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

HOTEL LA SALLE
Chicago, Illinois
December 3, 4, 5, 1941
PROCEEDINGS
FORTY-FIFTH ANNUAL MEETING
OF THE
UNITED STATES LIVE STOCK
SANITARY ASSOCIATION
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Mark Welsh .................................................. College Park, Maryland

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C. R. Donham, Lafayette, Ind.

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Jos. Barber, Providence, R. I.

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Don E. Kenney, Salt Lake City, Utah

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Wm. Moore, Raleigh, N. C.

J. L. Axy, Indianapolis, Ind.
R. L. West, Saint Paul, Minn.
Mark Welsh, College Park, Md.
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>
<tr>
<th>Meeting Date</th>
<th>Place</th>
<th>President</th>
<th>Secretary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 28-29, 1897</td>
<td>Fort Worth, Tex.</td>
<td>*</td>
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<tr>
<td>1898</td>
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<tr>
<td>1899</td>
<td>Chicago, Ill.</td>
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<tr>
<td>1900</td>
<td>Louisville, Ky.</td>
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<tr>
<td>Oct. 8-9, 1901</td>
<td>Buffalo, N. Y.</td>
<td>E. P. Niles</td>
<td>F. T. Eisenman</td>
</tr>
<tr>
<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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<tr>
<td>1905</td>
<td>Guthrie, Okla.</td>
<td>Hon. W. P. Smith</td>
<td>S. H. Ward</td>
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<tr>
<td>Sept. 16-17, 1907</td>
<td>Richmond, Va.</td>
<td>D. F. Lucky</td>
<td>G. A. Jarman</td>
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<tr>
<td>Dec. 5-7, 1910</td>
<td>Chicago, Ill.</td>
<td>Chas. E. Cotton</td>
<td>J. J. Ferguson</td>
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<tr>
<td>Dec. 6-8, 1911</td>
<td>Chicago, Ill.</td>
<td>John F. DeVine</td>
<td>J. J. Ferguson</td>
</tr>
<tr>
<td>Dec. 5-6, 1912</td>
<td>Chicago, Ill.</td>
<td>Mazvek P. Ravenel</td>
<td>J. J. Ferguson</td>
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<tr>
<td>Dec. 2-4, 1913</td>
<td>Chicago, Ill.</td>
<td>Peter F. Bahnsen</td>
<td>J. J. Ferguson</td>
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<td>Feb. 16-18, 1914</td>
<td>Chicago, Ill.</td>
<td>S. H. Ward</td>
<td>J. J. Ferguson</td>
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<td>Dec. 5-7, 1916</td>
<td>Chicago, Ill.</td>
<td>O. E. Dyson</td>
<td>J. J. Ferguson</td>
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<td>Dec. 2-4, 1917</td>
<td>Chicago, Ill.</td>
<td>J. G. Wills</td>
<td>S. H. Ward</td>
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<td>Dec. 2-4, 1918</td>
<td>Chicago, Ill.</td>
<td>M. Jacob</td>
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<td>Dec. 1-2, 1919</td>
<td>Chicago, Ill.</td>
<td>G. W. Dumphy</td>
<td>D. M. Campbell</td>
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<td>Nov. 29-30-</td>
<td>Chicago, Ill.</td>
<td>S. F. Musselman</td>
<td>D. M. Campbell</td>
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<td>Dec. 1, 1920</td>
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<td>Nov. 28-30, 1921</td>
<td>Chicago, Ill.</td>
<td>W. F. Crewe</td>
<td>Theo. A. Burnett</td>
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<td>Dec. 6-8, 1922</td>
<td>Chicago, Ill.</td>
<td>T. E. Munce</td>
<td>Theo. A. Burnett</td>
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<td>Dec. 5-7, 1923</td>
<td>Chicago, Ill.</td>
<td>W. J. Butler</td>
<td>O. E. Dyson</td>
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<td>Dec. 3-5, 1924</td>
<td>Chicago, Ill.</td>
<td>J. G. Ferneybough</td>
<td>O. E. Dyson</td>
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<td>Nov. 30-</td>
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<td></td>
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<td>Dec. 1-2, 1927</td>
<td>Chicago, Ill.</td>
<td>L. Van Es</td>
<td>O. E. Dyson</td>
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<td>Dec. 2-5, 1928</td>
<td>Chicago, Ill.</td>
<td>C. A. Cary</td>
<td>O. E. Dyson</td>
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<tr>
<td>Dec. 4-6, 1929</td>
<td>Chicago, Ill.</td>
<td>Chas. G. Lamb</td>
<td>O. E. Dyson</td>
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<td>Dec. 3-5, 1930</td>
<td>Chicago, Ill.</td>
<td>A. E. Wight</td>
<td>O. E. Dyson</td>
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<tr>
<td>Dec. 2-4, 1931</td>
<td>Chicago, Ill.</td>
<td>J. W. Connaway</td>
<td>O. E. Dyson</td>
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<tr>
<td>Nov. 30-</td>
<td>Chicago, Ill.</td>
<td>Peter Malcolm</td>
<td>O. E. Dyson</td>
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* Information not available.
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<tr>
<th>No.</th>
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<th>Location</th>
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<th>Name 2</th>
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<tr>
<td>37</td>
<td>Dec. 6-8</td>
<td>1933</td>
<td>Chicago, Ill.</td>
<td>E. T. Faulder</td>
<td>O. E. Dyson</td>
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<td>38</td>
<td>Dec. 5-7</td>
<td>1934</td>
<td>Chicago, Ill.</td>
<td>T. E. Robinson</td>
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<td>39</td>
<td>Dec. 4-6</td>
<td>1935</td>
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<td>Edward Records</td>
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<td>40</td>
<td>Dec. 2-4</td>
<td>1936</td>
<td>Chicago, Ill.</td>
<td>Walter Wisnicky</td>
<td>L. Enos Day</td>
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<tr>
<td>41</td>
<td>Dec. 1-3</td>
<td>1937</td>
<td>Chicago, Ill.</td>
<td>R. W. Smith</td>
<td>L. Enos Day</td>
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<td>42</td>
<td>Nov. 30-Dec. 1-2</td>
<td>1938</td>
<td>Chicago, Ill.</td>
<td>D. E. Westmorland</td>
<td>L. Enos Day</td>
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<td>43</td>
<td>Dec. 6-8</td>
<td>1939</td>
<td>Chicago, Ill.</td>
<td>J. L. Axby</td>
<td>L. Enos Day</td>
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<td>44</td>
<td>Dec. 4-6</td>
<td>1940</td>
<td>Chicago, Ill.</td>
<td>H. D. Port</td>
<td>L. A. Merillat</td>
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<tr>
<td>45</td>
<td>Dec. 3-5</td>
<td>1941</td>
<td>Chicago, Ill.</td>
<td>E. A. Crossman</td>
<td>Mark Welsh</td>
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</tbody>
</table>
ADDRESS OF THE PRESIDENT

We are assembled here this morning to open the Forty-fifth Annual Meeting of the United States Live Stock Sanitary Association, and the thirty-third to be held in the city of Chicago. Never in the history of this organization have we been confronted with problems which require such careful consideration. In all the world's history never has a supply of food been so acute a problem. At this very moment it is a serious one, but as the war goes on, and no man knows for how long it will go on, this problem is going to increase in intensity. With peace, when and if it comes, will come the call for food and more food, for rehabilitation of lands that have been ravaged. America will be called upon to feed millions of hungry and undernourished men, women, and children in Europe and possibly Asia and Africa. And when we think of food we think instantly of meat and meat food products. The American live stock industry and allied agencies represented here today must function as never before. Production and more production and conservation must be our watchword.

In this stepping-up process to produce more food, there is always a tendency to neglect certain fundamental principles which have been established, often times at great cost and inconvenience. Because a state of emergency exists there should be no excuse for the live stock sanitarian to neglect to enforce regulations which are a vital part of our whole live stock industry. The introduction of Foot and Mouth Disease, for instance, into the great dairy and beef herds of North America might be a greater menace to the American public than the invasion of a small army of parachute soldiers from Axis powers.

The dairy industry is being called upon to produce every quart of milk possible for wartime and humanitarian purposes, but the milk hygienist must be prepared to assume greater responsibility in safeguarding public health. Under the Lend-Lease Act the Administration has made certain commitments to supply definite quantities of food up to June 30, 1942. According to Secretary of Agriculture Claude R. Wickard here are some of the foods which the United States Government is committed to deliver, and I quote: “The British in that period will need a supply of cheese, evaporated milk, and dry skim milk that will require the processing of between 4½ and 5 billion pounds of milk. They will need a billion and a half pounds of pork and lard, the produce of some nine million hogs. They need eggs, about 500 million dozen, the output of over 50 million hens; and they will need 18 million pounds of poultry meat. There are other items included in the food commitments, but the major role of food in America’s defense across the Atlantic will be played by the products of dairy cows, hogs, and chickens.” Here indeed is a challenge to the Live Stock Industry of America. We believe the industries will meet this challenge and produce food in access of the amounts set up as goals. But it is no easy problem. Consider the request of increasing the milk production on our farms from an estimate of about 117 billion pounds in 1941 to 125 billion pounds in 1942, notwithstanding our production this year will be 5 per cent larger than in 1940. Bear in mind that in many dairies the production per cow is now at a high level. To reach the suggested goal, production per cow must be increased on farms where at the present time it is at a low level. This means increased food for the dairy cows.
In addition to increasing the production per cow, we must increase the number of dairy cows. It is estimated that we will need an increase of about 3 per cent for 1942 over 1941, or approximately 700,000 milk cows. To assist in this program it is suggested that the Bang's Disease control project be modified during the emergency, and heavy producing cows which are classified as reactors be placed in quarantine during their lactation period, rather than being immediately slaughtered. In a recent article published in the daily press Dr. Thomas M. Parran, Surgeon General of the United States, is quoted as saying we must increase by 50 per cent the production of milk in the United States. Of course this is an impossibility at the present time, but if we are to plan for a long-time program, it might be accomplished in two or three years.

It will not be such a problem to raise an additional 9 or 10 million hogs, provided the feed for them can be produced. But here again greater precaution must be taken to safeguard the health of the millions of extra hogs needed to meet the requirements of the Government to fulfil their commitments to the British Government. It would be just as criminal to allow large numbers of hogs to die from Hog Cholera or other swine diseases as it would be to allow an epidemic of typhoid to break out in one of our army camps where thousands of soldiers are housed. These diseases are preventable. It is not the intention of the speaker to discuss in detail any of the many diseases which the livestock industry is vitally interested in. Your committees have prepared an excellent and very full program covering many of these diseases. If we assemble promptly at the opening of each session, this program can be completed on time and there will be ample time for the discussion of each paper.

We observe many new faces here today. We welcome you and want you to feel at home and take part in our deliberations. Also we are missing quite a number who have made it a practice to attend our annual meetings. Some are only temporarily absent and we shall look forward to their return. Sadly, we acknowledge the departure of some of our members who during the year have passed to the Great Beyond.

Last year the Executive Committee was asked to give consideration to increasing the membership of the Association. I know this has been done and as a result we expect our membership this year will exceed that of any previous year. However, there are still hundreds of veterinarians and others directly connected with the livestock industry that should be associated with us.

The matter of selling advertising space in the Association's printed proceedings has been given a great deal of thought, and it is hoped that definite plans will be adopted shortly so that at least a small amount of advertising will appear in our next annual report. Perhaps the Secretary will make a further report on this matter. It is regretted that the report of the proceedings of the Forty-fourth Annual Meeting was delayed in printing and distribution. This was due largely to the fact that contributors to the program neglected to return their manuscript to the Secretary. It is hoped that the report of this meeting can be published by the first of March 1942. This will be possible if all concerned will do their part and cooperate more fully with the Secretary.

In closing I wish to express my sincere appreciation to the committees who have
made possible this splendid program. No report of the year's activities would be complete without mentioning the work of our most efficient Secretary-Treasurer, Dr. Mark Welsh. After all, the "lion's" share of carrying on this organization falls on the Secretary. He has done a fine job and no one appreciates it more than the President, who depends almost entirely on him in handling the affairs of this Association. I want to express to him my hearty appreciation and sincere thanks for the excellent manner in which he has carried on during the past year.

In conclusion, I wish to take this opportunity of pledging the loyalty of this Association to the Administration in Washington and offering our full support in helping to carry out their gigantic plan of feeding not only millions of our own people, but our less fortunate brothers across the sea.
REPORT OF THE SECRETARY-TREASURER

I appreciate very much the kind comments that the President has made and I can assure you as well as Dr. Crossman that it has been a pleasure to work with him during this past year.

This is purely a financial report of the status of the Association for the period of December 1, 1940, through November 30, 1941.

FINANCIAL STATEMENT

December 1, 1940, through November 30, 1941

Receipts
Cash in Prince George's Bank & Trust Company 11/30/41. $1,572.82
Deposit in transit........................................ 13.57
Return on U. S. Treasury Bond.......................... 400.00
Interest on U. S. Treasury Bonds...................... 165.53
Official memberships................................... 1,175.00
Individual memberships................................. 700.00
Registration Fees...................................... 422.00
Reprints and Proceedings.............................. 723.05
Total.................................................................. $5,171.97

Disbursements
Salary—Secretary-Treasurer.............................. $600.00
Labor.................................................................. 14.25
Fidelity Bond premium.................................... 25.00
Travel.................................................................. 12.90
Postage.......................................................... 154.78
Stationery and Printing
Programs and envelopes 1940......................... $108.50
Proceedings and Reprints.............................. 1443.85
Billheads...................................................... 9.00
Envelopes for programs 1941......................... 39.91 1,601.26
Reporting Service 1940.................................. 100.00
Miscellaneous
Badges....................................................... $90.00
Incorporation charges.................................... 27.00
Bank charges................................................ 6.42
Notary fees.................................................. 5.50
Expenses 1940 meeting.................................... 15.05
Mailing materials, etc.................................... 11.41
Rubber stamp................................................ 1.15
Expenses—Poultry Committee 1940............... 60.91 218.34
Total.................................................................. 2,726.53
Cash on hand, Prince George's Bank and Trust Company......... $2,445.44
REPORT OF THE SECRETARY-TREASURER

Assets

Cash on hand (12/1/40) .................................. $1,586.39
Cash—U. S. Treasury Bond ................................ 400.00
U. S. Treasury Bonds ..................................... 4,800.00
Furniture and Fixtures .................................... 116.50
Net Gain .................................................. 459.05

Total Assets ............................................. $7,361.94

Liabilities

Net Worth—November 30, 1941 ............................. $7,361.94

MARK WELSH,
Secretary-Treasurer.

On motion of Dr. Axby the report of the Secretary-Treasurer was referred to the Executive Committee and to be audited by a special committee appointed by the President.

REPORT OF THE AUDITING COMMITTEE

DR. WILLIAM MOORE, Chairman, Raleigh, North Carolina

DR. C. P. BISHOP, Harrisburg, Pa.

T. O. BRANDENBURG, Bismarck, North Dakota

Your special Auditing Committee appointed by the President 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.
MEMORIAL SERVICE

UNITED STATES LIVE STOCK SANITARY ASSOCIATION

December 3, 1941

Today we pause from labor for this short interval to memorialize and pay tribute to the following men, who during the last year have passed to that bourne from whence no traveler ever returns:

Colonel Walter Frazer—San Diego, Cal. Died September 27, 1940.
Frank Jelan—Omaha, Nebraska. Died December 2, 1940. Member of the B.A.I., retired.
Earl P. Maxwell—Columbus, Ohio. President of the Columbus Serum Company. Died December 3, 1940.

I respectfully ask all assembled to arise and remain standing, during which time a silent prayer may be directed to Him Who sees all, hears all, and Who said: "Whosoever believeth on Me shall not perish but have everlasting life," humbly asking for the peaceful repose of the soul of each, anticipating somehow, some way, a glorious reunion—in God’s way, on "That Beautiful Isle of Somewhere."

SILENT PRAYER

We are glad, and the world is better, for their having passed this way. They were not unmindful that some four hundred years ago our forefathers came to this land with the hope in their hearts that they could establish and maintain the true spirit of the Fatherhood of God and the Brotherhood of Man, ever grateful to those who, with courage, devotion and tolerant Christian spirit, hewed their way through the wilderness, developed the prairies, conquered the mountains, harnessed the rivers, and with the inspiration given them by a firm belief in Divine Providence, created in this land a great Republic that stands as the last bulwark of Democracy in the world.

We shall believe they are not gone, “they’re just away”, and during their absence we will emulate them and continue their practice of being grateful for the greatest
blessings of having an opportunity to live in the greatest country beneath the blue canopy of Heaven.

We shall be grateful for and we will follow that leadership of democratic government—whenever it may be—when they show a determined spirit and action to uphold the ideals our forefathers fought for, that they do not perish. We, as they, shall be grateful for private and personal blessings—the blessings of freedom of speech, freedom of assembly, freedom of the press, and freedom of worship.

That their efforts may not have been in vain, we pledge anew our hearts, our hands, and our sacred honor for National Unity, that the dangers beyond our shores shall not jeopardize the fundamental principle of Life, Liberty and the Pursuit of Happiness.

They were typical examples of:

**God's Plan**

If only success lay down the stream,
The prize at the foot of the hill—
There would be small need for men to dream,
Small need for their courage and skill.

If the race went never to the swift,
Nor the battle unto the strong—
Then men would do little more than drift,
Though the days of their years be long.

But since all currents flow from success,
And the prize tops the hill's highest peak—
Since races are won by speed, no less,
And defeat ever brands the weak.

Then all men must climb, all men must row,
And all men must have flying feet—
And all men must battle, blow for blow;
God's Plan to make victory sweet.

"They Are Not Gone"

Again I say, "They're just away", members of that innumerable caravan, destined for that land not made with hands, eternal in the Heavens.
To their souls, Peace, Peace, Amen.

Mr. President, I move that this service be made of permanent record and a copy be sent to the family of each deceased member.

J. L. Axby.
PERSONAL SURVEY OF WARTIME ANIMAL-DISEASE CONTROL IN GREAT BRITAIN

BY A. EICHHORN, D.V.S.

In August of this year a request was received by the United States government from the Ministry of Agriculture of Great Britain to delegate a specialist in animal disease control to visit Great Britain for the purpose of discussing problems which might result in the adoption of measures for the control of infectious diseases of animals. It was my privilege to receive the assignment.

The responsibility for the control and eradication of infectious diseases in Great Britain is vested with an organization similar to the U. S. Bureau of Animal Industry. On the other hand, all research pertaining to problems in agriculture is administered by the Agricultural Research Council, which is responsible for the development of research projects and the allocation of such funds as are required for the execution of the projects. The Council appoints committees consisting of specialists who are known to have the best qualifications for research on the respective projects. Thus, committees for the study of Bang's disease, bovine mastitis, Johne's disease, tuberculosis, diseases of swine, etc., are functioning. They meet at various times for the purpose of discussing the problems and any new developments which might be advantageously taken up.

The opportunity was afforded the writer to attend conferences of several of these committees and, while research on many of the projects is necessarily lacking during this emergency, it is realized that efforts must be concentrated on disease control which will be of immediate benefit to the livestock industry. Primary consideration, therefore, is given to diseases which have an influence on milk and meat production. In view of the fact, however, that the importation of animal feeds on which Great Britain greatly depended prior to the present war is very much restricted, all animals are maintained on rations which have to be greatly reduced or at least materially changed from the normal practice. Accordingly, the numbers of hogs and poultry have been greatly reduced. Although every effort is being made to maintain the number of milk-producing cows, the lack of food concentrates has resulted in a diminished production of milk. In order to provide the greatest possible supply of milk, the control of diseases influencing milk yield is being given primary consideration and, from available data, it appears that the reduction of milk yield because of Bang's disease and mastitis amounts to about 15 per cent.

BANG'S DISEASE

Since the recognition of the infectious nature of Bang's disease, efforts have been made in Great Britain to control the infection. The first country in which large-scale vaccination with live organisms was instituted is Great Britain, the government having undertaken the production of vaccine without regard to the virulence

1 From the Animal Disease Station, Bureau of Animal Industry, U. S. Department of Agriculture.
2 Beltsville, Md.
of the organisms. This practice was abandoned after several years, although early reports indicated that a marked reduction in the incidence of abortion followed in cases where this form of vaccination was practiced. Unquestionably, the use of virulent organisms for that purpose tended to spread the infection and one could safely assume that the present extent of the disease in Great Britain might be due at least partially to the wide application of vaccination. It is now accepted that approximately 35 per cent of the herds in Great Britain are infected and no definite procedure has been adopted for the control of the disease.

The livestock sanitary officials, as well as the veterinary profession, were informed of the experiments conducted in the United States with strain 19, but aside from the limited experimental work, the use of vaccine has not been encouraged. More recently McEwen claimed to have developed a live vaccine from a strain which, although antigenic, did not induce an agglutination titer in the injected animals. Results of uncontrolled field tests published by McEwen and also experimental data seem to confirm this assertion and, based on these results, the committee on Bang's disease appointed by the Research Council has undertaken controlled experiments to establish or disprove the claims of McEwen.

During my visit to the experimental farm of the Agricultural Research Council at Compton, I had the opportunity of observing these experiments, in which ten young animals were vaccinated and ten left as controls under strict isolation. During the first pregnancy all were exposed to artificial infection. Of the vaccinated animals, one gave birth to a premature calf and in four of the others organisms were isolated either from the milk, afterbirth or discharges following parturition. Thus, it is evident that five of the ten animals shed infection following parturition.

After citing the results of the experimental work with strain 19 in the United States, in addition to the field results of the vaccination of approximately 20,000 calves, the authorities in charge of this project looked with favor upon calfhood vaccination with strain 19 and officially requested the U. S. Department of Agriculture to send and loan the British government a technically trained man to inaugurate the production of this vaccine. This request is now receiving the attention of the Bureau of Animal Industry.

**BOVINE MASTITIS**

Bovine mastitis has been studied intensively in Great Britain because of its prevalence and the great losses associated with its presence. The principal causative factor is recognized as *Streptococcus agalactiae*, although staphylococcus infections, while not as prevalent, are more destructive in their action. Several years ago Dr. Minett, who unquestionably was the foremost authority on bovine mastitis in Great Britain, developed a procedure for the control of the infection which, however, from the practical standpoint, has not gained much favor because of the extensive laboratory work involved. At the present time veterinarians are directing their attention principally to sanitary measures for the control of the infection. The difficulty in carrying out the measures required for this procedure is unquestionably responsible for the widespread prevalence of the disease.

From time to time chemotherapeutic agents have been employed, particularly acriflavine and enzotiz, but they have not been acclaimed as specific nor have they
been proved sufficiently effective to justify their general application. More recently gramicidin has been employed experimentally in several herds with promising results and other newly developed chemotherapeutic agents also are being tested. Thus, the control of mastitis is at best largely limited to hygienic and sanitary precautions.

TUBERCULOSIS

As in most Central European countries, tuberculosis is widespread in Great Britain. It is estimated that 35 to 45 per cent of the animals are infected with the disease. In the past years efforts have been made to stimulate its eradication from milk-producing herds by offering a bonus to those who would agree to eliminate the infection from their herds. The bonus amounted to 2 cents on a quart of milk. As a result of this effort, many dairy-herd owners volunteered for participation in the program. Because of the present emergency, however, even this limited effort towards tuberculosis control is more or less abandoned.

Unquestionably, with the effort of increased milk production and the lack of proper feed, the incidence of tuberculosis will be on the increase and it is regrettable that human infection of the bovine type will unquestionably also increase proportionately, especially as in Great Britain pasteurization is practiced only to a limited extent.

It is indeed fortunate that the efforts in the United States towards eradication of tuberculosis have progressed to the present state where the control program has not only practically eliminated the danger of infection to human beings, but also has proved to be a great economic achievement.

A method of control based on vaccination is being considered and will depend upon the results of controlled experiments now in progress. In 1937, the discovery was announced by Wells that the English field mouse, or vole, is frequently found to be infected with tuberculosis. The acid-fast organism responsible for this disease peculiarly does not conform to any of the recognized types of tubercle bacilli. It does not cause progressive tuberculosis in guinea pigs or rabbits, but does produce a marked resistance to subsequent injections of virulent bovine or human tubercle bacilli. In preliminary vaccination experiments in cattle it was found that animals vaccinated in various ways with relatively large doses of the vole bacillus and subsequently exposed to virulent tubercle bacilli showed practically no lesions of tuberculosis in some instances when killed a few months later, while control animals showed extensive infection.

The writer viewed the cattle in the present vole-vaccine experiment in Cambridge, but it will be at least two years before the test is completed, as the authorities intend to allow some of the cattle to live two or three years to determine whether the disease is completely resisted or merely temporarily arrested. If the vole vaccine should prove effective, it may be feasible for the British, with their high incidence of bovine tuberculosis, to practice this method of control.

HOG CHOLERA

Hog cholera has not been recognized in Great Britain as being as destructive as in the United States, although in the past few years it has gained in its extent, and the losses, especially since the present war, have increased. Because of the limited ex-
tent of the infection, the use of the simultaneous treatment has been prohibited and efforts have been made to control the infection either through slaughter or serum treatment alone, as has been the practice in Canada. The scientists, after learning of the discovery of a modified virus by Dorset and his coworkers, aim to follow the procedure in Great Britain and have undertaken large-scale experiments with the gentian-violet vaccine. The experiments carried out for the past few years are now practically concluded and vaccination of pigs by this procedure will be undertaken under field conditions within a short time.

Experiments have established that gentian-violet vaccine becomes “inactivated” about the third day of incubation and that the immunity following the injection of the vaccine is established by about the twelfth day. Furthermore, the vaccine retains its protective value after storage of at least 248 days when kept in the dark at room temperature, whereas at refrigerator temperature it appears to remain potent for years. Pigs of any age respond favorably to the vaccination. The experiments which were conducted on a large scale are sufficiently convincing to justify the authorities in permitting the application of the procedure for the prevention of swine fever.

In view of the importance of controlling swine diseases, the following information concerning studies of necrotic enteritis and swine fever might be opportune:

Studies on necrotic enteritis have demonstrated that the Bact. suipestifer is probably the most important factor in the development of the disease. In the experimental work it was aimed to determine the infective dose required to induce the disease and for this purpose groups of 5 to 10 pigs, aged about 9 to 12 weeks and kept on diets believed to be adequate in every way, have been given various doses of Bact. suipestifer. It was found that 0.005 cc. (a little under 2 million organisms) of the strain of organism used caused a mild attack of the disease in 9-weeks-old pigs but very slight effect in 12-weeks-old pigs. On the other hand, 0.05 cc. usually caused severe disease in 9-weeks-old pigs but mild effects in 12-weeks-old pigs. One-half cubic centimeter caused very severe effects in 9-weeks-old pigs and mild to moderately severe effects in 12-weeks-old pigs. Age thus appears the more important factor affecting susceptibility, but there was also some indication that weight or age, good or bad mothers, and certain dietetic factors also played a part. The work has established that necrotic enteritis can be artificially set up by quite small doses in pigs on diets that appear to be adequate in every way, and appears to have provided a satisfactory basis for study of some of the other agencies which have a bearing on the susceptibility of the pigs. All experimental work with chemotherapeutical agents, including the sulfonamide preparations, has had no favorable effect on the course of the disease.

FOOT-AND-MOUTH DISEASE

With the widespread prevalence of foot-and-mouth disease throughout Europe, the infection appears periodically in Great Britain and causes a great deal of concern to the livestock sanitary authorities. Although the method of introduction has not been established in all cases, it is generally agreed that the importation of infected meat and meat products is responsible for the outbreaks. As a matter of fact, a recent survey showed that 50 per cent of the outbreaks occurred primarily in swine as a result of feeding uncooked garbage. Strict requirements for garbage
cooking are now being enforced and it is hoped that through this effort the incidence of the disease will be materially reduced.

Efforts to eradicate the disease as soon as possible after its appearance resulted in the development of an organization which has proved very successful. Immediately upon report of a suspicious case, the veterinary authorities proceed with the slaughter of infected and exposed animals. Strict quarantine measures are inaugurated within given areas around infected centers and laboratory equipment is provided in various places for bleeding recovered animals in order to inoculate all animals surrounding the infected centers.

During this emergency, as many as possible of the animals are salvaged after slaughter, which, prior to the war, was not permitted; likewise, the burning of carcasses, which was the former practice, had to be abandoned because of the blackouts throughout the country, and at the present time the burial of carcasses is required.

The recent outbreak of foot-and-mouth disease in Ireland, particularly in the area around Dublin, resulted in prohibition on the importation of live animals to the British Isles. This restriction materially increased the meat shortage, as approximately a million beef animals were imported annually from Ireland to Great Britain.

FOOD RATIONING

Due to the shortage of food, a strict rationing system had to be established, especially with regard to meat and dairy products. It would require considerable time to describe the procedure which is followed by the Food Ministry in allocating and distributing the food supplies and, therefore, only a brief description of the method will be given here. All farm products are purchased by the Minister of Food and allocated according to the demand in the different localities. The slaughter of food animals is limited to 800 establishments (prior to the war, 25,000) and shipped to the distributing centers. Each shop has registered all of its customers and they are compelled to trade in that one store only. Apparently this practice has given excellent results, as customers have no difficulty in obtaining their allocated rations.

Foodstuffs rich in proteins, particularly meat, eggs and cheese, are principally rationed, because of restricted importation and reduced numbers of food-producing animals within the country. The effort to increase production of grains has necessitated the plowing up of pastures and has resulted in the maintenance of numbers of animals on reduced pasturage or in the slaughter of animals which could not be maintained under these conditions, both tending to reduce the normal milk supply.

The reduced importation of animal feeds, which, prior to the war, constituted a large percentage of the total consumption, has interfered with the usual finishing of the animals for slaughter purposes. Table 1 shows the quantity of animal feeds imported by Great Britain prior to the war and which now, because of lack of facilities, is no longer available. The restriction of meat consumption, therefore, is apparent, and unless the shortage can be met by increased importation, the restriction will have to continue during this emergency.

Meat inspection, even prior to the war, was vested with the local boards of health, and especially in smaller communities such inspection was not conducted along modern lines of meat hygiene, being carried out in many instances by untrained lay...
inspectors. Only in larger cities has an efficient organization been maintained for systematic inspection based upon the latest scientific knowledge on this subject. It is only natural that in the presence of shortage of food even the existing regulations have been more or less neglected, a fact especially apparent in the distribution of milk when it was noted repeatedly that the individual family container was filled with a dipper from the can on a cart. It is, therefore, obvious that circumstances arising with the stress of emergency may readily affect established rules of proper hygiene and sanitation and it behooves us to recognize such possibilities in advance of any emergency with which our country might be confronted.

Considering the reduced diet and the crowded living conditions in shelters and in emergency quarters, the very limited occurrence of human infectious diseases until

**Table 1.—Net imports and estimated consumption of animal feedstuffs other than those wholly home produced**

Annual average for the 3 year period 1934–1936 (in thousands of long tons).

<table>
<thead>
<tr>
<th>COMMODITY</th>
<th>TOTAL CONSUMPTION</th>
<th>NET IMPORTS</th>
<th>HOME PRODUCED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL CONSUMPTION</td>
<td>Quantity</td>
<td>Total Supplies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>per cent</td>
<td></td>
</tr>
<tr>
<td>Wheat (for feed)</td>
<td>1,150</td>
<td>257</td>
<td>22.3</td>
</tr>
<tr>
<td>Wheat by-products</td>
<td>2,290</td>
<td>2,090</td>
<td>91.3</td>
</tr>
<tr>
<td>Barley and barley meal</td>
<td>795</td>
<td>563</td>
<td>69.9</td>
</tr>
<tr>
<td>Oats and oat products</td>
<td>1,928</td>
<td>110</td>
<td>5.7</td>
</tr>
<tr>
<td>Corn and corn meal</td>
<td>3,215</td>
<td>3,215</td>
<td>100.0</td>
</tr>
<tr>
<td>Other cereal and cereal products</td>
<td>420</td>
<td>340</td>
<td>81.0</td>
</tr>
<tr>
<td>Oilseed cake and meal</td>
<td>1,519</td>
<td>1,519</td>
<td>100.0</td>
</tr>
<tr>
<td>Molasses</td>
<td>254</td>
<td>176</td>
<td>69.3</td>
</tr>
<tr>
<td>Other animal feedstuffs</td>
<td>75</td>
<td>75</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*The principal feedstuffs wholly home produced and not included in this table are hay, turnips, swedes and mangolds, straw, cabbages, vetches, etc., sugar-beet pulp and tops, potatoes, beans and peas and white fish meal. A considerable quantity of brewers' grains, etc., also is used, but is produced partly from imported materials.

The present time is striking. No serious epidemics have developed, which speaks well for the splendid functioning of the health authorities in this emergency. A considerable number of cases of so-called food poisoning, mostly of a paratyphoid nature, have been reported, which might be attributed to the desire of conserving "leftovers" without proper facilities for storage.

The veterinary profession is doing its part in the effort to safeguard the health of the animals and has been very successful in its efforts to minimize or prevent any great losses from the ravages of infectious diseases. Its members recognize the importance of their services and have repeatedly received commendations on their work. It is hoped that the splendid efforts to improve breeds, which always has been the primary aim of the livestock industry of Great Britain, will be continued and that after the conflict it will be possible to reestablish the great livestock industry of Great Britain.
BOVINE TUBERCULOSIS ERADICATION IN THE UNITED STATES AND ITS RESULTING BENEFICIAL EFFECTS ON HUMAN HEALTH

BY J. ARTHUR MYERS, M.D.

In the entire history of tuberculosis control, there is no accomplishment which even approaches that of the veterinarians and their allies in the United States. There are not sufficient superlatives in the English language to adequately describe your accomplishments and pay the tribute that you deserve. In reviewing much of the literature by men and women who advocated the control of tuberculosis in cattle, one finds a constant predominant aim, namely, to protect human beings against the bovine type of tubercle bacillus.

For centuries it was strongly suspected that scrofula or consumption of cattle was transmissible to man. After Villemin, Chauveau and Gerlach proved that tuberculosis is transmissible from animal to animal, Koch discovered the tubercle bacillus, Theobald Smith described the bovine type and Ravenel proved conclusively that this type causes tuberculosis in man, there were a few unbelievers and doubters, but for the most part the veterinarians and their allies possessed that admirable quality of accepting facts established scientifically in the laboratories and discarding whims and personal opinions. From this came the greatest victory ever won over tuberculosis. It included the solution of one of man’s greatest economic problems and also the solution of one of his most serious public health problems.

It has been said that when Jenner introduced a practical and safe method of vaccination against smallpox, he added four years to the span of man’s life on the earth. When the final analysis is made, it may be truthfully said that the control of tuberculosis among domestic animals, particularly cattle, has had an equal effect on longevity.

All tuberculosis in the human body begins in a microscopic way: When the organisms first enter the body, the tissues are not sensitized and, therefore, the reactions to them are nonspecific. These organisms are phagocytosed by white blood cells in essentially the same manner as other organisms and even inanimate material of the particulate type. These are focalized at one or many places in the body, where tubercle formation occurs. During the first few weeks of the development of tubercle, the tissues of the body become sensitized to tuberculo-protein so that the individual reacts to the tuberculin test in a characteristic manner. All of this is brought about by the bovine type in the same manner as the human type of tubercle bacillus. There is no doubt that large numbers of human beings of all ages formerly developed primary tuberculosis from the bovine type of tubercle bacillus and this markedly increased the incidence of tuberculin reactors wherever human beings associated with tuberculous cattle or consumed the products of these animals.

Thus, the rapid decline in the incidence of tuberculin reactors among children of this

1 From the Medical School, University of Minnesota and the Lymanhurst Health Center.
2 Minneapolis, Minn.
country in the past ten or fifteen years is probably due more to the protection you have afforded them against the bovine type of tubercle bacillus than any other single factor.

The development of primary tuberculosis complexes in the human body results in allergy, which sets the stage for specific reactions to tubercle bacilli, and these may result in clinical tuberculosis. This is easily demonstrated by introducing a measured amount of tuberculin, let us say 2 to 5 mgm., into the layers of the skin of a child or an adult who has not been infected with tubercle bacilli. No reaction whatsoever occurs, but if the same amount of tuberculin is introduced into the layers of the skin of an individual whose tissues have become sensitized from primary tuberculosis, an intense, specific reaction occurs. The tuberculo-protein which the tuberculin contains is a deadly poison to the allergic tissues. It actually causes necrosis of the skin and later the dead part sloughs out. There is a similar occurrence when tubercle bacilli find lodgment in allergic tissues. Foci of these organisms become manufacturing plants of tuberculo-protein, which is a deadly poison to the adjacent tissues. Necrosis occurs, and if the lesion is in the lung, the necrotic tissue is likely to find its way into the ramifications of a bronchus and a cavity is left in the lung.

The source of the tubercle bacilli which cause destruction of tissues may be either endogenous or exogenous; that is, the bacilli may come from lesions of previously established primary complexes or from outside sources through exposure to persons or animals who have tuberculosis in the contagious stage. The allergy which makes the development of the clinical type of tuberculosis possible in the human body may be established by the bovine type, as well as the human type, of tubercle bacillus. Thus, by protecting them against the bovine type of tubercle bacillus you have prevented the stage from being set for this destructive form of tuberculosis in large numbers of human bodies.

It is probably this protection you have afforded, more than any other factor, that is responsible for the sharp decline in tuberculosis morbidity and mortality in the United States during the past ten or fifteen years.

There can be no doubt that in the past much of the tuberculosis that caused illness and death of human beings in this country was due to the bovine type of tubercle bacilli. In fact, in 1910 Park estimated that in about 10 per cent of all infants dying from tuberculosis, the bovine bacillus was responsible. He later reported that from bacteriologic examinations 66 per cent of fatal generalized tuberculosis in children was found to be due to the bovine bacillus. In 1914, Mitchell studied cervical lymph nodes of 72 children and 8 adults who were treated surgically for tuberculosis and found the bovine bacillus was responsible for the disease in 65 of the children and 6 of the adults.

Since accurate typing of tubercle bacilli has been possible, the seriousness of the bovine type of tuberculosis in man has been better appreciated. For example, in 1937 Dr. A. Stanley Griffith of Cambridge University pointed out that in England 50 per cent of the cases of cervical lymph-node tuberculosis and 50 per cent of the cases of tuberculosis of the skin were caused by the bovine type of tubercle bacillus. Moreover, approximately 25 per cent of the cases of tuberculous meningitis and 20 per cent of the cases of tuberculosis of the bones and joints and genito-urinary tract, respectively, were due to this type of organism. He estimated that 6 per cent of all deaths from tuberculosis among human beings in England were caused by the bovine
type of tubercle bacillus, that 2,000 deaths occur annually and at least 4,000 new cases develop each year among humans in that country. In Germany Lange reported somewhat lower, but still appalling, figures.

For a long time it was thought that chronic, pulmonary tuberculosis in man was almost never caused by the bovine type of tubercle bacillus; in fact, only four such authentic cases were reported prior to 1922. However, when special investigations were made, such cases began to come to light, and by 1937 Griffith reported 163 such cases in Great Britain alone. He found that it is impossible by the clinical course of the disease or by x-ray film inspection to differentiate between the pulmonary lesions in man caused by the human and the bovine type of tubercle bacilli. Sizeable numbers of cases of pulmonary tuberculosis in man due to the bovine type of tubercle bacilli have been reported in other countries, such as Denmark, Holland and Sweden. Hedvall of Lund, Sweden, in reporting 65 cases, stated that the only way to distinguish between those caused by the human and the bovine types of bacilli is by typing the organisms. He stated further that there is reliable evidence that bovine tuberculosis can be transmitted from cattle to man, from man to man and from man back to cattle. He found that the bovine type of tubercle bacillus causes just as serious disease in man as the human type.

In this country the individual who becomes infected with the bovine type of tubercle bacillus is rapidly becoming a rarity. You have almost put an end to the teaching facilities for this disease in the schools of nursing and medicine in the United States. Fifteen years ago we could select excellent cases from our tuberculosis clinics almost any day from which to teach our students. Today these cases are so rare that many months may pass without one appearing in our clinics. At the University of Minnesota we have a small list of names of such cases and we actually send for and pay them to allow us to demonstrate their cases to students and graduates in nursing and medicine. Already we have made photographs of these individuals, for we know that the time is near when this type of tuberculosis in man must be taught from pictures rather than from living patients.

The control of tuberculosis in cattle, therefore, has markedly reduced the incidence of tuberculous infection, the morbidity and the mortality from tuberculosis in man.

VETERINARY ACHIEVEMENT POINTS PATH TO HUMAN TUBERCULOSIS CONTROL

Your second great accomplishment is that you have taught those working in human medicine many valuable lessons. Indeed, you have pointed the way for the control of tuberculosis in man caused by the human type of tubercle bacillus. The following facts are only a few of the large number which you have demonstrated beyond doubt and which can be used to great advantage in controlling tuberculosis in man:

1. The tubercle bacillus is not ubiquitous. We now know that this organism is not present in the air or anywhere else except in the immediate surroundings of persons with the disease in the contagious stage.

2. A brief exposure (a few minutes) to a person with contagious tuberculosis may suffice to transmit the disease to previously uninfected persons. The old idea that a long, intimate contact exposure (months or years) is necessary is obsolete.
3. You have shown that tuberculosis is not an inherited disease, that it is always a result of contact exposure.

4. You have shown that in animals contagious tuberculosis is nearly always a disease of adult life. Only a few years ago the child was the center of attraction among tuberculosis workers, but today the activities have shifted to adults, since we have learned from your experience that contagious tuberculosis exists in the body of a child with extreme rarity.

5. You have demonstrated the great importance of quarantine of tuberculous animals at our ports of entry, international borders, our state and county borders, and even farm lines. Since you have done this so effectively, it has become obvious that quarantine must be used in a similar manner to prevent tuberculous persons from spreading their disease to other human beings and animals. You also have protected other nations against our tuberculous cattle, and we must do likewise with human beings by demanding adequate examination before issuing passports.

6. You have demonstrated that attempts to produce artificial immunity have resulted in disappointment and have proved that all methods tried to date have been of no avail. There are still a few persons in the field of human medicine propagating for the general administration of immunizing agents. They have no firm foundation on which to stand. Your demonstrations in this connection afford us the best evidence with which to combat such propaganda.

7. You have demonstrated beyond all doubt the best method of administering tuberculin (intracutaneous) and have proved for all time the specificity of this test. The volume of work done on the tuberculin test exceeds that of any test for any other disease. Your evidence for the specificity of the test is so overwhelming that every open-minded person who takes the time to listen or read, and actually thinks, must accept it. Despite these facts, in reviewing the literature on the control of tuberculosis among animals, I have noted with considerable disgust that an occasional person rose up in condemnation of the tuberculin test. One would think that such thoughts had vanished from the human mind long ago and, yet, I read in the October 16, 1941, issue of the Milwaukee Sentinel, a large headline, "Revision of T. B. Tests Is Recommended," with a subline, "Scientific Paper Is in Favor of Abandonment." The authors of the article to which this newspaper referred are said to have made the statement that confidence in the tuberculin test has been shaken by the fact that there has been no apparent decrease in the percentage of reactors after years of intensive segregation of infected persons and cattle. The trend now, they said, is toward abandonment of the test as applied to human beings. Many factors are concerned in this trend, they said further; probably the most potent is the economic one, for it is felt that when the major part of any group is likely to react to tuberculin, it is cheaper to x-ray the number than to test the group and then to x-ray.

If these statements are true, one wonders where these authors have been for the past decade. Have they failed to keep informed or do they belong to that group which always refuses to accept the truth? Have they not seen or accepted the splendid accomplishments of the veterinarians as reported by the United States Bureau of Animal Industry, showing the marked reduction in the number of reactors among cattle in this country? Have they not seen the postmortem reports, giving
irrefutable proof of the marked reduction in slaughterhouse losses from tuberculosis in cattle? Have they not observed the tumbling down of incidence of infection, morbidity and mortality from tuberculosis among the human family in parts of this country where vigorous tuberculin-testing campaigns have been in effect?

This newspaper article emanated from Madison, Wis. Is it possible that residing in Madison they have not learned of the fine and successful tuberculosis campaign conducted by the late Dr. R. H. Stiehm, always beginning with the tuberculin test, among the students of the University of Wisconsin? Is it possible they have not learned that tuberculosis committees of great national organizations, such as the American Academy of Pediatrics, the American Student Health Association and the American School Health Association, strongly recommend the tuberculin test for all students and faculty members of the schools, colleges and universities of this country? Is it possible that these authors would omit the tuberculin test in the future campaign against bovine tuberculosis and permit the wily tubercle bacillus to regain its former foothold and resume its terrible destruction of animal life and cause suffering and death of large numbers of human beings?

In the field of tuberculosis in man at the present moment, there are some persons who are creating confusion with reference to the method of administering the tuberculin test and others who are outrightly condemning it. This is because of such factors as inexperience, jealousy and lack of knowledge of the fundamentals of tuberculosis. Such individuals know that the test has an error of approximately 3 per cent. They take this insignificant error and make of it what seems to them a serious problem. On this basis they condemn the test, completely ignoring its 97 per cent efficacy. Such persons speak frequently and loudly; in their ignorance they think they have established a new fact, when in reality the fact they are emphasizing is within a few months of the age of tuberculin itself.

True students of tuberculosis in man are unanimous in support of the tuberculin test as the first step in the examination of any individual for tuberculosis. They know that all other methods of examination, including the x-ray film, are so limited in their scope and are so crude that with them alone tuberculosis could not possibly be controlled, but with a delicate chemical test, such as we have in tuberculin, tubercle bacilli can be sought out with great accuracy in the bodies of human beings. These are the persons who already have, or may have at any time, clinical tuberculosis. True students of tuberculosis in this country recommend the omission of the tuberculin test only when working in areas where nearly 100 per cent of the population is infected. These areas, however, have become rare and are limited in extent.

8. You have taught us to attack tuberculosis on the area plan, using the county as the unit. For example, the Tuberculosis Committee of the Minnesota State Medical Association is developing a state-wide campaign against tuberculosis. It has selected the county of Meeker as a demonstration area, where the following procedures are in effect:

a. The testing with tuberculin of all citizens of the county, regardless of age. This is screening out those who have living tubercle bacilli in their bodies and, thus, are potential cases of destructive forms of the disease.

b. Making x-ray film inspection of the chests from standard 14"x17" films to determine whether there are any gross lesions that might be due to tuberculosis, in the 75 per cent of the lungs visualized.
c. Careful examinations of those who have shadows on their x-ray films to determine the cause of the diseases that cast the shadows.

d. Immediate treatment of those who have reinfection type of disease in the pre-contagious and pre-symptom stage.

e. Immediate isolation of those found to have disease in the contagious stage.

When the work began in Meeker county, it was estimated that approximately 25 per cent of the entire population would react to tuberculin. However, in the 5,600 persons already tested, only 15 per cent were found to react. Of the 800 reactors who had x-ray films of their chests, together with other phases of the examination, eight were found with significant clinical pulmonary tuberculosis. Thus, in this 800, there remain 792 whose chests are apparently clear at present. Each one of them is a potential case of clinical tuberculosis at some subsequent time; therefore, they need to be reexamined periodically. Some of them will develop the type of tuberculosis which will become contagious if undetected and untreated. Since there is no way to determine in which of the reactors this will occur, the only safe procedure is to reexamine all periodically. This makes our control procedures time-consuming and expensive. Moreover, it is not as promptly effective as your procedure.

One worker in the x-ray field has stated that an x-ray film of the chest is comparable to a postmortem examination. Of course, such a statement is ridiculous in the extreme, because: (1) A single x-ray film of the chest includes an inspection of only 75 per cent of the lungs and it is a poor inspection at that because it is not focused at different levels and, therefore, many changes in the tissues in the part of the lungs visualized escape attention; (2) lesions must be gross in order to cast significant shadows on the x-ray film; (3) one can not determine the etiology of a lesion from the shadow it casts on a film; and (4) numerous clinical tuberculous lesions develop in parts of the body other than the lungs. Thus, it is obvious that we are extremely handicapped in detecting the location of tuberculous lesions in the bodies of tuberculin reactors because all of the phases of examination available to us combined are in no sense of the word comparable to a postmortem examination. However, when gross lesions are present in that part of the lungs which is inspected by x-ray film, they often cast shadows before they cause symptoms or abnormal physical signs and before they become contagious. For this reason we always use the x-ray film inspection of the chests of tuberculin reactors, not with the thought of sweeping clean, but with the hope of screening from a given population those who have gross disease that is near or already in the contagious stage. The expense of this procedure would have been beyond the realm of physical possibility had the old costs of x-ray film work been permitted to continue. Fortunately, we now have a method of making excellent, standard-size x-ray films by a rapid method at a cost within the reach of everyone.

There are other methods of making miniature films of chests, but they are only in the experimental stage and it is questionable whether they will ever be as satisfactory and convenient as the usual standard-size films. The new, inexpensive, standard-size film has removed x-ray inspection of the chest from a luxury within the reach of only a few persons to a routine procedure available to all. Thus, an annual inspection of the chest of all tuberculin reactors in Meeker county can be made without great expenditure of funds. However, this serves only as a screen
for those who have developed gross lesions since the last examination; all such persons should be completely examined to determine whether their disease is tuberculous.

This demonstration is being carried out so effectively in Meeker county that already the physicians in other counties are contemplating campaigns against the disease. The Committee is of the opinion, therefore, that the time is near at hand when the majority, if not all, of the counties will be combed for tuberculosis by the medical profession and their allies.

In our Meeker county demonstration the veterinarians have been of extreme value. They have full knowledge of the fundamentals of tuberculosis control and speak with authority, since they have practically eradicated tuberculosis from the cattle herds of that county.

9. The veterinarians have given us another procedure of great value, namely, the accreditation of counties. During this year the Tuberculosis Committee of the Minnesota State Medical Association procured from the State Department of Health the average mortality caused by tuberculosis over the past five years for each of the 87 counties of the state. They then decided to establish a standard by which a county might receive special recognition for its tuberculosis-control accomplishments. It was decided that one part of the standard should be a mortality of 10 or less per 100,000 of the population and the other part should be an incidence of tuberculous infection, as manifested by the tuberculin test, not to exceed 15 per cent of the senior students in the high schools of the county. Lincoln county, Minn., was found to have an average mortality for the past five years of 5.5 per 100,000. Within the past six weeks the physicians in that county tested the senior high-school students and found an incidence of 7.4 per cent reactors. Thus, this county is now ready for special recognition and it is a great delight to us that on December 11, 1941, a large celebration is to be held in Tyler, Lincoln county, when the Minnesota State Medical Association, the Minnesota Department of Health and the governor of the state will officially recognize Lincoln as an accredited county. There are three other counties in the state which probably will meet the standards during the coming year.

By following your example, we believe tuberculosis in man can be reduced to a disease as minor as smallpox, diphtheria and typhoid fever. We have methods of treating pulmonary tuberculous lesions so that they are prevented from becoming contagious. We have institutions for isolating the more advanced and contagious cases. To take them from the home and isolate them in an institution seems as satisfactory as the slaughter of a tuberculous animal, as far as the control of the disease is concerned. Unfortunately, however, the isolation of contagious cases of tuberculosis has created an extremely serious problem among the personnel of the hospital or sanatorium. In fact, this is one of the most pathetic situations in the entire field of tuberculosis at the present moment. Large numbers of persons taking instruction in tuberculosis or devoting their lives to the care of the tuberculous in these institutions have lost their own health and many have lost their lives because no satisfactory provision has been made to protect them against tubercle bacilli.

Isolation of tuberculous patients also has created a large financial problem. It is
now costing the United States about $75,000,000 annually to maintain institutions for the tuberculous. Although this is an expensive procedure, it is the only way to prevent the spread of the disease in homes and communities. In this respect the sanatorium has done effective work, but from the standpoint of controlling disease in the individual patient, not as much can be said. The mortality over a period of ten years after the disease is first detected is appalling and for advanced cases it is very little different from what it was a quarter of a century ago.

One of your members, Dr. W. H. Feldman, with his collaborators, has within the past year made the greatest contribution of all time to the chemotherapy of tuberculosis. For the first time in the history of man, tuberculosis in at least one species of animals has been controlled. It now seems more than possible that the drug he has used, made available under the trade name of “promin,” may have a beneficial effect on human beings suffering from tuberculosis. Tuberculosis workers everywhere are eagerly waiting for further information on this subject.

You can afford much help in the control of tuberculosis in man by continuing to show that it is possible to keep tuberculosis among animals under control by the use of the tuberculin test.

You can also help us by constantly calling to the attention of the public your justifiable fear of uninfected cattle becoming infected from human beings.
EQUINE ENCEPHALOMYELITIS AND ITS CONTROL

BY COLONEL R. A. KELSER, V.C.\(^1\)

Within the past decade encephalomyelitis of virus type has become the most important equine disease in this country. It is important, first because of the extent to which it has and can occur among susceptible horses and mules; secondly, because of its mortality rate; and finally, although by no means of least importance, because man is readily susceptible to it. The extent to which the disease might occur among susceptible animals is evidenced by the experience of 1938, when approximately 185,000 cases were reported. This was the largest outbreak in the history of the country.

As is well known, two types of equine encephalomyelitis occur in the United States, the so-called "Eastern" and "Western" types. Until recently the two types of the disease were sharply separated geographically, the "Western" variety occurring west of the Appalachian range of mountains, and the "Eastern" type east of such range. In Alabama, lying directly at the southern end of the Appalachians, both forms of the malady are known to occur. During the latter part of the past summer (1941) the "Eastern" type of encephalomyelitis virus was recovered and identified by the Army Veterinary School in brain specimens from fatal cases of the disease in the region of Brownsville, Texas. This constituted the first knowledge of the occurrence of the "Eastern" type of encephalomyelitis west of the Appalachian-Alabama line.

When Meyer, Haring, and Howitt (1) made known the results of their classical work in 1931, in which they definitely proved that equine encephalomyelitis was of virus origin, the general belief was that the infection was carried by food or water contaminated by infected animals. As the mode of transmission of this disease is an exceedingly important subject, I would like to discuss it at some length.

Following the discovery of a virus as the cause of equine encephalomyelitis consideration was quite naturally given to the possibility that infection occurred by way of the alimentary tract. One could, however, on careful study of epizoological factors question such mode of transmission.

In a rather extensive outbreak of what was diagnosed "forage poisoning" at Fort Benning, Ga., in August, 1929, the disease made its appearance among Army animals which had been turned out in low pastures shortly after the area had recovered from severe inundation. All cases of the disease in this outbreak were removed to the veterinary hospital where they were treated as cases of "forage poisoning," and not being considered infectious, they were not isolated from other hospital cases. In spite of direct and indirect contact with numerous animal patients in the hospital for other conditions there was no spread of the disease. Upon removal of all animals from the lowland pastures to their organizational stables the outbreak of the disease at Fort Benning was promptly terminated. Reflecting back on this experience after the virus etiology of equine encephalomyelitis had been es-

\(^1\) Surgeon General's Office, War Department, Washington, D. C.
tablished, it was considered that the 1929 outbreak at Fort Benning was undoubtedly of virus origin and that it had not spread by ordinary contact.

Another point which proved of importance in our early consideration of the transmission question developed in 1932 when we observed that in a number of instances the disease appeared to be following water courses and irrigation systems.

Coupled with the above indicated observations was the well recognized fact that outbreaks of equine encephalomyelitis of virus type cease with the onset of cold weather. All of this suggested to the author the possibility of an insect vector.

The fact that the mosquito is about the first insect to go with the onset of chilly weather, and with the knowledge that mosquitoes are capable of transmitting at least two other virus diseases (yellow fever and dengue) this species of insect was the first thought of as a possible vector.

At the time, we had at our laboratories at the Army Medical School, a colony of *Aedes aegypti*. As this species of mosquito was known to be capable of transmitting both yellow fever and dengue, it was decided to initiate experiments to determine whether or not it could also transmit the virus of equine encephalomyelitis. Most of you are familiar with the outcome of that research (2) first published in 1933, and in which it was proved that the mosquito *Aedes aegypti* was capable of transmitting the virus of equine encephalomyelitis from guinea pig to guinea pig and from guinea pigs to horses. It was further shown that the transmission was not mechanical but occurred after multiplication or maturation of the virus within the mosquito and that once infected the insect was capable of transmitting the disease for most if not all of its ordinary life. These initial findings, as is now well known, have been abundantly confirmed and since then numerous other species of Aedes have been proved capable of transmitting the infection. Thus, up to the present time the following species are known to be able to convey the disease:

- *Aedes aegypti*
- *Aedes sollicitans*
- *Aedes cantator*
- *Aedes albopictus*
- *Aedes dorsalis*
- *Aedes vexans*
- *Aedes taeniorhynchus*
- *Aedes atropalpus*
- *Aedes triseriatus*
- *Aedes nigromaculis*

It will be noted that thus far the various species proved capable of transmitting equine encephalomyelitis are of the Aedes genus. It is of interest to note that the flying range of Aedes exceeds that of any other genus of mosquito. For example, as Matheson (3) pointed out, *Aedes sollicitans* in New Jersey has been found as far as 40 miles from its breeding grounds; *Aedes vexans* as far as 30 miles.

Another interesting fact in connection with mosquito transmission of equine encephalomyelitis is that there is apparently greater virulence in mosquito infection. For example, the intradermic or subcutaneous injection of guinea pigs with virus-containing brain tissue emulsion frequently fails to produce the disease. On
the other hand, a single infected mosquito biting a susceptible guinea pig but once will ordinarily produce the disease and usually in a shorter period of time than a successful subcutaneous inoculation.

The question of reservoirs of infection for mosquitoes has been a much discussed subject. In 1933, Giltner and Shahan (4) found that the pigeon was susceptible to artificial infection with the virus of equine encephalomyelitis. A few years later (1938) Fothergill and Dingle (5) in connection with studies of an outbreak of the disease in the human family, found pigeons naturally infected with the virus. During the same year, Tyzzer, Sellards, and Bennett (6) recovered the virus of equine encephalomyelitis from a ring-necked pheasant from Connecticut. In 1939 Van Roekel and Clark (7) proved the sparrow susceptible to intracerebral inoculations, and in 1940 Davis (8) showed that cowbirds and sparrows, and to a lesser extent, some other birds were susceptible to both artificial inoculation and infection by mosquitoes.

Recently (1941), Hammon (9) and his associates, on the basis of virus-serum neutralization tests, presented evidence that the following avian species can be infected with the virus of equine encephalomyelitis: chicken, dog, goose, owl, pigeon, turkey, flicker, killdeer, pheasant, and quail. They not only found in the blood of such species neutralization substances for the equine encephalomyelitis virus but also for the virus of St. Louis encephalitis. In addition to the avian species, Hammon and his associates found neutralizing substances for "Western" encephalomyelitis virus in the following species: cow, dog, goat, horse, pig, sheep, field mouse, and weasel.

In a very recent report (1941), Cox, Jellison, and Hughes (10) announced the recovery of the virus of "Western" encephalomyelitis from a prairie chicken. The virus was isolated not only from the brain tissue of this bird but also from the spleen.

The great variety of birds and other animals which evidence now indicates have been infected with the virus of equine encephalomyelitis adds further substantial support to the importance of the mosquito as the vector of this disease.

Occasionally the question is raised as to the frequency of mosquitoes feeding on birds under natural conditions. Let it be said that this is of very common occurrence. It is well exemplified by the extent to which wild birds are parasitized by the mosquito-transmitted avian malaria plasmodium.

Another important finding in connection with the mosquito transmission of equine encephalomyelitis is that recently (1941) reported by Hammon (11) and his associates wherein Culex tarsalis was found, in nature, harboring the virus of equine encephalomyelitis. While it has not as yet been proved that this particular species of mosquito is capable of transmitting the disease, the finding nevertheless indicates that there are sources or reservoirs of equine encephalomyelitis virus available in nature to mosquitoes, and we do know at least ten species of another genus definitely capable of transmitting it.

During the past summer (1941) a serious outbreak of encephalomyelitis occurred in the human family in the states of North Dakota, South Dakota, and Minnesota, and over the North Dakota line in Canada. It also occurred, to a lesser extent, in adjacent states. In all, something over 3,000 cases occurred with a mortality rate
of about 10 per cent. Investigation indicated that the causative agent was the virus of equine encephalomyelitis, "Western" type. This was the largest outbreak of human encephalomyelitis in the history of this country. While there have been previous cases and outbreaks of encephalomyelitis in man, due to the equine virus, this latest outbreak, because of the number of cases involved, emphasizes the importance this disease might assume from the standpoint of human health.

Epidemiological evidence in the outbreak in the human family in North Dakota, South Dakota, and Minnesota, indicated that the mosquito was undoubtedly the important transmitting agent in this epidemic.

In 1936, Syvertzon and Berry (12) found the tick _Dermacentor andersoni_ capable of transmitting the "Western" type of equine encephalomyelitis virus to the gopher. In 1940, Kitselman and Grundmann (13) found _Triatoma sanguisuga_ harboring the virus of equine encephalomyelitis. They reported that a single guinea pig developed the disease after placing in the cage _Triatoma_ harboring the virus of equine encephalomyelitis.

While ticks, _Triatoma_, and possibly other insects, may be of definite importance in the perpetuation of the virus and in its transmission to certain species of animals, it is exceedingly unlikely that they are of great significance in the ordinary transmission of the disease to horses and man.

In the control of encephalomyelitis among Army animals we have had most excellent results from vaccination. In 1938, the year of the very extensive outbreak of approximately 185,000 cases reported, vaccine was employed only on a limited scale in the Army because of the question at that time as to just how effective vaccination might be. All Remount stallions (approximately 700) were vaccinated just prior to the encephalomyelitis season with the brain tissue type of vaccine. Later in the summer when the disease started to make its widespread appearance the Army instituted all reasonable control measures and vaccine was employed where the disease made its appearance at an Army camp, post or station, or occurred among civilian animals in close proximity to Army installations. It will be recalled that it was during the encephalomyelitis season of this year (1938) that the chick tissue type of vaccine became available and such vaccine as was utilized by the Army during the latter portion of the season was of that variety. A total of 42 cases of encephalomyelitis occurred among Army animals during this year (1938).

By the end of the 1938 outbreak it was quite evident that the chick tissue type of encephalomyelitis vaccine, when properly prepared and used, was a highly valuable agent for the prevention of the disease. Accordingly, it was decided that all Army animals would be immunized with this type of vaccine prior to the advent of the anticipated 1939 season. To this end, arrangements were made to manufacture the vaccine for military use in the laboratories of the Army Veterinary School, Army Medical Center, Washington, D. C. In order that only freshly prepared vaccine would be used, its manufacture was not commenced until after the first of the year and shipment started to various Army posts in March. All vaccinations were completed by the middle of June. During 1939, approximately 35,000 animals of the Regular Army, National Guard, and R.O.T.C. units were immunized with this vaccine.

The vaccination of all military animals was repeated in 1940 under the same
COLONEL R. A. KELSER, V.C.

conditions as in the preceding year. As in 1939, approximately 35,000 animals were immunized. This year, (1941) the animal population of the Army was increased so that approximately 50,000 horses and mules were vaccinated with the encephalomyelitis vaccine prepared by the Army Veterinary School.

Among all of the immunized animals during the years 1939, 1940, and 1941, there was, with one exception, no case of equine encephalomyelitis. The exception was the case of an animal at Fort Brown, Texas, which had been previously immunized against the "Western" type virus and which developed the "Eastern" type disease after such type of infection was discovered in the vicinity of Brownsville, Texas, and before immunity against the "Eastern" type virus was affected by revaccination of the animals against this variety of the malady.

Up to and including 1940, all encephalomyelitis vaccine administered to Army animals was by way of the subcutaneous route, two 10 cc. doses of the vaccine being given with an interval of one week between doses. This year (1941), the intradermal method of administering the vaccine was adopted, giving two 1 cc. doses a week apart. While the dose was reduced from 10 cc. to 1 cc. the tissue content of the vaccine was increased from 20 to 30 per cent. Because of the increased movement of military animals about the United States, it is planned that when the 1942 vaccination is undertaken, all military animals will be immunized against both the "Eastern" and "Western" types of virus. For this purpose a bivalent vaccine representing equal parts of antigen for the two types of virus will be employed. The intradermal dose will be 2 cc., repeated after one week.

As is well known, there have been a number of reports of untoward and serious reactions following the use of the chick tissue type of encephalomyelitis vaccine. Fortunately, the Army has experienced an exceedingly few cases of reactions of consequence. We attribute our good fortune to the fact that only very fresh vaccine has been used and that the utmost care was exercised in the administration of the agent.

Of the few reactions which did occur among Army animals, several types were observed. There were a few cases of a true anaphylactic type, coming on within less than an hour after the injection of vaccine. These readily responded to the prompt administration of adrenalin. Other allergic reactions noted included urticaria, unusually large swelling at point of injection, etc. Still another type was a condition in which the outstanding characteristic was marked liver damage. Finally, we had several cases which, some thirty days or longer after vaccination, developed some degree of paralysis, especially of the hind quarters. In one or two of these cases it was initially thought that an atypical case of encephalomyelitis was present. None of these cases, however, showed any evidence of fever, nor was virus recovered in any instance.

CONCLUSIONS

In bringing this brief talk to a close, I might state the following conclusions:

1. Equine encephalomyelitis of epidemic type is a virus disease in which the important mode of transmission is through the agency of mosquitoes.

2. Other modes of infection, or other vectors, while possibly of importance in perpetuating the virus in nature and producing occasional cases of the disease
among horses, are of minor importance in common outbreaks as observed in this country.

3. Control and prevention of the disease, then, involves anti-mosquito measures or immunization of susceptible animals.

4. Animals can be rendered highly immune to the disease through vaccination with a properly prepared vaccine of the chick tissue type. Two intradermal doses of 1 cc. each (2 cc. each if bivalent) produce effective protection for at least one year.

REFERENCES


Swine influenza as demonstrated by Shope (1) is caused by a filtrable virus associated with *Haemophilus influenzae suis*, an organism closely resembling the Pfeiffer bacillus.

In 1918 Koen recognized this condition as a separate entity and suggested the term swine influenza. The bacteriological flora of this disease were studied by Murray (2) who isolated a micrococcus which produced pneumonia and pathological changes similar to those of influenza. Dorset, McBryde and Niles isolated *B. bronchisepticus* and *B. suisepicus* but were unable to reproduce the disease with these organisms. Studies of the epizoology of swine influenza by McBryde (4) showed that the disease is of a seasonal character and that it is associated with unhygienic quarters and exposure to unfavorable weather conditions. Healthy hogs brought into contact with affected animals develop influenza in three days. McBryde suggested the possibility of man becoming infected with influenza by contact with infected pigs, and emphasized the close relationship between the two diseases. McBryde, Niles and Moskey (5) and Fulton (6) isolated a pleomorphic rod from cases of swine influenza; inoculations of cultures of this organism reproduced a similar condition in susceptible pigs. Swine influenza was also reproduced by nasal instillation of tracheal and bronchial exudates from affected pigs and by contact of susceptible pigs with affected animals.

Pigs instilled with swine influenza virus and *Haemophilus influenzae suis* cultures developed symptoms of stupor, excitability and high temperature in 25 to 48 hours. The temperature increased rapidly to 105 or 106 and remained above normal for three to five days. There was an increase in the respiratory rate to 40 or 60 per minute, occasionally developing into “thumps.” In some pigs occasional recurrent periods of high temperature were observed during three or four weeks after instillation. Susceptible pigs placed in contact with infected pigs developed clinical symptoms of swine influenza identical to those seen in infected pigs. Table 1 shows the temperature readings for a pig infected with swine influenza virus and a pig placed in contact after the development of clinical symptoms in the inoculated animal.

The characteristic lesions of swine influenza are: atelectasis, especially of the cardiac, apical, and intermediate lobes, peribronchial pneumonia and bronchiolar catarrh. Emphysema develops between the affected lung tissue and normal areas, especially if the involvement is diffuse, affecting small areas surrounding adjacent bronchi. In pigs experimentally infected with filtered influenza virus, the atelectasis is restricted to the pendent portions of the lobes and there is very little peribronchial involvement. In pigs infected with swine influenza virus and cultures of *Haemophilus influenzae suis*, the atelectatic lesions are more extensive and may extend to the pendent portions of the posterior lobes. Peribronchial pneumonia

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1 Contribution from the University of Pennsylvania School of Veterinary Medicine and the United States Bureau of Animal Industry cooperating.
is found in the upper portions of the anterior and posterior lobes; bronchial catarrh occurs throughout the bronchial and bronchiolar system. Systemic and bronchial lymph nodes are edematous. The liver, spleen and stomach, are normal.

Pigs heavily infested with ascaris frequently show very extensive lung lesions and considerable atelectasis of the posterior lobes, together with lobular catarrhal pneumonia. Pigs affected with necrotic enteritis also show more extensive lung lesions than pigs in which no intestinal lesions are observed.

The term Stock Yards swine influenza was suggested (7) as descriptive of swine influenza following exposure to adverse weather or shipping conditions. In this form catarrhal lobar pneumonia and fibrinous pleuritis are seen in addition to the typical lesions of swine influenza. Intestinal symptoms of diarrhea frequently follow the pneumonic symptoms.

Studies of several outbreaks of swine influenza in pigs shipped from Indiana and Ohio to the Philadelphia Stock Yards and of pigs suffering from swine influenza in a garbage feeding plant showed lesions of atelectasis and lobar fibrinous pneumonia, in many instances associated with fibrinous pleuritis and in occasional cases fibrinous peritonitis. Swine influenza virus was isolated from filtrates of the atelectatic lesions and cultures of Pasteurella suiseptica from lung exudates.

Large doses (20 cc. of a suspension corresponding to tube 3 of the McFarland nephelometer) of cultures of Pasteurella suiseptica, highly virulent for rabbits, were instilled intranasally in several pigs. In a few cases transient elevation of temperature lasting 24 hours was observed; however, most animals showed no clinical reaction.

In table 2 it is seen that the administration of small doses of Pasteurella suiseptica with swine influenza virus produced marked clinical reactions resulting in death in some cases. Four of ten pigs infected with swine influenza virus and cultures of Pasteurella suiseptica died in two to 12 days. Susceptible pigs placed in contact with swine suffering from Pasteurella swine influenza showed no reaction.

Manninger (8) and Anrieu (9) found that large doses of Pasteurella cultures might produce clinical reactions in swine and cattle but that this condition was not transmitted by contact.

Pigs placed in contact with a mild infection of swine influenza, or with animals immediately following experimental infection with swine influenza virus and cultured of Haemophilus influenzae suis frequently developed sufficient resistance to

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**TABLE 1.—Swine influenza infection by instillation**

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>INFECTION</th>
<th>POST INFECTION DAILY TEMPERATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Virus*</td>
<td>Culture†</td>
</tr>
<tr>
<td>80</td>
<td>cc.</td>
<td>cc.</td>
</tr>
<tr>
<td>83</td>
<td></td>
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</tr>
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</table>

* Swine influenza virus.
† Haemophilus influenzae suis.
‡ Pig put in contact.
withstand infection with virulent swine influenza virus and cultures of *Haemophilus influenzae suis*.

In table 3 pig 508 kept in contact with a mild infection of pig 78 developed sufficient immunity to withstand a virulent infection with swine influenza virus and cultures of *Haemophilus influenzae suis*, administered 31 days later. Pig 509 immunized by the administration of virus and culture resulting in a negative reaction also withstood test infection 31 days later, control pig 506 developed typical influenza.

**Table 2.** Infection of pigs with *Pasteurella suis*epitica and with mixtures of *Pasteurella suis*epitica and swine influenza virus

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>PASTEURELLA CULTURE</th>
<th>SWINE INFLEU-</th>
<th>POST INFECTION DAILY TEMPERATURE</th>
</tr>
</thead>
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<tr>
<td></td>
<td>cc.</td>
<td>cc.</td>
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<td>511</td>
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</tr>
<tr>
<td>59</td>
<td>3</td>
<td>12</td>
<td>104.4</td>
</tr>
<tr>
<td>55</td>
<td>Contact</td>
<td>Contact</td>
<td>101.4</td>
</tr>
</tbody>
</table>

**Table 3.** Production of immunity, or the carrier state, by contact of susceptible pigs with mild cases of swine influenza

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>SWINE INFLUENZA</th>
<th>CLINICAL REACTION</th>
<th>TIME</th>
<th>TEST INFECTION</th>
<th>CLINICAL REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Virus</td>
<td>cc.</td>
<td>3</td>
<td>None</td>
<td>days</td>
</tr>
<tr>
<td>78</td>
<td>cc.</td>
<td>12</td>
<td>None</td>
<td>31</td>
<td>12</td>
</tr>
<tr>
<td>508</td>
<td>Contact</td>
<td>3</td>
<td>None</td>
<td>31</td>
<td>12</td>
</tr>
<tr>
<td>509</td>
<td>Contact with 78</td>
<td>3</td>
<td>None</td>
<td>31</td>
<td>12</td>
</tr>
<tr>
<td>506</td>
<td>Contact</td>
<td>3</td>
<td>None</td>
<td>31</td>
<td>12</td>
</tr>
</tbody>
</table>

* Number of days infected pig showed temperature over 104° F.

† Total number of degrees above 104° F. during time pig showed clinical symptoms. (Reaction of 104.0, 106.2, 105.5 would be recorded as clinical reaction 3 days and Temperature over 104° F. 3.7)

In table 4 pig 508 was placed in contact with a carrier of *Pasteurella suis*epitica, eight days after having been in contact with pig 78. Pig 511 previously infected with *Pasteurella suis*epitica developed symptoms of swine influenza after three days. Experiments with pigs 91, 92 and 93 show that carrier infection in pig 91 was transmitted to both a normal pig 92 and to a pig previously given a dose of *Pasteurella suis*epitica intranasally.

Pigs that have recovered from experimental swine influenza infection are kept in a feed lot. Two of the recovered pigs have developed symptoms of thumps innape-
tence and clinical evidence of swine influenza following inclement weather one and
three months following experimental administration of swine influenza virus and
cultures of *Haemophilus influenzae suis*. Both pigs died and on autopsy showed
lesions of atelectasis and lobar broncho-pneumonia, swine influenza virus and cul-
tures of *Pasteurella suiseptica* were isolated from the lungs of both animals.

These experiments with contact infection and the development of swine influenza
in recovered animals suggest that swine influenza virus may remain latent in the
lungs of apparently normal animals, which under adverse weather conditions might
become carriers of swine influenza infection.

Shope (10) has found that the lung worms, *Metastrongylus elongatus* and *Choro-
strongylus pudentotectus*, may harbor the swine influenza virus during passage
through the earth worm intermediate host. Swine influenza was induced by feeding
infected lung worm larvae and injecting cultures of *Haemophilus influenzae suis*.
Injections of killed cultures produced a mild filtrate disease. Later experiments
(11) showed that feeding embryonated ascaris eggs activated swine influenza virus
carried by infected lung worms. Activation could be produced in December,

TABLE 4.—Infection with swine influenza by contact with a carrier

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>PREVIOUS TREATMENT</th>
<th>TIME AFTER TREATMENT</th>
<th>DAILY TEMPERATURE FOLLOWING CONTACT OF TWO PIGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>days</td>
<td>1</td>
</tr>
<tr>
<td>508</td>
<td>Contact (table 3)</td>
<td>8</td>
<td>103.2</td>
</tr>
<tr>
<td>511</td>
<td>Pasteurella carrier</td>
<td>7</td>
<td>101.3</td>
</tr>
<tr>
<td>91</td>
<td>Carrier by contact</td>
<td>4</td>
<td>102.8</td>
</tr>
<tr>
<td>92</td>
<td>None</td>
<td></td>
<td>102.8</td>
</tr>
<tr>
<td>93</td>
<td>Pasteurella carrier</td>
<td>4</td>
<td>102.5</td>
</tr>
</tbody>
</table>

January, March and the first week of April but failed during the last of April and
during May, June, July and August, but was again possible in September.

The possibility of hog cholera infection interfering with the development of
swine influenza immunization was suggested by experiments in which pigs injected
with live swine influenza virus for immunization developed influenza and cholera
following accidental hog cholera infection (7).

An outbreak of cholera associated with pneumonia developed in a herd of
102 pigs which had been vaccinated against hog cholera four months previously.
Lesions of hog cholera were found in two of these pigs, the remainder were treated
with anti-hog cholera serum. During the next two weeks 20 animals died. One of
these was sent to the Veterinary School and on autopsy showed congestion of the
lymph nodes, a few petechia on the kidneys and congestion of the stomach mucosa.
The lungs showed atelectasis of the cardiac lobes and catarrhal broncho-pneumonia
of the entire lung. Filtrates of the atelectatic portions of the lung were made and
swine influenza virus was isolated by both mouse passage and inoculation of the
developing chick embryo.

Atelectatic lesions of the cardiac lobes were observed in a number of autopsies
of pigs used for the production of hog cholera virus. Filtrates of two samples of
these lungs were made, and swine influenza virus was recovered by the Brandly (12) egg passage technic and by mouse passage.

Complete data on these experiments is given in a recent paper (13). Table 5 shows some of the isolation experiments demonstrating the presence of swine influenza virus in the blood stream of pigs affected with cholera and swine influenza. Swine influenza was never isolated from the blood or lungs of pigs unless the lungs showed lesions of swine influenza.

Table 5 shows that filtrates of affected lung tissue and blood serum obtained from pigs showing lesions of hog cholera and swine influenza contained swine influenza virus. Four of ten lots of hog cholera virus were found to contain swine influenza virus when cultivated in the developing chick embryo.

Table 5.—Isolation of swine influenza from the blood and lungs of pigs affected with hog cholera and swine influenza

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>SOURCE</th>
<th>LESION*</th>
<th>ISOLATION OF SWINE INFLUENZA VIRUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Lung</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>S2</td>
<td>Lung</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>20</td>
<td>Lung</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>27</td>
<td>Lung</td>
<td>Cholera</td>
<td>None</td>
</tr>
<tr>
<td>49</td>
<td>Lung</td>
<td>Cholera</td>
<td>None</td>
</tr>
<tr>
<td>50</td>
<td>Blood</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>20</td>
<td>Blood</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>27</td>
<td>Blood</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>7</td>
<td>Blood virus§</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>54</td>
<td>Blood virus§</td>
<td>Atelectasis and cholera</td>
<td>Isolated†</td>
</tr>
<tr>
<td>21</td>
<td>Blood virus§</td>
<td>None‡</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Blood virus§</td>
<td>None‡</td>
<td></td>
</tr>
</tbody>
</table>

* Lesions of lung and internal organs suggestive of influenza or cholera.
† Swine influenza virus isolated by egg passage technique.
‡ No swine influenza virus recovered.
§ Defibrinated hog cholera virus.

Inoculation of pigs with blood from pigs affected with both hog cholera and swine influenza resulted in the development of influenza and hog cholera as shown by the development of atelectatic lesions of the lungs and of petechiation of the kidneys, bladder and the pleural surface of the lungs.

Table 6 shows that pigs injected with blood containing both hog cholera and swine influenza virus developed lesions of both conditions. Swine influenza virus was recovered from the affected lung tissue. Pigs immunized against swine influenza developed lesions of hog cholera and a pig immunized against hog cholera developed a mild reaction typical of filtrate swine influenza.

Petechiation of the visceral pleura was found in cases of experimental infection with both cholera and swine influenza viruses, petechiation of the pleura was not observed in pigs infected with swine influenza virus alone.

Pigs vaccinated with the minimum, 15 cc. dose of anti-hog cholera serum were
exposed to contact infection with swine influenza in a series of experiments. Three
days after vaccination three pigs which had been exposed 15 minutes developed
symptoms of swine influenza and hog cholera and on autopsy presented lesions of
atelectasis and hog cholera.

Numerous pigs vaccinated against hog cholera with proper dosage have been
used for swine influenza infection experiments two to four or more weeks after

**Table 6.** Inoculation of pigs with blood containing both hog cholera and swine influenza

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>PREVIOUS IMMUNIZATION</th>
<th>INFECTION WITH CHOLERA AND INFLUENZA BLOOD NO.</th>
<th>LESIONS ON AUTOPSY</th>
<th>ISOLATION OF SWINE INFLUENZA VIRUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>None</td>
<td>20</td>
<td>Atelectasis cholera</td>
<td>Isolated</td>
</tr>
<tr>
<td>62</td>
<td>Swine influenza</td>
<td>20</td>
<td>Cholera</td>
<td>None</td>
</tr>
<tr>
<td>63</td>
<td>Swine influenza</td>
<td>20</td>
<td>Cholera</td>
<td>None</td>
</tr>
<tr>
<td>67</td>
<td>None</td>
<td>20</td>
<td>Atelectasis cholera</td>
<td>Isolated</td>
</tr>
<tr>
<td>82</td>
<td>Hog cholera</td>
<td>67</td>
<td>Clinical filtrate swine influenza*</td>
<td></td>
</tr>
</tbody>
</table>

* Development of mild temperature reaction on third day typical of filtrate disease. 1—Blood 20 and 67 contained both hog cholera and swine influenza viruses (see table 5).

**Table 7.** Breakdown of hog cholera immunity following injection with swine influenza

<table>
<thead>
<tr>
<th>PIG TAG NO.</th>
<th>PREVIOUS SWINE INFLUENZA IMMUNIZATION</th>
<th>IMMUNIZATION HOG CHOLERA</th>
<th>INFECTION</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time Immunized</td>
<td>Time Immunized</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>days</td>
<td>days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td></td>
<td>8</td>
<td>Swine influenza</td>
<td>Influenza and cholera</td>
</tr>
<tr>
<td>103</td>
<td></td>
<td>8</td>
<td>Swine influenza</td>
<td>Influenza and cholera</td>
</tr>
<tr>
<td>124</td>
<td></td>
<td>15M</td>
<td>Swine influenza</td>
<td>Influenza and cholera</td>
</tr>
<tr>
<td>126</td>
<td></td>
<td>15M</td>
<td>Swine influenza</td>
<td>Influenza and cholera</td>
</tr>
<tr>
<td>166</td>
<td></td>
<td>60</td>
<td>Swine influenza</td>
<td>Swine influenza</td>
</tr>
<tr>
<td>125</td>
<td>15M</td>
<td>3</td>
<td>Influenza-cholera</td>
<td>No reaction</td>
</tr>
<tr>
<td>127</td>
<td>3</td>
<td>6</td>
<td>Influenza-cholera</td>
<td>No reaction</td>
</tr>
<tr>
<td>138</td>
<td>1</td>
<td>1</td>
<td>Influenza-cholera</td>
<td>No reaction</td>
</tr>
<tr>
<td>145</td>
<td>1</td>
<td>1</td>
<td>Influenza-cholera</td>
<td>No reaction</td>
</tr>
<tr>
<td>132</td>
<td>31</td>
<td>1</td>
<td>Influenza-cholera</td>
<td>No reaction</td>
</tr>
</tbody>
</table>

immunization. Under this treatment cholera has not been observed. Table 7 shows the breakdown of hog cholera immunity following injection with swine influenza.

The development of hog cholera is improperly vaccinated pigs following infec-
tion with swine influenza suggests that swine influenza infection may be a factor in
the production of "serum breaks," and the study of the occurrence of swine in-
fluenza and cholera in herds previously vaccinated against hog cholera suggest
that swine influenza may also be a factor in the development of "virus breaks."

Two cholera susceptible and two cholera immune pigs injected intramuscularly
with untreated swine influenza virus, and later infected with hog cholera developed symptoms of swine influenza; the two cholera susceptible pigs developed both swine influenza and cholera.

Cholera vaccination experiments with two lots of hog cholera virus containing swine influenza virus and two lots of hog cholera virus free from swine influenza virus contamination showed that 11 out of 16 (69 per cent) of the pigs vaccinated with anti-hog cholera serum and hog cholera virus containing swine influenza virus contained neutralizing substances in the blood stream when tested 10 days after vaccination. None of the 8 pigs vaccinated with anti-hog cholera serum and hog cholera virus free from swine influenza virus contained neutralizing substances when tested 10 days after vaccination.

Five of six lots of anti-hog cholera serum tested were found to contain neutralizing substances against swine influenza virus. One lot neutralized swine influenza virus in dilutions of 1-100 as demonstrated by negative results when the mixtures of swine influenza virus and anti-hog cholera serum were instilled into white mice. The presence of neutralizing substances in anti-hog cholera serum suggests that some of the pigs used for the production of anti-hog cholera serum were immunized with hog cholera virus containing swine influenza virus.

Swine influenza virus has been isolated from blood obtained at the time of death of 11 pigs which showed lesions of swine influenza and hog cholera. Seven cholera vaccinated pigs vaccinated 8 to 21 days before infection with swine influenza showed swine influenza virus in the blood stream 8 to 31 days after exposure to swine influenza virus. Swine influenza virus was not found after 40 days.

Swine influenza virus was not isolated from the blood stream of pigs autopsied following an attack of swine influenza, unless these pigs had been exposed to hog cholera or had been vaccinated against hog cholera within 21 days.

Swine influenza has been cultivated in the developing chick embryo using the Brandly technique and the Cox (14) method of yolk sac inoculation.

Fourteen strains of swine influenza virus have been cultivated in 10 to 13 day chick embryo for 15 to 95 generations during the past three years. Virus of the 6th, 17th, 36th and 38th egg passage, strain 815, obtained from Dr. R. E. Shope of the Rockefeller Institute, Princeton, N. J., were highly virulent for mice and when mixed with cultures of Haemophilus influenzae suis produced typical swine influenza reactions in pigs. A 50th egg passage virus was pathogenic for mice in dilutions of 1–100 and produced a very slight reaction in a pig. The 79th, 82nd and 84th egg passages of strain 815 were no infective for pigs when administered with cultures of Haemophilus influenzae suis, and did not kill mice when instilled in dilutions of 1–10. Some strains of swine influenza virus became non-virulent after fifteen of twenty passages.

Swine influenza virus is quite uniformly distributed throughout the developing chick embryo; it was found that the inflammatory exudate in the chorio-allantoic and amniotic sacs, the chorio-allantoic membrane and the embryo were pathogenic for white mice in about the same dilutions.

Immunization experiments showed that pigs injected with infected swine lung extracts developed some resistance to swine influenza infection administered 70 to 80 days later. Nasal instillation was slightly more efficient. Egg passage swine
influenza virus was considerably more antigenic and quite satisfactory increases in resistance were observed when pigs were injected with 20 cc. of virulent egg passage swine influenza virus. Simultaneous injection of *Haemophilus influenzae suis* or *Pasteurella suis* bacterins increased the resistance of immunized pigs to test infection with swine influenza virus and cultures of *Haemophilus influenzae suis*.

Table 8 shows that intranasal instillation of 20 cc. non-virulent egg passage swine influenza virus produced considerable resistance to a test infection of swine influenza virus and cultures of *Haemophilus influenzae suis* administered 76 days later.

Treatment of swine influenza virus by merthiolate 1-500 reduced the infective powers of the virus for mice but did not prevent the production of lesions in mice

**Table 8.—Resistance of pigs to swine influenza infection 40 to 83 days following administration of egg passage swine influenza virus**

<table>
<thead>
<tr>
<th>No. Pigs Used</th>
<th>Method of Immunization</th>
<th>Treatment of Antigen</th>
<th>Reaction Following Test Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>None</td>
<td>None</td>
<td>Days Clinical Symptoms*</td>
</tr>
<tr>
<td>11</td>
<td>Intramuscular</td>
<td>Formol 0.1%</td>
<td>5.9</td>
</tr>
<tr>
<td>6</td>
<td>Intramuscular</td>
<td>None</td>
<td>1.4</td>
</tr>
<tr>
<td>6</td>
<td>Nasal</td>
<td>Formol 0.1%</td>
<td>1.3</td>
</tr>
<tr>
<td>7</td>
<td>Nasal</td>
<td>None</td>
<td>2.6</td>
</tr>
<tr>
<td>10</td>
<td>N-V† Sub-Cut</td>
<td>None</td>
<td>1.5</td>
</tr>
<tr>
<td>11</td>
<td>N-V† Sub-Cut</td>
<td>None</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>Subcutaneous</td>
<td>Merthiolate§</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Nasal</td>
<td>Merthiolate§</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Number of days each pig showed clinical symptoms or temperature over 104°F.
† Average total temperature above 104° during time pigs showed clinical symptoms.
‡ Non-virulent egg passage virus after 84 egg passages.
§ Virus treated with 1-500 merthiolate.

instilled under ether. Doses of Merthiolate 1-100 were apparently sufficient to destroy swine influenza virus but this amount of merthiolate was toxic to mice.

Immunization experiments shown in table 8 suggest that non-virulent untreated swine influenza virus produces greater resistance to test infection than does attenuated merthiolate treated virus and formol killed egg passage virus.

A few experiments with hyper-immune swine influenza serum produced by repeated subcutaneous injections of egg passage swine influenza virus were made. Large doses, 100 cc., of a serum neutralizing mouse strain swine influenza virus in dilutions of 1–100,000,000 slightly decreased the severity of swine influenza infection and increased the time required for contact infection to develop. Pigs injected with 100 cc. anti-swine influenza serum before exposure required nine days to develop clinical symptoms when placed in contact with pigs inoculated with swine influenza virus and cultures of *Haemophilus influenzae suis*. Untreated pigs sick-
ened in two days. Treatment of affected pigs with 120 cc. of anti-swine influenza serum and with 120 cc. of anti-swine influenza serum in addition to 120 cc. of anti-hog cholera serum produced no abatement of symptoms or only slight reduction of temperature.

Recent papers by Burnet (16) report on the cultivation of human influenza virus in the developing chick embryo by the amniotic technique, Burnet reports that the power to produce symptoms on ferrets becomes progressively reduced, but that the immunizing power is essentially the same. Virulence for mice reached a peak between the 30th and 40th amniotic passage.

Summary

Swine influenza following exposure and shipment to the Philadelphia Stock Yards was associated with Pasteurella suiseptica infection, and was characterized by atelectasis, catarrhal pneumonia and fibrinous pleuritis.

Instillation of 20 cc. of cultures of Pasteurella suiseptica, highly virulent for rabbits, was non-pathogenic for pigs.

Small doses of Pasteurella suiseptica cultures added to swine influenza virus caused the development of a non-transmissible form of swine influenza which was fatal to four out of ten infected pigs.

Contact of susceptible pigs with animals recently infected with swine influenza, or with pigs infected with non-virulent swine influenza virus induced the production of neutralizing substances in the blood stream.

Recurrence of swine influenza in experimentally infected pigs occurred following the occurrence of inclement weather. These relapses suggest the production of a carrier state following infection with swine influenza.

Swine influenza virus was isolated from the blood of pigs showing lesions of atelectasis and hog cholera.

Subcutaneous injections of 2 cc. blood obtained from pigs showing lesions of both hog cholera and swine influenza produced lesions of both diseases.

Petechiation of the visceral pleura was an outstanding lesion of infection with hog cholera and influenza.

Vaccination of pigs with anti-hog cholera serum and hog cholera virus containing swine influenza virus induced the development of neutralizing substances in 69 per cent of the vaccinated pigs.

Vaccination of pigs with 20 cc. of non-virulent egg passage swine influenza virus induced a considerable increase in resistance to infection with swine influenza virus and cultures of Haemophilus influenzae suis.

Untreated egg passage swine influenza virus was more antigenic than merthiolate treated or formol killed virus.

Intranasal instillation of egg passage swine influenza virus was found to be the most efficient method of increasing resistance to swine influenza infection.

REFERENCES

IMMUNOLOGICAL STUDIES WITH HOG CHOLERA TISSUE VACCINE

By William H. Boynton, D.V.M.,¹ Gladys M. Woods, M.A.,¹
F. W. Wood, D.V.M.,² and N. H. Casselberry, D.V.M.²

The use of hog cholera tissue vaccine in the field has shown a need for clarification of some points in regard to the immunization of swine against cholera and for additional information on others.

First, it must be reiterated that when anti-hog cholera serum and virus are used for the immunization of swine against cholera, a reaction follows the administration of the virus which frequently results in serious herd losses, because hog cholera virus aggravates bacterial infections which may be present at the time of vaccination or acquired shortly thereafter. Practically, this means that weak pigs or pigs apparently healthy but suffering from infections other than cholera are, if exposed to cholera virus, as in the simultaneous method, usually eliminated. On the other hand, such pigs are unaffected by the administration of tissue vaccine, and come through the vaccination with no greater loss than would normally occur if the animals were left untreated. If pigs vaccinated by either method are later exposed to cholera virus, the survivors in the serum-virus treated group will probably show little or no reaction to the exposure but the weak pigs in the tissue vaccine treated group may show sickness and losses may occur. If, however, no exposure to cholera occurs following vaccination, the weak pigs in the tissue vaccine treated group ordinarily will reach market. In brief, the simultaneous method results usually in speedy elimination of the weak pigs; the tissue vaccine method affords the weak animals a good chance of survival.

Next, since definite information on the effect of certain modifications of the tissue vaccine method would be desirable, experiments have been conducted during the past two years to determine: (1) the duration of immunity in pigs immunized with a single dose of tissue vaccine; (2) the immunity resulting from the intracutaneous administration of tissue vaccine; and (3) the degree of active immunity which may be expected from the simultaneous use of anti-hog cholera serum and tissue vaccine.

EXPERIMENT 1

In the experiment on the duration of immunity following a single dose of tissue vaccine, groups of susceptible pigs were given, respectively, 10 and 5 cc. doses. These were held with susceptible control pigs for varying intervals and then given hog cholera virus to test their immunity.

a. In the first portion of this experiment, one group of seven pigs, given 10 cc. of vaccine each, was held with three unvaccinated controls for approximately three months following the administration of vaccine and then the vaccinated and control animals were injected with 2 cc. of virus each. The controls developed cholera in due time; the seven vaccinated animals remained well. A similar group receiving

¹ Division of Veterinary Science, University of California, Berkeley, California.
² Cutter Laboratories, Berkeley, California.
HOG CHOLERA TISSUE VACCINE

the same dosage was held for four months after vaccination with similar results; that is, the vaccinated group remained well and the controls sickened with cholera.

b. In the second portion of this experiment, groups of seven pigs with three controls to a group were treated with 5 cc. of tissue vaccine, held, respectively, for periods of approximately one, two, three, four, five, and six months after treatment and then given an injection of 2 cc. of virus each. One of the vaccinated pigs in

**Experiment 1.—Experiment on the duration of immunity following a single dose of tissue vaccine**

<table>
<thead>
<tr>
<th>NUMBER OF PIGS</th>
<th>DATE OF VACCINATION</th>
<th>DOSAGE OF VACCINE</th>
<th>PERIOD BETWEEN VACCINATION AND IMMUNITY TEST</th>
<th>DATE OF VIRUS INJECTION</th>
<th>DOSAGE OF VIRUS</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>10</td>
<td>88</td>
<td>Dec. 13, 1940</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>10</td>
<td>128</td>
<td>Jan. 22, 1941</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experiment a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>5</td>
<td>35</td>
<td>Oct. 21, 1940</td>
<td>2</td>
<td>One discarded before injection</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>5</td>
<td>65</td>
<td>Nov. 20, 1940</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>5</td>
<td>88</td>
<td>Dec. 13, 1940</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sept. 16, 1940</td>
<td>5</td>
<td>128</td>
<td>Jan. 22, 1941</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Apr. 30, 1941</td>
<td>5</td>
<td>154</td>
<td>Oct. 1, 1941</td>
<td>2</td>
<td>One died; two others sickened</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Apr. 30, 1941</td>
<td>5</td>
<td>184</td>
<td>Oct. 31, 1941</td>
<td>2</td>
<td>Two showed sickness; seven survived</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

the one-month group was discarded before virus injection, leaving six pigs for the immunity test. In the group kept for five months, one of the vaccinated pigs died. Two others sickened but recovered. Two of the vaccinated pigs in the group held for six months showed sickness but all survived. All of the vaccinated pigs in the other groups remained well. The controls on all the groups developed cholera in the usual time, with the exception of two controls on the two-month group which

³ Later results on a group of seven pigs tested eight months after vaccination show that they were satisfactorily protected.
sickened from a condition other than cholera and were discarded before the test was completed.

No essential difference between the effects of the 10 cc. and 5 cc. doses was noted but the immunity induced by a single 5 cc. dose appeared to be somewhat less complete five or six months after vaccination than it was at the earlier periods.

c. In the third portion of this experiment, 1034 pigs, assembled from twenty-seven different farms, had been vaccinated in the field by practicing veterinarians with a single 5 cc. dose of tissue vaccine. As would be expected, these pigs were from herds with varying histories; some of the animals represented herds free from trouble, others had a history of losses from various causes in previous years. The time between vaccination and the immunity test varied from approximately one month to six and one-half months. To check the immunity of the vaccinated animals, they were injected with 2 cc. of hog cholera virus each. Eight unvaccinated controls used in this experiment received the same dose of virus at the same time. All the controls and ten of the vaccinated pigs sickened, presumably of hog cholera or complications. These deaths in the vaccinated groups occurred among pigs from six farms. The vaccinated pigs from the other twenty-one farms remained healthy. Three of these losses were from one farm, two each from two other farms, and one each from three farms. It is an interesting fact that all of the deaths occurred in pigs vaccinated for the shorter periods of time before the immunity test, and suggests that the better protection afforded pigs in the groups vaccinated for the longer periods before virus injection may have been due to the possibility that the older pigs had recovered from bacterial infections so prevalent in the younger pig groups.

EXPERIMENT 2

To find out whether immunity may be induced by intracutaneous administration of tissue vaccine, a few swine were treated by this method.

a. In the first part of this experiment, a group of seven pigs was given an intracutaneous injection of 2 cc. of tissue vaccine, held, with three controls, for one month and then each of the vaccine treated pigs and unvaccinated controls was injected with 2 cc. of virus. The controls developed cholera at the expected time, but all the vaccinated pigs remained well.

b. In the second part of this experiment, a group of seven pigs received an intracutaneous injection of 1 cc. of tissue vaccine and was held along with three controls for approximately two months before receiving virus. The controls developed cholera, and one of the vaccinated seven died.

c. In the third part of this experiment, two groups of seven pigs and three controls each were used. In each group, seven pigs received an intracutaneous injection of 0.5 cc. of tissue vaccine. At the expiration of one month, the vaccinated and control pigs in one group were injected with 2 cc. of hog cholera virus each. The second group was held for approximately three months and then all of the pigs were injected with 2 cc. of virus each. In each group, the three control pigs de-

4 Figures from the latest field report indicate a total of 140 pigs from 38 farms given the immunity test and 368 days, the longest time interval between vaccination and this test. No deaths other than the ten reported above have occurred.
HOG CHOLERA TISSUE VACCINE

developed cholera, and two of the vaccinated pigs showed evidence of cholera infection for a few days but all of the vaccinated pigs survived.

The results thus far seem to show that a very satisfactory immunity may be conferred by the intracutaneous administration of tissue vaccine but these results need to be amplified before any definite conclusions can be drawn.

**Experiment 2.—Immunological effect of the intracutaneous administration of tissue vaccine**

<table>
<thead>
<tr>
<th>NUMBER OF PIGS</th>
<th>DATE OF VACCINATION</th>
<th>DOSAGE OF VACCINE</th>
<th>PERIOD BETWEEN VACCINATION AND IMMUNITY TEST</th>
<th>DATE OF VIRUS INJECTION</th>
<th>DOSAGE OF VIRUS</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb. 19, 1941</td>
<td>cc. 2</td>
<td>30 days</td>
<td>Mar. 21, 1941</td>
<td>2</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td>Mar. 21, 1941</td>
<td>2</td>
<td>All developed cholera</td>
</tr>
<tr>
<td>Experiment b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb. 19, 1941</td>
<td>1 cc.</td>
<td>58 days</td>
<td>Apr. 18, 1941</td>
<td>2</td>
<td>One died</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td>Apr. 18, 1941</td>
<td>2</td>
<td>All developed cholera</td>
</tr>
<tr>
<td>Experiment c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Jan. 10, 1941</td>
<td>0.5 cc.</td>
<td>30 days</td>
<td>Feb. 9, 1941</td>
<td>2</td>
<td>Two showed sickness; all survived</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td>Feb. 9, 1941</td>
<td>2</td>
<td>All developed cholera</td>
</tr>
<tr>
<td>7</td>
<td>Jan. 10, 1941</td>
<td>0.5 cc.</td>
<td>89 days</td>
<td>Apr. 9, 1941</td>
<td>2</td>
<td>Two showed sickness; all survived</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td>Apr. 9, 1941</td>
<td>2</td>
<td>All developed cholera</td>
</tr>
</tbody>
</table>

**Experiment 3**

In this experiment on the effect of the simultaneous use of anti-hog cholera serum and tissue vaccine, susceptible pigs were given simultaneous injections of 30 cc. of serum and 5 cc. of tissue vaccine. As in the previous experiments, these animals were subjected to immunity test at intervals varying from one, two, three, and five months after the administration of the serum and vaccine.

The first group of fourteen pigs and six unvaccinated controls was held one month and then given 2 cc. of virus each. Two of the fourteen serum-vaccine treated pigs died, and all six controls developed cholera.

The second group of fourteen pigs was held, together with six controls, for two months before all were injected with 2 cc. of virus each. The controls sickened with cholera; one of the serum-vaccine treated pigs died, and two others sickened but survived.

A third group of seven pigs held, with three controls, for three months, was injected with 2 cc. of virus each. The controls developed cholera, but no losses occurred in the serum-vaccine treated group.
A fourth group of seven pigs was held, with three controls, for five months and then each received the usual dose of 2 cc. of virus. The controls developed cholera; one death occurred among the serum-vaccine treated group, and five others sickened but recovered.

From this experiment, it seems plain that some active immunity may be expected in animals receiving the serum-vaccine treatment, but that the immunity produced is modified by the action of the serum. It would seem that serum and vaccine in combination may be useful in the treatment of herds exposed to hog cholera, and in herds in which animals sick from unknown causes render the use of serum and virus dangerous. In herds of this character it would be advisable to give a second injection of vaccine in from two to four weeks or as soon as the animals appear healthy.

**EXPERIMENT 3.—Experiment on the effect of the simultaneous use of anti-hog cholera serum and tissue vaccine**

<table>
<thead>
<tr>
<th>NUMBER OF PIGS</th>
<th>DATE OF VACCINATION</th>
<th>DOSAGE OF SERUM AND VACCINE</th>
<th>PERIOD BETWEEN SERUM-VACCINE TREATMENT AND VIRUS INJECTION</th>
<th>DATE OF VIRUS INJECTION</th>
<th>DOSAGE OF VIRUS</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Jan 10, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 30</td>
<td>Feb. 9, 1941</td>
<td>2 cc.</td>
<td>One died</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb. 28, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 28</td>
<td>Mar. 28, 1941</td>
<td>2 cc.</td>
<td>One died</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Jan. 10, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 61</td>
<td>Mar. 12, 1941</td>
<td>2 cc.</td>
<td>Two sickened; all survived</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>May 7, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 63</td>
<td>July 9, 1941</td>
<td>2 cc.</td>
<td>One died</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb. 28, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 98</td>
<td>June 6, 1941</td>
<td>2 cc.</td>
<td>All remained well</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb. 28, 1941</td>
<td>30 cc. serum 5 cc. vaccine</td>
<td>days 161</td>
<td>Aug. 8, 1941</td>
<td>2 cc.</td>
<td>One died; five others sickened; six survived</td>
</tr>
<tr>
<td>3 controls</td>
<td></td>
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</table>

SUMMARY

In the experiments on the duration of immunity following the use of a single dose of tissue vaccine, pigs held up to four months after receiving a single 10 cc. dose and pigs held up to six months after receiving a single 5 cc. dose, were protected

* For later results, see footnotes inserted on page 40.
HOG CHOLERA TISSUE VACCINE

against cholera infection satisfactorily. No detectable difference in the degree of immunity was shown between pigs receiving the 5 cc. and 10 cc. dosage.

Results of the experiment conducted in the field show that pigs receiving a single 5 cc. injection of tissue vaccine were protected for periods up to 202 days. As would be expected, a few pigs in the field experiment failed to show complete immunity against cholera. This fact further confirms previous findings that pigs harboring bacterial infection when vaccinated either fail to develop a solid immunity or exposure to virus after vaccination favors the development of concurrent infections. The immunity shown under field conditions in this experiment seemed to be greater in pigs vaccinated for longer periods. This apparent contradiction may be explained on the grounds that the older animals; that is, those vaccinated for the longer periods, were freer from bacterial infections than the younger pigs.

Experimental trials with the intracutaneous injection of tissue vaccine indicate that susceptible pigs may be immunized against hog cholera by this method. Trials with the intracutaneous method are as yet insufficient to warrant any definite conclusions.

Experimental results following the simultaneous injection of anti-hog cholera serum and tissue vaccine seem to show that some active immunity may be expected from this treatment. However, there seems to be a definite modification of the immunity as compared with that obtained from the vaccine alone method and, in general, the immunity seems to be reduced. Results so far would indicate that serum and vaccine in combination may be of value when used on herds in which losses are occurring from infections other than cholera, or in which there may be a suspicion that cholera infection exists, or when used on pigs purchased from sales barns or whose history is unknown.

The results reported here further demonstrate the adequacy and safety of tissue vaccine as an immunizing agent against hog cholera and as an agent which can be used without fear of aggravating intercurrent infections or spreading hog cholera infection.
CELL CHANGES IN THE GALL BLADDER AS AN AID IN THE DIAGNOSIS OF HOG CHOLERA


Although much progress has been made in connection with the immunological phase of hog cholera, as yet no laboratory method of diagnosis has been devised for this disease except the expensive and time-consuming method of filtration of material from a suspected case and subsequent inoculation of the filtrate into a pig, the only known species of animal susceptible to cholera. The costliness of this method both in the time and money involved has forced the field veterinarian to depend for his diagnosis almost entirely upon history, clinical symptoms, and autopsy findings, with such laboratory aid as the seldom practicable leucocyte and lobular counts. The more experienced the veterinarian is in clinical diagnosis of cholera, the more he encounters difficulties due to the overlapping of symptoms and lesions of various hog disease entities. Any reliable means of diagnostic aid would, therefore, be of inestimable benefit, particularly in doubtful cases in which the advisability of immunization measures is open to question.

The finding of inclusion bodies in some other virus diseases suggested that similar bodies should be demonstrable in cholera. In fact, more than thirty years ago, Uhlenhuth and Böing (1, 2) claimed the presence of cell inclusions in the conjunctiva during the early stages of the disease but inasmuch as these bodies have been reported in healthy animals, they are considered of no diagnostic significance to-day. For this study, the gall bladder which is affected in this disease and has heretofore received scant attention from workers on hog cholera, was selected as tissue in which pathological changes might be distinguishable. The technic of securing the preparations from this tissue is as follows:

The gall bladder is dissected from the liver and placed on a firm surface. An incision is made extending along its entire length and into the neck of the bladder. The bile is removed and the mucous surface then carefully swabbed with cotton two or three times to get rid of the greater portion of bile adhering to the bladder wall. Scrapings of the mucous membrane are taken from the neck and upper fourth of the gall bladder, since it is in this area that the true mucoid glands are found. A thin smear of these scrapings is made on a clean glass slide. This is allowed to dry in air and is then fixed in methyl alcohol for fifteen minutes, and again allowed to dry in air. To stain, eosin-methylene blue or any of the polychrome methods such as Wright’s, Leishman’s, Jenner’s, or Giemsa’s method may be used. However, the most dependable results and the most clear-cut differentiations have been obtained with Kingsley’s (3) stain. In this method, the fixed preparation is flooded with stain which is allowed to act for seven minutes. The stained smear is then thoroughly washed with distilled water and after being air dried, is ready for microscopic examination.

1 Division of Veterinary Science, University of California, Berkeley, California.
2 Cutter Laboratories, Berkeley, California.

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Fig. 1.—Cells from gall bladder scrapings of an apparently healthy pig, showing indistinctly stained nuclei. a, nuclei showing a slight network of chromatin; b, deeply stained nuclei filled with mucoid-like substance; c, stringy, mucoid-like substance.
A total of more than 600 smears of gall bladder scrapings from field and laboratory cases have been examined thus far. In addition, some fifty preparations have

Fig. 2.—Cells from gall bladder scrapings of a cholera-infected pig, showing sharply stained nuclei. *a*, so-called inclusion bodies; *b*, nucleoli.
been studied from apparently healthy swine brought to slaughter, from laboratory and field cases affected with severe pneumonia of both *suiseptica* and *supestifer* types, pigs suffering from enteritis and verminous infestations, and one case diagnosed as erysipelas.

In all these non-cholera cases, the glandular and epithelial cells failed to take the stain readily. The nuclei in many instances showed a slight network of chromatin with stringy, mucoid-appearing substance throughout the preparation. The more deeply stained nuclei among these cases were filled with this stringy, mucoid-like material.

In cholera cases, on the other hand, the nuclei of both the glandular and epithelial cells stained very sharply and distinctly. Inclusion bodies, so-called, were observed in the nuclei of many of the glandular cells. These bodies stained a deep magenta and were easily differentiated from the nucleoli which stained a light blue. The stringy, mucoid-like substance was absent in preparations from more advanced cases and was apparently replaced by a granular reddish purple precipitate. In general, preparations from cholera-infected pigs destroyed on the sixth day after virus inoculation showed less clear-cut results than those from pigs destroyed on the seventh day, or from the usual field cases. Likewise, experimental pigs subjected to a more reduced ration for two days preceding their destruction on the sixth day, showed less distinctly stained cells.

To substantiate the finding of inclusion bodies, a few smears were stained with aqueous nigrosine. Dark-staining bodies were observed in some of the nuclei and in the cell body as well. Since the bodies were less prevalent in smears stained by nigrosine, this suggested that the bodies stained by Kingsley's method may not all be of the same substance; that is, some of the bodies may, perhaps, be composed of coagulated mucoid-like material.

Whether or not these bodies are true inclusion bodies in the same sense as the bodies found in other virus diseases is not now known. Nor is it understood why the glandular and epithelial cells of the gall bladder in cholera-infected animals stain so sharply and uniformly in contrast to those from non-cholera cases and why, in the more advanced stages of cholera particularly, the mucoid-like substance is replaced by a granular precipitate. The explanation for these apparent differences in affinity for stain and the changed appearance of the entire background in the smears might possibly be based on some chemical change which may occur in the bile of cholera cases. Whatever the explanation for these findings may be, and whether or not the bodies observed are true inclusion bodies, upon the basis of the studies so far, a manifestly different and easily discernible microscopic picture can be obtained from the gall bladder scrapings of cholera-infected pigs, which suggests a possible future method to aid in confirming the diagnosis of cholera.

REFERENCES

REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES OF SWINE

F. L. Carr, Chairman, Columbus, Ohio; Frank Breed, Lincoln, Nebr.; L. P. Doyle, Lafayette, Ind.; C. N. McBryde, Ames, Iowa; L. Van Es, Lincoln, Nebr.; and R. Fenstermacher, St. Paul, Minn.

Your committee sent questionnaires to the regulatory officials of the principal swine raising states for information on the prevalence of certain infectious diseases of swine during the past year.

The following is based upon the replies received from this survey:

It seems that there has been no unusual outbreaks of swine disease the past year and while some sections report an increase in a particular disease another section reports a decrease in the same disease.

Hog cholera is still the condition causing the greatest loss in swine raising sections, in spite of the fact that the preventative vaccination against this disease is probably more reliable and effective than any other vaccination against any infectious disease in common use.

The subject of hog cholera and the immunization against this disease is to be discussed as a part of the regular program at this meeting, consequently we will not discuss it further in this report.

Swine erysipelas continues to show an increase over the previous year according to most of the reports received, however we have received no reports of any unusual or widespread outbreaks.

Swine erysipelas is one disease that will receive increased attention and study in the future as it is becoming evident that it is of considerable economic importance.

Brucellosis of swine is reported by a few states but most sections do not report any marked spread of the infection. It seems that this is a condition that should be given some thought by regulatory officials that steps may be taken to prevent this disease becoming widespread among swine.

The enteric diseases continue to be a very important factor in swine raising sections and the survey indicates a gradual increase rather than a diminution in this class of ailments. This group of diseases is likely not all due to a specific infection and probably should not be thus grouped but whatever the etiology there is a common ground from the standpoint of symptoms.

From the viewpoint of a regulatory official it is safest to consider this group of conditions as infections and handle them as a contagious disease.

Swine influenza does not seem to have been very prevalent the past year—most states report a decrease in this condition. However some localities report increased outbreaks.

At the request of the committee Dr. J. Traum of Berkeley, California kindly consented to furnish a brief report on Vesicular Exanthema in Swine. Quoting Dr. Traum:

"Vesicular exanthema in swine, a disease thus far found only in California, was first called to your attention in 1934 by your Committee on Miscellaneous Transmissi-
ble Diseases. This disease is clinically indistinguishable from natural and experimental foot and mouth disease and experimental vesicular stomatitis in swine. Its behavior in test animals, however, warranted the use of a new name to differentiate it from either vesicular stomatitis or foot and mouth disease. It was first definitely differentiated from the latter in 1933, although it probably was in California in 1932, but then not properly diagnosed. In these two outbreaks, seven premises, containing 23,500 hogs were involved. Since then, the records of the California State Department of Agriculture show that the disease has been reported every year including the present, with the exception of 1937 and 1938.

"Since the appearance of the disease 367 premises have been found to have been infected, and of these, 344 were garbage-feeding ranches, while 23 were grain-feeding establishments. The first observation of vesicular exanthema on grain-feeding premises is found in the report of the State Department of Agriculture for the fiscal year ending June 30, 1940.

"For more detailed information on this disease, the reader is referred to the Journal of the American Veterinary Medical Association, March, 1936, and September, 1940, and to the 21st Annual Report of the State Department of Agriculture Bulletin, Volume 29, Number 4."

The gravest problem facing regulatory officials in connection with swine diseases is the contamination and spread of infection caused by the traffic in hogs. Usually in this connection we think of community sales and I would not minimize the danger from this source for it is a very real menace. Another factor that is important in considering the spread of swine disease is the movement of livestock by truck, no matter what the origin of the shipment. At the present time there is very little or no regulation over truck movements of livestock, based upon health considerations.

It seems that trucks transporting live stock interstate should be considered common carriers and be subject to similar requirements to those imposed upon railroads and other transportation companies. We feel that this subject should be given real study not alone by regulatory officials but by all livestock interests. It is natural for any group to be reluctant to have additional requirements placed upon their business and consequently proposals for additional supervision usually meet with opposition from the very groups that the supervision should benefit. It is a fact that the loose method now employed governing the movement of live stock by truck both intra and interstate is a menace to live stock health and that the best interest of the industry would be served by closer supervision of such movement. If it is necessary to have supervision of movement of livestock by railroad it is certainly not even debatable that for exactly the same reasons a similar supervision of truck shipments should be inaugurated.

There is general agreement among veterinarians that the one outstanding source of the dissemination of swine disease is the community auction and sales barn. All parties are agreed that these sales should be rigidly supervised but in many cases the machinery to do so seems too complicated and the ensuing cost prohibitive. There is a legitimate need and an economic reason for some sort of market for hogs known as feeders: Many breeders are so situated that they cannot fatten all their pigs and of course many feeders fatten more hogs than they could produce. Consequently we are faced with the problem of trying to control the contamination
often resulting from these markets and at the same time not making the regulations such a burden that they can not be economically carried out.

The suggestion that we hear given the most often is that the state should have inspectors at all sales, such inspectors being employees of the state under salary. This arrangement is probably the best where it is at all practical.

However in many states this is not feasible on account of the large number of such established auctions.

Inspection to be of much value must be maintained at all times and it should be possible for the inspector to actually go over the individual lots and if animals are suspicious, to allow time for individual examination.

Another factor which makes it extremely difficult to properly supervise these auctions is that a large number of animals are handled in a short time and that before all consignments have arrived at the auction some have been sold and are being removed; this means that an inspector is usually rushed too much to do the best work.

The problem varies much in different states and sections. In those auctions whose activities are largely confined to handling fat stock the problem is comparatively simple but in auctions dealing largely in livestock going back to the farms the need for adequate inspection is great and correspondingly complicated.

In spite of the drawbacks and difficulties attendant upon adequate inspection at auction markets there is no doubt that much can be done to at least decrease the amount of contamination from these markets.
EQUINE BREEDING HYGIENE

By W. W. Dimock

From a study of breeding problems in mares, it has been found that it is not only advisable, but necessary, to consider a great variety of conditions, many of them more or less related, and overlapping in effect. However, the relationship is not always apparent. Our first work on breeding problems in mares consisted of an examination of barren mares to determine the condition of the reproductive organs and to classify the abnormal conditions that were apparently responsible for the failure of the mares to conceive when bred. It was found that a considerable number of mares were suffering from an infection of the genital tract in the form of vaginitis, cervicitis, and metritis.

Of approximately 4,000 barren mares, with an average of two examinations per mare, the record reveals that 25 per cent, or one out of four, were suffering with an inflammation of the genital tract due to streptococcic infection. These figures are based on a bacteriological examination of the cervix, making the culture with a platinum needle or a swab. In about 10 per cent of the cases examined other bacteria were found, such as, B. coli, staphylococcus, encapsulated bacilli (viscid rod) and pyocyaneus. Sixty-five per cent of all barren mares cultured were bacteriologically negative. After some experience, one becomes able to recognize, on clinical examination, all normal and all badly diseased mares.

It is not possible in every instance to determine the presence or absence of infection in many cases of the clinically intermediate type. To determine the presence or absence of infection in the borderline cases and to determine the particular type of infection in all that show evidence of cervicitis and metritis upon clinical examination, it is necessary to resort to cultural methods.

In the beginning, most of the mares available for examination were those that had been barren for two or more years. This naturally gave a high percentage of mares showing infection. Later, culture tubes were inoculated from the cervix of all barren mares in the group to make sure that the cervix of clinically normal mares was actually free of microorganisms and that culture tubes inoculated from such mares in the field would remain free of bacterial growth. Thus it was found that mares, apparently normal on visual examination of the vagina and vaginal cervix, were bacteriologically negative, and that culture tubes inoculated from the cervix of mares, showing on clinical examination evidence of inflammation, would usually show growth of bacteria.

As a cause of sterility due to genital infection in mares, streptococci are the most important. This microorganism is still further important in equine breeding hygiene because it is a cause of abortion and of navel ill in foals. Records of exami-

1 The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

2 Department of Animal Pathology, Kentucky Agricultural Experiment Station, University of Kentucky, Lexington, Ky.
nation revealed that 18 per cent of all fetuses cultured showed streptococci and 25 per cent of all foals examined, that died from navel ill and joint ill, showed streptococcic infection. Therefore if 25 per cent of the cases of sterility in brood mares, 18 per cent of all cases of equine abortion and 25 per cent of all cases of navel ill are due to streptococcic infection, then it becomes apparent that streptococcic infection in connection with equine breeding problems is most serious and that it is worth while to attempt to prevent this type of infection in brood mares.

It should be remembered that the portal of entrance of streptococcic infection in the genital tract of mares is always through the genital tract. This particular streptococcus lives on the external genitals of mares and stallions. From the standpoint of streptococcic abortion in mares, and navel ill in foals, prevention is to be accomplished by making sure that the microorganism is not in the genital tract when the mare is bred, and is not introduced at the time of service. In other words, the mating of clean, healthy, normal mares to vigorous, fertile stallions, with the observation of hygienic measures that will prevent the entrance of streptococci at the time of service will help materially to reduce the incidence of these two conditions. The mare's tail should be bandaged with a clean bandage, the external genitals should be washed thoroughly with soap and water, rinsed with clean water, and the vestibule of the vulva wiped out with moist absorbent cotton. The stallion should be washed with soap and water and rinsed with clean water before the service. After the service, wash with soap and water and rinse with a mild nonirritating antiseptic.

Conditions which favor entrance of streptococci into the genital tract of mares are tears and lacerations at the time of parturition, that are not surgically corrected at the time; mares in poor flesh that have become sunken in the perineal region; mares that have produced several foals, the vulva having become relaxed with a marked loss of tone and the lips of the vulva thin and membranous. The conformation of the mare in the perineal region will be found to vary considerably in the different breeds and in different individuals of the same breeds. All of the above conditions favor the entrance of microorganisms into the genital tract and for all such mares everything possible should be done in the way of surgery to prevent seepage of infected material into the vulvo-vaginal canal and into the vagina.

It is well known that many young mares that have never been served, particularly the thoroughbred in racing condition, developed vaginitis, cervicitis, and sometimes metritis. This is probably due to the fact that in racing form, the mares are rather thin in flesh, sunken in the perineal region, and in addition, when galloping, there is a strong suction movement forward into the genital tract. Such mares, both old and young, are often spoken of as Wind Suckers. For mares that are injured, that have a sunken relaxed membranous condition of the vulva, and for the young mare as well, the operation know as Suturing the vulva or perineal repair proves most effective, not only as a means of prevention but also in bringing about recovery after infection has occurred.

One form of the operation is to remove a section of the mucous membrane at the junction of the lips of the vulva about \( \frac{1}{2} \) inch wide on each side and down from the upper commissure from 1 to 2 inches, depending upon the condition of the
parts. Bring the two raw surfaces together with sutures or clamps. This procedure is quite generally used and is most satisfactory, especially for emergency cases such as directly after foaling and immediately following service by the stallion.

A more complete operation is often advisable with certain types of mares, particularly old mares that are sunken in the perineal region, and those where the lips of the vulva are thin and membranous. The more complete operation consists in removing more of the mucous membrane on each side of the lips of the vulva. Make an incision from the upper commissure of the vulva down each side at the junction of the skin and mucous membrane for about $1\frac{1}{4}$ to 2 inches. Peel the mucous membrane from the roof of the vulvo-vaginal canal, anteriorly about $1\frac{1}{4}$ inches. Remove all the mucous membrane from this inner point on the roof out to the lower cut margin on the lips of the vulva. In other words, take off a triangular piece of the membrane on each side of the inner lips of the vulva. Insert two deep sutures, being sure that the needle goes through the mucous membrane at the lower or inner cut surface of the mucous membrane. Tie sutures on the outside, but not too tight. Above, between, and below the two sutures use metal clamps to hold the cut surfaces of skin in line and in direct apposition. For suturing material, the dry dermis and tension sutures are satisfactory.

After four or five days remove the two deep sutures and adjust any of the clamps that have become loose or misplaced. It is frequently advisable to remove some of the old clamps and insert fresh ones at this time so that the skin wound will heal smoothly and uniformly. A mild antiseptic on both the inside and outside of the wound is all that is necessary. Observe cleanliness while performing this operation but no unusual precautions are necessary; however, the administration of a prophylactic dose of Tetanus Antitoxin is a good precautionary measure.

Ordinarily the operation is performed under local anesthesia, but where mares are fractious and difficult to handle, 1$\frac{1}{4}$ ounces of Chloral Hydrate by mouth is used in addition to the local anesthesia.

The Parturient Mare.

Many observations and many detailed examinations of parturient mares, from one to 10 days following parturition, reveal that a much larger number of mares that give birth to a normal foal are not in condition for service on the ninth day or first heat period following parturition.

It has long been an established custom to accept without question a mare with foal at side for service on the ninth day following parturition; however, many so-called foaling mares are not in condition to breed on the ninth day or first heat period following parturition. It has been found worth while to examine the parturient mare on the fourth to eighth day, and to withhold from service all mares that have not made a normal recovery. It should be remembered that the parturient mare, although normal on the ninth day, is far more liable to become infected at the time of service than is the normal non-parturient mare.

All available evidence indicates that streptococcic infection of the genital tract of mares occurs not infrequently following parturition. The microorganism is frequently present in the vagina, cervix and uterine secretions soon after delivery of
the foal and until the time of the first heat period (ninth day). Under what may be considered a normal recovery the uterus and cervix will be free from bacteria as determined by bacteriological examination of the uterine secretion as it comes through the cervical canal from the sixth to the tenth day following parturition. If the mare has not completely recovered by the ninth day and is admitted to service there are four possible results:

1. Conception occurs and the infection is overcome, the mare giving birth to a normal foal at term.

2. Conception occurs but later the mare aborts. The tissues of the fetus are usually positive to streptococci, on culture; the afterbirth is diseased and the mare shows upon examination unmistakable evidence of endo-metritis.

3. Conception occurs and the mare carries the fetus the normal gestation period but gives birth to a diseased foal.

4. Conception does not occur. The mare may be served several times during the spring and summer, which still further aggravates the inflammatory process, the usual result being a well-established case of streptococcic metritis.

A foaling mare bred on the ninth day may be normal in every way but the streptococcus may be introduced at the time of service. Because of this, emphasis is placed on the value of cleanliness as regards both the mare and the stallion at the time of service. In case streptococci are present in the genital tract when the mare conceives, as stated above, the infection may under favorable conditions die out and cause no harm. Quite as often, however, the bacteria multiply, producing sufficient disturbance to cause the mare to abort or give birth to a diseased foal.

It is well known that the number of healthy foals produced in the United States is low when compared with the number of mares bred; and that the number of services per pregnancy is high. In many groups of mares, both large and small, the production of live healthy foals is below fifty per cent.

It has been found possible to increase the breeding efficiency and production of live healthy foals by from 10 to 20% through the adoption of procedures and practices that come within the meaning of equine breeding hygiene.

The streptococcus that causes metritis, abortion and infection of the new-born is a normal inhabitant of the external genitals of mares and stallions and is probably more or less prevalent in stable refuse, dust, etc. found in and around stables.

In addition to streptococcic infection, which, as already stated, is a cause of metritis, abortion and navel ill in foals, there are a number of other conditions that may well be mentioned, as they are very important in the production of horses and mules.

Streptococcic abortion: To be prevented through the application of principles of equine breeding hygiene.

Salmonella abortion: This is not a genital infection and is probably seldom if ever spread at the time of service. Abortion due to the Salmonella abortivoequinus may be very definitely controlled through vaccination of the mare early in the period of gestation. In all abortions other than those due to Salmonella, the blood will be negative to the agglutination test for Salmonella abortivoequinus infection. Mares immunized to Salmonella abortivoequinus by vaccination are not protected against virus-abortion infection.
Virus abortion: The characteristic features of virus abortion are:

a. Susceptible mares abort following natural exposure and experimental inoculation with raw and filtered material from aborted fetuses.
b. The disease usually occurs in epizootic form.
c. The mare expels the fetuses without showing indications of approaching abortion.
d. The fetal membranes are not usually retained.
e. The mares suffer no apparent physical reaction.
f. The genital tract returns to normal quite as promptly as it does following a normal parturition. Mares which have aborted may be bred the same season and will usually produce a normal foal the following year.
g. The gross pathology in aborted fetuses is rather uniform and consists of lesions not observed thus far in abortion due to other causes. The lesions observed on gross examination are small, multiple, grayish-white areas of degeneration in the liver; hemorrhages on the heart, spleen and lungs and congestion of the colic lymph glands. An excessive amount of fluid in the thoracic cavity may be found, and occasionally, serous fluid is present in the peritoneal cavity. A single fetus may exhibit all the above-mentioned changes, or only one or two may be observed.

All aborted fetuses are bacteriologically negative, except where streptococcic infection was already present and where Shigella equirulis had invaded the fetus previous to the entrance of the virus. In those sections of the country where the distance to a laboratory is too great to transport the fetus, the following procedure is recommended:

Collect a blood sample from the mare and have it tested by the agglutination method for Salmonella abortivoequinus infection. Hold an autopsy on the fetus in the field, remove several inch-square blocks of liver tissue, place in a one-half pint jar, fill the jar with 10% formaldehyde solution and ship to a laboratory where histopathological sections can be made. If it is a case of virus abortion, the blood test will be negative, the liver sections will show areas of degeneration. In the liver cells around the degenerated areas will be found intranuclear inclusion bodies. Histopathological sections of the liver show that the areas of degeneration observed on the surface extend throughout the liver substance. Areas of focal degeneration are less pronounced in other tissues and organs. Reliable evidence that this type of abortion in mares is of viral origin is the occurrence of intranuclear inclusion bodies thus far observed most strikingly in sections from the liver and lungs.

The typical inclusion bodies are intranuclear in position and acidophilic in staining properties. The basophilic chromatin is absent from the central portion of the nucleus but is collected at a number of points in the inner margin of the nuclear membrane, leaving a clear space between the inclusion body and the displaced nuclear membrane. In most cases the inclusion appeared as a homogeneously stained mass of material, while in a few instances the mass appeared to be made up of numerous fine particles. The intranuclear inclusion bodies show up quite well when sections are stained with hematoxylin and eosin. Inclusion bodies have been observed in the respiratory epithelium lining of the lungs and in a few instances they were observed in the epithelium of the intralobular bile ducts.

In attempting to work out methods to control equine virus abortion in mares,
convalescent serum from a mare that had recently aborted, and a hyperimmune serum were tried. The hyperimmune serum was from a mare that had aborted and then received several intravenous injections of thoracic fluid and liver extract from a fetus. The liver extract is centrifuged to take out the coarse particles. Favorable results from the use of these serums were apparent from field observations. More recently a liver tissue vaccine was prepared and used. The tissue vaccine has been used on mares in groups where the disease had already made its appearance and as a prophylaxis. The vaccine is administered intradermally; each mare receiving three injections five to seven days apart at not later than the fifth or sixth month of gestation.

The results have been most encouraging although it is too early to draw conclusions as to the real effectiveness of tissue vaccine for the prevention of equine virus abortion. Abortion in mares may result from a number of causes other than streptococci, Salmonella and virus abortion.

Ten percent of 850 cases studied and recorded in our official record were twin pregnancies, the great majority of which showed no infection. Quite a few aborted equine fetuses have a severe torsion of the umbilical cord; all structures of the cord being distended and edematous.

Some fetuses are underdeveloped, having the appearance of an emaciated animal, others well rounded with abdomen distended and all structures soft, moist and edematous. Finally there are included a few cases that were definitely accidental. All cases not showing evidence of bacterial nor virus infection are classified as bacteriologically negative and constitute 40% of the total.

Physiological upsets and nutritional deficiencies apparently account for a considerable number of the abortions recorded as bacteriologically negative.

Infections of the new born. The loss of foals from those dead at birth (full term) up to six months of age has long been a serious problem to the horse breeding industry. Owners, attendants, and even veterinarians have held a great variety of opinions as to the different causes and factors involved. Of all the different opinions advanced, especially by owners and attendants, the prevailing has been that of injury and post-natal infection.

The possibility of prenatal infection never has, until recently, received the attention that it deserved. Today perhaps, as never before, the different factors which may, in one way or another, play an important part are beginning to be understood. It is possible to give in a majority of cases, a definite answer as to the cause of death provided a thorough examination is made.

Of all the causes to be considered some are comparatively easy of recognition, while others are only found after a careful study and thorough application of special technique. In general the causes of death among young foals may be divided into two main groups. In one group is to be included all the different types of infection that may be found in foals, and in the second group are to be included all non-infectious cases such as nutrition, delayed delivery, dystocia, accidents, malformations, deformities, etc.

Streptococcic Infection. Twenty-five per cent of foals suffering with symptoms of so-called navel ill and joint ill have been found, upon examination, to be infected with streptococci. The age of the foal, location and distribution of infection in
the body, together with an accurate knowledge of the condition of the genital tract of the mare and health of the foal at birth, will usually enable one to determine with a high degree of accuracy the origin of the infection. The streptococcus isolated from foals has in most instances proved to be the same as that isolated from the genital tract of mares suffering with cervicitis and metritis. Foals suffering with navel ill, joint ill and septicemia from streptococcic infection most often represent cases in which the infection was acquired in utero. Postnatal cases of streptococcic infection may occasionally be met with. Keep in mind that streptococcic metritis is rather common in mares, that this infection may be introduced at the time of service and that over 50% of mares, following a normal parturition, will show streptococci in the uterine secretions at some time between the first and tenth day following parturition, that streptococci normally live on the mucous membrane of the vulvo-vaginal canal and external genitals of mares. They find in the normal secretion following parturition and particularly in a pathological exudate a medium favorable for growth, extension and development of increased virulence. Therefore the prevention of streptococcic infection in foals as a prenatal infection is dependent upon the condition of the mare when bred and the prevention of the introduction of infection into the uterus at the time of service.

Shigella equirulis. This type of infection in foals, in the United States, was unrecognized up to a few years ago. On the basis of a postmortem and bacteriological examination of 650 foals, ranging in age from birth to six months of age, it has been found that Shigella equirulis is present in 37%. In very young foals, Shigella equirulis produces extreme prostration, the foal being unable to stand or nurse; hence the name, "A Sleeper." A clinical differentiation of shigella infection from streptococcic infection in foals is not an easy matter. In a small percent of cases there are some rather striking differences in the clinical picture. However, since a definite clinical picture of these different types of infection is observed in something less than a majority of cases, it can be seen how often a foal might be treated for one infection while in fact an entirely different causative agent was present. On postmortem examination a diagnosis on the basis of lesions is more reliable than on clinical symptoms. In certain cases of Shigella infection, lesions in the kidneys, joint cavities and synovial bursae will be found that are sufficiently characteristic to warrant a diagnosis on the gross pathology. On the other hand, in a certain percent of cases, typical lesions are absent and a bacteriological examination will be necessary if the true nature of the infection is verified.

The predominating gross pathological changes are confined to the kidneys and joints. The cut surface of both the cortex and medulla is usually abnormally dark in color and shows congestion, hemorrhage and inflammation. Throughout the cortical portion and standing out in sharp contrast to the dark background, are small, multiple abscesses or areas of necrosis. These areas are of a grayish or very light brown color and vary in size and distribution in the same kidney but very considerably in different kidneys. There is a rather definite line of demarcation between the diseased area and the surrounding kidney tissue.

The distribution of the necrotic areas is consistently uniform with the glomerular structures of the kidney. All this seems to indicate that the condition is primarily a glomerulonephritis followed by suppuration and necrosis. Uniformity in size
and distribution of the diseased areas indicates an independent origin and simultaneous distribution of the infection to each of the diseased foci in each individual kidney. In only an occasional case will be found a kidney in which there is a noticeable difference in size and distribution of the areas of necrosis or in which is found a single large, irregular, diseased area.

The joints of the legs are quite as often infected as are the kidneys; however, there is a much wider range of pathological change which makes a postmortem interpretation more difficult. In many instances culture tubes inoculated from the joint cavity are positive to Shigella equirulis when the gross evidence of disease in the joint is practically nil. The articular cartilages usually are normal. The joint capsule shows congestion even in the mildest type of cases. Further, the majority of the joints of all four legs may show evidence of disease to a mild or marked degree, the other extreme being that one joint will show purulent arthritis, while the other joints of the legs appear normal and may be negative on culture. The heart, liver and spleen often show congestion, hemorrhage and degeneration but with little or no tendency to abscess formation and necrosis. In the more chronic cases of older foals, where septicemia and pyemia are evident on both clinical and postmortem examination, organs and structures other than the kidneys may show areas of suppuration and necrosis.

Shigella equirulis may be isolated from verminous aneurysms of the mesenteric arteries of foals that die from parasitism and other causes, and not be found in any other organ or tissue of the body. Apparently a normal habitat for this bacillus is the tonsilar crypts of horses. The microorganism was readily isolated from the tonsilar crypts of 11 out of 12 horses cultured at time of autopsy.

Other Infections. Occasionally S. abortivoequinus infection will be found in foals. In very young foals it produces a septicemia, in older foals there is a tendency to localization and abscess formation.

Corynebacterium equi. In foals from one to four months of age this bacillus may be found. There is no apparent connection between this infection and joint and navel ill in very young foals. The major gross lesion is pneumonia, characterized by abscess formation. Bacilli of the colon-aerogenes group and non hemolytic streptococci are sometimes isolated under conditions that practically eliminate postmortem invasion, thus indicating that they represent primary infections and may be prenatal in origin.

Many members of the U. S. Live Stock Sanitary Association are not engaged in practice; however, all are interested in animal hygiene. If a practitioner is to be successful in carrying out the details and technical procedures of a program on equine breeding hygiene, he will need first, to secure the confidence and cooperation of those immediately in charge of the brood mares and stallions. Every member of this association can do something to help owners and managers to understand the basic principles of breeding hygiene and the benefits that may be derived by observing every precautionary measure and employing, to look after the technical details, the best veterinarians available.
THE VETERINARIAN'S PLACE IN PUBLIC HEALTH WORK

By N. C. Dysart

This paper provides an opportunity for me to express my deep appreciation and gratitude for the indispensable work which the veterinary profession has performed in the promotion of health legislation and policies in the city of Columbus.

Since 1929, when the first veterinarian was appointed on the Board of Health, an excellent system of new regulations relating to food sanitation and inspection has been built up, until at the present time I believe it is second to none in the entire nation.

In the promulgation of these regulations the Board of Health has relied on the technical knowledge and sound judgment of the veterinary members of the Board. The policy of having a veterinary member is now firmly established and I feel sure that it will never be reversed.

Allow me to suggest that you gentlemen of the veterinary profession insist that the Board of Health in your city or county must have a veterinary member. I believe the veterinary profession has been too reserved in offering its services for the promotion and betterment of the public health.

The importance of veterinary medicine has grown to be so great in matters directly relating to the public health that in my opinion no Board of Health can be properly balanced unless its personnel includes a representative from the veterinary profession. A number of boards of health now have such members but they are all too few.

It may be that some education of the public will be necessary in your community in regard to the utility of the veterinarian in this field. In this regard I am sure that the medical profession will be glad to work with you.

In developing the subject of the veterinarian's place in public health work, I shall draw on our experience in Columbus to a great extent.

The work of the veterinarian in a modern city health department is manifold. In Columbus we are centrally located in the state and have a large number of small packing houses which do not ship meat interstate and therefore do not come under Federal inspection. We are compelled to spend most of the veterinarians' time and energies on inspection of meat and meat products. When I say we are "compelled" to do this, I mean that we should prefer to allot more of the veterinarians' time to the inspection of dairies, restaurants, milk plants, wholesale and particularly retail food establishments of all types. However, we must live within our extremely limited budget.

I might say parenthetically that each year regularly we request city council to appropriate funds for more veterinarians for inspection work and are just as regularly turned down because of shortage of funds.

Several years ago the Board of Health initiated the policy of employing only veterinary graduates in the division of food inspection. The reason for this policy is that the inspector can be employed in all the many and diverse activities which are carried on in that division, whereas the lay inspector could be used only in very limited capacities and then only after a long period of apprenticeship and training.
There is no question that many health department activities must be carried on by members of the veterinary profession if these activities are to be of such value as the public has the right to expect. What layman could possibly have the requisite understanding of problems we meet daily in connection with rabies control? What layman has the fundamental training essential to cope with the problems involved in the prevention of undulant fever and anthrax? Who but a veterinarian would be qualified to diagnose bovine mastitis?

Public health has as its purpose the reduction of morbidity and mortality and the promotion of comfort and well-being.

Let us inquire into the good offices of the veterinary profession in relation to these matters. It has been said by a number of excellent authorities that the infant death-rate of a locality is perhaps the best index of its healthfulness. This assertion may be true because the infant is peculiarly susceptible to its environment.

The infant death-rate—that is, the number of deaths of children under one year of age per thousand live births—in Columbus has consistently and steadily declined, with minor fluctuations, from 120.9 in 1910 to 35.6 in 1940. The death rate of children under two years of age dying of diarrhea and enteritis declined during the same period from 53.5 per hundred thousand population to 5.2.

This tremendous decrease in the mortality of infants and the death-rate for diarrhea and enteritis under age two has coincided with and been in proportion to the increase in effectiveness of public health control and supervision of milk sanitation.

There is no doubt in my mind that this marvelous saving of young lives has in very large measure been made possible by the progress in research made by the veterinary profession, and the application of these advances by you who are in practice and by the veterinarians engaged in public health work.

The well-informed public health administrator who would seek to reduce his infant mortality rate must first of all improve the sanitary quality of his milk supply. This implies continuous and efficient inspection or supervision from the farm to the consumer's doorstep by men trained in the veterinary profession.

Tuberculin testing and the eradication of tuberculosis of cattle and the pasteurization of milk together have practically eliminated the glandular tuberculosis of children which was such a common sight within the memories of most of us. The reduction of morbidity and mortality from tuberculosis of the bones, joints and peritoneum has also been marked.

The veterinarian is the individual to whom the public looks for protection against diseases which are transmissible from animal to man.

In the Columbus Department of Health we employ a considerable number of veterinarians. The chief food inspector is of course a veterinarian and has charge of the division of food inspection. Five veterinarians are assigned as inspectors of meat and meat products in the abattoirs of the city; one inspects dairies, one is milk analyst and specialist on food poisoning cases and two are inspectors of restaurants and other food handling establishments.

The term "food inspection," as we ordinarily use it in the department, includes not only food inspection per se but also sanitation of food handling establishments,
cleanliness of utensils, inspection of personnel and in fact any and all factors which might militate against a clean and wholesome service of food.

In speaking of the place of the veterinarian in public health we may properly mention the opportunity offered him in research work in relation to the dissemination of diseases to man by both domesticated and wild animals. Cannot someone discover a practicable and simple method of demonstrating trichinosis at the abattoir? The problems are many which suggest themselves as waiting for the research veterinarian to solve. The surface of the field of research endeavor has scarcely been scratched.

The close relationship that exists between veterinary and human medicine is manifest when one considers the list of animal diseases to which man is susceptible, and this list is rapidly growing as our progress in research develops.

Among the virus infections alone which may be transmitted from animal to man are rabies, equine encephalomyelitis, lymphocytic chorio meningitis, cowpox, foot and mouth disease and psittacosis. We know that these may be communicated to man by various modes of transmission, as by direct contact, by inhalation of infective particles and by insect vectors.

However, a vast number of problems still await solution in relation to the virus diseases which are acquired by man from animals. What, for instance, do we know about the life history of the rabies virus? How efficient is rabies vaccination? Is it true that equine encephalomyelitis is transmitted by mosquitoes? How can we develop a practical and effective means of control of psittacosis?

Seasonal and geographic incidence have suggested that mosquitoes may be responsible for equine encephalomyelitis, and under experimental conditions they seem to have been incriminated but no infected mosquitoes have ever been caught in districts where the disease is endemic. Demonstration of a latent stage of the virus in an animal reservoir would certainly be an important contribution to our knowledge of the disease.

As to psittacosis, perhaps the use of the complement fixation test as adapted by Meyer and Eddie may be the solution by aiding in the diagnosis of infected birds.

The veterinarian engaged in public health work should have a practical mind in addition to his technical training. At times he should even be able to assume the gumshoe technique of a detective—in fact one of our inspectors who happens, however, to be a layman of long experience, has well earned his nickname of Sherlock.

Safeguarding of community health is dependent in great degree on expert inspection of the food supply in general and of meat and milk and their many products in particular, since these latter constitute probably the most important articles of diet and are so easily contaminated and made unfit and even dangerous for human consumption.

A substantial increase in the consumption of clean and safe milk is one of the most important factors in the promotion of group health.

In Columbus, the direct bacterial count of milk—by the Breed method—is routine procedure. Samples from each producer are collected in sterile tubes as the milk arrives at the pasteurizing or distributing plant. The count and types of bacteria are noted and when indicated the producer is notified as to the result and the proper action to be taken by him to correct the condition. If streptococci are
found, the producer is required to employ a veterinarian to examine each cow for mastitis by the bromthymol method and by a physical examination. Any cow found to be afflicted with mastitis is excluded from the dairy herd.

In these days of rapidly growing urban populations, the problem of milk supply resolves itself into how to obtain the safest product for the greatest number.

Few consumers appreciate the elaborate and careful system of inspection which is represented in the bottle of milk delivered at their door each morning. Being one of the most easily contaminated articles of food, it also may absorb disagreeable odors and act as a culture medium for pathogenic bacteria.

Only clean milk produced under sanitary conditions should be used for human consumption. Park and others have shown that milk of high bacterial content, even when pasteurized, is not a wholesome food for infant feeding.

Without proper inspection and supervision, milk may contain the organisms of tuberculosis, undulant fever, septic sore throat and numerous other serious transmissible diseases. But, under health department supervision, the householder has no fear whatsoever in making it the exclusive diet of his baby, than whom nothing is more precious and important in the whole wide world.

Incontrovertible evidence of the value of expert inspection and supervision of milk supplies is presented by the fact that milk-borne diseases in the large cities are almost unknown while the few epidemics reported are confined chiefly to rural areas and small towns.

In closing, I should like to give you a general idea of the volume of work done by the eight veterinarians and six lay inspectors in a city of 300,000 population.

During the year 1940 the division made, in round numbers, 3400 inspections of dairies and 39,000 inspections of dairy cows. Sixteen thousand five hundred wholesale and 2,550 retail milk samples were collected and examined. Four thousand inspections were made of retail food establishments. Ante-mortem inspections were made of 57,000 cattle, 223,600 hogs, 23,000 sheep, and 14,500 calves and approximately the same number of post-mortems on each of the above classes was done. Over 3000 calls were made to investigate dogs which had bitten over 1000 people, and 24 dogs were found to have rabies.
The greatest Livestock Sanitary Program of all time—The U. S. Bovine Tuberculosis Eradication Campaign—has now progressed to that gratifying stage where the disease no longer constitutes a major problem in livestock sanitation.

Likewise, the nation-wide program for Bang’s Disease control, with the Federal Bureau of Animal Industry and the various state sanitary authorities cooperating is well beyond the initial stage of its evolution. Judicious application of efficient measures and sound policies similar to those practiced in the Tuberculosis Movement renders the ultimate solution of Bang’s Disease as unquestionable as that of Tuberculosis.

We, as Veterinarians, guardians of the health and welfare of the nation’s livestock, may and should look upon these already accomplishments and commendatory progress with a deep sense of pride. However, we are presently confronted with a deeper sense of responsibility to our profession; again with the bovine species; in this instance the milk cow. We refer to Bovine Mastitis, with its dual implication of both Public Health and Livestock Sanitation.

The real importance of this ever-growing problem is recognized and acknowledged by both dairymen and veterinarians. Nevertheless, there is no systematic, concerted cooperative action being taken for its solution, such as is in vogue in Tuberculosis. This, however, is quite understandable, due to the fact that we do not have available adequate diagnostic services for a definite diagnosis of infectious mastitis. True, there are a multiplicity of tests at hand for this disease, but practically all tests taken individually or in combinations, except a bacteriological examination of milk samples fall short of a reliable and dependable diagnosis.

All other tests, thymol blue, strip cup, physical examination et cetera, fail to detect the dangerous occult subclinical case of mastitis. By the term subclinical we refer to the cow that harbors mastitic streptococci or other pathogens in one or more quarters of the udder, without any gross manifestation of the disease, either as regards the physical condition of udder or the physical or chemical conditions of the milk. Such animals are definite carriers of the infection and potential spreaders of the infective agents of mastitis.

It is these very subclinical cases, unknown and undetected by the ordinary means of diagnosis that are today causing havoc with apparent relapses or reinfections in many herds where the supervising veterinarian thought he had the disease suppressed or eradicated. The incidence of mastitis in a herd can be materially and transitorily reduced by ordinary diagnostic tests in most herds, but it is impossible to entirely eradicate the disease unless the hidden, dormant subclinical cases are ferreted out by bacteriological means and considered and treated accordingly.
Therefore, in view of these facts and existing conditions your Committee is here-with recommending that just as soon as it is financially possible, that adequate facilities be provided by the various state sanitary authorities so that this all-im-portant diagnostic service can be rendered to all the veterinarians engaged in dairy practice in their respective states. It is then and only then that the mastitis prob-lem can be approached in an intelligent, efficient and satisfactory manner.
FACTORS AFFECTING THE VIABILITY OF STRAIN 19 BRUCELLA VACCINE

BY E. LELAND LOVE, Assistant Veterinarian, AND C. K. MINGLE, Associate Veterinarian

Steadily increasing distribution of Brucella abortus vaccine by numerous commercial laboratories during the past few years has emphasized the need for adequate control to insure maximum potency for the product throughout the expiration period.

Two very important factors influencing the quality of living bacterial vaccines are generally recognized; namely, viability and antigenic quality of the culture employed. However, very few experimental data relative to the modifying effect of varying conditions encountered in production methods are available. Obviously until such determinations have been made, control procedures must necessarily suffer from the standpoint of effectiveness.

Alterations in the antigenic quality observed in connection with dissociative changes have been definitely established for Brucella abortus strain 19 and may occur to such an extent as to affect materially the immunological value of the strain. This value may be modified further in a product of otherwise acceptable density by a reduction in the number of viable cells. The correlation between viability and immunological response is sufficiently close to justify every effort to hold this loss to a minimum within the expiration period.

THE EFFECT OF HYDROGEN-ION CONCENTRATION ON THE VIABILITY OF BRUCELLA ABORTUS SUSPENSIONS

Experimental

In view of the restricted pH range suitable for optimum growth of Brucella abortus under artificial cultivation methods it was considered advisable to study the effect of various hydrogen-ion concentrations on the viability of Brucella suspensions. The studies were conducted at the Bureau’s Animal Disease Station, Beltsville, Md.

Twelve separate quantities of vaccine were prepared with Brucella abortus strain 19 in the usual manner except for the fact that these twelve covered a buffered1 pH range extending from 3.8 to 8.0 inclusive. Variations between consecutive lots were in all cases held to a maximum of one-half point on the scale as determined electrometrically.

Comparable cell concentrations approximating 0.5 per cent were established for each suspension by means of the Hopkins2 vaccine tube. All samples bottled in 30 cc. white hard glass vials were held at ±4°C. during the nine-month period of the experiment. Adequate material permitted the use of previously unopened containers for each examination.

1Animal Disease Station, Bureau of Animal Industry, U. S. Department of Agriculture.
Routine viability counts were made at approximately thirty day intervals covering a period of nine months following production.

Established methods were employed in securing final dilutions of $10 \times 10^{-6}$ in sterile physiological saline. Vaccine samples were vigorously shaken for five minutes in a mechanical shaker prior to preparation of the original dilutions. These as well as subsequent dilutions, contained in 150 cc. Pyrex bottles, were shaken in a similar manner. Measured amounts from each bottle were uniformly spread over the surface of serum-potato agar plates. These plates were in all cases incubated at least 48 hours before inoculation in order to insure sterility as well as to reduce the excess surface moisture. The incubated plates were inverted and held at 37°C for 96 hours at which time counts were made under a wide field binocular microscope. These results, calculated on the basis of dilutions employed, are represented in terms of viable Brucella cells per cubic centimeter.

This procedure has been repeatedly checked with direct microscopic counts as well as Hopkins tube and photronreflectometer determinations and has been found exceptionally accurate.

Relative densities were calculated on the basis of total cell concentration determined by the Hopkins tube in conjunction with the photronreflectometer. Corresponding pH values for all samples were established electrometrically at the same time viability determinations were made.

Results

Table 1 summarizes the results of viability determinations in the various pH ranges extending over a period of nine months. The extremely low original counts obtained in the case of the two vaccines buffered to 3.8 and 4.4 respectively are quite remarkable in view of the fact that all samples were only three days old when first examined. The remaining ten suspensions covering a pH range of 5.0 to 8.0 gave satisfactory counts corresponding very closely to the predetermined cell concentration. At three months, a definite trend is apparent in the appreciable loss exhibited in all cases. These losses are accentuated in the extreme upper and lower ranges while they appear to be less pronounced in the medium 6.3 and 6.8 groups. Within the following three months, covering a six months' period from the production date, the decrease in viability continues to be very marked. At this time it has progressed to the point that only two samples exhibit a viability greater than $10 \times 10^9$ per cubic centimeter. The antagonistic action of high alkalinity is apparent in the failure to demonstrate viability in $10 \times 10^{-6}$ dilutions after 6 months in those samples having original pH values of 7.8 and 8.0.

At the end of nine months the viability of all except three of the original twelve samples had dropped to a point where it was undetectable in the dilutions employed.

The similarity of the pH range covered by these three samples, 6.3 to 7.2, and that recognized as optimum for artificial propagation of Brucella is interesting to note. While tolerable limits of 5.9 to 6.8 previously suggested by the Bureau are confirmed, a preferred reaction of 6.3 appears justified on the basis of these studies. In general the diminution in viable cells appears to be most rapid in the case of the highly alkaline and acid concentrations during the first three months while in...
the middle range, between 6.3 and 7.2, the most pronounced drop occurs between the third and sixth months. Furthermore, it is significant to note that within the usual six months' expiration period detectable viability had dropped below 10^9 per cc. in all except two samples, these having respective pH values of 6.3 and 6.8.

The phosphate buffers employed throughout the experiment remained quite stable within the 3.8 to 7.2 range where a maximum variation of 0.2 was observed after nine months. However, somewhat greater changes took place in the higher alkaline range where an average drop of 0.4 of a point was observed during the same period.

Table 1.—The influence of hydrogen-ion concentration on the viability of Brucella abortus vaccine

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>BUFFERED pH</th>
<th>CELLS</th>
<th>VIABILITY AT INDICATED INTERVALS FOLLOWING PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Viable Brucella per cc.</td>
</tr>
<tr>
<td>1</td>
<td>3.8</td>
<td>.58</td>
<td>.48 × 10^9</td>
</tr>
<tr>
<td>2</td>
<td>4.4</td>
<td>.58</td>
<td>1.20 × 10^9</td>
</tr>
<tr>
<td>3</td>
<td>5.0</td>
<td>.45</td>
<td>13.35 × 10^9</td>
</tr>
<tr>
<td>4</td>
<td>5.6</td>
<td>.58</td>
<td>13.27 × 10^9</td>
</tr>
<tr>
<td>5</td>
<td>5.9</td>
<td>.68</td>
<td>14.27 × 10^9</td>
</tr>
<tr>
<td>6</td>
<td>6.3</td>
<td>.58</td>
<td>14.57 × 10^9</td>
</tr>
<tr>
<td>7</td>
<td>6.8</td>
<td>.58</td>
<td>14.35 × 10^9</td>
</tr>
<tr>
<td>8</td>
<td>7.2</td>
<td>.58</td>
<td>12.71 × 10^9</td>
</tr>
<tr>
<td>9</td>
<td>7.5</td>
<td>.45</td>
<td>11.90 × 10^9</td>
</tr>
<tr>
<td>10</td>
<td>7.6</td>
<td>.67</td>
<td>14.62 × 10^9</td>
</tr>
<tr>
<td>11</td>
<td>7.8</td>
<td>.45</td>
<td>9.13 × 10^9</td>
</tr>
<tr>
<td>12</td>
<td>8.0</td>
<td>.49</td>
<td>10.71 × 10^9</td>
</tr>
</tbody>
</table>

0 = no viability in 10^-6 dilution. All samples held at ±4°C.

The effect of primary cell concentration on the viability of Brucella abortus vaccine

Experimental

With the establishment of an optimum pH for the preservation of viability in Brucella abortus suspensions having a uniform density approximating 12 × 10^9 cells per cubic centimeter, it was considered advisable to determine the effect of variations in density on viability where hydrogen-ion concentration was maintained as a constant factor.

A series of twelve suspensions of varying densities were prepared with Brucella abortus strain 19 in physiological saline uniformly buffered to a pH of 6.3. The cell concentrations employed were graduated in 0.09 per cent steps and covered a range extending from 0.18 to 1.08 per cent. These values were established and checked by means of the Hopkins vaccine tube and photorreflectometer to insure accuracy of original calculations. All experimental vaccine was bottled in 30 cc. clear hard
glass vials and was held at refrigeration temperatures of ±4°C. throughout the experiment. Provisions were made for conducting each set of determinations on individual samples taken from respective groups at regular intervals. By this procedure it was possible to maintain uniform conditions for all material examined throughout the holding period.

The procedure followed in making viability counts was identical with that described in the first part of these studies and will not be repeated.

Results

Table 2 summarizes the results of viability determinations over the nine months' period of observation. Although tests were made at monthly intervals, the results were such as to permit a condensed tabulation of data covering three month periods.

Table 2.—The effect of primary cell concentration on the viability of Brucella abortus vaccine

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>CELLS per cent</th>
<th>VIABILITY AT INDICATED INTERVALS FOLLOWING PRODUCTION</th>
<th>Viable Brucella per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 months</td>
<td>3 months</td>
</tr>
<tr>
<td>1</td>
<td>.18</td>
<td>4.53 × 10⁹</td>
<td>2.73 × 10⁹</td>
</tr>
<tr>
<td>2</td>
<td>.27</td>
<td>7.76 × 10⁹</td>
<td>3.57 × 10⁹</td>
</tr>
<tr>
<td>3</td>
<td>.36</td>
<td>9.10 × 10⁹</td>
<td>4.09 × 10⁹</td>
</tr>
<tr>
<td>4</td>
<td>.45</td>
<td>9.64 × 10⁹</td>
<td>6.65 × 10⁹</td>
</tr>
<tr>
<td>5</td>
<td>.54</td>
<td>12.26 × 10⁹</td>
<td>10.84 × 10⁹</td>
</tr>
<tr>
<td>6</td>
<td>.54</td>
<td>12.50 × 10⁹</td>
<td>10.44 × 10⁹</td>
</tr>
<tr>
<td>7</td>
<td>.63</td>
<td>14.27 × 10⁹</td>
<td>11.48 × 10⁹</td>
</tr>
<tr>
<td>8</td>
<td>.72</td>
<td>16.00 × 10⁹</td>
<td>12.50 × 10⁹</td>
</tr>
<tr>
<td>9</td>
<td>.81</td>
<td>19.96 × 10⁹</td>
<td>13.90 × 10⁹</td>
</tr>
<tr>
<td>10</td>
<td>.90</td>
<td>20.70 × 10⁹</td>
<td>15.88 × 10⁹</td>
</tr>
<tr>
<td>11</td>
<td>.99</td>
<td>22.48 × 10⁹</td>
<td>17.06 × 10⁹</td>
</tr>
<tr>
<td>12</td>
<td>1.08</td>
<td>27.05 × 10⁹</td>
<td>18.44 × 10⁹</td>
</tr>
</tbody>
</table>

Note: All suspensions buffered to a uniform pH of 6.3. All samples held at ±4°C.

With the exception of sample 12, having a predetermined cell concentration of 1.08 per cent, and a somewhat higher viable count approximating 1.21 per cent, viability determinations made at the time of preparation were well within the anticipated range. The most striking point reflecting the influence of cell concentration on the duration of viability is the consistently high counts obtained throughout the entire period in the case of samples 7, 8, and 9. The percentage cell concentration represented by these three samples; 0.63, 0.72, and 0.81 respectively, are somewhat higher than has heretofore been considered the optimum. However, the exceptionally stable viability associated with these concentrations is quite striking when compared with those of either higher or lower densities. The similarity of proportional reductions in viability observed in the first six and the last three samples was quite unexpected.

The modifying effect of cell concentrations on viability is exemplified in a com-
parison of the six month average percentage loss of 37.48 per cent in the three optimal range samples with the 55.68 per cent average for the other nine samples at the same time.

THE INFLUENCE OF EXCIPIENTS ON THE VIABILITY OF BRUCELLA ABORTUS VACCINE

Experimental

The recognized protective action of various substances on bacterial cells was considered of sufficient importance to warrant experimental study relative to the effect of such materials upon the viability of Brucella abortus vaccine.

The materials selected for study were bovine serum, glycerine, and dextrose. These excipients were employed in amounts of 5 and 10 per cent serum, 5 per cent glycerine, and 2 per cent dextrose. All dilutions were prepared in physiological saline. Two identical sets of vaccines, having comparable densities and hydrogen-ion concentrations, were prepared in the usual manner with Brucella abortus strain 19. Adequate controls for each group were available in the form of vaccine prepared in buffered 0.85 per cent saline and were subjected to parallel tests under uniform conditions.

Variations in original density and pH values were held to a minimum which did not exceed 0.14 per cent for cell concentrations and one-half point in hydrogen-ion concentrations. One duplicate set was maintained under refrigeration temperatures of ±4°C., while the other was held at room temperatures ranging from 20° to 30°C. Viability counts made at thirty day intervals over the nine month period of observation were carried out in the same manner as described for the two previous experiments.

Electrometric pH and density determinations were carried out at regular intervals as a check on the stability of these factors under conditions of the experiment.

Results

Compiled results of viability counts made at three, six and nine month intervals are indicated in table 3. The relative values obtained in parallel determinations made on the two sets held under respective temperature ranges are somewhat comparable when considered on this basis. The markedly lower actual counts uniformly observed in the case of room temperature samples appear to be largely an acceleration of similar trends prevailing under refrigeration. It is interesting to note the relatively high viability maintained by the control saline suspension held under refrigeration throughout the nine month observation period in contrast to a 99 per cent loss in viability observed at three months in a similar suspension held at room temperature.

Of the three excipients tested, bovine serum alone seems to support viability comparable with buffered physiological saline. It should be pointed out that the normal buffering action of the serum was sufficiently strong to raise the phosphate buffered 6.3 reaction 0.4 of a point in the 5 per cent serum suspension and 0.5 of a point in the case of 10 per cent concentrations. This change occurred promptly and was maintained at a uniform level throughout the experiment.

Consistently low counts characterized those samples containing 5 per cent
glycerine. The average drop of 40.05 per cent in two samples held at refrigeration temperatures was accentuated in the room temperature samples where negative counts were obtained in 10^-6 dilutions at three months. As a matter of fact the most pronounced viability loss in the glycerine suspensions held at room temperature took place during the first 30 days, at which time average viability counts of 0.04 \times 10^6 per cubic centimeter were obtained.

The rapidity with which 2 per cent dextrose reduced the viable cell count in both temperature ranges was quite unexpected in view of the accepted practice of incorporating small amounts of this sugar in Brucella media. Moreover, the exceedingly rapid sterilization observed at high temperature suggests the possible association of this material with the development of substances which may be toxic for Brucella abortus under certain conditions.

The modifying effect of temperature is again quite apparent in the 0.87 \times 10^9 count obtained at nine months in the refrigerated samples as compared to no viability in the 10^-6 dilution within three months on identical suspensions held at room temperatures.

With the possible exception of bovine serum, all of the excipients tested failed to maintain viability comparable with buffered 0.85 per cent saline. Furthermore, definite contraindications to the use of both glycerine and dextrose are apparent in the rapid viability loss observed in the room temperature samples. In general

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>EXCIPIENT</th>
<th>BUFFERED pH</th>
<th>VIABILITY AT INDICATED INTERVALS FOLLOWING PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>per cent</td>
<td>0 months</td>
</tr>
<tr>
<td>1</td>
<td>None</td>
<td>6.3</td>
<td>14.03 \times 10^9</td>
</tr>
<tr>
<td>2</td>
<td>5% serum</td>
<td>6.7</td>
<td>12.43 \times 10^9</td>
</tr>
<tr>
<td>3</td>
<td>10% serum</td>
<td>6.9</td>
<td>14.62 \times 10^9</td>
</tr>
<tr>
<td>4</td>
<td>5% glycerine</td>
<td>6.3</td>
<td>14.73 \times 10^9</td>
</tr>
<tr>
<td>5</td>
<td>5% glycerine</td>
<td>6.3</td>
<td>15.30 \times 10^9</td>
</tr>
<tr>
<td>6</td>
<td>2% dextrose</td>
<td>6.2</td>
<td>9.70 \times 10^9</td>
</tr>
</tbody>
</table>

0 = no viability in 10^-6 dilution.
the results confirm the recommended use of buffered 0.85 per cent saline as a sus-
pending medium for Brucella abortus vaccine and emphasizes the necessity of keep-
ing the product under refrigeration at all times.

**DISCUSSION**

From the data presented in the foregoing studies it is apparent that several
factors are of considerable importance in the maintenance of viability in Brucella abortus vaccine.

Prominent in this group is the hydrogen-ion concentration of the suspending
medium. The suspected modifying effect of this factor is substantiated by the
high degree of correlation between variations in pH and actual viability counts
observed at given periods. Within the 3.8 to 8.0 range covered, definite acceler-
ation of the death rate was apparent in the lower acid and higher alkaline concentra-
tions, this becoming progressively accentuated below 6.9 and above 6.8. On the
other hand pH values of 6.3 and 6.8 maintained a relatively high viability through-
out the nine month holding period. The maximum count at this time was \(2.63 \times 10^9\) and was obtained in the 6.3 suspension.

It should be pointed out that several buffers were tested before one of satis-
factory stability was found. The commonly employed Sørensens\(^6\) M/15 phosphate
mixtures have been repeatedly tested and found unsuitable for maintaining a
satisfactory reaction in Brucella vaccines.

The results of studies in connection with primary cell concentrations demonstrate
the modifying effect of this factor on viability. Although the increased death rate
observed in the higher densities was somewhat predictable on the basis of a pro-
portional concentration of toxic cellular elements, comparable changes occurring
in the lower densities were not anticipated. The optimum cell concentration from
the standpoint of uniform viability loss appears to have rather definite limits cover-
ing a range between 0.63 and 0.81 per cent. In the case of Brucella abortus sus-
pensions this would approximate a nephelometer reading of 14 to 18\(\times\) which is
somewhat higher than has been recommended for vaccine.

However, there is every indication that a slight increase over the primary den-
sities now employed, together with rigid pH control, would insure a more favorable
viability level over the six months' expiration period.

The relative values established in these studies for bovine serum glycerine and
dextrose as excipients for Brucella vaccine are not sufficiently great in any case to
justify substitution for the buffered 0.85 per cent saline currently employed. The
similarity of viability counts throughout the experiment in the case of 10 per cent
serum and the control saline suspension is interesting to note when contrasted with
the rapid loss in viability observed in connection with 5 per cent glycerine and 2
per cent dextrose.

The importance of temperature in the maintenance of viability in Brucella abortus vaccine cannot be overemphasized and is remarkably well demonstrated
in the wide variations of viability counts obtained in similar suspensions held at
different temperatures. These variations appear to be a reflection of an accentuated rate of destruction which in the case of refrigeration temperatures is held to a
The necessity for keeping strain 19 vaccine under refrigeration at all times is strikingly shown, especially if the vaccine is not used until several months after preparation.

**SUMMARY**

1. The modifying effect of pH, cell concentration, excipients, and temperature on viability of *Brucella abortus* strain 19 vaccine have been studied.

2. Recommended hydrogen-ion concentrations of 5.9 to 6.8 are confirmed as tolerable limits for the maintenance of maximum viability in *Brucella abortus* suspensions. A preferred reaction, buffered at 6.3, is justified by the results of viability determinations conducted over a period of nine months.

3. Primary cell concentrations also appear to exert a slightly modifying action on the duration of viability. Within an optimum density range of 0.63 per cent (14 X) to 0.81 per cent (18 X) viability loss was reduced to a minimum under the experimental conditions employed.

4. Bovine serum, glycerine, and dextrose in amounts of 5 and 10 per cent serum, 5 per cent glycerine, and 2 per cent dextrose were found to have no advantage as excipients in *Brucella abortus* vaccine in comparison with buffered 0.85 per cent saline. With the exception of 10 per cent serum the viability level of the control saline suspensions remained appreciably higher throughout the nine month holding period.

5. Further evidence in support of recommendations covering the refrigeration of *Brucella* vaccine at all times is observed in the contrasting viability counts obtained on identical suspensions held at ±4°C. and 20°C–30°C.

**REFERENCES**


5. Preparation of *Brucella abortus* vaccine. United States Department of Agriculture, Bureau of Animal Industry, Animal Disease Station, Beltsville, Md., April, 1941.

BANG'S VACCINATION—A PUBLIC HEALTH PROBLEM

BY MELVIN M. RABSTEIN, V.M.D.¹

The possibility that strain 19 may become established in the udder following vaccination, with subsequent elimination of the organism in the milk, is an important phase of the Bang's vaccination problem to which too little attention has been given. It is considered an important public health problem by many medical men, who in many instances, as members of local boards of health, have control of the sanitary measures for the production of milk in their localities.

At the 1937 meeting of the United States Livestock Sanitary Association, Dr. Gaylord Anderson, Professor of Preventive Medicine and Public Health at the University of Minnesota, spoke of the public health aspect of the use of Bang vaccines as follows:

"I should be prepared to accept the doctrine that the currently available Brucella vaccines are capable of conferring a certain degree of protection upon those animals to which they are administered. I cannot, however, accept the doctrine that their use has been proven devoid of a potential risk of so infecting the cow that the use of the milk is at the same time hazardous. We are attempting to protect the cow through the administration of an organism attenuated for the cow but we have no reason to believe that the organism is at the same time attenuated for man. We know that with some of the vaccines living organisms have been demonstrated in the milk. Furthermore, there is evidence, both from the laboratory and the field, to show that these organisms are still pathogenic for humans, though I do not believe we know anything, as yet, as to their relative pathogenicity as compared with non-attenuated organisms.

"Granted that the present vaccines are effective in either preventing or reducing the incidence of abortions, we then have a method of great value to the livestock industry. Until we can say, however, that the use of this vaccine is devoid of possible risk to the milk consuming public, or that the use of milk from vaccinated herds is less hazardous than the milk from naturally infected animals, we must, out of justice to the public, insist on the pasteurization of milk from these vaccinated herds."

Many of the objections to vaccination raised by Doctor Anderson have by now been eliminated. Vaccines on the market at present do not, as they once did, contain virulent organisms of the abortus, suis or melitensis types, but are required to contain *Brucella abortus* of low virulence. All vaccines are now prepared from strain 19, a culture of reduced virulence the character of which has shown no tendency to change even after repeated passage through pregnant cows (1). Moreover, by limiting vaccination to calves, having no active mammary tissue in which the organisms may become established, the possibility of *Brucella abortus* being eliminated in the milk of these animals following calving is further minimized.

A review of the literature will reveal that little work regarding the isolation of

¹ Federal Cooperative Agent, Maryland Live Stock Sanitary Service Laboratory, College Park, Maryland.
Brucella from animals vaccinated as calves with strain 19 has been reported. Data has been slowly accumulating, but more large scale projects are needed.

Haring (2) in 1938 tested the milk from 83 animals in one herd which had been vaccinated with strain 19 and found Br. abortus in two. The organisms recovered did not resemble strain 19, and it was considered that in both animals the immunity obtained was not sufficient to prevent infection following exposure. L. J. Tompkins (3) reported on a series of milk samples from 71 animals vaccinated as calves which were tested by the guinea pig method for Brucella abortus. One was found to be shedding, but the organisms recovered did not resemble strain 19.

The work presented here is a continuation of a project begun in 1938 and is supplemental to the work reported at the 1940 meeting of the A.V.M.A. in Washington, D. C. (4). The material for this work was obtained from those herds in which we were carrying on a calfhood vaccination program.

Our method of procedure was to draw quarter samples as aseptically as possible during the afternoon milking. The samples were then placed in the refrigerator overnight to allow the cream layer to rise. The following day about 0.1 cc. of cream from each sample was plated on bacto-tryptose agar and incubated under a ten per cent CO₂ tension for five to seven days. The cream from both right quarter samples was combined and 5 cc. each inoculated into two guinea pigs. The same procedure was followed with the cream from the two quarters on the left side, making a total of four guinea pigs used for each cow from which samples were drawn. These guinea pigs were usually blood tested after two weeks and autopsied after 28 days at which time all of the organs were cultured. An agglutination test was also run on the milk whey from each sample in dilutions of 1:12, 1:25, 1:50, 1:100 and 1:200.

Tests on 668 quarter samples of milk from 167 cows have now been completed. These samples have been divided into three groups according to the type of animal from which they were drawn.

In the first group there were 44 animals, 22 of which were showing a positive blood titer and 22 a suspicious blood titer at the time milk samples were drawn. No Brucella organisms were recovered from the 22 suspicious animals, but of the 22 positive animals Brucella organisms were isolated from the milk of six. In none of these cases did the isolated organisms resemble strain 19 either in their cultural characteristics or action on guinea pigs. A detailed history of these animals may be found in a previous paper (4).

The positive animals included in this group had either failed to lose their post vaccination titers or had become negative for a period of time and later returned to a positive status. Of our six positive samples, five belonged to the latter group; that is, they had lost their post vaccination titers but had later become positive. These were considered as cases of infection following natural exposure in infected herds to a virulent type of Brucella and were consequently dangerous animals. The remaining 16 animals had never lost their post vaccination titers and no Brucella organisms were recovered from the milk of any of these.

The second group consisted of 36 animals vaccinated as adults in infected herds. They were all negative at the time of vaccination, but carried a positive post vaccination titer at the time milk samples were drawn. The samples were taken in
three lots: at two, four and six weeks following vaccination. It has been suggested that the possibility of strain 19 infecting the udders of cows vaccinated during lactation was much greater than when the vaccine was used on calves with undeveloped mammary glands. However, we were unable to recover Brucella from any of the 144 quarter milk samples drawn from these animals.

In the last group there were 348 quarter milk samples drawn from 87 negative first calf heifers that had been vaccinated as calves. The milk was taken as soon after calving as possible, usually during the first two months following parturition. No Brucella was isolated from any of these.

From the work here reported it would appear that when animals are vaccinated with strain 19 the organism does not become established in the udder and subsequently eliminated in the milk.

REFERENCES


UNDULANT FEVER

By Dr. H. M. Guilford

Less than twenty years ago physicians looked upon undulant fever as a disease which rarely occurred in North America. Under the term Malta Fever it had been investigated by a British Commission and found to be caused by contact with goats and the use of goat's milk. No one therefore was believed to have undulant fever unless there were goats in the background.

In the year 1918 a bacteriologist discovered that the germ causing Bang's disease in cattle and the germ causing Malta Fever were identical. Subsequently to this it was announced that this species of germ invaded various animals especially those of herbivorous nature and that there were three subspecies of the germ; namely, a goat, a porcine, and a cattle variety, differing somewhat in laboratory characteristics. With these facts before them, physicians began to look for undulant fever from other sources than goats, and such cases were eventually found. But it was not until about 1928 that they were sufficiently numerous to be stressed in medical literature. The reason why these cases were not discovered before was because there is no disease of man with more variable symptoms. The cases were undoubtedly called typhoid, malaria, rheumatism, sepsis, nervous prostration and other troubles. The second reason was because confirmatory blood tests on the part of laboratories were not generally available to the medical profession.

The Wisconsin State Board of Health was informed of eight human cases in the year 1928, and in 1929 undulant fever was made a reportable disease to the State Health Department, and the State Laboratories of Hygiene began to make routine blood tests for that disease on all samples of blood sent in by physicians for diagnostic purposes with the exception of syphilitic blood samples. The blood test routinely made in the laboratory is an agglutination test. The goat, porcine and bovine types are not differentiated because of the technical difficulties in making routine differential tests. All persons having a blood test in a titer of one to eighty or above are reported back by the laboratories to the Communicable Disease Division of the State Board of Health. A questionnaire is then sent out to the physicians in attendance or health officers, eliciting the diagnosis and occupation of the patient, contact with farm animals and whether raw or pasteurized milk was used and age and sex. This laboratory check has helped in the location of cases. Ninety percent or better of those who have had blood tests of one to eighty titer or above have been declared to be clinical cases of undulant fever. There are many persons who have had positive blood tests in low titer who do not have clinical symptoms as for instance veterinarians. There are, however, some exceptions and clinical cases may occur in those of low titer tests, and some of those with high titer tests may not have symptomatic undulant fever. The final diagnosis is in the hands of the doctor.

Milk

The question has arisen as to whether direct contact with infected animals or the use of infected milk is the more common cause of the disease in man. To that end

1 State Board of Health; Madison, Wisconsin.
we have analyzed the case histories over the ten years, 1931 to 1940. During that period there were 904 cases reported to the State Board of Health and in 894 of these the questionnaire was answered. Investigators have stated variously that 10 to 40 per cent or even more of market milk contains the organism of Bang’s disease. An infected cow is said to shed it in the milk only periodically. In an infected herd only one or only a few cows shed it at one time. Where for instance 40 per cent of the herds are infected with Bang’s disease, it can be expected that much market milk will contain the germ and that it will exist in numerical proportion according to the dilution of infected milk with non-infected milk. For the most part it will be thinly distributed in the milk. The use of milk from a single infected cow is likely to lead to a higher intake of Bang’s bacilli than from market milk. The germ exists in greater concentration in the cream than in other portions of the milk. When the germ is found in the milk it is because of especial laboratory tests. It takes two or three days to grow a colony on agar media and ordinary bacterial milk counts made in the enforcement of laws and ordinances do not include it. It resists a considerable degree of souring and may be present in the milk for a long time. It is destroyed by proper pasteurization.

RAW MILK

In the study of 894 cases in Wisconsin 813 or 91 per cent of them consumed unpasteurized milk a part or all of the time. These raw milk users were divided into two groups. In the first group there were 436 persons or 48.8 per cent of all cases who also had contact with farm animals. The larger part were farm residents. It cannot be stated positively how many of this group contracted undulant fever from raw milk and how many direct from animals. There were 108 women residing in the country places in this group, but it is probable that their personal contact with animals was for the most part too limited for direct animal infection. On the other hand there were three males to one female in this group against an average of 1.6 male to one female in the urban group of raw milk users, and this would indicate therefore that animal contact is a considerable factor among the males. It would be problematical but nevertheless in reasonable accord with all the facts to assume that at least one third of this group derived their infection from milk, or about 16 per cent of the total cases studied. This we believe is placing the percent at a minimum.

In the second group of raw milk users there were 377 individuals or 42.2 per cent of all cases who used raw milk and had no contact with farm animals. The larger part of this group were residents of villages and cities. There was no evident connection with the bacillus of Bang’s disease in this group in any other way than through the medium of raw milk, and this entire group may be said to have contracted undulant fever by that medium.

PASTEURIZED MILK

Only 75 persons or 8.5 per cent of all cases used pasteurized milk and no raw milk at any time. These persons were also divided into two groups. In the first group there were 48 males and one female or 5.5 per cent of the total cases who also had contact with animals. Most all of them were urban residents and many of them
were slaughter house workers, butchers or handlers of meat products. This group may be said to have contracted the disease from animals as there was no other evident way of picking up the germ. In the second group there were 26 persons or 3 per cent of all cases who used pasteurized milk and had no contact with animals of whom 11 were males and 15 were females. Of these the source remains unknown. There was some uncertainty in the history of some of these cases.

There were in addition, five persons who claimed to have drank no milk whatever but four of them had contact with animals, and there was one person who stated he used condensed milk only and had no animal contact.

MILWAUKEE

The undulant fever situation in Milwaukee throws light on the part raw milk plays. All milk in that city is pasteurized with the exception of a little certified. There were 18 cases reported from there in 10 years, 14 of whom worked on meat products and 3 had managed to obtain raw milk at some time. There was one person in whom the source was undiscoverable. Nearly one fifth of the state's population is in Milwaukee, and if the state's rate for undulant fever had prevailed, there would have been about 170 cases instead of 18.

SUMMARY

The correctness of these statistics is in proportion to the correctness of the answers returned on a questionnaire. They represent at least a general picture of the situation. The disease is predominantly a male infliction, there being in the whole series 2.4 males to 1 female. As in cattle it has the peculiarity of attacking adults, as there were only 5.5 per cent of cases under 15 years of age, practically all whom consumed raw milk. Strange to say there were 2 males to 1 female in this group. Forty-two and two tenths percent of cases showed no other source than raw milk, and to this must be added a certain part of the cases on farms and in rural life who had both contact with animals and used raw milk. It would be within the analytical bounds of this study to conclude that at least 60 per cent of all cases were derived from raw milk and possibly 70 per cent.

As to the seriousness of the situation we may say that 90 cases reported annually in three million population is not numerically very great as compared with many other communicable diseases. The victims, however, are often sick a long time, the average being four months and the death rate for the years mentioned in this series was 2.6 per cent of the cases reported. As most physicians now take blood tests on persons who have pronouncedly febrile states, it is probable that not a great many of that class of cases remain unreported. There are doubtless numbers of low-grade ailing cases who never get into the hands of a physician or who are never diagnosed as undulant fever, but we have no way of finding out just how frequent they may be.

Inasmuch as the greater part of the population has consumed raw milk in past years, the question arises why more persons have not developed undulant fever. In many communicable diseases the dosage or amount of germs one receives, the personal immunity, and the type and malignancy of the germs are factors and undulant fever appears to be no exception. It is claimed that the more malignant goat and hog strains weave back through cattle to the human being. While it is
possible that some of this takes place, competent technicians in America have also found the bovine strain in human cases. As far as milk is concerned, the cow is responsible for the transmission of the disease whatever strain of organism is present.

The dwellers of urban communities can protect themselves from undulant fever as well as some other communicable diseases by the pasteurization of milk supplies. If however all the milk in the villages and cities of Wisconsin were pasteurized to the exclusion of that used in rural life, it would probably lessen the prevalence of undulant fever by that proportion of urban dwellers who have contracted undulant fever from raw milk or a little over 40 per cent. The ultimate remedy therefore is the elimination of Bang's disease in cattle as far as milk is concerned. The questionnaires returned from meat handlers have been too uncertain to ascertain the relative proportion of those handling only hogs and those handling only cattle, but both were apparently involved, and to eliminate Bang's disease in cattle would further eliminate some cases of undulant fever, as for instance, farmers handling abortive cattle. As far as Wisconsin is concerned it would appear that cattle are more dominant than hogs in causing undulant fever.

The State Health Department sends a copy of all undulant fever cases where particular herds are indicated to the State Veterinarian. If a cattle owner knows undulant fever has arisen from his herd, it should be an incentive for him to fall in with the Bang's disease prevention program and get his cattle tested. A few urban communities where some raw milk is still sold now require all raw milk entering the community to be from Bang's free herds.
REPORT ON BOVINE BRUCELLOSIS WORK, INCLUDING CALFHOOD VACCINATION

BY JOHN R. MOHLE¹ AND A. E. WIGHT²

Just a year ago it was our privilege to appear on the program of this Association and discuss bovine brucellosis, especially calfhood vaccination as an aid in the control and eradication of this disease. Since then much progress has been made in the bovine brucellosis control work conducted in cooperation with the various State livestock sanitary officials and the cattle owners. Before bringing to your attention some of the activities that have taken place in the immunization of calves against this disease, it is desirable to give a brief report of the work under the general plan of control.

LESS INFECTION—MORE ACCREDITED COUNTIES

During the fiscal year ended June 30, 1941, blood agglutination tests for brucellosis, many of which were retests, were applied to about 7,737,300 cattle, located in 697,615 herds, and 182,075 reactors were discovered. This infection of 2.4 per cent is the lowest disclosed in any year since the work was undertaken in 1934. The tests, which included many retests, were applied to cattle in localities where the work was conducted on an individual-herd basis under the voluntary plan and also in certain circumscribed areas where the testing of all dairy and breeding cattle 6 months of age and over is required under State laws and regulations. A little more than half the tests made during the year were conducted under the area plan.

One year ago there were 346 counties, in 20 of our States, which had been classified as modified accredited Bang's disease-free areas, as provided for in the regulations adopted by this Association in 1939 and approved by the U. S. Bureau of Animal Industry the same year. Since then additional counties have been added to the number, making a total of 446 in 23 States. These counties contain approximately 4,000,000 cattle exclusive of steers and calves. The blood agglutination test is now being conducted on the area basis in about 200 additional counties in the States already having accredited counties and one other.

In almost all the States there are some individual herds of cattle that are certified as being free from brucellosis. On November 1 of this year there were 70,504 accredited herds, containing about 1,391,000 cattle, in 43 States. This is a substantial increase when compared with the number in that status one year ago. On that date there were also approximately 14,732,000 cattle, contained in about 1,991,800 herds, under supervision in the brucellosis project, and the owners of approximately 1,149,700 additional cattle have indicated that they wish to have their herds placed under supervision.

As a result of a recent survey made by the cooperating State and Federal officials

¹ Chief of Bureau of Animal Industry.
² Chief of Tuberculosis Eradication Division, Bureau of Animal Industry, U. S. Department of Agriculture.
MORE THAN 15 '70
M SIGNIFIES THAT IN COUNTY-WIDE TESTING, CATTLE INFECTION DID NOT EXCEED 1 PERCENT AND HERD INFECTION DID NOT EXCEED 5 PERCENT.

BUREAU OF ANIMAL INDUSTRY U.S. DEPARTMENT OF AGRICULTURE
in charge of this work to determine the approximate extent of brucellosis among
dairy and breeding cattle 6 months of age and over, it appears that the percentage
is about 5 per cent. This percentage is higher than the results of official testing
for two reasons: (1) The 5 per cent figure includes areas where there is considerable
infection and where little or no testing has been done, and (2) it represents the
probable actual incidence of the disease whereas the lower figure, 2.4 per cent, is
based in part on a considerable amount of retesting. The incidence of brucellosis
was estimated to be approximately 10 per cent in 1934. Thus the evident progress
that has been made in the elimination of this disease during the last 7 years is clearly
apparent. In a number of States where there was considerable infection in the
beginning of the work, a very marked reduction in the incidence of the disease has
been noted since 1934.

OPERATING EXPENSES AND INDEMNITY PAYMENTS

During the past year the legislatures in almost all the States have been in session
and have provided funds for continuation of brucellosis control work. State
appropriations amounting to approximately $2,915,000 have been made available
for indemnity for a period of one year, and $1,350,000 for operating expenses.
In fact, provision for indemnity payments has been made in all States except Cali-
ifornia, Colorado, Indiana, Massachusetts, Nevada, Oklahoma, and Texas. Federal
funds for operating expenses and indemnity for the fiscal year ending June 30, 1942,
amount to $4,552,140.

The Federal Government expended during the last fiscal year about $2,450,000
for indemnity paid to owners of cattle reacting to the blood agglutination test for
brucellosis. The States expended during that time for the same purpose approxi-
mately $2,650,000. The average appraisal of cattle slaughtered for brucellosis
during that period was $93.28; the average salvage, $37.68; the average Federal
indemnity payment, $15.19; the average State indemnity payment, $17.19; and
the average loss to the farmer, $23.22. Of the reactors, 10 per cent were registered
purebred cattle.

Calfhood Vaccination

At the meeting of this Association last year proposed plans for conducting calf-
hood vaccination as an adjunct to brucellosis eradication by the test-and-slaughter
method were adopted, and it was understood that the livestock sanitary officials
in the various States would submit proposed plans for this work in their respective
States to the U. S. Bureau of Animal Industry for consideration. There was some
delay in getting the enlarged project started for various reasons, one of which was
the fact that the livestock sanitary officials in many of the States were not in posi-
tion to make definite plans until legislative action had been taken in regard to
brucellosis work. However, most of the State legislatures were in session last
winter and plans have now been made to conduct calfhood vaccination in conjunc-
tion with other brucellosis eradication work in 39 States. In the remaining States
some vaccination is being conducted though not under a cooperative plan.

Briefly, these plans are often referred to in the Bureau as B and C, leaving A to
apply to those herds under the test and slaughter project. The B and C projects
provide for the vaccination of heifer and bull calves between 4 and 8 months of age which are to be retained in the herd. Under the B plan the non-vaccinated reactors are removed for slaughter in the usual manner and the owner receives indemnity for them, while under the C plan the non-vaccinated reactors are retained in the herd for an indefinite period and the owner does not receive indemnity for those reactors. In some States numerals are used to identify these plans, while in other States the Bureau's B and C are designated as A and B, respectively. In order to have uniformity we are quite willing to change our nomenclature to meet the wishes of the majority of States. The volume of the calfhood vaccination work is increasing each month and in October approximately 11,000 calves in 34 States were vaccinated under the cooperative plans B or C. A few States have had their plans accepted, but they have not as yet reported any calves vaccinated. The number of calves vaccinated is about the same under each of the two plans. The Bureau of Animal Industry in cooperation with the State livestock sanitary officials has been making further observations of results of this branch of the work in order to determine if any improvement is possible.

Instructions have been issued to the men in the field calling attention to the importance of handling the Brucella abortus vaccine strictly in accordance with directions on the label of the package in which it is shipped. On March 3, 1941, circular letter No. 2301 to licensed producers of Brucella abortus vaccine was prepared giving requirements in regard to vaccine containers and labels. New trade labels were required to comply with regulations and the labels on the boxes and circulars regarding the vaccine were to call attention to the importance of storing the product under refrigeration and in transportation its temperature should not be allowed to exceed 55 degrees F. This circular also called for the marketing of the Brucella abortus vaccine in single-dose vials only. Contamination of vaccine sometimes resulted when the multiple dose bottle was used, and the use of the single-dose container also prevents the necessity of veterinarians taking more vaccine from refrigeration than will be needed for one day's injections. The vials must be of so-called "resistant" glass of uniform stability, and other glass containers used in the preparation and holding of the vaccine must likewise be resistant. This term in the sense used signifies glass having a chemical composition that is not harmful to the vaccine.

During the 12 months from November 1, 1940, to October 31, 1941, samples of 1,663 batches of strain 19 Br. abortus vaccine, prepared by 21 commercial biological concerns, were tested at the Bureau's Animal Disease Station at Beltsville, Md. These tests covered purity, viability, hydrogen-ion concentration, and density. Of this number 1,539 batches, or 92.5 per cent, were found to be satisfactory and 124 batches, or 7.5 per cent, were unsatisfactory, and therefore not marketed but destroyed under Bureau supervision. In fact, the requirements of the Bureau have continued to be on a rigid basis to insure that all vaccine shall be satisfactory for its intended purpose. At periodic intervals, carefully selected smooth-type cultures of strain 19 are supplied by the Bureau to each concern preparing vaccine under Government license. This greatly precludes the possibility of dissociated cultures being used for this purpose.

Considerable interest has been evinced in strain 19 vaccination in foreign coun-
tries. Requests for lyophilized cultures have been received from England, Sweden, Norway, Denmark, Mexico, various South American nations, South Africa, Australia, New Zealand, and even China, Thailand, and the Island of Java. This vaccine has also been used officially in selected herds in Canada for several years.

_Calfhood Vaccination Field Studies_

Last year this Association was given a report of the progress of studies of calfhood vaccination under field conditions, and it is our desire to include in this report information showing further progress in this activity. Following is a brief summary of results obtained in the study including those contained in the eighth semiannual report, which brings the data up to July 1, 1941:

On that date 248 of the 260 herds in which the study began in 1936 were still operating under the plan, and they were located in 24 States. There were remaining in these herds, 16.4 per cent of the original reactors and 15.5 per cent of the original suspects. The total number of animals vaccinated as calves that were still in these herds was 16,373, but the total number vaccinated since 1936 was 19,629. The difference is explained by the fact that some of the vaccinated animals had been disposed of for various reasons.

Among the cattle vaccinated as calves, 14,280 calvings occurred, involving five pregnancies. Of these, 8,284 were first calvings; 4,067 were second; 1,537 were third; 354 were fourth; and 38 were fifth. There were 13,804, or 96.7 per cent, normal calvings. Of the normal calvings, 11,801 dams or 85.5 per cent, were negative to the post-calving tests; 569, or 4.1 per cent, were positive; and 1,434, or 10.4 per cent, were classified as suspicious. Therefore, 14.5 per cent of the animals calving normally were classified as either positive or suspicious at the time of calving. On the other hand, there were 476 animals, or 3.3 per cent of the total, that aborted. Of this number, 298, or 62.6 per cent, were negative to the test at the time of calving; 142, or 29.8 per cent, were positive; and 36, or 7.6 per cent, were classified as suspicious. Consequently, on the basis of the blood agglutination test, only 178 abortions, or 1.2 per cent of the total calvings, could be attributed to brucellosis. The results may be considered as partial answers to the oft repeated question regarding the duration of immunity produced by strain 19.

The following tabulation shows the results of the eighth semiannual report on these studies, which covers the period from January 1 to July 1, 1941:

<table>
<thead>
<tr>
<th>Number of calvings</th>
<th>3,079</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal calvings</td>
<td>3,000</td>
</tr>
<tr>
<td>Post-calving test results:</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>2,600</td>
</tr>
<tr>
<td>Positive</td>
<td>92</td>
</tr>
<tr>
<td>Suspicious</td>
<td>308</td>
</tr>
<tr>
<td>Abortions</td>
<td>79</td>
</tr>
<tr>
<td>Post-calving test results:</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>57</td>
</tr>
<tr>
<td>Positive</td>
<td>18</td>
</tr>
<tr>
<td>Suspicious</td>
<td>4</td>
</tr>
</tbody>
</table>

(22 aborters, representing 0.7 per cent of the total calvings, showed positive or suspicious reactions on post-calving test.)
The following tabulation shows accumulated results of the calfhood vaccination field studies involving only the first, second, and third gestations, up to July 1, 1940, and up to July 1, 1941:

<table>
<thead>
<tr>
<th></th>
<th>To July 1, 1940</th>
<th>To July 1, 1941</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total calvings</td>
<td>8,182</td>
<td>13,388</td>
</tr>
<tr>
<td>Normal calvings</td>
<td>7,872 96.2%</td>
<td>13,425 96.7%</td>
</tr>
<tr>
<td>Post-calving tests of normals:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>6,526 82.9%</td>
<td>11,471 85.5%</td>
</tr>
<tr>
<td>Positive</td>
<td>399 5.1%</td>
<td>555 4.1%</td>
</tr>
<tr>
<td>Suspicious</td>
<td>947 12.0%</td>
<td>1,399 10.4%</td>
</tr>
<tr>
<td>Abortions</td>
<td>310 3.8%</td>
<td>463 3.3%</td>
</tr>
<tr>
<td>Post-calving tests of aborters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>182 58.7%</td>
<td>288 62.2%</td>
</tr>
<tr>
<td>Positive</td>
<td>99 31.9%</td>
<td>140 30.2%</td>
</tr>
<tr>
<td>Suspicious</td>
<td>29 9.4%</td>
<td>35 7.6%</td>
</tr>
<tr>
<td>Aborters positive or suspicious on post-parturition test, with per cent of total calvings</td>
<td>128 1.6%</td>
<td>175 1.3%</td>
</tr>
</tbody>
</table>

Up to July 1, 1941, there were 354 animals involved in the fourth gestation, 342 of which, or 96.6 per cent, calved normally and 12, or 3.4 per cent, aborted. Of those calving normally 299 were negative to the post-calving test, 13 were positive, and 30 were suspicious. Of those that aborted, 10 were negative, 1 was positive, and 1 was suspicious to the post-calving test.

There were 38 animals involved in the fifth gestation, 37 of which were normal and 1 of which aborted. Of those calving normally 31 were negative to the post-calving test, 1 was positive, and 5 were suspicious. The one animal that aborted was positive to the post-calving test.

SAFETY OF STRAIN 19

The length of time in which vaccinated animals continue to reveal a blood titer as shown by an agglutination test varies, and in a few instances the animals have continued to carry a titer throughout the entire period since vaccination but have given birth to healthy calves. It is appreciated that there are many steps in the calfhood vaccination program that are being used in conjunction with the test-and-slaughter method or alone that must be observed, but it is believed unnecessary to take them up in detail at this time.

An occasional letter is still received expressing fear that strain 19 will sometime become more virulent and will then produce the very disease it is intended to prevent. Frankly our fears are directly opposite as in our opinion the more natural tendency of a culture like strain 19 would be gradually to lose the low degree of virulence it now possesses. This view is supported by Eichhorn and Crawford in Farmers' Bulletin 1871 where they state "Many thousands of calves have been vaccinated with strain 19 and no evidence has so far been presented to show that its virulence has increased in this manner. Vaccinated calves have been placed with normal pregnant animals without causing the latter to react in any degree to the agglutination test or become affected with the disease." The unpublished work of
Huddleson has a most interesting bearing on this subject. During a recent visit to the Brucella laboratory at the Veterinary Department of Michigan Agricultural College, Dr. Huddleson discussed his most striking observations pertaining to the value of the catalase test for the determination of the virulence of various Brucella strains. He elucidated his statement by showing graphs in which the behavior of the three types of Brucella organisms was noted. One graph showed definitely that strain 19 possessed the lowest virulence of any strain of the three types and this degree of virulence persisted uniformly in cultures after numerous transfers.

The owners of cattle in herds in which this work is being done should be informed that, although Brucella abortus vaccine made from strain 19 of the Brucella organism has much power when administered properly and gives the cattle a good measure of immunity against brucellosis, it will not always protect them from gross exposure to the organisms of this disease. Good and approved sanitary practices in handling herds should be continued at all times even though the calves in the herds are vaccinated against this disease. We appreciate the fact that there are many cattle, both old and young, vaccinated against brucellosis and such herds are not under cooperative supervision.

It has been a pleasure for the Bureau of Animal Industry to work with the members of the Committee on Bang's Disease of this Association, and we hope the good relations will continue.

We are now regularly sending to livestock sanitary officials, veterinary inspectors, and others directly interested in brucellosis work reports showing progress in each State. One of these is a summary issued monthly. In addition the Bureau has prepared progress reports showing accumulative results since the establishment of the program July 1, 1934. Shortly after calfhood vaccination work began, the report forms were amplified to include data on this phase of the activities. We find that the monthly tabulations provide a convenient means of observing progress of calfhood vaccination and we trust that others find the information similarly useful.

Note: This report was supplemented by a map of the United States showing the estimated extent of bovine brucellosis in various parts of the country. A pamphlet composed of statistical tables showing progress of tuberculosis and bovine brucellosis eradication work likewise accompanied the report. Copies of the map and tables may be obtained, on request, from the Bureau of Animal Industry, Washington, D.C.
REPORT OF THE COMMITTEE ON BANG'S DISEASE  
(BRUCELLOSIS)


Your Committee wishes to report that satisfactory progress has been made with the program of Bang's disease control and eradication during the year. The program is being hampered by lack of funds and personnel due to the emergency, and may be further hampered in this respect. Your Committee recommends that every possible effort be made by disease control officials and livestock owners in this country to make progress and not lose, during the national emergency, any ground that has been gained. Your Committee is gratified to report that herds of cattle free from Bang's disease and cattle in modified accredited Bang's disease free areas in this country are proving extremely useful in national defense, as well as profitable to the owners, and further efforts in this respect can be considered no other than a national defense measure. Your Committee recommends that animal disease control officials and livestock owners in this country expend every possible effort to maintain adequate appropriations and personnel for the continuance of the Bang's disease eradication program.

Your Committee reports that there are now 446 counties in 23 states containing approximately 3,976,455 cattle in Bang's disease modified accredited free areas, and that area work is in progress in 200 additional counties in 24 states. In addition to this, Bang's disease eradication and control is being carried on under the individual herd plan, and there were on October 1, 1941, 70,504 accredited Bang's disease free herds containing approximately 1,391,000 cattle.

In the last annual report your Committee suggested a plan for calfhood vaccination, and during this year 39 states have adopted plans for calfhood vaccination, and 48,000 calves have been vaccinated with Brucella Vaccine, Strain 19. This procedure should give additional information as to the efficiency of this method of controlling Brucella infection. Your Committee is unanimous in again recommending that research with immunization procedures be continued.

The United States Bureau of Animal Industry, at the last annual meeting of this Association, recommended calfhood vaccination as an adjunct or aid to other methods of controlling Brucellosis infection in this country. Your Committee reports that this procedure has not been properly carried out in many instances as recommended by this Association and the United States Bureau of Animal Industry last year, and all too frequently the method has been used as a substitute for other control methods. Your Committee strongly recommends that this practice be discontinued and that testing and herd sanitation be carried on in herds where calfhood vaccination is practiced. Your Committee is agreed that calfhood vac-
cination is a means to an end, and should be used only to assist other approved methods of control.

Cattle owners should be aware of the fact that if living germ vaccines are improperly used, there is grave danger that they may eventually result in more harm than good to the cattle industry. Each infected herd presents a problem, the solution of which in every case should give the same answer, namely, a Bang’s disease free herd. The basic principles involved in all cases are the same, and the success in obtaining the solution depends upon the facilities available and thoroughness in the execution of the basic principles. Repeated blood tests and elimination of reactors may never result in the elimination of the disease unless supplemented by proper herd management and sanitation. The cardinal principle in connection with herd management is the suppression of exposure to infection, and this principle is essential in all methods of control.

Thirty-nine states have adopted methods of calfhood vaccination, and the majority are centered around the following three methods:

a. Test and immediate elimination of positive reactors with indemnities.
b. Test and immediate elimination of positive reactors with calfhood vaccination and indemnities.
c. Test and gradual elimination of positive reacting animals with calfhood vaccination and without indemnities.

Your Committee in previous reports to this Association has recommended that producers and distributors of Bang’s disease vaccine in this country be required to report each shipment of Brucella Abortus vaccine to the officials of the state of destination. The United States Department of Agriculture is commended for carrying out this recommendation during the year, and your Committee on Bang’s Disease urgently recommends that all states adopt and carry out suitable companion measures within each state.

Your Committee urges that persons responsible for the distribution, handling and administration of Brucella vaccine be fully instructed by the manufacturers or the United States Bureau of Animal Industry and their respective state livestock sanitary officials, in the proper handling and administration of this product. This is a living organism, and any beneficial results that may be obtained are dependent upon living organisms.

Complete written instructions as to the proper handling and administration of this product should accompany every package.

Your Committee again recommends that every possible effort be expended to discourage and to discontinue the promiscuous and irrational use of Brucella Abortus vaccine, and that its official use be limited to approved, qualified veterinarians under official federal state supervision.

Your Committee again desires to call attention to the fact that Brucellosis is a disease of farm animals and man, and is not confined to the bovine species.

Your Committee urges research organizations to study Brucella infections in animals other than cattle, and the relation of these reservoirs of infection to the control and eradication of Brucellosis.
FORUM ON BANG'S DISEASE

PRESIDENT CROSSMAN: Now comes a little novel entertainment. We have asked some eight or ten gentlemen to sit at this head table, not acting as a supreme court, but men taken from various walks of life. We haven't forgotten the layman as well as the research man. Dr. Ward Giltner will preside.

We realize that there are many men in this audience who know quite as much about Bang's disease as these men on the platform. Unfortunately, we have no funds to enable us to pass out copies of the Encyclopedia Britannica to those of you who may stump our experts. I am asking, however, that when you arise to ask a question, unless you have a very clear carrying voice, you please use one of the microphones in the center aisle, give your name and address, then present your question, and Dr. Giltner will decide to whom to assign it.

Will the gentlemen whom I shall name please come forward to the platform?

The following gentlemen took seats on the platform:

Dr. R. R. Birch, Cornell University, Ithaca, New York
Dr. I. F. Huddleson, Michigan State College, East Lansing, Michigan
Dr. W. E. Cotton, Alabama Polytechnic Institute, Auburn, Alabama
Dr. Hadleigh Marsh, Agricultural Experiment Station, Bozeman, Montana
Dr. Alex Wight, Chief, Tuberculosis Eradication Division, Bureau of Animal Industry, Washington, D. C.
Dr. Harry Caldwell, Practitioner, Wheaton, Illinois
Mr. Milton E. Miller, Killbuck Farm, West Salem, Ohio
Mr. A. J. Glover, Publisher and Dairyman, Fort Atkinson, Wisconsin

Dr. Ward Giltner assumed the Chair.

CHAIRMAN GILTNER: President Crossman, Ladies and Gentlemen: We are a little late in starting, therefore, the remarks that I had planned to make at this time, as a preliminary, will be omitted. For the benefit of the "quizzes" I will give their names before I read the question, and that is the only preparation they will have in advance of their giving the answer. This is entirely unrehearsed, as will be perfectly obvious to you as we proceed.

Dr. Wight, what is the probable duration of immunity in animals that were vaccinated as calves between the ages of 4 and 8 months, please?

DR. WIGHT: Mr. Chairman, I don't believe I am the one to answer that question. We have data on the field work, but we have men here who have done much more research, and I would like to pass the question on to one of them. (Laughter)

CHAIRMAN GILTNER: All right. Dr. Cotton, let's have the answer. I just wanted to show up Wight. (Laughter)

DR. COTTON: I think you have another gentleman who can answer that question better than I can. (Laughter)

We have pretty good evidence that there was a very good viability up to and including the third pregnancy. Probably it has been carried beyond that, as Dr. Crawford or Dr. Eichhorn could state. It seems to me that there is maximum immunity probably during the first pregnancy, and then it gradually tapers off.
There would be a good strong immunity lasting several years. That is my belief, but I haven't any exact proof other than what I have told you.

CHAIRMAN GILTNER: Stay right there, Dr. Cotton. The reason I asked that question of Dr. Wight is that he is a man of few words and I thought perhaps he would set a good example. (Laughter)

Do non-vaccinated animals that react in titers 1–400 and above retain their reaction longer than those that react positively in dilutions below 1–400?

DR. COTTON: Generally speaking, I would say they would, that one would reasonably expect them to do that. They are higher titers, and they take longer to come down.

CHAIRMAN GILTNER: I would like to have Dr. Eichhorn move over to the microphone nearest him; we may want to use you any moment now, Doctor. (Laughter)

Right now, for instance. Will rough colonies of Strain 19 that do not induce the production of agglutinins confer any immunity, Dr. Eichhorn?

DR. EICHHORN: While no experimental data are available to prove any pathogenicity for rough colonies, the evidence tends to suggest that rough colonies do not induce resistance comparable with smooth colonies. The absence of titers and lesions in artificially-infected guinea pigs tends to support this contention and furthermore the titer induced by the vaccine is indicative of a response in the animals through which we may assume the development of a resistance.

CHAIRMAN GILTNER: Dr. Huddleson, are rough colonies of virulent strains pathogenic?

DR. HUDDLESON: No.

CHAIRMAN GILTNER: Is there much tendency of Brucella to dissociate?

DR. HUDDLESON: Yes. (Laughter)

CHAIRMAN GILTNER: Maybe we can have this question answered as a duet by Dr. Cotton and Dr. Eichhorn.

What is the duration of the persistence of agglutinin in the bodies of adult cattle that have been vaccinated with Strain 19?

DR. COTTON: I could not answer that question. It is variable.

DR. EICHHORN: The persistence of the agglutination titer in cattle is very variable. We have no authentic data to establish and determine the reason for the great variation. Nevertheless, it has been experienced that such does occur.

CHAIRMAN GILTNER: Stand right there, Dr. Eichhorn. What is the maximum titer of agglutination induced by vaccinating calves not over 8 months of age?

DR. EICHHORN: The maximum titer also is variable; that is, the titer is not uniform. We have cases in which the titer is way over 1,000, while in other instances it runs about 200 or 300.

CHAIRMAN GILTNER: Here is another question along this line, and I shall ask Dr. Wight to check you on your reply: What are the effects of vaccinating calves 3 months of age and under?

DR. EICHHORN: We have no definite data to establish what the effects are. In the vaccination of animals against infectious diseases in general, we know that on vaccinating animals during the suckling period the duration of immunity is not as lasting and constant as in animals which are immunized after weaning. This is also substantiated by the experimental data of Watson in Canada wherein he
reports that failures which occurred were observed mostly in animals which were immunized at a very young age.

Dr. Cotton: I just want to say that I misunderstood the question. I thought it was in unvaccinated animals. They fade out, or nearly so, before 6 months but some of them do persist for a little longer time. Once in a while there is one that continues to react over a long period. I think Dr. Mohler mentioned that in his paper this morning.

Chairman Giltner: The people who own the cattle ought to have something to say, although, of course, they don't known anything about it. (Laughter) We will ask Mr. Miller and Mr. Glover to express themselves.

Mr. Miller, is it advisable to vaccinate cattle over 8 months of age in clean herds which have been exposed by the introduction of infected animals?

Mr. Miller: I hardly know why you ask me that question, with all these doctors around me. (Laughter) I don't think I would care to express an opinion on that.

Chairman Giltner: Even though they are your animals?

Mr. Miller: That's right.

Chairman Giltner: You write about this, Glover. Tell them.

Mr. Glover: It is expected the use of vaccine is to get rid of the infection. It is my idea that me should not vaccinate any calf over 6 months of age or after it is sexually mature, if we desire to get rid of the infection or have vaccination assist us to get rid of the disease.

Chairman Giltner: What about the range, Dr. Marsh? Do you stick by the conventional ages?

Dr. Marsh: Yes, in a general way. Sometimes it is advisable to vaccinate calves over 6 months of age.

Chairman Giltner: Dr. Wight, is it advisable to blood test calves prior to vaccination, and is it desirable to blood test all calves after vaccination?

Dr. Wight: In general the answer is yes, but conditions may be such that it is impractical to conduct the tests, and the work should not be stopped just on that account.

Chairman Giltner: Hold on to your microphone, please. No, give it to Dr. Birch. If the spirit moves you at any time, gentlemen, in the audience, please arise and ask a question.

Dr. Marsh: Why is it advisable to blood test the cattle prior to vaccination? What is gained by it?

Dr. Wight: We have been told we should not vaccinate animals carrying a titer.

Chairman Giltner: Let Dr. Cotton say something about that.

Dr. Cotton: Nearly all calves would be non-infected and would not react, but occasionally a calf is born with the disease, and it will continue to harbor the disease. It is an infected animal. Nearly all calves get rid of the infection soon after birth. They are not really infected. They have the organism in their digestive tract, but they get rid of it and become negative. But once in a while one of them will be a reactor. Theobald Smith pointed out two or three cases where the organisms remained in the lungs and eventually caused pneumonia. For that reason it is a good thing to test before vaccination.
I have been asked if the calf could have picked it up. Very young calves are quite resistant.

DR. CALDWELL: I was interested in the answer Dr. Wight gave on the question of whether or not they should be tested before vaccination. I cannot give the answer, being a practitioner, but we like to learn about these things. It seems to me it would be very possible in herds, and they should be tested to see if the disease has been picked up.

CHAIRMAN GILTNER: The research man and the practical men in the Bureau can learn a lot from practitioners, whether they will admit it or not. (Laughter)

Now, Dr. Birch, have you formulated the answer to question No. 10? Here it is: Is it advisable to blood test vaccinated calves prior to breeding and to breed only those that are negative?

DR. BIRCH: It is, if the objective is a clean herd—and the objective should be a clean herd. A vaccinated calf which reacts after it reaches breeding age is in precisely the same category from the sanitary standpoint as one that reacts from exposure. We cannot differentiate, by the test, between the two.

CHAIRMAN GILTNER: I believe this next question has been answered by Dr. Mohler in his paper, and perhaps by others. If not, will you answer it, Dr. Eichhorn?

What are the possibilities of cattle which are vaccinated when more than 8 months of age spreading Bang’s disease to susceptible cattle in the same herd?

DR. EICHHORN: I believe Dr. Mohler covered that question thoroughly. However, we are reasonably sure, from experiments conducted at the Animal Disease Station, that there is no danger of Strain 19 being responsible for spread of infection to susceptible animals when vaccinated at 8 months or any age.

DR. R. A. HENDERSHOTT (New Jersey): Are you speaking about negative animals, Dr. Eichhorn, or are you speaking about reacting animals?

DR. EICHHORN: I spoke of negative animals.

DR. HENDERSHOTT: Would there be any danger in inoculating a reacting animal?

DR. EICHHORN: It would not be dangerous, but, of course, we have to assume that the reacting animal is infected, and therefore should not be vaccinated.

CHAIRMAN GILTNER: I would like to ask Mr. Glover what his opinion is on this question: Is calfhood vaccination against Bang’s disease recommended in certified free herds or herds in which all the cattle are negative?

MR. GLOVER: There is a difference of opinion with reference to that question. It is a very debatable subject, but there are certified herds whose calves are vaccinated with apparent success.

CHAIRMAN GILTNER: Is that reply satisfactory, Dr. Wight?

DR. WIGHT: It suits me. (Laughter)

CHAIRMAN GILTNER: Dr. Wight, under what conditions and in what type of herds is calfhood vaccination considered to be the most advisable course to follow?

DR. WIGHT: At present the work is being conducted not only in individual herds, but in sections where there are groups of herds, and they are vaccinating all of the calves in that particular area. That part is rather new. In the range country a great deal of this work has been done.
CHAIRMAN GILTNER: Mr. Miller, what do you think about the vaccination of certified free herds?

MR. MILLER: It seems to me that in order to keep this infection at the lowest point, the certified free herds should have calfhood vaccination, and it would be an excellent thing. The laity are very much in favor of it, and I have heard talk that they would like to vaccinate their calves even though they have certified herds.

CHAIRMAN GILTNER: Dr. Wight, can a herd of cattle become accredited as Bang’s disease free if Brucella vaccine is used in connection with the vaccination of calves?

DR. WIGHT: Yes. I think most of you are familiar with that plan, and if you are not you can take it up with your state live stock sanitary official and the Bureau man of your state, and they can tell you what the procedure is.

CHAIRMAN GILTNER: Should a county be accredited for Bang’s disease if vaccination is used?

DR. WIGHT: Yes, I think it could be if the vaccination in herds is properly handled. But at present they are not permitted to keep the non-vaccinated reactors in a modified county.

CHAIRMAN GILTNER: There is a question concerning which there might be a difference of opinion. Are there any differences of opinion on this matter?

DR. HENDERSHOTT: I would like to ask what they are going to do with the adult animals that are vaccinated at the recommended age of 6 months but which animals still react and are in this accredited area? Dr. Wight made reference to the adult non-vaccinated reactor. How about the adult vaccinated reactor? What disposition is going to be made of that animal?

DR. WIGHT: There aren’t supposed to be any. (Laughter)

DR. HENDERSHOTT: That is exactly what I wanted to hear you say. Thanks, Dr. Wight. (Laughter)

CHAIRMAN GILTNER: Here is a practical matter for field men. What is the most practical method to use in identifying animals that have been vaccinated?

DR. WIGHT: That is a very good question. Several in the audience could answer it better than I can. I see Dr. McDonald from Louisiana, and Dr. Marsh is here from the range country. Perhaps he will have something to say.

CHAIRMAN GILTNER: What about that, Dr. Marsh?

DR. MARSH: Cronen and Wilkins are both in the audience. They know more about it.

DR. CHARLES E. COTTON (Minnesota): A man in Oklahoma has a special form of tattooing that is apparently meeting with approval.

DR. D. H. RICKS (Oklahoma): In Oklahoma we use a tattoo. We use the alphabet from A to L for the months of the year. We use the initials “O.V.” for “Oklahoma Vaccinated”, then the letter for the month, and then the numbers for the year. Calves vaccinated this month would have a tattoo reading “O.V.L.41”.

CHAIRMAN GILTNER: Dr. Hayes, what do you have to say about that?

DR. HAYES (Michigan): We use the “B.V.C.” tattoo, meaning Bang’s vaccinated calf, and we do not identify the year.

DR. H. F. WILKINS (Montana): We use a “U” punch in either ear to identify an officially vaccinated Bang’s calf.

DR. W. A. MCDONALD (Louisiana): We use a brand. We have a set of brands in
a series from 0 to 9, and we place a small number on the jaw. For instance, in January we use No. 1. If the month is March, the third number would be 3. In other words, the first number represents the year, the third number the month. We find that to be a very convenient brand to place on the animal as a permanent brand that you can see when riding out through the herd, and the brand will be there as long as the cow. Cattle men like it.

DR. R. M. GOW (Colorado): I would like to ask one question: They talk about identifying these cattle. Why do you identify them? You as a Bang’s committee have not passed any resolution yet in which you even recognize calfhood vaccination. Why is it necessary to identify them?

CHAIRMAN GILTNER: I am not on any committee. (Laughter) Why is it necessary to identify them? They’re all innocent. (Laughter) Nobody knows why it is necessary to identify them. (Laughter).

I will throw this question out among you: I don’t know who can answer it. There may be some extension veterinarian here who would want to stick his neck out.

What is the best method of encouraging the reaccreditation of herds by annual retests?

DR. V. S. LARSON (Wisconsin): I don’t know that it needs any encouragement in the State of Wisconsin except the benefits that go with it. In Wisconsin we sell dairy cattle to people from other states who want that class of cattle. The greatest inducement to that buyer is to come to a herd that is accredited, knowing that he will probably get Bang’s disease free cattle.

CHAIRMAN GILTNER: Just a moment. What about the backward states? What would you suggest they do?

DR. LARSON: Will you restate that? (Laughter)

CHAIRMAN GILTNER: It is just as well that you didn’t hear me. (Laughter) What would you suggest for the backward states?

DR. LARSON: What do you mean by “backward states”?

CHAIRMAN GILTNER: The other 47. (Laughter)

DR. LARSON: We let them take care of themselves.

CHAIRMAN GILTNER: You simply sell them cattle?

DR. LARSON: Yes, cattle that they want. (Laughter and Applause)

MR. GLOVER: We’ll arrange a revival for the backward states.

CHAIRMAN GILTNER: Let’s pass on to the interstate movement of cattle from vaccinated herds. This probably should be directed to the floor. Some state veterinarian should answer it.

What procedure should an importing state employ to protect itself against the admission of Bang’s reacting cattle?

DR. HENDERSHOTT, will you take a shot at that? (Laughter)

DR. HENDERSHOTT: I don’t know that we are having any difficulty at the present time with inshipped cattle, as far as their reaction to Bang’s disease is concerned. I must admit, however, that a year or two ago we were receiving some animals that were not negative to the test. The law provides that all cattle coming into our state must be negative to an agglutination test for Bang’s disease and that such test must have been conducted within thirty days of the date of importation.
In addition to that we are quarantining all cows upon entering New Jersey and are subjecting them to a retest for Bang's disease, which is conducted within three days of the time they are unloaded within the state. No animals are released from this quarantine until the health charts have been obtained from the state veterinarian of the state of origin nor until the retest for Bang's disease conducted in our own laboratory proves the animals to be negative. Any animal which gives a reaction to the agglutination test is consigned to immediate slaughter. If there is anything that engenders a wholesome respect for regulations, it is for the veterinarian of the state of origin to do his best to see to it that these regulations are complied with, and in addition thereto have the veterinarian on the receiving end check some or all of the cattle that are coming in. About a year ago we started to retest all cattle shipped into New Jersey. Early in this program there occurred about 4.4 per cent reactors. We import about 30,000 cows annually. At the present time, we test a great number of loads without finding a reactor, and we do not specify that our animals come from Bang's disease free accredited herds either.

DR. LARSON: I don't know that that needs any comment. The fact is that Dr. Hendershott gets a good portion of his cattle from Wisconsin, and whether he knows it or not, they come from Bang's free accredited herds. That's why they don't react. (Laughter)

CHAIRMAN GILTNER: Along the same line, what interstate shipment regulations should be enforced under present conditions where calfhood vaccination is being increasingly employed as a part of the Bang's disease program?

(a) Admission of negative cattle from an accredited herd where calfhood vaccination is applied.

(b) Admission of negative cattle from a herd under supervision in the state of origin when no reactors have been found within three months.

(c) Admission of positive reacting recently vaccinated calves where the mature herd was otherwise acceptable.

First, we will answer the question with reference to the admission of negative cattle from an accredited herd where calfhood vaccination is applied. I would like to hear Dr. Birch speak on that.

DR. BIRCH: I knew you would get around to a hard one, Dr. Giltner.

The interstate regulations generally, we can say, should provide that cattle may go from clean herds to clean herds, and that cattle from infected herds should not go at all. Regarding the vaccinated calves, there isn't much evidence that they spread Bang bacilli prior to reaching breeding maturity, but we cannot distinguish between an exposure-reaction and a vaccination-reaction. Hence, the regulations covering vaccinated cattle should be precisely the same that apply to cattle that are not vaccinated.

Then there is the question of the shipment of cattle from herds otherwise clean, in which there are vaccination-reactions in the calves only. That danger probably is not great, but the universal experience is that when cattle are shipped from herds in which there are reactors, there is considerable danger for reasons that we do not fully understand.

CHAIRMAN GILTNER: This ought to be a contentious subject along that same line, Dr. Birch, when it involves the admission of negative cattle from a herd under
supervision in the state of origin when no reactors have been found within three months.

DR. BIRCH: If the reactors have been found in the mature cattle, the period of three months would not be sufficient. However, it would be a considerable safeguard.

CHAIRMAN GILTNER: How about the admission of positive reacting recently vaccinated calves where the mature herd was otherwise acceptable?

DR. BIRCH: You mean the shipping of vaccinated calves out of the herd which is accredited?

CHAIRMAN GILTNER: Positive reacting, recently vaccinated calves where the mature herd was satisfactory.

DR. BIRCH: Well, it depends upon what kind of herds these calves are going into. If they are going into vaccinated herds, then they would be in the same status that any calf vaccinated in that herd would be. Theoretically, it should be permitted, but there are technicalities and difficulties in the way of doing that.

MR. GLOVER: May I ask a question? If we are going to permit the interstate shipment of recently vaccinated calves, isn't it important that they be blood tested before vaccination?

DR. BIRCH: No, not highly important because we cannot differentiate between vaccination-reactions and exposure-reactions. Reactors of either status should not moved into clean herds. I may add to that a more complete answer to one question which already has been partially answered. I should say that the test of the entire herd before any vaccinating is done is exceedingly important. I cannot see much reason for testing calves immediately before or after vaccination. If we test them immediately before, we really need to accept the idea that we would not vaccinate them if they were reactors. If we test soon afterward, all we are finding out is whether the vaccine contains Bang bacilli, alive or dead.

It is the testing of the entire herd before any vaccinating is done, and it is the continuance of periodic testing in the mature herd after it is done in order to work toward a clean herd, that are the important things.

MR. GLOVER: Thank you.

DR. HENDERSHOTT: May I ask a question? I have been laboring under the impression for a number of years that a calf that is a reactor to the agglutination test for Bang's disease may conceivably be a spreader of Bang's disease. I presume, from the answers that are given to this question, that I have been wrong. I would like to be corrected.

CHAIRMAN GILTNER: Dr. Cotton will correct you.

DR. COTTON: You mean any animal that reacts is apt to be a spreader?

DR. HENDERSHOTT: A calf that is carrying an agglutination response may be a spreader of Bang's disease. It is not a vaccinated animal, mind you. I am talking about the normal animal, born in an infected herd, suckling an infected dam which may have Bang's bacilli in its digestive tract and which is a reactor to Bang's disease.

DR. COTTON: Ordinarily that calf would not be a spreader after the infected milk worked out of its system and its bowels.
Dr. Hendershott: How long is it going to take, and how will we know when it is safe to put that animal in a clean herd?

Dr. Cotton: It will cease to react very shortly.

Dr. Hendershott: Isn't that the question asked Dr. Birch about shipping a reacting animal? He said he thought the animal ought to be tested prior to the administration of the vaccine.

Dr. Cotton: I think it should be tested before being vaccinated, to find if the animal is actually infected. I told someone some time ago that a few calves were born actually infected and they continued to be infected. Those animals would be dangerous, but these other calves that react only because they are nursing an infected cow—the agglutinins come from the milk, and they fade out.

Dr. W. H. Hendricks (Utah): May I ask a question? Suppose this calf carries a positive infection and is vaccinated with Strain 19. Is it more apt to continue to be a positive reactor, or will it lose its titer?

Dr. Cotton: I should think it would do no harm to vaccinate such a calf, but it is desirable to get rid of it and not take it along. I doubt if the vaccination would have any real effect one way or the other.

On the other question, "Admission of positive reacting recently vaccinated calves where the mature herd was otherwise acceptable", if the calves recently vaccinated are reacting because of vaccination, I don't see why they should not be admitted, but they should be tested later to determine whether they have lost their reaction before they are mixed with the other cattle. I can't see where they could do any harm. They cannot spread the disease. It has been proved pretty thoroughly that animals vaccinated with Strain 19 are not spreaders of infection.

Dr. Hendershott: Dr. Cotton, you are going to immunize this calf that Dr. Hendricks is talking about, i.e. this naturally infected animal. Do I understand you to state that when we immunize such an animal that such immunization places the blessing of the Almighty on it, that it is no longer a spreader, and has no chance of spreading Bang's disease?

Dr. Cotton: No, it might be a spreader.

Dr. Hendershott: You would want to take a calf that was an infected animal—you vaccinate it; it is showing an agglutination response both to the infection and to the vaccination, and you would be willing to put that calf in a Bang's accredited herd?

Dr. Cotton: No, I would not. I haven't said anything of the kind. I said the purpose of this preliminary test is to get rid of such an animal.

Chairman Giltner: Don't let your angry passions rise, gentlemen. (Laughter) I think this question should be addressed to both Mr. Miller and Mr. Glover representing the defense, and the state officials: Should there be any distinction made in the admission of cattle into the state for breeding purposes or for show purposes?

Mr. Miller: From the standpoint of the breeder we must say we would like to have some less stringent restrictions on show cattle coming into the various states. A fellow hasn't got all the time there is to watch test sheets to see that his cattle are not 31 days or 15 days over the limit, and there are a lot of other things to do on the
show circuit. Physical circumstances alter those conditions, and it is a job in itself to be shipping cattle over the country and keeping abreast of it without having too much red tape to go through in the way of tests.

However, we do not want to jeopardize the health of our cattle nor the health of cattle in any state. If those restrictions and red tape can be eliminated and made less stringent, it certainly would be a help to the average breeder and showman.

Mr. Glover: All I can say is that I agree with Mr. Miller about the unnecessary red tape, but I do think all our regulations should be directed to stop the spread of the infection.

Chairman Giltner: What do you think, Dr. McAdory?

Dr. I. S. McAdory (Alabama): Mr. Glover is right.

Dr. Gow: I would like to ask one question: If an animal up to 18 months of age (a beef animal) is not pregnant, what danger is there in showing her on the show circuit?

Chairman Giltner: Dr. Marsh, you are familiar with the beef breeds.

Dr. Marsh: I don't get the point.

Dr. Gow: I vaccinated a calf 6 months old. She is a show calf. (We don't breed beef cattle until they are 18 months of age.) She goes to your Fair. What danger is there of that animal spreading infection to the dairy cattle or to any other animal at the Fair? She is not pregnant, not bred.

Dr. Marsh: Does she react?

Dr. Gow: If one vaccinates a calf she is supposed to react.

Dr. Marsh: Not at 18 months.

Dr. Gow: You can say 8 or 15 months, but state her date, then.

Dr. Marsh: She should have lost her reaction by that time.

Dr. Gow: When should she lose it?

Dr. Marsh: She won't react to 1-100 at 18 months.

Dr. Gow: When will she lose it? What month should she lose her titer?

Dr. Marsh: That can't be answered in any particular month.

Dr. Gow: Then I will ask another question: Is she in danger of spreading to some man showing clean herds?

Dr. Marsh: If she does not react she does.

Dr. Gow: If she does react is she a dangerous spreader?

Dr. Marsh: What titer does she react to?

Dr. Gow: In Colorado they are reactors, because we can't ship them interstate, so we are not talking about titer.

Dr. Marsh: It isn't classified as a reactor for shipment purposes if it only gives a partial at 1-25 or 1-50. It would not be any more than that after 12 months as a result of vaccination of a 6 months old calf.

Mr. Glover: I would like to ask this gentleman a question: If a calf vaccinated at 6 months is still reacting at 18 months, do you know whether it comes from the vaccination or from another infection?

Dr. Gow: Let me ask you this: That animal is not bred until she is 18 months old. What danger is there of her being a spreader when she walks into your show? That is the question I am asking you.
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DR. COTTON: I think it would be zero. If she is not pregnant, and the reaction comes from the vaccination, I can't see how she could spread it.

DR. GOW: You said "if".

DR. COTTON: The virulent type would be another thing. If she reacts as the result of the vaccine alone, I can't see how she could infect anything if she were not pregnant.

DR. HENDRICKS: You said "if" it comes from the vaccination. That is what Dr. Gow is talking about.

DR. COTTON: The reaction comes from Strain 19, not from something else.

MR. NEWLIN (Michigan): It would seem that from the evidence given if we are going into calfhood vaccination (which we apparently are) that to answer Dr. Gow's question it is imperative that these calves be blood tested before they are vaccinated.

DR. MARSH: On this testing of calves before vaccination, if I understand it correctly, there is a tendency here to recommend that as a general procedure. I think that would be foolish. I don't see any point to it.

CHAIRMAN GILTNER: Are you speaking from the range standpoint or the general standpoint?

DR. MARSH: From the range standpoint. It would also apply to all cattle, in my opinion. It would be a waste of time. Will that calf carry the infection to maturity?

DR. COTTON: Certainly she would.

DR. MARSH: I have checked on a lot of heifers that showed a reaction, but I never saw one carry through.

CHAIRMAN GILTNER: Dr. Birch will summarize.

DR. BIRCH: This is not to be a summary, but the testing of calves before vaccination shows up a condition which we always find, or usually find, in the herds which should be vaccinated—that is, in the herds that carry heavy infection.

We do find among the calves a great many reactors. They are taking milk from infected cows, or recently have taken it, and under these circumstances we could hardly reject all reactors. The reactions are transient and tend to disappear soon after the calf ceases to take milk.

In this discussion I think we are tangled up in one particular. We are not considering the difference between the internal conditions in the herd and the question of reacting calves as it applies to the inter-herd movement of animals. Certainly we could not take out of our badly infected herds all of the animals that show reactions as young calves. Hence, for the vaccination program within the herd, the status of the young calves with regard to the agglutination test is not of great importance.

I think those who have raised the objection have done so on the ground that the cattle that are to be moved out of these reacting herds represent danger, and that is a legitimate objection.

DR. HENDRICKS: Dr. Giltner, one question, please, to Dr. Birch:
Would you mind answering this, then, in connection with the question asked by Dr. Gow? He wants to show that animal, to move it interstate and show it at 18
months after it has been vaccinated. If that animal carried a natural infection when it was vaccinated, might it not carry a reaction at 18 months even though it is not bred, and should not it be withheld from the show if it is a reactor?

Dr. Birch: Yes. It might be a spreader under those circumstances, and it should be withheld from interstate movement.

Dr. Gow: He said 18 months. What month would you put it at, then? I said 18 months arbitrarily. You can make it 10, 12, or 15 months. What month would you put it at?

Dr. Birch: The evidence, even with the fully virulent strain, is decidedly against spread before the animal becomes pregnant and before she gives milk.

Dr. Gow: All right, then. You said 18 months. Beef cattle can't be bred until they are 18 months old, so how is she a danger or a spreader in the show circuit?

Dr. Birch: I stated a while ago that the scientific evidence indicates that while these animals are not usually spreaders, the universal experience among sanitarians is that if that contact is permitted there are dangers involved. Sometimes these animals are pregnant when they are 18 months old, and we don't know they are. That is one danger.

Dr. Gow: Would you state, then, what month we could show them? We will leave the 12, 15, or 18 months out of it.

Dr. Birch: No, I can't say that in terms of months. When a reacting animal becomes pregnant she is a definite menace to clean cattle.

Dr. B. J. Killham (Michigan): I believe we have ample evidence to show that the unbred heifer is not dangerous as a spreader of Bang's disease. I do not think it is so important whether the reaction was acquired in a natural way or through vaccination, but how in a practical way is the Fair official going to determine whether or not that heifer has been bred? If you want years, put it down to 12 months; probably at 12 months the heifer has not been bred. After that it may be bred at any time and the Fair official cannot determine it.

Dr. Birch: That is a good suggestion.

Chairman Giltner: Thank you. Let's get away from the heat of the battle. (Laughter) Dr. Eichhorn, see if you can calm down the crowd a little by answering this: Is it desirable to consign to slaughter an animal that was properly vaccinated during calfhood that later reacts in the dilutions of at least 1-100, or should it be held for one or more retests at monthly intervals?

Dr. Eichhorn: It should be held for further retests, because from experience unquestionably the vaccinated calves might carry the titer for a long period, even up to breeding time, and still not be infected. But in the great majority of cases they lose the titer sometimes before pregnancy is established.

There are a couple of men here who haven't had a chance to answer any questions. In Dr. Mohler's paper the catalase test was mentioned as having been developed by Dr. Huddleson for the purpose of determining the virulence of the various strains. From the public health standpoint, I would like to ask Dr. Huddleson whether Strain 19, as indicated by the catalase test, is of such virulence which would endanger public health?

Dr. Huddleson: It is my opinion that in the present state of biological activity Strain 19 is not infectious for human beings, and I do not think there is any
possibility of it changing to the pathogenic form. There is a tendency for cultures to decrease in pathogenicity rather than increase.

DR. EICHHORN: Do you consider the agglutination titer in vaccinated calves as an index toward the development of immunity?

DR. HUDDLESON: I do not, Doctor.

CHAIRMAN GILTNER: Dr. Birch has the answer. What is it?

DR. BIRCH: The answer is that there is no cause and effect relationship there. The agglutinins are not the products that are producing the immunity, and in the exceptions we have found to the immunity, we have found them both among the high titer and the low titer calf.

CHAIRMAN GILTNER: By this time it is perfectly obvious that there are a great many questions which might arise in the minds of men here that are more pertinent and more desirable to answer than the ones I have here. If anyone feels the spirit move him, just float up to one of the microphones and ask your question.

DR. A. H. QUIN (Iowa): I wonder, Dr. Giltner, how you will in effect enforce any regulation or gauge any future activity if abortion vaccine continues to be sold direct to the cattle owners through every drug store from Pemberton to New Orleans, to be used on adult cattle, pregnant cows, herd bulls, and so on?

CHAIRMAN GILTNER: That's not so good! (Laughter) That question was put to me before I came here. Someone was telling me today that there is a case coming up before the courts on this matter of interference with trade as far as confining products to the veterinary profession is concerned. So let's wait and see how that comes out. (Laughter)

DR. T. C. GREEN (West Virginia): If a reacting calf before reaching sexual maturity is not actually an infected calf, I would like to know why we are condemning such cattle and paying state and federal indemnity?

CHAIRMAN GILTNER: Those are infected calves sometimes, aren't they, Dr. Birch?

DR. BIRCH: Some have residual infection, and others have transient infection. I don't know what the age limit is at which indemnities are being paid, but I do not think they are being paid on very young calves.

DR. WIGHT: As far as the federal government is concerned, there is no indemnity payment made for animals that are vaccinated as calves unless at least 18 months have elapsed since the time of vaccination. Further, there will be no payment made as indemnity on any animal that has been vaccinated after it was 8 months of age.

DR. GREEN: I don't think Dr. Wight understood my question. The point I am trying to make is that in the test and slaughter method it has been the practice to pay indemnity on all reactors over 6 months of age. Now, since these calves may not have natural infection but something which may be transient, why not hold the reacting calves that have not reached sexual maturity until they have been retested to determine whether or not the titer is transient?

DR. WIGHT: I would like to ask some of the field men about that. I haven't noticed very many animals going through that could be said to be in the class you describe. I would like to ask Dr. DeFosset about that.

DR. A. J. DEFOSET (Ohio): I don't know if I understand the question fully,
but it appears to me that the gentleman asked if a man should be paid indemnity on animals that react when they are vaccinated at 6 months.

Dr. Hendricks: No, just a calf under the age from which it might lose a natural titer.

President Crossman: A reacting heifer, unbred.

Dr. Green: My question has no connection with vaccination at all. The question has been brought out this morning that a titer may show on some calves that have not reached sexual maturity, but that it is transient and may recede, and one had an infection due to milk from the mother, or something of that nature.

We test those calves between 6 and 18 months of age, and they react and we condemn them. I will admit it is rare, but I have found them, and I imagine others have also. If it is transient, why shouldn't we hold those calves and test them to determine whether it is transient or not?

Dr. Defosset: We are making tests in all kinds of herds. We do not know whether the animals in the herd have been exposed to infection or not. They are an unknown quantity. We, of course, do not bleed calves until they have reached six months of age or over.

In our state we find very few that react at the ages of six months to one year, that is true, I don't know why more do not. We do have more that react when they reach the age of say 12 to 18 months; as a matter of fact, we get a few more reactors when they reach these higher ages.

Now, I presume the question is why they should be condemned at that age and why they should not be held to see if they will clear up. That is a debatable question. I do not know the answer. Of course, we are all trying to eradicate or control this disease. We don't want to compromise with it. I believe under present rules, very few animals may be destroyed which may not be actually infected. I am sorry that I cannot answer your question more completely.

Dr. T. H. Ferguson (Wisconsin): While we are on the question of making blood tests of calves before vaccinating, I wish to state that in a good many instances it causes unnecessary expense to the owner. If a client lives ten or twelve miles from his veterinarian's office and is having his calves vaccinated at the proper age against Bang's disease, he does not feel disposed to pay a veterinarian for a visit to get a blood sample for each calf. If they were all born the same day, and he could make a job lot of it, then it would be more satisfactory.

In the light of our present knowledge we know that in practically all cases this infection is caused by the calf swallowing the colostrum of an infected cow. If we instruct our clients how to properly handle these calves, this infection is bound to be removed in a few days, probably a few weeks at the most. By the time they are ready to vaccinate there is no danger of their being infected except in very rare cases.

I believe Dr. Cotton mentioned one or two cases pointed out by Dr. Theobald Smith where the organism remained in the lungs and eventually caused pneumonia. That was just one or two cases. Practically all calves, in my opinion, if they are properly handled from the time of birth until vaccination age, will not react to the blood test. It is almost impossible, in doing field work, to make these visits at any-
thing like a reasonable "break" for the owner. To blood test and then vaccinate a calf or two at a time may mean the expense of a twenty mile drive. For all practical purposes it seems to me that regulations permitting vaccination after the owner has been given proper instructions in disinfecting his premises where he keeps these newborn calves, and taking them away from any possible infected milk, would solve the problem in fine shape.

Dr. C. P. Bishop (Pennsylvania): I don't know whether I can add very much to this discussion. If a calf is not receiving milk from an infected dam, or if we feel it is a passive infection but find that after the animal is 6 months of age its test reacts positively, then we think it should be eliminated. However, there are a few cases that will clear up despite that, but we think if it is a passive infection from the milk and then positive after 6 months thereafter, the animal should be taken out.

Dr. E. A. Watson (Canada): On this question of testing calves, while it is an advantage no doubt to test the calf both before and after vaccination, from the practical point and from the aspect of efficiency of the vaccination, my own belief is that it would be more important to test the calf at a suitable interval after vaccination rather than before, because in our experience it is the calf that has not reacted satisfactorily to the vaccination which accounts for that small percentage which abort later on in their pregnancy.

I don't know the titer necessary, but the satisfactory reaction after vaccination is a very good index of the efficiency of the vaccination. From that point of view alone it is important to test the calves within a month or two after vaccination if they do not react positively to re-vaccination and get the best possible results. I do believe they account for the majority of the so-called breaks. Otherwise, the vaccine was not potent at the time it was administered.

Dr. E. M. Braggood (Connecticut): You are talking about infection of young calves. That has always been in my mind. I ask what you mean when you speak of a positive reactor soon after its birth. It does not mean that the calf is infected—it means that the calf (according to Dr. Theobald Smith and Dr. Little of the Rockefeller Institute) has picked up soluble antigens, that the calf is reacting, and that there are agglutinins in the blood and the colostrum of the dam. They show that if one takes a calf away from a positive mother so that it does not feed on the colostrum of the mother, that is, if the calf is removed within two days, the calf does not give any further reaction. Something happens to the lining of the digestive tract and it cannot absorb from the tract the agglutinins that are in the colostrum.

I believe that is the main reason why calves, with very rare exceptions, give up the reaction. They gradually shade off, and by the time they are 6 months old there are very, very few reactors. After that, if there is a reaction it may be an occasional reaction still holding over from calfhood, but if there is a definite reaction you may feel pretty well assured that it is infection from without. That is an important matter.

I am not advising whether you should have all calves tested or not, but I have been satisfied all these years—and I have mentioned it in the subject of Bang's abortion disease—that the number of calves which continue to be positive, no matter whether they are from positive or negative dams, is extremely small. As one
speaker said, it is only about one in a thousand. Of course, there are exceptions. I believe a number of speakers here have exaggerated the exceptions, and in my opinion we should clear that up.

CHAIRMAN GILTFNER: Thank you. Those who wish to continue the argument will please meet out behind the barn. (Laughter) In order to cool down a little, let's change the subject.

Dr. Huddleson, relative to the relationship of undulant fever to Bang's disease, it is stated that we should exclude men having tuberculosis from association with dairy herds, should this also apply to those having undulant fever?

DR. HUDDLESON: Who have had the disease?

CHAIRMAN GILTFNER: Either who have it as ambulatory cases, or who have had it.

DR. HUDDLESON: There is no reason why the person who has recovered from the disease should be excluded from handling dairy cattle. However, a person who has the disease has no business handling susceptible animals. He is a potential reservoir or source of infection. There is no definite data available to show that there is transmission from one human being to another, that is from an infected human being to a normal human being, yet we do know that infected human beings eliminate the organism in the urine and in the feces at wide intervals, maybe every few days. It is natural that a man who is infected may leave his excretions in the dairy barn around where the feed might become infected, and a man who is infected, just as in the case of an infected cow, should not be permitted to handle susceptible animals.

CHAIRMAN GILTFNER: Are precautions taken in a hospital where they handle a great many undulant fever cases as they would with typhoid?

DR. HUDDLESON: There is only one place I know of in the world, and that is on the Isle of Malta. There are no precautions taken there to separate brucellosis cases from the other infectious diseases or patients that are in the hospital. They may lie side by side in the same ward. They have no history there, through a great many years, of infection being transmitted from the brucellosis patient to others.

CHAIRMAN GILTFNER: Do the nurses take any precautions when going from case to case?

DR. HUDDLESON: Yes, the same precautions that are taken in handling of all infectious diseases.

CHAIRMAN GILTFNER: Try this, please, Dr. Huddleson: Do you think accidental inoculation with Strain 19 would imperil a human being?

DR. HUDDLESON: I am glad you ask that question, because that is going to be raised in the future.

When a veterinarian accidentally (or some of these farmers who are using vaccine) inoculate themselves, and a reaction follows, the question that arises—Is the reaction that follows and which may persist for several weeks active infection?

We know today that about 99 per cent of the veterinarians, after they are in cattle practice for more than two years, become sensitized to Brucella. That is, they manifest a skin allergy and a systemic reaction when the protein passes through the skin or mucous membrane.

A veterinarian who accidentally inoculated himself with whole organisms is
quite likely to show an allergic reaction which may persist for many weeks, and it is quite likely to be very serious.

The reaction, of course, will begin within 7 to 10 hours after inoculation. Since the reaction persists for a long time a physician may be called in. He is quite likely to say that it is due to an active infection from Strain 19, while in all probability it is nothing more than an allergic reaction due to the inoculation of whole organisms.

While I am on this question, I wish to say that you veterinarians should never permit a physician to give you a skin test with Brucella allergic material to determine whether you are allergic to brucellosis. It is not necessary and it is very likely to lead to a very serious reaction. Many veterinarians who clean cattle are showing an almost continuous allergic reaction, and naturally when they go to a physician, the physician is quite likely to say, “This is probably brucellosis.” If a skin test is performed, the reaction which follows may be very serious. A diagnosis of the disease in such cases can be made by other means.

CHAIRMAN GILTNER: Thank you. There is another question which I believe has been answered in previous papers. If someone thinks otherwise we will bring it up. “What danger is there of man contracting undulant fever through the use of milk drawn from cows that were vaccinated with Brucella vaccine as calves?”

I believe this question has been answered in the papers presented.

Are there any other questions relative to this human health aspect of the problem? Let’s retreat a little. What effect on milk production has the vaccination of adult cows? As I understand it, the Bureau of Animal Industry does not advocate the vaccination of adult cows, so I doubt very much whether anyone here would admit he has an answer to this question.

DR. A. B. CRAWFORD (Maryland): Several years ago, at the Animal Disease Station, we had an opportunity to secure data on this subject. There was a very valuable herd belonging to one of the government agencies, in which occurred an outbreak of Bang’s disease. The officials of that agency came to us and asked if we would care to vaccinate the herd. They were anxious to have it done, so we vaccinated the 60 animals in that herd. Twenty-three of them were in milk production. We made tests of the effect of vaccination on milk production in the twenty-three animals. The milk produced by each animal was weighed for a period of 12 days before the animals were vaccinated. We made tests of the effect of vaccination on milk production in the twenty-three animals. The milk produced by each animal was weighed for a period of 12 days before the animals were vaccinated. Immediately after vaccination the milk for 12 days was again weighed. The result showed that on the first day following vaccination there was about a 5 per cent decrease in the quantity of milk produced; on the second day it was between a 6 and 7 per cent loss; on the third to the fifth days there was a gradual decline in loss and on the sixth day the milk supply was back to normal. It remained at that point for the test period.

DR. A. K. KUTTLER (Idaho): Dr. Giltner, I think we have passed over the importance of identifying vaccinated calves too lightly. I believe there are some
good reasons why we should properly identify vaccinated calves, and I would like to have those reasons brought out.

CHAIRMAN GILTNER: Shall we take that up behind the barn, or decide it here? What do you think, gentlemen of the jury?

DR. FERGUSON: I would like to ask if there is any set rule on vaccination in herds with this Strain 19 in older cattle, where there have been outbreaks of abortion? There is a constant demand from clients who do not wish to submit their herds to the test and slaughter plan. These farmers are constantly having trouble from their cows aborting calves. They are primarily in the milk producing business. They do not raise cattle for sale. They only sell when the animal is unfit for dairy purposes and then for slaughter. But they want to try to maintain any protection they can against abortion in their herds.

This question comes to a veterinarian practicing in a dairy district two or three times a week. It is an old question and it might be a good thing to have it definitely answered here on the floor.

CHAIRMAN GILTNER: I think both questions relate to the same subject. What difference does it make whether you identify the vaccinated animals? What harm does it do to vaccinate mature animals? Dr. Wight, would you like to answer that?

DR. WIGHT: I think Dr. Cotton would know the answer better than I.

DR. COTTON: The vaccination of a mature animal will not fit in with the test and slaughter method; it interferes with it. That is the main reason for not vaccinating adult animals.

DR. FERGUSON: I understand that, Doctor, but here is a man, let us say, who has a herd. If you went in there and made a blood test you would probably find 20 per cent or more that would react to that blood test. The man is in the commercial business of producing milk. He is having trouble and is losing his calves as fast as he gets pregnant cows. The question is does Strain 19 confer immunity on aged animals?

DR. COTTON: Yes, I think adult animals are protected as well as the calves.

DR. FERGUSON: Now, here is where the farmer comes back at you: If you admit that it confers immunity on his aged animals, why can't he use it? He has already got an infected herd and he hasn't any desire to go through the test and slaughter plan, for the reason that he may have tried and failed, or some of his neighbors have had bad luck with the plan. Probably a good percentage of live stock farmers do not attend to all the a-b-c's of sanitation along with the test and slaughter or any other plan. They cannot see why, if there is the same virtue in Strain 19 for adult cattle as for calves, they cannot use it in their herds under proper restrictions in order to confer immunity on the cattle with which they are having trouble. Do I make myself clear?

DR. COTTON: I might say that in that herd it would be beneficial, I think, but of course, it interferes with the test and slaughter program. If a plan like that could be worked out it would probably be a good thing, but of course you want to guard it so you won't be worse off. If there is a safe way of doing it in herds of that kind, it would be a good thing.

DR. FERGUSON: That is one of the biggest questions I know of in actual practice. We meet it every day. It seems to me to be a problem that has to be handled in a
special way to give satisfaction to those men who want help. You can't sell a man
the test and slaughter method if he does not want it. I think this organization
should give that some consideration.

Personally, I can't see but that it could be worked out in such a manner that it
would have no material effect on the vaccination of calves exclusively, and the
test and slaughter plan. These men are not asking for indemnity—they want help
if there is help to protect their pregnant bovine females.

MR. MILLER: In that connection, and particularly in connection with the beef
herds with which we have had some experience, I have found that by vaccinating
cows that showed two negative reactions, whether or not they carried their calves
for full term (and all of the cows that were vaccinated were kept away from the
bull for a period of from 100 to 120 days), we have obtained as high as 90 and 96
per cent live calves out of a herd of approximately 90 beef cattle. That has run for
two years. We got about 89 per cent the first year after vaccination from mature cows
and 96 per cent the second year. We are well pleased with vaccination of mature
cows and the Ohio plan works well where infection is high.

DR. OSCAR SUSSMAN (Massachusetts): Up in Massachusetts some of the men are
interested in what part the milking goat would play in the Bang's disease
program. Some of them feel there may be some possibility of protecting them, since most
goat milk is not pasteurized, and many of the farmers want to get in on a program
in which goats will be tested. I would like to hear a discussion on this matter.

CHAIRMAN GILTNER: What is the attitude of the government in connection
with the goat in the program?

DR. EICHHORN: The government has no definite program with regard to testing
of goats. However, in the various states the boards of health, especially in the
eastern states, now require that goats be subjected to periodical testing. In some
states, it is 3 months, and recently we had an inquiry as to whether 6 months
would be sufficient. Some periodical testing of goats is advisable, and possibly
testing at 6 month intervals would be sufficient.

Now with regard to the prevalence of the diseases of goats, we have made a
survey—not an extensive one—and outside of some very few outbreaks or rather
positive reactions which we got from goats in the southwest, we have not had a
single instance of goat infection in the middle west nor in the east.

CHAIRMAN GILTNER: Dr. Eichhorn, there is a question that someone still is not
satisfied about, that is, the desirability of identifying the vaccinated calf. Do
you wish to say anything about that?

DR. EICHHORN: That is entirely up to the regulatory officials. If you will permit
me I should like to answer Dr. Ferguson's question with regard to vaccinating the
mature producing animals.

He said it does not matter to the man whether he gets any indemnity or not. If
he does not, then in the paper presented by Dr. Mohler it was distinctly pointed
out that there is a "C" group providing for just such instances.

DR. FERGUSON: Pardon me. I didn't hear Dr. Mohler's paper, and I didn't
quite catch the last sentence of Dr. Eichhorn's statement just now.

DR. EICHHORN: In most of the states there are three groups in which the cattle
can be handled. The "A" group is the test and slaughter method. The "B" group
is a combination of calfhood vaccination and the test and slaughter method in which indemnities are paid for the reacting animals. The "C" group is outside of these two other groups, and in this group the animals might be vaccinated, but the owners are not compensated for their reactors.

DR. FERGUSON: I understand those regulations perfectly, Doctor, but it does not make any provision for a farmer who wants to vaccinate his older cattle. Consider, for example, a herd in which a storm of abortion is coming on, and the farmer is worrying about his young stock which he is either then breeding or going to breed in 3 or 4 months. He would not come under any of those three regulations.

DR. EICHHORN: Possibly in some of the states the state sanitary authorities would not say to use a certain procedure, but in the majority of cases I think it provides that it is up to the individual whether he wants to follow that particular method as provided for in the "C" group.

DR. FERGUSON: It is provided in our state that such a farmer, if he has his herd tested and reports on the status of the herd's blood tests, is permitted to vaccinate his calves.

The men in my state want to know if there is any good in Strain 19 for old animals in herds where there is a storm of abortion breaking or already broken, and whether they will be permitted to use it or not.

There is a great deal of bootleg vaccinating going on now, which isn't a very desirable thing for this organization or for the veterinary profession. I believe some stand should be taken on that. A simple answer to my question will make it much easier for practitioners who have to handle these cases and problems every day.

DR. DEFOSSER: It seems now that we have two questions converging into one. We have one asking why calves should be identified; also, the question of whether or not we should endorse or approve the vaccination of adult cattle in such a program as we have in the United States today.

It seems to me we must keep in our minds the fact that farmers, dairymen, and breeders in this country are desirous of compensation in part for their diseased cattle. They have made that request known to the state legislatures and to Congress. Now then, since it is known that it is difficult to distinguish between a titer caused by vaccine and one caused by disease, it is obligatory on our part to determine when appraisements are made and indemnity vouchers certified, that we are certifying to cattle actually diseased. Isn't it essential that we know when calves react, what they are reacting to? If these calves or any other cattle when vaccinated would remain stationary in the herd or on the farm, like a tree, there would be no great concern.

We are, however, dealing with something that is transient or moving in the channels of trade. If calves a few months after vaccination move out into a herd where blood testing is going on, these calves, if not identified, may react and be unjustly destroyed. If the cows always remained where they were vaccinated, it would not make so much difference insofar as interference with the program is concerned, but these cows in many cases become objects of speculation and almost daily we may find some of them in our markets and if vaccinated and unidentified, certainly would break up a program such as we have now. I don't see how our breeders could continue to go to their legislative bodies and ask for appropriations
for indemnities if they knew the money might be used in payment for cows floating about with vaccine in their bodies.

I believe that is one of the questions we are faced with here and it is a very serious thing. I am certifying to vouchers daily in my office for cattle slaughtered because of brucellosis. I have certified to vouchers that aggregate $3,000,000 in public funds that the legislative bodies appropriated for the payment of indemnity. I think the breeders as well as sanitary officials are interested in knowing whether or not the animals were actually diseased or if they were destroyed because they were carrying a vaccine titer. We cannot be certain unless vaccinated cattle are identified.

DR. FERGUSON: I would just like to tell the doctor that he has the wrong slant on this matter. In the State of Wisconsin you cannot sell or move a cow without a blood test. You cannot transfer one cow to another man without a blood test. We all understand that. What I am talking about is a group of dairymen that haven't any desire to utilize the test and slaughter method. They know that if they wished to sell their herds tomorrow morning they would have to furnish a certificate of a negative blood test for each animal sold except for slaughter, and they would get no indemnity for animals slaughtered. The herds are breaking, now and then, with abortion disease. If there is any good in Strain 19 for adult cattle they want to know it. They are not putting the cattle on the market nor moving them. According to our state laws, cattle cannot change ownership for removal to another herd unless negative to the blood test; neither can they be pastured with other cattle without a test.

DR. HENDERSHOTT: Several things have been stated, and I have one or two things to say. One is in relation to the Bang's testing of goat herds.

In the eastern seaboard states there are a number of goat dairies. In New Jersey we have some 800 goat dairies, all of which are under supervision for the control of brucellosis and tuberculosis the same as any bovine dairy herd would be.

We have tested these herds of goats in the same fashion as we test a dairy herd, and we accredit them. We do not pay any indemnity; we have not found it necessary to indemnify except in two instances out of some 1400 goats that are tested annually. In the last four years we have discovered two reactors to the Bang's disease test, so brucellosis in goats in New Jersey is no problem whatever. We have had one reactor to the tuberculin test.

The question "Will the accidental inoculation of a human being with Strain 19 vaccine cause that person to have undulant fever?" has not been satisfactorily answered for me. Dr. Huddleson has talked about the veterinarian who has been exposed to brucellosis and carries an agglutination response to the disease, and the effect that an accidental inoculation of such an individual might have. I am interested in knowing the effect of Strain 19 accidentally introduced into a susceptible pure body, that is, one that has not been exposed previously to brucellosis.

DR. EICHHORN: May I answer that? From the experience of all personnel at the Animal Disease Station we have had several cases of undulant fever. In all I think about 8 or 9 cases resulted from accidental infections. In all these cases, however, we are reasonably sure that it was not Strain 19, although that strain is handled more frequently than the virulent strains which are being employed in
research work. The blood cultures which at the time were positive in those particular cases were tested, and in no instance did we find Strain 19 involved in that particular infection.

DR. HENDERSHOTT: That still does not answer my question.

DR. HENDRICKS: Gentlemen, the question Dr. Ferguson raised has not been answered either. I think Dr. Ferguson is entitled to an answer. The question is pertinent because every one of you has the problem in your own state, whether you are regulatory officials, practitioners or whatnot. You all know that a great many men are vaccinating lactating animals. What are you going to do about it? I know it is a very pertinent question for the practitioner. It is also a pertinent question with the regulatory officials, because you are trying to conduct in your state an area program in conformity with the Bureau, wherein calfhood vaccination may be used along with a test and slaughter program.

Now, if you are going to conduct an area program, you want to clean up with an idea of getting an accredited area. So the regulatory official says, "We don't want to vaccinate a mature animal because it will delay the date when we can obtain an accredited area." The practitioner says, "We have got a herd in which we are having a lot of trouble. We have too much infection to attempt to go under a test and slaughter program. We want to sell our milk and we want to stay in business, so what do we do? We want to prevent a storm of abortion. Shall we vaccinate open heifers and lactating cows?"

In my opinion those herds should be handled separately as a problem herd, and if in the best interests of the dairyman the practitioner can keep those animals in his herd and continue to produce milk, I think you have got to permit him to vaccinate his open heifers and his lactating cows, but that herd should be kept as a quarantine herd; should be kept separate, and should be handled entirely under a separate plan. Certainly it will delay the date when you can obtain an accredited area in that particular instance, but it is your problem, and you must handle it in your own state.

Now, gentlemen, I am an advocate of putting this program on a practical basis. Two years ago, I read a paper here on calfhood vaccination and the handling of this disease in western states. I find that we must work with the government. I also find we must make a program which is practical and with which the cattle owner can comply. I see no reason why, then, even though it is not always advisable to vaccinate mature animals, that we should not recognize it in these cases and permit it, but hold it under official control. If we do not do so, cattle men are going to vaccinate mature animals promiscuously, and the control program won't get anywhere. So why not give it some recognition and at the same time control it?

CHAIRMAN GILTMER: Ladies and gentlemen, on behalf of this distinguished panel and myself, and those who have participated from the floor, I wish to thank you. Adjourned.
A NEWER SPECIES—THE EXTENSION VETERINARIAN

B. J. KILLHAM

The extension veterinarian is not exactly a new individual but he is new in the field as compared to the veterinary practitioner, the veterinary inspector, the teacher of veterinary science and others.

When presenting a newcomer it is undoubtedly in order to tell something of his origin and to discuss his antecedents. Some wag might say that the extension veterinarian was sired by the extension service and dammed by the practicing veterinarian, but such an accusation would not be entirely true or fair because there is evidence to show that the practitioners in some states have initiated the efforts to establish an extension veterinarian.

The extension veterinarian came into being because of demands for service that were not being met by existing agencies. A veterinarian keenly interested in the subject has said: "Extension veterinarians justify their existence by keeping live stock owners and farmers conscious of the fact that the veterinary practitioners in their immediate communities can assist them materially in preventing live stock losses and saving many sick and injured animals"; and: "Extension veterinarians justify their existence by helping veterinarians, live stock owners and farmers and regulatory officials to promote the control and eradication of infectious live stock diseases."

A veterinarian doing educational work in the field must of a necessity be allied with the extension service. There is no other practical way of carrying on such an endeavor in an intensive way over a period of time.

Some might say why have an extension veterinarian, is the field not adequately covered by the practitioner, the research worker and the teacher? The answer is "no". The practitioner can and does do an enormous amount of extension work in his own community, but can he afford to do a complete job without the expenditure of too much time and effort and the sacrifice of some of his means of livelihood? Also, is there not a point beyond which the practitioner may not go without his motives being questioned or even suspected? Is it not conceivable that an honest, conscientious practitioner might be criticized severely for too strongly emphasizing certain prophylactic medications or biological treatments even though the procedures were absolutely sound and in accord with the best thought in the profession? Such promotion could be conducted by a person neutral insofar as financial profit is concerned. And, would it not be better to have a veterinarian engaged in the promotion rather than to leave the task to someone not qualified in veterinary science?

The research worker, the tireless behind-the-scenes toiler, is a basic instrument in the control and treatment of animal diseases, but he is like the dynamo in the power house—he needs conveyors to get his findings out to where they can do the most good. The reports of the research worker get to the veterinarian who has been trained to understand the technical discussions, but who, in a neutral capacity, is to

1 Michigan State College, East Lansing, Michigan.
carry what the animal owner should know to the animal owner and deliver it in terms that can be understood? This task is certainly not a job for an untrained person or one trained in other lines of endeavor. Pseudo-scientific writers during recent months have been raising havoc with animal disease control efforts by conferring with investigators and then publishing their own interpretations in so-called popular articles. Sometimes the investigators consulted seemed to be hand picked because of certain findings, and often it appears that the writers first try to find what it is that the animal owner is most anxious to hear or read with reference to a disease, and then the kind of findings—possibly incomplete or preliminary—that appear to support the desired end are published in highly embellished terms surrounded by arresting but often misleading headlines.

Something should be done to counteract such work. The research worker is too far behind the scenes to function in this capacity. The practitioner might be censored if he tried too much and the untrained worker might increase the muddle by efforts to clarify the situation. The extension veterinarian could and does function here and in other capacities, and the extension veterinarian usually being situated close to the research worker and familiar with his work is in a very good position to function efficiently.

The teacher of veterinary science reaches students and occasionally other persons, personally, and his opinions and advice may reach many others through the press and otherwise, but usually his influence filters through slowly and it may not reach interested persons by older routes until new ideas are old. It is true that veterinary extension work in some states is conducted by research workers and teachers on a part time basis, but here the very able individual in the background is doing his own interpreting in an extension capacity which is sometimes advantageous but the arrangement may present a handicap under some conditions.

It has been said that an extension veterinarian is "One who interprets the findings of research and evaluates them for immediate and future application to practical livestock production. He serves as a public relations representative for the veterinary profession before other groups". The interpretations of extension veterinarians for the laity should always, of course, relate only to the prevention and control of disease. Treatment of or for disease is and should remain the function of the practitioner. It might be contended that advising animal owners regarding the control and prevention of disease may be a means of diverting work from the veterinarian. That has not proved to be true and in our experience we have never encountered a practitioner who was opposed to his clients having knowledge of sound methods of disease prevention and control. Such knowledge usually means that the animal owner becomes more interested in the health of his animals and consequently he employs measures and prophylactic procedures which necessitate the services of a veterinarian. Witness the campaigns to control tuberculosis, Bang's disease, mastitis, hog cholera, horse parasites and many others. It is true that in some localities, even some states, work which should have gone to the veterinarian has been diverted to other channels, often with disastrous results, but in the main the practitioner has profited by these efforts and he has in turn shared the profit with the animal owner. Apparently many of the evils crept in before the advent of the extension veterinarian, and probably on account of his absence, be-
cause other persons, untrained in veterinary science, but already in the field took over tasks which they were not qualified to perform. It will take time to change some of these practices.

Veterinarians in some states have condemned extension work in all of its phases, even going so far as to try to prevent federal appropriations for the purpose. It is very apparent that the extension program in all states has not been entirely happy for the practicing veterinarian, and because of that situation efforts have been made to arouse discontent and opposition not only in affected states but also in states where there are no important conflicts with practitioners and where policies of cooperation and understanding are in effect. Need we say at this time that the extension system is too big to be upset by the veterinary profession? Is it at all probable that any veterinarian would oppose such extension efforts as the 4-H Club projects and much of the home demonstration work? If not, it must be phases of extension work and not the entire system that need correcting. It is not customary to blow up a ship to remove the barnacles.

The last County Agent in Michigan to attempt to vaccinate hogs was eased out of the picture nearly 25 years ago by a veterinarian—a veterinarian unofficially engaged in extension work who kept closer to the telephone than did the County Agent. Later the County Agent thanked him for the rescue from a distasteful position.

Should it not be possible to progressively correct the faults of a system by having a representative close to the seat of the trouble at all times. And, in the case of activities and projects relating to veterinary science why not a veterinarian—an extension veterinarian. It might be contended that a veterinarian in that position might swing over to the enemy—turn against the veterinary profession. Very well, then insist on having a voice in the selection or replacement of the representative and try to get a sound one at the outset.

In one of the states located a little south of here, an extension veterinarian spends much of his time enrolling and guiding young farm people in a project devoted to approved methods of producing healthy live stock and the prevention and control of diseases and parasites of farm animals. In this state it is also necessary to strongly emphasize rabies control. The one statement that appears on practically all of the literature emanating from the office of this worker is: "If an animal is sick or needs to be vaccinated, call a veterinarian."

In a western state the extension veterinarian has worked with F.F.A., 4-H Club members and veterinarians to the end that community testing for Bang’s disease has been conducted on a very satisfactory basis, and as a result of these efforts there will be much retesting of accredited herds to revert to the practitioners. A calfhood vaccination program is now to come in for consideration.

An extension veterinarian who acquired much formal education and experience in poultry husbandry before attaining his veterinary degree has developed and conducted continuation schools on poultry and poultry diseases for the veterinarians of his own and other states. This has opened a new field for many practitioners and has permitted them to much better serve their clients.

Artificial insemination offers a large field for use and abuse. Many phases of this work, particularly those relating to breeding difficulties and diseases of the
genital organs, should come under the supervision of a veterinarian. One state, through its extension veterinarian, has performed some outstanding work in carrying information to and providing help for veterinarians engaged in artificial insemination projects. This type of “trouble shooting” by a qualified veterinarian should be of immense value.

A couple of extension veterinarians may have been criticized for participation in schools designed to teach farmers to vaccinate their own hogs. Before you become one of the critics, may I ask if you have attended one of the schools or if you did your share to block the legislation which makes such schools mandatory? If the schools are required, someone must do the teaching. Would you have it done by a layman? The evidence indicates that much good has been accomplished through these schools despite their evil trends. Many of the farmers who attend come to audit and not to qualify, and much of the material presented pertains to sane disease control and prevention measures. If the word of many practitioners is acceptable, the schools perform a service even for the qualifiers, who, after a brief period of stumbling because of insufficient training, see the light and thereafter proceed on a sound basis. Presumably, the qualifiers are much like the graduates of a certain school of breeding who for the first year after leaving their Alma Mater are amply self-sufficient, but who acquire wisdom with the bumps and in the second post-graduate year are willing and eager to obtain help from persons who have had at least 200 times as much training.

Shortly after the appointment of an extension veterinarian in one state a few complaints of improper extension activities reported to the State Veterinary Medical Association resulted in the appointment of a committee which asked for and had a conference with the Extension Director, Dean of Agriculture and several college department heads. Following the conference the Dean of Agriculture appointed a committee composed of representatives from the dairy, animal husbandry, poultry, extension and veterinary divisions, with a veterinarian as chairman. After considerable deliberation the committee formulated a policy covering the relation of extension work to the veterinarian which was approved by the extension director and has now for more than ten years governed the relationship with practically no friction. A few excerpts from the policy statement follow:

“Animal and poultry husbandry can be considered as adequately protected against the losses of disease only when there is an adequate number of research workers studying the problem of disease and an adequate number of well trained and competent veterinary practitioners constantly available to animal and poultry producers.”

“To veterinarians we suggest that the practice of veterinary medicine as it applies to agriculture is largely an economic service. The practicing veterinarian has his service to sell. Unless it is sold at a price that enables both the seller and the purchaser to share equally in the profits of the sale, there is no economic justification for the consummation of the sale.”

“To animal and poultry husbandmen we suggest that profitable animal and poultry production is just as dependent on a constantly available competent veterinary service as is a profitable veterinary service dependent on animal and poultry production.”

“Extension workers in animal and poultry production should take cognizance of
the fact that efforts directed to the establishment and maintenance of competent and profitable veterinary service are primarily in the interest of agriculture, that the interests of agriculture and veterinary science, insofar as they are influenced by animal and poultry disease are mutual; and that a feeling of friendly interdependence and mutual confidence between animal and poultry husbandmen and veterinarians should be encouraged and fostered."

"Extension work has come into the agricultural colleges for the purpose of carrying the practical results of the researches of the colleges to the farmers and helping them apply them to their farms. So far, therefore, as extension workers are competent to understand and explain the findings of the college in their fields, it is expected that they will make these findings available to farmers, but where the need of farmers is for professional service, such as veterinary medicine, it is not the function of extension workers to give this service."

Although the number of extension veterinarians is not large—eleven full time and several others part time—many other specific instances of work and results could be cited, but for the sake of brevity let it be said that they are in the front ranks fighting Bang's disease, mastitis, hog cholera, rabies, parasitic infestations and the many other transmissible diseases affecting animals. Their function here is to aid in the control of animal diseases through educational efforts and organization. The actual testing or treating that may be required is the job of official veterinarians or practitioners, except in the few instances when demonstrations may properly be conducted.

There is a borderline task that should be performed by someone with the proper training and experience who could hardly be suspected of having ulterior motives in pressing his claims. Reference is had to educational work pertaining to animal diseases that are transmissible to man. After human beings become infected with such diseases the physician and health official have jobs on their hands, but prior to that development someone should advise and counsel regarding dangers and control possibilities, and that, obviously, should be the burden of the veterinarian. Extension veterinarians are doing much in this respect, particularly with such lay groups as service clubs, women's organizations and high school students. Practitioners who have the extension urge or desire to help because of community interest frequently apply to extension veterinarians for educational material to use in talking to lay groups about diseases transmitted to man from animals.

Because the interest in human health has been responsible for many of the appropriations provided for the control of animal diseases, this work with the borderline diseases is exceedingly important. Not many diseases of animals will have the appeal in this connection that was the lot of tuberculosis, but many will call for attention in a lesser degree. Although direct contact possibilities are and have been stressed, the dangers from milk and meat have been given much attention. Diseases such as tuberculosis, Bang's disease and mastitis have caused many regulatory measures aimed at checking the spread of these diseases through milk. With only one state in the Union having an outstanding meat inspection ordinance, does it not seem that the dangers through meat should be emphasized to better advantage? Extension veterinarians are trying to do just that, but they cannot put it over without more help.
One of the chief arguments in favor of the sincerity and soundness of the extension veterinarian in his relations with the practitioner lies in the fact that practically without exception extension veterinarians have had as one of their chief functions the fostering and supporting of associations and groups of veterinarians. Many local or regional groups of veterinarians have been organized into associations, meetings are arranged, programs are provided or augmented and even beyond the scope of the meetings late developments pertaining to veterinary science are reported to the practitioners at intervals. We all know that getting veterinarians together and keeping them advised are things not to be done if folks are conducting programs detrimental to veterinarians in any way.

Deep rooted causes for complaints against extension activities by practicing veterinarians are being worked upon tactfully and consistently by extension veterinarians. Newer extension workers are given special attention, short course students and cow testers are contacted and advised while still in college. Cooperative projects are conducted with dairy and animal husbandry divisions whereby lectures and demonstrations formerly attempted by members of those divisions are now the work of veterinarians. This fundamental work is even extended to high school agricultural instructors, high school students of agriculture, F.F.A. and 4-H Club members. The effects of this work are becoming apparent and because much of it has been with young people even better results can be expected in the not distant future.

Extension veterinarians sometimes find it necessary to preach in the wilderness. They go into places where qualified veterinary practitioners do not exist and probably could not exist under conditions that now obtain. There they discuss and occasionally demonstrate animal disease control and prevention. These efforts have served to dispel many erroneous ideas and have, at least, started sound animal health programs. Regions such as these are frequently infested with quacks, if not illegal practitioners, and the damage they do in the name of disease treatment is beyond calculation. Strange as it may seem "wolf-in-the-tail" and "hollow horn" have been diagnosed during the last decade. Until veterinary service associations, state subsidies or some other legitimate procedures induce qualified practitioners to serve these neglected territories it is probable that proper extension efforts will have to suffice.

Many of us recall that at the outset of the concerted tuberculosis eradication campaign, some veterinarians complained that the early testing was taking work away from the practitioners. That early testing, however, was just a form of extension work, and as a result the testing increased in volume and ultimately practically all reverted to the practitioners who qualified as accredited veterinarians. The same thing is happening in connection with the campaign directed against the control of Bang's disease. Much of the blood testing is yet conducted through official veterinarians but despite this the volume of testing initiated by practitioners is increasing. And, in this campaign there is also the calfhood vaccination to consider. The war against mastitis is just fairly started. Extension work is now building the ground plans for the long struggle for the control of this disease.

And so, with the important diseases mentioned, and others which may attain or
return to importance, the extension veterinarian shall continue to give battle. He will employ his knowledge of veterinary and allied sciences in an effort to promote sound animal disease prevention and control programs. He will in no instance endeavor to supplant or compete with the practitioner. While it is not stated that the extension veterinarian is working for the practitioner, it can definitely be asserted that the extension veterinarian is and will be working with the practitioner—and that to the end that both human beings and animals may be protected against diseases transmitted to, from or by animals.
CHEMOTHERAPY IN THE CONTROL OF AVIAN COCCIDIOSIS

By P. P. Levine

The use of chemotherapeutic agents in the feed and drinking water for the control of coccidiosis in chickens has been attempted unsuccessfully on numerous occasions. It wasn't until 1936 that Herrick (1) found sulphur to be effective for the prevention of infection with *Eimeria tenella*, the cause of acute caecal coccidiosis. Since then the coccidiostatic effect of a number of sulfonamide compounds has been demonstrated (2, 3, 4).

There are many requisites an effective therapeutic agent must have if avian coccidiosis is to be controlled. The prime essential is that it must be effective against all of the seven species of coccidia that attack chickens. The drug must be non-toxic and palatable. Furthermore, it must be easy to administer and its cost must be low enough to permit widespread application. Recent developments in the field of chemotherapy justify the prediction that a compound possessing these characteristics will be developed in the near future.

Two methods can be employed to demonstrate the coccidiostatic effect of any drug. In the first (2), the number of oocysts discharged by a group of treated chickens which have been given an infective feeding of coccidia is compared with the number discharged by a similarly infected control group. This method is useful in infections with *Eimeria acervulina*, *E. mitis*, *E. praecox*, *E. maxima*, and *E. hagani* since, in these instances, the number of oocysts eliminated gives an approximation of the severity of the infection. In the case of infections with *E. tenella* or *E. necatrix*, however, this method cannot be employed since there is no correlation between the severity of the disease and the number of oocysts discharged. Here one must compare the severity of the lesions and the mortality in the treated and control groups.

It is noted (Table 1) that flowers of sulphur in a concentration of 5 per cent of the ration is effective against infections with *E. tenella* (1) and *E. necatrix* (5). This treatment has no value when used against infections caused by the other five species of coccidia (6). Furthermore, the use of sulphur is not without deleterious effects on the birds. Rickets (7, 8, 9, 10), dermatitis (8, 11), cloacitis (1, 12), poor feathering (11), and retarded weight gains have been reported as a result of prolonged sulphur feeding.

The first sulfonamide drug that was tried, sulfanilamide (2), when fed in the proportion of 0.3 per cent of the ration, had a marked inhibitory action on all the species of coccidia except *E. necatrix* and *E. tenella*. It was found, however, that when the drug was withdrawn from the ration, the number of discharged oocysts increased. Nevertheless, the total number of oocysts discharged by the treated group did not equal that eliminated by the controls. Despite the fact that this drug was toxic for the birds, the results were encouraging enough to warrant further search among this group of compounds. Sulfapyridine (2) in a concentration of 0.7 per

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1 New York State Veterinary College, Ithaca, New York.
2 Unpublished data.
cent of the ration behaved in the same way as sulfanilamide with the difference that no toxicity was noted. Sulfathiazole in concentrations of 1.5 per cent of the ration controlled infections with *E. praecox* as effectively as sulfapyridine. Although no tests were run with *E. mitis*, *E. maxima*, *E. hagani* or *E. acervulina*, one can predict with reasonable certainty that the drug would also be effective against these species. A definite advantage possessed by sulfathiazole is that the severity of infections with *E. tenella* and *E. necatrix* is markedly reduced by it. No marked toxic effects on the birds were noted with the exception that the feces of treated birds were more moist than normal. Sulfaguanidine (4), one of the more recently developed drugs of the sulfonamide series, was found to be the most effective of all. At a level of 0.5 per cent of the ration, all species, with the exception of *E. necatrix* and *E. tenella*, were completely inhibited. Even when the medication was withdrawn, there was no subsequent discharge of oocysts. Of still greater significance was the fact that concentrations of 1.0 and 1.5 per cent effectively controlled infections with large numbers of oocysts of *E. tenella* and *E. necatrix*, respectively. Results procured by the writer have already been confirmed by Farr and Allen (13). As a matter of fact,

**Table 1.—The effect of chemotherapeutic agents against coccidial infections in chickens**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Praecox</th>
<th>Acervulina</th>
<th>Mitis</th>
<th>Maxima</th>
<th>Hagani</th>
<th>Tenella</th>
<th>Necatrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfanilamide, 0.3 per cent; toxic</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sulfapyridine, 0.7 per cent; non-toxic</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flowers of sulphur, 5 per cent; rachitogenic</td>
<td>-</td>
<td>-*</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Sulfathiazole, 1.5 per cent; slightly toxic</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Sulfaguanidine; very slight toxicity</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

+ = coccidiostasis; - = no effect; * = according to Dickinson (6).

sulfaguanidine has been found to be extremely effective against bovine coccidia (14) and against the ovine species (15). The toxicity of sulfaguanidine for chickens is quite low. Normal weight gains of young birds are retarded only to a slight degree. No symptoms or gross tissue lesions have been observed in any of the treated birds.

A definite shortcoming that all of the compounds (including sulphur) have in common is that the drug must be fed before exposure to infection takes place, if beneficial results are to be obtained. Once ingestion of lethal doses of oocysts has occurred, the infection will run its course even though the medication is instituted before symptoms of the disease become apparent. These considerations restrict the use of coccidiostatic compounds in the field. Our present knowledge of the action of sulfaguanidine would justify the use of this drug under circumstances where it is almost certain that exposure of birds to lethal doses of coccidia will occur. Medication of the flock for a period of two weeks will give the poultryman sufficient time to institute necessary changes in management and sanitary measures. Further possibilities of the use of this compound are obvious. Its greatest possible use may
well be to aid birds in acquiring an active immunity to coccidiosis. In this role it might be used not to prevent infection entirely but to reduce the severity of infections and thus enable birds to build up a resistance to infections which would ordinarily prove fatal.

REFERENCES

5. ———: Ibid., 31: 120, 1941.
8. ——— AND ———: Ibid., 19: 180, 1940.
A PLAN TO COMBAT AVIAN TUBERCULOSIS INFECTION AS FOLLOWED IN MICHIGAN

By C. H. Clark

Shortly after the program to suppress and eradicate tuberculosis among cattle had become well established and testing had been extended within the different states, a rather common presence of tuberculosis among farm poultry, particularly in certain areas, was noted. Dr. Van Es, first to make a comprehensive study related to this tuberculosis, demonstrated a rather significant bearing tuberculosis among poultry would have in the work of eradicating the disease among livestock. Other investigators and research workers have contributed to this information and knowledge, particularly as to types of infection—human, bovine, and avian,—so that there is available a large volume of useful information on the subject of avian tuberculosis.

Surveys made in conjunction with the testing of cattle for tuberculosis, special testing of poultry and other livestock with avian tuberculin, and various other reports as to the presence of the disease among poultry form the basis for a reasonably accurate tabulation by the United States Bureau of Animal Industry indicating the distribution and sectional prevalence of tuberculosis in farm flocks. A map of the United States prepared by the Bureau (which will be projected on the screen later) shows this distribution and the estimated prevalence in the different states. It is indicated by this map that the greater prevalence of avian tuberculosis occurs in the states of the North Central section, an area which forms a large part of the region commonly referred to as the “Corn Belt.” In some of this territory the number of poultry flocks found infected has represented as high as 85 per cent of the flocks within certain area, and, over comparatively wide sections in some of the states, tests of the poultry population have revealed a flock morbidity rate of from 40 to 50 per cent.

A significant fact of some economic concern is the high avian tuberculosis incidence in the greater portion of the area which provides the greatest egg and poultry meat production for this country. The production in eggs for different states has been outlined upon a map prepared by the United States Department of Agriculture indicating the proportionate egg production in the different states (this also will be projected on the screen later). Michigan is one of the states which contribute large amounts in this supply of poultry products, and in our state these are largely the production of farm flocks.

From special surveys and through observations made in carrying forward the program of eradication of tuberculosis among livestock—and in Michigan, by statute, poultry is defined as livestock,—we have accumulated quite accurate knowledge as to the prevalence of tuberculosis among poultry, and also of the avian type of infection as it may affect other farm animals, particularly swine. The disease has been found quite prevalent among our farm flocks. Our success in eradicating tuberculosis from cattle and the necessity of protecting this work from other tuber-

1 State Veterinarian, Lansing, Michigan.
culosis infection prompted a study of ways and means to suppress and eradicate avian tuberculosis.

In an endeavor to accomplish some measure of eradication, and this has at all times been co-operative with the Federal Bureau of Animal Industry, the development of a rather limited program has obtained under this. It was the thought in presenting this paper to describe and briefly discuss some of the plan which has developed in our program. Having made these general observations regarding avian tuberculosis, the further discussion will refer to the disease only as pertains to the specific procedure and the reasons for different requirements under the plan. It is obvious to the livestock sanitarian that any plan which may be followed to combat contagion must be based on the nature and behavior of the infection causing the disease if success is to be attained.

A primary underlying factor to be reckoned with is that young birds are highly susceptible to tuberculosis infection and they become affected through association with old birds in which the disease has developed. It has been quite generally accepted that the disease in young birds may be largely prevented through disassociation of the old and young of the species. This is evidenced in certain sections of the country where this practice is followed. The United States Bureau of Animal Industry recommends, and wisely so in our opinion, to protect young birds from tuberculous contamination by the old ones, to adopt the practice of annually replacing the chicken flock with day-old chicks reared in clean and sanitary environment. This in our experience will have a noticeable effect, and, where systematically and regularly followed from year to year, should eventually effect eradication.

"Give the Old Hen a Ride" has been the slogan and it should continue to be in raising poultry within flocks to which it can be applied. Such flocks include any used for commercial egg and poultry meat production, and the adoption of such management will have an economic advantage. In Michigan this would allow for a broad application of the recommendation, for it is estimated that approximately 90 per cent of all chicken flocks within the state are operated only for commercial egg and meat production. Of the other ten per cent, not more than one-half maintain recognized breed improvement flocks, and the others are engaged as supply flocks for eggs for commercial hatching. A similar division or breaking down into component parts of the poultry raising operation of the area where the great prevalence of tuberculosis occurs would no doubt follow about the same percentage lines.

When seeking to secure adoption of the recommendation to get rid of old birds annually, it was found a difficult and often impossible task. But convinced of the potential sanitary value for suppressing tuberculosis among poultry, those assigned studied the situation more intently. The pitfalls and difficulties experienced with chicks for replacement were observed to be the more potent cause for failure to secure adoption of the practice. In Michigan, as in any poultry producing state, commercial hatcheries are operated to supply replacement stock; the hen for hatching has practically disappeared or is used in only a very limited way. Day-old chicks from commercial hatcheries are a necessary commodity for perpetuating the poultry flocks. Chicks of a high viability—or, to use a term frequently applied, "high livability"—are essential if the practice of the annual replacement of flocks is to be accepted to an extent necessary and worth while for combating tuberculosis
among poultry. This conclusion is reached after listening to the frequent objections of poultry raisers against the practice recommended, and such objections it seems are most often based upon difficulties encountered with day-old chicks purchased.

It is without contradiction among those informed relative to chick mortality that pullorum disease infection has been the more common cause of death losses among chicks during the early days following hatching. The immediate concern was of ways and means to improve this situation. It led to contact with certain hatchery operators and the devising of a plan for testing all poultry flocks supplying eggs to the given hatchery. Such testing included tests for pullorum disease and also for tuberculosis. While it was recognized that pullorum disease was a most active factor in creating losses among day-old chicks, it was kept in mind that primarily the project was for tuberculosis eradication. Our later experiences have justified the requirement of having the tuberculin test included.

The plan as first outlined, with some lesser modifications and additions, has been closely adhered to, and the results obtained have been gratifying. Progress to make the plan more effective and extending its application over a larger field have moved rather slowly. This has not come from a lack of interest to those served or failure to note its value but in some degree to the reluctance of hatchery operators receiving benefits from the service to encourage competitors to embrace the plan. However, it is sufficient to say that the plan as it now operates has proved worth while and is recognized by co-operating hatchery operators as having a very distinct value to their business.

In extending the plan to a given hatchery, it is first required that the hatchery operator sign an agreement. The agreement reads essentially as follows:

1. I will not use or allow to be used for hatching any eggs that are not produced by hens which have passed a negative test for pullorum disease and avian tuberculosis approved by the Michigan Bureau of Animal Industry, such tests to be conducted during the last quarter of the year preceding the hatchery season; and that a negative record of pullorum test and tuberculin test, acceptable to the Michigan Bureau of Animal Industry, shall be furnished on all breeding stock brought on the hatchery premises or added to any flocks producing eggs for the hatchery.

2. All reacting fowls shall be removed at once from such flocks as produce eggs for my hatchery and slaughtered, and the premises where the producing fowls are to remain will be cleaned and disinfected. All fowls which are shown to be negative to the test will be identified by proper leg bands.

3. I will conduct my hatchery in compliance with reasonable recommendations for the control of infectious disease, removing egg shells and other refuse from the incubators and hatchery buildings to a point outside the hatchery buildings and disposing of such material in a manner that will prevent contamination of the hatchery buildings or premises.

Under the plan no attempt has been made to establish a comprehensive control and eradication program for pullorum disease. Certification or accreditation of flocks as disease-free is not undertaken. The one objective is the elimination from the flocks supplying hatching eggs of all birds proved positive to test for pullorum disease at a certain time when it may have a distinct effect upon the hatch.
yearly test has been found very effective, but, where desired by the hatchery, it may be arranged to have subsequent and more frequent pullorum tests applied.

All tests are required made by a qualified accredited veterinarian. The requirement of tuberculin tests of hatchery supply flocks has at times been questioned by some who have reviewed the plan, but we have been for continued use of this test on such flocks. Aside from a question as to spread of infection through eggs, the results of the yearly test for tuberculosis with immediate removal of reactors has been observed to favorably affect the health status of the flock. This has been distinctly noticed where extensive infection has been found in the flock. Elimination of tuberculosis from such flocks has shown marked improvement in productivity and hatchability. We have had some of this class of flocks in which the improvement could readily be measured by comparative analysis.

Another part of the plan provides for supervisory inspection of flocks following the testing. These inspections comprise at least two visits to each flock by the state or federal veterinarians assigned to the work. The sanitary surroundings of the flock and the equipment used are noted and recommendations for needed improvement are made the owner. Arrangements are made for tuberculin testing breeding swine, if any are kept. This service is optional to the owner. More frequent inspections are made of the hatchery premises and its operation. Sanitary and other measures that will assure production of more healthy chicks are required. A hatchery operating under this supervision can use only eggs from flocks tested as provided under the agreement and it may not handle chicks from other sources through the hatchery except from such origin.

The method employed in operating under the agreement, the tests as applied, and the costs involved are matters of detail that may be of special interest. The plan operates on a strictly voluntary basis under terms of an agreement signed yearly with the operator of the hatchery and the State as previously mentioned. The tests required are conducted by accredited veterinarians only, the hatchery operator naming a veterinarian of his choice but who must be approved by the State Veterinarian before becoming engaged in testing under the agreement. The rapid whole-blood test for pullorum disease is used and the intradermic tuberculin test for tuberculosis. In preparing for the pullorum testing, veterinarians have been instructed by the Extension Veterinarian of the State Agricultural College Extension Service. The Veterinary Division of the College has been very helpful in making this possible. Schools of instruction have been held for this purpose which have been very well attended. The state and federal supervision has closely followed the field work of the different veterinarians to assure compliance with all detail.

The two tests are applied at the same time, and at present the cost of these is fixed at three cents per bird. Of this cost the hatchery operator pays 1½ cents for the pullorum test and the State pays 1½ cents for the tuberculin test. The fees in each instance are paid direct to the veterinarian applying the tests. The antigen used in the pullorum testing and all help required to handle the birds in making the tests are supplied by the hatchery operator. Leg bands for identifying individual birds and the tuberculin from the Federal Bureau are supplied through the State.
PLAN TO COMBAT AVIAN TUBERCULOSIS

The veterinarian applying the test is required to give only his services, and quite often is furnished transportation without cost.

The veterinarian working at this seemingly low cost of test has derived satisfactory returns for his time and effort. This has been possible because of the nature of the work and further because of some special equipment devised and perfected in the course of developing the plan. The equipment to which we refer is a table for use in restraint of birds at the time of bleeding for the pullorum test and injection of tuberculin. The construction and design of the table and its assemblage in use will be shown in slides to be projected later on the screen. The tables are used in series; three separate units each for the restraint of eight birds at one time are recommended. It is possible by this aid to handle as many as 240 birds per hour with two helpers for placing and removing the birds. Under a normal run of testing, from 150 to 180 birds per hour can be handled without confusion or rush. Tables for this purpose are in some instances provided by the hatchery operator; in others the veterinarian has these as a part of his equipment.

In considering the veterinary service and its cost, it should also be taken into account that the hatchery is the unit in extending the service and not individual flocks. Further, this testing is not an emergency and can be arranged at the convenience of those concerned, except that it must be done within the time specified by the agreement signed with the State. Veterinarians who have been engaged have not found the work distasteful nor otherwise objectionable. Each of these is prepared for a more comprehensive service to the poultry raiser than merely testing flocks. He has been assisted in this by the Extension Veterinarian through a course of lectures and practical demonstrations held for veterinarians on poultry in health and disease. These schools of instruction have continued through two consecutive winters and have proved of great value to the veterinarians for becoming better informed on poultry and poultry diseases.

This hatchery supervision plan was commenced in Michigan with a single hatchery in 1932. The arrangement for the veterinary service has varied at different times but, throughout, the requirements for veterinarians to make the test have been adhered to. In the commencement of the work the hatchery paid this entire cost; later the service was provided direct through the state and federal co-operation. The present arrangement, outlined and discussed, has applied for the past three years and seems to be the most satisfactory. It permits of a more extended service from use of public funds and of the facilities available. There is a relation of avian tuberculosis to the general scheme of animal tuberculosis eradication which has been referred to and which we believe justifies the use of funds provided to eradicate tuberculosis of livestock along lines specified in this plan. The total cost of our handling thirty hatcheries, the number under supervision during the past year, has been very nominal. A somewhat similar plan has been in operation in each of our two southern neighboring states, Ohio and Indiana.

In conclusion, we would say that the plan discussed is designed as a means for a certain end. It is not complete by itself but is complementary to an effort made for securing an annual replacement of certain class of poultry flocks in a wider and more general adoption. It has for an objective a sufficient and satisfactory supply
of day-old chicks for replacement of old birds in flocks kept for commercial egg and meat production. A systematic tuberculin test is recommended for hatchery supply and breeding flocks in combating tuberculosis in this class of flocks. We are of the opinion that the eradication of tuberculosis from the large number of flocks maintained solely for commercial egg and meat can be best handled through adoption of the practice to "Give the Old Hens a Ride." If this can be adopted and applied over a period of years, it should result in avian tuberculosis becoming of infrequent occurrence, and our nation's poultry supply will be protected against this serious economic menace.
In spite of years of experimentation specific preventive measures have been developed for surprisingly few diseases. It is also true that field results are seldom as good as those reported for laboratory trials. This may be due to inadequate research or to improper field use of the methods developed. In any event, it would seem that every new laboratory development has to undergo certain misfortunes in the field before it is accepted. Failure to take advantage of research developments while persisting in old recommendations based on so-called “sanitation and hygiene” is pure ignorance.

Pox and laryngotracheitis are examples of diseases against which specific preventive measures have been developed. Neither disease was ever controlled by so-called “sanitation and hygiene” and the reasons are evident when we understand the epidemiology of the diseases. An analysis is worthwhile.

Pox is spread from flock to flock by mosquitoes so that no amount of sanitation would be a guarantee against an outbreak. A campaign against the mosquito is too big a job because several species are capable of serving as carriers. Anyway, the disease can also be spread by contact with infected birds or premises. Then too, certain free-flying birds could act as reservoirs of infection. These are the fundamental reasons why so-called “sanitation and hygiene” never made a dent in the control of pox.

And what of laryngotracheitis? The answer is that certain survivors of an outbreak become carriers of the virus. If some easy means of identifying carriers were available (as in pullorum disease) progress might be made. Unfortunately, the only way to identify a carrier is to swab its windpipe and then introduce the swab into the windpipe of a known susceptible chickens. There is no end to this procedure. More than this, the infection exists in pheasants so that a constant reservoir of infection is maintained in the wild.

It was stated above that effective preventive measures had been developed against pox and laryngotracheitis. And yet, anyone acquainted with the situation knows that in actual practice there are apparent and actual failures. Occasionally the results of attempted immunizations are even worse than a natural outbreak of the disease. These failures, apparent or actual, may be the responsibility of the diagnostician who advised the use of the vaccine, the manufacturer of the vaccine, the agency which authorised its production and distribution, or finally, the person who applied the vaccine. The responsibilities of each of these agencies is clearly evident and can be enumerated as follows:

1 Journal Series Paper of The New Jersey Agricultural Experiment Station and Rutgers University, Department of Poultry Husbandry, New Brunswick, N. J.
2 New Jersey Agricultural Experiment Station, New Brunswick, N. J.
THE DIAGNOSTICIAN

The diagnostician who calls a case of coryza laryngotracheitis and recommends vaccination for the latter causes the poultryman a needless expense, discredits the veterinarian, the manufacturer and the experiment station which developed the method. That vaccination in this case did no harm and actually immunized the flock against laryngotracheitis is inexcusable. The fact remains that the actual disease—coryza—was not controlled. Space does not permit a discussion of the differential diagnosis of respiratory diseases, including pox, but this subject was covered by the author in a paper presented before this group in 1937 (1).

THE MANUFACTURER

The greatest responsibility of the biological producer is that of consistently marketing a product which is always potent well beyond the expiration date. Moreover, the manufacturer should supply a suitable instrument for application of the product, and complete directions. These points will be discussed later.

THE LICENSING AGENCY

Before issuing a license to produce the products discussed in this paper a manufacturer otherwise equipped with physical facilities and personnel should be made to demonstrate his ability to produce adequately potent vaccine. An applicant for license should be compelled to produce successive test lots of vaccine which should be held and tested periodically by the licensing agency. On the basis of these tests the applicant is either denied a license or granted one with an expiration date some months short (as an added safety factor) of the time that the least potent lot tested retained adequate potency. Under existing conditions the manufacturer is only required to make purity and potency tests as soon as the lot is made. Obviously, the purity status of a vaccine does not change with holding, but, while a vaccine may show adequate potency immediately after preparation, the fact remains that many lots are wholly inadequate before the expiration date is reached.

THE VACCINATOR

The qualifications of the vaccinator may vary between the thoroughly experienced veterinarian and an ignorant poultryman. But all poultrymen are not dumb, and unfortunately, all veterinarians are not wise. The point is that the vaccinator should realize that the job has to be done properly.

FUNDAMENTALS OF VACCINATION

The method of immunizing chickens with fowl pox vaccine (virus) is crude indeed, and, appreciated or not, was borrowed from human medicine. Many years ago humans were immunized against small pox by exposure to the disease at a time of life and at a season which experience had taught would result in a high percentage of recoveries. In the same way chickens are immunized by giving them the disease. In fact, immunization (with fowl pox virus) differs from a natural attack in three respects, namely, location of lesion, size of lesion, and time of attack with reference to age. Thus, by infecting the web of the wing or a few feather
follicles on the leg the disease is kept away from the head where it might, as in natural outbreaks, spread to the eye or mucous membranes. By infecting a small area with needles or a few feather follicles a small lesion is produced which provokes a correspondingly less severe systemic reaction than would be caused by the extensive head lesions of the spontaneous disease. And finally, the vaccination is done at a favorable time in the life of the bird to avoid the production period which is so affected by the natural disease.

With these points in mind then, and given an adequately potent vaccine (virus), the job of vaccination is simple. On the basis of location alone the web of the wing offers no advantage over the leg, but since a small lesion is desirable, and since the “stick” method insures this, it is preferred and is best suited to wing vaccination. Moreover, the “stick” method eliminates the necessity of plucking feathers, requires less vaccine, and is the faster method. The age of the bird is important. The upper limit should be about one month before production starts, that is, 3 months for light breeds and 4 months for heavy breeds. Day old chicks are vaccinated in some sections, but the mortality attending vaccination is too high. As a rule, the bird should be at least a month old. Other things being equal birds 8 to 10 weeks of age are ideal for vaccination.

Most manufacturers supply a brush for the feather follicle method and a few supply an instrument for the “stick” method. If the latter is not supplied a suitable instrument can be made by implanting the butts of two sewing machine needles into a soft piece of wood so that the needles are parallel in two planes and about \( \frac{1}{8} \) inch apart. The needles or brush should be dipped into the vaccine before each vaccination. A block of wood with a hole bored to receive the vaccine container will prevent spilling.

All birds should be vaccinated at one time or non-vaccinated birds should be isolated. Vaccine should be mixed away from the poultry house and used that day. Needless to say, only healthy birds should be vaccinated because the shock resulting when fowl pox is used is quite severe.

Whatever the method of application, lesions are readily detected in a week and if the vaccine has been applied by the feather follicle method a scab forms. Lesions drop off in about 3 weeks and immunity is established 4 weeks after vaccination. If the vaccine has been properly applied failure of lesions to develop in known susceptible birds means impotent vaccine, and the flock should be revaccinated.

Since immunization with fowl pox is equivalent to a mild attack of the disease certain accidents occasionally occur and may be set down as follows:

1. A superimposed infection of coccidiosis may cause some deaths.
2. In a small percentage of birds (usually less than 5 per cent) secondary lesions may appear on the head. The virus is carried there by the blood.
3. Many chickens carry blackhead parasites in the intestine and rarely suffer ill effects but under the depressing influence of fowl pox virus these parasites invade the mucous membrane and spread to the liver causing death. This loss begins about the tenth day, is sometimes heavy (once over 25 per cent), and automatically stops about three weeks after vaccination. Such a misfortune can not be anticipated, but if it occurs the birds on these premises should receive only pigeon virus in subsequent years.
4. A situation similar to the above except that a trichomonad is involved and produces a greenish, gray pasty exudate throughout the esophagus.

5. Lymphomatosis (fowl paralysis) is widespread and during the period of depression following vaccinations many cases may appear. This loss, however, is not considered serious, since these birds would undoubtedly have died anyway, but only over a longer period.

**PIGEON POX**

Pigeon pox bears the same relation to fowl pox that vaccine virus bears to smallpox. Thus, fowl pox adapted to the pigeon and passed through this bird for several generations no longer produces a systemic reaction when brought back to the chicken; never causes secondary lesions; and will not spread to another bird. In the same way the calf can modify smallpox virus so that transferred back to the human it produces only the infection at the inoculation point; very little systemic reaction and the vaccinated person is not a source of infection. The pigeon pox lesion consists of a swelling of the feather follicles in contrast to the scab which forms in fowl pox.

It is common knowledge that vaccine virus does not give an immunity as lasting as that provoked by an attack of smallpox. And, by the same token, vaccination of fowls with pigeon pox cannot give as much immunity as an attack of fowl pox or vaccination with this virus.

Because pigeon pox does not produce a systemic reaction in chickens it is of particular value in vaccinating laying birds or flocks which, on the basis of past experience, are known to carry blackhead. Such flocks cannot be vaccinated with fowl pox so it is either a question of not vaccinating them at all or else be satisfied with the degree of immunity that pigeon virus can give. In other words, pigeon virus is an emergency vaccine insofar as the chicken is concerned and its value is to be appraised on this basis.

Pigeon virus has a particular affinity for follicular cells and should never be applied by the "stick" method. Since the degree of immunity is in proportion to the size of the vaccination lesion then the vaccine should be applied over a large area. The immunity that develops will usually protect fowls against natural infection in an enzootic area. But, if infection should occur, it is usually mild and has little effect on production. For successful vaccination the following points are to be observed:

1. Use a highly potent virus.
2. Do not stretch dosage (not less than 80 mgs. of dried virus in 4 cc. of diluent for 100 birds).
3. Apply only with a stiff bristled brush that retains this stiffness.
4. Direct bristles against openings of feather follicles, never in the opposite direction which closes follicles.
5. Infect an area about 1 by 2 inches.
6. Birds must be well feathered so that follicle openings will be large.

Every precaution listed above is very important, and curiously enough, most of them are disregarded in the majority of vaccinations. For this reason pigeon virus vaccination has come in for much undue criticism. Needless to say it is the
POX VACCINATION OF OTHER SPECIES

The discussion above concerned the vaccination of chickens with fowl or pigeon pox vaccine. Other species present a different problem. Thus, while pigeon virus fails to produce a systemic reaction in chickens it bears to the pigeon the same relation that fowl pox does to the chicken. Therefore, in vaccinating pigeons very few follicles should be infected and even then some reaction must be expected. And, while pigeon virus does not produce a solid immunity against fowl pox in the chicken, it will solidly immunize the pigeon against pigeon virus.

Outbreaks of pox in turkeys are common and have generally been considered to be caused by the same virus that affects chickens. However, a strain of turkey pox investigated by us (2) seems to cause a far more serious disease in chickens than fowl pox. That an immunological difference exists is suggested by the fact that turkeys vaccinated with fowl pox are protected through the market age but breeders held over occasionally contract pox. The solution for this would appear to be re-vaccination of breeders round the first of the year.

Some pigeon pox has been used on turkeys, and while field results are too meager to indicate its value it may be surmised that pigeon virus is less likely to immunize turkeys than fowl virus.

Pox in pheasant and quail is probably caused by the fowl virus.

LARYNGOTRACHEITIS

In the natural disease virus enters the respiratory tract and provokes symptoms in about 2 days. If the bird lives symptoms subside in about a week and the bird is solidly immune thereafter. The windpipe, eyes, nasal cavity or sinuses may be involved. The virus remains localized in the respiratory tract. If death occurs it is only because of suffocation.

In vaccinating against this disease the virus is painted on the cloacal mucosa where it provokes an inflammation by the second day. This increases in intensity and reaches a maximum on the fifth day after which it subsides very rapidly, and the bird is immune after the ninth day. The disease process remains localized and the virus does not spread to the respiratory tract by way of the blood any more than virus would spread by the same route to the cloaca in the natural disease. Since infection of the vent can not result in suffocation then vaccinated birds do not die. Moreover, vaccination is rarely followed by a systemic reaction so that laying birds can be vaccinated. A bird 6 weeks of age or older is suitable for vaccination. Fortunately, as soon as virus disappears from the vent (about 10 days) the bird is never a carrier.

Due largely to the inability of some laboratories to produce a sufficiently potent virus vaccination is sometimes followed by serious losses. Here is what happens. A product does not retain its potency and when used produces 20 per cent "takes" for example. These birds become duly immunized, but in a few days eliminate virus from the vent which infects the respiratory tract of the remaining birds with
the result that they develop symptoms about 10 days after vaccination. From
then on it is essentially a natural outbreak with the usual losses.

When manufacturers were confronted with these losses they insisted that their
product had passed the required tests and therefore could not have been responsible.
They frequently resort to the subterfuge of diagnosing the disease that followed
vaccination as “sinusitis,” “bronchitis,” “coryza,” or whatever was convenient.
Our own examinations left no doubt as to the nature of the disease.

Although impotent virus is by far the greatest cause of poor results, there are
others, so that for good results the important points may be set down as follows:

1. Certainty of diagnosis in the case of emergency vaccination, or certainty
that the farm has had the disease, or is liable to infection in the case of prophylactic
vaccination.
2. Use a potent virus (an adequate virus should produce over 95 per cent readable
“takes”).
3. Mix vaccine away from poultry houses.
4. Apply to the cloacal mucosa without contaminating other parts.
5. Use vaccine on the day it is mixed.
6. Do not stretch dosage.
7. Vaccinate all susceptibles or provide ample isolation.
8. Make check reading on the fifth day and revaccinate “No takes” if justified.
9. When vaccinating during an outbreak handle birds in houses free of disease
first. When vaccinating in infected pens avoid handling affected birds because
these soil the clothing and facilitate spread to those not affected.

By observing precaution No. 8 one can avoid heavy losses even when a very
poor vaccine has been used, but this does not justify poor vaccine. The risks
entailed by the use of poor vaccine are equivalent to those created if only a few
birds in a flock were vaccinated and 5 days later the material in the vents of these
used to vaccinate the remainder of the flock.

EXAMINATION OF COMMERCIAL VACCINES

Several commercial fowl and pigeon pox vaccines were obtained and submitted
to a critical examination. Table 1 lists for fowl pox vaccines the type of vaccine,
milligrams of virus, quantity of diluent, method of sealing virus and diluent con-
tainers and the type of instrument supplied for application.

An examination of table 1 shows the great variation existing in the amount of
virus supplied for the vaccination of 100 birds (10 to 40 mgm.). It is entirely pos-
sible, but not probable, that the 10 mgm. of dried material supplied by one labora-
tory contains as many virus units as the 40 mgm. supplied by another laboratory.
As a matter of fact our experience has demonstrated that the small quantity of virus
supplied by some laboratories is also of low potency. The table shows that there is
less variation in the amount of diluent supplied and this is not too important.

The manner of sealing the virus container is of some importance. For preserva-
tion of virus the evacuated and hermetically sealed ampoule is the best. The
other methods of sealing are alike in so far as preservation of virus is concerned but
vary in that some types of stoppers become loosened and permit spillage of virus.

The diluent is viscid since it is 50 per cent glycerine, and therefore, a stopper
tightly inserted occasionally slips out and the diluent is spilled. A rubber sleeved stopper is the best insurance against spillage.

Table 1.—Data on commercial foul pox vaccines

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>TYPE</th>
<th>VIRUS</th>
<th>DILUENT</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Amount</td>
<td>Sealed with</td>
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<td></td>
<td></td>
<td>mgm.</td>
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<tr>
<td>A</td>
<td>E</td>
<td>30*</td>
<td>RSD</td>
</tr>
<tr>
<td>A</td>
<td>F</td>
<td>30</td>
<td>RSD</td>
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<td>B</td>
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<td>30</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
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<td>40</td>
<td>CD</td>
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<tr>
<td>D</td>
<td>F</td>
<td>30</td>
<td>CD</td>
</tr>
<tr>
<td>E</td>
<td>F</td>
<td>25†</td>
<td>RD</td>
</tr>
<tr>
<td>F</td>
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<td>20</td>
<td>CD</td>
</tr>
<tr>
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<td>10</td>
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<td>H</td>
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<td>25</td>
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<td>J</td>
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<td>F</td>
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<td>C</td>
</tr>
<tr>
<td>O</td>
<td>F</td>
<td>20</td>
<td>CD</td>
</tr>
</tbody>
</table>

* Actually contained at least 100 mgm.
RSD = rubber sleeve stopper dipped; RS = rubber sleeve stopper; CD = cork stopper dipper; RD = rubber stopper dipped; SD = screw cap dipped; S = screw cap; C = cork stopper; R = rubber stopper; H = hermetically sealed; NS = amount not stated; E = egg propagated; F = chicken propagated.
† Broken when received.

Table 1 also shows considerable variation in the type of brush supplied for application of the vaccine. The brushes supplied by laboratories B, C, H, I, K, L...
and O are ideal in that the bristles are of the proper length, number and degree of stiffness. The bristles of brushes supplied by F and J are somewhat too long and after much use tend to become mop-like. The brushes supplied by laboratories D, E, and M are of the same type and in this order have more and longer bristles—the smallest being too large. The size of brush, however, is to be judged in relation to the amount of diluent supplied so that relatively less difference exists between E and M because E supplies 2 cc. and M 3 cc. of diluent.

The brush supplied by laboratory G is unique. It consisted of camel's hair mounted in a quill. The hairs are far too flexible, too short and possibly too few in number. Moreover, the short quill handle barely permitted the vaccinator to reach the bottom of the bottle and to overcome this it was suggested that a match could be used to lengthen the handle. Obviously this implement was devised by someone who has had no experience vaccinating chickens. In fairness to this laboratory which was informed of the situation it can be recorded that an adequate

![Fig. 1.—Instruments supplied by commercial laboratories for the application of fowl pox vaccine.](image)

brush will be henceforth supplied. Nevertheless, here is a case in which failure to immunize successfully might be due to the type of instrument supplied.

The applicators for the "stick" method of vaccination supplied by A were adequate except that the needles were not parallel in one or both planes which tends to cause tearing of the wing web. (See figure 1.)

Table 2 lists the same type of data given in table 1 except that it concerns pigeon pox vaccines.

An examination of table 2 again shows the great variation in the amount of virus supplied for 100 doses (20 to 86 mgm.). The amount of virus supplied is extremely important here because the degree of immunity produced is in proportion to the size of the vaccination lesion. In our experience 80 mgm. of dried virus produced from heavily infected chorio-allantoic membranes has given satisfactory results for 100 birds. In order to infect the large area of about 1 x 2 inches the virus has to be suspended in at least 4 cc. of diluent. With this in view it can be seen that the amount of virus and diluent supplied by some laboratories is entirely inadequate.
The brush supplied for pigeon vaccine application must have stiff bristles if it is to withstand the hard use of applying vaccine briskly to such a large area. A good brush is far more important here than in fowl pox. Fowl pox virus readily infects follicular and interfollicular tissue (hence a scab), whereas pigeon pox must be gotten into the follicle. Hence, a brush that becomes mop-like after a few applications fails to infect follicles. The brushes supplied by B, C, H, K and L are ideal. The bristles of brushes supplied by F and J are somewhat too long and tend to become mop-like. The brush supplied by N contains too many bristles in relation to 2 cc. of diluent. (See fig. 2.)

**DIRECTION SHEETS**

The direction sheets contained in the packages of the commercial pox vaccines already discussed were examined for adequacy of information to insure successful vaccination. An attempt has been made to compile this information in table 2.

**DISCUSSION OF TABLE 3**

Many laboratories failed to give a description of pox which is somewhat important if for no other reason than calling attention to the fact that the disease can produce diphtheria or an infection of the eye, or that in battery-grown birds, lesions often appear on the feet, shanks, or any part of the body.

When fowl pox is used the age limits of birds to be vaccinated should certainly be given. Birds under one month should not be vaccinated and 3 to 3½ months for light breeds and 4-4½ months for heavy breeds should be the upper limit. Two laboratories (E and F) made no mention of age limits and 2, (G and I), gave incomplete information. The former uses the term “to maturity” which strictly speaking would be till egg production begins and this is too late. The latter is incomplete in giving 5 months as the upper limit without stating that this applies only to heavy breeds.

With one exception all laboratories failed to advise mixing vaccine away from the poultry house and washing the hands afterwards. And, by the same token, too many laboratories failed to warn against careful handling of vaccine to avoid contaminating any part of the bird except the vaccination point. Again, in order to prevent spillage and resulting contamination a direction sheet should describe the making of a simple holder for the bottle of vaccine. The direction sheet should advise the vaccination of all susceptible birds at one time or else provide ample isolation for them, and yet, half of the sheets make no mention of the point.

The approximate time required for immunity to develop ought to be stated otherwise the appearance of pox 2 weeks after vaccination is apt to be interpreted as failure of the vaccine to immunize when actually enough time has not elapsed. Immunity begins in about 3 weeks and is complete in about 4 weeks. On this basis 6 laboratories gave adequate information, and 4 laboratories ignore the point entirely. Two laboratories, (D and J), fix immunity at too early a point, and 3 laboratories, (F, N and O) give incomplete information. One (F) states immunity is not developed “in a week or two” and one (O) states that immunity is complete when scabs drop off which is correct but too indefinite.

Rather precise information should be given as to the number of follicles to be
Table 2.—Data on commercial pigeon pox vaccines

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>TYPE</th>
<th>VIRUS</th>
<th>DILUENT</th>
<th>INSTRUMENT PROVIDED FOR APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Amount</td>
<td>Sealed</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mgm.</td>
<td>with</td>
<td>cc.</td>
</tr>
<tr>
<td>B</td>
<td>P</td>
<td>30</td>
<td>C*</td>
<td>NS</td>
</tr>
<tr>
<td>C</td>
<td>P</td>
<td>50</td>
<td>CD</td>
<td>NS</td>
</tr>
<tr>
<td>F</td>
<td>E</td>
<td>20</td>
<td>CD</td>
<td>NS</td>
</tr>
<tr>
<td>H</td>
<td>P</td>
<td>25</td>
<td>CD</td>
<td>2</td>
</tr>
<tr>
<td>J</td>
<td>P</td>
<td>40</td>
<td>RS</td>
<td>NS</td>
</tr>
<tr>
<td>K</td>
<td>E</td>
<td>80</td>
<td>H</td>
<td>4</td>
</tr>
<tr>
<td>L</td>
<td>E</td>
<td>40</td>
<td>H</td>
<td>4</td>
</tr>
<tr>
<td>N</td>
<td>E</td>
<td>40</td>
<td>CD</td>
<td>2</td>
</tr>
</tbody>
</table>

* Same legend as in table 1.

P = pigeon propagated.

Fig. 2.—Brushes supplied by commercial laboratories for the application of pigeon pox vaccine.

Therefore, in order to correct this it is suggested that 200 doses of vaccine by laboratory N, for example, be used for 100 birds, or in the case of laboratory L, two vials of virus be suspended in one bottle of diluent for the vaccination of 100 birds.
The brush supplied for pigeon vaccine application must have stiff bristles if it is to withstand the hard use of applying vaccine briskly to such a large area. A good brush is far more important here than in fowl pox. Fowl pox virus readily infects follicular and interfollicular tissue (hence a scab), whereas pigeon pox must be gotten into the follicle. Hence, a brush that becomes mop-like after a few applications fails to infect follicles. The brushes supplied by B, C, H, K and L are ideal. The bristles of brushes supplied by F and J are somewhat too long and tend to become mop-like. The brush supplied by N contains too many bristles in relation to 2 cc. of diluent. (See fig. 2.)

**DIRECTION SHEETS**

The direction sheets contained in the packages of the commercial pox vaccines already discussed were examined for adequacy of information to insure successful vaccination. An attempt has been made to compile this information in table 2.

**DISCUSSION OF TABLE 3**

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Rather precise information should be given as to the number of follicles to be
### Table 3.—Data on direction sheets of commercial pox vaccines

<table>
<thead>
<tr>
<th>POINTS TO BE EMPHASIZED</th>
<th>LABORATORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of disease</td>
<td>A</td>
</tr>
<tr>
<td>Age for vaccination (in months) fowl pox</td>
<td>B</td>
</tr>
<tr>
<td>Mix vaccine away from birds</td>
<td>C</td>
</tr>
<tr>
<td>Avoid contamination of birds during vaccination</td>
<td>D</td>
</tr>
<tr>
<td>Description of holder for vaccine</td>
<td>E</td>
</tr>
<tr>
<td>Vaccination of all birds or provide ample isolation</td>
<td>F</td>
</tr>
<tr>
<td>Time required for immunity to develop (in days)</td>
<td>G</td>
</tr>
<tr>
<td>No. of follicles</td>
<td>H</td>
</tr>
<tr>
<td>Prompt use after mixing vaccine</td>
<td>I</td>
</tr>
<tr>
<td>Limitations of pigeon vaccine</td>
<td>J</td>
</tr>
<tr>
<td>Complications when fowl pox is used</td>
<td>K</td>
</tr>
<tr>
<td>Time (in days) to read “takes”</td>
<td>L</td>
</tr>
<tr>
<td>Revaccinate if necessary</td>
<td>M</td>
</tr>
<tr>
<td>Direction sheet consulted</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POINTS TO BE EMPHASIZED</th>
<th>LABORATORY</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Description of holder for vaccine</td>
<td>E</td>
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<tr>
<td>Vaccination of all birds or provide ample isolation</td>
<td>F</td>
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<tr>
<td>Time required for immunity to develop (in days)</td>
<td>G</td>
</tr>
<tr>
<td>No. of follicles</td>
<td>H</td>
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<td>L</td>
</tr>
<tr>
<td>Revaccinate if necessary</td>
<td>M</td>
</tr>
<tr>
<td>Direction sheet consulted</td>
<td>N</td>
</tr>
</tbody>
</table>

* After this paper was prepared a more recent direction sheet was consulted and found to recommend 60 follicles.

- **A** = Adequately discussed; **N** = Not discussed; **I** = Inadequately discussed; **F** = Directions for use of fowl pox consulted; **FP** = Directions for use of fowl and pigeon pox combined in one sheet; **F&P** = Directions for use of fowl and pigeon pox given in separate sheets (both consulted); **P** = Directions for use of pigeon pox consulted.
infected when fowl and pigeon pox viruses are used. When the “stick” method is used (only with fowl virus) 4 inoculation points are produced with 2 needles, that is, 2 points of infection on either side of the web of the wing, and this is certainly adequate. Therefore, the infection of 4 feather follicles is also adequate. On this basis most laboratories give adequate information, but laboratories D and M prescribe a few too many follicles.

There is agreement in the recommendations of the number of follicles to be infected with pigeon virus (10-15) but the number if far too small in all cases. Actually, the number of follicles in an area 1 x 2 inches is more than 50.

With one exception all laboratories are credited with giving directions to brush the vaccine into the follicle openings, but actually the point should be stressed that the stroke should never be made in the opposite direction which closes the follicles. This is particularly important in applying pigeon pox.

Three laboratories make no mention of the point, and two give insufficient warnings to use vaccine promptly after it is once mixed.

Direction sheets on the use of pigeon pox virus should indicate the limitations of this virus, but 2 (F and J) are inadequate on this point.

The various accidents that sometimes follow the use of fowl pox virus should be described in every direction sheet, and yet, 9 laboratories make no mention of these and only 5 refer to them very briefly. These were discussed under fowl pox.

The only means of determining whether a vaccine is potent or not (providing the chickens are susceptible) is to read the “takes” and the time of reading ought to be given. The time interval during which “takes” can be read is quite long, that is, from about 5 to 25 days after vaccination depending on the method of application, virulence of virus, etc. However, some may not be able to read “takes” as early as the 5th day and sometimes scabs become detached towards the end so that readings at the extremes should be avoided. On this basis most laboratories give fairly adequate advice.

While most laboratories recommend reading for “takes” several (F, M, N and O) fail to advise revaccination in the event that the vaccine is found impotent and 6 (D, E, H, I, J and L) give inadequate information.

It is seen from the above that there is considerable variation in direction sheets which is evident by comparing the almost perfect directions of laboratory A with those of laboratory M, for example, which contains practically no information at all.

In addition to the above, direction sheets sometimes contain unwarranted, incorrect, and misleading information. Thus, as unwarranted may be cited the statements in the sheet of laboratory B “Production of vaccine in—Laboratories is done under U. S. Government license”—“Vaccine is manufactured in a separate department in the laboratory”—and, “before release, each serial of—vaccine is submitted to certain definite tests to check its potency and freedom from contamination.” No doubt these are calculated to impress the reader who does not know that these steps are required of the producer who does an interstate business. Curiously enough, this particular vaccine is often of low potency. The same sheet deals with other material calculated to further the sales of other products (bacterins and medicines) made by the same company.

Laboratory C's sheet states that pox vaccines are for “fowl pox in chickens
turkeys, geese, ducks and pheasants." Actually, ducks and geese cannot even be artificially infected with pox.

Laboratory D's sheet makes a similar error in claiming that fowl pox vaccine is "for the prevention of fowl pox (chicken pox) in chickens, turkeys and pigeons." The writer of this ought to try to infect pigeons with fowl virus. The same laboratory also leaves the impression that immunity will be developed whether scabs form or not.

The writer of the direction sheet for laboratory G evidently became confused. On the diluent bottle one is instructed to pour virus into diluent, but the direction sheet says to poor diluent into virus ampoule and shake. If one did the former he finds that the brush supplied is barely long enough to reach the bottom of the bottle. And, if one did the latter he is confronted with the problem of shaking the mixture contained in the remains of a hermetically sealed vial with a sharp edge and no cork. In fairness to the laboratory this discrepancy is being corrected immediately.

The direction sheet of laboratory N contains this curious statement with reference to the use of pigeon virus "Laying fowls are usually old enough so that natural resistance is developed before immunity, produced by the pigeon pox vaccination, wears off." Actually, resistance does not increase with age. Otherwise, however, this laboratory has a good direction sheet.

Laboratory K's sheet states that "the evidence of successful vaccination is the development of a swelling around the follicles or by the formation of a scab at the point of vaccination." It ought to state that the two kinds of reactions are typical of pigeon and fowl vaccines, respectively.

This incorrect statement is made by laboratory L "Pigeon-pox vaccine—is equally efficient against pox in turkeys—since the disease in both species of birds is caused by the same virus."

Finally, laboratory J states, with reference to pigeon pox vaccine, that it "aids in protecting—against diseases caused by pigeon pox virus." To be sure it does, but chickens are not liable to pigeon pox infection spontaneously.

From what has been said above it can be seen that some manufacturers of vaccine are sorely in need of fundamental information. The points emphasized may seem unimportant to the uninitiated, but if space permitted case histories could be cited to illustrate how failure to observe some seemingly minor precaution has resulted disastrously. The case of a complaining poultryman might be cited to illustrate the absurd. Searching for a possible explanation of why his birds contracted pox after vaccination it was revealed that he used only the diluent. The other bottle (virus), according to him, was dried up and he could see no use to make of it.

**POTENCY OF VACCINE**

For the most part laboratories have supplied sufficiently potent pox vaccines. The virus has good keeping qualities as compared with other viruses so that laboratories should experience no difficulties. However, one laboratory has supplied vaccine that produces only about 50 per cent "takes" with the result than an outbreak affecting about half the flock occurs later. Another laboratory which used to pro-
duce pox vaccine on the fowl that was never found lacking in potency now produces
an egg propagated vaccine that gives a low percentage of "takes."

But, while lack of potency is not common in pox vaccines, it is too frequently
a feature of certain commercial laryngotracheitis vaccines. The disastrous results
following the use of impotent laryngotracheitis vaccine have already been discussed.
A few tests on commercial vaccines are listed in table 4.

The age of the 2 lots tested from laboratory N was not known, but it is apparent
that the second lot failed to produce "takes" in at least 35 per cent of the birds.
The 6 lots tested from laboratory L are typical. The first and third lots tested
before the expiration date gave 100 per cent "takes" while Lot 4 tested about the
expiration date produced only about 10 per cent "takes." Lots 5 and 6, although
tested after the expiration dates, gave a very low percentage of "takes," and moreover, Lot 6 should have been better than 5. Identical lots used in the field actually
causad disastrous results as would be expected.

Two tests made on the same lot (1 and 2) from laboratory B but at different
dates illustrates how potency decreases. The first test, made about 3 months before
expiration gave 100 per cent "takes" while the second made 7 weeks after the
expiration date gave only 25 per cent "takes." But even lot 4 tested about 2½
months before expiration date gave only about 42 per cent "takes."

Lots 1, 2, 3, 6 and 8 from laboratory O tested well before the expiration date
gave satisfactory "takes," but lot 7 tested about 2 months after the expiration

<table>
<thead>
<tr>
<th>LABORATORY</th>
<th>EXPIRATION DATE</th>
<th>TESTED</th>
<th>NUMBER VACCINATED</th>
<th>READINGS ON 5th DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>N-1</td>
<td>?</td>
<td>7/9/40</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>N-2</td>
<td>?</td>
<td>10/24/40</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>L-1</td>
<td>6/23/37</td>
<td>5/8/37</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>L-2</td>
<td>6/27/37</td>
<td>9/21/37</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>L-3</td>
<td>?</td>
<td>5/24/38</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>L-4</td>
<td>8/2/38</td>
<td>8/24/38</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
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<td>10/24/40</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>L-6</td>
<td>7/7/40</td>
<td>10/24/40</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>B-1</td>
<td>8/1/37</td>
<td>5/8/37</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>B-2</td>
<td>8/1/37</td>
<td>9/21/37</td>
<td>4</td>
<td>1</td>
</tr>
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<td>B-3</td>
<td>?</td>
<td>5/24/38</td>
<td>4</td>
<td>4</td>
</tr>
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<td>8/24/38</td>
<td>38</td>
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</tr>
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<td>4/14/38</td>
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<td>4</td>
</tr>
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<td>8/24/38</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>O-3</td>
<td>6/22/39</td>
<td>2/2/39</td>
<td>42</td>
<td>39</td>
</tr>
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<td>O-4</td>
<td>8/21/40</td>
<td>4/22/40</td>
<td>74</td>
<td>65</td>
</tr>
<tr>
<td>O-5</td>
<td>8/21/40</td>
<td>7/18/40</td>
<td>84</td>
<td>34</td>
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<tr>
<td>O-6</td>
<td>12/30/40</td>
<td>10/24/40</td>
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<tr>
<td>O-7</td>
<td>6/6/41</td>
<td>8/14/41</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>O-8</td>
<td>10/10/41</td>
<td>8/14/41</td>
<td>21</td>
<td>16</td>
</tr>
</tbody>
</table>

TABLE 4.—Showing results of testing commercial laryngotracheitis vaccines
date certainly gave poor results. Lots 4 and 5 from this laboratory are actually the same serial. The first test made 4 months before expiration date gave satisfactory results, but the second test about a month before expiration date failed to produce "takes" in at least 40 per cent of the vaccinated birds.

The question might be raised as to whether these test birds were susceptible or not. Actually most of them were reared for laryngotracheitis experiments and known to be entirely susceptible. However, the last test recorded above was made on farm-reared birds of known history. But as evidence that they were susceptible these birds were revaccinated on July 23, 1940, and reread July 28 with the result that 27 showed "takes" and 15 were doubtful, thus accounting for the 35 negatives in the first vaccination.

**PREVENTION OF CONTAMINATED VACCINE**

If chicken-propagated vaccine is produced, the birds used should be reared from the day-old stage in complete isolation, otherwise they might become infected with some intercurrent disease, and thus contaminate the vaccine made from them. The practice of buying chickens from farms for vaccine production is inviting trouble. Although certain tests for freedom from contamination are required of all lots of vaccine these can be designed only to detect known infections.

Egg propagation of viruses offers the surest means of producing a product free of pathogenic bacteria and viruses. Moreover, a greater concentration of virus can be obtained by this method although such viruses, if not properly dried, decrease in potency somewhat more rapidly than chicken-propagated viruses.

**REFERENCES**

The appearance of a geneticist on the program of the United States Livestock Sanitary Association is a compliment to both of the sciences involved. Scientists, have long recognized the dependence of one science upon the other. For example the chemist is more and more dependent upon the contributions of the physicist, and the physicist not only welcomes the aid of the chemist but is also dependent upon many other sciences.

As pointed out by Menje (1930), the editors of Biological Abstracts have listed forty-seven major subjects under which to classify the work of biologists. Each of these forty-seven major subjects has at least one or more subheadings or branches of biology in which men are specializing. How can any one person ever hope to keep abreast of all the sciences when thousands of papers are being published annually? Certainly no one person can do so successfully. What is more natural than for us to turn to specialists when we need specific information from another field and devote practically all our time to one subject? Without this cooperation the danger of specialization becomes immediately apparent to all. Workers in pathology, genetics, or any other science must have a varied amount of familiarity with other biological knowledge in order to comprehend their own problems.

THE ROLE OF GENETICS IN PATHOLOGY

Genetics bears an important role in pathology. A study of pathology involves consideration of structural and functional changes caused by disease. A clear understanding of the normal morphology and physiology of an animal or its parts must be known before the pathological picture is clear. In much the same way, genetics is concerned not alone with defects and abnormalities of various kinds, but for each genetically abnormal condition found in an animal or plant, the geneticist must also consider the opposing normal allel. Morgan (1922) states this relationship quite precisely:

"It is true that the student of Mendelian heredity does not often trouble himself about the nature of the character that he studies. He is concerned rather with its mode of inheritance. But the geneticist knows that opposed to each defect-producing element in the germ-plasm there is a normal partner of that element which we call its allelomorph. We can not study the inheritance of one member of such a pair of genes without at the same time studying the other. Hence, whatever we learn about those hereditary elements that stand for defects, we learn just as much about the behavior of the normal partners of those elements. In a word, heredity is not confined to a study of the shuffling of those genes that produce abnormal forms, but is equally concerned with what is going on when normal genes are redistributed. This method of pitting one gene against the other furnishes the only kind of information relating to heredity about which we have precise knowledge."

1 Senior Geneticist, U. S. Regional Poultry Research Laboratory, East Lansing, Michigan.
Because of the very nature of pathology, by far the greatest proportion of specimens subjected to diagnosis are abnormal or defective in one or more respects. A few of these abnormalities or defects are genetic in origin. Many more are the direct result of a lack of genetic resistance to a specific pathogen. Genetic resistance or immunity to disease in both plants and animals is universally accepted as an established fact. It may be argued on a factual basis that absence of a disease does not always imply innate immunity. Nevertheless, there has been enough evidence accumulated in both plants and animals to demonstrate the importance of heredity in relation to disease.

A student of veterinary medicine recognizes immediately that a wide knowledge of biological phenomena is necessary to a more accurate diagnosis on the animal with which he is working. The appearance of a diseased condition in one animal should lead to a closer inspection of the flock or herd as a whole. A lack of knowledge of either the epidemiology or cause of a disease may result in wide-spread dissemination either through infection, or malnutrition, and also by defective germplasm.

Both in human and animal pathology the student has been prone to consider the individual host per se without due consideration of the genetic heritage of either the host or the pathogen, and the interrelation of the environment to both the host and the pathogen. There are numerous cases in which pathological conditions exist and which are directly caused by specific genes. The ability of the diagnostician to recognize and properly classify hereditary diseases and defects will add much to genetic knowledge and greatly assist in the ultimate eradication of heretofore incurable conditions.

Strong (1929) states:

"The solution to the problem of cancer lies entirely in the future. It may also be said to lie in the dark. Such being the case, it is fallacy to ignore entirely any possible approach to the solution. We cannot ignore entirely the problem of transplantation merely by maintaining that the findings up to date have been misinterpreted by investigators not trained in the science of genetics. . . . The use of the science of genetics in such a biological problem is not a vain approach."

Later, Strong (1940) writes "The directional path taken by the individual in the induction of specific tumor types is the resultant of the genetic constitution of the individual and is determined by heredity."

Little (1941a) (1941b) provides a resumé and bibliography on the genetics of spontaneous tumor formation and of tumor transplantation. Ample evidence is provided in his work to show that "... there is compelling evidence that the genetic constitution of an organism plays a part in determining whether or not it will develop a tumor or tumors."

Russell (1941) in his introductory comments on the part the geneticist may play in providing more useful material for experimental medicine, states that

"... any geneticist who samples the recent literature in such fields as physiology, bacteriology, pathology, cancer research, and experimental medicine in general is struck by three points. First, most of the workers who are still using animals of uncertain origin could profit by the use of inbred stock. Second, even when inbred animals are used, they are frequently not utilized to their full value. Third, owing
to a lack of understanding of the consequences of inbreeding, erroneous conclusions are sometimes drawn from the results obtained with inbred material."

GENETIC PRINCIPLES IN DISEASE CONTROL

As early as the eighteenth century, plant breeders recognized that certain varieties of wheat were more resistant to disease than others. Subsequently breeders found it was possible with selection, to establish varieties of wheat more or less resistant to specific diseases. Biffen (1905) demonstrated the resistance in certain varieties of wheat to mycotic stem rust and thus laid the foundation for important advances in the knowledge of heredity in disease. Rapid advances have been made in the study of resistance to disease in higher plants and many valuable resistant varieties have resulted. Progress in the same direction with animals is largely limited because of practical and intrinsic difficulties.

Innate resistance of domestic fowl to Salmonella pullorum has been demonstrated by Roberts and Card (1926) (1935) and by Roberts et al. (1939). The facts presented by these authors suggest that the difference between resistant and susceptible chickens is due to an inherited differential in the number of lymphocytes at the time of greatest susceptibility to pullorum disease, which is immediately after hatching.

Genetic resistance to fowl typhoid in the chicken is reported by Lambert and Knox (1932). Four generations of selection for resistance to a standard dose of fowl typhoid bacteria resulted in a decided decrease in mortality in the selected population. These authors, discussing the complexities of a genetic approach state:

"A genetic analysis of disease resistance presents many difficulties that are not encountered in the study of other quantitative characters. Perhaps the greatest of these difficulties lies in the establishment of definite criteria of resistance. While mortality probably furnishes the best index it, obviously, does not help one to determine the various sublethal degrees of infection which take place in the surviving population."

ENVIRONMENTAL INFLUENCE

The statement has been made that there is an inherent basis for every phenomenon of life. This is essentially true, but we must also recognize that the environment, for the most part, is an inseparable attribute of all life's phenomena. There is one very marked difference between heredity and environmental factors. The genetic make-up of an organism is fixed and unchangeable while the environment changes. Definitions of heredity and environment are more or less academic and are valuable only as a basis of discussion. Lush (1938) expresses clearly the present day thought on heredity and environment when he says:

"In the strictest sense of the word, the question of whether a characteristic is hereditary or environmental has no meaning. Every characteristic is both hereditary and environmental, since it is the end result of a long chain of interactions of the genes with each other, with the environment and with the intermediate products at each stage of development. The genes cannot develop the characteristic unless they have the proper environment, and no amount of attention to the environment will cause the characteristic to develop unless the necessary genes are present. If
either the genes or the environment are changed, the characteristic which results from their interactions may be changed.'"

It is true that the environment appears to have less influence on certain genetic characteristics than on others. For example, a White Leghorn fowl of the Single-Comb variety will develop a single comb regardless of environmental conditions. However, the possibility of such a bird succumbing to fowl typhoid will depend, not only on its innate resistance to the pathogen, but on many environmental factors affecting both the host and the pathogen.

Webster (1939) writes that "studies now under way indicate that the level of resistance, which is inherited, can be altered by many environmental factors, entirely aside from specific vaccines or sera. Not the least of these factors, for example, is diet."

Numerous other citations on the relative resistance of animals such as mice, rats, and larger animals to a specific pathogen could be given if time permitted.

An appreciation of the various genetic traits and their mode of inheritance comes only after a better understanding is obtained of the influence of the environment on these genetic traits. Observation will demonstrate rather quickly that there are relatively few known characteristics in animals that are inherited on a unit-factor basis. For the most part such characters are confined to morphological and color variations and apparently they are not influenced to any great extent by the environment. The great bulk of physiological differences in animals provide a major challenge to genetic investigators. Most, if not all physiological characters are influenced to a large extent by the environment surrounding the animal. The rate of growth attained by an animal is influenced markedly by the kinds and amounts of food fed. But further, parasitism both internal and external, may retard growth, even though ideal nutritional conditions be maintained. There are but few of the known environmental conditions surrounding an animal which will definitely limit growth.

THE GENETICS OF PATHOGENIC ORGANISMS

This subject leads us into an unchallenged and fertile field. There seem to be two schools of thought as to whether the smallest pathogenic organisms are organized living bodies or unorganized inanimate bodies with certain enzyme-like properties or possibly protein bodies capable of unlimited reproductive ability. The literature would tend to substantiate the theory that the smallest of the pathogenic organisms—the filtrable viruses—are micro-organisms having some of the attributes of higher forms of life.

Rivers (1939) states that "Nothing is known of genetics in viruses. Therefore, one wonders whether it is proper to speak of virus mutations. However, in spite of complete lack of knowledge of virus genetics... it has long been recognized that viruses may vary under natural conditions and that some variations can be deliberately brought about by experimental procedures."

Pathogenic organisms in general have morphologic and physiologic characteristics which have caused workers to classify them into species, genera, and families. Frequently, such classifications are based on the pathogenicity of these organisms
with relation to the host. Genetic change is suggested in the pathogen in that they mutate, hybridize, and recombine. It is still an open question whether, after successive generations, the host shows increased or decreased resistance to a virulent pathogen, or whether the pathogen has lost its virulence through genetic change. Riker's work (1926) (1939) bears out the indications that variations in the environment may change the virulence of the pathogen. To appraise properly the genetic capacity of the host aside from environmental influences, it is necessary to consider the innate capacity of the disease-inducing agent.

Stakman (1940) states that

"The problem of the genetics of pathogenic organisms is essentially the problem of their variation. That they do vary and that the variation sometimes is extremely important is common knowledge. But how, how much, and why do they vary? What are the limits of variation, both with respect to the kind and magnitude of the modified characters and with respect to their duration? Is the variation temporary or permanent; is it due to the effect of environmental factors or to genic changes either induced by the environment or independent of it? Can pathogenic microorganisms adapt themselves to new environmental conditions merely by being subjected to them? Can pathogens change in virulence as a result of host influences? Can they increase the virulence as a result of successive passages through a given host? Is the change, if it occurs, quite temporary; is it in the nature of a Dauermodifikation; or is it permanent and heritable? Or are the apparent changes due merely to natural or conscious selection of strains from a mixed population; and do new strains arise as a result of mutation and hybridization, as in the higher plants?"

Reed (1940) has stated that during the past 15 to 18 years the literature has been flooded with evidences of variability in pathogenic bacteria. The work of Arkwright (1920) points out that one of the most frequently observed variations in bacteria is a change of smooth to rough form of colonies. Not only do changes take place in the structure of the colony but there is also a change in virulence. The new type, rough, is quite stable and seldom is there a reversion from rough to smooth. Pathologically this change is of great importance in that the new variant no longer has the properties of the original colony. Apparently the new rough form represents a genetic change in the organism. Of greater significance is the fact that such changes in the pathogen present diverse immunological reactions in the host.

Gowen and Price (1936) describe the inactivation by X-ray and ultraviolet light of common tobacco virus and a mutant form aucuba derived from the common tobacco virus. These authors suggest certain gene-like attributes to viruses and stress the opportunities offered for the study of the genetic basis for the diseases they produce.

FURTHER APPLICATIONS OF GENETICS FOR DISEASE CONTROL

Medical science is more and more recognizing the advantages of using known genetic material in the fight against disease. Through the use of inbred stocks of small animals it has been demonstrated for many disease conditions that susceptibility and resistance are definitely inherited according to Mendelian principles.

There are numerous examples of the effect of inheritance of morphological and non-infectious pathological conditions in the animal kingdom.
Probably the practicing veterinarian knows more about the hereditary anomalies in livestock than the practicing physician knows about hereditary anomalies in human beings. For the most part this is due to the greater care and consequently greater knowledge used in the selection of livestock. It has been stated, and may be repeated with emphasis, that man uses greater caution in the selection of animals for breeding purposes than in the selection of his own mate. Few of the better breeders of livestock will use animals of unknown ancestry for breeding purposes.

Cuenot (1908) demonstrated a dominant lethal associated with yellow coat color in mice in which the animals designated as YY perish before birth and the yellow coat color is maintained only in the heterozygous (Yy) condition. The exact cause of death of the homozygous yellow individual is not known but it provides an excellent example of how a single gene can so disturb the life processes of an individual to the extent that development is inhibited close to the time of conception.

A lethal anemia of mice associated with white spotting is reported by Little (1915). Here we have evidence of a physiological defect which can be partly compensated for by injection of whole blood from normal animals (Gowen and Gay 1932).

Crew (1923) reports a pathological defect in Dexter cattle termed achondroplasia which results in extremely short legs together with generalized morphological disturbances throughout the body. This defect occurs with regularity in about one-quarter of the calves of Dexter cattle. It is interesting to note that such matings also produce the Kerry-type cattle having longer legs and narrower heads than the Dexter cattle. In the case of Dexter cattle we find the desirable type of short-legged, broad-headed individual in a heterozygous condition and consequently does not breed true.

Wriedt (1925) and Mohr (1926) (1929) report the occurrence of achondroplasia in cattle that is less extreme in its manifestation and is recessive in nature.

Lush et al. (1930) report in goats the condition wherein there is a failure of one or both testicles to descend into the scrotum. Hadley and Warwick (1927), McKenzie (1931), and McPhee and Buckley (1934) report similar instances of cryptorchidism in livestock. This defect is inherited as a recessive and is sex-limited in that it is only manifested in the male.

There are numerous other defects in the larger domestic animals which have a genetic basis. Some of the more common lethal defects are listed by Hutt (1934) and Eaton (1937).

Considerable evidence is available to show the widespread occurrence of deviations from normal or desirable structure in chicken embryos. In contrast to the placental relationship between the fetus and parent in mammals, avian embryonic development is completely separated from the parent. This fact permits a more complete embryonic examination of the avian egg. Despite this advantage, surprisingly few lethals of known genetic origin have been observed. This is not due to a lack of embryonic material inasmuch as industry statistics indicate that approximately thirty-five percent of all eggs fail to hatch. Investigators reporting on the examination of samples of eggs failing to hatch indicate that death of the embryo may occur at all periods of development. Many of these eggs were classified as infertile but the percentage of infertility is of questionable accuracy because some of
these eggs actually were fertile and the embryo died during the very early hours of development. Improper care of the eggs prior to and during incubation is responsible for a large part of embryonic death. Hence, optimum environmental conditions surrounding the egg during these periods will permit a greater diversity of genetic expression.

In closing may I express my appreciation for this opportunity of presenting a few of the researches of my colleagues in the field of genetics. Although it has been my task to stress the genetic implications as they pertain to pathology, I extol the valuable contributions made by the pathologist to the science of genetics.

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Your Committee on Transmissible Diseases of Poultry held two meetings during the year, one on August 13, 1941, at Indianapolis, Indiana, at which time five members were present. The other one was held on October 22, 1941, in connection with the Collaborators’ Conference of the Regional Poultry Research Laboratory, East Lansing, Michigan. This time only four of the members were present.

**PULLORUM DISEASE**

This disease is still a major problem to the poultry industry in many parts of the country. Difficulties encountered with the agglutination test and outbreaks of pullorum disease in tested and supposedly clean or fairly clean stock have discouraged some poultrymen, and given others good excuses for condemning and discontinuing the recommended control program. The result is that, in some localities, pullorum disease has increased in prevalence. Some poultrymen also have spread the erroneous idea that pullorum disease is mainly a disease of heavy breeds, and that White Leghorns are so resistant that they do not need to be tested. That such is not the case is amply proved by evidence observed in research and diagnostic laboratories. It is true that White Leghorns rather consistently show the lowest per cent reaction of any of the common breeds, but they are certainly far from being free from this disease. In this connection attention is called to a publication entitled: Some Facts Concerning Breeding Flocks and Chicks of Ohio Poultry Improvement Association Hatchery Members by G. S. Vickers and Bruce R. Davison, Poultry Department, Ohio State University, Columbus, Ohio, 1941. In this excellent work the authors show in a most convincing manner the value of intelligently applied pullorum disease control measures, more particularly repeated testing and lowered maximum reactor tolerance.

The reactor tolerance approved by the National Poultry Improvement Plan prior to June, 1941, was 10 per cent. In the future it will be as follows:

- Fewer than 9 per cent reactors in 1941–42
- Fewer than 8 per cent reactors in 1942–43
- Fewer than 7 per cent reactors in 1943–44
- Fewer than 6 per cent reactors in 1944–45
- Fewer than 5 per cent reactors in 1945-on

At the meeting of a group representing the National Poultry Improvement Plan in Chicago, Illinois, June 17, 1941, where these changes in reactor tolerance were adopted, two more changes were made in the Plan:

1. The minimum age at which chickens may be tested shall be 5 months instead of 4.
TRANSMISSIBLE DISEASES OF POULTRY

2. A new class in the National Poultry Improvement Plan has been established. Namely, "U. S. Pullorum Controlled". All breeders in this class shall be tested for pullorum disease under the supervision of an official state agency and shall contain fewer than two per cent reactors.

Beginning September 1, 1943, pullorum disease control will be made a requirement for participation in the breeding plan of the N.P.I.P. Thirty states have this requirement now. Only 12 per cent of the birds now under the Breeding Plan are not tested (September 11, 1941).

THE PLATE AND TUBE AGGLUTINATION TESTS

The work of Vickers and Davisson referred to above shows that the plate test is practically as efficient as the tube test as judged by the number of reactors found and the livability of the chicks from tested stock. Much of the trouble encountered in connection with the plate test has been due to poor antigens. Some of them have been so sensitive that agglutination reactions have resulted from the addition of any kind of serum, avian or mammalian, yes, even salt solution. There is reason to believe that we can look for better antigens in the future. The Bureau of Animal Industry has within the last year sent out test samples of very high grade antigens. Field and laboratory tests with this new antigen (T.G. Formul) are so satisfactory that the pullorum disease control program will no doubt take a great forward step.

NONSPECIFIC REACTORS AMONG MATURING PULLETS

In testing pullets that are just coming into production, some workers in the midwest have encountered what appears to be nonspecific reactors to the plate agglutination test for pullorum disease. The majority of such birds will also give more or less doubtful reactions to the tube test. Occasionally the percentage of this type of reactors is high. When the birds giving these reactions are held for two to three months and are then retested, they will generally be found to be negative.

While it is impossible to differentiate these false reactions from weak, specific ones, a well trained, experienced worker will be struck by the unexpected and unreasonably high percentage of reactors and by the conspicuous uniformity of the degree of agglutination caused by the blood or serum of different birds. A person lacking in training and experience may fail to see anything irregular in such reactions and may, therefore, cause considerable numbers of valuable birds to be unnecessarily destroyed. Here, then, is one of several reasons for placing pullorum disease control work in the hands of properly trained professional people.

The causes of nonspecific pullorum agglutination reactions have been under investigation at the Michigan Agricultural Experiment Station for several years. One cause, the oversensitive antigen, was recognized over ten years ago and has been referred to previously in this report. The next step in this project was to see whether chickens carry in their intestines, organisms antigenically related to Salmonella pullorum. In the course of these studies S. pullorum was isolated much oftener than expected from the intestines of chicks, growing stock and adults from annually pullorum tested stock showing a low percentage of reactors and little or no mortality from pullorum disease. It appears that low grade intestinal infections
with *S. pullorum* may exist, at least for some time, without causing noticeable mortality or sufficient antibody stimulation to make it possible to eliminate such carriers by the agglutination test. The relationship of this condition to outbreaks of pullorum disease in relatively clean stock is obvious.

Besides *S. pullorum*, 14 other salmonellae were isolated, four of which had never before been found in chickens, namely: *Salmonella californica*, *Salmonella urbana*, *Salmonella aberdeen* and *Salmonella hvittingfoss*. It was also the first time that *S. aberdeen* had been isolated in the United States. In one series of examinations salmonellae were found in 48 of 294 birds (16.94 per cent). About half that many carriers were found in another series of examinations involving 477 intestinal samples, some of which consisted of duodenal loops of chicks. When five or more chicks from one flock were submitted for examination, five duodenal loops were examined as a composite sample. None of these 14 salmonellae are antigenically related to *S. pullorum*. Therefore, their presence does not appear to have any connection with nonspecific reactions in the pullorum agglutination test. Pullorum positive and negative sera will agglutinate some members of the proteus shigella and escherichia groups of organisms isolated from chickens.

**METHODS OF ISOLATION AND PATHOGENICITY FOR MAN AND MONKEYS**

The use of selective enrichment broth media, containing such bacteriostatic agents as brilliant green or tetraethionate, followed by MacConkey's or bismuth sulphite agar plates was found to be necessary for successful isolation of salmonellae from the intestines of chickens.

Several of the salmonellae isolated have been found in cases of intestinal disorders in man. None of them produced symptoms of disease when fed to monkeys in large doses. Whether this can be interpreted to mean that they are not pathogenic for man is questionable.

An account of the work dealing with methods of isolation and pathogenicity has been accepted for publication in the Journal of Infectious Diseases.

**EFFECT OF CHEMICAL COMPOSITION OF BLOOD ON THE AGGLUTINATION TEST**

At present work is in progress to determine if the composition of the blood during the early stages of egg production may have any effect on agglutination. The electrophoretic method of analysis is employed, and results obtained so far indicate that the gamma globulin content of pullorum positive birds is high, and that it is low in doubtful reactors, in some cases much lower than that of negative birds. Some of the doubtful reactors also showed an atypical albumin fraction, moving slightly faster than albumin. In sera showing high agglutination titer, the albumin concentration was decreased.

**PULLORUM DISEASE IN TURKEYS**

Pullorum disease in turkeys is less prevalent than in chickens. However, it is transmitted from the turkey hen to the poult through the egg and no doubt also in the incubator. Infected chickens may also very likely be a menace to poults. During the 1940–41 breeding season, Dr. E. S. Weisner, Extension Veterinarian in Poultry Pathology, Michigan State College, supervised the testing of 6953 breeders.
in Michigan flocks. There were only 36 reactors (0.518 per cent). Therefore, it seems that now is the time to attempt to eradicate this disease from turkeys. Unfortunately, the plate test is not satisfactory because it does not detect carriers with sufficient accuracy. The tube test is of some value before the hens come into production. After production is well under way, about March 1, the tube test becomes less effective due to cloudy reactions produced by sera of females.

**Pullet Disease**

This disease is very prevalent during the late summer and fall and continues to appear increasingly throughout the east and midwest. It is found in turkeys as well as chickens. Attention is called to the work on this disease by Erwin Jungherr and Jacob M. Levine, Am. Jour. Vet. Res., II, 4: 261–271, July, 1941.

**The Avian Leukosis Complex**

Avian leukosis is the most prevalent disease in poultry. There is an impression that it is decreasing in prevalence. This may be true in certain flocks. However, while there may be less of the paralysis aspect of the disease, the visceral form and the leukemic manifestations are increasing.

Much research is being carried out on this problem. Progress will be slow because of the peculiar nature of the malady. Some of the main difficulties in connection with research on leukemia are: Long incubation period, rather low percentage of takes in inoculated birds, lack of leukemia free stock, making it very difficult to measure the results from inoculation and contact exposure experiments, and finally lack of serological tests that might be used for detection of carriers and determination of antigenic similarities or difference in the strains of the virus.

**Diseases of Birds Transmissible to Man**

Within recent times the equine encephalomyelitis virus has been found in pheasants, the psittacosis virus recovered from pigeons and in one instance from chickens. Several varieties of paratyphoid organisms known to have caused enteritis in humans have been isolated from chickens. These findings reveal the necessity for careful study of diseases of birds from the point of view of public health.

**Fowl Cholera and Ruptured Yolks**

This disease is now very rare in some states. At the New Jersey Agricultural Experiment Station it has been shown that the fowl cholera bacillus is frequently found in ruptured yolks, and that cultures must be made directly from the peritoneal cavity or the abdominal air sacs for successful isolation of *Pasteurella avicida*.

Work with this problem in other states has not corroborated these findings. In California *P. avicida* was isolated from tissues of 40 per cent of a large number of birds showing ruptured yolks, while in other states it is conspicuous by its absence no matter what material is examined. Thus the problem of ruptured yolks does not seem to be solved. It may be appropriate to suggest that cultural examinations should be accompanied by inoculations of rabbits in order to make the results more convincing one way or another.
REPORT OF COMMITTEE

TUBERCULOSIS

In many localities in the midwest avian tuberculosis is still prevalent. Your attention is called to a map published by the Bureau of Animal Industry U.S. Department of Agriculture, January, 1941. This map shows the extent of avian tuberculosis in the United States. During the spring of 1941, 55.55 per cent reactors to the tuberculin test were found in a flock of 54 fine looking New Hampshire Red pullets within a few miles of Lansing, Michigan. These birds were well fed, well housed and the egg production was 60 per cent. Thirty reacting pullets were bought by the Experiment Station and held for observation. Several have died and were found to have tuberculosis by bacteriological examination.

NEED OF VETERINARY SERVICE FOR POULTRYMEN

Practicing veterinarians are continuing to take more and more interest in poultry disease. Several states are conducting extension schools in poultry husbandry, hygiene and pathology for practicing veterinarians. Still there is need of extending veterinary service to a much greater extent than has been done to the present time.

REMEDIES

Spending of large sums of money for useless remedies continues to be one of the greatest drains on the poultryman’s pocketbook. For example, in some states, fowl cholera and fowl typhoid are practically extinct, yet a number of “dime-a-dozen poultry experts” travel through the country selling cholera-typhoid vaccines. Many other remedies of very questionable nature are sold in quantities. Most of the people who sell these remedies have had no training in the fundamentals of medical science and very little schooling even in the superficial aspects of avian pathology and hygiene.

It seems that the logical remedy for this situation is a serious attempt to extend bona fide veterinary service to all who need it. This is a subject that should be given earnest consideration. In this connection, your attention is called to three articles that deal with this subject:


All these articles contain ideas that are worthy of consideration.

RESEARCH IN CHEMOTHERAPY

It is encouraging to note that some progress has been made in experimental work with some drugs which promise to become useful in the control of certain poultry diseases. For further information you are referred to the Report of the Special Committee on Poultry Diseases of the Am. Vet. Med. Assoc., Jr. A.V.M.A., Nov 1941.
The application of our knowledge of the parasites of domestic animals, to their control and treatment is still greatly hampered by a number of factors. Two of the most important of these are, firstly, the still too common habit of not attempting to identify them in veterinary practice and, secondly, lack of accurate information on their geographical distribution.

Too often the cause of illness or of death in an animal is referred to as “parasitism” instead of as being due to a specific parasite. Probably no two parasites have identical effects on the host and to refer to a cause of a given disease as parasitism is no more informative than to refer to that of another disease as bacterial. For many years, it is true, nomenclature presented great difficulties to the veterinarian and a ready means of diagnosis was not available to workers outside of the laboratory. The knowledge of pathogenicity was equally rudimentary; it is still far from complete but sufficient data have been published to make it perfectly clear that some internal parasites are of less pathogenic importance than others. Those potentially pathogenic only become so under, what is to the parasite, a favourable condition. Unfortunately, conditions of domestication too often introduce these favourable conditions.

It is of fundamental importance that everyone who has to prevent and to cure the many parasitic diseases of livestock should be able to correctly diagnose the species (or in some cases group of species) of parasites present. If the identity is not known, the specimens should be submitted to a suitable parasitological laboratory. Once identified the wealth of literature available makes the remainder of the procedure comparatively easy. Its seasonal distribution is known, the weak points in its life cycle and bionomics become amenable to control and the best method of treatment can be applied.

It will enormously simplify this work if the accurate distribution of the parasite is known. Climate is a potent factor governing this distribution, so also are soil, agricultural practices and so on. We have distributed domestic animals throughout the world and with them their parasites. Some have gained a foothold in one place, others in another. The introduction of stock into new countries has enabled them in some cases to pick up new parasites from the indigenous fauna. We are far from having a true picture of the result. We do not know in many cases, what parasites can spread from one section of the country to another by the movement of stock nor do we realize what species can become settled once they are introduced.

On the suggestion of the late Maurice Hall, the International Veterinary Congress in New York appointed an international committee to collect data on this subject and this committee at its Zurich meeting in 1938 decided, inter alia, to attempt to map out the world distribution of those parasites of domestic animals which are at least potentially pathogenic and so make available to the worker outside of the
laboratory, the essential data which he requires to conduct a prevention campaign. The war has rendered this project temporarily unfeasible and it may be many years before the collection and publication of these data are possible.

North America has perforce, had to shoulder many of the tasks of civilization and your Committee is of the opinion that a start should be made as soon as practicable on such a project. This cannot be done in a day and a longer period of preparation is necessary before results are available. It is necessary to have representatives in all parts of the continent, who will collect information from local workers. It is equally necessary that these local workers must be able to recognize the parasites when they see them. Making such a census must involve the examination in the aggregate of millions of specimens, and correlating the presence of these parasites with the existence of disease. Seldom is disease caused by a single factor alone; it is almost always a complex of symptoms. Other factors, including resistance, nutritional level, as well as numbers of parasites and other disease producing agents must be considered. Accordingly, diagnosis requires professional skill and judgement; this postulates a sound training in veterinary parasitology and in other branches of veterinary medicine.
THE VALUE OF BLOOD EXAMINATIONS IN THE DIAGNOSIS OF BOVINE TUBERCULOSIS

R. A. HENDERSHOTT, D.V.M. AND C. B. JOHNSTON, D.V.M.

A review of the reports made by recent committees on tuberculosis of the United States Livestock Sanitary Association and of the American Veterinary Medical Association, indicates a desire upon the part of the members of these committees to explain the "no visible lesion reactor," as well as non-specific reactions to the tuberculin test. In addition, the sensitization of cattle through contact with tuberculous poultry, and the so-called "skin lesion cases," have received attention in these reports.

It is well that all of these subjects be recognized and given consideration by members of the veterinary profession.

Today, I wish to discuss, not the conditions which might cause false tuberculin reactions but more particularly those cases of tuberculosis which fail, for some reason or other, to be disclosed through the application of the routine tuberculin tests.

Some two years ago, owners of abattoirs in New Jersey were asked to report to the Department of Agriculture, all cases of tuberculosis found on post mortem inspection of slaughter or straight cattle.

Too often these reports indicated that animals disposed of for slaughter and originating in herds thought to be free of tuberculosis, revealed lesions at the time of slaughter.

Since such a condition exists in the tuberculin tested herds in New Jersey, is it not reasonable to expect that a similar situation may exist in other states, inasmuch as the routine tuberculin testing is conducted in cooperation with the federal government and through the application of a standardized tuberculin test technique.

That such a deduction is justified is confirmed by the records compiled by Dr. L. M. Hurt of Los Angeles County, California, which indicate that the incidence of tuberculosis in cattle imported into that area has been increasing at the rate of one-tenth of one per cent annually.

Our own experience with cattle imported from other states also lends support to his findings.

1 This is the second of a series of papers dealing with the value of hematology in the diagnosis of tuberculosis.

At the time the first paper was presented at the American Veterinary Medical Association meeting in Indianapolis, on August 11-15, 1941, it was our intention to work out several additional phases of this aid to diagnosis and to have a report completed in time for this meeting. Unfortunately, my co-worker has been called into active service and his loss to the Bureau has temporarily caused a delay in the completion of certain projects that we had planned. However, the work has been continued and it is the purpose of this report to bring up to date the progress we have made.

2 Bureau of Animal Industry, New Jersey Department of Agriculture, Trenton, N. J.
Although an excellent piece of work has been done in reducing the incidence of tuberculosis in livestock throughout the nation, it is equally important that we come to the full realization that this disease has not been entirely eradicated.

About a year ago, recognizing that the tuberculin test was not disclosing all cases of tuberculosis in our herds, we sought some method which might be used as an adjunct to the intradermic tuberculin test to bring about the desired result.

A review of the literature indicated that many workers have made use of the study of blood cells in tuberculosis.

Bredeck working in the human family, reported in 1929 a study of the blood of tuberculous individuals. He made differential counts prior to the injection of tuberculin and again at the end of 24 hours. He found that in tuberculous patients there was an extreme shift to the left of the neutrophilic leucocytes, according to the Schilling index and that there was a lowered lymphocyte count with an extremely high monocyte count in certain individuals. He states in his conclusions: “The Schilling procedure, together with the subcutaneous tuberculin test, constitutes our most delicate and most accurate method in the diagnosis of early manifest and induced focal activity.”

In a review of the veterinary literature, many workers have studied the blood picture of cattle infected with tuberculosis. Fraser (5), in 1930, presented a detailed study of the blood of sheep and cattle in both health and disease. With reference to tuberculosis, he studied not only clinical cases, but reactors to the intradermal test, as well as a series of calves, which in the course of an experiment in connection with B.C.G. vaccine, were inoculated with large doses of tubercle bacilli and developed acute miliary tuberculosis in consequence. In reactors, he states that there occurs slight shifting to the left in the Schilling index, however, not passing the limits found for normal cattle. In clinical tuberculosis, he found in some animals a lymphocytosis, while others showed an increase in the neutrophilic leucocytes. He concluded that no constant variation was observed. In experimental tuberculosis, he observed a shift to the left in the Schilling index which, while not as marked as that observed in the human family, was of definite value as an indicator of myeloid activity.

Hofferber (6), in 1934, studied the blood picture of 106 slaughter cattle, of which 69 were free from tuberculosis and 37 infected. He conducted red and white cell counts, differential counts and hemoglobin estimation. He found that the blood picture varied considerably with the activity of the disease. He observed a decrease in erythrocytes with a decrease in the hemoglobin content, and usually a considerable alteration of the polymorphonuclear leucocytes to mononuclear leucocytes and immature cells. He concludes that although a diagnosis of tuberculosis cannot be made from the blood picture alone, it may, however, prove of value when used with chemical aids or other aids to diagnosis.

Thijn (12), in 1938, studied the blood picture in 12 healthy and 25 tuberculous cattle. He observed that tuberculous animals usually exhibited a degenerative anemia and sometimes a leucopenia, a monocytosis, or a neutropenia. He also concluded that the blood picture alone, cannot be considered sufficient basis for diagnosis.

Thiele (11), in 1938, working in Germany, reported on “The Leucocytic Blood
Picture of Cattle During the Performance of Intradermal Tuberculin Tests." He studied the leucocytic cell count in 59 cattle which showed no clinical evidence of infection, as well as in nine clinical cases of tuberculosis. In cattle showing negative or doubtful reactions, where the increase in the skin measurement did not exceed 3 mm., there was no significant change in the blood, whereas in 36 reacting cattle, a definite increase in neutrophiles occurred. This increase in the neutrophilic leucocytes was evident 12 hours after injection, and reached its maximum within 32 hours. In four clinical cases, leucocytic changes were noticed 20 hours after injection. He suggested that a differential leucocyte count might be usefully employed to assist in the diagnosis by the intradermal test.

Stasney and Feldman (13), of the Mayo Foundation, in 1938, reported on the character of the leucocytic response to tuberculin in sensitized calves. The object of this experiment was to compare the reaction obtained in calves with that previously noted in rabbits; namely, a leucocytic response similar to the so-called leukemoid reaction associated with tuberculosis in the human family.

In their experiment, six of eight three month old calves were infected by the injection of virulent tubercle bacilli. The blood of these calves was examined on three successive days prior to inoculation and weekly thereafter, for a period of eight weeks. Following the eighth weekly blood examination, the calves were injected intracutaneously in each caudal fold with 0.2 cc. of standard intradermic tuberculin, containing approximately 0.25 gram of K.O.T. per cc.

Following the intradermic injection of tuberculin, blood smears were examined on each of the succeeding three days. Within 24 to 72 hours, they noted an increase in the total leucocyte count, accounted for mainly, by an increase in the neutrophiles (polymorphonuclear leucocytes). At the same time, a decrease in the number of lymphocytes was noted. On the 11th day following the intradermic injection of tuberculin, each calf was injected subcutaneously with a solution of tuberculin, equivalent to 2 grams of K.O.T. Blood studies were made 24 and 48 hours following this injection and revealed a definite increase in neutrophiles with a marked shift to the left; at the same time the lymphocyte count showed a tendency to decrease.

They also noted that the subsequent administration of larger doses of tuberculin was followed by the appearance of immature cells in excess of those observed following the first or intradermic injection.

These workers do not mention the application of change in the neutrophilic-lymphocytic ratio as an aid in the diagnosis of tuberculosis.

**METHODS**

Blood samples were drawn from the jugular vein into a 5 cc. glass syringe containing approximately 0.2 gram of sodium oxalate. Blood films were prepared on 3 x 1 inch glass micro-slides and the films were made through the use of a 20 x 26 mm. cover slip. Blood films were stained with Giemsa stain or May-Grünwald. Fresh stains were prepared daily by adding one drop of stain to 1 cc. of neutral distilled water. The films were first fixed in 95 per cent acetone-free methyl alcohol and then stained for 30 minutes in the diluted stain. The films were then rinsed in neutral distilled water and allowed to air dry.
Oxalated samples were used to make total white cell counts and all white counts were completed within 24 hours. (Trenner pipettes were used in making dilution, using \( \frac{1}{10} \) normal hydrochloric acid as the diluent.)

Differential counts were made using the four field meander method. One hundred cells were counted on each film except where total white cell counts were in excess of 15,000, in which instances, 200 cells were counted.

At the beginning of our work standard subcutaneous tuberculin containing 0.0625 gram of K.O.T. per cc. was employed. At present we are using 2 cc. of intradermal tuberculin prepared by the United States Bureau of Animal Industry containing approximately 0.25 gram of K.O.T. per cc.

| TABLE 1.—Comparison of the percentage formula by various workers |
|---------------------|---------------------|---------------------|---------------------|---------------------|
|                     | LYMPHOCYTES | MONOCYTES | NEUTROPHILES | EOSINOPHILES | BASOPHILES |
| 1 Dimmock and Thompson: adult cattle | 54.2 | 1.4 | 30.4 | 13.15 | 0.59 |
|                       | A 31-76     | B 0.2-3.3 | 13-35.8 | 3.9-26.5 | 0.1-1.2 |
| 2 duToit: adult cattle | 49 | 3.7 | 38.8 | 8 | 0.5 |
|                       | A 25-65.5   | B 2.5-5.5 | 27-54.5 | 4-16 | 0.5-1 |
| 3 Kohanawa: adult cattle | 51.7 | 4.3 | 33 | 10.9 | 0.1 |
|                       | A 44.6-56.4 | B 2.2-6.2 | 27.9-40.4 | 6.1-16.8 | 0.0-3 |
| 4 Sergent and associates: adult cattle | 59.5 | 7.5 | 22 | 10 | 0.9 |
|                       | A 29.5-31.5 | B 1-29.5 | 4.5-51 | 1.5-23 | 0.5 |
| 5 A. C. Fraser: adult cattle | 54.7 | 6.7 | 28.4 | 9.9 | 0.1 |
|                       | A 29-76.4   | B 1.8-18.2 | 16.2-56.4 | 1.2-25.4 | 0-1.4 |
| 6 Hoffner: adult cattle | 51 | 7.5 | 36 | 5 | 0.5 |
|                       | A 48-68     | B 3-6 | 29-34 | 8-17 | 1 |

A = average percentage; B = minimum-maximum range.

A number of workers, notably Dimmock and Thompson (3), duToit (2), Kohanawa (9), Sergent (10), Fraser (5), Hoffner (7), and Canham (2) have set forth the leucocytic formula for normal adult cattle.

We have studied the leucocytic formula of a number of apparently normal cattle prior to and 24 hours following the subcutaneous injection of 2 cc. of tuberculin and have tabulated our results according to the following age groups: adult cattle, bred heifers and young stock under one year of age.

Following the lead provided by Bredek's study of the leucocytic formula exhibited in tuberculosis in man and induced through the injection of subcutaneous tuberculin, we proceeded to study the changes occurring in the blood of tuberculin test reactors.

We observed that though there was not always a shift to the left as noted by
DIAGNOSIS OF BOVINE TUBERCULOSIS

Bredeck (1), there was, however, a marked alteration in the neutrophilic-lymphocytic ratio.

In practically all cases in which lesions of tuberculosis were found on post-mortem, the blood survey revealed a marked increase in the number of neutrophiles and a corresponding decrease in the number of lymphocytes.

In order to determine the optimum hour for obtaining the post injection blood smear, 22 tuberculous and 24 non-tuberculous animals were studied over a 24-hour period.

<table>
<thead>
<tr>
<th>TABLE 2.—Average leucocytic formula in negative cattle</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>64 adults</td>
</tr>
<tr>
<td>Basophiles</td>
</tr>
<tr>
<td>Eosinophiles</td>
</tr>
<tr>
<td>Immature neutrophiles</td>
</tr>
<tr>
<td>Neutrophiles</td>
</tr>
<tr>
<td>Lymphocytes</td>
</tr>
<tr>
<td>Monocytes</td>
</tr>
</tbody>
</table>

| 18 bred heifers                              |              |                 |                                         |
| Basophiles                                   | 0.22         | 0.33            | +50                                    |
| Eosinophiles                                 | 7.67         | 7.17            | -6.52                                  |
| Immature neutrophiles                        | 0.17         |                 | -100.00                                |
| Neutrophiles                                 | 17.06        | 21.06           | +23.45                                 |
| Lymphocytes                                  | 70.72        | 68.00           | -3.85                                  |
| Monocytes                                    | 4.17         | 3.44            | -17.51                                 |

| 41 animals under one year of age             |              |                 |                                         |
| Basophiles                                   | 0.12         | 0.10            | -16.67                                 |
| Eosinophiles                                 | 2.80         | 2.78            | -0.71                                  |
| Immature neutrophiles                        | 0.12         | 0.02            | -83.34                                 |
| Neutrophiles                                 | 21.51        | 21.20           | -1.44                                  |
| Lymphocytes                                  | 70.93        | 72.00           | +1.51                                  |
| Monocytes                                    | 4.52         | 3.90            | -13.72                                 |

* 24 hours following administration of 2 cc. tuberculin subcutaneously. Each cubic centimeter contained 0.0625 cc. KOT.

This is graphically presented in table 3.

The hematological method of surveying herds suspected of containing tuberculous animals, has now been applied to 12 herds in New Jersey. As the histories and results in all of them are quite parallel, one has been selected to demonstrate what can be accomplished through the use of this method of diagnosis. This herd will be designated "S.N.,” and its history is as follows:

It normally contains an average of about 80 animals. Since the initial test in
December, 1933, we have removed 222 reactors to date. This herd always has been troublesome, as indicated by the fact that it was subjected to 20 herd tests between 1933 and January, 1940, at which time it was accredited. On the annual reac-

ting test conducted on January 8, 1941, of 89 head subjected to test, 40 reacted.

It was decided to make a critical survey of this herd, using the intradermic and cytological methods after the 40 reactors to the intradermic tuberculin test of January 8, 1941, were removed.
Accordingly, on February 28, 1941, oxalated blood samples were collected and blood smears made from 51 of the animals in this herd, which now totalled 79. Thirty new additions were made to the herd following the removal of the 40 reactors. Due to circumstances beyond our control, only 51 blood samples of the 79 head were collected at this time. Each animal was given 2 cc. of subcutaneous tuberculin, which contained .0625 gram of Koch's Old Tuberculin per cc., and post injection blood smears were made 24 hours later.

As the result of the intradermic test of February 28 to March 3, 1941, 5 animals were declared reactors; the hematological picture confirmed this diagnosis. In addition, 17 animals which passed the tuberculin test exhibited a change in the neutrophilic-lymphocytic picture which we have judged significant of tuberculous infection. Five of the 17 animals were consigned to slaughter, along with the 5 intradermic test reactors and all revealed gross lesions of tuberculosis. The 12 remaining blood-positive cows were segregated and held for retest and study.

Table 4 illustrates the test result and post mortem findings of the 10 removed at this time.

In this group it will be noted that there is, through a comparison of the pre and post injection counts, in each instance, a marked increase in neutrophiles, associated with a comparable decrease in lymphocytes. In some instances, the pre-injection counts are not normal. However, in every instance, through the use of tuberculin, a picture typical of that exhibited by infected animals was obtained. One animal, no. 49095, shows a shift to the left according to the Schilling index. Another animal, no. 32950, which failed to react to the tuberculin test, exhibited, along with a neutrophilia and lymphopenia, a monocytosis involving an increase of 116.66 per cent of the total monocytes, or an increase from 12 to 26 per cent of the leucocytic count.

Also in this group occurs an animal no. 2591, which exhibited a 76.47 per cent decrease in total number of lymphocytes, or a decrease from 34 to 8 per cent. This is the greatest percentage decrease of lymphocytes observed thus far.

Fearful that the injections of tuberculin used to stimulate the cytological response might, in some manner, have interfered with the proper interpretation of the intradermal tuberculin test, it was decided to conduct a tuberculin retest at least one week in advance of the next blood examination.

On April 29, 60 days following the preceding tuberculin test, this herd was subjected to an intradermal retest resulting in the condemnation of 11 animals. These reactors were maintained on the premises pending a blood examination. It is significant that again the 12 blood-positive animals left in the herd failed to react to the tuberculin test.

On May 6, pre-injection temperatures were taken on all animals in this herd, also blood smears and oxalated blood samples were collected just prior to the injection of 4 cc. of subcutaneous tuberculin. Temperatures were recorded every two hours and blood smears were made at varying intervals over a 24 hour period. Twenty-six animals reacted to this subcutaneous tuberculin test.

It is interesting to note, that of the 12 blood-positive animals, which had twice successfully passed an intradermal test, 5 reacted to the subcutaneous test. All 12 animals again exhibited a change in the leucocytic formula characteristic of the picture observed in tuberculosis.
To recapitulate, permit us to summarize the material up to this point.
Eleven of this herd now comprised of 72 animals reacted to an intradermal test conducted on April 29. Included in this test, were the 12 animals declared blood positive on the test of February 26. None of these 12 reacted to the intradermal test of April 29. On May 6, all 72 animals were subjected to the subcutaneous test,

<table>
<thead>
<tr>
<th>TAG NUMBERS</th>
<th>TOTAL WHITE CELL COUNT</th>
<th>RASPBERRY</th>
<th>KOHLSCHNEIDER</th>
<th>NEUTROPHIL</th>
<th>LYMBOCYTE</th>
<th>MONOCYTE</th>
<th>TUBERCULIN TEST 2/28-3/3/41</th>
<th>POST MORTEM FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX. NO.</td>
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<td>7250</td>
<td>3</td>
<td>26</td>
<td>65</td>
<td>3</td>
<td>Pos.</td>
<td>Caseous lesions, bronchial mediastinal and mesenteric lymph glands</td>
</tr>
<tr>
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<td></td>
<td>10250</td>
<td>2</td>
<td>11</td>
<td>51</td>
<td>33</td>
<td>Pos.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>9700</td>
<td>17</td>
<td>4</td>
<td>29</td>
<td>41</td>
<td>Pos.</td>
<td>Caseous calcareous lesions, cervical caseous lesions, lungs</td>
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<td>46</td>
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<td>5</td>
<td>18</td>
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<td>Marked lesions, cervical and bronchial lymph glands, lungs extensive mediastinal. p’d for cooking</td>
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<tr>
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<tr>
<td>8</td>
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<td>7850</td>
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<td>45</td>
<td>37</td>
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<td>22</td>
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<td>Well marked caseous cervical, slight caseous bronchial, mediastinal and mesenteric</td>
</tr>
<tr>
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<td>50</td>
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<td>Pos.</td>
<td>Slight caseous lesions, Bronchial, marked caseous lesions of lungs</td>
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<td>32</td>
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<td>23</td>
<td>28</td>
<td>47</td>
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</table>

Amount of tuberculin—2 cc. of 0.0025 per cc. subcutaneous tuberculin.

* = pre-injection counts; † = post-injection counts.

resulting in 26 reactors. Five of these reactors were among the 12 blood positives of the tuberculin tests of February 28 and April 29.

At the time the subcutaneous test of May 6 was being conducted, the entire herd was re-surveyed by the blood method, resulting in 46 being declared positive. The 46 blood-positive include the 12 blood-positives held over from the February 28
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</tbody>
</table>

**TABLE 5**

**POST MORTEM FINDINGS**

- Slight caseo-calcareous mediastinal lymph glands
- Well marked caseo-calcareous cervical lymph glands
- Slight caseo-calcareous bronchial and mesenteric lymph glands
- Slight caseo-calcareous lesions of the mediastinal and mesenteric lymph glands
- Caseo-calcareous lesions of bronchial and mediastinal lymph glands
- Extensive caseous cervical, well marked caseo-calcareous bronchial and mediastinal, slight caseo-calcareous, lungs and mesenteric
- Slight calcified mediastinal lymph glands
- No visible lesions
- Slight caseo-calcareous mediastinal and mesenteric
- Posted 5/24/41. Slight caseo-calcareous lesions bronchial mediastinal, slight calcareous lesions, mesenteric lymph glands
- Posted 5/24/41. Well marked caseo-calcareous mesenteric, slight caseo-calcareous mediastinal and cervical lymph glands
- Slight caseo-calcareous mediastinal and mesenteric

Amount of tuberculin—2/28/41, received 2 cc. subcutaneous containing 0.025 gram KOT. 8/6/41, received 4 cc. subcutaneous containing 0.025 gram KOT.

1 This cow calved 2:20 a.m. May 7, 1941. Gave a positive picture from the 8th hour through to the 21st hour. Practically normal count at 24th hour.

* = pre-injection counts; † = post-injection counts.
test, as well as all intradermal and subcutaneous test reactors of the April 29 and May 6th tests.

The data, covering this group of 12 animals is given in table 5.

To summarize briefly, since February, 46 blood positive animals have been condemned to slaughter.

Twenty-six of these reacted to the subcutaneous test.

Eleven of the 26 subcutaneous test reactors reacted also to the intradermal test.

On post-mortem, 44 revealed gross lesions of tuberculosis and two were no-visible-lesion cases.

<table>
<thead>
<tr>
<th>Table 6.—Average of the leucocytic formula</th>
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</tr>
<tr>
<td>BEFORE INJECTION</td>
</tr>
<tr>
<td>24 HOURS AFTER</td>
</tr>
<tr>
<td>PER CENT CHANGE BASED ON INCREASE OR</td>
</tr>
<tr>
<td>PERCENT</td>
</tr>
<tr>
<td>OF TOTAL TYPE</td>
</tr>
<tr>
<td>CELLS COUNTED</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>159 tuberculous animals</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Basophiles</td>
</tr>
<tr>
<td>number</td>
</tr>
<tr>
<td>46</td>
</tr>
<tr>
<td>Eosinophiles</td>
</tr>
<tr>
<td>1,502</td>
</tr>
<tr>
<td>Immature neutrophiles</td>
</tr>
<tr>
<td>48</td>
</tr>
<tr>
<td>Neutrophiles</td>
</tr>
<tr>
<td>4,574</td>
</tr>
<tr>
<td>Lymphocytes</td>
</tr>
<tr>
<td>9,015</td>
</tr>
<tr>
<td>Monocytes</td>
</tr>
<tr>
<td>723</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>15,908</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>536 negative animals</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Basophiles</td>
</tr>
<tr>
<td>157</td>
</tr>
<tr>
<td>Eosinophiles</td>
</tr>
<tr>
<td>5,334</td>
</tr>
<tr>
<td>Immature neutrophiles</td>
</tr>
<tr>
<td>108</td>
</tr>
<tr>
<td>Neutrophiles</td>
</tr>
<tr>
<td>16,754</td>
</tr>
<tr>
<td>Lymphocytes</td>
</tr>
<tr>
<td>28,928</td>
</tr>
<tr>
<td>Monocytes</td>
</tr>
<tr>
<td>2,325</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>53,606</td>
</tr>
</tbody>
</table>

Twenty animals, including the two no-visible-lesion cases, never reacted to the tuberculin test. Conversely, 18 animals which were removed on the blood test alone revealed lesions. This concludes the discussion of the "S.N." herd.

At the outset, you will recall we explained that we were presenting, in detail, the data obtained in one of 12 herds which have been surveyed by the hematological method.

To date, a study as described in this paper has been completed on 12 herds consisting of 695 head of cattle, 125 of which were proved to be infected with tuberculosis as determined by post mortem examination and 549 of which were negative to the tuberculin tests and blood examination; 21 have not been slaughtered.

It is interesting to note, that to date, of the 695 animals studied, we have con-
demned a total of 159 animals which were declared positive to the blood survey. Seventy-three of these animals were positive and 86 negative to the tuberculin test. Of the 159, 125 revealed gross lesions on post mortem examination. Thirteen failed to show lesions and 21 have not been slaughtered.

Four of the 13 no-visible-lesion cases, reacted to the tuberculin test. The remaining 9 were negative to the tuberculin test.

Of the 73 positive to the tuberculin test, 69 revealed gross lesions on post mortem and 4 were no-visible-lesion cases.

Of the 86 blood positive tuberculin test negative, 65 have been slaughtered and 56 revealed gross lesions. Nine failed to show lesions, 21 have not yet been slaughtered.

The average per cent of the various kinds of leucocytes obtained in pre-injection and post-injection smears, as well as the percentage of change found on the 695 animals following injection of tuberculin subcutaneously, is given in table 6.

**DISCUSSION**

We have felt the need, in our tuberculosis eradication program, of a more critical means of establishing complete freedom from tuberculosis to the end that we shall be able to materially reduce the number of breaks in our accredited herds. We believe we have, in the procedure, outlined in this paper a valuable adjunct to the tuberculin tests that is worthy of use in certain herds.

We desire to re-emphasize a point which has been made in the majority of the committee reports on tuberculosis both of The American Veterinary Medical Association and of the United States Live Stock Sanitary Association: namely, that We can ill afford to rest on the laurels, so justly earned by our profession, in the splendid accomplishment obtained to date in tuberculosis eradication. Let us not become so complacent about the situation that we are blinded to the fact that, in order to accredit an area, it was necessary to reduce tuberculosis only to one-half of 1 per cent.

To date, the tuberculin tests have performed yeoman service in the reduction of this malady of cattle, and we find ourselves in a position that is comparable to a football team that has succeeded, after many thrusts, to reach its opponent's one yard mark. From here on, concerted effort and often change of tactics, is required to get the ball over. Perhaps the blood survey of problem herds is the forward pass which, when completed, will place this game in our won column along with Contagious Pleura Pneumonia and Foot and Mouth Disease.

We entertain the feeling that perhaps more critical study of the cytological changes in the blood of all forms of animal life will provide the members of our profession with an additional weapon to assist them in the problems presented in diagnosis and control of ailments of animals.

**CAUTION**

From experience gained in training men in our laboratory to stain and make counts of the blood of cattle, we have been impressed with the precautions that one must take in conducting a blood survey. It is suggested that studies first be conducted on known tuberculin test reactors until one is proficient in judging infection
by this method. At the outset we studied known reactors and then applied the blood test to herds in which breaks had occurred. Caution was exercised in consigning blood positive, tuberculin test negative animals to slaughter. In each instance the post mortem findings obtained served as a guide for the condemnation of additional blood positive cases.

CONCLUSIONS

1. A study of 2,313 blood smears involving 695 cattle, 125 of which were tuberculous and 549 non-tuberculous is presented.
2. A study of the differential blood counts over a 24-hour period of 22 tuberculous and 24 non-tuberculous cattle following injection of tuberculin subcutaneously is given.
3. The average differential blood count, by age groups, of normal cattle prior to and following the subcutaneous injection of tuberculin, is set forth.
4. The average differential count and the percentage of change in the various types of leucocytes exhibited in 536 negative cattle is shown.
5. The average differential count and the percentage of change in various types of leucocytes exhibited in 159 blood positive cattle is shown.
6. The observation is made of a constant change in the neutrophilic-lymphocytic ratio in tuberculous cattle induced by the injection of tuberculin.
7. A method is outlined which should prove of value in the detection of tuberculosis in cattle in advance of the time when the tuberculin tests would disclose infection.

We wish to acknowledge the splendid spirit of cooperation exhibited by the United States Bureau of Animal Industry, through the Federal Inspector in Charge in New Jersey, Dr. J. R. Porteous, as well as associates in the New Jersey Bureau of Animal Industry Laboratory who gave their time and effort unstintingly to make this report possible.

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TIME HAS PROVED THE EFFICIENCY AND VALUE OF BOVINE TUBERCULOSIS ERADICATION WORK

BY A. E. WIGHT

The title of this paper was suggested by the chairman of the Committee on Tuberculosis of this Association, Dr. E. T. Faulder. His suggestion was much appreciated, and at this time I wish again to compliment him on the valuable contribution he has made to the bovine tuberculosis eradication work in this country. As Director of the Bureau of Animal Industry of the State of New York, he has made it possible to conduct the bovine tuberculosis eradication program in an orderly manner in that State where the disease was very prevalent up until a few years ago. It has been a pleasure to cooperate with Dr. Faulder, and I am sure I express the opinion of all of us who have had an opportunity to engage in this activity with him.

The value of this accomplishment of eradicating bovine tuberculosis is difficult to measure. Many statements regarding it have been published time and time again. References to this feature are produced in an excellent manner by Dr. J. Arthur Myers, Professor of Preventive Medicine at the University of Minnesota, in his book entitled "Man's Greatest Victory over Tuberculosis." Dr. Myers presented an excellent paper on the relation of bovine tuberculosis eradication to human health at the opening session of this annual meeting of our Association.

In times such as exist today, when there is such an increased need for meat, dairy products, and eggs, the fact that tuberculosis in livestock has been so greatly reduced is appreciated more than ever. Not only is it possible for the farmers to produce more of these products, but the products themselves are so much safer to use than when tuberculosis was prevalent in the livestock. Also, there has been a tremendous reduction in the amount of meat condemned as unfit for human food due to tuberculosis.

PROGRESS OF THE WORK

The total number of tuberculin tests applied to cattle during the fiscal year ended June 30, 1941, was approximately the same as the year before, namely about 12,230,000. The total number of reactors disclosed, however, was less, being 40,702, or 0.3 per cent, the lowest average degree of infection reported since the cooperative tuberculosis eradication work was undertaken in 1917.

The combined State, Territory, and County funds expended for this work during the last fiscal year amounted to approximately $3,630,000, which included indemnity payments and operating expenses. The Federal expenditure for the same purposes during that period amounted to approximately $1,830,000.

Most of the tuberculin testing during the last 12 months was conducted under the area plan and consisted of periodical testing in order to remodify counties in the modified accredited tuberculosis-free area. As a result, it was possible to remodify all the counties that were due for remodification.

On November 1, 1941, there were approximately 261,600 herds, containing

1 Chief, Tuberculosis Eradication Division, Bureau of Animal Industry, United States Department of Agriculture.
BOVINE TUBERCULOSIS ERADICATION WORK

3,912,500 cattle, in the United States fully accredited as free from tuberculosis. In some of the States there is considerable interest in keeping up the accreditation of tuberculosis-free herds, and this applies especially in sections where there are quite a number of registered purebred cattle.

During the fiscal year 1941 it was necessary to apply the tuberculin test to approximately 238,000 dairy and breeding cattle intended for interstate shipment in order to comply with the requirements of the States of destination. Of this number only 19 were reported as reacting to the test, or 0.01 per cent.

APPRAISED VALUE, SALVAGE, AND INDEMNITIES

The average appraisal of cattle reacting to the tuberculin test during the last fiscal year was $96.50, and the average salvage was $40.99, about $3.85 more than the average amount of salvage received by owners during the previous fiscal year. The combined State and Federal payments received by the owners of tuberculous cattle amounted to an average of approximately $37.43, which is slightly more than that received last year. Of the total reactors slaughtered, 6 per cent were purebred and registered. The method followed in making the Federal payment has been the same as during the previous fiscal year.

POST-MORTEM RESULTS SHOW LESS TUBERCULOSIS IN CATTLE AND SWINE

The records of the Meat Inspection Division of the U. S. Bureau of Animal Industry indicate that there continues to be a reduction each year in the number of cattle showing lesions on post-mortem examination. There were approximately 10,102,600 cattle, not including reactors, slaughtered at establishments operating under Federal supervision during the last fiscal year, and of this number only about 8,000 showed any evidence of tuberculosis, or 0.07 per cent of the total slaughtered. This is less than half the number reported as retained for tuberculosis during the year 1936, when approximately the same number were slaughtered. Last year 1,868 carcasses were condemned as unfit for food or passed for cooking under Federal supervision.

Out of approximately 48,700,000 hogs slaughtered under Federal supervision during the last fiscal year, about 4,000,000, or 8.2 per cent, showed some evidence of tuberculosis. About 31,000 or 0.06 per cent of all those slaughtered, were either condemned as unfit for food or passed for cooking under Federal supervision. This is a substantial reduction in the percentage of tuberculosis found among hogs on post-mortem examination compared to the amount found five years ago. Much of the tuberculosis found in hogs upon post-mortem examination is of the avian type.

The location of centers of infection of tuberculosis among cattle and swine has been made possible during the past year because of information obtained at the packing centers where infected animals are discovered. This feature of the work is a very valuable one. There are a number of instances during the year when some infection has been found, and this illustrates very clearly the value of these reports that are furnished by the meat inspection service.

AVIAN TUBERCULOSIS

The efforts to control and eradicate avian tuberculosis, which is readily transmitted to swine, have been continued. During the last fiscal year the veterinarians
who have been engaged in the tuberculin testing of cattle in States where there is considerable infection of the avian type made observations of approximately 126,000 flocks and they reported infection on about 5,600 of these farms. In 11 of the Central and North-central States veterinarians assigned to the avian tuberculosis work observed approximately 11,500 flocks of poultry, containing about 1,687,000 birds. These veterinarians applied the tuberculin test to quite a number of these fowls, locating about 13,000 reactors. These veterinarians also applied tuberculin tests to swine on many farms during the year. They found that a higher percentage of swine reacted to the avian tuberculin than to the mammalian type.

A sound motion picture entitled "Tuberculosis in Poultry and Swine" has been produced by the U. S. Department of Agriculture during the past year. The results of showing this film in many places in the sections where avian tuberculosis is quite prevalent have been very satisfactory. This film is made in 16 and 35 millimeter sizes, and the use of it can be obtained by communicating with the Extension Service of the Department of Agriculture, Washington, D. C.

CONCLUSIONS

It is gratifying to observe that more research work in connection with the study and diagnosis of animal tuberculosis and other features pertaining to it are being continued. This is especially important at this time. As time passes the follow-up work, consisting of periodic tuberculin testing of cattle and necessary sanitary measures, continues to be important, especially in sections of the country where the disease existed to considerable extent at the beginning of the work. This feature, as previously stated, is clearly aided by the reports received from the packing centers showing the retentions of cattle and swine on account of tuberculosis. Adequate funds should be provided for the proper continuation of necessary tuberculin testing.

As usual this paper contains some statistical information on the subject of tuberculosis eradication, but there are many who wish to have more of such data. Therefore, a special statistical pamphlet has been prepared, and copies are now available for those who may desire such material. This pamphlet also contains some results obtained in the control and eradication of brucellosis (Bang's disease) in cattle.

Thus we have seen in this report some of the influences that tuberculosis eradication work has had on the nation's food resources. Briefly, the tuberculosis eradication campaign, by reducing the extent of animal tuberculosis, has greatly strengthened the agricultural position of this country, so important at this critical time in world affairs. The practical eradication of bovine tuberculosis means a greater volume of meat and milk and greater safety to the consuming public. Our meat and dairy resources strengthen also the economic position of the United States and place this country, at a fitting time, in a position to do extensive humanitarian work abroad. The results of this campaign give promise of adding materially to the position of the United States when the nations are ready to gather around the council table.

Before closing I wish to again express my appreciation of the splendid cooperation received from the various State livestock sanitary authorities with whom we have
been cooperating during the past year, and also, to compliment the many employees and others who have participated in this activity during the past year. May I also extend my best wishes to those of our group who have entered the military service.

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 that time?
THE NO-VISIBLE-LESION CASE PROBLEM IN TUBERCULOSIS ERADICATION

BY WILLIAM A. HAGAN

The plan for eradicating tuberculosis from the cattle of this country, which has been operating for the last twenty years, is based upon the assumption that tuberculin is a reliable agent for distinguishing between animals that are infected and those that are not infected with that disease. Now that the greater part of the tuberculous cattle have been eliminated, it may be said that the millions of tests which have been required to bring this about have demonstrated that the method is as reliable as most veterinarians believed when the work was begun.

The job has not been completed, however. Bovine tuberculosis has been greatly reduced in incidence but has not yet been eradicated. The progress which has been made during the last two decades is something to which we may properly "point with pride," but the remainder of the job is likely to prove more difficult in many ways than the part which has been done, and new types of problems will have to be faced and overcome. If complete eradication is to be brought about, many years of work lie ahead of us, and we shall have to fight for appropriations from state and federal governments to carry it on. This is a matter of considerable importance, because it appears that many dairymen now consider the job as practically completed and this view has been encouraged by the various "Achievement Day" programs and by press and radio releases. It is proper that those who have had to do with the carrying on of this work should receive full credit for the work they have done and for what has been accomplished, but I am afraid that much of this has created the impression that the battle is won when, as a matter of fact, it probably is not more than half won so far as reaching the day when the last tuberculous cow shall be eliminated. With the feeling that many livestock men now have that the disease no longer is of consequence to them, the pressure for appropriations to continue the work is likely to relax and we are likely to encounter more and more difficulty in obtaining appropriations adequate to enable the job to be finished. We know that we now have a cattle population which is highly susceptible to tubercle infection and that, unless the last nests of infection are hunted down and destroyed, the gains that have been made can quickly be lost. We shall be doing the livestock industry of this country a great disservice unless these facts are emphasized. In other words, I believe that instead of talking so much of what has been accomplished, we should do well, at this stage of the work, to stress the difficulties which lie ahead and to indicate the importance of finishing the job.

Formerly, there were many who regarded the tuberculin test as practically infallible. The great French authority on tuberculosis, Calmette, makes the following statement in his book entitled "Tubercle Infection and Tuberculosis in Man and Animals": "Whenever a tuberculin reaction is positive, there exists somewhere a follicular lesion or at least a gland containing tubercle bacilli whose presence may be disclosed by experimental inoculations of the guinea pig." We now know that

1 New York State Veterinary College, Cornell University, Ithaca, N. Y.
the tuberculin test, when applied to cattle, is not as accurate as this and as some today believe it to be. The accuracy of the test is judged by the results of the autopsies examinations, but these are not dependable, as is well known. Complete autopsies are not done, hence lesions undoubtedly are occasionally missed, and lesions too small to detect with the naked eye may be the cause of reactions. In these instances, the postmortem examination does not do justice to the accuracy of the test. On the other hand, there are many small granulomatous lesions, abscesses and areas of necrosis in the tissues of animals which even the most experienced cannot diagnose with certainty on the basis of a gross examination alone. When the meat inspector knows that the animal is a tuberculin reactor, he is likely, in such cases, to give the benefit of the doubt to the test and to indicate them on the postmortem report as tuberculous lesions. This is not a criticism of the meat inspectors for they can hardly do otherwise. I am sure that most lesions diagnosed by the meat inspectors as tuberculous actually are those of tuberculosis but there is undoubtedly a substantial error here now that the majority of reactors show only minimal lesions.

The effect of such errors is especially serious when only one or two animals in a herd have reacted, and as time goes on, this situation is becoming more and more frequent. If the lesions found by the meat inspector are not those of tuberculosis, such herds are heavily and unjustly penalized because of the mistaken diagnoses. It appears to me, that eventually the accuracy of the meat inspector's diagnosis will have to be checked by laboratory examinations in all cases. In instances when only one or two reactors are found in herds in which the history is clear, it seems to me that laboratory examinations are indicated now. The method is cumbersome and expensive, but the stigmatizing of herds as tuberculous, with all that goes with it—the losses in sales of stock not to speak of the costs of retests that now are carried out, is expensive too. Would it not be worth the expense of determining so far as possible whether such herds are, or are not, infected? Would it not be better to base the final diagnosis of such cases on the anatomical findings rather than on the fact that the animal did, or did not, react to tuberculin? Let me say here that I am perfectly aware that laboratory examinations will not give a perfect answer to this problem. The specimens would have to be collected with great care to avoid contaminating one with another and this will not be easy on the killing floor. It is possible, however, to clear up definitely the nature of most lesions of this kind in the laboratory and I believe it would be worth doing.

The number of no-visible-lesion reactors (hereafter referred to as N.V.L. cases) has been a matter of concern since the beginning of the test and slaughter method of eradicating the disease, as the number of papers dealing with the matter indicates. The earlier writers usually attempted to point out reasons why lesions were not always found in reactor cattle and quite generally regarded such animals as early cases of the disease. Skeptics appeared, however, one of the first being Hastings (7) of Wisconsin, who as early as 1914 presented convincing evidence that some animals which reacted to tuberculin were not really tuberculous. The same viewpoint was emphasized by Bruner (1), in the early days of the country-wide campaign against the disease, and by the writer of this paper (5) about ten years ago when the campaign was at its peak. Data were presented by all three of these authors
which showed that among dairy cattle a few individuals exist which are transitorily hypersensitive to tuberculin and will react even though tuberculosis is absent. So long as considerable numbers of tuberculous animals existed, these augmented the reactor group only slightly. As the disease was reduced, however, these animals have constituted a larger and larger proportion of the reactor group. As Bruner stated it in 1920: "As the disease decreases the inefficiency of the test increases in so far as not being able to demonstrate the disease on autopsy or laboratory examination is concerned."

Bruner showed that the number of N.V.L. cases in Pennsylvania increased from 3 per cent of all reacting cattle in 1913 to 11 per cent in 1919. It is to be noted that during this period the intradermal test had not yet superseded the subcutaneous or thermal method. Between 1920 and 1924, according to Schroeder (12), the percentage of N.V.L. cases in the area under federal-state supervision amounted to 8.5 per cent of the total number of reactors. In 1931, Wight (14) reported that they had amounted to about 11 per cent during the three preceding years.

For the ten-year period immediately preceding 1940, I have no data, although it is well known that the percentage of such cases with relation to the total number of reactors has been steadily rising. For the last fiscal year, Dr. E. T. Faulder (3), of the Department of Agriculture and Markets of the State of New York, informs me that the figure is about 32 per cent for his state. For the United States, Dr. Mohler (11) informs me that it is about 41 per cent.

These figures appear appalling and there is no doubt that it is a serious matter, but the situation is not nearly so bad as it sounds. Percentages are often misleading unless they are interpreted in terms of the actual numbers involved, and it is so in this case. The actual number of these cases has decreased greatly during the last ten years. Up to the end of the fiscal year closing on June 30, 1930, about 0.83 per cent of the total number of animals tested in New York proved to be N.V.L. cases. During the past year, only 0.13 per cent fell into this category. Since about 7 per cent of all cattle tested in New York from 1916 to 1930, inclusive, were reactors, it is obvious that a large part of the N.V.L. cases of the earlier period were actually tuberculous animals since the great decrease in the proportion of such animals can be explained only on this basis. According to Dr. Mohler, the number of N.V.L. cases in the United States in 1931 was about 0.2 per cent and at the present time is about 0.14 per cent based upon the total number of animals tested.

Accurate as the tuberculin test is, it is subject to errors which, when multiplied by the millions of tests that are conducted annually, are being translated into condemnations of rather large numbers of animals which apparently are not affected with tuberculosis. During 1940, there were 1,754 N.V.L. cases in New York alone. These were culled out of tests upon 1,365,000 cattle and thus represent a very small part of the total number, nevertheless, they cost the public about $65,000 in indemnities alone. Since more than half of these were from fully accredited herds in which no other evidence of tuberculosis was found, the losses in other ways probably exceeded the indemnity costs.

The question of why non-tuberculous cattle react to tuberculin can be answered only in part, or perhaps it would be better to say that we know a number of reasons why such animals react but do not know how often any of them are actually re-
sponsible for the cases found in the field. We know that cattle may easily be sensitized by human tubercle bacilli so they will react typically to ordinary tuberculin, and that such animals do not ordinarily show any gross lesions because of the infection (2b). We know, also, that avian tubercle bacilli (4, 10) and the organism of Johne's disease, occasionally but not generally, will cause sensitization to ordinary mammalian tuberculin. Those sensitized to the avian tubercle bacillus, induced by picking up this organism from ground over which tuberculous chickens have run, usually show no gross lesions, and those sensitized to the Johne bacillus have lesions which do not resemble those of tuberculosis and, therefore, are likely to be overlooked. Probably more important than any of the foregoing situations in most parts of the country are the sensitizations which occur from contact with acid-fast bacilli of the so-called saprophytic group. Hastings, Beach and Webber (9) early suggested that non-specific sensitization to tuberculin might be induced by these organisms which occur abundantly in nature and in the intestinal canal of all cattle. These organisms find their way into the tissues of some animals, since they have been detected in the mesenteric lymph nodes by the Wisconsin group and by ourselves. Other organisms apparently get into the subcutaneous tissue of cattle through abrasions of the skin, since Traum (13), Hastings and co-workers (9), ourselves (5), and others have found them there. Apparently, such organisms do not regularly sensitize to tuberculin, but that they sometimes do has been demonstrated by Hastings, Beach and Thompson (8), and by Crawford (2a). That animals react by such sensitization only occasionally fits in with the fact that only a small percentage of N.V.L. cases are found in the field.

We believe that typical reactions to tuberculin generally represent actual allergic hypersensitization to antigens contained in tuberculin. If this is so, the spurious reactions occur in animals that happen to be sensitized to antigens similar to, or identical with, some of those of mammalian tubercle bacilli. The only place where such related antigens occur, so far as we know, is in other acid-fast organisms. Experimentally, it can be shown that a certain amount of cross-sensitization can be produced in experimental animals between many acid-fast organisms, and sometimes animals will react to filtrates of heterologous organisms as well as to those of the homologous organism. Good reactions can often be obtained with avian tuberculin in animals which have been inoculated with various saprophytic acid-fast bacilli, but only rarely can good reactions be obtained with mammalian tuberculin. Again, this fits in with the observation that the N.V.L. cases are rare individuals.

The complement fixation test offers evidence confirming the fact that group sensitizations to acid-fast bacilli occur commonly in cattle. We (6) have found that not only animals affected with tuberculosis and Johne's disease will fix complement in the presence of antigens made from acid-fast organisms, but that a considerable number of apparently normal cattle also have this ability. The allergic test is much more specific in acid-fast infections than the complement-fixation test, but when such group antigens are commonly present one should expect, rather than be surprised to find, that an occasional animal will respond, non-specifically, to the allergic test.

Whatever the cause of these false reactions, they are now being thrown into bold
relief by the elimination of the greater part of the bovine tubercle infection. When many cases of tuberculosis existed, it was necessary to use a plan of procedure which ignored any inaccuracies in the test. Now that the numbers of reactors in most herds are much fewer, it is time to take there errors into consideration. If the present procedure is continued, a considerable number of cattle will be sacrificed unnecessarily and cattle will still be reacting to tuberculin after the disease has been eradicated. The time will come, and I believe it already is here in many of the dairy areas of the eastern and midwestern states and perhaps elsewhere, when a change in procedure is in order. Absolute dependence upon the results of single tuberculin tests should cease, and the veterinarians who are conducting the tests should be given greater responsibilities in making their diagnoses. They should be permitted and encouraged to take the history of the animal, and of the herd, into consideration as well as the results of the tests before the brand is put on. So far as the handling of herds is concerned, this should depend on the finding of the meat inspectors, supplemented as I have already indicated, by laboratory checking, rather than upon the result of the tests alone. In other words, we should face the fact squarely that at least half of the cattle that now appear to react to tuberculin are not affected with tuberculosis and should seek other means of arriving at a diagnosis.

It is known that non-specific sensitizations of cattle generally are transitory. If retests are made upon animals affected with the so-called "skin-lesion tuberculosis" at 60-day intervals, it frequently is found that they will react once and not thereafter. This is true also of animals that have been sensitized by injection with saprophytic acid-fast organisms, and Schroeder (12) states that cattle that have been sensitized with human tubercle bacilli will ordinarily react only once, although they may later be re sensitized by further contact with such organisms. If a considerable part of the spurious tuberculin reactions are caused by group sensitizations, most of these animals can be saved from condemnation and the herds of which they are a part can be saved the stigma attached to the situation simply by holding them for a 60-day retest. If any of these animals represent recent infections with genuine tuberculosis, they should react a second time, and in the meantime not many will have advanced to the stage at which they become spreaders of infection. There is some hazard, of course, and it would be best to hold such animals apart from the main herd as far as is feasible during this period. It is assumed that this procedure would be followed only in fully accredited herds, after careful consideration of the history of the animal and of the entire herd. As I see it, it will be better to take the chances of breaks in a few herds than to continue indefinitely to pick out non-tuberculous reactors from many herds.

As to other checks upon the accuracy of the tuberculin test in cattle, I am afraid that we have little at present upon which to depend. X-ray examinations which are so helpful in human tuberculosis are not practicable in cattle. Likewise, little dependence can be placed upon physical examinations. Sputum cup examinations will indicate whether or not a particular animal is, or is not, a spreader at the time the sample is taken, and this test might be useful when dealing with particularly valuable animals, but it cannot be generally used. There is a possibility that tuberculin may be improved, a product being obtained which may be more specific than
that which is used on cattle today. We are planning to make some tests upon cattle to determine whether P.P.D. (purified protein derivative) offers any hope of eliminating spurious reactions by virtue of greater specificity. The complement-fixation test may possibly prove helpful, but, if it is to be useful, it will have to be refined beyond the stage at which it is today, for at present it evidently is less specific than the tuberculin test. I have already referred to the desirability of laboratory checking of the nature of lesions found in animals slaughtered as reactors.

In this paper, I have brought out little that will be new to those who have been engaged in, or have followed, the great work of bovine tuberculosis eradication in this country. I am calling attention to the fact that we are about due for some shifting in the mode of attack of the problem now that the greater part of the disease has been eliminated. Unless a shift is made, large numbers of animals will be slaughtered unnecessarily. The method proposed may not be the answer, but it, or other new methods, should be tried.

REFERENCES

REPORT OF COMMITTEE ON TUBERCULOSIS


Your Committee on Tuberculosis this year has contacted the Live Stock Sanitary officials of all states offering them the opportunity to submit to the Committee any problems relating to tuberculosis.

The accreditation of all the states is recognized as an outstanding achievement. It is gratifying to review the records which show that the control of bovine tuberculosis is apparent and the incidence of tuberculosis maintained below 0.5 of 1 per cent—every effort should be put forth to reduce the percentage.

Your Committee feels that it is well to review the situation which confronts the livestock industry with respect to tuberculosis.

(a) Reducing the incidence of tuberculosis to below 0.5 of 1 per cent cost the sum of approximately $360,000,000, and this large investment must be protected by the expenditure of necessary funds for the periodic retesting of all cattle to insure against the possibility of re-infection.

(b) In approaching the eventual complete eradication involves the perplexing problem of no visible lesions and this is a matter that should be given constant attention by the Live Stock Sanitary people of all the states and the large force of Veterinarians engaged in conducting tubercular tests.

(c) That the efforts of research workers should be directed to a more intensive study of non-specific or pseudo tuberculin reaction to the end that either through possible improvement of the test fluid, the technique of applying the tuberculin test, the reading of reactions, or the development of new procedures, fewer non-tuberculous animals will be sacrificed.

(d) That increased attention must be given to the elimination of tuberculosis from other types of livestock as well as poultry and wild life. In this connection, a program of eradication of tuberculosis in poultry and swine should be intensified.

(e) To prevent the spread of tuberculosis from infected herds, Live Stock Sanitary officials should exercise their authority to impose quarantines in all cases where there is a possibility of animals being sold from a herd before such herd has passed a sufficient number of satisfactory tests.

(f) That in infected herds a profound study of the conditions obtaining in the herd should be made to determine the source of infection, such study to include a critical examination for tuberculosis of all animal life maintained on the premises as well as the history of the health of human beings with which the cattle are in contact.

(g) That the present technique of injection should be carried out with precision so as to eliminate this factor as a possible cause of indecisive reaction.

1 Absent.
(h) That caution should be exercised to correctly evaluate the past history when making a reading of the tuberculin test.

(i) That records kept of tuberculin tests of herd should be such that, when animals shipped interstate react and show lesions, notification should be sent to the Live Stock Sanitary official of the state of origin.

(j) That in each case, when at slaughter animals reveal lesions of tuberculosis, a report be sent to the Live Stock Sanitary official giving tag number, recorded brand, description of animal, and name of consignee so that the herd from which it came may be retested.

(k) That more adequate control of truck movement of cattle and closer supervision of traffic of animals to live stock markets should be exercised.

(l) Laws, rules or regulations to be maintained in all states requiring all trucks used in the transportation of live stock to be thoroughly cleaned and disinfected at regular intervals.

In the opinion of your Committee on Tuberculosis, it has been deemed advisable to recommend changes in paragraphs 1 and 7, in the Uniform Methods and Rules for the Establishment and Maintenance of Tuberculosis-free Accredited Herd and Cattle and Modified Accredited Areas.

December 4, 1941.

1. (a) A tuberculosis-free accredited herd of cattle is one in which the entire herd has passed two (2) negative, successful annual physical examination and tuberculin tests. Herds in which infection occurs shall be quarantined and shall be subjected to three tuberculin tests not less than sixty days apart and on which tuberculosis is not demonstrated before quarantine may be revoked, and further, such herds shall be submitted to a tuberculin test not less than twelve, nor more than fourteen months following the test on which infection was disclosed, and shall not be re-accredited unless the absence of tuberculosis is established; such physical examinations and tuberculin tests shall be applied by an accredited veterinarian, or by a veterinarian regularly employed by the State, or United States Bureau of Animal Industry.

7. Milk or other dairy products fed to calves must originate from cows negative to the tuberculin test and in herds operating under the accredited herd plan. Milk or other dairy products from reactors to the tuberculin tests, or from outside or unknown sources, shall have been pasteurized.

By this it is intended to provide release from quarantine when, in the opinion of the officials in charge, tuberculin sensitization due to tubercle bacilli has not been established.
STUDIES ON THE TREATMENT OF WOUNDS IN EXPERIMENTAL RABIES

BY HOWARD J. SHAUGHNESSY, PH.D., AND JOSEPH ZICHIS, PH.D.1

In 1899 the work of Follen Cabot (1), which is the basis for the general use of fuming nitric acid in the treatment of local wounds to prevent rabies, was published. He injected 1 cc. of a 20 per cent suspension of a rabies infected rabbit medulla into the thighs of guinea pigs. Twenty-four hours later an incision ½ inch long was made over the seat of the puncture, exposing the nerve. The tissue in the wound surrounding the point of the puncture was carefully swabbed out and the fuming nitric acid applied.

It appears to us that Cabot’s technique is subject to criticism from at least two standpoints. It would be very difficult to locate and expose with an incision the locus of infectious material which had been deposited in the thighs of the guinea pigs with a hypodermic needle 24 hours previously. It also seems possible that application of cauterizing materials, especially fuming nitric acid, to the region of the exposed sciatic nerve may have damaged the nerve sufficiently to prevent progression of the virus along its fibers.

Poor (2) repeated Cabot’s studies in 1911 on a limited scale and with a different technique. An incision was made on the back of the neck of the guinea pigs after the hair was removed and the subcutaneous tissues on either side were cut in several places with scissors. The wound was infected with a swab dipped in an emulsion of street virus and the edges of the wound were brought together with adhesive plaster. Twenty-two hours later the wounds were opened up and fuming nitric acid applied with a swab. Five of 12 animals treated in this way survived, while all of the 8 controls succumbed.

Rosenau (3) writes in his text, “Experiments under my supervision (unpublished) indicate that practically all guinea pigs may be saved by prompt application of nitric acid; that its effectiveness decreases with time, but that it is still partially protective up to forty-eight hours. No other substance gives equally good results. Strong germicides, such as carbolic acid are not reliable; nitrate of silver is valueless; formalin and the actual cautery are not effective.” It is unfortunate that the unpublished experiments referred to above are not available for analysis. The conflict between Rosenau’s and Cabot’s results in respect to the value of silver nitrate and the actual cautery is difficult to understand in view of their complete agreement in regard to the use of fuming nitric acid.

Since cauterization was formerly employed in the treatment of all types of wounds but was later abandoned in favor of simple cleansing and the use of relatively non-irritating germicides, we decided to study the relative values of similar methods in experimental rabies. The substances used in the main experiments were fuming nitric acid, 20 per cent green soap solution and tincture of iodine. Some other germicides, including formaldehyde, two of the new mercurial compounds, peroxide,

1 Division of Laboratories, Illinois Department of Public Health, Chicago, Illinois.
potassium permanganate, and oil of eucalyptus were tried, but the tests were of preliminary nature and do not warrant any conclusions.

**METHODS AND MATERIALS**

**Virus.** For these studies it was necessary to obtain a rabies virus which would, with some degree of consistency, kill either guinea pigs or mice by the intramuscular or subcutaneous routes of injection. Because it was desired to simulate the mode of infection resulting from a rabid dog bite, an attempt was made to find a rabies street virus which could be used. Twenty-six strains of street viruses were tried and it was found that all of them lost their ability to infect by the intramuscular and subcutaneous routes after a few passages either in guinea pigs or mice. Consequently only some of the preliminary experiments were conducted with street viruses and a fixed virus, S-1, was used for the main experiments.

The virulence of S-1 virus for guinea pigs was such that 0.5 cc. of a 1 per cent suspension of an infected guinea pig brain when injected intramuscularly killed them within 10 days.

In these studies the virus preparations to which the animals were exposed consisted of a 10 per cent suspension of 2 or 3 freshly obtained infected guinea pig brains. All the virus dilutions were made in hormone broth.

Guinea pigs, weighing about 450 grams each, were employed in the main experiments. Albino Swiss mice were used in some of the preliminary experiments. However, it was found that treatment of the wounds with fuming nitric acid and the other antiseptics killed a large per cent of the mice and consequently they could not be used for these experiments.

The methods of inflicting the wounds and contaminating them with the virus of rabies were designed to approximate bites by rabid dogs as closely as possible. Several methods were tried but only Method 3 proved to be satisfactory.

This method consisted of making an incision about 1.5 cm. long and 0.5 cm. deep on the neck slightly anterior to the shoulder blades of each guinea pig. Two-tenths cubic centimeter of the virus suspension was immediately placed in the wound using an 18 gauge blunt hypodermic needle, following which the wound was slightly irritated with the tip of the needle. The hair was always clipped from the site of inoculation prior to making the incision. Aseptic technique was observed.

The nitric acid was applied to the wounds by means of a sealed Pasteur pipette. The wounds were washed with the soap solution under the pressure of a 20 cc. syringe through an 18 gauge blunt needle. The iodine was applied with a cotton swab on a wood applicator.

The diagnosis of rabies in the experimental animal was established by: detection of Negri bodies in the brain smears; neutralization of the virus with antirabic sera; and by intracerebral injection of brain emulsions from the test animals.

**EXPERIMENTAL**

Experiments 1 to 12 were of a developmental nature in which 26 different strains of street virus were applied to wounds made by different methods in both mice and guinea pigs. Due to the rapid loss of infectivity of the street viruses by
H. J. SHAUTHNESSY AND J. ZICHIS

these methods of inoculation, it was impossible to standardize these procedures and they were, therefore, discontinued.

Experiments 12 to 16: The guinea pigs in these experiments were inoculated with S-1, a fixed rabies virus, by Method 3. Twenty per cent solution of green soap, fuming nitric acid and tincture of iodine were used to treat the virus infected wounds. The antiseptics were applied to the wounds about 30 minutes after they were infected with the virus. One hundred sixty-five guinea pigs were employed in these experiments, and in each experiment they were arranged as to methods of treatment as indicated in table 1. About 60 cc. of the soap solution was used to

irrigate each wound. The nitric acid and the tincture of iodine were applied by the methods outlined above.

Thirty-six per cent of the control guinea pigs, 96 per cent of those treated with soap solution, 96 per cent treated with fuming nitric acid, and 90 per cent treated with tincture of iodine, survived infection with the rabies virus (table 1). Due to the fact S-1 is a fixed virus and typical Negri bodies could not be found in the brain smears of the experimental animals, the diagnosis of rabies in these experiments was confirmed by the neutralization test with antirabic serum. Antirabic serum was kindly supplied by Dr. Harold Johnson of the Alabama State Health Department.

### Table 1.—Results in guinea pigs treated about 25 minutes after infection with rabies virus

<table>
<thead>
<tr>
<th>EXPERIMENT NO.</th>
<th>RABIES VIRUS USED</th>
<th>METHOD OF INFECTATION</th>
<th>ANTISEPTICS USED TO TREAT THE WOUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controls, no treatment</td>
</tr>
<tr>
<td>12</td>
<td>S-1</td>
<td>Method 3</td>
<td>*2/5</td>
</tr>
<tr>
<td>13</td>
<td>S-1</td>
<td>Method 3</td>
<td>3/10</td>
</tr>
<tr>
<td>14</td>
<td>S-1</td>
<td>Method 3</td>
<td>3/10</td>
</tr>
<tr>
<td>15</td>
<td>S-1</td>
<td>Method 3</td>
<td>3/10</td>
</tr>
<tr>
<td>16</td>
<td>S-1</td>
<td>Method 3</td>
<td>5/10</td>
</tr>
</tbody>
</table>

Average per cent of survivals ........... 35.6% 95.6% 95.6% 90.0%

* Numerator = number of guinea pigs that survived; denominator = number of guinea pigs used.

### Table 2.—Results in guinea pigs treated about 3 hours after infection with rabies virus

<table>
<thead>
<tr>
<th>EXPERIMENT NO.</th>
<th>RABIES VIRUS USED</th>
<th>METHOD OF INFECTATION</th>
<th>ANTISEPTICS USED TO TREAT THE WOUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Controls, no treatment</td>
</tr>
<tr>
<td>18</td>
<td>S-1</td>
<td>Method 3</td>
<td>*4/10</td>
</tr>
<tr>
<td>19</td>
<td>S-1</td>
<td>Method 3</td>
<td>1/10</td>
</tr>
<tr>
<td>20</td>
<td>S-1</td>
<td>Method 3</td>
<td>0/20</td>
</tr>
</tbody>
</table>

Average per cent of survivals ........... 16.6% 82.5% 70.0% 60.0%

* Numerator = number of guinea pigs that survived; denominator = number of guinea pigs used.
was made only on representative animals. Cultures made of the brain and heart blood of representative guinea pigs failed to show the presence of pathogenic organisms.

These experiments indicate that treatment of the wounds 30 minutes after infection with rabies virus with either soap solution, fuming nitric acid, or tincture of iodine was of definite value.

However, it is not always possible to treat rabies wounds in persons or animals 30 minutes after they are inflicted. Consequently the effect of treatment with these agents when applied to wounds 2 hours following their contamination with rabies virus was studied.

Experiments 18 to 20: The guinea pigs were inoculated with the S-1 virus as described. One hundred forty animals were used and they were divided in each experiment according to the method of treatment, as indicated in table 2.

As shown in table 2, 16 per cent of the control animals, 82.5 per cent treated with soap solution, 70 per cent treated with fuming nitric acid, and 60 per cent of those treated with tincture of iodine survived following the virus inoculation. Because S-1 virus was also used in these experiments, it was necessary to establish a diagnosis of rabies on representative guinea pigs by the neutralization test.

The results of these experiments indicated that treatment of wounds infected with rabies with all three antiseptics was beneficial, even when the treatment was instituted 2 hours following the inoculation with rabies virus.

SUMMARY AND CONCLUSIONS

The fatality rate from rabies in untreated control guinea pigs in our experiments was many times higher than in animals whose wounds were treated by the application of fuming nitric acid. Averaging the results of the five experiments in which treatment was instituted within about 30 minutes after contamination of the wounds with rabies virus, the fatality rate of the group of guinea pigs whose wounds were treated by irrigation with green soap solution was exactly the same as in those in which cauterization with fuming nitric acid was employed.

When the guinea pigs were treated 2 hours following their inoculation with rabies virus, the results were essentially the same as when they were treated 30 minutes following the inoculation.

REFERENCES

REPORT OF THE COMMITTEE ON RABIES


During the meeting of the U. S. Live Stock Sanitary Association in December, 1940, a rabies committee of the American Animal Hospital Association appeared before the National Assembly of Chief Live Stock Sanitary Officials and presented a report on rabies with certain recommendations. The recommendations in effect were that an organized effort be made to eradicate rabies from the United States and that a committee be formed consisting of two representatives from each of the following organizations: 1) the U. S. Live Stock Sanitary Association, 2) The American Veterinary Medical Association, 3) the American Animal Hospital Association, 4) the American Medical Association, 5) the American Kennel Club, 6) the American Humane Association, and 7) the U. S. Department of Agriculture.

The functions of the committee were to be:

(a) Promulgate a basic plan which would be applicable to the conditions prevailing in each State,

(b) Arrange for a revision of the Federal statutes whereby the Federal Government may cooperate with the several States for the control and eradication of rabies,

(c) Provide for a Federal appropriation to carry out the work in cooperation with the States and to assist in providing and financing dog laws, both Federal and State, capable of enforcement.

This report was accepted by the National Assembly of Chief Live Stock Sanitary Officials and the secretary of that association contacted the various organizations mentioned and requested the appointment of two members to serve on a committee. On November 6, 1941, a meeting of the representatives of the various organizations was called by the secretary of the National Assembly of Chief Live-Stock Sanitary Officials at New York. In attendance at the meeting were representatives from the American Animal Hospital Association, the American Humane Society, the American Kennel Club, the U. S. Live Stock Sanitary Association, and the U. S. Bureau of Animal Industry. It was not possible for the other organizations to have their representatives at the meeting at that time.

A general discussion of the rabies situation and present methods for the control of the disease were considered. Particular attention was given to a discussion of a uniform State law covering the control of dogs. The control of rabies in this country must be considered on a long-time basis. The complexity of the problem makes it essential that steps be taken carefully and only after due consideration. Further meetings of this group are contemplated to consider advisable methods of procedure.

It is the recommendation of the rabies committee of the U. S. Live Stock Sanitary Association that the committee be continued and that it be authorized to coordinate its activities with those of other organizations interested in the control of rabies.
**Table 1—Rabies in the United States by States during the Year 1940**

<table>
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<tr>
<th>STATE</th>
<th>DOGS</th>
<th>CATTLE</th>
<th>BIRDS</th>
<th>LAMBS</th>
<th>SHEEP</th>
<th>SWINE</th>
<th>CATS</th>
<th>GOATS</th>
<th>MISCELLANEOUS</th>
<th>MAN</th>
<th>TOTAL</th>
<th>REMARKS</th>
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</tr>
<tr>
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<td>0</td>
<td>0</td>
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</tr>
<tr>
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<td>0</td>
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<td>19</td>
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<td>194</td>
<td>Species not given, mostly dogs</td>
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Rabies species mostly given but probably in 1940 and not in the United States.
Your committee again has been furnished material on the incidence of rabies in the various States in 1940 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 1940, there were 6,194 cases in dogs, 326 in cattle, 25 in horses, 53 in sheep, 71 in swine, 260 in cats, 4 in goats, 277 miscellaneous, 28 in man, and a grand total of 7,238 cases.

Table 1 gives a report on the incidence of rabies by States for the calendar year 1940. 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.

**Table 1.—Concluded**

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<td>53</td>
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<td>260</td>
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<td>277</td>
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Your committee again has been furnished material on the incidence of rabies in the various States in 1940 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 1940, there were 6,194 cases in dogs, 326 in cattle, 25 in horses, 53 in sheep, 71 in swine, 260 in cats, 4 in goats, 277 miscellaneous, 28 in man, and a grand total of 7,238 cases.

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**REPORT OF COMMITTEE ON MISCELLANEOUS TRANSMISSIBLE DISEASES**

ADOLPH EICHHORN, Chairman, Beltsville, Md.; A. E. CAMERON, Ottawa, Can.; L. M. HURT, Los Angeles, Cal.; HADLEIGH MARCH, Bozeman, Mont.; D. E. WESTMORLAND, Frankfort, Ky., and A. C. TOPMILLER, Nashville, Tenn.

During the past year losses from (various) miscellaneous diseases which are not being treated by the special committees were not extraordinary and no striking epizootics have been observed.

The most noteworthy observations were the numerous cases of encephalomyelitis in man, resulting mainly from the western type of equine encephalomyelitis virus. This is of particular importance because from year to year a greater number of such cases have occurred in man which obviously should be recognized as being of major concern to the veterinary profession and public health authorities in order that
the method of transmission and the original hosts should be established to facilitate such control measures which will effectively eliminate the infection.

Thirty-one States during the past year reported 24,816 cases of infectious equine encephalomyelitis. Fourteen States reported the absence of the disease and three failed to report.

Every State (total number 22) west of the Mississippi River reported cases, these comprising about 96 per cent of the total for the country. Only about 4 per cent of the total occurred east of the River: Wisconsin, Indiana, Illinois, Florida, Michigan, North Carolina, Maryland, Connecticut, and Kentucky, given in the order of decreasing prevalence from 411 cases in Wisconsin to one case in Kentucky. However, the case in Kentucky was confirmed by histopathological examination.

The mortality rate in areas where the western type of virus is known to prevail, or where by reason of circumstantial evidence it is presumed to be, remains at about 25 per cent, according to present figures. In like manner, mortality due to eastern virus continues high—far in excess of that for the western disease. A number of strains of eastern type virus were identified from Texas cases by the Bureau and the Army. In these localities the mortality was correspondingly high.

This information was furnished through the courtesy of the Pathological Division of the Bureau of Animal Industry.

Philip and Cox have demonstrated antibodies for St. Louis virus in horses and men in Colorado, and Hammon has demonstrated St. Louis antibodies in horses and other mammals and birds in Washington. Cox has further demonstrated that horses are susceptible to the St. Louis virus, and that the symptoms produced by St. Louis virus are similar to those produced by western equine virus. Hammon and his associates have isolated both St. Louis virus and western equine virus from Culex tarsalis mosquitoes collected in epidemic areas.

With the extension of the present war and the spread of animal diseases among the combating nations, it is necessary that the Live Stock Sanitary Associations in the United States keep strict vigilance in order to prevent their introduction. Hides and skins brought from foreign countries have been proved to be carriers of viruses and pathogenic bacteria. In order to minimize the danger from such sources, especially with regard to effectively destroying viruses, the Bureau of Animal Industry conducted experiments with the view of determining the efficiency of sodium bifluoride and sodium silicofluoride as hide disinfectants. For this purpose, the virus of vesicular stomatitis was used as the infective agent.

This virus was selected because of its similarity to the virus of foot-and-mouth disease and because the U. S. Department of Agriculture does not experiment with the latter virus in the United States owing to its great danger to the livestock industry. Two methods of procedure were followed in the study. Salt-cured calfskin in the presence of infected guinea pig pads and salt-cured calfskin artificially impregnated with the virus were placed in the various soak solutions for 24- and 48-hour periods at room temperature. The proportion of salt-cured calfskin to the quantity of soak solution was 1 to 5 by weight.

Both sodium bifluoride and sodium silicofluoride constantly killed the virus in dilutions of 1 to 10,000 after 24 hours' soaking. By analogy with similar research by the British Foot-and-Mouth Disease Research Committee, it is a logical assum-
tion that sodium bifluoride and sodium silicofluoride are also effective in destroying the virus of foot-and-mouth disease.

Unquestionably, bovine mastitis is one of the most serious diseases affecting the dairy industry in the United States at the present time. Recent reports from various sources indicate that its incidence is increasing and in some localities to a rather alarming extent. In the light of present conditions, the reasons for this are readily understandable. An improved national economy as the result of defense efforts, greater purchases by the military services for their expanded forces, and unusual demand for exportable dairy products can only be met by increased milk production. Since only the normal number of young animals are coming into lactation, any increase in production must be met by the individual animal. It is a fact, only too well recognized, that forced milk production is usually reflected by rapid deterioration of the udder as the result of mastitis.

A large percentage of mastitis is caused by the same types of bacteria, found commonly elsewhere in the world. These are the streptococci and staphylococci. The remaining cases of mastitis result from invasion of the organ by rod-like bacteria, *Aerobacter aerogenes*, *Pseudomonas aeruginosa* and a few others. At present the principal emphasis is placed upon *Streptococcus agalactiae*. However, it seems probable that more cases of mastitis may be attributed to these other forms than has been generally realized in the past and that more attention will be accorded to them in the future. Unfortunately because of this lack of attention, comparatively little information is available concerning their mode of transmission, effect on the diseased part and the host as a whole, their term of residence in the udder, means of diagnosis, prophylaxis, and therapy. This is a matter which requires concentrated study and effort in the future.

Because of the extensive knowledge now at hand relating to *S. agalactiae*, various measures of either a prophylactic or therapeutic nature or a combination of both, are now being tried to combat this infection. Control measures to prevent spread of these streptococci from infected to healthy cows consist in the detection and segregation of diseased animals and the use of sanitary procedures and better management practices. Success in controlling the spread of infection and eventual establishment of a herd free from it, depend almost entirely upon the intelligent and strict cooperation of the dairyman. This fact has been amply demonstrated in the last few years during which it has been tried in certain herds. Vaccination against this form of mastitis has been found to be of no prophylactic value.

The same statement can be made for bacterins, vaccines, and serums in the treatment of diseased cows. These have been tested rather extensively. On the other hand, certain chemotherapeutic agents now being tested appear to have some value in curing mastitis caused by *S. agalactiae*. Included among these are Entozon, Acriflavine, Novoxil, and Tyrothricin (Gramicidin). Relatively good results have been reported from the use of all four, although some apparently incurable cases have been encountered and also a certain percentage of treated quarters fail to return to normal subsequently. So far as is known, these products are of no benefit in the treatment of mastitis due to other causes. Because of the relatively recent introduction and use of these products in the United States and the comparatively small number of cows which have been treated, no final conclusion
RESOLUTIONS

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can be drawn as to their ultimate value in the treatment of streptococcal mastitis
and whether they will lend themselves to practical application by the veterinarian.

Because of the lack of information concerning mastitis of other types, no specific
control measures or therapeutic agents are available.

Another transmissible disease which is widely distributed and is of importance in
sheep-raising sections is foot-rot. During the past year, Beveridge, in Australia,
has published a bulletin which advances our knowledge of this disease. He has
isolated a new species of microorganism which he calls *Fusiformis nodosus*, and
which we have not hitherto differentiated from *Actinomyces (Fusiformis) necrophorus*,
with which he can reproduce foot-rot, without the presence of *necrophorus*. He has also confirmed our observation that premises remain infective
only a very short time, although *necrophorus* may remain alive in soil for many
months, or even years. These findings are important from the control standpoint,
as it has been shown that premises, even when wet, quickly lose their infectivity.

With regard to the control of other infectious diseases, the usual procedures
have been practiced since no new preventive or curative measures have been de-
veloped for combating them. It is only obvious that it behooves the livestock
sanitary authorities and particularly the veterinary profession to be on guard for
any untoward development with regard to livestock diseases especially at this time
when an emergency might arise which will necessitate the safeguarding of the
health of our livestock.

REPORT OF THE COMMITTEE ON RESOLUTIONS

WILL J. MILLER, Chairman, Topeka, Kansas; R. M. Gow, Denver, Colo.; D. M.
CAMPBELL, Chicago, Ill.; J. V. KNAPP, Tallahassee, Fla., and
R. S. ROBINSON, Pierre, S. D.

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 an adequate defense program is to insure a continuing, ample supply of
meat, meat products and dairy products, the basis of the Army and Navy ration
and of the diet of all the citizens; and

WHEREAS: Any step lessening the safeguards at present applying to imports of
live animals or dressed meats from the countries where foot-and-mouth disease
exists would constitute a 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.

WHEREAS: The Live Stock Sanitary officials of the several States are conducting
live stock disease eradication and control programs that are essential to public health and national defense, and

WHEREAS: The use of non-corrosive metal tags, in permanently identifying individual animals with non-removal tags placed in the ears of cattle and swine, particularly serve as a means of permanently identifying them for inter-state movement, for sale purposes, and for reporting their status in regard to tuberculosis, Bang’s disease, and other infections. Metals that would corrode would be of little value as the identifying number would soon be difficult or impossible to distinguish.

Therefore Be It Resolved: That the United States Live Stock Sanitary Association respectfully urge the Office of Production Management to allocate the needed metals to manufacture such a tag, and similar identifying tag, for use in the several States, as aforementioned.

The Secretary is hereby instructed to deliver this resolution to the proper officials.

WHEREAS: A large part of the interstate transportation of live stock is now accomplished in motor trucks; and

WHEREAS: The transportation of live stock over long distances without unloading for water, feed and rest is not only inhumane and uneconomical, but also contributes to the spread of disease by rendering such starved and exhausted animals unduly susceptible to infection to which they may be exposed en route or at the end of their journey; therefore be it

Resolved: That the Legislative Committee of this association be and hereby is instructed to use its best efforts and all proper means to the end that the Congress amend the “28-hour law” regulating the interstate transportation of live stock by rail to apply also to the interstate transportation of live stock by motor truck; and that the Secretary, U. S. Department of Agriculture, be authorized to issue necessary regulations for carrying this amendment into effect.

Resolved: That the U. S. Live Stock Sanitary Association hereby approve the promulgation, by the Secretary of Agriculture, of amendment 15 to B.A.I. order 276 effective January 1, 1942 and strenuously oppose its being rescinded or repealed or amended and that the Secretary of this Association be directed to so notify Hon. Claude R. Wickard, Secretary.

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 largely to the control of brucellosis in cattle.

Resolved: That we extend to the manager and other employees of the Hotel La Salle 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.
REPORT OF THE COMMITTEE ON BIOLOGICS


During the past year your Committee on Biologics has concerned itself with an endeavor to obtain the cooperation of the federal government, to the end that live stock sanitary officials might have adequate control over the sale, distribution and use of biologic products consisting in whole or in part of live viruses or live organisms within their respective states.

That our efforts have met with a measure of success is borne out by the issuance of Amendment 15 to B.A.I. Order 276. This amendment was signed by Hon. Claude R. Wickard, Secretary of Agriculture, on June 16, 1941, and becomes operative January 1, 1942.

It is universally stated and held that the basic industry of this land is agriculture. It is an equally well recognized fact that the keystone of the arch of agriculture is the live stock industry, which, to remain profitable and productive, must be kept healthy. Science has developed and placed in our hands biologic agents which are useful in the prevention and treatment of certain of the contagious and infectious diseases. Proper use of these agents is an aid in the prevention and control of disease, and conversely these same agents, when employed improperly, may serve to establish new centers of disease and to aid materially in its perpetuation and dissemination.

In the proper use of these agents containing living viruses or living organisms, one must be acquainted with not only differential diagnosis of disease, but must have an understanding of the conditions in which their use is contra-indicated, as well as those which would indicate their use. We believe that the Hon. Claude R. Wickard recognized these fundamental truths and believed that the use of these products could best serve the purpose for which they were intended when employed under the supervision and control of the officials in each state who are charged by law with the control of contagious and infectious diseases of live stock.

At present, nations at war are seriously considering the possibilities of a sabotage of live stock through the medium of viruses and living organisms, and are preparing to meet such emergencies. In the interest of national defense, if not in the interest of sound disease prevention, is it not imperative that more adequate control must be had over the distribution and use of those biologic agents which contain living viruses or microorganisms? Particularly in this time of trial and emergency, when the government is bending all effort to increase the live stock production of the nation, it is imperative that Disease, Enemy No. 1 of the live stock industry, be overcome. It would appear to your Committee that to fail to exercise control over these products could only be interpreted as a lack of sincerity in this nation’s avowed desire to increase the production of live stock in the interest of national defense.

To ascertain the benefits that might accrue to those charged with control of products covered in Amendment 15, a questionnaire was sent to live stock sanitary
officials. Opinions received from the states indicate that practically all of the officials felt the amendment would be of assistance to them in the discharge of their duties in the control of diseases of livestock. Secretary of Agriculture Claude R. Wickard is to be commended by live stock breeders and officials for his vision, wisdom and understanding, exhibited in the promulgation of Amendment 15. Your Committee wishes to go on record as recommending and endorsing Amendment 15 to B.A.I. Order 276 prescribed by the Secretary of Agriculture, and feels that immeasurable harm could occur should these products mentioned in the Amendment be sold without supervision.

REPORT OF THE COMMITTEE ON POLICY


Your Committee on Policy has attended to their duties and wish to make the following recommendations for your consideration:

1. We recommend that the Executive Committee of this Association give further consideration to the recommendations of this Committee as set forth in the report of the proceedings of 1940.

2. We recommend that the officers and active members of the U. S. Live Stock Sanitary Association lend every effort to procure a more definite and stable membership, and that measures be taken to collect yearly dues from all members.

3. That methods of publicity be adopted whereby members of the Veterinary profession in good standing and other interested persons may be informed of their eligibility for membership in this Association.

4. Your Committee recommends that a policy of procuring proper paid advertisements to be run in our Annual Report, be adopted if and when, in the opinion of our officers, such a policy would prove to be of sufficient benefit to warrant the effort.

5. It is further recommended that the Committee on Policy be appointed by the President of this Association in the following manner:
   a. The Committee shall consist of five members.
   b. The members shall be selected from different geographical sections of the United States.
   c. One member shall be selected from the ranks of the Bureau of Animal Industry; one member shall be a layman and three members shall be selected from the ranks of the regulatory Live Stock officials of the respective states, in good standing.

6. Your Committee further recommends that all matters of policy and all recommendations made by members of this Association be referred to the Committee on Policy, whose duty it shall be to study, prepare and present for the consideration of the Executive Committee, all policies of a general nature affecting this Association.
LEGISLATION

REPORT OF THE COMMITTEE ON LEGISLATION


Your Committee on Legislation begs leave to make the following report:

We recommend Federal laws or Federal regulations authorized by law placing all persons, firms or corporations engaged in the interstate transportation of live stock by truck under the same requirements relative to unloading for rest, feed and water as now apply to shipments by railroads;

We recommend that all interstate live stock shipments by truck shall be accompanied with a bill of lading, and subjected to the same requirements as to accompanying health certificates as shipments by any and all other methods of transportation;

We recommend that any interstate shipments of live stock not accompanied with proper health certificate shall not be made without a special permit from the chief sanitary officer of the state of destination;

We recommend that all states be urged to provide adequate laws for the regulation and supervision of sale barns and community sales, and that each respective entity be required to pay a license fee commensurate with supervisory expense, and that a bond of $10,000 be required, conditioned upon the compliance with all laws, rules and regulations made and provided by the respective state in adjudicating all cases arising out of irregular sale barn transactions;

We recommend that all laws, rules and regulations relative to calfhood vaccination definitely set out all such vaccination shall be under official supervision only;

We wish to go on record as approving "Amendment 15 to B.A.I. Order 276," promulgated June 16, 1941, by Claude R. Wickard, Secretary of Agriculture, to be effective on and after January 1, 1942, and vehemently oppose its amendment or repeal, and

Respectfully request the Secretary-Treasurer of the United States Live Stock Sanitary Association to so inform the Hon. Claude R. Wickard, Secretary of Agriculture, Washington, D. C.

REPORT OF COMMITTEE ON REVISION OF CONSTITUTION AND BY-LAWS


Chairman Moore indicated that his Committee had no report to make and recommended that his Committee be abolished and that the functions of it be transferred to the Committee on Policy.

A motion was made and passed that this action be taken.
REPORT OF COMMITTEE ON UNIFICATION OF LAWS AND
REGULATIONS

A. W. MILLER, Chairman, Washington, D. C.; H. A. SEIDELL, Des Moines, Iowa;
W. H. LYTLE, Salem, Ore.; T. B. JONES, Phoenix, Ariz.; AND R. L.
HARDING, Hartford, Conn.

Your Committees on Unification of Laws and Regulations during recent years
have given this perplexing problem a great deal of study and have submitted several
comprehensive reports with specific recommendations of measures which it was felt
if adopted would do much to accomplish the objective that all of us have in mind;
that is, a reasonable degree of uniformity in Federal and State livestock sanitary
rules and regulations.

The recommendations have each year been approved by this association but the
net results have been, to put it mildly, very disappointing. This year the com-
mittee decided to limit its report to a brief reference to the situation with respect to
the mallein testing of horses for interstate shipment. This requirement was dis-
cussed in the report for 1939, at which time four States, Iowa, Minnesota, Rhode
Island, and Vermont, required a mallein test, health certificate, and special permit,
and six States, Idaho, North Dakota, Oregon, South Dakota, Utah, and Wisconsin,
and two Territories, Hawaii and Puerto Rico, required a mallein test and health
certificate. The committee, in its report for 1940, included the following recom-
mendation:

"Inasmuch as glanders in horses is practically nonexistent in the United States,
we recommend that state requirements for the Mallein test for the interstate move-
ment of horses be eliminated and that horses be permitted to move interstate subject
to more or less uniform regulations which would provide for clinical inspections and
freedom from contagious or infectious diseases."

This committee is pleased to report that seven of these States, Idaho, Minnesota,
North Dakota, Oregon, South Dakota, Vermont, and Wisconsin, no longer require
the mallein test for incoming shipments of horses and recently we received a letter
from Dr. W. H. Hendricks, State Veterinarian of Utah, advising that in the revision
of his State regulations which was in preparation this requirement was being
dropped. This leaves only the States of Iowa and Rhode Island and the Territories
of Hawaii and Puerto Rico with a mallein-test requirement still in effect. We hope
that a year from now Iowa and Rhode Island will also have dropped this require-
ment. In fairness we should state that in the case of Rhode Island the requirement
is in the State's basic law and consequently can not be changed as readily as in those
States where it is part of the rules and regulations.

We have not included the State of Nebraska in this summary because the re-
quirement of a mallein test in that State is a limited one applying only to stallions
and jacks. The reason for such a requirement is not clear to this committee and we
hope that at next year's meeting it will be possible to announce that this requirement
also has been rescinded.
REPORT OF THE NOMINATING COMMITTEE

R. W. SMITH, Chairman, Concord, New Hampshire; WILLIAM MOORE, Raleigh, North Carolina; and E. T. FAULDER, Albany, New York

Dr. Smith: 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. I. S. McAdory, Auburn, Alabama  
**First Vice-President:** Dr. W. H. Hendricks, Salt Lake City, Utah  
**Second Vice-President:** Dr. J. M. Sutton, Atlanta, Georgia  
**Third Vice-President:** Dr. R. A. Hendershott, Trenton, New Jersey

Mr. President, I move that the report of the Nominating Committee be accepted.

The motion was seconded by Dr. Axby and unanimously carried. The officers were inducted into their respective positions and each made a short speech of acceptance following which the meeting was adjourned.