate species (11) these varieties will be considered merely as *S. typhi muriurn*. By placing these *Salmonella* species, found in fowls, in the proper groups of the Kauffmann-White schema (11), we have compiled the following table (Table I).

| TABLE I.—Paratyphoid organisms found in fowls in the United States |
|-----------------|-----------------|-----------------|-----------------|
| GROUP B         | GROUP C         | GROUP D         | FURTHER GROUPS   |

Excluding the three varieties of *S. typhi muriurn*, but including the newly described species, we have listed thirty-three species of the genus *Salmonella* that may be encountered in fowls in the United States. By adding *S. pullorum* (not recognized as a species, see *Salmonella* Sub-committee (11)) and *S. gallinarum*, 35, or nearly one-half of the recorded *Salmonella* species may be encountered in fowls.
SALMONELLA INFECTIONS

RECORDED INCIDENCE OR PATHOGENICITY OF SALMONELLA TYPES FOUND IN FOWLS

This work was primarily designed to study the incidence of these organisms in man and the common domestic animals. A great deal of work has been done on paratyphoid in foxes and other fur bearing animals. Reviews of this nature covering other fields of paratyphoid incidence would be very enlightening and useful.

The following material is given, not with the thought that it is complete in any sense, but merely as an attempt to start an evaluation of the paratyphoid group both in human and veterinary medicine.

Unless specific reference to other literature is made the following material on incidence and pathogenicity of the Salmonella species is taken from Topley and Wilson (15).

Group B

1. *S. paratyphi* B is a common cause of enteric fever in man, occasionally acute gastro-enteritis. Bornstein et al (34) recorded a fatal case of typhoid-like fever from which *S. paratyphi* B was isolated. They cited references to isolations from animals. It has been recorded as found in hogs by Bruner and Edwards (25). Bahrenburg and Ecker (39) incriminated this species as the cause of a fatal case of meningitis in man. It is reported found in infantile infections in South America by Hormaeche and Peluffo (14).

2. *S. saint pauli*. Bornstein and Saphra (36) have encountered this organism in the stool and urine of a patient with intermittent fever. Edwards and Bruner (24) reported finding *S. saint pauli* in turkeys.

3. *S. typhi murium*. This is the commonest and most wide-spread of the paratyphoids. It has been incriminated in gastro-enteritis (food-poisoning) in man. This organism has numerous synonyms, some of which are: *Bact. aertrycke, Bact. typhi murium, Salmonella aertrycke, B. pestis caviae, Bact. psittacosis, "Breslau bacillus," B. paratyphi, B type Breslau*. It is a natural pathogen of rodents, and has also been found in infections in guinea-pigs, parrots, sheep, pigeons, chicks, turkeys, canaries, ducks, and pigs (see Topley and Wilson (15) for cited references). Bornstein, Saphra and Strauss (34) described the isolation of *S. typhi murium* (blood cultures) from a fatal case of endocarditis in man. Rubin et al. (35) recorded the isolation of *S. typhi murium* from the lymph nodes of normal hogs. Hormaeche and Peluffo (14) have isolated this species from a varied assortment of infantile infections (mainly enteritis). Henning (38) described an outbreak of purulent arthritis in foals caused by the Copenhagen var. of *S. typhi murium* and has isolated this species from cattle and sheep in South Africa (13). He cited numerous instances of similar reports. Dimock, Edwards and Bruner (44) have recorded *S. typhi murium* infection in horses following treatment for intestinal parasites. Hinden (49) reported that this organism was the cause of 24 cases of poisoning (probably infection-authors) in a children's hospital ward. The source was unknown.

4. *S. chester*. Bornstein et al. (34) have isolated *S. chester* twice from man affected with gastro-enteritis. They cited that Hormaeche had isolated this organism from healthy hogs. They have also encountered *S. chester* in a healthy human carrier.
C. W. DARBY AND H. J. STAFSETH

Hormaeche and Peluffo (14) have isolated the same species from infantile infections in South America.

5. *S. derby* has been isolated from cases of food poisoning in man, and from swine that had died of swine fever. Bornstein et al. (34) encountered *S. derby* five times in man in cases of gastro-enteritis—also in healthy human carriers. Rubin et al. (35) found this organism in the lymph nodes of apparently normal hogs. It was also isolated from hogs by Ferrario (41) and from infected infants by Hormaeche and Peluffo (14) in South America.

6. *S. california* was reported in turkeys by Edwards, Bruner and Hinshaw (27).

7. *S. bredeney*. In a case report Hinshaw, Taylor and McNeil (33) described *S. bredeney* infections in chukars, turkeys, and ducks in California. They also cited references to *S. bredeney* infections in man associated with diarrhea, osteomyelitis, enteritis, and one with an abscessed jaw. They cited other references to *S. bredeney* infections in turkeys as well as in quail and guinea fowl. *S. bredeney* was also isolated once from the mesenteric lymph node of an apparently normal hog by Rubin et al. (35). Hormaeche and Peluffo (14) isolated it from infantile infections in South America.

8. *S. cholerae suis*. The historic "hog-cholera" bacillus is an important secondary invader in hog cholera, and apparently plays a role in enteritis of swine. It has been isolated from dogs and may occasionally cause acute gastro-enteritis in man. Bornstein et al. (34) have frequently encountered this organism in human infections and it was recovered in pure culture from cases of pleuritis, blood cultures from bronchopneumonia, peritonitis, abscesses, septicemias, and endocarditis. They (34) also found this organism in infantile infections. Rubin et al. (35) isolated the kunendorf variety from the lymph nodes of normal hogs. A case report is submitted by Neter (37) of a bacteremia in a boy caused by this species. Neter cited numerous references to *S. cholerae suis* infections in humans covering a wide variety of pathological conditions. The kunendorf variety was isolated from infantile infections in South America by Hormaeche and Peluffo (14).

9. *S. oranienburg*. *S. oranienburg* was first isolated from cases of food poisoning in man. Bornstein et al. (34) isolated *S. oranienburg* from the peritoneum in a case of fatal cholecystitis and peritonitis, also from a healthy carrier. They isolated this once from an infected infant. Hormaeche and Peluffo (14) isolated it from infected infants in South America.

10. *S. manhattan* has been recorded by Edwards and Bruner (23) isolated from a chicken and a turkey. Bornstein and Saphra (34) have found this species in man in Massachusetts.

11. *S. bareilly* was isolated from humans affected with mild enteric infections in India. It was found by Bornstein et al. (34) in appendicitis and cholecystitis in humans, also once from an infected infant. Rubin et al. (35) and Bruner and Edwards (25) have encountered this organism in hogs.

12. *S. montevideo* was found in infected humans by Bornstein et al. (34); also in one healthy human carrier. Hormaeche and Peluffo (14) found this species in infected infants in South America.

13. *S. newport* was isolated from cases of food poisoning in man and also from the feces of a dog. It was found in human infections by Bornstein et al. (34). They also
recorded *S. newport* in diarrhea of infants. Bruner and Edwards (25) recorded it found in hogs. Hormaeche and Peluffo (14) described *S. newport* infections in infants in South America; a similar report is cited by Sosa (42) in Argentina. Eriksson and Malmstrom (47) described eight cases of gastro-enteritis resulting from eating smoked ham. *S. newport* was incriminated in this outbreak.

14. *S. muenchen* was isolated from a fatal case of gastro-enteritis. Bornstein et al. (34) reported it from infected humans. They also isolated this organism from an epizootic in guinea pigs in New York City. It was isolated from infections of infants in South America by Hormaeche and Peluffo (14).

15. *S. oregon* was recorded by Edwards and Bruner (23). It was isolated from a turkey and from the mesenteric lymph node of an apparently normal hog.

16. *S. litchfield*. Edwards and Bruner (24) pointed out that this organism has been isolated from a case of food poisoning in man and also from an outbreak of paratyphoid infection in turkeys.

**Group D**

17. *S. enteritidis*. There have been numerous reports of isolations of this organism in man. It has been isolated from cattle, and is probably a natural pathogen of rodents. Bornstein et al. (34) have encountered this organism frequently in animals. Henning (13) has isolated it from cattle in South Africa. The majority of infections in cattle are apparently due to the dublin variety, now *S. dublin*. Guthrie and Montgomery (46) described twenty-seven cases of *S. enteritidis* infection in children. This appeared in epidemic form in a maternity hospital with milk as the probable source; more than one-half of the children died. All had enteritis, some enteritis with septicemia, purulent meningitis, and cholecystitis. Christiansen (48) reported the isolation of this species from abscesses of the mesenteric lymph nodes of the colon and caecum of a horse, and from verminous thrombi of the mesenteric arteries of a horse.

18. *S. eastbourne* was isolated from a case of enteric fever in man. Bornstein and Saphra (36) reported that this species was isolated in Havana from the spinal fluid of a young child with fatal meningitis.

**Group E**

19. *S. london* was isolated from human feces. It was also isolated from pigs by Hormaeche (cited by Bornstein (34)). Bruner and Edwards (28) encountered it in a chicken. Saito (45) has studied five cases of *S. london* infection in man, one of which was fatal.

20. *S. give* was isolated from human sources by Bornstein et al. (34) and was recorded in turkeys and chickens by Bruner and Edwards (28). It was found in the mesenteric lymph nodes of apparently normal hogs by Rubin et al. (35).

21. *S. anatum*. *S. anatum var. muenster* has been isolated from cases of food poisoning in man. Bornstein et al. (34) isolated it from man. It was recorded in turkeys, chickens and ducks by Bruner and Edwards (28). Rubin et al. (35) isolated it from the mesenteric lymph nodes of apparently normal hogs. It was found in hogs by Bruner and Edwards (25). Hormaeche and Peluffo (14) incriminated it in infected infants in South America.
22. *S. nevington* was isolated from pigs by Hormaeche (cited by Bornstein (34)). Bruner and Edwards (28) isolated it from turkeys, chickens and a duck. It was found in the mesenteric lymph node of an apparently normal hog by Rubin et al. (35). Bornstein and Saphra (36) have isolated this species from three cases of gastroenteritis in humans and from New York sewage. Hormaeche and Peluffo (14) isolated it from infected infants in South America.

23. *S. senftenberg* was isolated from cases of acute gastro-enteritis in man. It was found by Bornstein et al. (34) in Chinese dried eggs. Bruner and Edwards (28) isolated it from turkeys, chickens and man (normal carrier). Bornstein and Saphra (36) have isolated this species from a normal carrier, and cited Hormaeche as having found it in children in South America. Hormaeche and Peluffo (14) isolated it from infected infants in South America.

24. *S. new brunswick* was found in turkeys, a chicken, and a hog by Bruner and Edwards (28), and in the mesenteric lymph node of an apparently normal hog by Rubin et al. (35).

25. *S. aberdeen* was isolated from a case of acute gastro-enteritis in man.

26. *S. worthington*. Bornstein and Saphra (36) found this species in a stool culture from a case of enteritis in man. They cited Edwards and Bruner as having found it in a child, probably a carrier.
27. *S. wichita*. Bornstein et al. (34) recorded six isolations of this organism from diarrhea in infants. Two of these cases were fatal. It has been found in turkeys by Edwards. Bruner and Edwards (25) also recorded this organism as having been found in hogs.

28. *S. hvittingfoss* was isolated from cases of gastro-enteritis in man which occurred in Hvittingfoss, Norway. (52)

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<tr>
<th>TABLE II-C.—Salmonellas of group D</th>
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<tbody>
<tr>
<td>SPECIES</td>
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<tr>
<td>17. <em>S. enteritidis</em></td>
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<tr>
<td>18. <em>S. eastbourne</em></td>
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Salmonellas of group E

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>MAN</th>
<th>FOWLS</th>
<th>HORSES</th>
<th>CATTLE</th>
<th>SHEEP</th>
<th>SWINE</th>
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<tbody>
<tr>
<td>19. <em>S. london</em></td>
<td>+</td>
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<td>20. <em>S. give</em></td>
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<tr>
<td>21. <em>S. anatum</em></td>
<td>+</td>
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<tr>
<td>22. <em>S. newington</em></td>
<td>+</td>
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<tr>
<td>23. <em>S. senftenberg</em></td>
<td>+</td>
<td>+</td>
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<tr>
<td>24. <em>S. new brunswick</em></td>
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<tr>
<th>TABLE II-D.—Salmonellas of further groups</th>
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<tr>
<td>SPECIES</td>
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<td>-----------------------------------</td>
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<tr>
<td>25. <em>S. aberdeen</em></td>
</tr>
<tr>
<td>26. <em>S. worthington</em></td>
</tr>
<tr>
<td>27. <em>S. wichita</em></td>
</tr>
<tr>
<td>28. <em>S. hvittingfoss</em></td>
</tr>
<tr>
<td>29. <em>S. kentucky</em></td>
</tr>
<tr>
<td>30. <em>S. minnesota</em></td>
</tr>
<tr>
<td>31. <em>S. meleagridis</em></td>
</tr>
<tr>
<td>32. <em>S. illinois</em></td>
</tr>
<tr>
<td>33. <em>S. urbana</em></td>
</tr>
</tbody>
</table>

29. *S. kentucky*. Bornstein et al. (34) cited Edwards as having encountered this organism in man. Bornstein and Saphra (36) have isolated *S. kentucky* from a case of gastro-enteritis of man in Pennsylvania.

30. *S. minnesota* was isolated from infected infants in South America by Hormaeche and Peluffo (14).

31. *S. meleagridis* was found in turkeys and a chicken by Bruner and Edwards (28), Bornstein and Saphra (36) reported receiving a culture of this species from Venezuela, originally isolated from a human suffering with typhoid-like fever.

32. *S. illinois* has been found in hogs, Hungarian partridges, and turkeys (22).

33. *S. urbana*. Edwards and Bruner (29) reported that this organism was isolated from the blood and contents of the colon of a hog showing hemorrhagic enteritis.
This culture was isolated from chickens by Mallmann (18). Bornstein and Saphra (36) have found this species in two humans with enteritis and in one healthy carrier.

Tables II A, B, C and D show the above data in a tabulated form. A brief study of these tables will point out that practically all of the Salmonellas isolated from birds have also been incriminated in a variety of pathological conditions in man.

**DISCUSSION**

Our primary problem is to determine the importance of these paratyphoid organisms as they directly affect fowls. In the literature cited it has been clearly shown that they are responsible for much of the death losses in chicks and poults. Their role in the adult bird, other than a carrier state, is not well known. A portion of our experiment station work is now devoted to this problem.

**TABLE III.** Isolations of salmonella from college flock by Mallmann et al. (18)

<table>
<thead>
<tr>
<th>Salmonella species</th>
<th>No. Isolated</th>
<th>No. of Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella california</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Salmonella worthington</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Salmonella oranienburg</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Salmonella paratyphi B</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Salmonella give</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Salmonella new brunswick</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Salmonella urbana</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Salmonella aberdeen</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Salmonella hvingfoss</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Salmonella muenchen</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

Table III is taken from Mallmann, Ryff and Matthews (18). Since the source of this material was the Michigan State College flock, a fairly complete history of the birds is available. A study of this table shows that ten different species of Salmonella were isolated, all of which are potentially pathogenic for man. Most of these cultures were obtained by culturing pieces of intestine submitted from our poultry pathology department.

Table IV is taken from Ryff and Corbett (53). The source of these cultures was also the college flock taken the year following Mallmann's isolations. As indicated in their table a few of these cultures were from outside consignments. Again these were cultures obtained from chicken intestines. The data show the cultures isolated and the gross diagnosis at autopsy. This study was not comprehensive enough to warrant a correlation between cultures isolated and necropsy diagnosis. It is of interest to note that Ryff and Corbett isolated six Salmonella species (S. pullorum and S. gallinarum excepted) and only two, S. oranienburg and S. paratyphi B were isolated by Mallmann. In the two investigations fourteen different Salmonella species have been isolated from one flock.

The public health aspects of these findings are undetermined. A survey of the
European literature reveals numerous references to paratyphoid food poisoning or infections incriminating duck eggs. That paratyphoid in ducks is important to public health was pointed out by Clarenburg (31) in 1939. Henning (13) also cited numerous cases of food poisoning traced to duck eggs. Lerche (22) presented a comprehensive report of paratyphoid infections in poultry; he has discussed the public health prob-

<table>
<thead>
<tr>
<th>TABLE IV.—Isolations of salmonella from college flock by Ryff and Corbett (63)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOURCE</strong></td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>Private</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Private</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
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<tr>
<td>College</td>
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<tr>
<td>College</td>
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<td>College</td>
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<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Private</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>College</td>
</tr>
</tbody>
</table>

lems of these infections. His discussion deals primarily with the conditions encountered in Europe.

There are very few reports incriminating chickens and turkeys as sources of human food poisoning. The material reviewed in this paper shows, however, that there is a strong possibility that this may take place. A great deal of work must be done before this problem is settled.

Mallmann (18) fed the sub-cultures of the ten paratyphoids, isolated from chickens to monkeys without apparent deleterious effects. In any consideration of the patho-
genicity of the paratyphoid group it must be remembered that these organisms are encountered generally in diseases of the young, whether man, animals or birds. Table V is taken from Hormaeche and Peluffo (14) to emphasize this point. Their data also show the role played by Salmonellas in enteritis in infants.

**Table V.—Mortality from infantile enteritis (14)**

<table>
<thead>
<tr>
<th>AGES</th>
<th>SALMONELLA</th>
<th>SHIGELLA</th>
<th>CAUSES UNKNOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Deaths</td>
<td>Per cent</td>
</tr>
<tr>
<td>0-1</td>
<td>46</td>
<td>14</td>
<td>30.43</td>
</tr>
<tr>
<td>1-2</td>
<td>21</td>
<td>3</td>
<td>14.27</td>
</tr>
<tr>
<td>2-3</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3-12</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table VI—Diagrammatic presentation of data from Ostrolenk and Welch (43)**

Hedstrom (50) described a paratyphoid outbreak in poultry caused by *S. typhi murium*. In this outbreak the losses were heavy among the young birds. About two weeks after the outbreak started in the poultry, four adult members of the family became ill. *S. typhi murium* was isolated from the feces and agglutinins were demonstrated in the blood serum of the patients.
SALMONELLA INFECTIONS

Braga (51) has shown the possibility of hen's eggs being carriers of paratyphoid organisms. He isolated organisms from two of 249 hen's eggs examined and from associated typhoid-like human cases.

Wanner (54) demonstrated paratyphoid organisms in apparently healthy birds. He has also shown that the organisms may be obtained from the shells, yolks, and whites of eggs laid by infected birds.

References have been found incriminating pigeons (56), cats (55, 57) and dogs (58, 59) as sources of paratyphoid in man. Although it has been assumed, and in a few instances proved that paratyphoid organisms may be carried by flies, we believe the work of Ostrolenk and Welch (43) very appropriate in a paper of this nature. The following is a tabulation of their data.

1. Flies fed on food infected with S. enteritidis are capable of infecting other flies, food, water and surfaces with which they come in contact.
2. S. enteritidis apparently survives in the fly during its life-span; approximately four weeks.
3. Transfer of S. enteritidis from infected flies to mice and retransfer of infection from infected mice to flies was demonstrated.
4. Fly eggs planted in mash infected with S. enteritidis resulted in infected maggots, pupae and adults.

We have presented this data diagrammatically in Table VI.

This material has been presented to stress the important role flies may play in paratyphoid of man and animals.

SUMMARY

1. A review of the literature shows that 35 species of the genus Salmonella have been found in poultry in the United States.
2. Literature has been cited incriminating most of these species in pathological conditions in man.
3. Their incidence in other food-producing animals has been shown.
4. The importance of Salmonellas occurring in poultry to public health has not been determined.
5. Their importance in adult flock morbidity and mortality is uncertain.
6. Experimental data have been cited definitely incriminating flies as vectors of paratyphoid organisms.

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17. **EDWARDS, P. R., AND BRUNER, D. W.**: The antigenic analysis of salmonella species derived from domestic animals. 3rd International Congress for Microbiology, 629–630, 1940.


AVIAN PNEUMOENCEPHALITIS

By J. R. Beach

Division of Veterinary Science, University of California

During 1940, a type of nervous disorder which had not been seen previously, or at least in a sufficient amount to attract attention, occurred in many flocks of growing chicks in one poultry district in California. Nearly all outbreaks either accompanied or closely followed a respiratory disease which was believed to be infectious bronchitis. Failure of studies at that time to reveal the cause of the nervous disturbance or that it was related to the respiratory disease led to the belief that a nervous disorder of unknown origin was occurring coincidentally with infectious bronchitis, a conception since found to be incorrect. Instead, the respiratory trouble has been shown to be distinct from infectious bronchitis and a part of a disease in which both the respiratory organs and the central nervous system are involved. This disease became known as "a respiratory-nervous disorder." It seems appropriate, however, that this be replaced by the descriptive scientific name of "avian pneumoencephalitis."

In studies at the University of California and the California State Department of Agriculture during the present year (1942), it has been found that the disease is not confined to growing chicks but also occurs in nearly mature pullets and laying chickens of any age and has a wide distribution in the State. Furthermore, it has been identified in one flock of turkeys by Hoffman and in another by the writer.

CAUSE

Pneumoencephalitis is caused, as was first determined by Stover, by a virus which readily passes Berkefeld N and medium grade Mandler candles and gradicol membranes of medium porosity. Stover reports success in all of 3 attempts at filtration through Berkefeld W candles.

The virus has been shown to be present in the lung, spleen, and brain tissue and in the circulating blood and tracheal exudate of chickens during the early stages of the disease. It has been demonstrated in blood taken from chicks by cardiac puncture on the third day after inoculation and before any symptoms had developed. Virus has also demonstrated in the intestinal contents of dead chicks and in the night feces of sick chicks collected the following morning.

The results of inoculation of a large number of chicks indicates that the concentration of virus in tissues of naturally infected chickens is apt to be relatively low. After a few passages through chickens, however, the amount or virulence of virus has increased so much that fatal infection has been produced by inoculation with 0.1 cc. of dilutions of lung, brain and spleen as high as $10^{-4}$. The amount or virulence of virus in the tissues, however, has been found to decrease so quickly after the onset of the disease that inoculation with material from field cases and even very severe cases of artificially induced infection of a few days standing has in numerous instances yielded negative results. By inoculating chicks with different
tissues from the same infected chickens, the virus has been found more consistently in the lung than in the other tissues or tracheal exudate (table 1).

**PRESERVATION OF THE VIRUS**

Virus in lung, desiccated in vacuo over phosphorous pentoxide and stored in the refrigerator, has remained viable for 195 days. In tissues suspended in 50 per cent glycerin and stored in the refrigerator, the virus was unchanged in 50 days, but in 85 days its virulence had appreciably decreased. Virus in sealed ampoules stored

<table>
<thead>
<tr>
<th>INOCULUM</th>
<th>NUMBER INOCULATED</th>
<th>NUMBER CASES OF</th>
<th>INCUBATION PERIOD</th>
<th>NUMBER NOT INFECTED</th>
<th>NUMBER CLINICAL CASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung.</td>
<td>115</td>
<td>107</td>
<td>8</td>
<td>4</td>
<td>99</td>
</tr>
<tr>
<td>Brain.</td>
<td>111</td>
<td>93</td>
<td>11</td>
<td>4</td>
<td>84</td>
</tr>
<tr>
<td>Lung.</td>
<td>44</td>
<td>43</td>
<td>1</td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td>Spleen.</td>
<td>40</td>
<td>33</td>
<td>7</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>Lung.</td>
<td>18</td>
<td>16</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Blood.</td>
<td>21</td>
<td>9</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Lung.</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Tracheal exudate.</td>
<td>9</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

* Chicks developed definite symptoms.
† Chicks developed no symptoms but were refractory to reinoculation.
‡ Average.
§ Chicks developed no symptoms and were susceptible to reinoculation.

in a "dry-ice" refrigerator has retained full virulence for 7 months, the longest period tested.

**NEUTRALIZATION OF THE VIRUS**

Since viruses, as a class, are neutralized by immune serum, it was of interest to determine whether this virus was typical in this respect. Immune serum was obtained from a chicken which had survived infection with Strain 1 virus and was refractory to reinoculation with the same virus. Normal serum for use as a control was obtained from a stock chicken. Mixtures of serum and previously titrated virus were prepared in which the concentration of virus was at least 100 times that necessary to infect. The mixtures were kept at refrigerator temperature for 4 hours before they were used for inoculation of chickens. The amounts of serum and virus used and the results of the inoculations are given in table 2.

From the data given in table 2, it is seen that chickens were not infected by intra-
muscular injection of at least 100 times the minimum infective dose of virus when it was mixed with an equal volume of immune serum. The relatively less severe infection in chickens inoculated with mixtures of serum diluted 1-10 and virus suspension indicated that partial neutralization of the virus had occurred. The effects of injection of mixtures of more dilute immune serum or undiluted normal serum and virus suspension were not different from those of inoculation with virus suspension alone.

### TABLE 2.—Neutralization in vitro of strain 1 virus with blood serum of a chicken immunized against strain 1 virus

The chickens were inoculated by intramuscular injections of 0.1 cc.

<table>
<thead>
<tr>
<th>VIRUS</th>
<th>SERUM</th>
<th>CHICK NUMB.</th>
<th>AMOUNT SERUM</th>
<th>AMOUNT VIRUS DIL.</th>
<th>RESULTS</th>
<th>INCUBATION PERIOD</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain 1. 7070 trex. culture. Generation. 20. 1–500 dilution of embryo</td>
<td>7357</td>
<td>7664 7665</td>
<td>.05</td>
<td>.05</td>
<td>-</td>
<td></td>
<td>Chicks susceptible to subsequent inoculation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7666 7667</td>
<td>.005</td>
<td>.05</td>
<td>+</td>
<td>6</td>
<td>Both had nervous symptoms. One died, one recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7668 7669</td>
<td>.0005</td>
<td>.05</td>
<td>+</td>
<td>5</td>
<td>Both had nervous symptoms. Both died</td>
</tr>
<tr>
<td>Normal stock chick</td>
<td>7670</td>
<td>7671</td>
<td>.05</td>
<td>.05</td>
<td>+</td>
<td>5</td>
<td>Both had nervous symptoms. Both died</td>
</tr>
<tr>
<td>None</td>
<td>7672</td>
<td>None</td>
<td>.05</td>
<td>+</td>
<td></td>
<td></td>
<td>Both had nervous symptoms. Both died</td>
</tr>
<tr>
<td></td>
<td>7674</td>
<td>None</td>
<td>.005</td>
<td>+</td>
<td>4–5</td>
<td></td>
<td>Both had nervous symptoms. Both died</td>
</tr>
<tr>
<td></td>
<td>7676</td>
<td>None</td>
<td>.0005</td>
<td>+</td>
<td></td>
<td></td>
<td>Both had nervous symptoms. One died, one survived</td>
</tr>
</tbody>
</table>

**EMBRYO CULTURE OF THE VIRUS**

Cultivation of the virus in chick embryos 8 to 10 days old has been successfully accomplished by inoculation on the chorio-allantoic membrane using the Burnet method.
Table 3.—Examples of isolation of the virus by embryo culture from material in which the virus content was too small for detection by inoculation of chickens

<table>
<thead>
<tr>
<th>INOCULUM</th>
<th>RESULTS OF INOCULATION OF CHICKENS</th>
<th>VIRUS ISOLATED IN CULTURE</th>
<th>FIRST GENERATION OF THE CULTURE AT WHICH THE EMBRYOS WERE DEAD</th>
<th>TESTS FOR VIRUS IN EMBRYONIC TISSUES BY INOCULATION OF CHICKENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood, strain 1</td>
<td>-</td>
<td>+</td>
<td>7th 6th 10th 16th</td>
<td>C-A†</td>
</tr>
<tr>
<td>Berkefeld N filtrate of tracheal exudate, strain 1</td>
<td>-</td>
<td>+</td>
<td>6th 6th 10th 16th 19th</td>
<td>C-A C-A C-A Emb.†</td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Fr.</td>
<td>+</td>
<td>1st 3rd 4th 10th</td>
<td>C-A C-A D</td>
<td>+</td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Bi.</td>
<td>-</td>
<td>+</td>
<td>3rd 6th 10th 14th 22nd 26th 38th</td>
<td>C-A C-A Emb. Emb. Emb.</td>
</tr>
<tr>
<td>Blood, strain C</td>
<td>-</td>
<td>+</td>
<td>25th 14th 22nd 26th 38th</td>
<td>C-A C-A Emb. Emb.</td>
</tr>
<tr>
<td>Blood, strain L</td>
<td>-</td>
<td>+</td>
<td>13th 6th 9th 13th 13th</td>
<td>C-A C-A Emb.</td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Bo.</td>
<td>-</td>
<td>+</td>
<td>4th 9th 17th</td>
<td>C-A C-A</td>
</tr>
<tr>
<td>INOCULUM</td>
<td>RESULTS OF INOCULATION OF CHICKENS</td>
<td>VIRUS ISOLATED IN CULTURE</td>
<td>FIRST GENERATION OF THE CULTURE AT WHICH THE EMBRYOS WERE DEAD</td>
<td>TESTS FOR VIRUS IN EMBRYONIC TISSUES BY INOCULATION OF CHICKENS</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Generation of culture</td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain TK2</td>
<td>-</td>
<td>+</td>
<td>6th</td>
<td>6th</td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Bu2</td>
<td>-</td>
<td>+</td>
<td>4th</td>
<td>4th</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Bu3</td>
<td>-</td>
<td>+</td>
<td>8th</td>
<td>8th</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkefeld N filtrate of lung, strain Bu4</td>
<td>-</td>
<td>+</td>
<td>11th</td>
<td>11th</td>
</tr>
<tr>
<td>Spleen, strain Sch</td>
<td></td>
<td>+</td>
<td>2nd</td>
<td>4th</td>
</tr>
<tr>
<td>Berkefeld N filtrate of intestinal contents, strain 1</td>
<td>-</td>
<td>+</td>
<td>32nd</td>
<td>32nd</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkefeld N filtrate of feces, strain 1</td>
<td>-</td>
<td>+</td>
<td>28th</td>
<td>8th</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* Chicks showed no symptoms but were refractory to reinoculation.
† C-A = chorio-allantoic membrane.
‡ Emb. = embryo.
§ L = living.
¶ D = dead.
technique or by direct injection into the embryos through the air cell. The material for the initiation of cultures has comprised blood and bacteriologically sterile suspensions in infusion broth or saline of brain and spleen, and filtrates of suspensions of lung, tracheal exudate, intestinal contents, and feces of infected chickens. The brain and spleen tissues, which were sterile, were finely ground for suspension in broth or saline without bacterial contamination by use of a glass tube grinding apparatus. When the Burnet technique was employed, 2 or 3 drops of the original inoculum were deposited on the exposed chorio-allantoic membrane and transplants for subsequent generations were made with small pieces snipped from the chorio-allantoic membrane or embryo with sterile scissors. For transplanting by injection through the air cell, the embryo was ground with the glass-tube grinding apparatus and suspended in broth or saline.

Inoculation on the chorio-allantoic membrane has invariably caused a diffuse grayish thickening of the membrane, oftentimes accompanied by injection of the blood vessels, around the point at which the inoculum was deposited, irrespective of whether or not virus was present—thus, what at first was thought to be a lesion caused by the virus proved to be nothing more than a reaction of the membrane to the foreign material. The thickened chorio-allantoic membrane and the embryos have never contained enough virus for detection by the inoculation of chickens unless the embryos died during the interval between transplantation. The time from inoculation to death of the embryos has varied from 24 to 96 hours. Chickens have regularly been inoculated with the material with which cultures were initiated. In case the chickens became infected, the embryos of the first generation of the culture succumbed. As is shown in the data presented in table 3, however, virus was isolated in culture from a number of the inoculums in which it was not detected by the inoculation of chickens. The embryo culture, therefore, in addition to being a convenient method of propagating virus, has proved a valuable aid in the diagnosis of pneumoencephalitis, has made possible to detect virus in intestinal and fecal material, and to establish that recovered chickens may be virus-carriers when procedures more customarily employed have failed.

Inoculation of embryos by injection through the air cell proved unsatisfactory for initiating cultures or transplanting young ones because embryos sometimes succumbed when the inoculum contained no virus, and, therefore, death of the embryos was not an accurate index of the presence of virus. Once virus is established in the culture, however, this simpler technique is suitable for its continued propagation.

**DIFFERENTIATION OF THE DISEASE FROM INFECTIOUS BRONCHITIS AND LARYNGOTRACHEITIS**

As was stated earlier, pneumo-encephalitis has been found to be distinct from infectious bronchitis. This statement is based upon the results of cross-immunity tests conducted by Stover and the writer. The former found all of 35 chickens and the latter all of 10 chickens which were refractory to infectious bronchitis to be susceptible to pneumo-encephalitis virus.

By the same procedure, both Stover and the writer have shown that pneumo-encephalitis is unrelated to infectious laryngotracheitis.
While the studies herein reported were in progress, outbreaks of a disease of the central nervous system, which was identified as avian encephalomyelitis, occurred in a few flocks of chicks. This was the first known occurrence of the disease in California and it afforded an opportunity for direct comparison between it and pneumo-encephalitis. Symptomatically, the two were similar. The incubation period following inoculation of the former, however, ranged from 26-50 days, while that of pneumo-encephalitis has averaged 5 days. A total of 59 chicks was used in the avian encephalomyelitis transmission experiments. Twenty-seven of these survived and all proved susceptible to reinoculation with pneumo-encephalitis virus. This is regarded as satisfactory evidence that the two diseases are distinct.

DIFFERENTIATION OF AVIAN PNEUMOENCEPHALITIS VIRUS FROM EQUINE ENCEPHALOMYELITIS (WESTERN) AND ST. LOUIS ENCEPHALITIS VIRUS

Since it is known that Western equine encephalomyelitis and St. Louis encephalitis are common, although apparently harmless, infections of chickens in Pacific Coast states, it was of interest to determine if these viruses were related to that of avian pneumoencephalitis.

Through the cooperation of Dr. Wm. McD. Hammond, of The George Williams Hooper Foundation for Medical Research, neutralization tests of serum from 4 chickens immune to pneumoencephalitis were made with each virus. Neutralizing antibodies for these viruses were not demonstrated in any of the 4 serums. One neutralization tests, using commercial Western equine encephalomyelitis antiserum and avian pneumo-encephalitis virus, was made. This also yielded negative results.

In another experiment, 6 chicks were inoculated intramuscularly with Western equine encephalomyelitis virus (chick embryo origin). None of these developed any signs of infection and all were susceptible to subsequent inoculation with avian pneumoencephalitis virus.

SYMPTOMS

Most outbreaks of pneumoencephalitis in chicks have begun as a respiratory trouble manifested by rales, coughing and gasping, and a peculiar low chirp. In a few days, some of the chicks have developed symptoms of involvement of the central nervous system. The respiratory phase has usually terminated within 1 or 2 weeks. Cases with involvement of the nervous system, however, have continued to appear for a longer time. In addition, the appetite of the flock has usually decreased and many of the chicks became droopy. The respiratory phase has often affected practically 100 per cent of a flock, the nervous phase from 1 to 45 per cent.

The nervous symptoms consist of ataxia, partial or complete paralysis of one or both legs, incoordination of the neck muscles, and tremor of the head, not all of which are exhibited by one bird (figs. 1, 2, 3 and 4). Chicks fatally affected are likely to become prostrated, show clonic spasms, and go into a state of coma before
death. The majority of those which survive retain the nervous symptoms indefinitely. The average mortality is probably between 5 and 10 per cent. A greater

![Figure 1](image1)

**Fig. 1.—Pneumoencephalitis. Natural infection.** Right and left, paralysis of legs. Center, paralysis of legs and wings.

![Figure 2](image2)

**Fig. 2.—Pneumoencephalitis. Natural infection.** Incoordination of neck muscles and paralysis of legs.

loss has resulted in some flocks, however, from un thriftiness of the survivors. The majority of infected flocks have been from 3 to 10 weeks of age.

In many flocks of nearly mature pullets and laying chickens the disease has been a bronchitis-like affliction characterized by a sudden onset and extremely rapid
spread. The loss from death has been nominal. Egg production, however, has practically ceased within a week and has not returned to the pre-outbreak level until one or two months later. Cases of nervous system involvement have either been absent or the number so small that they were unnoticed. This is a previously undiagnosed type of respiratory trouble which has been present in the State for at

Fig. 3.—Pneumoencephalitis. Natural infection. Incoordination of neck muscles. (Photo courtesy H. A. Hoffman.)

Fig. 4.—Pneumoencephalitis. Artificial infection. Incoordination of neck muscles. (Photo courtesy D. E. Stover.)
### TABLE 4
Summarized data of effect of pneumoencephalitis in 20 flocks of white leghorns on 5 farms

<table>
<thead>
<tr>
<th>FLOCK NO.</th>
<th>AGE</th>
<th>NUMBER BIRDS</th>
<th>EGGS PER DAY</th>
<th>DAILY FEED CONSUMPTION</th>
<th>PER CENT MORTALITY</th>
<th>PREDOMINANT SYMPTOMS*</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td></td>
<td>months</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>350</td>
<td>0</td>
<td>48</td>
<td>4</td>
<td>8</td>
<td>7.5 Anorexia, respiratory</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>350</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td>7</td>
<td>8.5 Anorexia, respiratory</td>
</tr>
<tr>
<td>3</td>
<td>5½</td>
<td>322</td>
<td>5</td>
<td>26</td>
<td>15</td>
<td>4</td>
<td>3.7 Anorexia, respiratory</td>
</tr>
<tr>
<td>4</td>
<td>5½</td>
<td>320</td>
<td>3</td>
<td>27</td>
<td>14</td>
<td>30</td>
<td>5.9 Anorexia, respiratory</td>
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<tr>
<td>5</td>
<td>6</td>
<td>342</td>
<td>3</td>
<td>15</td>
<td>59</td>
<td>17</td>
<td>1 bird Anorexia, depression</td>
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<tr>
<td>6</td>
<td>6</td>
<td>346</td>
<td>3</td>
<td>10</td>
<td>63</td>
<td>18</td>
<td>10 0 Anorexia, depression</td>
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<tr>
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<td>6</td>
<td>328</td>
<td>33</td>
<td>10</td>
<td>56</td>
<td>32</td>
<td>6 6 4.8 Anorexia, depression</td>
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<td>8</td>
<td>6</td>
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<td>3 7 2.0 Anorexia, depression</td>
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<td>6</td>
<td>423</td>
<td>82</td>
<td>13</td>
<td>78</td>
<td>38</td>
<td>3 11 4.0 Anorexia, respiratory</td>
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<tr>
<td>10</td>
<td>6</td>
<td>293</td>
<td>27</td>
<td>4</td>
<td>44</td>
<td>26</td>
<td>4 3 4.0 Anorexia, depression</td>
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<tr>
<td>11</td>
<td>6</td>
<td>310</td>
<td>47</td>
<td>2</td>
<td>57</td>
<td>28</td>
<td>3 7 5.1 Anorexia, depression</td>
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<tr>
<td>12</td>
<td>6½</td>
<td>344</td>
<td>58</td>
<td>17</td>
<td>50</td>
<td>20</td>
<td>3 9 4.6 Anorexia, depression</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>298</td>
<td>137</td>
<td>12</td>
<td>55</td>
<td>39</td>
<td>9 5 2 birds Anorexia, depression</td>
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*Symptoms: Anorexia, respiratory, depression.
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<tr>
<td>14</td>
<td>148</td>
<td>2328</td>
<td>139</td>
<td>20</td>
<td>16</td>
<td>10</td>
<td>No data</td>
<td>21.8</td>
<td>Anorexia, depression, respiratory, many cases of paralysis, tremor and incoordination</td>
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<td>22</td>
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<td>30</td>
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<td>11</td>
<td>4.0</td>
<td>Anorexia, depression</td>
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<td></td>
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<td>8</td>
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<td>31+</td>
<td>102</td>
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<td>9</td>
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<td>12</td>
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<td>7</td>
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<td>0</td>
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</tr>
</tbody>
</table>

* A few cases with definite involvement of the central nervous system seen in all flocks except Nos. 5, 6, 8, 13 and 20.
least 4 or 5 years and has been known in different localities by such names as “flu” and “9-day pneumonia”.

Another type of disease of laying chickens with which the virus has been identified is manifested as follows: A variable number of the chickens became droopy and the appetite of the flock declined. The number of droopy chickens sometimes increased so rapidly that, by the end of a week, nearly all of them were sitting about on the roost or floor and eating little or no food. Egg production uniformly decreased rapidly and, in some flocks, ceased entirely. At the beginning of some outbreaks, numerous floor or yard eggs, many with imperfectly formed or soft shells, were laid. In addition to the above, a variable number of the chickens developed nervous symptoms like those described for chicks. Coughing and rales, although usually heard, have not been a predominant symptom. Affected flocks have begun to improve within a week or 10 days after depression was first observed and have quickly regained normal appetite and appearance. Egg production, however, as shown in table 4, has remained below the pre-outbreak level for from 3 weeks to more than a month. Some flock owners have reported that the lowered egg yield lasted for 2 months. The mortality has varied from a negligible number to 21 per cent. On some farms on which the disease has appeared for the first time, it has progressed from pen to pen until the whole population, regardless of age, has become infected.

Many instances of apparent relationship between occurrences of the disease in different age groups of chickens on a farm have been observed. In some cases, the disease in chicks has been preceded by infection of adults and in other cases the reverse has been true.

Cloudiness of the air sacs with a film of grayish or yellowish exudate is the only lesion which has been found on autopsy of either chicks or adults which can be considered as at all characteristic of pneumoencephalitis, and this is far from constant. Mucous exudate is usually present in the tracheas of chickens which have shown respiratory symptoms but is not of a character which differentiates it from other respiratory infections. Consequently, gross postmortem findings are of lesser value than antemortem symptoms as diagnostic aids.

TRANSMISSIBILITY

Experimentally, the infection has been transmitted to healthy chickens by contact exposure to infected birds and by injection of blood or suspension of tissues intramuscularly, intracerebrally, intraperitoneally, subcutaneously, intranasally, intratracheally, into the bursa of Fabricius, and into the air sacs. Stover has reported transmission also by placing virus, enclosed in a gelatin capsule, into the crop.

Contact exposure was brought about by inoculating 1 or 2 of a group of chickens which were confined in one cage. In the first experiment, 2 of 3 chicks not inoculated showed symptoms on the 10th and died on the 11th day. The third chick remained healthy and was susceptible to subsequent inoculation. In the second experiment, 11 healthy were caged with 2 inoculated chicks. Eight of those not inoculated became fatally infected, the first symptoms being observed on the 8th
to 14th day. The 3 which developed no symptoms were refractory to inoculation later, which indicates that they had had subclinical infection.

All of the methods of injection tried were effective means of transmission. Intramuscular injection, however, as shown in table 5, has given the most consistent

<table>
<thead>
<tr>
<th>INOC. METHOD</th>
<th>NUMB. INOC.</th>
<th>NUMBER CASES OF</th>
<th>AVER. INCUBATION PERIOD</th>
<th>NUMBER CLINICAL CASES</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Clinical infection</td>
<td>Sub-clinical infection</td>
<td></td>
</tr>
<tr>
<td>Im.*</td>
<td>113</td>
<td>96</td>
<td>17</td>
<td>4.7</td>
</tr>
<tr>
<td>lc.‡</td>
<td>108</td>
<td>95</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>Im.</td>
<td>57</td>
<td>56</td>
<td>1</td>
<td>4.8</td>
</tr>
<tr>
<td>Intr.§</td>
<td>59</td>
<td>43</td>
<td>8</td>
<td>5.4</td>
</tr>
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<td>Im.</td>
<td>24</td>
<td>22</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Air sac§</td>
<td>24</td>
<td>17</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Im.</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Inas.¶</td>
<td>11</td>
<td>9</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Im.</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Iv.</td>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Im.</td>
<td>18</td>
<td>17</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ip.**</td>
<td>18</td>
<td>14</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

* Im = Intramuscular inoculation.
† Ic. = Intracerebral inoculation.
‡ Intr. = Intratracheal inoculation.
§ Air sac = Injection into air sac.
¶ Inas. = Instillation into nostril.
|| Iv. = Intravenous inoculation.
** Ip. = Intraperitoneal inoculation.
†† Subclinical infection = chicks developed no symptoms and were refractory to reinoculation.
‡‡ Not infected = chicks developed no symptoms and were susceptible to reinoculation.

Table 5.—Comparison of results of intramuscular and other methods of inoculation with tissues from the same sources

results—consequently, this has been adopted as the routine method of inoculation with material of unknown virus content, in testing chicks for resistance to known virulent material, and in titrating the virulence of cultures or tissues of chicks.

Unlike natural infection, respiratory symptoms are of relatively infrequent occurrence in that which is artificially-induced. Instead nervous symptoms, like
those which are seen in field outbreaks characterize the disease which is induced by inoculation. The type and frequency of occurrence of these are given in table 6.

The lesions in fatal cases induced by inoculation with material from field cases consist of cloudiness of the air sacs of a portion of the chicks and, therefore, are not different from the findings in cases of natural infection. After a few passages through chicks or embryos, however, with consequent enhancement in the virulence or concentration of virus in the tissues, changes indicative of involvement of the blood vascular system are of frequent occurrence. These consist of petechial or more diffuse hemorrhages in various portions of the digestive organs and paleness of the spleen which is sometimes so marked that the organ appears bloodless. In

<table>
<thead>
<tr>
<th>TABLE 6.—Distribution of symptoms in 785 chickens inoculated in groups of 2 or more</th>
</tr>
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<tbody>
<tr>
<td>Definite evidence of infection was seen in at least one chicken of each group</td>
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<table>
<thead>
<tr>
<th></th>
<th>chicks with CNS symptoms*</th>
<th>chicks with respiratory symptoms</th>
<th>AVERAGE INCUBATION PERIOD</th>
<th>DIED</th>
<th>RECOVERED</th>
<th>SURVIVED BUT RETAINED CNS SYMP.</th>
<th>PERCENT† INCIDENCE OF TYPES OF CNS SYMPTOMS</th>
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<tbody>
<tr>
<td>Numb. Per cent</td>
<td>Numb. Per cent</td>
<td>days</td>
<td>Numb. Per cent</td>
<td>Numb. Per cent</td>
<td>Number Per cent</td>
<td>Ataxia</td>
<td>Paralysis of legs</td>
</tr>
<tr>
<td>564‡</td>
<td>77.7</td>
<td>5</td>
<td>462 81.9</td>
<td>57   10.1</td>
<td>45         8.1</td>
<td>28.9</td>
<td>53.7</td>
</tr>
</tbody>
</table>

* Symptoms of involvement of central nervous system.
† Per cent of chicks with CNS symptoms.
‡ Includes 43 chickens which were normal when examined < 24 hours before death.
92 additional chickens, in which no symptoms were observed, were refractory to reinoculation with highly virulent virus and therefore considered as having had subclinical infection.

In table 7, which gives the incidence of the type and the location of lesions found, it is seen that the hemorrhages, usually submucous but occasionally subserous, are located more frequently in the proventriculus than in other parts of the digestive system. The data also show that 67 per cent of the chicks had cloudy air sacs; 15 per cent, cloudiness of the mesentery; and that 22 per cent showed no gross pathology. Occasional additional autopsy findings were petechiae on the heart or internal surface of the sternum, submucous or subserous hemorrhages of the gizzard, subcutaneous edema in the cervical or pectoral region, cloudiness of the pleural covering of the lung and of the pericardium, dirty-brown fluid in the crop and proventriculus, and marked distention of the rectum with urine.

Notwithstanding the wide distribution of the virus in tissues of infected chickens and the variety of routes by which transmission has been accomplished, inoculation of chicks with material from field cases has given very irregular results even when the specimens were procured at the beginning of an outbreak and were in the early stages of the disease. Such difficulty in transmission has been particularly preva-
lent with tissues from infected adults. In fact, had it not been possible to isolate the virus by embryo culture, few of the diagnoses of the infection in adult chickens would have been definitely established. This is illustrated by the data given in table 3. The irregularity with which attempts to transmit the infection with material from field cases have succeeded probably accounts for our failure to demonstrate the infectiousness of the disease when it was first observed in chicks in 1940 and of like failures from earlier studies of the respiratory type of the disease in laying pullets.

In these transmission trials, no significant difference has been observed in the morbidity rate among chickens ranging in age from 7 days to 2 years. The mortality rate has been fairly constant for all ages up to 100 days, but in older birds it has tended to become less.

**Table 7.—Per cent incidence of lesions in 564 inoculated chickens which died from central nervous system involvement**

<table>
<thead>
<tr>
<th>CLOUDINESS OF</th>
<th>HEMORRHAGES†</th>
<th>SPLEEN</th>
<th>NO GROSS LESIONS</th>
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</thead>
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<tr>
<td>Air sacs</td>
<td>67.3</td>
<td>4.9</td>
<td>23.6</td>
</tr>
<tr>
<td>Mesentery</td>
<td>15.5</td>
<td>5.8</td>
<td>6.7</td>
</tr>
</tbody>
</table>

* Occasional post-mortem findings are petechiae on heart and internal surface of sternum; subcutaneous edema of cervical or pectoral region; cloudiness of pleura of lung or of pericardium; urate stasis of kidney; crop and proventriculus filled with dirty brown fluid; marked distention of rectum with urine.
† Mostly submucous petechiae but occasionally more diffuse and located on serous surface of the organs.
‡ Appeared devoid of blood.

**Immunological relationship of viruses from different sources**

The disease has been identified in a large number of chicken flocks and in 1 flock of turkeys. Since the locations of the flocks were as much as 500 miles apart, it was thought advisable to determine if there might be more than one strain of the disease—consequently, many chickens which had survived an infection with virus from one source were inoculated again with that from a different source. The results of these cross-immunity tests, as illustrated by the data given in table 8, revealed that all of the strains of virus (including that isolated from turkeys) thus far studied, are immunologically identical.

**Animals susceptible**

Three turkey poults were inoculated with Strain 1 virus and 3 with Strain C. All proved highly susceptible. As stated earlier, 2 outbreaks of disease in turkeys have been identified as pneumoencephalitis.

Pigeons were susceptible only to larger doses of the virus than are required to infect chickens, and were more readily infected by intracerebral than by intramuscular injection. The infection in these birds also differed from that in chickens
in that the virus concentration appeared to be greater in brain tissue than in the lungs and spleen. However, virus was demonstrated in the lung and spleen tissue of pigeons by inoculation of chickens and by embryo culture.

Two young Mongolian pheasants were tested and found as susceptible as the control chickens, and so, too, were 2 young California quail.

Mice were refractory to intramuscular, intraperitoneal, intracerebral, and intranasal injection of virus.

Attempts to infect guinea pigs did not give clear-cut results and require repetition.

**Table 8.—Summary of cross-immunity tests with strains of pneumoencephalitis virus from different sources**

<table>
<thead>
<tr>
<th>STRAIN OF ORIGINAL INFECTION</th>
<th>REINOCULATED* WITH</th>
<th>STRAIN OF ORIGINAL INFECTION</th>
<th>REINOCULATED* WITH</th>
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<tr>
<td></td>
<td>Strain of virus</td>
<td>Num. chicks</td>
<td>Days between inoculation</td>
</tr>
<tr>
<td>1 F</td>
<td>18</td>
<td>8-10</td>
<td>Bo 1</td>
</tr>
<tr>
<td>1 L</td>
<td>62</td>
<td>12-31</td>
<td>Pr C</td>
</tr>
<tr>
<td>1 C</td>
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<td>Bu 1</td>
</tr>
<tr>
<td>1 Bu</td>
<td>6</td>
<td>14</td>
<td>Do C</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>10</td>
<td>Sch C</td>
</tr>
<tr>
<td>Bi</td>
<td>L</td>
<td>10</td>
<td>Tk2 C</td>
</tr>
<tr>
<td>3363</td>
<td>1</td>
<td>2</td>
<td>Fr L</td>
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</tbody>
</table>

* Normal control chicks used with each lot of chicks reinoculated. All developed severe infection.

**Isolation of the virus from the lungs of chickens which survived natural infection**

**Trial 1.** Two hens, 3 years old, were obtained from a flock 2 months after it had recovered from the respiratory type of the disease. The infection had been of short duration and had caused no deaths. The 2 hens were normal, vigorous birds and showed no lesions at autopsy. Before being killed, the birds were bled by cardiac puncture to provide serum for neutralization tests. The lungs were pooled, finely ground with sand, and suspended in infusion broth. A portion of the suspension was passed through 2 Berkefeld N filters.

Chicks were inoculated intramuscularly with the lung suspension and the 2 Berkefeld filtrates. None of these developed any signs of infection and all were susceptible to subsequent inoculation with the strain (Bu3) of the virus which had been isolated from the flock when the outbreak was in progress.

Embryo cultures were initiated with the Berkefeld N filtrates. The embryos of one of these (N-2) showed no evidence of infection and was discontinued after 18 generations. In the other culture (N-6), the embryos were unaffected for 10 generations; but, in the 11th and subsequent generations to the 30th and last, the embryos died within 48 to 72 hours. The chorio-allantoic membranes and the
**TABLE 9.—Neutralization in vitro of cultured virus with blood serum of hens which had recovered from natural infection**

<table>
<thead>
<tr>
<th>VIRUS</th>
<th>SERUM</th>
<th>CHICKS INOCULATED*</th>
<th>AMOUNT SERUM</th>
<th>AM'T OF VIRUS DILUTION</th>
<th>RESULTS</th>
<th>INCUBATION PERIOD</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain 1. 1-500 dilution of embryo</td>
<td>Bu 4 Hen 1</td>
<td>7777 7778</td>
<td>0.05 0.05</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7779 7780</td>
<td>0.005 0.05</td>
<td>+</td>
<td>6 9</td>
<td>Susceptible to subsequent inoculation with active virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7781 7782</td>
<td>0.0005 0.05</td>
<td>+</td>
<td>5 4</td>
<td>Both dead 6th day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bu 4 Hen 2</td>
<td>7783 7784</td>
<td>0.05 0.05</td>
<td>+</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7785 7786</td>
<td>0.005 0.05</td>
<td>+</td>
<td>6</td>
<td>Dead 7th day</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7787</td>
<td>0.0005 0.05</td>
<td>-</td>
<td></td>
<td></td>
<td>Refractory to subsequent inoculation with active virus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7788</td>
<td>+</td>
<td>7</td>
<td></td>
<td></td>
<td>Recovered</td>
</tr>
<tr>
<td>Normal stock chickens</td>
<td>7789 7790</td>
<td>0.05 0.05</td>
<td>+</td>
<td>4</td>
<td></td>
<td></td>
<td>Dead 7th day</td>
</tr>
<tr>
<td>None</td>
<td>7791 7792</td>
<td>None 0.05</td>
<td>+</td>
<td>4</td>
<td></td>
<td></td>
<td>Dead 6th day</td>
</tr>
<tr>
<td></td>
<td>7793 7794</td>
<td>None 0.005</td>
<td>+</td>
<td>5</td>
<td></td>
<td></td>
<td>Dead 6th day</td>
</tr>
<tr>
<td></td>
<td>7795 7796</td>
<td>None 0.0005</td>
<td>+</td>
<td>5 7</td>
<td></td>
<td></td>
<td>Dead 7th day</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Survived but retained nervous symptoms</td>
<td></td>
</tr>
</tbody>
</table>

*Inoculation made by intramuscular injection.*
dead embryos of the 16th and 30th generations were tested by inoculation of chicks and found to contain highly virulent virus.

Neutralization tests were made with serum from each of the 2 hens and Strain 1 cultured virus. The amounts of serum and virus used and the results of inoculation of chicks with the serum–virus mixtures are given in table 9. From these data, it is seen that chickens were not infected by the intramuscular injection of at least 100 times the amount of virus necessary to infect, when it was mixed with an equal amount of serum from hen 1. The serum of hen 2, however, was capable of producing only partial or transitory neutralization of the virus.

**Trial 2.** Two chickens, 3 months old, were obtained from the survivors of a flock which had been infected at the age of 2 weeks. One of the chickens had partial paralysis of the legs; the other, incoordination of the neck muscles. In other respects, both were of normal appearance and in a fairly good state of nutrition. Autopsy revealed no gross pathological changes. The lungs were pooled, and finely ground with sand with the addition of infusion broth. A portion of the suspension was passed through a Berkefeld N filter. Three chicks were inoculated intramuscularly with the lung suspension and the filtrate; embryos, with the filtrate only.

The chicks remained healthy and were susceptible to subsequent inoculation with active strain L virus.

The embryos of the 1st generation of the culture of the Berkefeld filtrate were not affected, but those of the 2nd and subsequent generations succumbed. Active virus was demonstrated in the chorio-allantoic membrane of the 4th to 10th generations by intramuscular inoculation of chicks.

The results of these experiments show that chickens can carry the virus in their lungs for as long as 2 to 3 months following recovery from natural infection.

**VACCINATION EXPERIMENTS**

Experiments in immunization by vaccination conducted thus far, although of limited scope, have yielded encouraging results. Three small lots of vaccine have been prepared from infected chick embryos. Each lot of embryos was titrated by the intramuscular inoculation of chicks with doses of 0.1 cc. and found infective in all dilutions up to and including \(10^{-7}\), the highest dilution tested. The embryos were finely ground with sand or with an electric mixture with the addition of formalized saline. The final products contained 37.5 per cent embryo tissue and 0.2 per cent or 0.1 per cent (lot 3) formalin. The virus suspensions were tested and found both bacteriologically sterile and noninfective for chicks and embryos after 7 days storage in the refrigerator.

Chicks, ranging in age from 2 days to 96 days, were given an intramuscular or intraperitoneal injection or 2 injections a week apart of the embryo suspension in 0.1-, 0.25-, 0.5, or 1.0-cc. amounts. After an interval of from 14 to 78 days, each chick, together with nonvaccinated controls, was inoculated intramuscularly with cultured virus.

The results are presented in table 9. Summarizing these data, we find that (1) 70 of 71 chicks, which received 2 doses of vaccine when 7, 28, 45, 85 or 96 days old, were refractory when tested 14 to 27 days after vaccination. The one chick not
### Table 10.—Results of tests for immunity by the intramuscular inoculation of chickens which had received a single dose of vaccine or 2 doses given a week apart

<table>
<thead>
<tr>
<th>TRIAL NO.</th>
<th>AGE OF CHICKS WHEN VACC.</th>
<th>DAYS BETWEEN VACC. AND INOC.</th>
<th>METHOD OF VACC.</th>
<th>DOSE OF VACCINE</th>
<th>NUMB. OF CHICKS</th>
<th>RESULTS OF INOCULATION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>85 days</td>
<td>18</td>
<td>Im.</td>
<td>0.5 cc., 2 doses</td>
<td>6</td>
<td>6 0</td>
<td>2 infected died; 2 recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 cc., 2 doses</td>
<td>6</td>
<td>6 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25 cc., 2 doses</td>
<td>6</td>
<td>6 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 cc., 2 doses</td>
<td>6</td>
<td>6 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td></td>
<td>4</td>
<td>0 4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>28 days</td>
<td>19</td>
<td>Im.</td>
<td>0.1 cc., 2 doses</td>
<td>8</td>
<td>7 1</td>
<td>Infected chicks had mild symptoms; recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 cc., 2 doses</td>
<td>8</td>
<td>8 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td></td>
<td>6</td>
<td>0 6</td>
<td>All infected died in 4–6 days</td>
</tr>
<tr>
<td>3</td>
<td>2 days</td>
<td>23</td>
<td>Im.</td>
<td>0.1 cc., 2 doses</td>
<td>6</td>
<td>3 3</td>
<td>All infected died in 2–6 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 cc., 1 dose</td>
<td>6</td>
<td>1 5</td>
<td>3 infected dead on 4th day; 2 recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td></td>
<td>6</td>
<td>0 6</td>
<td>All infected died in 4–10 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Im.</td>
<td>0.1 cc., 2 doses</td>
<td>12</td>
<td>2 10</td>
<td>7 infected died in 4–7 days; 3 recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 cc., 1 dose</td>
<td>12</td>
<td>1 11</td>
<td>9 infected died in 4–8 days; 2 recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td></td>
<td>7</td>
<td>0 7</td>
<td>5 infected died in 5–10 days; 2 recovered</td>
</tr>
<tr>
<td>4</td>
<td>3 days</td>
<td>15</td>
<td>Im.</td>
<td>0.1 cc., 2 doses</td>
<td>21</td>
<td>12 9</td>
<td>8 infected died in 3–7 days; 1 recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>18 0</td>
<td>All infected died in 3–4 days</td>
</tr>
</tbody>
</table>

**AVIAN PNEUMOENCEPHALITIS**
refractory had a mild infection of short duration. (2) Thirty of 32 chicks, which received 1 dose of vaccine when 7 or 96 days old, were refractory when tested in 14 to 27 days. The 2 chicks not refractory were fatally infected. (3) Seventeen of 39 chicks, which received 2 doses of vaccine, the first when 2 or 3 days old, were refractory when tested in 15 to 78 days. Twenty-two had severe infection. (4) Two of 18 chicks, which received 1 dose of vaccine when 2 or 3 days old, were refractory when tested 28 or 78 days later. Sixteen had severe infection. These results show that the chicks which were vaccinated at the age of 7 or more days were given a high degree of protection against the virus and that 2 doses of vaccine were slightly more effective than 1 dose. Chicks vaccinated at the age of 2 or 3 days, however, were very inadequately protected.

SUMMARY

1. Avian pneumoencephalitis is proposed as a suitable name for a newly identified virus disease of poultry in which both the respiratory tract and the central nervous system are involved and which has previously been termed a respiratory nervous disorder. It has been shown to be distinct from other known virus infections of

<table>
<thead>
<tr>
<th>TRIAL NO.</th>
<th>AGE OF CHICKS WHEN VACC.</th>
<th>DAYS BETWEEN VACC. AND INOC.</th>
<th>METHOD OF VACC.</th>
<th>DOSE OF VACCINE</th>
<th>NUMB. OF CHICKS</th>
<th>NUMB. refractory</th>
<th>NUMB. infected</th>
<th>RESULTS OF INOCULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>days</td>
<td>96</td>
<td>14</td>
<td>Ip.†</td>
<td>1.0 cc., 2 doses</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td>Ip.</td>
<td>1.0 cc., 1 dose</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>10</td>
<td>Ip.</td>
<td>0.5 cc., 2 doses</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>All infected dead 5th day</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-vacc. controls</td>
<td>0.5 cc., 1 dose</td>
<td>10</td>
<td>8</td>
<td>2</td>
<td>All infected died in 5-6 days</td>
</tr>
</tbody>
</table>

* Im.—intramuscular injection.
† Ip.—intraperitoneal injection.
‡ Inoculation made intramuscularly with cultured virus.
poultry in the United States. Outbreaks have occurred in both young and adult chickens and in turkeys. Mongolian pheasants and California quail and pigeons have been shown to be susceptible to artificial infection.

2. The virus has been found in the lungs, spleen, brain, blood and tracheal exudate of infected chickens, especially those in the early stages of severe infection. It has also been demonstrated in intestinal contents and feces.

3. The virus in lung tissue, dried over phosphorous pentoxide while frozen and then stored in the refrigerator for 195 days, produced the disease. Preserved in 50 per cent glycerine, its virulence was reduced, but not destroyed, in 85 days. When stored in a dry-ice refrigerator, it retained full activity for 7 months, the longest period tested.

4. It has been shown that the sera of chickens that have recovered from either natural or artificial infection will neutralize the virus. By cross-immunity tests, strains of virus from many sources, some separated from each other by a distance of 500 miles, were found to be immunologically identical.

5. The virus was readily cultivated in chicken embryos inoculated either by depositing the inoculum on the chorio-allantoic membrane or by injecting it through the air cells. The former method of inoculation, however, is considered preferable. Embryo culture has provided a convenient method of propagating virus and also has been the means by which, in numerous instances, it has been isolated from tissues in which the virus content was too small for detection by the inoculation of chickens.

6. The infection has been transmitted to healthy chickens by contact exposure to diseased ones and by injection of infected tissues intramuscularly, intracerebrally, intraperitoneally, subcutaneously, intranasally, intratracheally into the bursa of Fabricius, the air sacs and the crop. Intramuscular inoculation, however, has been the most consistent means of artificial transmission.

Notwithstanding the wide distribution of the virus in the tissues of infected chickens and the variety of routes by which transmission has been accomplished, the inoculation of chickens with material from field cases has given very irregular results.

7. Virus has been demonstrated in the lungs of chickens 2 to 3 months after they had recovered from natural infection.

8. Encouraging results have been obtained in preliminary experiments in the immunization of young chickens with formalized saline suspensions of infected chicken embryos.

REFERENCES
FOUR YEARS PROGRESS IN ERADICATION OF PULLORUM DISEASE FROM TURKEY FLOCKS

BY W. R. HINSHAW, E. McNEIL, AND T. J. TAYLOR

Division of Veterinary Science, University of California, Davis

INTRODUCTION

At the 1940 meeting of this Association, the writers (1) reported two years progress on a pullorum disease eradication project for turkeys. The fourth season's testing has just been completed, and the results of the four years are given in this paper. This project was started in July, 1939, in cooperation with the Ramona Turkey Growers Association in San Diego County, California. The purpose of the project is, 1) to demonstrate methods of eradication of pullorum disease from flocks of turkeys, 2) to demonstrate methods of preventing recurrence of infection, and 3) to collect data pertinent to the project.

As a guide, a brief program patterned after the Pullorum Disease Control Section of the National Poultry Improvement Plan (2) was adopted. This program, published in our previous paper has been followed with slight modifications, and will not be reprinted. The program includes laboratory, field, and hatchery supervision and has for its aim, eradication of the disease from the cooperating ranches.

The tube agglutination test (1-25 dilution) made according to the technique described at the 36th annual meeting of this Association (3) was used. Three strains of Salmonella pullorum have been used for making the antigen. The following is a brief history of these strains:


P179. Isolated in 1937 by Dr. E. E. Jones from the liver of a turkey poult that died during an acute outbreak of pullorum disease.

Two of these, P19, and P20, are the same as used by the Eastern States Pullorum Disease Conference Group for testing chickens. These cultures have proven satisfactory for making antigens for testing turkeys and are in use by several laboratories at the present time.

Previous to this year, blood samples were collected by the well known puncture method. This year samples have been taken with a 2 cc. Luer type hypodermic syringe and a 20 gauge one-half inch needle. The technique used is similar to that described several years ago by Martin and Olney (4). Turkeys can be bled very rapidly by this method, which has proven superior in every way to the puncture method. Several syringes and needles are used, and each used syringe is rinsed twice with tap water and finally with 10 per cent glycerinated physiological saline before it is used for another bird.
The minimum age for testing has been 4 months. It was found by experience that this was a satisfactory age for taking samples and not too young for selection of breeders. Owners are asked to segregate the birds to be used for breeders at least 2 weeks before collection of the blood samples. Making the initial test at 4 to 5 months of age allows time for at least 2 additional tests of infected flocks at monthly intervals before many of the females are laying eggs. This is necessary to avoid difficulty with "cloudy" reactions experienced in laying birds.

The tests are incubated at 37°C for 20-24 hours, and read with the aid of a two-tube (15 watt each) fluorescent light placed against a black background. All reactors are rechecked using dilutions of 1-40, 1-80, 1-160, and 1-320.

Diagnosis of pullorum disease is based on the history of the flock, number of reactors to the initial test, and the titers obtained on the reset tests. No flock is condemned on the basis of the test alone unless it is evident from the number of reactors, and their titers, that pullorum disease does exist. Flocks having a history of freedom of pullorum disease are not condemned until autopsy and bacteriological examinations of reactors verify the test results. In such instances the report is held at the laboratory until the suspicious reactors are rebled, killed for autopsy, and the bacteriological studies completed. If the reactions are proven to be due to nonspecific causes, the owner is given a negative report for pullorum disease but told of the results of bacteriological studies (see nonspecific reactions). The number of times when it is necessary to resort to such procedures is not great and the number of birds involved is usually small. The effect on the morale of the grower makes the increased work well worth while. Under no consideration is a flock condemned without following this procedure if only reactors with titers of 1-25 or 1-40 are found. We continually remind the grower that the purpose of the test is to aid us in diagnosing pullorum disease and not merely to pick reactors in his flock. Such a system is workable only in a well organized program, where the field work and laboratory work are closely correlated.

Each spring, growers have been urged to submit poults to the laboratory for autopsy and bacteriological studies. Attempts have been made to get poults from each hatch, and from as many sources as possible. The purpose of this follow-up work has been to correlate causes of losses with the subsequent testing results.

Another very important part of the program has been the use of eggs for local replacements from flocks free on the first test, and which had no nonspecific reactors. The latter procedure has proven to be a valuable aid in reducing the number of nonspecific reacting flocks each succeeding year.

RESULTS

Agglutination tests

The summary of the results of four seasons of testing is given in Table I. Included is the status of the flocks determined by the initial test and at the end of the testing season. The first year is the only one in which all the flocks have not been given at least one negative report by the time of the hatching-egg season. In 1939-40, all infected flocks that were not cleared by retesting, were tested
monthly throughout the hatching season to reduce chances of infection in eggs sold. In 1940–41 and 1941–42, the few infected flocks were either tested until free, or sold before the hatching season. This year (1942–43) all of the flocks were found free on the first test; so it has not been necessary to retest any of them.

**Table I.**—Comparison of status of flocks at the beginning and at the end of the testing season

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL FLOCKS</th>
<th>FLOCKS FREE ON INITIAL TEST</th>
<th>FLOCKS FREE AT END OF SEASON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL FLOCKS</td>
<td>FLOCKS FREE ON INITIAL TEST</td>
<td>FLOCKS FREE AT END OF SEASON</td>
</tr>
<tr>
<td></td>
<td>NUMBER</td>
<td>PERCENT</td>
<td>NUMBER</td>
</tr>
<tr>
<td></td>
<td>PERCENT</td>
<td></td>
<td>PERCENT</td>
</tr>
<tr>
<td>1939–40</td>
<td>80</td>
<td>40</td>
<td>50.0</td>
</tr>
<tr>
<td>1940–41</td>
<td>58</td>
<td>48</td>
<td>81.03</td>
</tr>
<tr>
<td>1941–42</td>
<td>51</td>
<td>49</td>
<td>96.1</td>
</tr>
<tr>
<td>1942–43</td>
<td>43</td>
<td>43</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Three infected flocks sold after the first test.
† Four flocks sold before the end of the season.

**Table II.**—Summary of results of testing of two groups of turkey flocks

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL FLOCKS TESTED</th>
<th>TOTAL NUMBER TURKEYS</th>
<th>FLOCKS FREE ON FIRST TEST</th>
<th>REACTORS TO FIRST TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flocks</td>
<td>Turkeys</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>Per cent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1939–40</td>
<td>80</td>
<td>28,810</td>
<td>40</td>
<td>50.0</td>
</tr>
<tr>
<td>1940–41</td>
<td>58</td>
<td>21,129</td>
<td>47</td>
<td>81.03</td>
</tr>
<tr>
<td>1941–42</td>
<td>51</td>
<td>27,234</td>
<td>49</td>
<td>96.1</td>
</tr>
<tr>
<td>1942–43</td>
<td>43</td>
<td>28,437</td>
<td>43</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Group A**

**Group B**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TOTAL FLOCKS TESTED</th>
<th>TOTAL NUMBER TURKEYS</th>
<th>FLOCKS FREE ON FIRST TEST</th>
<th>REACTORS TO FIRST TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flocks</td>
<td>Turkeys</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>Per cent</td>
</tr>
<tr>
<td>1938–39</td>
<td>33</td>
<td>9,153</td>
<td>17</td>
<td>51.5</td>
</tr>
<tr>
<td>1939–40</td>
<td>36</td>
<td>11,904</td>
<td>14</td>
<td>38.9</td>
</tr>
<tr>
<td>1940–41</td>
<td>19</td>
<td>8,329</td>
<td>9</td>
<td>47.4</td>
</tr>
<tr>
<td>1941–42</td>
<td>25</td>
<td>18,218</td>
<td>5</td>
<td>20.0</td>
</tr>
</tbody>
</table>

* Results for 1942–43 not available.

It will be noted that only 50 per cent of the flocks were free on first in 1939–40, but by a retesting and culling program, 24 additional flocks were negative by the end of the season. In Table II (Group A) is given the number of birds tested each year. It will be noted that while the number of flocks decreased, the total number of birds tested did not materially decrease. Since 1939–40, many growers with small flocks have quit turkey raising to go to work in defense industries. The remaining growers in turn have increased the size of their flocks. The progress made in the eradication of the disease from the cooperating ranches is shown in these 2 tables.
Table II gives the results obtained by the cooperating group which accepted an organized plan of eradicating the disease, as contrasted with one which had no organized plan and which accepted eggs from flocks having greater than zero per cent reactors. It is interesting to note that when both groups started testing, the degree of infection was about the same. Both groups are in the same part of the state. In their first year of testing, Group B made no retests. In Group A's first year, testing was continued in all infected flocks throughout the season at monthly intervals, or until a negative test was obtained. Also in all except 11 cases, growers used eggs from free sources and had them hatched in a cooperating hatchery. The results of such attempts were that at the beginning of the second season, Group A had 81.03% of its flocks and 80.8% of its turkeys free on the first test, while Group B had 38.9% of its flocks and 24.9% of its turkeys free on the first test. The percentage of reactors on the first test was 0.72 as contrasted with 2.94.

Group A started its third season with 96.1% of its flocks free, while Group B had 47.4% of its flocks free (less than at the beginning of the first season). During this season, the manager of Group B was persuaded to do more retesting, but was not convinced that it was necessary to reduce the infection below 1%. As a result, 5 of the flocks had reactors on the last test. This was particularly unfortunate, since these flocks were used for local replacements. The disastrous results can be seen in the table; only 20% of the flocks and 7.8% of the turkeys were free on the first test the next year. In contrast, Group A had 96.1% of the flocks and 97.5% of the turkeys free on the first test, and has not had a complaint from its customers for three years. In its fourth testing season, Group A has 100% of its turkeys free on the first test.

It was mentioned elsewhere that during the first season of testing, certain flocks were tested at monthly intervals throughout the hatching season. There were several reasons why it was impossible to obtain a negative test on these few flocks. Probably most important was the fact that testing was not started until many of the birds had begun to lay. It was also difficult to convince all growers of the need for sanitation during the first year, and to convince certain members that it is imperative to obtain a negative test.

Table III gives several cases to illustrate that the spread of infection is a biological fact and is therefore never static. Flocks 1 and 2 are perhaps the best examples. When the progeny of flock 1 was tested on the owner's ranch the next year, the per cent of infection was 3.1. On the second test of flock 2, there were only 2 reactors (1.2%). Four months after this test, eggs from the flock were suspected of being responsible for an outbreak of pullorum disease, so the owner was persuaded to retest the flock. At this time there were 38 reactors (28.4%). It was proven that 11 of his eggs in a large group of eggs contaminated a hatch and accounted for 2 local outbreaks.

Flock 4 illustrates the dangers of carelessness in removing reactors. On the fifth test there were 15 reactors out of 926 birds (all in one pen). The owner found 14 of them, and refused to handle the birds again to locate the fifteenth. On the next test he had 82 reactors (9.1%).

It was difficult to convince the owner of flock 5 that it was necessary to test a
third time. Yet on the third test the percentage had increased to 6.2. There were definite problems of sanitation and segregation on this ranch, and also egg eating was prevalent among the breeders.

Flocks 3, 6, 7, and 8 further illustrate the fact that it is not safe to stop testing even when there are less than 1% reactors.

These data show the folly of hatcheries and egg handling groups having a program based on the acceptance of flocks which have a minimum percentage of reactors greater than zero.

<table>
<thead>
<tr>
<th>FLOCK NUMBER</th>
<th>1st test</th>
<th>2nd test</th>
<th>3rd test</th>
<th>4th test</th>
<th>5th test</th>
<th>6th test</th>
<th>7th test</th>
<th>8th test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.8</td>
<td>0.2*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.7</td>
<td>1.2</td>
<td>28.4</td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.8</td>
<td>0.2</td>
<td>3.1</td>
<td>2.4</td>
<td>2.3</td>
<td>1.5</td>
<td>4.5</td>
<td>3.2</td>
</tr>
<tr>
<td>4</td>
<td>9.2</td>
<td>10.3</td>
<td>3.3</td>
<td>2.3</td>
<td>1.6</td>
<td>9.1</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.8</td>
<td></td>
<td>6.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>13.4</td>
<td>2.2</td>
<td>6.2</td>
<td>3.6</td>
<td>3.1</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4.6</td>
<td>1.4</td>
<td>1.9</td>
<td>9.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td>2.7</td>
<td>4.8</td>
<td>0.7</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Italics indicate percentages where some laboratories would have stopped testing.

Bacteriological studies of reactors

During the first 2 years of the project, autopsies were made on as many reactors as possible to determine the incidence of *S. pullorum* in various tissues, and the percentage of reactors that yielded the organism. Some data on such autopsies had been previously collected. A total of 213 reactors from known infected flocks were examined, and 87 (40.8 per cent) of them yielded *S. pullorum* from one or more tissues.

Data on the titers of 72 of the 87 birds are available. A total of 17 (23.6%) had an end titer of 1-25; 20 (27.8%) of 1-40; 10 (13.9%) of 1-80; and 25 (34.7%) of 1-160 or greater. The highest titer found was 1-1280 in one bird. It will be seen from these data that about one fourth of the reactors that yielded *S. pullorum* on autopsy would have been missed if a 1-40 to 1-50 dilution test had been used instead of 1-25.

The reproductive tissues yielded the highest percentage of cultures of *S. pullorum*. If only the ovary (or testes), oviducts, umbilical yolk masses and abdominal exudate (caseated masses, etc.) had been cultured 94% of the positive isolations would have been made. It is also significant that had the ovaries alone been cultures, only 44% of the total number would have been detected. Thus the oviduct is a very important organ to include in bacteriological studies of this nature. Of 58 livers cultured 19 (32.7%) yielded *S. pullorum*; 7 of 61 spleens (11.5%); 3 of 12 lungs (25.0%); 5 of 51 intestines (9.8%); 4 of 25 bursas of Fabricius
ERADICATION OF PULLORUM DISEASE

(16.0%); 0 of 9 kidneys; and 1 of 9 pancreas (11.2%) were also positive for S. pullorum.

These results indicate that if the reproductive organs plus any abnormal lesions are cultured, a high percentage of the possible isolations will be made. In no case was S. pullorum isolated only from the intestine. In 3 instances the liver was the only source of the organism, and in another the spleen and the liver alone yielded it. An abscessed lung in one bird, and the bursa of Fabricius in one, were the sole sources of cultures. The incidence in lung tissue is not significant since only abnormal lungs were cultured.

NONSPECIFIC REACTIONS

The agglutination test must be considered as only one part of the diagnostic procedure for determining Salmonella pullorum infection in a flock. Furthermore, the function of a testing laboratory is to diagnose the disease, rather than merely to determine whether a flock has reactors to the test. The test is an accurate means of determining carriers in the flock, but as in all similar tests nonspecific reactions are at times unavoidable. A thorough knowledge of the egg sources, place of hatching and diagnostic records on the flock, will aid the laboratory in making a diagnosis. In flocks that have an accurate history of freedom from pullorum disease, autopsies will prove a further aid in making a diagnosis if only a few reactors are found.

Tables IV and V show some of the reasons why such procedures are necessary. In Table IV is given the results of testing and subsequent bacteriological examination of eight turkeys from seven flocks. These flocks all had histories which indicated that they were free of pullorum disease, and yet a few reactors (less than one per cent) to the pullorum agglutination test were found on the original test of each. Most of the reactors were of very low titers (1-25 to 1-50), but examples like those shown in the table occurred in each flock. All the reactors were culled, and killed for autopsy. Neither Salmonella pullorum nor any other Salmonella was isolated from any bird recorded in this table.

The predominating organisms isolated from the tissues of these reactors are given in the table. Coccus types were obtained most frequently. These were small Gram positive cocci occurring in pairs and in short chains. Paracolon, coliform, Pseudomonas, and Proteus types were less often found as the predominating organisms.

The true significance of these organisms to the nonspecific reactions has not yet been determined by infection of birds and subsequent testing of them. Hurt and McCulloch (5) and Holm, et al. (6) reported on the relation of coccus types to nonspecific pullorum reactions. The organism isolated by us from both poults and adults in these nonspecific reacting flocks is similar to that described by Hinshaw and Dunlap (7) as a cause of false reactions. It is of interest that the trouble from this coccus type of nonspecific reaction has now largely disappeared from ranches that experienced trouble for two or three years. We believe this is because these ranches have secured their replacements from ranches where the coccus infection does not exist.
Table IV.—Examples of non-specific agglutination reactions in pullordum-disease-free flocks

<table>
<thead>
<tr>
<th>Flock</th>
<th>Turkey Number</th>
<th>Titers</th>
<th>Possible Cause of Nonspecific Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S. pullorum</td>
<td>S. typhimurium</td>
</tr>
<tr>
<td>9</td>
<td>247</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>10</td>
<td>773</td>
<td>320</td>
<td>80</td>
</tr>
<tr>
<td>11</td>
<td>758</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>54</td>
<td>160</td>
<td>80</td>
</tr>
<tr>
<td>13</td>
<td>384</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>277</td>
<td>640</td>
<td>1280</td>
</tr>
<tr>
<td>15</td>
<td>848</td>
<td>160</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>344</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

Table V.—Examples of reactors to the pullorum test which yielded only other Salmonella types on autopsy*

<table>
<thead>
<tr>
<th>Flock</th>
<th>Turkey Number</th>
<th>Titers</th>
<th>Salmonella Sp. Isolated From</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S. pullorum</td>
<td>S. typhimurium</td>
</tr>
<tr>
<td>1</td>
<td>457</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>768</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>601</td>
<td>40</td>
<td>5120</td>
</tr>
<tr>
<td>4</td>
<td>441</td>
<td>25</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>702</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>243</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>471</td>
<td>160</td>
<td>640</td>
</tr>
<tr>
<td>5</td>
<td>102</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>285</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>444</td>
<td>25</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>7</td>
<td>941</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>964</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>8936</td>
<td>160</td>
<td>320</td>
</tr>
</tbody>
</table>

*S. typhimurium isolated from all birds except 8936-flock 8; S. derby isolated from it.
In each instance these reactors have been tested also with both "O" and "H" types of Salmonella typhimurium antigen. It will be noted that with two exceptions all of them reacted to the "O" type of antigen. Only one gave an "H" type of reaction. From this flock coliform types predominated and coccus types were not isolated.

In all of the flocks referred to above, the eggs were from "free-on-first-test flocks" and they were hatched in a hatchery that accepted only eggs from "free-on-first-test flocks." Pouls from all of the ranches had been secured for autopsy during the breeding season, and Salmonella spp. had not been isolated. As mentioned above, a coccus indistinguishable from the one isolated from the nonspecific reactors was isolated from the pouls.

These flocks were all given negative reports on the basis of histories and autopsy findings, and all have proven to be free on first test this year.

The fourteen birds in Table V represent examples of birds picked as reactors to the pullorum test, but which on autopsy yielded Salmonella typhimurium in 13 instances and S. derby in one. The reactions to both "O" and "H" types of S. typhimurium antigens are given when available.

Pullorum disease was not diagnosed in flocks 1–4, and these represent flocks where a faulty diagnosis would have been made if only the pullorum agglutination test had been used. In flocks 1 and 2 typhimurium infection was diagnosed for the first time by autopsy of suspicious reactors to the pullorum test. The histories of these flocks indicated that they were free from pullorum disease; so when the reactors were found, they were secured for autopsy as an aid in making a correct diagnosis. A previous diagnosis of typhimurium infection had been made in flocks 3 and 4. Both pullorum disease and typhimurium infection were known to exist in flocks 5 to 7 inclusive and both S. pullorum and S. typhimurium were isolated from reactors in these flocks. S. pullorum was not isolated from the examples cited.

Turkey 8936, flock 8, was the only reactor in a flock of 475 birds which had a history of freedom from both pullorum disease and typhimurium infection. The entire flock was tested for pullorum disease and with both "O" and "H" types of S. typhimurium antigen. The single reactor was secured for autopsy and S. derby was isolated from the intestines. The other organs (liver, spleen, kidney, bile, and ovary) were negative for Salmonellas. An analysis of the antigenic structure of this organism reveals why the bird reacted to the S. pullorum and "O" type S. typhimurium antigens. S. typhimurium has as somatic components I, IV, V, XII; S. pullorum IX and XI; and, S. derby I, IV, and XII. S. derby and S. typhimurium have three common components, I, IV, and XII, while S. derby and S. pullorum have only one, XII. This fact accounts for the higher titer with typhimurium "O" than with S. pullorum.

S. pullorum and S. typhimurium have only XII in common. Since this is only one of the four somatic antigens of S. typhimurium, and since sera vary in the number and ratio of the possible components, it can easily be seen why the pullorum test can pick only a few of the typhimurium reactors.

These are only examples of non-specific reactors that are apt to occur. Johnson and Pollard (8) reported that an organism belonging to the Lactobacilli may
cause non-specific reactions. Recently Bunyea and MacDonald (9) reported that antigens prepared from cultures of *Aerobacter aerogenes* and *Escherichia acidi-lactici* isolated by them from turkeys, gave cross agglutinations with *Salmonella pullorum* antigen.

Reference has already been made to reports on coccus types causing nonspecific reactions. In a previous report (1), we called attention to traumatic injuries often being associated with low titer reactors from which it is impossible to isolate *S. pullorum*. In the same paper we also referred to the possibility of typhimurium infection causing reactions. Other *Salmonella* which have somatic antigens in common with *S. pullorum* that have been reported in turkeys include *S. gallinarum*, *S. california*, *S. enteritidis*, *S. panama*, *S. sandiego*, *S. saint paul* and *S. chester*. All of these can conceivably cause reactions like those reported in Table V.

**ANTIGENS**

Turkey blood serums appear to react differently than do chicken blood serums to *S. pullorum* antigens. Greater difficulty has been experienced with partial reactions at 1-25 dilutions in flocks known to be free of the disease. However, bacteriological examination of tissues from reactors has shown the need for using the 1-25 dilution at least as a finding dilution, because of the high percentage of low titer reactions that yield *S. pullorum* (see Bacteriological Findings).

Some of the reasons for nonspecific reactions are discussed under that heading. Hypersensitivity of the antigen is another important cause of such reactions. Much needs to be learned about this problem, but certain observations bearing on the subject are discussed below.

The strains used for making antigens must be continually scrutinized for loss of smoothness and they should never be used if they have a tendency to show any roughness. The individual strains should be tested for antigenicity and smoothness each time a new lot of antigen is to be made. Low titer anti-serum as well as high titer anti-serum and negative serums should be used to check the antigens made from each strain before pooling them. Duplicate check tests should be made using an antigen which is known to be workable.

For checking a new antigen it is also recommended that each lot be used for setting up 50 to 100 tests on blood samples from a flock known to be free from pullorum disease. As a control, the same sample should be set up with an antigen which has been checked, and preferably one that has already been used for testing several negative flocks. If partial or complete reactions occur in the tests with the new antigen, it should be considered too sensitive for use.

An example of how such a procedure aids in eliminating unsatisfactory antigens is given below. Several lots of commercial antigens were submitted for checking against our antigen. A high percentage of flocks that has been tested with these antigens had reactors in them, even though there was no history of pullorum disease. When the antigens were compared with our own by the procedure described above, it was discovered that they were supersensitive, and when checked for roughness were found to be sensitive to 1-500 dilution of Acriflavine. Table VI gives a summary of these comparative studies. The flocks from which the samples used for these comparative tests were collected, had a combined total of 5500 birds
and all, were free-on-first-test to the control antigen. The antigens were diluted and adjusted for pH so they were identical to the control antigen. With 5 exceptions, the reactions to the test antigens were partial, but they were good enough to condemn a flock if the test alone had been used for diagnosis.

A study of the cultures used for making these antigens indicated that the hypersensitivity was largely due to one of the three strains used for their production. Antigen D in the table was made from the same strains as the others, but after an attempt had been made by the laboratory supplying it to select smooth strains. Though some improvement was noted, the antigen was still unsatisfactory for use.

The observations above show why it is desirable to check newly made antigens with a large number of samples from known pullorum-disease-free flocks before they are released for use. It is equally important to compare them with the routine antigens on both low titer and high titer antiseraums of known titers. Antigens that are unduly sensitive to these tests should likewise not be used. The antigens referred to in Table VI would have been considered satisfactory for use if they had only been tested with positive antiseraums and a single stock supply of negative serum.

**TABLE VI.**—Effect of using hypersensitive antigens on known negative seraums*

<table>
<thead>
<tr>
<th>FLOCK</th>
<th>NUMBER OF SAMPLES</th>
<th>ANTIGEN</th>
<th>NUMBER OF REACTORS AND DEGREE OF REACTIONS (1-25 DILUTION)</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4+</td>
<td>3+</td>
</tr>
<tr>
<td>1</td>
<td>162</td>
<td>A</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>A</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>69</td>
<td>A</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
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<td>1</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>D</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

*Serums from flocks known to be free of pullorum disease. All of them were negative at 1-25 dilutions with the control antigens.

CLOUDY REACTIONS

Laboratorians who have had any experience with agglutination tests for pullorum disease of chickens are familiar with the so-called "cloudy" reaction phenomenon experienced in testing layers. This phenomenon is likewise met with in laying turkey flocks and, if anything, is more exasperating than in the case of chickens. In general, the recommendations of Casman, Valley and Rettger (10) and Valley and Casman (11) to reduce the phenol content of the antigen to 0.2 to 0.3% and to adjust the H-ion concentration to a pH of 8.2 to 8.5 has eliminated this problem.

Occasionally flocks of turkeys in heavy production produce seraums which are not corrected by these adjustments. In such instances, we have resorted to further reduction of the phenol content of the antigen. This is done by using unphenolated physiological saline for diluting the concentrated antigen which is
preserved with 0.5% phenol as usual. To avoid trouble with bacterial growth in the serum-antigen mixtures, the tests are incubated at 50°C for four to five hours and then at room temperature overnight before reading them. This method had proven satisfactory. It has also been possible by this method to reduce the H-ion concentration to pH of 8.0, a factor which aids in reduction of non-specific reactions seen in some tests when an antigen having a higher pH is used.

Whenever possible it is recommended that turkey flocks be tested before they are in production, in order to avoid cloudy reactions. We prefer an antigen having a pH of 7.6 to 7.8 for routine use when cloudy reactions are not a problem.

DISCUSSION

One of the most important reasons for starting this project was to determine whether the tube agglutination test could be used successfully, 1) as an aid in diagnosing pullorum disease in adult turkey flocks, 2) as an aid in eradicating the disease from infected flocks, 3) to determine sources of pullorum disease-free flocks. Another reason was to obtain information on the problems confronting groups interested in developing pullorum diseases eradication sections of breeding programs.

The results reported in our previous paper (1) and in the present one show definitely that the test can be used successfully as a diagnostic aid. Ample evidence has been secured to prove that the disease can be eradicated from infected flocks, by a combination of eliminating reactors to the test, frequent retesting, culling of infected pens, and sanitation. It has also been demonstrated that the test can be used for determining sources of free flocks. Some of the problems concerned with the use of the test for these ends have been answered, but admittedly many others remain unanswered.

It is evident from our studies that pullorum disease in turkeys will continue to be a problem if complete eradication of the disease is not made the goal in breeding programs. For this reason it is suggested to Regulatory and Control agencies that any proposed plans for such programs be based on giving recognition only to non-reacting flocks.

Plans are now being studied by the National Turkey Federation for development of a National Turkey Improvement Plan which will incorporate both a disease and breeding program, patterned after the present National Poultry Improvement Plan for chickens. If such a plan is put into operation, it is suggested that the class now known as "Pullorum Tested" in the National Poultry Improvement Plan for chickens be deleted from the turkey program.

A class which would correspond to the Controlled Class could be incorporated into the plan, but limiting recognition only to infected ranches which have been successful in obtaining a negative report by a retesting and culling program. Eggs from such ranches should not be used for hatching purposes until at least one negative test is obtained. Poults from this Class should be sold only for the production of market turkeys. Replacements for the breeding flock should be secured from "Pullorum-Passed" flocks and from hatcheries accepting only eggs from "Passed" flocks. This system has been successfully used in this project to eliminate infection from ranches (see discussion of Tables I and II).
ERADICATION OF PULLORUM DISEASE

It is our opinion that no testing at all is as valuable as any half-way plan (see Table II, Group B). The function of a testing program should be to eradicate the disease, and not to be a sales promotion scheme. It is also our opinion that any plan which certifies flocks as having been tested and reactors removed is merely a plan certifying that infection exists on the premises. On the other hand, a plan to recognize infected ranches that have sold all of their infected pens of birds, and have shown by a retest that the non-reacting pens have not become infected, will encourage growers to test and at the same time give assurance to buyers of eggs that they have a fair chance to escape losses from pullorum disease. This is the plan suggested above as one that might be called "Pullorum-Controlled." It is not recommended as the ideal, but only as an emergency plan which will help the turkey growers to produce poults for market purposes until the number of "free-on-first-tests" flocks becomes sufficient to supply all the needs of the buyer of turkey eggs.

"Free-on-first-test" flocks could be classed as Pullorum-Passed, the same recognition given for chickens falling into this classification. If desired, the class Pullorum-Clean as used for chickens, could be used for "free-on-first-test" flocks that meet the requirements of this grade. Preferable, however, would be a simplified system using only two classes: 1) Controlled, and 2) Passed. To give credit for the number of years a flock is "free-on-first-test" this number could be stated in the certificate, i.e., Pullorum-Passed—2 years, or Pullorum-Passed—3 years.

The tube agglutination test should be the official test for such a program, since a satisfactory whole-blood antigen has not been developed for testing turkeys. The tube test was adopted for use in this project because of the findings of Hinshaw et al. (12) that the whole blood test was only 50 per cent as efficient as the tube test for detecting carriers of pullorum disease in turkey flocks.

Probably the greatest value of the agglutination test is its use in detecting pullorum disease-free-flocks, and for detecting diseased pens of birds on an infected ranch. It is doubtful if most growers will find it profitable to attempt eradication of the disease from infected pens of birds by a retesting program. The best way to salvage part of an infected flock is to divide the breeders into small units at least two weeks before testing. If a diagnosis of pullorum disease has been made on any group of birds, the survivors should be segregated and sold for meat purposes. Reacting pens should also be sold as meat birds. Non-reacting pens should be retested within two weeks to a month after the disposal of the reacting pens to make sure that the infection has not spread to the non-reacting pens. Such salvaged lots should only be used as a source of eggs for the production of meat birds. Eggs for replacements for the breeding flock should be secured from flocks that are known to be "free-on-first-test" and hatched in hatcheries that accept only eggs from flocks of similar status.

SUMMARY

1. This paper reports results of a pullorum disease eradication program, which was started in July 1939, as a cooperative project of the University of California with the Ramona Turkey Growers Association. The program included supervision
of the agglutination testing (tube test, 1–25 dilution), field supervision of flocks, inspection of hatcheries and frequent advisory conferences with the members of the Association.

2. The results of such a testing program are compared with those obtained by unorganized testing where true eradication was not the goal (Table II). When the two groups started testing, the incidence of infection was about the same (50.0% and 51.5% of the flocks or 30.3% and 31.04% of the birds). At the beginning of the fourth season, the cooperating group had 100% of its birds free on first test, while the non-cooperating group had 20% of its flocks and 7.8% of its birds free.

3. One of the most important means of eradicating the disease from the community, has been the practice of securing eggs for local replacements from “free-on-first-test” flocks. Such eggs must, of course, be hatched in a hatchery which accepts eggs exclusively from flocks of such a status.

4. A total of 213 reactors from known infected flocks were examined bacteriologically. Salmonella pullorum was isolated from 87 (40.8%). If only the reproductive organs of these had been cultured, 94% of the positive isolations would have been made. The oviduct was found to be even more important than the ovary as an organ to be examined for S. pullorum infection. Other organs from which it was isolated are: liver, spleen, gall bladder, lung, bursa of Fabricius, and intestine. Approximately 25% of the infected carriers had an end titer of only 1–25.

5. Although the agglutination test has proven a reliable means of picking reactors, a few nonspecific reactions are unavoidable. Coccus types have been found as the predominating organisms in these nonspecific reactors. In other cases, the test has picked other Salmonellas having common antigenic components. S. typhimurium has been the most common of these.

6. The preparation of the antigen has been shown to be one of the most important parts of such a program. All strains should be carefully studied for smoothness, and the newly prepared antigen should always be checked against a known workable one for hypersensitivity. This should be done on 50 to 100 samples from flocks known to be free from pullorum disease.

7. “Cloudy” reactions present an equal, if not greater problem, in testing laying turkeys, than in testing laying chickens. The usual procedure for eliminating this reaction in chicken serums is not always as successful for turkey serums. A satisfactory method has been to further reduce the phenol content of antigens by using non-phenolated saline to dilute the concentrated antigen. These tests are then incubated at 50°C. for 4 to 5 hours and at room temperature overnight.

8. The problems involved in testing programs are discussed.

ACKNOWLEDGEMENTS

We wish to acknowledge the following agencies and people for their cooperation and assistance in carrying out this project: Ramona Turkey Growers Association, for the use of its facilities, and especially Mr. A. E. Matlack, its manager, for his continued cooperation; the Zoological Society of San Diego for use of its laboratory facilities; and Dr. P. R. Edwards, University of Kentucky, for aid in identification of Salmonella species isolated.
REFERENCES


REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES OF POULTRY


Most of you, no doubt, know something concerning the demand for greater production, made on the poultry industry by our government, to meet the needs of the allied nations. For example; 4,200,000,000 dozen eggs are required during 1942. This represents an increase of 700,000,000 dozen eggs over the 1941 production, and means that we must have a marked increase in the number of layers. Secretary Wickard has called on the poultry industry to produce 200,000,000 extra chickens during the fall and winter months to supplement our meat supplies. The national poultry organizations have suggested that 200,000,000 additional chickens be reared to a weight of at least three pounds, to supply an additional 600,000,000 pounds of poultry for consumers this winter.

At present there is even a great need of poultry feathers due to the fact that importations of 3,000,000 pounds of water fowl feathers from China, Poland, Hungary and Russia have been cut off. It is estimated that we need 10,000,000 to 15,000,000 pounds per year.

During the first ten months of 1942, American hatcheries produced 13 per cent more chicks than in 1941 when the previous hatching record was set.

All this will tax our housing facilities and there is great danger of crowding and poor management which in turn will favor spread of disease. It has been estimated that last year 125 chickens were kept where no more than 100 should have been kept. Under the new production goal, 145 chickens will be housed where no more than 100 should be kept. In others words, each bird will have a 19-inch square of space instead of a 24-inch square, which is considered adequate. Such conditions are obviously conducive to the spread of disease.

In this connection it well to remember that adult mortality has doubled in the last 20 years. There is now a loss of 150,000,000 adult fowl a year. A great portion of this loss could be prevented if we could get poultrymen to apply seriously, many well-known, effective preventive measures. For example; this year fowl pox seems to be very prevalent. Today no poultryman needs to be materially bothered by this malady because of the effectiveness of readily available fowl pox vaccine. Laryngotracheitis can be effectively prevented by vaccination. Tuberculosis can be controlled by well-known procedures, and proper sanitary management can do much to reduce losses due to a number of other diseases. However, the situation is complicated by indifference on the part of many poultrymen and veterinarians and by the fact that so much misinformation is spread by representatives of poultry remedy manufacturers, some of which produce so-called poultry disease experts at almost the same rate as they do pills. If the ranks of our veterinary practitioners are thinned materially by our armed forces it does not require much imagination to see what may happen as far as the poultry disease situation is concerned.
TRANSMISSIBLE DISEASES OF POULTRY

PULLORUM DISEASE

The demands for this greatly increased production means that there will be a great need of chicks from pullorum tested stock. One may, therefore, ask, how does the pullorum disease control program stand now? In answer to this question it may be stated that during 1941-42, 4,745,203 more birds were tested under the National Poultry Improvement Plan than in 1940-41, which was 38.85 per cent more than during 1940-41. The total number of birds tested during this past year was 97 per cent of the total number tested during the first 15 years of the official testing work, and yet with this large increase in the total number of birds tested the number of reactors was only 53 per cent of the number removed from breeding flocks during the first 15 years of official testing. At present a little over 96 per cent of the birds under the National Poultry Improvement Plan are tested. In the fall of 1943, participation in the pullorum phase will be prerequisite to participation in the breeding plan. During the past year approximately 70 per cent of the official pullorum testing of chickens was done with the rapid test, 28 per cent by the tube test and 2 per cent by the plate serum method. During 1920-21 less than 5 per cent of the states had pullorum disease control programs. Now nearly all of the states have such a program. In 1920-21 less than half a million birds were tested, while during 1941-42 about 17 million birds were tested. The percentage of reactions were nearly 14 per cent in 1922 and a little less than 3 per cent in 1942.

All these figures are taken from publications issued by the United States Department of Agriculture. Some of us who are in close contact with the work done under the National Poultry Improvement Plan are inclined to believe that the figures quoted do not tell the whole story about pullorum disease control. First of all, the outstanding pullorum disease work, the work that has shown the most gratifying results, has been done in Massachusetts and Connecticut and antedates the N. P. I. P. by many years. More recently some very fine work has also been done in Ohio under the auspices of the Ohio Poultry Improvement Association and the Poultry Department of the Ohio State University. This work shows in a most convincing manner the value of multiple or repeated testing as a means of reducing chick mortality. No doubt, effective pullorum disease work is done in other localities also, but much of the pullorum testing, done under the N. P. I. P., is really of the nature of a sham battle. This is not the fault of the Plan, but is a reflection on those who are charged with its execution and the collaborators in the Plan.

Furthermore, there are reasons to believe that the percentages of reactors given for 1922 and 1942 are in error. It seems certain that there were more than 3 per cent reactors in 1942 if all the tests are included. Thus, while progress is being made in the control of pullorum disease much remains to be done to make this program as effective as it ought to be. The problem of nonspecific reactors, which is very troublesome in some localities, mostly during the last half of October, November and the first half of December, demands increased research activities.

The progress with pullorum disease eradication in turkeys is not so successful in most places. This is partly due to the fact that the agglutination test is not very efficient when applied to turkeys. You have heard Dr. Hinshaw's report of the four-year program employed in California. This lends encouragement to our
efforts and we would urge all concerned to make serious attempts at the control of pullorum disease in turkeys because of its increased prevalence.

PARATYPHOID INFECTIONS IN POULTRY

You have just heard the paper presented by Dr. Darby. It is evident that the Salmonella group is a very important group of pathogens in poultry as well as in mammals. The fact that it has been shown by Hedstrom (Sweden) that Salmonella typhi murium infection of poultry can be transmitted to man, indicates how important it is to continue studies on these organisms and to apply all the applicable sanitary measures in the control of paratyphoid infections. Unfortunately, the great variety of antigenically different species in the Salmonella group makes it impractical to undertake blood testing as a means of control and eradication of so-called paratyphoid infection of poultry.

RECENT DEVELOPMENTS IN RESEARCH

Virus diseases

From the New Hampshire Experiment Station reports have come to the effect that a virus has been isolated from birds affected with so-called “blue comb” or “pullet disease.” Whether this virus is actually the cause of this disease remains to be proved by further investigation.

The Rhode Island Station has reported the discovery of a new respiratory disease caused by a virus, and the California Station has reported the discovery of a new virus disease that manifests respiratory and nervous symptoms. According to personal communications from Dr. Donald D. Stover of Petaluma, California, this disease appears to manifest itself in a variety of forms.

A virus disease formerly known as psittacosis, now seems to affect birds other than those belonging to the psittacine species. At least a virus, very similar to the psittacosis virus, has been isolated from pigeons and chickens. Serological tests indicate that other species of domesticated birds may also harbor the virus. For such reasons the name ornithosis is now used to designate this type of virus infection in birds other than the psittacines. The ornithosis virus has been found to be pathogenic for man, infections in humans having resulted from contact with pigeons and chickens.

Infectious bronchitis is a virus disease not only of chicks but of older birds as well. It produces a high morbidity but not generally a high mortality. It is serious because of its wide distribution and also because it is difficult to control. In Utah this disease is said to have caused more trouble than any other single disease during the past two years. The mortality is only about 5 to 6 per cent but the loss in production is said to be tremendous. There is an urgent need of research aiming at the control of this disease.

Dr. Frank J. Brands of the Bureau of Food and Drugs of the New York City Department of Health, who was asked to present a paper at this meeting dealing with his wide experience in the inspection of poultry, but was unable to do so on account of illness, states, in a personal communication: “I have found that the
incidence of the avian leucosis complex is rapidly becoming more of an appalling nature to all parties concerned, particularly to the consuming public,” and urges that drastic measures be adopted for the control and ultimate eradication of this disease.

Much effort is being directed toward the study of the avian leucosis complex. Measures such as strict quarantine and sanitation, together with selective breeding for viability in flocks, closed to the introduction of stock from outside sources, have given some encouragement. However, specific measures for prevention and control of this serious malady remain to be developed.

Protozoan diseases

Infectious catarrhal enteritis in turkeys has now been proved to be caused by *Hexamita meleagridis*. The work of Dr. W. R. Hinshaw of the California Experiment Station has established this fact, and, in addition, has shown how the disease is spread and how it can be reasonably well controlled.

Trichomoniasis of turkeys and chickens is reported to be a serious problem to the poultry raisers in Missouri. Trichomoniasis of the lower digestive tract continues to be the most prevalent. The investigations have shown that infection of the crop is also present. Twenty per cent of a flock of turkeys, in which a systematic examination of the crops was made, were found to be affected with the crop form of trichomoniasis. Contrary to the report of Dr. Hinshaw for California, the losses from trichomoniasis infection of the lower digestive tract have been very severe in Missouri. Sixteen counties of the thirty-two turkey-producing counties are now known to be infected with trichomoniasis, the economical loss resulting from mortality in poults affected with trichomoniasis amounted to a conservative estimate of $28,960 in 1941. The average mortality for the same period was 48.4 per cent. It is estimated that this situation will repeat itself in 1942 or perhaps may be somewhat worse. This disease affects the poults at about three to six weeks of age, but the organism may be found in poults of all ages.

Experiments conducted at the Missouri Experiment Station showed that poults were susceptible to the trichomonads of the chicken and turkey only. The exact nature of trichomoniasis in poults is not known, but it is believed that a form of malnutrition results from infection with the trichomonads.

Hexamita infection of turkeys has been observed in this study, but to date has had very little significance as far as mortality is concerned.

Further information has recently been gained by Dr. E. P. Johnson of the Virginia Experiment Station on the transmission and life cycle of *Leucocytozoon smithi* in turkeys.

At the Wisconsin Experiment Station it was found that steamed bone meal tends to aggravate the effects of coccidiosis. Four times as many chicks died from coccidiosis among those given either 2 or 3 per cent steamed bone meal as among those getting only the bone meal contained in 4 per cent meat scrap. In this connection it may be well to think of the possible influence of substitute rations, which may be used as a result of war conditions, on the communicable diseases of poultry. Those engaged in poultry disease work ought to keep such possibilities in mind and be on the lookout for evidence of such conditions.
Bacterial diseases

According to Bunyea and MacDonald of the Bureau of Animal Industry, United States Department of Agriculture, certain strains of *Aerobacter aerogenes* and of *Escherichia acidii lactici* are pathogenic for turkeys and may be responsible for a considerable mortality in young poults. The fact that there is some antigenic relationship between *Salmonella pullorum* and these organisms may throw some light on so-called nonspecific reactions encountered in serologic testing of turkeys and even chickens for pullorum disease.

Schwarte and Biester of the Iowa Station found that they could infect chickens fatally by intracranial injection of Listerella isolated from cattle. Intravenous injections did not cause disease.

McCulloch and Fuller of Washington State College have suggested the feasibility of disinfecting chick boxes by painting them with water glass (sodium silicate) so that they can be used more than once. This may become necessary if the war lasts long enough, but unless they are disinfected carefully and thoroughly, re-used chick boxes may become an excellent means of spread of such diseases as chick bronchitis, pullorum disease and perhaps others.
As mentioned in the last report of this committee, the National Rabies Committee is composed of representatives from the U. S. Live Stock Sanitary Association, the American Veterinary Medical Association, the American Animal Hospital Association, the American Medical Association, the American Kennel Club, the American Humane Association, and the U. S. Bureau of Animal Industry. This committee held a meeting April 25, 1942, in New York to further discuss the control of rabies in the United States.

Representatives of the U. S. Bureau of Animal Industry on this committee were asked to supply information as to the additional legislation necessary to enable the Bureau to participate in the rabies control program, and how a cooperative project on this problem would be inaugurated with the States. When this information is supplied to the National Committee it is understood another meeting will be held for considering further plans.

It is believed by your committee that each State should carefully review the laws and regulations under which the rabies problem is handled in that State. Several States, particularly New Jersey and Connecticut, have laws under which rabies apparently can be handled satisfactorily. The New Jersey laws are of recent enactment, but the Connecticut laws have been in effect for a number of years. It is suggested that live stock sanitary authorities get copies of these laws from the officials of New Jersey and Connecticut for study and comparison with their own present laws.

Since the question frequently arises in outbreaks of rabies as to the transmissibility of the disease through milk and meat of animals that have been exposed to or affected with the disease, your committee submits the following for the consideration of livestock sanitary officials and others regarding this question:

Considerable attention has been given this subject from time to time over a period of years, with particular reference to the presence of rabies virus in the milk and udder tissue. The great majority of investigators on this subject, after considerable observation and study, reported negative results. In a few instances, how-

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<th>CATS</th>
<th>GOATS</th>
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TABLE 2.—Rabies in the United States by states during the year 1941

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ever, investigators reported the presence of rabies virus in the milk and udder tissue. The U. S. Bureau of Animal Industry (Report of Chief of Bureau 1935) conducted some experimental work on this subject and inoculated the virus of rabies intralingually into two milking cows on different occasions. Samples of milk were taken from these animals during the course of the disease at frequent intervals. In addition, milk from the cistern and udder tissue of the animals at death was collected and all samples were inoculated into rabbits subdurally. All these inoculations resulted negatively. In addition, a calf and four pigs were fed the milk taken daily from the cows from the time of exposure to their death from rabies. The mucous membranes of two of the pigs and the calf were scarified frequently. In no case did the animals show any harmful effects from the consumption of this milk. In other tests, rabies virus in the form of a brain emulsion was added to milk and then fed to four hogs, the mucous membranes of two of which were severely scarified. These animals remained healthy.

It appears, therefore, from the information available on this subject, that while the virus of rabies may at times be found in the milk, the chance of such a happening is quite remote, and that from a practical standpoint there would appear to be little danger in the consumption of milk from even a rabid animal. Milk secretion is usually considerably diminished at the clinical appearance of the disease, with the result that in most cases milk has been consumed only before the animal has shown any evidence of the disease. However, the milk from a rabid or suspected rabid cow naturally should be condemned as unfit for consumption.

The same position should be taken with respect to the meat or meat-food products of a rabid or suspected rabid animal. The disposition of farm animals that have been exposed to the bites of a rabid dog also presents a practical sanitary police problem. The International Rabies Conference held in Paris in 1927 under the auspices of the Health Committee, League of Nations, made the following recommendation on this point: "Animals bitten by rabid animals whether treated or not after the bite, should not be butchered between the 8th day at the very least and the end of 3 months following the bite." Since this may be a problem of considerable importance in areas where rabies exists, the recommendations above quoted form a basis for methods of procedure.

Your committee again has been furnished material on the incidence of rabies in the various States in 1941 through the courtesy of Dr. John R. Mohler, chief of the Bureau of Animal Industry, U. S. Department of Agriculture. According to the reports received for the calendar year 1941, there were 6,648 cases in dogs, 418 in cattle, 39 in horses, 68 in sheep, 159 in swine, 294 in cats, 9 in goats, 212 miscellaneous, 30 in man, and a grand total of 7,877 cases.

Information collected by the U. S. Bureau of Animal Industry since 1938 on the incidence of rabies in the United States is tabulated in table 1.

RECOMMENDATION

It is recommended that the committee on rabies be continued and that it be empowered to coordinate its activities with the National Rabies Committee, looking to ways and means of controlling rabies on a national basis.
Table 2 gives a report on the incidence of rabies by States for the calendar year 1941. This table was compiled from a questionnaire sent by the Bureau of Animal Industry, U. S. Department of Agriculture, to the livestock sanitary official and health officer in each State. In the report from some States the statistical data from both sources were used.
REPORT OF THE COMMITTEE ON POLICY

J. G. Hardenbergh, Chicago, Ill.; W. B. Earl, Reno, Nev., and
R. R. Dykstra, Manhattan, Kans.

Your Committee on Policy has nothing new to report this year. We feel that
this is not the time to change the policy of this Association and we refer you to
the report of last year, and would remind you of Section 6 of that report which reads
as follows:

"Your Committee further recommends that all matters of policy and all recom-
mendations made by members of this association be referred to the Committee on
Policy whose duty it shall be to study, prepare and report, for the consideration of
the Executive Committee, all policies of general nature affecting this Association."

Inasmuch as we have received no requests or recommendations from any of our
members, we feel there should be no change or suggestions made at this time.

REPORT OF THE NOMINATING COMMITTEE

J. L. Axby, Chairman, Indianapolis, Indiana; E. S. Brasher, Jackson, Mississippi;
and R. W. Smith, Concord, New Hampshire

Dr. Axby: Your Nominating Committee has met and has spent some time in
considering our officers for presentation to you. We wish to present to you the
following report:

President: Dr. W. H. Hendricks, Salt Lake City, Utah
First Vice-President: Dr. J. M. Sutton, Atlanta, Georgia
Second Vice-President: Dr. R. A. Hendershott, Trenton, New Jersey
Third Vice-President: Dr. William Moore, Raleigh, North Carolina

Doctor Axby moved that the report be accepted and that nominations be closed
and the Secretary-Treasurer be instructed to cast the unanimous vote of the Asso-
ciation for the election of the nominees.

Secretary Welsh cast the unanimous ballot. The officers were inducted into
their respective positions and each made a short speech of acceptance following
which the meeting was adjourned.