Proceedings
FORTY-NINTH
ANNUAL MEETING
of the
UNITED STATES
LIVESTOCK SANITARY
ASSOCIATION

HOTEL LA SALLE
Chicago, Illinois
December 5, 6, 7, 1945
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HISTORICAL

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

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

<table>
<thead>
<tr>
<th>Meetings</th>
<th>Date</th>
<th>Place</th>
<th>President</th>
<th>Secretary</th>
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<tr>
<td>1</td>
<td>Sept. 28-29, 1897</td>
<td>Fort Worth, Tex.</td>
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<td>2</td>
<td>1898</td>
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<td>3</td>
<td>1899</td>
<td>Chicago, Ill.</td>
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<td>4</td>
<td>1900</td>
<td>Louisville, Ky.</td>
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<td>5</td>
<td>Oct. 8-9, 1901</td>
<td>Buffalo, N. Y.</td>
<td>E. P. Niles</td>
<td>F. T. Eisenman</td>
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<td>7</td>
<td>Sept. 22, 1903</td>
<td>Denver, Colo.</td>
<td>W. E. Bolton</td>
<td>Hon. W. P. Smith</td>
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<td>8</td>
<td>Aug. 23-25, 1904</td>
<td>St. Louis, Mo.</td>
<td>J. C. Norton</td>
<td>Hon. W. P. Smith</td>
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<td>9</td>
<td>1905</td>
<td>Guthrie, Okla.</td>
<td>Hon. W. P. Smith</td>
<td>S. H. Ward</td>
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<td>11</td>
<td>Sept. 16-17, 1907</td>
<td>Richmond, Va.</td>
<td>D. F. Luckey</td>
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<td>14</td>
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<td>Chicago, Ill.</td>
<td>Chas. E. Cotton</td>
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<td>Dec. 6-8, 1911</td>
<td>Chicago, Ill.</td>
<td>John F. DeVine</td>
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<td>S. F. Musselman</td>
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<td>25</td>
<td>Nov. 28-30, 1921</td>
<td>Chicago, Ill.</td>
<td>W. F. Crewe</td>
<td>Theo. A. Burnett</td>
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<td>Dec. 6-8, 1922</td>
<td>Chicago, Ill.</td>
<td>T. E. Muncie</td>
<td>Theo. A. Burnett</td>
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<td>27</td>
<td>Dec. 5-7, 1923</td>
<td>Chicago, Ill.</td>
<td>W. J. Butler</td>
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<td>28</td>
<td>Dec. 3-5, 1924</td>
<td>Chicago, Ill.</td>
<td>J. G. Ferneyhough</td>
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<td>31</td>
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<td>L. Van Es</td>
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<td>32</td>
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<td>C. A. Cary</td>
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<td>33</td>
<td>Dec. 4-6, 1929</td>
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<td>Chas G. Lamb</td>
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<td>34</td>
<td>Dec. 3-5, 1930</td>
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<td>A. E. Wight</td>
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<td>35</td>
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<td>J. W. Connaway</td>
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* Information not available.
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<td>R. W. Smith</td>
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<td>1940</td>
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<td>H. D. Port</td>
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<td>1941</td>
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<td>E. A. Crossman</td>
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<td>1942</td>
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<td>I. S. McAdory</td>
<td>Mark Welsh</td>
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<td>1944</td>
<td>Dec. 6-8</td>
<td>Chicago, Ill.</td>
<td>J. M. Sutton</td>
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<td>1945</td>
<td>Dec. 5-7</td>
<td>Chicago, Ill.</td>
<td>C. U. Duckworth</td>
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</table>
ADDRESS OF THE PRESIDENT

BY C. U. DUCKWORTH, D.Y.M.

Sacramento, California

The Association has seen fit to confer upon me what I consider a great honor. I recall a long time ago sitting in the back of a room in this very hotel as a student, listening in open-mouthed amazement to the discussions and deliberations. From the back of the room to the rostrum has been a long journey and one made possible through the assistance and guidance of some of the men of this organization.

I wish to express appreciation to the membership of this Association for having conferred upon me the honor of being President this year. To the committees who have worked under difficulties and in confusion, I particularly wish to express appreciation.

I feel that I would be ungrateful if I failed at this time to say a word of appreciation of one man—our good friend Bill Butler from Montana took me by the hand when I needed assistance very badly as a student and was very helpful to me in reaching this rostrum from the back of the room.

We are gathered here today to conduct the business of this Association. Many things have happened since we met here a year ago. You will recall that in the spring of the year Germany was still fighting and in summer the Japs were still going strong. The administration, through its various offices in Washington, had requested that travel be held to a minimum and that conferences be postponed. Your officers, in compliance with the intent of the requests of the government, sent out notifications to the effect that there would be no meeting this year. Following the collapse of the Axis powers, we felt that a meeting this year was desirable and necessary, so notices again went out—this time rescinding the prior notification and announcing that a meeting would be held.

Because of this situation, the chairmen of the various committees have been at a decided disadvantage and if the committees have been unable to prepare a report as complete as they would like, I know that you will understand it was not because of lack of desire or lack of ability, but rather due to the confusion almost throughout the year.

This Association, at its inception, was one designed to take care of a specific need based upon livestock disease eradication and control. Fifty years ago that probably was an adequate objective—today, that is no longer true. The Association has outgrown its name just as surely as a boy outgrows his pants. We have an Association now comprised of industry in many of its ramifications—livestock for meat production; cattle for dairy production; processing plants which prepare livestock and livestock commodities for distribution to the consumer; educators in various phases of agriculture; feed concerns; livestock disease control authorities; geneticists; dieticians; practicing veterinarians; and many others.

The combined objective of all concerned is to assist in delivery to the consumer of the best possible product at a cost conducive to adequate purchase and at a reason-
able profit to the producer and handler. It is recognized, of course, that disease control is basic and that those of us in the Association having to do with the control of diseases have a constant objective which we know is never ending. Disease can and does mean the difference between profit and loss and, therefore, must be taken into consideration wherever livestock is produced. Others of us are concerned with the marketing of livestock and livestock products and in that field we must take into consideration the great differences in marketing today and marketing a few short years ago. Using milk as an example, it can well be remembered by some that milk was delivered within a matter of hours after production and most of the consumers were personally acquainted with the farmer who produced the milk, he being a part of the local community. Today, milk and other dairy products move 100 miles, 500 miles, a thousand miles and the consumer knows nothing of the producer nor his environment. Such a difference necessitates an entirely different marketing structure, which involves a different kind of production, processing, transportation, and delivery, and all subject to regulation to insure the quality of the product as delivered to the consumer.

The problems facing the people in research are manifold and complex and must, of necessity, involve the basic processes of biology. Immunization is based upon the reaction or the lack of reaction of the body cells to an exciting factor. In the presence of natural immunity, certain pathogens can not affect the host detrimentally, but, unfortunately, may continue to live until such time as they can be transmitted to a susceptible host. Others stimulate the bodily processes to resistance, either sufficiently strong for recovery of the host or insufficient for life to continue.

In our studies, we have endeavored and are continuing to endeavor to assist nature in stimulating these bodily processes to a point where resistance to pathogens is enhanced to such degree as to render the pathogen in question either completely innocuous or to a degree incapable of causing the death of the host. Present methods of rearing mammals or domestic poultry, far different than nature intended, may be conducive to continuing increase in susceptibility to known diseases and probably new diseases. Adjustment of the bodily reactions may be such as to make invasion possible by factors heretofore not known or regarded as detrimental to the animal economy.

Continuing research for biologics controlling diseases will no doubt continue, but I think it must be appreciated by all that repeated injections for the purpose of stimulating immunity or resistance to several diseases is costly and onerous to the livestock owner. It is my opinion that we must extend our trend of thought in the matter of disease control toward the old theory of the survival of the fittest. Briefly, let me comment, as an example, upon a few things that have been done and are being done with other agricultural commodities. I think wheat offers us a classic example of what selective breeding can do. Not only has wheat been selected and adjusted to the length of the growing season, but also as to its resistance to diseases destructive to wheat. A few healthy stalks in a field otherwise destroyed by diseases have been taken, grown, and developed into strains free of the diseases in question. Fruit trees, through the means of grafts, have been grown resistant to certain diseases. Unfortunately, in livestock we cannot take advantage of the factors involved in grafting as is done in fruit trees. For instance, it was known
that a certain fungus affected the roots of orange trees when such roots were of the sweet orange variety. This fungus, however, did not affect a sour orange root, therefore, sweet orange was grafted on sour orange root and the fungus problem was overcome.

On the animal side and on the human side, we know that exposure to certain diseases over generations has a tendency to create a natural resistance and that this resistance is stronger apparently in some individuals than in others. Does this not offer us a clue or furnish us a guide toward the breeding of livestock more capable of resisting destructive diseases? The wonders that have been accomplished anatomically and physiologically by selective breeding are apparent daily and now taken for granted.

We have changed the shape of a hog to a point that would have been unbelievable one hundred years ago. When we wanted large sides of bacon we built hogs peculiarly favorable to the production of bacon. When we wanted great quantities of lard we built hogs to produce lard. We have increased the amount of meat available on cattle and created almost a square box with a leg at each corner to take the place of the old greyhound-like longhorn of a few short years ago. We have made veritable milk producing machines of the dairy cow. We have built an udder on a cow that is a marvel of production. The cow, originally designed to give a small amount of milk to start a calf, now is capable of giving four, five, ten gallons of milk a day, and through selective breeding we increased the butterfat content or the serum solids content of that milk to a point far different than milk produced years ago. Our knowledge gained by such breeding should be of material assistance in guiding us toward the breeding of disease resistant animals, rather than the susceptible types now in evidence throughout the country. Let us recognize that such a program is, of necessity, long and discouraging, but in these days of miracles and understanding I think it is well said that the impossible is only something that takes a little longer to do.

Constant study is necessary in the treatment of diseases through accepted methods and procedures, as well as through the use of new preparations. The need of such studies is well exemplified, I believe, by the sulfonamides and the present DDT, both of which preparations have been known for years, but the usage not even dreamed of. In the field of practice, accepted methods are used, but the practitioner is constantly being confronted with the fact that known methods are inadequate. To prove this statement, you merely have to go back a few years to remember how various treatments have been advocated and have become nationwide almost overnight. We all remember the use of methylene blue as a treatment for what was then infectious abortion. We remember when sodium cacodyolate was heralded and used very extensively for numerous conditions and the more recent advent of sulfonamides and penicillin—the rapid growth of the usage of all of these indicating lack of satisfaction of methods and preparations available. The use of biologics, dangerous themselves, offers a great field for further study. These products are difficult to control and it might be easier to find ways and means of controlling communicable diseases through breeding or the use of biologics incapable themselves of causing the disease.

I do not think that we can ever hopefully think of a Utopian world free of com-
municable diseases, but if we are to think of a world with less communicable diseases and scourges we must endeavor to bring such about more through natural resistance, than by induced resistance or treatment. Needless to say, none of us will live long enough to see such a situation, but if those of us alive today can contribute toward that end we will have accomplished much in the welfare of our people generations hence and the thought of such contribution is far more satisfactory than immediate personal gain.

As to those of us engaged in regulatory activities, it is my opinion that one of the most important tasks we have before us is to adjust our trends of thought in such a way as to better serve the interests represented by and regulated by the agencies with which we are connected. The promulgation of laws and regulations must be regarded in such a way that we recognize the great authority and responsibility with which we are entrusted. Laws and regulations strike at the very foundation of the rights given men by our constitution. Regulations that are well thought out before being made effective can be of assistance to industry and consumer alike; whereas regulations based upon insufficient information can be detrimental to all concerned.

In this organization, with its great variation of membership, we can, through cooperative thought and study, recommend regulations that will be acceptable to the majority of the industry regulated and thereby gain the necessary support of such industry, or we can fail to recognize a basic principle of our type of government and thereby fail in our objective.

The job ahead is enormous and endless. Last year, the cash income for farmers in the United States was approximately twenty billion dollars, of which in excess of eleven billion was derived from livestock and the products of livestock. Every member of this Association has a participation in one way or another with this great production. We know that most men are inherently honest and we know that it is our job to work for and with that honest element and to make sure that the few dishonest persons do not conduct themselves in such a way as to endanger our livestock population or to endanger the health of the consumer by means of unsuitable livestock products.

Whether we work for a governmental agency, or whether we are in production or distribution, we all owe an obligation to the ultimate consumer and this organization, I know, will stand as a tower of strength to safeguard that portion of agriculture it represents and the consumer who makes necessary and possible our great production.
When your secretary honored me by asking that I appear on this program he stated that he expected nothing more than a few words of greeting. I shall surely try to stay within the limits he prescribed.

First I want to thank you for the invitation. It gives me an opportunity to make to you a promise and of you a request. The promise is this. I shall make every effort to have the Bureau of Animal Industry continue its policy of working in close cooperation with the members of this Association in controlling, eradicating, and preventing contagious and parasitic diseases of our livestock. The request is that you continue giving the Bureau your fine support and cooperation. I realize that, in our work together, honest differences of opinion will arise occasionally. I believe these should be expected. And I believe further that a frank discussion will usually prove they are of relatively minor importance. We may expect, in some instances, the development of some personal friction. Good administration and judicious handling of personnel should prevent such friction from becoming serious. The job ahead is too big for any one group whether it be State veterinary officers, Bureau veterinarians, or any of the others which might be mentioned. But if all of us work together we can continue making progress.

We have been asked if there will be changes in the Bureau. The answer is both yes and no. Insofar as we know Bureau methods have never been static. A very brief review of its history reveals constant change in personnel, projects under way, and methods of procedure. In spite of our efforts to the contrary, Father Time will see to it that changes in personnel continue and I hope and expect that we can continue to under-take new worthwhile projects and to develop new methods and techniques. But the objectives of the Bureau have been constant through the years. Drs. Salmon, Melvin, Mohler, and Miller and their able staffs have ever striven to protect our farm animals from disease and to make livestock production a safe and profitable enterprise for the American farmer. These objectives shall not change.

We shall continue to emphasize research in the different fields related to production of livestock and preservation of health of domestic animals. And with equal vigor we shall continue our efforts to apply the results of this research in the field.

We know that the task ahead is still a big one; that the responsibilities are great. But, if we can judge the future by the past, we can have every confidence that, working together, we can do the job.

I thank you.
THE PUBLIC HEALTH VETERINARIAN

By James H. Steele, D.V.M.

States Relation Division, United States Public Health Service, Washington, D. C.

The maturity and intellectual growth of any profession is evaluated in terms of the constructive public service it contributes to society's advancement. If we use this yardstick to measure the public services given by the veterinary profession, we will find it has long been one of the leaders in the effort toward better living for all mankind. The services of this profession have not only been of value in the field of agriculture, with which so many people associate veterinary science, but they have also been valuable in economics, nutrition, and public health.

Professional groups the world over are acquainted with the excellent work accomplished in the field of agriculture by the American veterinarians. The manner in which bovine tuberculosis was brought under control is studied as closely by veterinary officials in other countries as tactics and strategy of war are studied by professional soldiers. Men of science, both in America and abroad, are carefully watching the campaign being waged against brucellosis in this country. Today the world looks to the American veterinarians for leadership in animal disease control just as it looks to the United States for leadership toward a better world.

Veterinary science also protects the commercial value of animal products which play a great part in the economy of our country. There is a direct correlation between the areas of the earth that support an extensive animal industry and the areas which maintain a high standard of living. The United States, Canada, Australia, Argentina, and South Africa, bear out this thesis. It has been impossible for a successful animal industry to develop in the areas of the world where disease and lack of veterinary services have existed. It is also in these areas where animal industries have not been developed that the most extensive mineral and protein deficiencies have been found in the human diet. Intensive research has been under way in all parts of the world, since the realization of nutrition's importance, to determine the foods essential to healthful living and to discover which areas have insufficient quantities of food to provide each person with a minimum diet. The lack of adequate amounts of protein and mineral of animal origin have been the most notable nutritional deficiencies observed on a world-wide scale. Impaired skeletal and muscular development resulted when these two essential dietary components were not present. Public health medical personnel have always maintained that nowhere in the world is it possible to build a successful health program where an animal industry is not in operation to provide the necessary proteins and minerals for the human diet.

Now that I have summarized some of the contributions made by the veterinary profession to society, let us consider the history and the future possibilities of the veterinarian in the field of public health.

Public health has taken great strides in the United States in the past decade under the leadership of men who saw in public health programs the path to higher
standards of living for increasing numbers of men. The veterinarian has been an integral part of this growth, not only for the past ten years, but also for the 30 years preceding the last decade. Despite this, his professional status in public health has not improved. There are approximately 400 veterinarians filling public health positions in the United States according to information received by the U.S. Public Health Service. About 375 of these men are employed in local health departments and 25 in state health departments. Veterinarians in the state health departments are primarily concerned with laboratory work and the manufacture of biologicals. In local health departments the veterinarian has worked mainly with problems concerning food and rabies. Local men have seldom had assistance from their state health departments except in milk sanitation. No other group in public health work has been left so much to itself to work out its problems in the best way possible as has the local public health veterinarian. This lack of leadership and guidance from state and national levels has often resulted in the loss of morale, initiative, and imagination.

Through the efforts of national officials, educational leaders of the veterinary profession, and the outstanding work of the Army Veterinary Corps, the United States Public Health Service has become cognizant of the vast field of veterinary public health workers who have no national representation, and in many cases no state guidance. The relation of the public health veterinarian to the field of public health is being thoroughly reviewed at the present time.

A good reason for widespread encouragement of veterinary science lies in the fact that there is a direct correlation of the incidence of animal diseases found in man and the incidence of the same diseases found in animals. For instance, when anthrax is prevalent in animal populations there is a proportionate increase in the human population. Despite the increasing number of animal diseases reported in man, the enzootic diseases of bovine tuberculosis and glanders have been brought under control through the efforts of veterinarians in the Bureau of Animal Industry. These two diseases were significant public health problems thirty years ago before programs were inaugurated to eradicate or control them. Today glanders is unknown in the United States and bovine tuberculosis is an insignificant public health or clinical problem. However, in areas of the world where the veterinarian has not had an opportunity to deal with these diseases they remain an important public health problem, as for instance, bovine tuberculosis is very prevalent in Europe and glanders prevails in China.

As there is not sufficient time to read the following list of animal diseases known to be transmissible to man, a copy of it will be included in the published proceedings of this meeting. The diseases listed, all constitute problems of a varying degree to the public health veterinarian. The thing that the public health veterinarian is most interested in, is learning how to prevent the transmission of these diseases to man. To accomplish this purpose he should study the diseases carefully from all angles in order to be able to draw upon his own knowledge and that of his professional colleagues. He should also conduct epizootiological studies in order to bring to light information valuable to the practicing veterinarian, the veterinary regulatory officials, and the public health service.

What are some of the public health problems that we face today that the veter-
Diseases of Animals Transmissible to Man

Common Names of the Disease | Organism Causing Disease
--- | ---
1. Actinobacillosis (wooden tongue) | Actinobacillosis ligniersi
   | Actinobacillosis actinomycetemcomitans
2. Actinomycosis (lumpy jaw) | Actinomyces bovis
   | necrophous
   | hominis
3. Anthrax (splenic fever) | Bacillus anthracis
4. Aphthous fever (foot and mouth disease) | Virus; A, O, & C types
5. Balantidiosis | Balantidium coli
6. Botulism (food poisoning) | Clostridium botulinum type A, B, C, D, and E
7. Brucellosis (undulant fever) | Brucella abortus
   | " melitensis
   | " suis
8. Chagas disease | Trypanosoma cruzi
9. Coccidioidomycosis | Coccidioides immitis
10. Cowpox | Virus
11. Dermatomycoses | Achorion schoenleini
   | " gallinarum
   | " quinckeanum
12. Encephalomyelitis | Blastomyces farciminosus
13. Endemic Typhus | Trichophyton equinum
   | " mentagrophytes
   | " granulosum
   | " felineum
   | " megnini
14. Erysipeloïdosis | Microsporum minimum
15. Glanders (farcy) | " lanosum
16. Infectious anemia | Aspergillus fumigatus
17. Leptospirosis (Weil's Disease) | Virus; eastern, western, St. Louis, and Venezuelan type
18. Listerellosis | Rickettsia mooseri
19. Louping ill | Erysipelothrix rhusiopathiae
20. Lymphocytic—choriomeningitis | Malleomyces mallei
21. Ornithosis (Pigeon Fever) | Virus
22. Plague | Leptospira icterohaemorrhagiae canicola
23. Psittacosis (Parrot Fever) | Listerella monocytogenes
24. Rabies | Virus
25. Rat Bite Fever | Pasteurella pestis
26. Salmonellosis (Food Poisoning) | Virus
   | Spirillum minus
   | Salmonella types

The Salmonella Types

S. aberdeen | S. abony | S. abortus-bovis
S. abortus-equ | S. abortus-ovis | S. adelaide
THE PUBLIC HEALTH VETERINARIAN

S. altendorf  S. amager  S. amersfoort
S. amherstiana  S. anatum  S. arechavaleta
S. ballerup  S. bareilly  S. berta
S. bispebjerg  S. blegdam  S. bonariensis
S. bovis-morbificans  S. braenderup  S. brandenberg
S. bredeney  S. budapest  S. california
S. cardiff  S. carrau  S. cerro
S. chester  S. cholerae-suis  S. claibornei
S. concord  S. coeln  S. dar-es-salaam
S. derby  S. dublin  S. durban
S. duesseldorf  S. eastbourne  S. enteritidis
S. essen  S. florida  S. gallinarum
S. gaminara  S. give  S. glostrup
S. goettingen  S. grumpensis  S. infantis
S. inverness  S. habana  S. hartford
S. heidelberg  S. heves  S. harmaechei
S. hvittingfoss  S. illinois  S. javiana
S. kaapstad  S. kaposvar  S. kentucky
S. kirkee  S. kottbus  S. lexington
S. litchfield  S. loma-linda  S. london
S. medelia  S. manhattan  S. meleagridis
S. mikawashima  S. minnesota  S. mississippi
S. montevideo  S. moscow  S. munchen
S. muester  S. narashino  S. new-brunswick
S. newington  S. newport  S. niloese
S. nyborg  S. onarimon  S. onderstepoort
S. oranienburg  S. oregon  S. oslo
S. panama  S. pomona  S. poona
S. paratyphi C  S. pretoria  S. pueris
S. potsdam  S. reading  S. rostock
S. pullorum  S. saint-paul  S. salinatis
S. rubislaw  S. schleissheim  S. selandia
S. san-diego  S. senftenberg  S. shangani
S. simsbury  S. stanley  S. solt
S. sundsvall  S. swartzengrund  S. szentes
S. taksony  S. tel-aviv  S. tennessee
S. thompson  S. tim  
S. typhi-murium  S. typhi-suis  S. uganda
S. urbana  S. vejle  S. virchow
S. weltevreden  S. wichita  S. worthington
S. zagreb  S. zanzibar

27. Sarcocystosis

28. Sporotrichosis

29. Staphylococcus (food poisoning)

30. Streptococcus infections

Sarcocystis bertrami
" blanchardi
" miescheriana
" blanchardi

Sporotrichium beurmanni

Staphylococcus aureus
" albus

Streptococcus spp.
Group A, B, C, D, & E (Lancefield)
Some of the 36 animal diseases on the previously mentioned list are more important than others as public health problems. I, therefore, propose to mention briefly the problems inherent in a group of the more important of these diseases. The first of these diseases is brucellosis. One path that this infection takes can be controlled through the pasteurization of all dairy products. Other paths of infection that are not so easily dealt with travel through meat products, direct contacts with infected animals and their waste products, and perhaps other undisclosed avenues. Although every year more cases of human brucellosis are reported, few state and local health departments are equipped to make epizootiological investigations of such cases. The public health veterinarian, in addition to investigating brucellosis outbreaks among man, is the person logically equipped to carry on liaison work with the regulatory veterinarians of the U. S. Department of Agriculture and the state departments of agriculture in planning control programs to combat this disease. The incidence of reported cases in man has risen steadily in the past decade according to the United States Public Health Service weekly reports. Here is a summary of these reports for the past ten years.

**Brucellosis: Cases and deaths reported annually in U. S. (§)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1927</td>
<td>112</td>
<td>2</td>
</tr>
<tr>
<td>1928</td>
<td>669</td>
<td>13</td>
</tr>
<tr>
<td>1929</td>
<td>975</td>
<td>41</td>
</tr>
<tr>
<td>1930</td>
<td>1,453</td>
<td>66</td>
</tr>
<tr>
<td>1931</td>
<td>1,578</td>
<td>74</td>
</tr>
<tr>
<td>1932</td>
<td>1,502</td>
<td>82</td>
</tr>
<tr>
<td>1933</td>
<td>1,788</td>
<td>87</td>
</tr>
<tr>
<td>1934</td>
<td>2,017</td>
<td>74</td>
</tr>
<tr>
<td>1935</td>
<td>2,008</td>
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<td>1936</td>
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<td>1941</td>
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<tr>
<td>1942</td>
<td>3,228</td>
<td>79</td>
</tr>
<tr>
<td>1943</td>
<td>3,734</td>
<td>98</td>
</tr>
</tbody>
</table>

Where another of these diseases, equine encephalomyelitis, exists in animals, public health officials are experiencing a growing concern. Up to the present time, four different varieties of the virus have been found in equines, namely, the western, eastern, St. Louis, and Venezuelan varieties. An increasing knowledge of this
disease indicates that it may become an even more important problem in the future. The number of domestic and wild animals reported as being infected with the disease increases annually, providing a greater animal reservoir from which man may become infected. The reported cases of equine encephalomyelitis in humans has followed directly the trend of the disease as reported in equines. When epizootics have occurred, the disease assumes epidemic proportions in man.

Rabies remains one of the most exasperating problems public health officers have yet to cope with in most parts of the United States. We have knowledge as to the control of the disease but lack the coordinated efforts of all the agencies concerned in tackling the problem vigorously and intelligently. This is one problem that the public health veterinarian will be faced with in any community and it will take intelligence and resourcefulness to solve it. A public health problem that costs the nation as many dollars and as much anxiety as rabies should not be dismissed, simply, as a local problem. The local health services should be able to look to the national and state health authorities for leadership in the fight to eliminate rabies as a public health problem. In the speaker's opinion, a three-pronged attack consisting of immunization, quarantine, and destruction of wild and semi-wild animal carriers of rabies would aid materially in bringing the problem under control.

One of the major causes of enteric diseases is the salmonella group of organisms. Animal carriers of salmonelloses are extensive but just how extensive has not as yet been determined. This is an epizootiological problem for the public health veterinarian to solve in cooperation with epidemiologists, veterinary practitioners and regulatory officials.

The extent of the salmonella animal reservoir is indicated by the report of Staf- seth and Darby (1) in which they describe 35 varieties of salmonellas found in poultry, most of which have also been found in human cases of enteric disease.

Barnes (2) wrote in the Naval Medical Bulletin (1944) that there are nearly 180 salmonella types of which 131 are described as established types, and the rest represent strains with minor varying characteristics. He divided the salmonella organisms which cause human disease into three groups, enteric fever, gastroenteritis, and carrier cases. This grouping was based on clinical manifestations. Thirty-four different salmonella organisms alone, were isolated from enteric fever, 75 were isolated from gastroenteritis and 33 from carrier cases. Some of the same organisms were found in all three of these groups. In discussing the significance of the animal reservoir of disease caused by the salmonella organism, Barnes states that there are a few salmonella types such as S. typhi, S. paratyphi B, S. sendai, et cetera, that are primarily infectious to human beings, but by far the richest animal reservoir of salmonellas capable of causing human disease is found in the lower animals used by man for food.

Recently Watt and Carlton (3) reported an outbreak of Salmonella typhimurium among premature infants in New Orleans. Six of these cases proved to be positive cases of S. typhimurium. Contaminated fingers of the nursery attendants were thought to have been the cause of the infection's spread from the originally infected infant whose mother was found positive for S. typhimurium, to the other children.

Shortly after this outbreak Watt (4) reported the occurrence of salmonellosis which infected 21 individuals aboard an American merchant vessel. Epidemiologi-
cal evidence indicated that the infection resulted from contaminated eggs. Salmonella montevideo was found to be the strain of organism causing the disease. These eggs were traced to their origin in southern Iowa where further examination of egg samples disclosed the presence of S. pullorum, S. gallinarum, S. cholera suis (var. Kunzendorf) and S. derby.

Hauser, Trenting, and Bieffelth (5) have recently reported a case of food poisoning which resulted from home made sausage contaminated with Salmonella berta.

These cases serve to show that salmonellosis has become an important health problem. That more cases are not reported, we think, is due to the absence of the public health veterinarian to conduct epidemiological and epizootiological investigations. It is reasonable to suppose that the mystery surrounding much food poisoning will be solved when a sufficient number of public health veterinarians are able to put their scientific knowledge to the best use at strategic places.

Trichinosis, a serious problem in areas where garbage feeding of hogs is allowed with inadequate supervision, is a problem for which a solution is known (6) but because of economic pressure the health of man is being jeopardized. While the solution to this problem is largely a regulatory and administrative one, the solution to trichinosis which is often an enzootic problem in rural areas among people of certain customs, is an educational one. In connection with educational problems relating to animal disease reservoirs, the public health veterinarian has a co-worker in the field of public health education. The public health educator can be of invaluable assistance to the veterinarian and in turn the veterinarian can be of great aid to the health educator.

The purpose of this paper in reviewing significant animal disease problems is to emphasize the great need for public health veterinarians to facilitate a well balanced health program. In working out such a program the veterinarian needs to understand the relations of various types of health workers within the health department. He needs this information in order that he may operate at maximum efficiency in dealing with problems of the nation’s health. When the public health veterinarian knows the professional objectives of the health officer, the public health nurse, the health educator, the sanitary engineer, and the laboratory worker, he can coordinate his objectives with theirs. And they in turn must understand the objectives of the public health veterinarian, to integrate their work with his.

The efforts of all health workers are directed toward reducing mortality and morbidity from disease and providing freedom from the fear of disease in order that everyone may have optimal health. The difference between public health workers and medical workers at large has been that public health workers have sought to prevent problems from arising and medical workers at large have, for the most part, been concerned with meeting the problems after they arise. The veterinary profession like the public health service has been largely founded on preventive medicine and its greatest advances have been made in the control and eradication of infectious diseases. Infectious disease control is strongly emphasized in veterinary education. With this background, then, the veterinarian is ideally equipped both professionally and intellectually to meet public health obligations.

In the field of public health the veterinarian’s predominant purpose is to prevent the transmission of animal diseases to man either by direct contact or through ani-
mal products. To achieve this purpose he must have a thorough knowledge of infectious animal diseases and their means of transmission to man. His objective must always be the eradication of the foci of disease and when eradication is not feasible it is necessary to prevent its spread by other barriers. To accomplish this it may be desirable to request assistance from such fellow workers as the sanitary engineer to build physical barriers, the health educator and public health nurse to disseminate knowledge, and the entomologist to control insect vectors. Beside the cooperation of his fellow health workers, the veterinarian must have the courage of convictions based soundly on education and experience to do what he believes is right for the benefit of man.

The time is ripe today for the veterinary profession to participate more fully in public health work. Leaders in the public health field understand that the services that veterinarians are able to give in the battle against disease are of value to the over-all health program. In view of the opportunities for increased service, the profession owes it to humanity to do its best to live up to its possibilities.

In order to provide veterinary public health leadership for the future, graduates in veterinary science must also have further training in public health. Such training may be received at graduate schools of public health or through in-service training. The U. S. Public Health Service has established an in-service training center at Atlanta, Georgia, which provides a three months' training period for health workers including veterinarians. One of the greatest values of advanced public health education is that it provides for the study of public health as a whole entity. The earlier training in the veterinary schools gives the veterinarian his basic tools to work with in public health and the advanced training in graduate schools would be designed to give him the more refined tools to assist him in his investigations such as statistics, epidemiology, ecology, infectious human diseases, sanitation, administration, and other specialized studies.

There is also a need for an undergraduate course of public health administration and methods. The speaker believes that even the veterinary student who does not wish to go into public health work will benefit from such a course in public health. From a course of this kind he would derive an understanding of the various fields of public health and of what the approximate position of the veterinarian is in the health organizations of the country. This training probably would encourage more practitioners to participate in local health activities as members of special committees or as members of local boards of health. In this capacity veterinarians could be just as valuable serving as policy makers of public health as they could be as public health workers.

In closing this discussion let me re-emphasize the following points that have been made in this talk. The veterinary profession has in the past, contributed much to the benefit of better living through the mediums of agriculture, economics, nutrition, and public health. While the field of public health has grown very rapidly in the past decade, the veterinarian has not always grown in stature as a public health worker. There are many animal disease problems that are a direct public health concern and the public health veterinarian is needed to solve them. Food sanitation has not been stressed in this paper as it has received attention in other papers given here today. However, it will certainly constitute a large part of the work of
the public health veterinarian. The need for understanding and diplomatic relations between the public health veterinarian and other public health workers and the need for an increased scope in veterinary education have been touched upon. The possibility that the veterinarian may be an important contributor to public health through civic and government activities and organizations has been mentioned.

The future will judge the veterinary profession in the light of its contributions to the advancement of society and the improvement of health is essential to such an advancement. The practitioner, the regulatory official, and the public health worker, as members of the veterinary profession, all have their part to play in contributing to the well-being of the nation. Our profession, which has done a fine job in the past, must begin preparing for the bigger jobs of the future.

BIBLIOGRAPHY

During the past year the Supreme Being has seen fit to call to their reward the following prominent and revered members of our association:

Dr. Miller F. Barnes, U. of P. Lemoyne, Pennsylvania. Director of Laboratories of the Pennsylvania Bureau of Animal Industry. Renowned for his work in Brucellosis control and father of the present agglutination test for detection of carriers of Brucella abortus infection. Died December 8, 1944.

Dr. Oscar Victor Brumley, O.S.U. Columbus, Ohio. Long an educator and leader in public health and veterinary work. The second dean of the College of Veterinary Medicine, past president of the A.V.M.A. 1937-38. Died January 13, 1945.


Dr. Charles G. Lamb, President of the United States Livestock Sanitary Association, 1908 and 1929. Died March 27, 1945.

Dr. Edward A. Watson, Dominion Animal Pathologist, Canada. Died March 12, 1945.

Dr. Homer A. Wilson, Former State Veterinarian of Missouri. Died October 5, 1945.

Dr. W. J. Fretz, Retired United States Inspector in Charge in Minnesota. Dr. Fretz was born in Hamlin, Kansas, October 14, 1877, graduated from American Veterinary College, New York, 1899. Joined U. S. Bureau September 1, 1900, and was recognized for his ability in control of tuberculosis. Retired July 31, 1945. Died September 13, 1945. Survived by his widow, Ruby C. Miller Fretz.

Standing silent prayer by all.

It has fallen to my lot to try in some measure to substitute for Dr. J. L. Axby who has so admirably taken care of this assignment in the past few years. No words of mine can adequately express the keen sense of personal loss all of us feel on this occasion. All of the men listed as having been called to their reward today have been instrumental in laying the foundation and overseeing the erection of the cornerstone of disease prevention and eradication measures designed to keep the livestock of this nation in good health.
No words of mine can add or detract from the monument they, through their own efforts have left behind. The pages of veterinary history are replete with their advice and also record the progress that has been made through adherence to measures advocated and advanced by them. It remains for us to call to mind the contributions made by each of these outstanding men and to strive to carry on in their places to the end that the lessons they taught will continue to bear fruit in a more healthy livestock population.

Together with the bereaved relatives we can take solace in the knowledge that theirs was a life devoted to the wellbeing of man and that the world in which we live has been enriched because of their sojourn in it.
REPORT OF THE ADVISORY COMMITTEE ON ANAPLASMOSIS

W. H. BOYNTON, Chairman, Berkeley, Calif.; I. N. McADORY, Auburn, Ala.;  
W. W. ROSENBERRY, Oklahoma City, Okla.; H. SCHMIDT, College  
Station, Tex.; H. C. SIMMONS, Jackson, Miss.

The insidiousness which marks anaplasmosis makes it one of the diseases most  
difficult to control. The prime difficulty in respect to control is the fact that  
cattle which recover from anaplasmosis remain carriers indefinitely. Added facts,  
that deer in their natural state are known to harbor the infection, and that the  
disease is naturally insect-borne, indicate the possible range of spread of this  
disease and further explain the problems involved in its eradication. To cope  
with an infection of this character, a crying need exists for some reliable and  
practical means of detecting carriers, but, so far as is known, no such method  
has yet been developed and all measures for handling anaplasmosis must be  
limited within the narrow scope of our present-day knowledge concerning  
transmission, treatment and prevention.

Transmission occurs in nature through insect vectors, but man has been incrimi-
nated repeatedly and has been the agent of transmission as often, perhaps, as  
insects in the outbreaks reported. Warnings have been reiterated against the  
use of unclean instruments in any operation by which even minute quantities  
of blood may be carried over from one animal to another, yet the histories of  
continued outbreaks reveal that several weeks previous to the outbreak, the  
animals concerned had been subjected to dehorning, to the tuberculin test, to  
bleeding for brucellosis test, or to vaccination against blackleg or other  
diseases, particularly anthrax, which seems to be the most frequently-occurring  
"needle" method of transmission. Human carelessness, entirely unnecessary and  
avoidable, has contributed and is contributing grievously to the spread of this  
disease.

Of the natural vectors, ticks are, in general, the chief disseminators. However,  
several species of flies\(^1\) and at least two species of mosquitoes\(^2\) have been  
found capable of transmission also, and in certain areas the evidence points  
to these insects as the responsible agents. Nineteen species of ticks\(^3\) have  
been proved vectors; fur-

\(^1\) Stomoxys calcitrans (Sanders)  
Tabanus sulcifrons (Howell, Sanborn, Rozeboom, Stiles, and Moe)  
T. abactor  
T. venustus  
T. equalis  
T. erythraeus  
T. americanus  
T. oklahomensis  
T. fumipennis (Sanders)

\(^2\) Psorophora columbiae (Howell, Stiles, and Moe)  
P. ciliata

\(^3\) Boophilus decoloratus (Theiler)  
*B. annulatus (Smith and Kilborne (Dikmans))  
*B. microplus (Rosenbusch and Gonzalez)
thering the importance of their rôle in anaplasmosis are the facts that some of this
group of nineteen inhabit a variety of hosts and nine species are known to transmit
Anaplasma through their eggs.

Dissemination of the infection by flies, mosquitoes, and man is accomplished
simply through direct mechanical transfer of blood from a sick or carrier animal to a
susceptible one, and in flies and mosquitoes the evidence seems to show that trans-
misson is likely to depend upon contact of these insects with an acute case of the
disease. The transfer of blood by these three agents must, therefore, be consum-
mated within a very short time. Tick dissemination is less direct. Ticks which
become infected during the larval or nympha! stages may continue to transmit
Anaplasma through the adult stage. Their infectiveness may persist then for some
time, even if they are not permitted to survive to completion of their life cycle; con-
sequently, of all the vectors known, ticks are the greatest potential menace.

With our new knowledge of the insecticide, D.D.T., it is possible that the spread
of insect-borne anaplasmosis may be greatly reduced. However, this chemical
apparently does not act as a repellent, and a combination of D.D.T. with a repellent
would probably be needed for most effective results. Squibb, of the Division of
Animal Industry of the Interamerican Institute of Agricultural Sciences at Tur-
rialba, Costa Rica, has developed an inexpensive spraying mixture of D.D.T. and
rotenone, which is claimed to have protected cattle against cattle ticks up to 80
days. Thus, it now seems logical to expect rapid development of methods which
will shield cattle against the various insects involved in the spread of anaplasmosis,
and the outlook for insect eradication is increasingly hopeful.

To a long list of drugs used in treatment, a number of recently-tried compounds
have been added. Limited trials have been carried out* with iron cacodylate in 5
per cent dextrose solution and with four proprietary compounds used in combination
with 5 per cent dextrose solution: i-mer-cu, a product containing iodine, mercury,
and copper; aricyl, an arsenical compound; filsol, a preparation of antimony; and
protedzin, a pararosaniline dye and copper compound. None of these preparations

*B. australis (Quevedo)
*Rhipicephalus simus (Theiler)
R. bursa (Sergent, Donatien, Parrot and Lestoquard)
R. sanguineus (Rees)
R. evertsi
R. appendiculatus
*Ixodes ricinus (Helm)
I. scapularis (Rees)
Dermacentor variabilis (Rees)
*D. andersoni (Rees)
D. albipictus (Boynton, Herms, Howell and Woods)
*D. occidentalis “ “ “ “ “ “
*Hyalomma lusitanicum (Sergent, Donatien, Parrot and Lestoquard)
H. aegyptium
Ornithodorus lahorensis (Rastegaieff)
Argas persicus (Howell, Stiles and Moe)

*Biological transmission has been proved in these nine cases
*Work done by the Chairman of this Committee.
appeared to be superior to 5 per cent dextrose solution containing 30 grains of sodium cacodylate per hundred pound weight of the animal. Smith and Howell, reporting on chemotherapy of 275 cases of anaplasmosis, obtained satisfactory results with sodium cacodylate and aricyn alone or with dextrose solution, but failed to produce desirable results with calcium gluconate, formalin, cobalt sulfate, and sodium iodide given, in each case, with dextrose solution. They claimed the most promising results were obtained with neosalvarsan, tryparsamide, cobalt chloride, and sodium sulfathiazole, also in combination with dextrose solution.

Two recent trials of penicillin proved disappointing: a dosage of two million units appeared to be of no particular advantage in facilitating recovery in the first experimental cow and did not kill the infective agent, since the second cow developed the disease upon inoculation of blood from the first animal. The second animal died: therefore, in that case, the same large dosage of penicillin could be considered of no avail whatever. In so far as is yet known, no chemical compound used in treatment has been effective in destroying Anaplasma, but, unquestionably, any medicinal treatment which investigators have shown to be of value in speeding recovery may be recommended. It should be kept in mind, however, that treatment must be administered when the animal is in the early stages of the disease; no response can be expected from any treatment given when the animal is in the advanced stages of the infection. Good nursing is essential and is frequently adequate for recovery without medicinal treatment, but tried compounds, such as sodium cacodylate with dextrose solution, do hasten the resumption of lactation in milch cows and do, in general, lessen the debilitating effect of the disease.

In regard to blood therapy, limited trials on the value of plasma seemed to show that plasma from normal cattle was of no benefit and that from carrier cattle was contraindicated. Blood transfusion has been advocated by various investigators including Smith and Howell who recently reported very successful results on 18 cattle so treated. Your Committee, with the exception of Dr. Schmidt, who dissents, does not recommend this procedure and your Chairman wishes to go on record as unalterably opposed to it. Laboratory confirmation of a clinical diagnosis is the exceptional, rather than the routine, practice among veterinarians and clinical evidence of anaplasmosis is insufficient to warrant the submission of a sick animal to transfusion of blood from another animal unless the donor is known absolutely to be Anaplasma-free. Moreover, if, as has been claimed, cobalt has the property of stimulating bonemarrow to increased production of red cells and of augmenting the concentration of circulating blood cells with resultant increased blood volume, what great advantage would blood transfusion have over a method of treatment using dextrose solution in combination with cobalt chloride which is far more easily available and very much safer? Smith and Howell suggest, furthermore, that little risk would be incurred even with blood obtained from a federally inspected abattoir, but upon what criterion normal-looking blood would be judged Anaplasma-free or otherwise has not been stated. This would certainly be an exceedingly dangerous practice, and any practice which may lead to the introduction of carriers where none may have existed previously is worthy of condemnation on the ground that it is based on a short-sighted view and is definitely no proper approach to long-range control of anaplasmosis.

Prevention of this disease is dependent, thus far, solely on precautionary meas-
uress which tend to stop the dissemination of *Anaplasma*. Attempts to develop a reliable method of immunization against anaplasmosis without also developing a carrier state have not yet proved successful. In the hope that passage of infected bovine blood through animals other than cattle would provide both a means of immunizing the latter against this disease and a less expensive experimental animal which could be substituted for the cow, limited experiments\(^6\) have been carried out on sheep, pigs and goats. Since deKock and Quinlan, Rees and Giltner have shown, respectively, that splenectomizing carriers may bring about a recurrence of infection, sheep, goats, and a pig were splenectomized in an attempt to lower their resistance sufficiently to produce visible symptoms. The splenectomized animals in no case presented any visible reactions after they were injected with bovine carrier blood, thus confirming Rees' work on splenectomized sheep, but blood from both splenectomized sheep and goats became infective for cattle. Blood from a splenectomized pig and from unsplenectomized pigs and goats which had received bovine carrier blood neither infected cattle nor induced immunity in them. This was proved by the fact that cattle given blood from these animals developed anaplasmosis upon later inoculation with bovine carrier blood. In association with the evidence presented by these limited experiments on pigs, it may be said that since passage of infected blood from cow to pig and from pig to cow failed to transmit the disease, the *Anaplasma*-like condition reported in swine does not appear to be related to bovine anaplasmosis.

In reviewing the precautionary measures to be practiced for prevention of anaplasmosis, the following should be stressed: thorough disinfection between operations of the hands of the operator, of nose tongs, and of any instruments used in de-horning, castrating, ear-marking, drawing blood for serum tests, vaccinating against other diseases and the like, segregation of known carriers from normal animals, and repulsion or eradication of ticks and other insect vectors by spraying and dipping methods, particularly to be applied to animals in the acute or convalescent stage of anaplasmosis.

The home-bred herd should be recommended as opposed to calfhood inoculation. In some endemic areas, severe losses have occurred in cattle newly introduced from outside sources while the home-bred animals have remained apparently healthy. Certain stock owners who had reported heavy losses among imported cattle found a very marked diminution of losses when they followed the practice of home-breeding. The home-bred stock seem to acquire a resistance to anaplasmosis, possibly through calfhood infection, and may, if they are healthy carriers, be fit for marketing, although they should not be sold for breeding stock. The risks of disseminating the disease are less in home-bred animals because carriers may not be present, and, if they are, most of the susceptible cattle may escape infection. Calfhood inoculation, on the other hand, simply results in building up a reservoir of infection in the entire calf crop.

Branding or otherwise identifying carriers should be a required practice for all recovered animals, whether naturally or artificially infected, but this practice has limitations which should be fully recognized. It must be remembered that calfhood

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\(^6\) Unpublished work. Unreported work by Wm. H. Boynton, Berkeley, California. Splenectomies performed by Dr. Birdsall N Carle.
infection may be so mild as to be overlooked entirely, and, for this reason, some animals would escape branding. Also, a conclusive diagnosis of anaplasmosis would be prerequisite to the branding and this would have to be made by a properly equipped agency. All these procedures would entail a definite and expensive program for handling the disease.

With no means at hand of immunization without creating a state of premunition, and no methods of detecting carriers or of destroying the infective agent in them, no solution to the control of anaplasmosis is discernible at present and your Committee respectfully suggests that the Federal Government should furnish increased financial support to institute a program designed both to stimulate and aid further investigations on this disease and to establish practicable measures of control.
DISCUSSION OF REPORT OF ADVISORY COMMITTEE ON ANAPLASMOSIS

BY DR. HUBERT SCHMIDT

There is one strong statement made in the report from which I must dissent. This statement involves the principle of blood transfusion in the treatment of anaplasmosis. A number of reasons are advanced for going on record condemning the practice, but I do not agree that all of these necessarily prove that this practice must be condemned. I believe that wherever a marked destruction of erythrocytes occurs, especially when it reaches such a degree that dyspnoea develops from a lack of oxygen carrying capacity of the blood, that a blood transfusion is indicated and helpful. The argument that few practitioners ever make a definite microscopic diagnosis of anaplasmosis does not refute this principle.

The argument that the donor may be a carrier therefore does not enter into the picture. The thought that blood from a carrier animal may superimpose an infection upon the one already existing would likewise not enter into the question on account of the period of incubation and the establishment of an immunity from the primary infection before the second infection could develop. If anything, I believe that more experimental data are needed before the practice can be roundly condemned.

I have no information on the rapidity with which cobalt chloride will stimulate the production of erythrocytes and the number that can be thrown into the blood stream to come to the rescue of an animal already gravely depleted of erythrocytes and in which a large volume of erythrocytes is needed right now. For the present I would prefer to leave the whole question of blood transfusion open.

REPLY BY DR. WILLIAM BOYNTON

I should like to refer you to Smith and Howell's article "The Chemotherapy of 275 Cases of Anaplasmosis,"—Veterinary Medicine, October 1944, as having some bearing on the point I made. They report that if an animal appeared to have anaplasmosis, it was treated and according to their figures in the table on page 385, blood smear examinations were made on a total of 170 treated cattle and of this number 23 were negative to anaplasmosis. Unless the blood donor was known to be anaplasma-free as I have stated, it seems to me that if these animals had been subjected to blood transfusion you could very easily have 23 new cases of anaplasmosis on your hands.

Practitioners, particularly those who cover large areas, or those who do not have access to laboratory facilities, usually have to make a diagnosis on the spot and treat at once accordingly because they know treatment cannot be delayed for several days awaiting a confirmatory laboratory report. In California at any rate, they are obliged to proceed in this fashion.
REPORT OF SPECIAL COMMITTEE ON COMMUNITY
AUCTION SALES

C. E. Fidler, Chairman, Springfield, Ill.; Frank Carr, Columbus, O.; George
Rathman, Topeka, Kans.; Justin Cash, Kansas City, Mo.; William
Moore, Raleigh, N. C.; J. R. Synder, Lincoln, Nebr.

In reviewing the reports of the previous Committees on Community Auction
Sales I find that their views are synonomous.

The salebarn has been a permanent institution for many years. Forty years ago
it was confined to the sale of horses. Modern machinery has replaced the horse,
and as a result the salebarns became more generous in their scope. Animals of all
kinds are now being sold, including horses, mules, cattle, swine, sheep, and poultry.
These salebarns have increased in numbers to the extent that more animals are sold
through them than in any other manner.

Not only are animals moved intrastate, but many thousands are shipped inter-
state. This procedure has developed into a complex problem, especially in the corn-
belt states where heavy importations take place. This has a tendency to break
down the law as well as the rules and regulations of the state of destination.

To illustrate, two-thirds of Illinois is surrounded by rivers which have seventy-six
bridges and ferries leading from this state to other states. These bridges are open
to traffic twenty-four hours of the day, and you can readily observe the financial
impossibility to maintain inspection at all times. As a result, this gives the un-
scrupulous dealer (bootlegger) an opportunity to bring animals into the state not
accompanied by an interstate health chart or permit.

Such animals are delivered to the salebarn to be sold on the following day. Many
of these animals have been purchased from stock yards or salebarns from other
states, loaded and transported several hundred miles without feed or water, reaching
the salebarn in a state of exhaustion. If such animals have been exposed to infec-
tion enroute and are in the stage of incubation, they may be classified by the sale-
barn veterinarian as normal. A few days after these animals are sold and delivered
to the purchaser disease breaks out among them and in most cases the loss is quite
extensive.

In receiving comments from members of the Committee on Community Auction
Sales I have accumulated sufficient evidence to formulate certain rules and regulations
whereby the veterinarian in charge could be empowered by law to enforce such
rules and regulations compiled by the sanitary officials for the control of animal
diseases. The following suggestions are offered from members of this committee:

We believe that community sale laws and regulations should provide that these
markets operate under a bond which must be supplied before the license is issued.
It should provide for the inspection of all livestock by a veterinary inspector ap-
proved by the livestock sanitary officials. Provisions should be made for the
inspection of all livestock brought to the sale before being offered for sale—quar-
antining, if necessary, any livestock which shows indications by temperature, clini-
cal symptoms, or testing, that they are unhealthy. When such diseased animals are
found, they should be either quarantined on the premises of the community sale or sent back to the farm of the owner of such diseased livestock. It should be considered a misdemeanor punishable by a fine for any person to knowingly deliver diseased livestock to a community sale.

All necessary tests, vaccinations, inspections, etc., should be done by the veterinary inspector in charge, and animals should not be released from the premises without his approval.

We are of the opinion that the following items should be included in such a law for the control of livestock diseases: (1) A properly constructed barn that can be readily cleaned and disinfected (2) thorough cleaning and disinfecting at least weekly (3) the isolation of visibly sick animals (4) the separation of animals to be sold for immediate slaughter from those that are to be returned to the farm (5) the testing of cattle for Bang's disease and Tuberculosis and the vaccination of hogs that are to be returned to the farm, and (6) cleaning and disinfecting all trucks used to haul livestock.

Each operator of a community sale should keep the following records for each lot of property consigned to or sold through such community sale, namely: (a) The name and address of the consignor; (b) A description of the property which, in the case of livestock, should include the kind, approximate age, the sex and any marks, brands or other distinguishing or identifying marks; (c) The method by which the property was delivered to the community sale and in the case of property delivered by motor vehicle, the name of the operator, the make of manufacture and the State license number of such motor vehicle, (d) The name and address of the purchaser of said property, and (e) The price for which the property was sold or exchanged and the commission or other fees charged by the community sale.

Such records shall be kept by the operator of a community sale at the establishment or premises where the sale is held and conducted or at such other convenient place as may be approved by the officials. Such records should be open for inspection by all peace officers or officials at all reasonable times and should be retained and preserved for a period of at least two years.

In case any community sale sells livestock or other property by weight, the scales upon which such property is weighed should be regularly inspected and tested.

Community sales handling livestock during inclement weather should be equipped with facilities for housing the livestock during such inclement weather. If livestock is held on the premises for more than ten hours, then facilities for feeding and watering the livestock so held should be provided. The yards, pens and premises where livestock is held or handled should be regularly cleaned and disinfected for the purpose of preventing the spread of infectious, contagious and communicable animal diseases.
REPORT OF COMMITTEE ON LAWS AND REGULATIONS


Your committee has reviewed the report of the Committee on Laws and Regulations governing the interstate movement of livestock as adopted in 1944. We concur in this report and recommend adoption of the provisions contained therein by the various states.

We recommend that a copy of this report and the 1944 report of the Committee on Laws and Regulations governing the interstate movement of livestock be forwarded to the various state secretaries, directors, and commissioners of agriculture, the secretaries of the various purebred livestock associations, the secretary of the American National Livestock Association, the National Wool Growers' Association and the secretary of the American Veterinary Medical Association.

We recommend that representatives of livestock producers be continued on the committee, and that an open invitation be extended to state secretaries, directors and commissioners of agriculture and the various purebred and commercial livestock associations to join in the deliberations of the committee.
The experiences of the Federal Meat Inspection Service during the recent war emergency are still quite fresh in our minds and it has occurred to me that you may be interested in hearing an account of some of them. Although the organization had many years of experience and had weathered satisfactorily one previous major world conflict, the entry of our country into World War II could not help but create a feeling of apprehension in those responsible for steering the Federal meat inspection program. Although we knew that we had under our supervision the larger part of the meat-packing industry, at least that part consisting of plants of substantial volume, we could not tell how our inspection activities as then organized would fit into the procurement program of the armed forces.

Before the final plan of procurement for the armed forces was worked out, there was considerable local buying by the Army to supply the numerous camps, posts, and cantonments that were being organized throughout the country. It then appeared that if the Army was to be able to procure federally inspected meats, as was then and still is its policy, it would be necessary to extend the inspection service to literally thousands of small killing and processing plants. This brought about the consideration that prompted the enactment by Congress of the so-called Fulmer Act which permitted the expending of Federal meat inspection funds to extend the inspection service to plants that were engaged exclusively in a local business within the confines of their respective States. The Army in the meantime worked out its procurement program and organized the large market centers with which we have become familiar and through which most, if not all, of its meat procurement in this country has been handled. This contemplated transaction involving large quantities of meat and therefore the small so-called intrastate meat plant was no longer in the picture. The result was that the Meat Inspection Service took on very few small plants. For the most part, the plants which have been added to the list of inspected establishments that we had at the start of the war, have been plants of substantial volume with a potential area of distribution involving interstate commerce. During World War II we enlarged our field of inspection by some 270 of these plants, most of which have indicated that they intend to continue to conduct an interstate business under Federal meat inspection beyond the period of the emergency.

It was gratifying to all of us to realize that it was not necessary at any time during the war emergency to refuse inspection to any meat-packing plant for which it was requested and which was able to meet the sanitary requirements. At no time could it be said that the armed forces were unable to obtain federally inspected meat in this country where they wanted it and in the amounts that they required. During the unprecedented hog slaughter of 1944 the demands for inspection for the record slaughter of livestock were met in each case.
Judging from a survey which we are now conducting of plants that took on the inspection during the war, we will go into the postwar period with approximately 35 percent more inspected establishments than we had prior to the war. These plants have equipped themselves to meet the sanitary and inspectional requirements and have an enviable record of production during a period when meat was so essential to the successful prosecution of a global war.

One of the major problems in assimilating this large number of establishments involved applying the labeling requirements of the meat inspection regulations. This important phase of our work is not very well understood by most people not directly connected with the meat-packing industry. Usually discussions of Federal meat inspection before groups such as yours and with the livestock interests generally are confined to considering the ante-mortem inspection, post-mortem inspection, and sanitary requirements of our work.

As required by law, the Meat Inspection Division of the Livestock Branch has worked out a program of control for labels, which applies the recognized concepts of informative labeling for foods and at the same time precludes representations in labels which may be misleading to consumers. This program of label control is made effective through the requirement that an inspected establishment may not use a label until it has been approved by the Division. Responsibility for prior review of a label is a heavy one. It calls not only for a thorough understanding of modern labeling requirements as reflected by related statutes and administrative and court decisions, but for a thorough knowledge of the products of the packing industry and their preparation. It is necessary always to anticipate merchandising trends and economic developments to be in a position to guide properly and control production of an ever-increasing variety of meat food products.

This control of labeling of the large number of plants that came under inspection had to be applied in such a way as to accomplish the kind of consumer protection which had become the rule under Federal meat inspection, and at the same time to permit these establishments to conduct a normal domestic business. The labels used by these plants on meats and meat food products prepared for Government procurement were no problem. Such products were for the most part standard items, and could be delivered to the armed forces under plain labels which carried all pertinent label information, and they could be obtained from local printers almost overnight. For use on commercial deliveries, large stocks of labeled cartons and wrappers were on hand at these plants, for the most part some adjustment was necessary to be made in the label before these stocks could be used under the inspection. Adjustments to conform with labeling requirements were brought about in many ways. Blocking out of certain features by printing press was accomplished at the same time that required labeling information was printed on the material. Combination sticker labels and rubber stamp imprints were also used. It took the combined resourcefulness of the industry and our labeling people to assimilate these new establishments under circumstances that would permit the use of stocks of packaging materials which were becoming increasingly difficult to obtain.

I believe the most important part of our experience during the emergency has been the fact that the requirements which we have come to feel to be essential in admin-
istering an effective meat inspection program have stood the test of another emergency. We have gained renewed confidence in the knowledge that our requirements for adequate ante-mortem and post-mortem inspection with proper facilities for conducting these inspections and adequate equipment for the sanitary handling of meat and meat food products, linked up with thorough reinspection activities, are essential. Similarly, our requirement that meat and meat food products be distributed under labels which are informative and which bear no misleading feature, increased in significance during the period when there were so many temptations to cheapen and adulterate foods.

We have taken considerable comfort in the thought that through our efforts our armed forces have been supplied with clean meat derived from healthy animals. Also, the requirements of Federal meat inspection assure the consuming public generally that a meat product is prepared according to the representations contained on the label. Requests that large amounts of nonmeat materials be added to standard meat items were denied. Furthermore, the labeling requirement which calls for an ingredient statement was an invaluable aid in the enforcement of ceiling price regulations.

You are all aware of the background of Federal meat inspection and the important part that this country's export meat trade assumed in formulating the inspectional requirements. For the period of around a half of a century during which export meat products have been subject to the inspection, a rigid application of sound principles of veterinary inspection and meat hygiene have gained for the meat products of this country an enviable reputation for wholesomeness which is unequaled in the world today. Products prepared under Federal meat inspection when so identified are accepted without question in all countries. I am happy to say that this reputation for our export trade has been held intact during the difficult war years.

Our organization expanded tremendously during the war. It was necessary to employ and train a great number of persons. This helped to focus our attention on the need for consolidating the large body of regulatory material governing the conduct of the inspection. Early this year we issued the revised set of meat inspection regulations, which brings up to date all previous regulations and includes some new material. The new regulations give our inspectors in the field a more effective working tool, and furnish inspected establishments and others with concise information concerning the responsibilities under the inspection.

You will be interested in the attention that has been done on some of the animal diseases that give special concern to the meat inspector. The regulations just referred to contain extensive material on the handling of animals and carcasses affected with anthrax. Epithelioma of the eye of cattle receives close attention. Guides for the disposition of animals and carcasses affected with this condition were worked out in close collaboration with laboratory research men of the Pathological Division of the Bureau of Animal Industry. Similar cooperative effort has been directed to the formulation of adequate regulations concerning swine erysipelas and vesicular diseases. The latter will be of particular interest to those of you who are located in areas where vesicular exanthema and vesicular stomatitis occur from time to time. The requirement for refrigeration of cattle carcasses showing infestation with cysticercus bovis has been modified to increase the period of refrigeration at 15°F.
from six days to ten days, and, as an alternative, the meat may be heated throughout
to a temperature of at least 140°F. Some small changes appear in other parts of the
ante-mortem and post-mortem regulations, but in the main, the regulations covering
such conditions as tuberculosis, actinomycosis, pneumonia, septicemia, and the
like remain unchanged.

There is always a tendency on the part of those who are subject to Government
regulation and others who are not inclined to give a program the necessary study
before giving expressions of opinion, to brand as technical many of the requirements
that are found by experience to be necessary in administering any regulatory law.
No doubt, this criticism is desirable, if not necessary, to remind the regulatory official
that the requirements should be those of necessity rather than of convenience.
The past war emergency has been of considerable assurance to us that although in
the aggregate the Federal meat inspection program appears to consist of a large
number of general and specific requirements, they are in fact all necessary to regulate
an industry of such great magnitude. These requirements are essential to assure
the production of clean meat from healthy animals, produced under conditions which
will assure its wholesomeness, and distributed under labels that are not misleading.

In closing, I want to express to you our appreciation for the fine cooperation that
has existed between the Federal and State livestock sanitary officials and the field
offices of our service. The combined efforts have accomplished much which
otherwise would have been left undone.
THE GENESIS OF BOVINE UDDER INFECTION AND MASTITIS: I. THE INCIDENCE OF STREPTOCOCCAL AND STAPHYLOCOCCAL INFECTION IN RELATION TO PREDISPOSING FACTORS

BY JAMES M. MURPHY, V.M.D.

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Through the maze of conflicting reports concerning the many aspects of the bovine mastitis problem, one point on which many investigators agree is the greater prevalence of streptococcal udder infection in older than in younger cows (Bendixen (1), Klein and Learmonth (12), Plastridge et al. (25), Seelemann (28), Schalm (29), and others). Just why the incidence of streptococcal infection should increase with age has not been shown, but aside from the general consideration that it may be due to the degree of exposure (Udall (32)), there are several possible explanations based on the existence of predisposing factors. These include the greater chance for injury provided by each succeeding lactation period (Bendixen (1)), incompetency of the closing mechanism of the teat (Davis (4), Johnston (9), Little (15)), the occurrence of "nonspecific mastitis" (Peterson and Hastings (24)), the effect of hormones (Francis (7)), and the necessity for prior sensitization (Jones and Little (11), Little (14)).

With the udder staphylococci the picture is somewhat different. Although staphylococci have been regarded, since the earliest work on milk bacteriology (26), as constituting the major part of the so-called "normal udder flora," little serious attention has been given to them except when they have been found to cause mastitis. With the exception of the data obtained by Bendixen (1), which showed that staphylococcal infection of the udder did not follow the increasing-with-age pattern shown by the streptococcci, there appears to be no information on the comparative incidence of streptococcal and staphylococcal infection in cows of different ages under natural circumstances.

The analysis reported in this paper, based on seven years' observation of an experimental herd of milking cows, was made in order to add to our knowledge of the genesis of udder infection.

METHODS

All examinations were made in the herd of the Dairy Research Station of the New Jersey Agricultural Experiment Station. This herd, composed of approximately 120 milking animals equally divided between the Guernsey and Holstein breeds, is maintained for experimental purposes and has been virtually self-contained for the duration of this study and for at least the three preceding years.

General Plan of Study

Since November 1, 1937 this herd has been under continuous observation according to the following plan:

1 Journal Series Paper of the New Jersey Agricultural Experiment Station, Rutgers University, Department of Dairy Husbandry.
(a) Samples of colostrum (10 to 20 cc.) were drawn aseptically from each quarter of each cow prior to calving and were examined bacteriologically.

(b) Beginning seven to ten days after parturition, a sample of strict foremilk (20 cc., none discarded prior to sampling) was obtained from each quarter at 30 to 60 day intervals throughout the lactation period and was examined both bacteriologically and biochemically.

(c) Every day, before the afternoon milking, each udder was examined superficially for injury and swelling, and the foremilk was examined for gross abnormality by means of a strip-cup.

(d) Each udder was examined at about 90-day intervals by means of the Udall system of udder physical examination (32).

(e) If any of the aforementioned examinations revealed any new infection or any departure from the usual on the part of a quarter or its secretion, strict foremilk was drawn every afternoon from the quarter or quarters involved until all desired information was obtained. These samples were examined bacteriologically and biochemically.

**Sampling and Basic Procedure**

The udder was washed with sodium hypochlorite solution and the ends of the teats scrubbed with alcohol-saturated cotton just prior to aseptic collection of the quarter samples of strict foremilk by the author. The milk was examined culturally by plating one cc. of a 1–20 dilution in 12 cc. meat infusion blood agar (bovine blood). Plates were inspected after 24 hours' incubation at 37°C., and colonies were removed to fluid medium after 48 hours’ incubation. Suitable identification measures were applied to such broth cultures.

**Interpretation of Infection**

The results of the bacteriological examinations were divided as previously reported into four groups.

(a) Uninfected: samples containing fewer than 200 staphylococci per cc., or non-hemolytic udder diphtheroid bacilli in any number.

(b) Staphylococcus-infected: samples containing 200 or more staphylococci per cc., alone or in combination with nonhemolytic udder diphtheroid bacilli.

(c) Streptococcus-infected: samples containing streptococci, alone or in combination with staphylococci or nonhemolytic udder diphtheroid bacilli.

(d) Miscellaneous-infected: samples containing bacteria other than streptococci, staphylococci, or nonhemolytic udder diphtheroid bacilli.

**Analysis of Data**

In this analysis the bacteria have been referred to by their generic names only, regardless of the fact that many of them have been identified as to species. The staphylococci encountered were of both the hemolytic (*Staphylococcus aureus*) and nonhemolytic types. The streptococci were of Minett's groups I, II, and III. At any one time, at least 90 percent (and usually 95 percent) of the streptococci were of Minett's group I (*Streptococcus agalactiae*).
The incidence of infection was calculated in two different ways: by lactation periods, and as the percentage of the milking time occupied by infection.

In the first case, a lactation period was classed as infected if at any examination (other than colostrum) during that particular period the foremilk of one or more quarters was found to conform to the designation "streptococcus-infected" or "staphylococcus-infected." By this method of analysis, many lactation periods were classed as "streptococcus-infected" and also as "staphylococcus-infected," and thus they contribute to the incidence of each type of infection as though they were separate lactation periods. For this reason, the data pertaining to the incidence of streptococcal and staphylococcal infection by lactation periods cannot be combined to express the total incidence of infection.

In the second case, each lactation period, composed of the record of each of four udder quarters, was divided into a first, middle, and last third. Thus each lactation period record was actually divided into twelve parts \((\frac{1}{12}\)'s\) and each \(\frac{1}{12}\) was rated as "streptococcus-infected," "staphylococcus-infected," or "uninfected." In this way a figure was obtained which represented the percentage of the milking time occupied by a particular type of infection. Such figures representing streptococcal infection and those representing staphylococcal infection can be combined to represent the total percentage of the milking time occupied by streptococcal and staphylococcal infection.

RESULTS

During the seven years covered by this report, a deliberate attempt was made to keep the herd free of practices which might be expected to change significantly the incidence of udder infection. Four hundred and fifty-one complete lactation periods of 205 individuals were studied, and the records range from one complete lactation on some cows to as many as five consecutive complete lactations on others. There were 119 first, 96 second, 66 third, 66 fourth, 48 fifth, 28 sixth, 15 seventh, eight eighth, three ninth, and two tenth lactation periods. Because of the small number of sixth and higher lactation periods only the first five have been used. Thus this analysis was based on 395 complete lactation periods of 195 individuals involving the bacteriological examination of 15,000 samples of strict foremilk.

In figure 1 is shown the percentage of lactation periods that were classed as streptococcus or staphylococcus-infected in each of the first five lactation period groups. The incidence of streptococcal infection increased in almost a straight line from 14 percent of the first lactation periods to 58 percent of the fifth lactation periods (14.3, 28.1, 28.8, 46.2, and 58.3 percent respectively). The incidence of staphylococcal infection, although fluctuating slightly, stayed within a narrow range of 77 percent through all five lactation periods (79.0, 74.0, 72.7, 83.1, and 79.2 percent respectively).

In figure 2 is shown the percentage of the milking time occupied by streptococcal and staphylococcal infection. Streptococcal infection existed in only 2 percent of the total milking time of the first lactation periods, and increased to 27 percent in the fifth lactation period (2.0, 5.5, 8.6, 16.1, and 27.2 respectively). On the same basis the incidence of staphylococcal infection remained very constant at about 29 percent during all five lactation periods (25.6, 29.6, 28.8, 32.3, and 29.5 respectively).
FIG. 1. The percentage of lactation periods classed as streptococcal or staphylococcal infected

FIG. 2. The percentage of the milking time occupied by streptococcal and staphylococcal infection

DISCUSSION

The increasing-with-age incidence of streptococcal infection of the udder has been observed so often that it can now be accepted more or less as a rule. Perhaps the most extensive data of this kind were compiled by Seelemann (28) who found, from
the examination of 6,834 cows, that 8.6, 30.1, 42.0, 44.1, and 51.7 percent respectively of the animals in their first to fifth lactation periods were infected with streptococci. The comparable figures from the present study are 14.3, 28.1, 28.8, 46.2, and 58.3 percent. Although obtained as the result of the examination of cows many times during complete lactation periods, rather than from single examinations, these figures are remarkably similar to those of Seeleman.

It is well known that only one quarter or several quarters of an udder may be infected, that infection may occur at any time during the lactation period, even that infection is not always permanent, so that figures denoting the incidence of infection are not so accurate when based on one or two examinations as when based on many, and would be far more accurate if stated as the percentage of the milking time during which the udder as a whole was infected. Thus a comparison of figures 1 and 2 shows that the incidence of streptococcal infection per lactation period rose from 14.3 percent in the first period to 58.3 percent in the fifth period, a fourfold increase. Similarly, but to a greater degree, streptococcal infection as the percentage of the milking time increased from 2.0 percent in the first lactation period to 27.2 percent in the fifth period, an increase of almost fourteenfold. This shows that not only does the incidence of streptococcal infection per cow increase with age, but both the number of quarters infected and the duration of the infection also increase.

Although the increasing-with-age pattern shown by streptococcal infection can be accepted, none of the theories advanced by way of explanation has been accorded any degree of acceptance. These theories, in general, concern themselves with predisposing factors because the naturally occurring increasing-with-age pattern suggests the existence of such factors, and also because of the well-known difficulties attending attempts to establish streptococcal infection by artificial means in the face of the general acceptance of the teat canal as the natural portal of entry.

Perhaps the most popular of these theories is that injury to the tip of the teat is a major factor in bringing about streptococcal infection of the udder. Bendixen (1) found that most of the teats that showed evidence of injury were infected with streptococci, and this led him to suggest that the increasing opportunity for teat injury provided by each succeeding lactation period might largely explain the increasing-with-age pattern. He pointed out, however, that streptococcal infection was also present in teats showing no evidence of injury. Approaching the problem from another point, Ferguson (6) made a comprehensive investigation of the type of infection following obvious injury (natural) of 283 teats, and found streptococcal infection in 72 percent of the cases. In only 24 percent of the cases, however, was the infecting organism *Streptococcus agalactiae*. In the present study, in which at any time at least 90 percent of the streptococcal infections were due to *St. agalactiae*, obvious injury occurred so infrequently that it could not possibly have coincided with the incidence of streptococcal infection. It appears reasonable to conclude therefore, as did Christiansen and Nielsen (3), that although obvious injury of the teat undoubtedly plays a part in the genesis of udder infection, it is not the major factor involved.

Closely allied to the injury theory (which in itself often supposes some degree of incompetency of the closing mechanism) is the matter of teat patency. Davis (4), Johnston (9), and Udall (32) have suggested that incompetency of the closing
mechanism of the teat might be responsible for an increased passage of microorganisms into the teat. The author (21) has observed that the incidence of streptococcal infection was higher in glands the teats of which were judged to be patent than in those the teats of which were judged to be nonpatent. Because of the lack of a satisfactory method by which to determine the presence of patency, the author was unable to obtain data either in support of, or in contradiction to, the suggestion of Little (15) that the incidence of teat patency might increase with each lactation period as a result of the constant forcing of milk through the teat opening, and might thereby aid in the explanation of the increasing-with-age pattern of the streptococci.

“Nonspecific mastitis” has been suggested by Peterson and Hastings (24) as a primary or predisposing condition following which Str. agalactiae causes chronic mastitis as a secondary invader. Inasmuch as the true nature of “nonspecific mastitis” has not yet been determined, it is not possible to discuss it in relation to the increasing-with-age pattern shown by the streptococci.

Similarly Francis (7), in a theoretical discussion of the pathogenesis of chronic bovine mastitis, concluded that the possibility of the existence of a hormonal (particularly estrogen) disturbance of the udder constituting a precursor to subsequent streptococcal infection was worthy of further consideration. Although Reece and Murphy (27) have shown that synthetic estrogen (diethylstilbestrol dipropionate), when administered to milking cows in advanced lactation, caused a reduction in milk yield and caused the milk to become macroscopically abnormal in a manner similar to that seen in chronic mastitis, there are no observations available at present on which to connect the action of hormones directly to the incidence of streptococcal infection.

Many experiments (18) have shown, in general, that (1) the inoculation of large numbers of streptococci into the teat cistern results in infection in a majority of cases, (2) the external application of streptococci to the artificially injured teat results in infection in a majority of cases, and (3) the external application of streptococci to the intact teat meatus often fails to result in infection. In the face of these experiments, Christiansen and Nielsen (3), Jones and Little (11), and Little (14, 15) have very carefully studied the problem of artificial infection of the udder. Their results were in agreement with most previous work and added three important points: the ease with which infection took place following the nontraumatic introduction of streptococci into the teat cistern appeared to depend on the number of organisms introduced; by the external application of streptococci to the intact teat, infection occurred more readily when cultured material (usually containing millions of streptococci per cc.) was used than when noncultured material (usually containing less than 50,000 streptococci per cc.) was used; and infection was more difficult to produce in a heifer than in cows by external application to the intact teat meatus. It was suggested by Jones and Little (11) that the udder must first be sensitized to streptococci before the organisms could become established, and Little (14) considered that certain of his results confirmed this suggestion. Nevertheless, these observations appear to relate more nearly to the increasing-with-age pattern of the streptococci on the basis of the general theory that the pattern is due to the degree of exposure provided by succeeding lactation periods.
Thus far the efforts to explain the increasing-with-age pattern of the streptococci have revolved largely around experiments and observations concerning the streptococci only. The streptococci, however, are not the only bacteria having been found to live within the udder. Various forms of staphylococci (including micrococci, etc.) have long been recognized in aseptically drawn milk from the bovine udder; in fact such organisms are found so frequently that many believe they are present in all mammary glands. Plastridge et al. (25) have amply reviewed the literature pertaining to the general subject of staphylococcal infection of the udder.

The staphylococci that are present in aseptically drawn milk are coming to be recognized as definite inhabitants or infections, rather than as chance contaminants not actually residing in the udder. Thus Bendixen (1), Plastridge et al. (25), Bull et al. (2), Murphy et al. (19, 20, 21, 22, 23), and others have shown that not all quarters harbor staphylococci and that the same organism can be recovered from various fractions of milk or by repeated testing. There is a great tendency to divide the staphylococci, however, into pathogenic and nonpathogenic forms, inasmuch as several workers have demonstrated that a rather clear division exists, and that this division is correlated with certain specific cultural characteristics, notably the ability or inability to hemolyze bovine erythrocytes. The hemolytic varieties, being more pathogenic, are receiving much greater attention. This is probably entirely justified on the basis of the public health and the control of clinical mastitis, but Shattock (30) and Murphy (20) have both warned that the establishment of staphylococci (whether pathogenic or nonpathogenic) in the udder should not be ignored. One reason is of importance here: that somewhere in the process of becoming established in the udder, and in maintaining themselves there, the streptococci and the staphylococci might show differences as well as similarities, and therefore the study of the two forms in the same way and in the same individuals might aid in the study of the genesis of udder infection in general. Such an observation, apparently of definite significance, has been the result of the present investigation: while streptococcal infection increased with age, as has so often been demonstrated, staphylococcal infection remained constant for five lactation periods at about 77 per cent on a lactation period basis and at about 29 per cent on the basis of the percentage of the milking time.

In attempting to interpret our own results, as well as those of other workers, we have had to change our conception of bovine mastitis (in the general sense) as it pertains to all conditions in which the portal of entry of the invading microorganism is the teat canal. The acceptance of the teat canal as the portal of entry for the streptococci is well founded, but very little is known regarding the portal of entry in the case of staphylococcal infection. Evidence to support the assumption that the teat canal is the portal of entry, however, is accumulating (13, 16, 17, 18), and in our own work we have found nothing to dispute this. The present discussion is based, therefore, largely on the assumption that the teat canal is the common portal of entry of both the streptococci and the staphylococci.

Bovine mastitis in the general sense is usually divided into two phases: the infection phase in which a pathogenic microorganism is present in the udder, and an inflammation (mastitis) phase in which the composition of the udder secretion is changed and (or) the tissues are pathologically altered. In our investigations into
the genesis of bovine mastitis, we have found that the term "infection" as used to
describe the infection phase of the ordinary infection-inflammation concept is by
no means adequate. The inadequacy rests on the requirement of the definition
of the word "infection" that tissue be invaded and that the invader be pathogenic.
By common usage, the word "infection" has been applied when such organisms are
found in aseptically drawn milk, but no satisfactory evidence has been presented
to show that tissue is actually invaded. When aseptically drawn milk is subjected
to bacteriological examination in or on agar culture media without prior incubation,
therefore, one is usually observing the microorganisms that have successfully in-
vaded the udder cavity and have reproduced therein sufficiently to be detected.
Furthermore, to require that the microorganisms so detected possess pathogenic
properties in order to be referred to as an "infection" would be to overlook the fact
that nonpathogenic microorganisms detected under such circumstances must have
been able to surmount the same obstacles as did the pathogenic microorganisms.
The only alternative would be to refer to the presence of pathogenic microorganisms
as an "infection" and to find another word by which to refer to the presence of
nonpathogenic microorganisms. Inasmuch as actual invasion of tissue has not been
demonstrated in ordinary udder "infection," and inasmuch as either pathogenic or
nonpathogenic microorganisms can invade the udder cavity and reside therein, a
common word is needed by which to designate this condition. We consider that
the proper word for this condition or phase is inhabitation because there is no reason
to believe at present that pathogenicity per se has any bearing on the ability of a
microorganism to gain entrance to the cavity of the udder and to multiply therein.
In view of the widespread use of the term "infection" in this connection, it is not
considered desirable to recommend a change to the term "inhabitation" at this time.
It should be sufficient to continue to use the term "infection," but to use it in the
broader sense of "inhabitation."

In order to gain entrance to the udder cavity, microorganisms must presumably
surmount certain obstacles and be subjected to certain forces that appear to be of
significance as aids or barriers to their entrance. Attention can only be drawn to
these by creating a separate phase that we shall call the "invasion phase." Thus
by the use of a three-phase concept of invasion-infection-inflammation, the genesis
of bovine mastitis can be studied more logically.

From the standpoint of the microorganism involved, the invasion phase should
be more or less mechanical, involving transportation to the teat and passage into
the interior of the udder. Once having reached the interior of the udder, the in-
vasion phase is completed, and the invader, regardless of the possession of patho-
genic ability, must be able to remain and pursue its vital life processes in the en-
vironment provided by the interior of the udder. Merely gaining entrance to the
udder cavity should not be considered to constitute "infection." Inflammation,
being the reaction of the tissues to injury (in this case by the bacteria or their prod-
ucts), probably will not develop to any great extent until infection has become
established to the point that the organisms are free to exert whatever pathogenic
ability they possess.

From the standpoint of the udder, the invasion and infection phases must be
largely passive in that the invading microorganisms are merely meeting, and finding
themselves capable or incapable of surmounting, conditions already present. Once infection is established, however, the body may take a very active part in attempting to neutralize or overcome the pathogenic manifestations of the infecting microorganisms (inflammation phase).

When the teat canal is the portal of entry, the three phases must follow in the order named, and are of genetic importance in the order named. Though the infection phase is observable, at least in part, by the use of bacteriological procedures, and the inflammation phase is observable by means of various physical and biochemical determinations on the gland and its secretion, the invasion phase, as it occurs naturally, is not directly observable by any means at our disposal at the present time. We must make use of the infection phase and artificial infection experiments, therefore, and draw from their study any conclusions that are referable to the invasion phase as it occurs naturally. In doing so, it is entirely right (and in fact necessary for the sake of clarity) to disregard the inflammation phase, since this phase must follow the other two in any case where infection is involved.

One can assume, without hesitation, that the tip of the teat is in almost constant contact with staphylococci, inasmuch as these organisms are widely distributed in nature and are common inhabitants of the skin and mucous membrane of animals. \textit{Str. agalactiae}, on the other hand, is usually considered to be confined to the bovine udder and to surroundings contaminated by the secretion from infected glands. Even though good evidence has recently been advanced (8) suggesting that the prevalence of \textit{Str. agalactiae} is more widespread than was formerly supposed, there is still reason to believe that exposure of the teat is much greater in the case of the staphylococci than in the case of \textit{Str. agalactiae}. Streptococci other than \textit{Str. agalactiae} are probably in as constant contact with the tip of the teat as are the staphylococci. This is substantiated by Ferguson's (6) finding that infection with such streptococci constitutes the major result of injury to the tip of the teat.

In nature, it is probable that only small numbers of any particular organism would be present at any time at the external meatus of the teat, and artificial infection experiments show that small numbers of pathogenic organisms placed at the uninjured external meatus of the teat, or in some cases even placed directly through the teat canal, only occasionally result in the establishment of infection. The force or forces that bring about the passage of the bacteria from the external meatus through the teat canal to the teat sinus probably would act equally on the staphylococci and streptococci, inasmuch as these organisms are similar in size, general cultural characteristics, and so forth. Whether the force is suction, as suggested by Davis (4), and at least partly demonstrated by Johnston (9) and by Little (15), or something as yet undetermined, should not apply to one organism much more than to another.

The passage of bacteria into the teat canal might, quite reasonably, be aided by injury to the tip of the teat and by teat patency. It has been shown above that obvious injury to the tip of the teat would not explain the increasing-with-age incidence of general streptococcal infection, and of course, it would not explain the constant incidence of staphylococcal infection of the udder. On the other hand, teat injury usually results in infection of the gland with streptococci other than \textit{Str. agalactiae} even though the overall incidence of this type of infection is often
very low (6). Thus it appears that obvious injury per se plays little part in the genesis of staphylococcal and *Str. agalactiae* infection of the udder, whereas it is probably of significance in the genesis of infection with streptococci other than *Str. agalactiae*. This conclusion is also shared by Ferguson (5). Any incompetency of the closing mechanism of the teat remaining after healing of a wound would, of course, fall into the realm of teat patency.

Teat patency has been shown (21) to be correlated with a greater incidence of streptococcal infection, but at the same time it was correlated with a greater incidence of staphylococcal infection. Thus there can be little question that teat patency aids whatever force or forces are responsible for the passage of microorganisms into the teat cavity. However, inasmuch as teat patency apparently aids both streptococcal and staphylococcal infection, and inasmuch as streptococcal infection increases with age whereas staphylococcal infection has a constant age incidence, it appears at present that Little's (15) suggestion that increasing incompetency of the teat meatus with age might explain the increasing-with-age pattern of the streptococci is without foundation.

There is, obviously, much more to the invasion phase than can be appreciated from the information at our disposal at present. For example, the anatomical features that exist, and the physiological forces that operate to allow or aid the streptococci and staphylococci to gain access to the teat cavity, would most certainly not prohibit the many other bacteria in the cow's environment from also entering. It has long been a practice, when collecting foremilk aseptically for bacteriological study, to discard an unmeasured amount of milk before taking the sample to be used. This practice appears to have grown out of a belief that the very first milk drawn from a quarter is likely to be contaminated with bacteria from the exterior of the teat, from the teat canal, or from the teat cistern itself. It has been shown, however, that when the udder and the external teat meatus are properly cleaned the very first milk (strict foremilk) does not contain a miscellaneous assortment of bacteria (19, 31) and that such milk is more suited to the study of udder infection than is foremilk (in the usual sense) (19). It is probable, therefore, that many different kinds of organisms in small numbers are entering the teat canal more or less constantly, but that the number of these organisms is so small that they ordinarily are not demonstrable by the cultural methods usually employed (plating of fresh milk). What the usual careful cultural methods generally show, therefore, is the bacteria that have reproduced sufficiently to be seen.

This leads to the main problems faced by the bacteria in the infection phase: to remain within the udder and to reproduce. That only a few of the myriad bacteria present in the environment of the cow are ever able to remain in the udder, and to reproduce sufficiently to be seen by the usual methods, has surely been apparent to many investigators. As Jones and Little (10) have said, "It is clear that the udder contains a relatively limited flora of organisms which have adapted themselves to their environment. The organisms usually encountered are streptococci and various types of micrococci."

Jones and Little (10) and Johnston (9) have suggested that the flow of milk from a quarter, as long as the cow is milking normally, will tend to check the establishment of infection by the removal of the invading organisms. Johnston considered
that this action would be more or less efficient according to the opportunities afforded for the lodgment of the bacteria, such as the normal irregularities in the surface of the lining mucous membrane of the teat and any pathologically altered areas such as abrasions. Recent studies (23) have shown that there is no correlation between the natural occurrence of streptococcal and staphylococcal infection and the degree of normal surface irregularity of the teat mucous membrane, but nothing is known of the relation between pathological alteration of the mucous membrane and the establishment of udder infection. Nevertheless, the periodic outward flow of milk must be a factor in limiting the establishment of infection in the udder. In this respect bacterial multiplication would probably be of importance also, inasmuch as the greater the number of a particular invader, the greater chance there would be for it to survive the outward flow of milk.

Perhaps the main reason why so few of the bacteria and other microorganisms present in the cow's environment are able to become established in the udder is that they must be able to pursue their vital life processes in the environment provided by the interior of the udder (and teat). Thus such factors as the oxygen concentration, the kind and amount of nutrients, and the temperature provided might be very effective in prohibiting many microorganisms from infecting the udder. Furthermore, Jones and Little (10) have pointed out that it is probable that many bacteria capable of multiplying in milk, such as some members of the intestinal and vaginal flora, frequently come in contact with the teat, yet relatively infrequently are encountered in the udder. These investigators were able to demonstrate that there was present in the milk of all the cows they examined a substance which inhibited the growth of mastitis streptococci. They were also able to demonstrate that the milk of cows which had been in the herd for several years and had no history of mastitis possessed greater inhibitory power than did the milk of a group of cows which had had several attacks of mastitis. It is entirely possible, though not supported by any evidence, that the resistance to udder infection and mastitis observed by Murphy et al. (22) was related in some way to this inhibitory power. It is of importance to note that the resistance to udder infection in this case applied to both streptococcal and staphylococcal forms, that is, "susceptible" cows showed a greater incidence of both streptococcal and staphylococcal infection than did the "resistant" cows.

Thus it is in the infection phase, not in the invasion phase, that we must look for any major predisposing factors or for an explanation of the difference in the age incidence of streptococcal and staphylococcal infection. If this difference is not due to a difference in the degree of exposure, then some condition—the prior occurrence of "nonspecific mastitis", prior sensitization to streptococci, the action of hormones, or some other condition—must arise which would aid, or be necessary for, the natural establishment of Str. agalactiae as an udder inhabitant. This could mean, of course, that a fundamental difference exists in the genesis of these two forms of udder infection but such should not be assumed on the basis of present evidence. The facts indicate, however, that a closer scrutiny of the relationship of age to the incidence of streptococcal and staphylococcal infection might reveal information of significance.
Data are presented which confirm and strengthen the often-observed increasing-with-age pattern shown by natural streptococcal (Streptococcus agalactiae) infection of the udder.

Data are also presented which demonstrate that naturally occurring staphylococcal infection does not follow the increasing-with-age pattern shown by the streptococci, but remains at a relatively high level throughout succeeding lactation periods.

The current theories advanced in explanation of the increasing-with-age pattern of the streptococci, and the genesis of udder infection in general, are reviewed and discussed at length in relation to the constant-with-age pattern of the staphylococci.

A three-phase concept (invasion-infection-inflammation) of the genesis of bovine mastitis in the general sense is advanced in place of the present two-phase concept (infection-inflammation). In the three-phase concept the meaning of the word "infection" has been broadened to have the meaning of "inhabitation."

It is shown that obvious injury to the teat and teat patency can, at best, play only minor roles in the genesis of udder infection. The data suggest that if a major predisposing factor exists it operates in the infection phase, not in the invasion phase. It is further indicated that a closer scrutiny of the relationship of age to the incidence of streptococcal and staphylococcal infection might reveal information of significance.

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REFERENCES

REPORT OF COMMITTEE ON MEAT AND MILK HYGIENE

M. O. BARNES, Chairman, Olympia, Wash.; M. BARKER, Ottawa, Ontario, Can.;
W. L. Boyd, St. Paul, Minn.; J. S. Koen, Storm Lake, Ia.; JOHN R. MOHLER,
Washington, D. C.; A. F. SChALK, Columbus, O.; E. H. WILLERS, Honolulu,
T. H.

During the past four years our entire efforts have been fully engaged in supplying
our Armed Forces, the Armies of our Allies and our civilian population with an
adequate ration of foods of animal origin. That these efforts were successful is
a well established fact. The livestock industry of our nation expanded to meet
that need.

Looking forward into the future we are faced with the certainty that it will be
necessary to look for new and different markets if the high production levels of the
past few years are to be maintained. There is no surer method, in our opinion,
than to increase the per capita consumption of meats, poultry and dairy products
in this country. We feel that one of the best ways to accomplish this increase is
to market higher quality, more wholesome food products.

We should make every possible effort to stimulate interest in extending meat
inspection to small cities, towns and rural areas in the United States. We would
like to call to the attention of this Association the outline for a model code as
suitable for adoption by States, Counties or Municipalities, which was recently
prepared by the Committee on Food Hygiene of the A.V.M.A. This outline is to
be made available to every community interested in local meat inspection legislation.

There is a fast moving change in the marketing methods for dressed
poultry. The trend is for the eviscerating of poultry at the dressing stations far from the
larger markets and after immediate quick freezing, it is shipped through trade
channels to the consumer. There is the possibility now, to extend competent
post-mortem inspection to the poultry marketing industry. We should take
advantage of this opportunity.

We recognize that the highest quality dairy products cannot be manufactured
from a poor quality milk. There is a very definite need for improving the quality
of milk produced on the farm. In this there is a well marked place for the vet-
erinarian. A concerted effort should be made to encourage the veterinarian in
this public health work and he should have an opportunity both in under-graduate
and post-graduate study to prepare himself for the milk and meat hygiene field.

In order to bring further emphasis to this Committee's report of last year we
again recommend that as quickly as possible the fluid milk industry discontinue the
practice of bottling for human consumption so-called "emergency milk."

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THE RESPONSE OF INDUCED AND NATURAL EIMERIA TENELLA INFECTIONS TO SULFAGUANIDINE

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In the study of Eimeria tenella infections at the University of Delaware Substation it quickly became apparent that certain differences existed between artificially induced and natural caecal coccidiosis in chicks. These differences made necessary certain changes in the procedure followed when a treatment was transferred from induced to natural infections. In describing these differences the pens treated with sulfaguanidine will be used because this drug gave high protection from losses and symptoms compared to the commonly used treatments and no treatment in inoculated chicks.

INDUCED COCCIDIOSIS

The sporulated oocysts used in the inoculation experiment were obtained and prepared for use as follows: caeca were obtained from chicks that died of Eimeria tenella infection. The caecal pouches were opened and dropped into a 2.5 percent potassium dichromate solution and held near 80°F. for several days. The progress of sporulation was followed by frequent microscopic examinations. The number of sporulated oocysts fed per chick was approximated roughly by counting the sporulated oocysts in one drop of the suspension and multiplying by the volume, allowing 20 drops for each cubic centimeter. Enough of this suspension was used to allow 50,000 sporulated coccidia per chick. This material was thoroughly mixed in a wet mash and five pounds were placed in each pen of 150 chicks. Results indicated that a satisfactorily uniform dosage was obtained.

Beginning at 48 hours after inoculation one pen of 150 chicks one week old received one percent sulfaguanidine in the mash for five successive days, while a similar pen of 150 chicks received coccidia but no treatment. On the fifth day after inoculation 2.7 percent of the treated chicks died of caecal coccidiosis, while 80.0 percent of the chicks died in the untreated pen. Treatment for five consecutive days extended through the expected period of losses on the fifth and sixth days after inoculation.

At four weeks of age the surviving chicks in these pens were given a second dose of 50,000 sporulated oocysts with no treatment. No symptoms or losses occurred. A similar pen of susceptible chicks of the same age were given 50,000 sporulated coccidia without treatment. A mortality of 83.3 percent followed. A complete immunity was present in all the chicks subjected to a second inoculation without a second treatment. The results of this experiment are presented in Table 1.

The ability to check the infection with sulfaguanidine after inoculation with development of resistance to later exposure is at variance with the conclusions of Levine, 1941 (2), (3). He stated that sulfaguanidine had no curative effect on chicks already affected, and that the administration of sulfon drugs must precede infection, they are valueless after infection has taken place.
NATURAL COCCIDIOSIS

With sulfaguanidine producing outstanding control from caecal coccidiosis in inoculated pens of chicks it seemed logical that a large part of this protection could be transferred to flocks exposed to the natural infection. A series of trials were initiated in pens of 900 broiler cross chicks which were housed, fed and managed in a manner found typical in commercial flocks of broilers in Delaware.

The 0.5 percent dosage of sulfaguanidine reported promising by Allen and Farr, 1943 (1) was used in one pen for 10 consecutive days beginning with the appearance of symptoms at 41 days of age. Two groups of losses from caecal coccidiosis occurred. The first loss occurred between 41 to 45 days of age and the second between 64 to 67 days of age, the latter beginning 12 days after the termination of the sulfaguanidine feeding period. Caecal coccidiosis losses in this pen amounted to 2.6 percent.

In a second pen sulfaguanidine was fed at the rate of 0.75 percent for ten consecutive days beginning with the appearance of symptoms at 41 days of age. Caecal coccidiosis losses were recorded from 39 to 45 days of age and again from 67 to 71 days of age. The second group of losses began 16 days after the termination of the treatment. Coccidiosis losses totaled 1.6 percent.

A third pen was given 0.5 percent sulfaguanidine for one day every third day beginning at 28 days of age, which preceded the appearance of symptoms. Symptoms appeared in the form of numerous bloody droppings at 43 days of age at which time a 10 day continuous feeding of 0.5 percent sulfaguanidine was begun. One death from caecal coccidiosis occurred at 41 days of age, 6 on the 45th and one on the 51st day of age. Severe losses began 10 days after termination of treatment at 62 to 72 days of age. Losses from caecal coccidiosis totaled 18.8 percent in this pen.

A fourth pen received 0.75 percent sulfaguanidine every third day beginning at 28 days of age, which preceded the appearance of symptoms, and was continued until the termination of the disease in the untreated control pen. The last treatment was given at 49 days of age. Losses began on the 50th day of age and continued to the 72nd day of age for a total of 6.7 percent mortality from caecal coccidiosis. This schedule of intermittent feeding appears to have prevented infection during the treatment period and resulted in the birds remaining susceptible.

<table>
<thead>
<tr>
<th>TABLE 1.—The effect of sulfaguanidine on induced caecal coccidiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TREATMENT</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1% sulfaguanidine, 9 to 14 days of age</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>None</td>
</tr>
</tbody>
</table>
Due to the failure to establish resistance or immunity in all the birds following the methods of treatment just described, further study was undertaken. Two pens of 900 chicks each were used, one receiving no treatment, and the other receiving one percent sulfaguanidine in the mash for one day at the first appearance of symptoms and repeated every fifth day for three treatments. Regular mash was fed on the four days between treatments. This schedule was based on the fact that severe hemorrhages appear on the fifth day of infection. Following the arresting of the disease with a one day treatment, four days were allowed for susceptible chicks to pick up the natural infection with the succeeding treatment being given before the fifth, or fatal day. In theory, this would allow a maximum number of chicks to pick up the natural infection between treatments, which is essential to the development of immunity.

The first treatment was given at 28 days of age on the appearance of the first death in the pen. The second and third 24 hour sulfaguanidine feeding periods were given at 33 and 40 days of age. Six days instead of four as planned elapsed between the second and last treatments. A total of three pounds of sulfaguanidine was used for the 900 chicks. In the treated pen 14 chicks or 1.6 percent died of caecal coccidiosis between 34 and 43 days of age. There were no further losses from this cause during the remainder of the growing period.

In the untreated control pen 64 or 7.1 percent died of caecal coccidiosis between 41 and 57 days of age. At 15 weeks of age the treated chicks averaged 3.71 pounds each and the untreated 3.36 pounds each. A total of 2577 pounds of broilers were sold from the untreated, and 3143 pounds were sold from the treated pen, a difference of 566 pounds in favor of the treated pen. Information on this experiment is presented in Table 2.

**DISCUSSION**

In artificially inoculated chicks the disease is in the same stage of development in each chick at the time treatment is given. Maximum benefit from the treatment is thereby obtained. In natural outbreaks exposure occurs in different chicks in the pen over a period of about two weeks. On any day during this period there are present in the flock susceptible chicks free of infection and chicks in all stages of the infection that would correspond to the first, second, third, fourth, and fifth, or fatal, day of infection in inoculated chicks. Treatment of long duration in a natural outbreak will benefit those few chicks in the right stage of the disease but will also prevent infection in the chicks not yet exposed. It appears essential that the successful application of the known highly effective drugs to natural outbreaks must consist of repeated treatments of short duration allowing sufficient time between treatments for the susceptible chicks to pick up the natural infection.

**SUMMARY**

Sulfaguanidine gave a high protection against losses in chicks receiving heavy doses of sporulated Eimeria tenella oocysts. Chicks surviving the initial inoculation with and without treatment were found to be completely immune to a second heavy inoculation without a second treatment.
In a natural outbreak a ten day feeding period of sulfaguanidine arrested the disease, but numerous susceptible birds remained, as evidenced by further losses after termination of the treatment.

The intermittent feeding of sulfaguanidine at a 0.75 percent level every third day beginning before symptoms appeared prevented infection with a severe outbreak of the disease occurring after termination of eight one day treatments.

One-half percent sulfaguanidine fed as a preventative every third day did not suppress symptoms or losses, but an additional 10 day feeding period arrested the outbreak. Further losses occurred after termination of treatment.

When one percent sulfaguanidine was fed for one day on the appearance of symptoms, and repeated five and 12 days later, mortality from caecal coccidiosis was reduced and the average weight per bird was increased in comparison to untreated controls.

### Table 2.—The effect of intermittently fed sulfaguanidine on caecal coccidiosis

<table>
<thead>
<tr>
<th></th>
<th>1% SULFAGUANIDINE</th>
<th>NO TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. chicks started</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>No. lost from caecal coccidiosis</td>
<td>14</td>
<td>64</td>
</tr>
<tr>
<td>Percentage of mortality from caecal coccidiosis</td>
<td>1.6</td>
<td>7.1</td>
</tr>
<tr>
<td>Age at first and last death, days</td>
<td>34-43</td>
<td>41-57</td>
</tr>
<tr>
<td>Age sulfaguanidine fed, days</td>
<td>28, 33, 40</td>
<td></td>
</tr>
<tr>
<td>Average weight per bird at 15 wks., lbs.</td>
<td>3.71</td>
<td>3.36</td>
</tr>
<tr>
<td>Total pounds sold</td>
<td>3,143</td>
<td>2,577</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

1. Sulfaguanidine is highly effective in controlling losses from Eimeria tenella in inoculated chicks.
2. In natural outbreaks the preventative effect of a continuous dosage of sulfaguanidine resulted in a high susceptibility of the chicks to Eimeria tenella following termination of treatment.
3. Intermittent feeding of sulfaguanidine promises to be the most effective method of controlling natural outbreaks.
4. Proper coordination of treatments with the course of the disease is essential to the successful use of sulfaguanidine in controlling losses from natural outbreaks of Eimeria tenella.

**REFERENCES**

1. **Allen, R. W., and M. M. Farr, 1943.** Sulfaguanidine as a prophylactic during the period of acquirement of resistance by chickens to caecal coccidiosis. American Journal of Veterinary Research, 4: 50.
3. **Levine, P. P., 1942.** Poultry disease control. Veterinary Medicine, 37: 68.
NEWCASTLE DISEASE IN NEW JERSEY

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During the winter of 1944-45, there were outbreaks of a respiratory disease in laying flocks in South Jersey which caused little mortality, and which occurred irrespective of vaccination against laryngotracheitis. At the time it was assumed that these were outbreaks of infectious bronchitis. In the light of further developments, however, it will be recalled that these outbreaks differed from bronchitis in that the drop in egg production was more precipitous and more nearly approached zero than is seen in the latter disease.

The first suspicion of a new disease was aroused when the chick season opened and with it appeared a bronchitis-like disease, followed by the development of the nervous symptoms already described for Newcastle disease.

Six live chicks from such a case were brought to the laboratory February 5, and three of them were autopsied that day. Brain material was collected aseptically from each of the chicks, spleen material from one, and liver tissue from the remaining two. Finally, tracheal exudate, one spleen, one lung, and the clouded air sacs containing yellowish exudate from the same three chicks were combined, ground with sand, and suspended in broth for filtration. On the following day, the three brain, two liver, and one spleen samples were suspended in broth, cultured, and each was inoculated into three 8-day-old embryonated eggs. The composite tissue and exudate suspension was passed through a Berkefeld V filter, cultured, and the filtrate inoculated into each of four eggs in a dose of 0.2 c.c. The eggs inoculated with one brain suspension were dead on the third day, as were those given the splenic suspension. Of the four eggs inoculated with the filtrate, one was dead on the second day, and the remaining three were dead on the third day. No active agent was recovered from the other two brain suspensions or from the two liver suspensions.

Two of the remaining three chicks died on February 6 and 10, respectively, and a virus was recovered from each. The sixth chick recovered. After some time it was bled and its serum tested for neutralizing bodies, as will be detailed later.

On February 14, a neutralization test was made in eggs. This showed that a virus suspension made from the serosa and the liver of an embryo dead from the original brain inoculation, and having a titre of $10^{-4}$, was completely neutralized by an immune Newcastle serum.

ROUTINE ISOLATION OF VIRUS

At this point (February 19) a consultation with Dr. R. A. Hendershott resulted in a decision to make a careful investigation of all suspicious outbreaks in order to determine the extent of Newcastle infection, and thereby supply the information...
necessary for regulatory procedure. Accordingly, brain or spleen samples, but usually both, and occasionally other tissues were collected from all live specimens of suspicious cases presented at the N.J. State Poultry Laboratory (Vineland) that served the area involved. Later, when suspicious cases were presented at New Brunswick the same procedure was followed. It should be made clear here, however, that tissue samples were collected regardless of the stage in the course of the disease just as long as the bird was alive.

Brain samples were collected by means of a Pasteur pipette, and spleen samples in like manner or, in the case of chicks, merely by aseptic removal of the whole spleen with sterile forceps.

Samples were held in a frozen state until suspended for inoculation, at which time a small quantity of suspension was streaked on agar. About 1 c.c. of broth was aspirated into a pipette and released in the tube containing the tissue, but only after the tip of the pipette had been used to crush the tissue against the side of the tube. Sometimes the inoculations were made before the results of sterility tests were known. In other cases, the suspended tissues were refrozen until agar plates had incubated.

Eggs were usually set twice a week to insure a continuous supply for inoculations, likewise made twice a week. For the most part the eggs were 10 or 11 days old, but on rare occasions 8-, 9-, or 12-day-old ones were used.

Tissue suspensions were not centrifuged, and usually each suspension was inoculated into three eggs. The dose was approximately 0.1 c.c., given through the chorioallantoic membrane. Inoculated eggs were usually candled morning and evening for the first two or three days after inoculation and thereafter only once a day. In the beginning, incubation was continued through the twenty-first day, and the chicks were destroyed; but later, all eggs containing living embryos were opened on the seventeenth to the twentieth day of incubation and the embryos destroyed. In only two cases were eggs incubated for as short a time as 6 days after inoculation.

Whenever possible, eggs were harvested on the day the embryos died, but occasionally there was a delay of one or two days. Every dead embryo was cultured, and the liver and occasionally the serosa were reserved for further inoculation.

If all the embryos inoculated with a given tissue suspension died, and if the bacteriological examination was negative, it was assumed that Newcastle virus was responsible for the deaths. That this assumption was justified is evidenced by the fact that in all subsequent passages all embryos continued to die, and usually, in a somewhat shorter time. Moreover, in all neutralization tests the virus was inactivated by an immune serum.

In those cases in which, of the three or four embryos inoculated, only one died, the liver suspension of this one was passed repeatedly until every embryo lived through at least 6 days' incubation. When two of three embryos died, if reinoculation of one of them failed to yield an active agent on further passage, a liver suspension of the other was used to continue the passages. The only exception to this procedure followed the observation that embryos dead within 24 hours in primary passages always gave negative results, and therefore reinoculations from such embryos occasionally were omitted.
Here we wish to point out that no reinoculations with material from living embryos were made to carry out the so-called "blind" or "faith" passages as described by Beach (1). Our object was to make a diagnosis as soon as possible, and the isolation of a virus by "blind" passages can be an endless process. Incidentally, Beach makes no statement as to the time at which material was harvested from live embryos to carry out the next inoculation. Since he asserts that the virus kills the embryo in from 24 to 96 hours, it is possible that longer incubation might have resulted in death of some of the embryos and hence earlier isolation of the virus from these. We shall cite cases of recovery of the virus from embryos dead after 96 hours.

Whether a higher percentage of isolations would have resulted had we carried out blind passages cannot be determined. On the other hand, we believe that, since several tissues were examined from each suspicious outbreak, the chances of recovering the virus were fairly good. At least, the method used had the advantage of speed.

**Table 1.—Number of tissues examined and passages through which carried before a negative result was obtained**

<table>
<thead>
<tr>
<th>TISSUES</th>
<th>NUMBER</th>
<th>DETERMINED NEGATIVE AFTER PASSENGES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Spleen</td>
<td>86</td>
<td>63</td>
</tr>
<tr>
<td>Brain</td>
<td>114</td>
<td>72</td>
</tr>
<tr>
<td>Liver</td>
<td>32</td>
<td>21</td>
</tr>
<tr>
<td>Serum</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Spleen and brain</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>239</td>
<td>161</td>
</tr>
</tbody>
</table>

**NEGATIVE FLOCKS**

Tissues collected from 74 different sources ultimately gave negative results. In this group there were 250 tissues, of which 9 samples were contaminated and 2 broken, thus leaving 239 for inoculation. All of these, except one from a turkey and one from a blackbird, had come from chickens. Most of the flocks were in New Jersey, though there were one or two each in New York, Virginia, Delaware, and Pennsylvania. The kinds of tissue and the number of generations through which they were carried before a negative result was reached are given in table 1.

From table 1 it can be seen that about two-thirds of the negative samples were determined as such in the first inoculation into eggs; that is to say, not a single inoculated egg died.

**POSITIVE FLOCKS**

A total of 66 tissues were examined from 15 flocks which, as a result of recovery of the virus from one or more tissues, were known to be infected. The results are given in table 2.
It is evident from table 2 that the virus was found more often in spleen tissue than in brain tissue. The table also shows that less than half of the tissues from known infected flocks yield the virus.

Of the 15 negative brain samples, 12 were eliminated as such on primary inoculation, whereas two were carried to the second and one to the third passage. Of the 22 negative spleen samples, 20 were eliminated as such on the primary inoculation and two on the second passage. The two liver samples were carried through the second and ninth passages respectively. The single blood sample was negative in the first passage.

**Table 2.—Distribution of virus in 66 tissues from 15 infected flocks**

| FLOCK | BRAIN | | | LIVER | | | BLOOD | | | TOTALS |
|-------|-------|---|---|---|---|---|---|---|---|---|---|
|       | No. + | No. - | No. + | No. - | No. + | No. - | No. + | No. - | No. + | No. - |
| 1     | 2     | 2    | 3     | 0    | 0   | 2    | 0    | 1    | 5    | 5    |
| 2     | 0     | 2    | 1     | 1    |     |      |      |      | 1    | 3    |
| 3     | 1     | 1    | 0     | 2    |     |      |      |      | 1    | 3    |
| 4     | 1     | 1    | 1     | 1    |     |      |      |      | 1    | 1    |
| 5     | 2     | 1    | 3     | 1    |     |      |      |      | 5    | 2    |
| 6     | 0     | 3    | 1     | 3    |     |      |      |      | 1    | 6    |
| 7     | 0     | 1    | 1     | 1    |     |      |      |      | 1    | 2    |
| 8     | 1     | 1    | 1     | 1    |     |      |      |      | 1    | 1    |
| 9     | 1     | 1    | 1     | 1    |     |      |      |      | 1    | 1    |
| 10    | 1     | 1    | 1     | 1    |     |      |      |      | 1    | 1    |
| 12    | 3     | 0    | 1     | 0    |     |      |      |      | 3    | 0    |
| 13    | 0     | 1    | 1     | 0    |     |      |      |      | 1    | 1    |
| 14    | 1     | 1    | 1     | 8    |     |      |      |      | 2    | 11   |
| 15    | 1     | 1    | 0     | 2    |     |      |      |      | 1    | 3    |

| Totals... | 7 | 15 | 19 | 22 | 0 | 2 | 0 | 1 | 26 | 40 |

Six of the seven positive brain samples killed every egg in the first generation as well as every egg in every subsequent passage. Of the 17 eggs primarily inoculated with these six samples, four died within 24 hours, four within 48 hours, and nine within 72 hours. Of the three eggs inoculated with the positive brain sample not determined as such on the primary inoculation, only one was killed; the other two hatched. A liver suspension from the one embryo that died on the sixth day killed the three embryos on the next passage in 2, 2 and 1 days respectively.

Thirteen of the 19 positive spleen samples killed every embryo on the first passage as well as every embryo in all subsequent passages. Of the 40 eggs into which these 13 spleen suspensions were inoculated in the first passage, four died with 24 hours, nine within 48 hours, 22 within 72 hours, two within 96 hours, one within 120 hours, and two within 148 hours.

The remaining six positive spleen suspensions which did not kill all embryos in
NEWCASTLE DISEASE IN NEW JERSEY

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the first passage but which killed all embryos in the second and subsequent passages are detailed in table 3.

From the above results it can be seen that although most embryos die within 96 hours (over half of them on the third day), as stated by Beach, occasional embryos on primary inoculation live beyond this period and yield the virus.

Although the fact is evident in the data, we wish to point out that of the 26 positive samples, 19 were determined as such on the first passage, that is, they killed every embryo, and the remaining seven killed every embryo by the second passage.

It has been pointed out that although the virus was recovered in a higher percentage from the spleen than from the brain, yet actually in nine positive chicks from each of which both brain and spleen samples were examined, brain and spleen TABLE 3.—Results in first and second egg passages of positive splenic suspensions which did not kill all embryos in the first passage

<table>
<thead>
<tr>
<th>FIRST PASSAGE</th>
<th>SECOND PASSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>D 3, D 1, H</td>
<td>D 2, D 3, D 3</td>
</tr>
<tr>
<td>PD, NPD, D 5</td>
<td>D 4, D 3, D 3</td>
</tr>
<tr>
<td>D 4, D 19, A 19</td>
<td>D 2, D 2, D 2</td>
</tr>
<tr>
<td>A 20, D 8, A 20</td>
<td>D 3, D 2, D 3</td>
</tr>
<tr>
<td>D 8, D 4, A 20</td>
<td>D 1, D 20, D 20 and D 2, D 3</td>
</tr>
<tr>
<td>D 2, D 8, A 20</td>
<td>D 2, D 3</td>
</tr>
</tbody>
</table>

Key: D means died, and the number following indicates day of death; H means hatched; PD and NPD mean pipped dead and not pipped dead on 21st day; A means alive and number following indicates the day the egg was opened and the embryo destroyed. The italic in the first column indicates the egg that supplied the liver suspension for the second passage.

were positive in three, brain positive and spleen negative in four, and brain negative and spleen positive in only two. In other words, seven brains and five spleens contained virus.

FLOCK HISTORIES

Unfortunately we lack complete histories on the flocks involved, and therefore in most cases the final mortality is not known.

Flock 1: February 5. 1400 sex-linked chicks 4½ weeks old, 20 died in a pen of 300 in 2 days. Virus recovered from three of five chicks examined from this group. A pen of pullets developed a respiratory disease February 2 and was sold February 3. In one pen of 120 N.H. pullets of a lot of 700, production dropped to 0 in 1 week. Lot of 400 Leghorn pullets gasping, off feed, and production dropped to 0 in 1 week. All adults affected by February 17 and sold. A lot of 1000 cross-bred chicks 5 weeks old on February 14 suffered a loss of 95 in one week.

Flock 2: Respiratory disease began February 6 in end pen of a house of six pens containing cross-bred pullets. This pen was sold February 8. By February 15 disease spread to two adjoining pens, and production dropped from 65% to 17%
in 3 days. These were sold around the end of February, and the remaining three pens never became affected. On February 21 disease spread to another house of 700 cross-bred pullets, and by February 23 production had dropped from 50% to 30%. The virus was recovered from one of two spleens collected from these pullets February 23. There were also 500 seven-week-old chicks, 500 two-week-old, and 350 day-old chicks on the place on February 8, and by February 20, the two older groups had contracted the disease.

Flock 3: Virus recovered from one of two spleens from a lot of 1000 N. Hampshire and sex-linked chicks 7 weeks old presented March 10. The virus had already reached 200. But a disease had started February 26 in 800 N.H.'s 2 weeks old which caused 150 deaths by March 6. At the same time the disease attacked 800 cross-bred chicks 2 weeks old and 21 had died—the final mortality is not known. There were also 175 Leghorn pullets which took the disease March 6, and production dropped from 60% to 0. Two pens of 550 yearlings failed to contract the disease.

Flock 4: Virus was recovered from a brain sample of a 5-week-old sex-linked chick presented March 31. The virus had already reached 75 in a lot of 1200. A respiratory disease had started between February 15 and 20 in a flock of 850 Leghorn pullets, in which production dropped from 55% to 10% and remained low for 3 weeks. A flock of 220 Leghorn pullets did not take the disease, and 300 Leghorn cockerels 3 weeks old had not contracted it yet.

Flock 5: Virus recovered from one of two spleens examined from a lot of 1200 Leghorns 5 weeks old on February 26. There had been a loss of 150–200 in 4 weeks, and half the flock was affected. The adults on the place were not attacked.

Flock 6: Flock of 1000 N. Hampshire chicks 7 weeks old on April 16, which had suffered a loss of 100 in a week. Virus recovered from a single spleen examined. On April 20, brain and spleen samples were collected from three more chicks of the same lot and again virus was recovered from either or both tissues in each case. By this time the mortality had reached 300. The disease also spread to 1200 Leghorn chicks 6 weeks old. However, 75 N.H., and 28 Leghorn breeders as well as 1200 pullets escaped the disease.

Flock 7: Flock of 800 N.H. chicks 5 weeks old on May 3, when 8 died. The spleen of one live chick was collected and yielded the virus. By May 15 a total of 80 had died and about 40 more were affected. At this time spleens and brains were collected from each of three chicks but no virus was recovered. On the same place there were 12 week-old six-linked and cross-bred chicks to a total of 2000 which were not affected.

Flock 8: Virus recovered from a single spleen collected May 11 from a 6-week-old Leghorn in a flock of 1200. The final mortality was 350. Apparently the disease had begun in February, because a flock of 500 Leghorn pullets dropped from 60% production to 18 eggs in one week. However, 900 Leghorn, 700 Red pullets, and 500 hens escaped the disease.

Flock 9: Virus was recovered from one of two spleens collected June 16 from a lot of 500 N. Hampshire chicks 2 weeks old which had sickened that day. Two days later a brain collected from a 14-week-old Leghorn out of a lot of 900 that had "colds" and suffered a loss of 30 birds in 3 weeks, gave no results. A flock of old
hens had "colds" around the first of the year, dropped in production, and were sold. Later a lot of 500 October-hatched pullets dropped from 250 to 150 eggs and was sold. May 1944 hatch of pullets was also sold when production dropped from 80% to 50%. A lot of 250 March, 1944 hatch contracted a "cold" and was retained. Finally, the disease reached 1000 N.H. chicks 5 weeks old and 500 Leghorns 6 weeks old; 160 of the former died in 2 weeks.

Flock 10: June 12 two spleens were collected from a flock of 2000 cross-bred chicks 6 weeks old which had suffered a loss of only 18 in one week. The virus was recovered from one of the spleens. A flock of 600 Leghorn pullets had had a respiratory disease for 4 weeks and six died. Production dropped from 40% to 0 in 10 days. In another lot of 470 W.Rocks 12 weeks old some were just beginning to cough, but 600 cross-bred birds 18 months old were not affected.

Flock 11: Three 6-week-old B.P.Rock chicks were presented July 27 from a flock of 1600. Spleens were collected from the two live chicks and the virus was isolated from one. The loss had been 100 chicks in the last week, and 200 more were affected.

Flock 12: Three live Red chicks 6 weeks old were presented September 5 and the virus was recovered from the spleen of each one. These came from a very large plant where chicks are brooded the year round and the total population of all ages may at times reach 50,000. According to the caretaker, the loss is usually about 500 out of a lot of 3200, and the disease runs a course of about 10 days. The disease was characterized by marked gasping, but paralytic symptoms were never noticed. It is not known how long the disease has been on the plant, but apparently it had been present in several broods.

Flock 13: The same as Flock 2, but these birds were not on the plant during the outbreak in February. This lot of 900 cross-bred pullets now 5 months old and producing about 100 eggs daily had a "cold" at the age of 5 weeks and later about 6 cases of fowl paralysis developed. Recently a single bird developed a wryneck, and exhibited posterior propulsion. It was held from August 28 till September 5 when brain and spleen samples were collected. The virus was recovered from the spleen.

Flock 14: Flock of 1000 cross-bred pullet and 1000 cross-bred cockerel chicks 3 weeks old on October 1. Although pullets and cockerels were in adjoining pens, only the pullets were said to be affected and 200 had died. Of 5 spleens collected only one yielded the virus. On October 13, when the same chicks were about 5 weeks old brains and spleens were collected from five chicks, but only one brain yielded the virus. The loss by then had reached 600.

Flock 15: October 12. Flock of 4500 cross-bred chicks 10 weeks old in which the loss had been 8 to 10 a day for a week; 20% of flock affected. A flock of 100 chickens 4 months old in a run outside the house had had a respiratory disease 3 to 4 weeks before the younger birds became affected. Brain and spleen samples were collected from each of two birds, but only one brain sample yielded the virus.

LOCATION OF OUTBREAKS

Flocks 1, 2, 3, 4, 6, 7, 8, 9, and 13 are in Cumberland County, Flock 5 is in Atlantic, Flock 10 is in Gloucester, Flock 11 is in Middlesex, Flock 12 is in Essex,
Flock 14 is in Ocean, and Flock 15 is in Salem. Atlantic, Cumberland, Gloucester, and Salem Counties are in South Jersey; Middlesex and Ocean are on either side of the middle line; and Essex County is in North Jersey. Thus the disease has been diagnosed in 7 of the 21 counties.

**NEUTRALIZATION TESTS**

*Method:* The virus suspension was prepared by grinding with sand the serosa and liver or the liver only from an infected egg. About 5 c.c. of broth or saline was added and the suspension frozen after about 0.1 c.c. was streaked on an agar plate for sterility. After thawing, the sediment was resuspended before centrifugation, and then 10-fold dilutions were made. In determining the virus titration, equal quantities of virus dilutions and broth (or saline) were mixed. Likewise, to determine the reduction of the virus titre by serum, equal quantities of the virus dilutions and undiluted serum were mixed and along with the virus-broth (or saline) mixtures incubated from \( \frac{1}{2} \) to 1½ hours. Usually 10- or 11-day-old incubated eggs were used, although in one case 8-day eggs were used. The total dose of virus dilution and broth (or saline) and virus dilution and serum was 0.1 c.c. per egg inoculated through the serosa, and at least two eggs were inoculated with each dilution. Incubation was then continued, and the eggs were usually candled twice daily during the first 3 days, and thereafter only daily. Incubation was continued until hatching in some cases; in others, the living embryos were destroyed on the seventeenth to the twentieth day. All dead embryos were harvested and cultured. In any batch of eggs certain embryos are obviously weak and may die non-specifically, and consequently some checking by reinoculation had to be done.

**IDENTIFICATION OF UNKNOWN VIRUS**

The first neutralization test was that to establish the nature of the virus isolated from the first outbreak investigated. The three eggs inoculated with the brain of one of the chicks in this case all died on the third day. The liver and serosa of one of these eggs supplied the virus suspension prepared as already described. The serum was known to neutralize completely a Newcastle virus of a \( 10^{-6} \) titre. In this case, 8-day embryonated eggs were used. Every embryo receiving the virus-broth mixtures died though the \( 10^{-6} \) dilution, but not in the \( 10^{-7} \). The two eggs that received the \( 10^{-5} \) dilution died in 3 days, one of the two that received the \( 10^{-4} \) dilution did not die until the eighth day, but all others were dead within 48 hours.

The egg that died on the eighth day was subinoculated 20 days later and killed the two embryos in 24 hours. In the next passage, 8 days later, the three embryos also died within 24 hours. A third passage, 42 days later, killed the three embryos within 48 hours, and a fourth, after 18 days, killed one embryo in 24 hours and two in 48 hours. This case is detailed because of the unusually long time required for death to occur.

In the series of eggs that received virus dilutions and serum, all but one lived through 8 days following inoculation, at the end of which time the embryos were destroyed. The exception was an egg that was noted to be weak before inoculation and that had received serum and \( 10^{-8} \) virus dilution. It died on the second day, and a subinoculation made 26 days later showed that death was not due to virus.
A second neutralization test was made when a virus was isolated from an outbreak in Central Jersey. In this instance the livers from two eggs were used to prepare the virus suspension. The eggs used were 11 days old. Virus dilutions from $10^{-1}$ to $10^{-7}$ were made, but the suspension was active only through the $10^{-3}$ dilution. The eggs that received Newcastle-immune serum and virus lived.

A third neutralization test was made to identify the virus when an outbreak was found in North Jersey. The eggs were 10 days old, and again the virus suspension was made from the livers of two embryos. In this case all embryos through the $10^{-8}$ virus dilution died and also one of the two which received a $10^{-7}$ dilution. The eggs which received the virus and Newcastle-immune serum lived. Thus, a virus suspension that titred at least $1-1000$ was completely neutralized.

**NEUTRALIZATION TESTS WITH RECOVERED BIRDS**

In at least some cases virus was not recovered by egg inoculations even though the outbreak appeared to be typical of Newcastle. In some cases serum was collected from these flocks at a later date in order to run a neutralization test. Thus, three brains from 4-week-old chicks and one from an 8-week-old chick collected March 20, failed to yield virus. On April 21, three blood samples were collected from birds that had shown wryneck for 3 weeks. When first run against a liver suspension virus that titred only $10^{-3}$, each sample gave complete neutralization. One of the samples was run a second time on a serosa-liver virus suspension that killed all eggs through the $10^{-8}$ dilution (not end point), and the only eggs that received virus and serum and that died were the two which received non-diluted virus and one each of those that received the $10^{-1}$ and $10^{-2}$ virus dilution. Thus, there was neutralization of at least 10,000 doses. In the same test was included serum from the one bird which recovered out of the six presented on February 6 (flock 1) and which was bled May 16, and found to neutralize at least 1000 doses of virus. Even here, one egg receiving the $10^{-2}$ and $10^{-3}$ virus dilution survived.

A brain sample collected March 14 from a pullet that showed wryneck failed to yield virus. The flock of 800 sex-linked pullets had had a respiratory disease January 6. A flock of 1400 Leghorns was also affected, but 1200 hens on the same farm were unaffected. By February 9, one room of 350 of a flock of 2300 sex-linked chicks 3 weeks old had become affected, and by March 3, 90 had died. On March 13, blood samples were collected from the hens. Two sera, each representing a mixture of three sera, were run. One of the composite samples neutralized 1000 and the other at least 100,000 doses of virus. In the same series was included a composite serum sample of three sera collected March 13 from hens 2 to 4 years old. This sample neutralized at least 1,000,000 doses of virus. In this case, a flock of 2500 Leghorn pullets had a respiratory disease in February, production dropped to 0, and 100 birds died. By February 21, 200 Leghorn chicks 2 weeks old contracted a respiratory disease. A single brain sample collected February 23 from a pullet, killed three of four embryos in 24 hours and the fourth within 48 hours. The liver of the latter was used for the next passage, but no virus could be demonstrated.

From a flock of 8-week-old chicks that had already suffered a 10% mortality in 10 days, three brain, two spleen, and four serum samples had been inoculated with negative results. Some time later a serum from this flock neutralized at least
100,000 doses; in fact, only one of the two eggs that received the $10^{-1}$ virus dilution and serum and one of the eggs which received the $10^{-7}$ virus dilution died. In the same series were included three sera from a suspicious outbreak in New York. These had been collected soon after the attack and neutralized at least 100, 10,000 and 10,000 doses, respectively. Egg inoculations with four spleen, three liver, and one brain samples collected late in the course of the disease had previously given negative results. Also in this series was included a composite sample of two sera from 13-week-old birds which had intestinal coccidiosis but which at 9 weeks of age had shown some suspicious symptoms, but this sample did not even neutralize 10 doses of virus.

A bird was kept from February to May 16 in a separate cage but close to the one survivor from flock 1 already mentioned. On May 16 it was bled. Its serum failed to neutralize even 10 doses of virus.

From the results of neutralization tests it is evident that at least some of the flocks which failed to yield virus on egg inoculation, nevertheless had the disease. Presumably the specimens from which tissues were collected were in the later stages of the disease when the virus concentration was low or the virus had entirely disappeared.

Thanks are due Mr. C. B. Hudson for technical assistance.

REFERENCE

SOME ASPECTS OF FEDERAL POULTRY INSPECTION

BY P. J. BRANDLY, D.V.M.

Poultry Pathologist, Poultry Inspection Service

Eighteen years have passed and more than a billion pounds of dressed poultry have been inspected since the Federal poultry inspection service was established. Of this amount of poultry inspected, over 18,000,000 pounds, or 1.69 percent, were condemned as unfit for food—an amount representing an estimated cash value of $5,000,000. It might be interesting to review the yearly records of inspection to note the expansion of the service and explain the variance of percentage condemned.

Table 1 shows the number of pounds of poultry inspected.

The variance in the yearly percentage of condemned poultry is due to the practice during the early years of inspection, of using a large percentage of culls for canned poultry products. The percentage condemned from such birds is so high that such poultry is now seldom presented for inspection. Another factor lowering the percentage condemnation in recent years is the increased inspection of U. S. Grade A boilers and turkeys. There has been a steady decrease in the inspection of lower quality poultry, at least until the recent war years when the scarcity of poultry compelled the processor to purchase any birds available. It should be mentioned, however, that during this time most of the poultry inspected went to the armed forces and was of good quality.

The percentage of condemnations depends largely on the quality, age, and origin of the poultry. The average of condemnations of U. S. Grade A broilers is less than \( \frac{1}{2} \) of 1 percent. However, in a lot of U. S. Grade C broilers inspected on the Del-Mar-Va Peninsula in the spring of 1944, 140,000 out of 250,000 pounds, or 56 percent, were condemned. Midwestern A and B grade fowl usually suffer about 2 percent condemnation, due largely to the high incidence of avian tuberculosis. The percentage of condemnation of old roosters is not as a rule so high, it being about 1 percent for Midwestern A and B grades.

U. S. Grade A turkeys usually have a very low percentage of condemnation. However, the percentage of condemnation in some individual lots and in low-grade turkeys is sometimes high. In the case of flocks affected with an acute systemic disease the condemnation may run as high as 90 percent. Losses from condemnation in ducks and geese usually are very low.

Table 2 shows the percentage of poultry condemnation during 1944 in all areas in the United States for each cause listed. This is based on the number of birds and not on weight as are the figures in table 1. Expressed in weight, inspections that year included 170,240,090 pounds, of which 2,111,652 pounds, or 1.24 percent, were condemned.

Unfortunately no accurate picture of the incidence of poultry disease can be gained from a study of these records because of the following facts. Poultry is usually carefully graded and only the better quality, though sometimes only the poorer quality, is presented for inspection. A large quantity of South American...
poultry was inspected in 1944. Some lots of South American turkeys had a high incidence of tuberculosis whereas tuberculosis in turkeys originating in the United States from areas where the incidence of avian tuberculosis is high only infrequently

Table 1.—Poultry, dressed: Quantity officially inspected and quantity rejected, United States, 1898–44

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Inspected</th>
<th>Rejected</th>
<th>Rejected per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1928</td>
<td>3,150,423</td>
<td>369,649</td>
<td>11.72</td>
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<tr>
<td>1929</td>
<td>20,702,016</td>
<td>812,055</td>
<td>3.92</td>
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<tr>
<td>1930</td>
<td>22,571,400</td>
<td>997,954</td>
<td>4.42</td>
</tr>
<tr>
<td>1931</td>
<td>15,986,239</td>
<td>773,013</td>
<td>4.83</td>
</tr>
<tr>
<td>1932</td>
<td>14,515,707</td>
<td>492,772</td>
<td>3.39</td>
</tr>
<tr>
<td>1933</td>
<td>15,316,739</td>
<td>468,173</td>
<td>3.06</td>
</tr>
<tr>
<td>1934</td>
<td>18,461,442</td>
<td>538,147</td>
<td>2.91</td>
</tr>
<tr>
<td>1935</td>
<td>23,266,090</td>
<td>515,808</td>
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</tr>
<tr>
<td>1936</td>
<td>32,950,582</td>
<td>697,488</td>
<td>2.11</td>
</tr>
<tr>
<td>1937</td>
<td>43,578,769</td>
<td>738,913</td>
<td>1.69</td>
</tr>
<tr>
<td>1938</td>
<td>43,538,661</td>
<td>793,965</td>
<td>1.82</td>
</tr>
<tr>
<td>1939</td>
<td>62,607,663</td>
<td>968,543</td>
<td>1.54</td>
</tr>
<tr>
<td>1940</td>
<td>77,590,774</td>
<td>1,273,317</td>
<td>1.64</td>
</tr>
<tr>
<td>1941</td>
<td>94,499,280</td>
<td>1,573,339</td>
<td>1.66</td>
</tr>
<tr>
<td>1942</td>
<td>147,300,893</td>
<td>1,913,699</td>
<td>1.30</td>
</tr>
<tr>
<td>1943</td>
<td>180,910,916</td>
<td>1,736,279</td>
<td>0.96</td>
</tr>
<tr>
<td>1944</td>
<td>178,776,082</td>
<td>2,232,742</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Table 2.—Poultry, condemned: Percentage of condemnations for each cause listed (8,111,652 pounds)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>40</td>
</tr>
<tr>
<td>Emaciation</td>
<td>4</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>15</td>
</tr>
<tr>
<td>Leucosia</td>
<td>8</td>
</tr>
<tr>
<td>Peritonitis</td>
<td>4</td>
</tr>
<tr>
<td>Tumors</td>
<td>4</td>
</tr>
<tr>
<td>Abscesses</td>
<td>3</td>
</tr>
<tr>
<td>Bruises</td>
<td>3</td>
</tr>
<tr>
<td>Parasites</td>
<td>1</td>
</tr>
<tr>
<td>Decomposition</td>
<td>11</td>
</tr>
<tr>
<td>Cadaver</td>
<td>1</td>
</tr>
<tr>
<td>Other Causes</td>
<td>6</td>
</tr>
</tbody>
</table>

show gross lesions. Some low grade Canadian poultry with high percentage condemnation was also inspected during 1944. Only a small amount of mature poultry raised in the eastern United States is inspected.

There are now 103 establishments in the United States which are eviscerating
poultry or processing poultry under the supervision of the Federal poultry inspection service. The location of these plants by states may be of interest.

Iowa 13  New York 12  Illinois 11
Nebraska 10  Missouri 9  Minnesota 9
New Jersey 4  Oregon 4  California 4
Arkansas 3  Pennsylvania 3  Maryland 3
Michigan 2  Massachusetts 2  Utah 2
South Dakota 2  Oklahoma 2  Virginia 2
Delaware 1  Kansas 1  Kentucky 1
Indiana 1  Wisconsin 1  Washington 1

The post mortem inspection work is performed by qualified veterinarians and the standards of the inspection service have been successfully maintained even during the war years with rapid expansion and difficulties in obtaining professional personnel.

The laboratory of the poultry inspection service was established in June 1944. The Pathological Division, Bureau of Animal Industry, U. S. Department of Agriculture, has furnished office space, equipment, and a helping hand.

It might be well to point out here that the research or diagnostic laboratory approaches the study of poultry disease from a different standpoint than does the laboratory of poultry inspection service. The former studies disease with the purpose of controlling it; the latter is primarily concerned with the wholesomeness of the slaughtered bird. The determination of the disposition to be made of carcasses of birds slaughtered for food is the chief function of the poultry inspection service laboratory. The duties of the laboratory include the establishment and maintenance of uniform interpretations by the inspectors of the instructions governing disposal of diseased carcasses and parts; to determine wholesomeness of processed poultry products, to study unusual conditions in localities where poultry inspection is carried on, and to determine the disposition of such cases. For example, frozen chicken livers which contained numerous white pinhead granules were sent to the laboratory last winter. These livers had previously been inspected by our service and the presence of the granules was not observed before the livers were frozen.

Histological examination revealed the presence of numerous needlelike crystals arranged in radiating bundles typical of tyrosin crystals as observed in stored mammalian meat products. Tyrosin deposits have been observed in frozen lamb livers but have not previously been reported in poultry products.

Avian tuberculosis which causes the heaviest condemnation loss is of great concern to the poultry inspection service. We do not feel that the meat inspection regulation covering disposal of mammals affected with tuberculosis are applicable to poultry inspection because of the following reasons.

1. **Anatomical difference.** The lymph nodes in mammals which usually filter out and localize tuberculosis infection at least for a time are absent in chickens and only partially developed in waterfowl. Because of this anatomical difference the primary lesions in fowl are found in the organs.

2. **The inability of chickens to arrest or overcome Tuberculosis Infection.** Tuberculous lesions in chickens do not undergo calcification, and the phagocytes are not able to overcome all of the organisms phagotized by them. The wandering phag-
ocytes engulf the organism within the lesion and then move out of the lesion, sometimes carrying live organisms which establish themselves outside the primary lesion or gain access to the general circulation. “The continuous progressiveness of tuberculosis in chickens with its marked tendency to spread to the spleen and bone marrow indicates that a tuberculous bacillemia is a common manifestation of the disease.” Feldman.

3. **No thermic reaction in Birds as a result of Tuberculosis Infection.** “Unlike tuberculosis infection in many of the mammals the disease in chickens apparently does not induce a febrile state. Even though the disease be most severe the temperature of the affected bird remains within the normal range.” (Feldman) The noxious products in the tissues resulting from fever need not be considered when judging poultry carcasses affected with tuberculosis.

4. **Resistance of Fowl to the Bovine and Human Strains of Tuberculosis.** Chickens have never been shown to be naturally infected with any strain of the tuberculosis organism except the avian strain. Therefore, we are dealing only with avian tuberculosis in poultry inspection.

5. **Resistance of Man to Avian Tuberculosis Infection.** In writing of avian tuberculosis infection in man Feldman states. “As a matter of fact in only a relatively small number of instances has the evidence necessary to prove an avian type of infection in man been presented. The rarity of such cases can only indicate that human beings are extremely resistant to this form of the tubercle bacillus.” Therefore, the danger of transmitting the disease to man is very slight.

The reasoning behind the present instructions of the Assistant Administrator of the Production and Marketing Service governing the disposal of poultry carcasses and parts thereof affected with tuberculosis, is as follows: If the Meat Inspection regulations in which generalized tuberculosis necessitates condemnation, were applied to poultry inspection, all poultry carcasses showing any lesions would have to be condemned because of the great possibility that the disease was a tuberculous bacillemia. However, because chickens only become naturally infected with the avian strain of the tuberculosis organism while man is extremely resistant to this strain and because birds do not develop a febrile state with this infection the present instructions were issued by the Assistant Administrator.

**Section 2.** Carcasses of poultry affected with tuberculosis shall be disposed of as follows:

**Rule A**—The entire carcass shall be condemned if any of the following conditions occur:

(a) Cachexia
(b) Extensive lesions of tuberculosis in the liver, spleen, or intestines, or in any combination of these organs.
(c) Any lesions of tuberculosis in organs or parts of the carcass other than the liver, spleen, or intestines.

**Rule B**—An organ or part of a carcass shall be condemned under the following conditions:

(a) When it contains lesions of tuberculosis
(b) When it has been contaminated with tuberculous material.

**Rule C**—Carcasses of poultry may be certified for food when the lesions are
slight and confined to the liver, spleen, and intestines, and the carcass is well nourished and in good condition. Under this rule carcasses showing such lesions may be certified after the parts containing the lesions are removed and condemned in accordance with Rule B.

It is not the intent of the instructions to allow the passing for food of any poultry carcasses affected with tuberculosis which show cachexia, particularly atrophy of breast muscles or anemia or any carcass which might contain lesions in the flesh or parts that may be eaten with the flesh or carcasses with heavy infection even though confined to the sites of predilection. The usual sites of infection are the liver, spleen, intestines and bone marrow. If the carcass has lesions in any other organ then it must be concluded that the disease was in an advance state or that the resistance of the bird was not great enough to limit the disease to the usual sites of infection and some tuberculous lesions may be in the edible parts. Therefore, any lesions in any organ or part other than the organs of predilection is cause for condemnation of the entire carcass.

Some of our experiences with tuberculosis in birds is here related. We notice a higher incidence of tuberculosis in hens than in roosters from the same area.

Tuberculosis in muscovy ducks originating in the area around York, Pa. has been observed quite a number of times in females but never in males. Tuberculosis in other domesticated ducks has been reported by some inspectors, but so far as we have been able to determine no laboratory confirmation of these cases has been made nor have specimens been sent to our laboratory.

My own experience with turkey inspection is limited to those raised in the eastern United States and in turkeys from that area I have never diagnosed tuberculosis. However, last fall a consignment of dressed Argentine turkeys, slaughtered in South America were eviscerated in Omaha. Some of these birds had lesions which were different from any I had ever seen. They occurred in the lungs, the liver, the spleen on the mesentery, and in the bone marrow, and were perfectly spherical. In individual birds they were the same size except for the bone marrow lesions, which were smaller. In different birds the size of the lesions varied from 4 to 15 mm in diameter.

One of our men in the poultry inspection service said that he had seen such lesions before and that the laboratory diagnosis was tuberculosis. Histological examination of the Argentine turkey lesions showed a necrotic center surrounded by giant cells, epithelioid cells, and a dense connective tissue capsule. Numerous acid-fast organisms were present in the necrotic center. We were unable to find any daughter or secondary tubercles in the material examined.

Tuberculosis in chickens is so regularly characterized by the development of secondary tubercles around the primary lesion that on macroscopic examination we look for these secondary tubercles and the resulting irregularly shaped lesion, in order to aid in the diagnosis of tuberculosis.

We concluded that the turkeys under consideration were able to prevent the escape of the tuberculosis organisms from the primary lesion and for that reason these turkey lesions differed from those usually found in chickens. There was a question as to whether or not all turkeys have this resistance to the spread of the tuberculosis organisms from the primary lesion. A study of the literature failed
to reveal any specific description of tuberculosis in turkeys although it is reported by many workers. As a result of these observations inspectors in the field were asked to send in turkey specimens which they thought to contain tuberculosis lesions.

The first 24 specimens suspected of tuberculosis were received from the East and Middle West, and examined, but in no instance did the laboratory findings confirm the gross diagnosis. These lesions, confined usually to the liver, are of a conglomerate nature. Macroscopically they are characterized by a great amount of connective tissue containing numerous yellow necrotic centers. They varied in size from 10 to 40 mm. in diameter and usually protruded slightly above the liver surface and extended deep into the liver substance, occasionally completely through the liver. Histologically they were typical granulomatous processes containing multiple areas of necrosis composed of a deeply staining hyaline material and pycnotic nuclei. These necrotic areas were surrounded by giant cells, mononuclear cells, and connective tissue. In none of these cases were acid-fast organisms found in the lesions.

This material was from turkeys which had been slaughtered, New York dressed, frozen, stored and defrosted prior to eviscerating. Despite the fact that the presence of parasites could not be demonstrated we feel that these were old lesions of histomoniasis or possibly trichomoniasis. The high incidence of these lesions in some flocks is of interest, reports of from 40 to 60 percent in a lot having been received.

Then the next three cases, two originating in Minnesota and one in Oklahoma, showed lesion characteristic, both macroscopically and histologically, of tuberculosis as usually observed in chickens and numerous acid-fast organisms were demonstrated therein. U. S. reared turkeys do not show the high incidence of tuberculosis observed in some lots of South American turkeys, and the lesions do not necessarily differ from those usually seen in chickens. Our reports show that poultry originating in southern Minnesota, northern Iowa, South Dakota and parts of Nebraska, Missouri and Illinois usually have a higher incidence of tuberculosis than does that originating from other midwestern areas. Excepting in a few localities eastern and southern raised poultry rarely show lesions of tuberculosis. These findings are in accord with the F.A.I. field studies on avian tuberculosis.

While the poultry inspection service is not directly concerned with the control and eradication of poultry diseases we do contribute at least indirectly to such programs.

More and more of the large eviscerating establishments prefer to purchase poultry from areas known to be relatively free from tuberculosis. The price paid for birds from areas known to have a high incidence of the disease is usually scaled down to permit profitable operations.

REFERENCE

REPORT OF THE COMMITTEE ON TRANSMISSIBLE DISEASES OF POULTRY


As in world events, this past year has been an eventful one from the standpoint of transmissible diseases of poultry. It has witnessed, as you just have heard in the foregoing discussion, the spread of Newcastle disease to the eastern shores of the United States. This highly infectious and contagious disease of fowl which up until a few years ago was considered to be primarily a problem of the far East, may constitute a major poultry scourge for some time to come. It behooves, therefore, everyone of us interested in the welfare of food animals, to become familiar with this disease in order to combat effectively this new enemy. Aside from new problems, studies of old and well recognized diseases such as pullorum disease have brought to light new angles important to the livestock sanitarian. For these reasons, your Committee on Transmissible Diseases of Poultry has endeavored in the present report to give—without claim to completeness—a bird's eye view of the more important events in the field of infectious diseases of poultry during the past year. The information has been gathered largely from or through observations and communications of the Committee members whose cooperation is hereby gratefully acknowledged.

SALMONELLOSSES

Domestic fowl are recognized now among the most efficient purveyors of bacterial organisms of the genus Salmonella which comprises the causative organisms of pullorum disease, fowl typhoid,¹ and paratyphoid.

Pullorum disease. One measure of the efficiency of the nation-wide testing program is the number of breaks in previously pullorum clean flocks. Probably due to the enormous demand for chicks under wartime exigencies, there has been noted some increase in breaks. Although comprehensive figures are not available, a limited survey in 10 northeastern states conducted by the Department of Veterinary Science of Massachusetts State College (1) showed a total of 228 breaks during the 1944–45 testing season, as compared with 206 during 1943–44. A breakdown of the data indicated the increase to be confined to 6 states while 4 other states reported a decrease. The percentage of positively reacting birds to the tube agglutination test varied from 0.5 to 5 per cent or more with the majority belonging to the lowest percentage group. With rare exceptions, breaks were attributed to direct or indirect introduction of the disease from apparently infected flocks. Other sources of S. Pullorum infection have to be watched for as Simeone (17) has demonstrated such infection also in duck and guinea hen eggs.

¹ Sometimes classified as Shigella.
Detailed follow-up study of every break and wholehearted cooperation of testing agencies, hatcherymen and flock owners is necessary to hold to a minimum such breaks which are not only expensive to the owner but highly detrimental to the whole program of pullorum disease eradication. Understanding of and widespread education as to the true meaning of the terms “pullorum clean” and “pullorum passed,” as defined in the National Poultry Improvement Program, are indispensable.

The occurrence of field variants of *Salmonella pullorum* has been known since the work of Plastridge, Rettger and Van Roekel, but was not thought to interfere to any extent with the standard laboratory methods used in the eradication of pullorum disease. From Ontario comes a disquieting note to the effect that studies by Younie (20) and later by Gwatkin and Bond (6) and Wright (19) suggest the frequent occurrence of a serologic variant which is not readily detected by the standard tube agglutination test. According to Wright (l.c.), the organism is believed to be partially lacking in somatic factor XII and perhaps containing an unlisted additional antigenic factor; about 50 per cent of pullorum strains collected from the U.S.A. were serologically related to the Ontario variant. In the hands of the Canadian investigators double-testing with standard and so-called “X” variant antigen has apparently facilitated pullorum disease eradication in certain flocks. Although this work will be watched with interest, study of experimental lots of so-called “X” antigen, produced by various biologic houses, would suggest the “X” antigen to have an unusually broad antigenic basis, in common with other bacterial variants, and to give nonspecific positive reactions in unrelated diseases, such as fowl cholera, colibacillosis, etc.

In viability studies of *Salmonella pullorum* under simulated natural conditions, Felsenfeld and Young (3) found the organism to survive on contaminated vegetables for 2 to 5 weeks at room temperature, and for 4 to 8 weeks in the ice box. The only exception was on onions, probably on account of their volatile oils of known disinfecting properties. These observations, together with their previous report (2) on the occasional pathogenicity of *S. pullorum* for man, suggest the possibility of human salmonelloses resulting from eating or handling contaminated vegetables previously fertilized with Salmonella infected animal manure.

Fowl typhoid, closely related to pullorum disease, is becoming again of importance, after years of relative quiescence, especially in the Delmarva broiler area, central Texas, New Jersey and southern New England. According to Hall and associates of the U.S. Bureau of Animal Industry (7) the disease affects chickens of all ages, particularly in the summer, is transmitted by pen contact with healthy survivors and through the egg, and is often complicated with pullorum disease in the field. Efforts are being made to differentiate pullorum disease and fowl typhoid carriers serologically.

Aside from pullorum disease and fowl typhoid also known as metasalmonelloses, other Salmonella infections of birds and other animals are widespread and important. Due to modern advances in the serologic differentiation of Salmonella organisms, the early subdivision of salmonelloses into human and animal paratyphoid has been largely supplanted by the realization of the importance of animal paratyphoid as a source for human infections. With regards to avian salmonelloses,
this subject has been treated comprehensively in a recent paper by Hinshaw, McNeil and Taylor (11). Working with 561 cultures, exclusive of \textit{S. pullorum} and \textit{S. gallinarum}, from 353 outbreaks, these authors found turkey salmonelloses to be due to \textit{S. typhimurium} in 6 per cent and to \textit{S. bareilly} in 5 per cent with the corresponding figures for chicken salmonelloses as 35 and 42 per cent, respectively. Further confirmation of the relationship of avian salmonelloses to Public Health comes from the recent report of Gordon and Buxton (5) in England who observed a case of food poisoning in man, probably caused by the consumption of an infected duck egg.

While eradication must remain the principal goal in the control of avian salmonelloses, this is not always possible due to our inability, except in the case of pullorum disease and fowl typhoid, to detect the healthy carrier bird by a blood test. A relatively small number of adult carriers may be the source of severe outbreaks in young birds. To reduce mortality and thus effect an economic salvage, treatment of birds with sulfonamides may be tried, according to the reports of Severens, Roberts and Card (16) on pullorum disease, and of Hammond (8) on fowl typhoid. In the former condition sulfadiazine, also sulfamerazine, was found to be particularly effective, in fowl typhoid sodium sulfathiazole. While it is good to know that one does not have to watch entirely helplessly the ravages of these diseases, reliance on medicinal treatment alone as against prevention and eradication would be contrary to the principles successfully applied by this Association over a number of years.

\textbf{PARASITIC DISEASES}

Although parasitic diseases are treated separately in another report to this Association, a few observations may be included here.

According to information received from Dr. J. P. Delaplane, the stomach worm \textit{Dispharynx spiralis} has been observed for the first time in chickens in Texas. In the same area certain protozoan diseases of turkeys seem to assume economic importance among them infections with \textit{Hexamita meleagridis} and \textit{Leucocytozoon smithi}. The latter infection has also been found by Dr. Beaudette in blood smears received from Portage la Prairie, Manitoba Province, Canada, where an outbreak was reported to have killed 4500 out of 8000 young turkeys. This infection is known to occur in Nebraska, California, Virginia, Maryland, Missouri, Georgia, Alabama, North Dakota and elsewhere. Together with previous reports to this Association on the occurrence of hexamitiasis, aside from California, also in New Jersey, Connecticut and elsewhere, the present report from Texas would suggest an almost nation-wide occurrence of hexamitiasis. Unfortunately the popular treatment with mercuric chloride in the water has proved unsuccessful in critical tests by McNeil and Hinshaw (15).

Cecal or bloody coccidiosis caused by \textit{Eimeria tenella} undoubtedly constitutes a major problem of the poultry industry, especially in commercial broiler production. As eradication of the disease has proved economically impracticable, it has been attempted—as a necessary evil—to develop a mode of living with this disease. In this, sulfonamides have been used with varying success in the treatment of the acute disease, but, as you have heard, are less effective as a preventative
under simulated field conditions. Sulfamethazine (sulfamezathine) in saturated solution has been shown by Horton-Smith (12-14) to have a considerable prophylactic effect followed by immunity. This claim has been supported in part by Hawkins (9) and Hawkins and Kline (10) who found the drug in concentrations of 0.4 to 1 per cent in the feed to greatly reduce death losses but to be ineffective in the drinking water, if given in galvanized containers.

Improvement of the general sanitary aspects of the poultry farm is promised by the work of Wolfenbarger and Hoffmann (18) who applied DDT as a 2 per cent solution in deodorized kerosene for the control of flies, which frequently act as mechanical carriers of disease agents.

PULLET DISEASE

Pullet disease or blue comb (avian monocytosis) has been discussed in detail before this Association at the last meeting. The incidence in New England during the past year has been relatively low; indirect reports have been received of its occurrence in Washington and Michigan. Dr. A. J. Durant has diagnosed it for the first time in two or three flocks in central Missouri during September 1945. In England a similar condition has been observed by Gordon and Blaxland (4).

NEWCASTLE DISEASE

In 1942, Dr. J. R. Beach reported to this Association the existence of an apparently new respiratory-nervous disease in poultry, primarily chickens, termed by him avian pneumoencephalitis. On June 3, 1944, Dr. A. W. Miller, Chief of the Bureau of Animal Industry, stated in Circular Letter Number 2652, to inspectors in charge and state live stock sanitary officials, that the virus of pneumoencephalitis had been determined to be immunologically identical with that of Newcastle disease. In follow-up Circular Letter Number 2724 of March 10, 1945, it was disclosed that Newcastle disease also existed in the southern part of the state of New Jersey. In a similar Circular Letter Number 2730 to licensed producers of laryngotracheitis and pox vaccines, of April 4, 1945, all producers were requested to discontinue the use of fowl in the production of laryngotracheitis, fowl pox and pigeon pox vaccine. Production of such vaccines by the use of chicken-embryos was permitted as in the past. Unlicensed intrastate producers such as the Storrs Agricultural Experiment Station complied voluntarily with this request. On May 18, 1945, the Northeastern Poultry Producers' Council, under the leadership of Secretary Leon Todd, called a meeting of a few northeastern poultry pathologists, which was attended by Drs. Beaudette (New Jersey), Jungherr (Connecticut), Levine (New York), Stubbs (Pennsylvania), and Van Roekel (Massachusetts). Following this meeting, at which Dr. P. P. Levine acted as secretary, recommendations cited below, for handling suspected Newcastle disease outbreaks on a farm were transmitted to the Northeastern Poultry Producers' Council for further action.

Quarantine Procedure: (a) No live birds should be brought on or taken off the premises; (b) no feed bags or other poultry equipment should leave the premises during the quarantine period; (c) no visitors should be permitted; (d) all eggs should be dipped in an effective disinfectant before leaving the premises, and should be packed in cases not contaminated with virus.
TRANSMISSIBLE DISEASES OF POULTRY

Eradication Procedure: (a) Slaughter all fowls including pigeons, ducks, geese, turkeys, and guinea fowls under the supervision of a regulatory official. This should be done within the state where the outbreak occurred; (b) clean and disinfect the premises after depopulation; (c) it is recommended that a 30-day interval should elapse before any other birds are brought on to the premises; (d) a reinspection of the premises should be made by a regulatory official after repopulation with new birds to determine the efficacy of the eradication procedure.

Federal Cooperation: (a) In view of the fact that this disease is no respector of state lines, it is very strongly urged that the Federal Government take an active part in the control measures. This should include assistance in the quarantine procedure and in making available laboratory facilities for the specific diagnosis of this disease.

So far the Committee is not aware that any further action has been taken.

The point of greatest importance would be to learn the exact distribution of the disease, an investigation which has to be made on a nation-wide basis. Some states may not have suitable facilities available, and it would seem that Government help will be necessary in some instances to make such facilities available.

In order to make concise directions available, the committee has prepared an outline which can be made available for immediate distribution.

DIAGNOSTIC PROCEDURES FOR NEWCASTLE DISEASE

A. By isolation of the virus
1. Select live birds showing initial symptoms (respiratory distress).
2. Collect portions of spleen and brain aseptically and prepare approximately a 1 to 5 dilution in broth.
   Test for sterility.
   Keep frozen if not processed immediately.
   Inject up to 0.1 cc. of the supernatent fluid into the allantoic sac of not fewer than 5 eight-to-twelve day embryonated chicken eggs. Reincubate eggs and candle daily for next six days. Remove dead embryos for examination and sterility test.
   Harvest allantoic fluid and embryonic tissue for further passages and specific serum neutralization tests.

B. Identification of suspected virus obtained by above technique
1. Titrate suspected agent in eggs. Use 3 eggs for each of the following dilutions:
   1:100; 1:10,000; 1:1,000,000
   Reincubate eggs as in paragraph 2 above.
2. Recover virus from embryos dying on second or subsequent days. This virus may be sent to the United States Bureau of Animal Industry or typed with specific serum received from the Bureau.
3. For neutralization test titrate suspected agent as outlined in paragraph 1. in
   1:100; 1:10,000; 1:1,000,000
   but add equal parts of Newcastle-immune serum and inoculate embryonated eggs. Consider the test positive if mortality is prevented in the two highest dilutions.

C. Identification of Newcastle disease by neutralization tests on chicken serums is permissible only in known infected states.
REPORT OF COMMITTEE

1. The procedure is the same as in B-3 except that known Newcastle virus and suspected chicken serum are used. Blood samples must be obtained under aseptic conditions, allowed to coagulate and serum removed. The test is considered positive if it neutralizes at least 1,000 minimal embryo lethal doses.

In areas where evidence of the disease has appeared for the first time the diagnosis should be based alone on the isolation of the virus.

Although the manufacture of vaccines from fowl has been discontinued, the greatest menace comes from unsupervised interstate shipment of adult birds which are potential carriers, to egg laying contests, poultry shows, and the like, and from the wartime practice of returning empty crates and egg cases to the shipper. By the same token, the practice of shipping specimens for diagnosis across state lines carries a potential danger and should be discontinued. Chick-sexing may contribute to the spread of the disease.

The danger of interstate traffic of poultry and poultry equipment, may be illustrated by a recent experience in Connecticut. A Massachusetts hatchery, occasionally receives returned empty egg cases from Vineland, New Jersey, and operates a dressing plant in conjunction with the hatchery business. Some employees work in both parts of the plant. The hatchery sold 5 lots of approximately 7000 day-old chicks each to 5 widely separated premises in Connecticut. The first affection occurred in early October and was characterized by "colds", while the subsequently affected flocks showed typical respiratory-nervous symptoms. The virus has been identified from 2 of the outbreaks. Further work is in progress. Whether infected lots have gone to other premises in Massachusetts and Maryland has not been learned. It was interesting however, to note that some shipments from the same hatch apparently escaped infection and that spread of the disease on the premises was delayed.

MR. CHAIRMAN: This report has been signed by all members of the Committee, except Dr. Stafseth who is abroad. I move you to refer this report to the Executive Committee.

REFERENCES


REPORT OF THE COMMITTEE ON LEGISLATION


During the past year the most important duty of your committee was to develop support for House Bill 3289 introduced in Congress and referred to the committee on agriculture. We regret to report that this bill, so important if we in this Nation are going to able to control Rabies, has been pigeonholed because of the activity of certain Veterinarians in one or two of the eastern states who were successful in developing considerable opposition to it.

This piece of legislation reported in detail in the report of the Committee on Rabies elsewhere in this years proceedings should have the support of all members of the Veterinary profession and every agency and individual interested in the well-being of dogs.

Rabies in this country is on the increase and we believe destined to continue to increase until we are successful in obtaining passage of the legislation needed to provide that the Federal Government can coordinate nationwide control of this eradicable disease.
SOME WARTIME DEVELOPMENTS IN LIVESTOCK PARASITE CONTROL

By Benjamin Schwartz

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Of the weapons that have been developed against animal parasites, the parasiticides—chemicals known as anthelmintics when used against flukes, tapeworms and roundworms, and as insecticides when used against insect and related arthropod parasites—have been exploited more extensively than any others. During the war when our livestock producers had to meet unprecedented demands for animal food and fiber, the use of chemicals for combating external and internal parasites was resorted to on a larger scale than ever before. Fortunately, the research work on the control of livestock parasites by chemotherapy, conducted in peacetime by Federal, State, and other agencies, supplied a rich background of knowledge that could be utilized at once in the interest of livestock conservation. Moreover, parasitologists working under the stress of wartime conditions added rather rapidly new knowledge to that already available. As a consequence of greatly accelerated research programs throughout the war period, livestock producers had the advantage of a rapidly growing storehouse of practical information on how to combat more effectively, and with less expenditure of manpower than in any previous period, livestock pests of all kinds that stood in the way of attaining maximum production of food, fiber, and animal byproducts.

That our livestock producers made generous use of the fruits of peacetime and wartime research is amply attested by the unprecedented use of anthelmintics and insecticides, some of which were available only in limited quantities because of wartime restrictions. It is rather significant that despite difficulties, manufacturers and processors of parasiticides increased their output facilities in many instances to meet the increasing demands for chemical weapons so urgently needed to check the ravages of external and internal parasites.

NEW KNOWLEDGE AIDED CATTLE GRUB CONTROL

Shortly after we became involved in the war it became apparent that our supply of leather would be inadequate to meet the military, civilian, and other demands for shoes and other articles made in whole or in part of leather. This naturally focussed attention on cattle grubs—enemy No. 1 of cattle hides. Fortunately, the peacetime research on cattle grubs that had been in progress for years in the U. S. Department of Agriculture, State agricultural experiment stations, and elsewhere, showed quite conclusively that rotenone-containing materials, such as derris powder and cube powder, were more destructive to grubs in the skins of cattle than any other medicinal agent tested for this purpose. The knowledge already at hand when the war broke out was widely disseminated by Federal and State agencies. Moreover, the research programs directed toward improving grub
control procedures were stepped up significantly, partly in the interest of rotenone conservation and partly for improving grub control eradication programs.

It was my privilege to discuss cattle grub control before this Association at its 1942 meeting (1). Since that time rotenone-containing materials incorporated in dusts, washes, sprays, and dips (2) have been used by stockmen more extensively and with better results than ever before. This was done despite the fact that large sources of rotenone material were cut off early in the war when the military hordes of Japan overran Malaya, Java, Sumatra, and the Philippines.

Of the various preparations of rotenone-containing materials that I discussed at the 1942 meeting of this Association, the wash—prepared by dissolving 12 ounces of derris powder or cube powders, having a 5 percent rotenone content, and 4 ounces of granular laundry soap in a gallon of warm water (3)—has stood up unaltered the tests of continued research and practical field use. In a critical test with the wash made by parasitologists of the Federal Bureau of Animal Industry in Colorado early this year on approximately 2,500 head of cattle, representing the total bovine population in an area of about 120 square miles, the grub kill was approximately 95 percent following a single application. The efficacy of the treatment was established by repeated post-treatment extractions of grubs and the examination of each specimen to determine whether it was living or dead. Moreover, a survey of the area in the spring months, when the heel flies strike, showed conclusive evidence of a greatly diminished heel fly population and a corresponding decrease in the symptoms of cattle associated with the activities of these insects.

Two other rotenone preparations that I discussed in 1942 have been modified in the light of new experimentation and increased field experience as follows:

In preparing rotenone-containing dusts, sulphur and talc have been eliminated as carriers and replaced by (a) double ground cream Tripoli earth, (b) micronized volcanic ash, known commercially as Friantite M3x, and (c) pyrophyllite ground so fine that 90 percent of it will pass through a 325-mesh screen; this pyrophyllite is known commercially as Pyrax ABB. Experience gained during the war showed, moreover, that 1 part of derris powder or cube powder containing approximately 5 percent rotenone may be mixed with 2 parts of any of the three carriers named and applied to the backs of cattle with a shaker can. The success of this and other treatments with rotenone-containing materials depends upon the thoroughness with which the insecticide is worked through the hair into the grub holes, as well as upon the stage of development of the grubs. Second instar grubs are much less susceptible to treatment than third instars.

In the light of experience gained since December 1942, it has been determined that to achieve a high degree of success in destroying cattle grubs through the application of rotenone-containing liquids with pressure sprayers, the preparation should contain not less than 7\(\frac{1}{2}\) pounds of derris powder or cube powder, having a 5 percent rotenone content, per 100 gallons of water. No ingredients other than the chemical and water need be used. It was determined also that the preparation should be applied to the backs of cattle as a fine spray with a power-operated orchard sprayer capable of attaining a pressure of at least 400 pounds at the nozzle rather than 250 pounds as formerly recommended.

Dipping in rotenone-containing solutions is practical where large numbers of
WARTIME DEVELOPMENTS IN PARASITE CONTROL

CATTLE ARE TO BE TREATED IN AREAS WHERE THE WINTERS ARE NOT TOO SEvere. Not less than 10 pounds of derris powder or cube powder, having 5 percent rotenone content, and 2 ounces of sodium lauryl sulphate—a wetting agent—are needed for each 100 gallons of water (4).

CATTLE LICE CAN BE CONTROLLED BY TWO TREATMENTS WITH ROTENONE

Rotenone-containing dip has the advantage, moreover, of destroying lice—pests that have become of increasing concern to cattlemen all over the country. It is important to remember, however, that rotenone materials destroy only the motile lice, the eggs or nits escaping the injurious action of the insecticide, and hatching at various intervals following dipping. The 30-day interval between 2 successive dippings for the destruction of grubs will not eradicate lice. Where it is important to control lice as well as grubs, one extra dipping, 16 days after the first dipping for grubs, should be given. The quantity of rotenone-containing powder for the extra dipping to control lice may be reduced to 1 pound per 100 gallons of water, because lice are much more susceptible to this insecticide than are grubs.

SHEEP TICKS CAN BE ERADICATED BY DILUTE ROTENONE DIPS

Another important and economical use of derris powder or cube powder came to light through wartime research on sheep-tick control conducted by parasitologists of the Federal Bureau of Animal Industry. To conserve the limited supplies of rotenone available during the war, tests were made with highly dilute solutions of rotenone-containing materials prepared by adding small quantities of the insecticide to water, up to 6 ounces of derris powder or cube powder having a 5 percent rotenone content, to 100 gallons of hard or soft unheated water (5). It was determined that a single dipping of tick-infested sheep, after all the shear cuts had become completely healed, in a solution containing only 6 ounces of the insecticidal powder per 100 gallons of water, eradicated these pests. Considering the ease of preparing this dilute rotenone dip and its low cost (only a fraction of a cent per head) (6), there appears to be no valid reason why sheepmen everywhere should not, through concerted action, eradicate sheep ticks altogether.

PHENOTHIAZINE IS A VERSATILE ANTHELMINTIC

Up to 1938 phenothiazine was known to organic chemists as a chemical curiosity that had been synthesized in 1885, and to entomologists as an experimental insecticide that had been tested as a mosquito larvacide as well as for the control of the coddling moth. In December 1938 parasitologists of the Federal Bureau of Animal Industry, after considerable experimentation, first announced the discovery of the value of phenothiazine as an anthelmintic in swine. In the three years that followed, this drug was found to possess rather exceptional merit as an anthelmintic for the removal of a large array of gastrointestinal roundworms from various species of farm animals, especially horses, cattle, sheep, and goats (7).

Although phenothiazine was first found to possess anthelmintic efficacy three years before Pearl Harbor and was, in fact, standardized as to dosage and efficacy for various species of nematodes that occur in the digestive tract of farm animals...
Before we became involved in the war, one of the most significant developments in connection with the use of this drug as a parasiticide came to light as a result of wartime research. I refer to the discovery of the value of a phenothiazine-salt mixture for the control of gastrointestinal parasites of sheep—a discovery which was second in importance only to the basic discovery of phenothiazine as an anthelmintic (8).

**Phenothiazine-Salt Mixtures Effective in Controlling Sheep Parasites**

Besides destroying the vast majority of the common stomach worms and nodular worms, and having, moreover, a significant anthelmintic action against other species of gastrointestinal nematodes of sheep and other animals, phenothiazine, much of which passes through the alimentary tract chemically unaltered, is also destructive to nematode eggs in the feces. In view of this property of the drug, it appeared logical and highly desirable to develop a scheme of medication that would insure a more or less continuous elimination of small quantities of phenothiazine with the droppings. It appeared evident that if this could be achieved many, if not most, of the nematode eggs, and the larvae that hatch from uninjured eggs, would be destroyed before they could reach the infective stage. Experiments designed to achieve these results for the control of sheep parasites were undertaken by parasitologists of the Federal Bureau of Animal Industry shortly after the discovery of the anthelmintic properties of phenothiazine. At first phenothiazine-feed mixtures were tested, and later these were replaced by a phenothiazine-salt mixture in the ratio of 1 to 9, on the assumption that a sheep's natural appetite for salt might insure a sufficient intake of the drug to kill nematode eggs in the droppings.

This investigation was planned with the knowledge that neither phenothiazine nor any other known anthelmintic is 100 percent effective in removing the species of parasites against which it is specifically directed. Considering the large numbers of eggs produced by parasitic nematodes, and the relatively short period required for the development to fertile maturity of many pathogenic species, it was quite evident that even a small number of worms, not removed by treatment, could pyramid to significant levels in a relatively short time in the late spring, summer and early fall. To eliminate the need of repeated medication at rather frequent, intervals during the pasture season, a scheme of self-medication was designed and tested.

A regime, involving the more or less continuous intake of even small doses of an anthelmintic, however desirable it might prove from the standpoint of parasite control, could not be considered, on an a priori basis, as being altogether free of risks. On the contrary, various possible risks had to be taken into consideration. It became necessary, therefore, to determine the effect on the health of adult sheep and lambs of a continuous intake of small doses of phenothiazine and to ascertain whether such regime would arrest growth, injure the wool, impair the reproductive functions, interfere with gestation and lambing, or prove otherwise injurious. The information concerning the efficacy of the phenothiazine-salt medication on a continuing basis for controlling gastro-intestinal parasitism was not released, therefore, until the possible risks just mentioned had been eliminated through long-
sustained investigations. It was not until after two years of continuous experimen-
tation with a flock of government-owned sheep at the Agricultural Research
Center of the U. S. Department of Agriculture at Beltsville, Maryland, that the
value and safety of a phenothiazine-salt mixture for the control of roundworms of
sheep was first announced (8). This work was later confirmed by others (9, 10, 11).

This type of self-medication, which is both curative and prophylactic, is not to be
regarded as a substitute for the full therapeutic treatment with the drug, but rather
as an adjunct to it. Heavily parasitized sheep should be treated with full ther-
apeutic doses (about one ounce per adult sheep and one-half ounce for lambs
weighing not over 60 pounds). Following such therapeutic treatment, the phe-
nothiazine-salt mixture should be made available to the entire flock during the
season when the weather is sufficiently mild to permit the normal development of
roundworm eggs and the metamorphosis of the larvae to the infective stage. In
practice, treatment with full therapeutic doses of phenothiazine should be given
to the entire flock when the plan is first initiated, preferably early in the spring.
This is to be followed by a regime of phenothiazine and salt, as outlined, during the
entire pasture season. This procedure should, in most cases, prevent the acquisition
by lambs of an injurious parasite load. As an additional precaution, however, the
breeder flock should be treated again with full therapeutic doses early in the winter,
after the onset of cold weather, to condition the ewes to withstand the winter with-
out being burdened by a heavy parasitism (12).

This, in short, is the scheme of sheep parasite control developed during the war as
a substitute for repeated treatments during warm weather. Its obvious advantages
are (a) the elimination of repeated individual handling of sheep and lambs, (b)
saving of time, labor, and risks incident to forced medication, and (c) ultimate
elimination of the need for anthelmintic medication other than the free-choice
ingestion by sheep and lambs of salt medicated with phenothiazine.

The degree to which phenothiazine was used by sheep growers and other stockmen
during the war is well illustrated by the steady rise in the production and distrib-
ution of this drug in this country from 1939 to 1941, and the increase in its use
during the war years 1942 through 1944. The figures are as follows: In 1939,
the first year that phenothiazine was known to be valuable as an anthelmintic, the
total consumption was 900 pounds; in 1940 the consumption was 70,000 pounds; in
1941 it was 600,000 pounds; in 1942 1,325,000 pounds were used by stock-
men in this country; in 1943 the figure rose to 2,779,000 pounds; and in 1944, the
last year for which figures are available, 2,965,000 pounds were consumed.

**HEXACHLORETHANE-BENTONITE SUSPENSION EFFECTIVE IN REMOVING
LIVER FLUKES FROM CATTLE**

Another important wartime development for the control of livestock parasites
was the formulation by O. W. Olsen (13) of the Zoological Division of the Bureau
of Animal Industry of a medication containing hexachlorethane as its active in-
gredient. Hexachlorethane, a solid, closely related chemically to carbon tetrachlo-
ride and tetrachlorethylene, was introduced as a treatment for the removal of liver
flukes from domestic ruminants by European workers. Because it is insoluble in
water and dissolves in solvents which are more or less injurious to cattle, Olsen
tested a combination of hexachlorethane and bentonite—the latter being a finely powdered clay—for the preparation of an aqueous, anthelmintic drench. He determined that, in proper combination, hexachlorethane and bentonite form a stable suspension in water. The suspension is prepared by mixing the ingredients in the following proportions: 1 pound of finely ground hexachlorethane, 1¼ ounces of bentonite, and 25 ounces of water; the addition to the mixture of about ½ teaspoonful of white flour facilitates the mixing and tends to stabilize the resultant suspension (14). The mixing is done either with a power-driven apparatus of sufficient speed to insure an even distribution of the ingredients, or by passing the freshly prepared mixture twice through a 20-mesh screen. A measured dose of 6½ ounces of the suspension for cattle and half that amount for calves over 3 months old is administered with a metal dose syringe. This treatment removes most of the liver flukes harbored, especially the mature ones from cattle whose livers have not yet become extensively injured by the flukes.

Although treatment with hexachlorethane-bentonite suspension was first announced in June 1943, the preparation has been in commercial production for about two years. Considering the fact that liver flukes have a spotty distribution in this country, occurring principally in the Gulf Coast area and in the Rocky Mountain and Pacific Coast States, the treatment under discussion has already become well known and used with a marked degree of success by many cattlemen.

**SODIUM FLUORIDE IS AN EFFECTIVE ASCARICIDE**

A significant development in connection with wartime research in parasitology was the demonstration by parasitologists of the Federal Bureau of Animal Industry of a simple, inexpensive, and practical method of ridding pigs of ascarids—the most ubiquitous and most injurious parasites affecting swine. Despite the fact that ascarids are pests of swine the world over, that practically all swine producers are familiar with them, that they have been studied extensively by parasitologists for many decades, there was, until quite recently, no especially effective medication for their removal. Until the discovery of phenothiazine as an anthelmintic, oil of chenopodium (American wormseed oil) was the only known effective remedy for the removal of ascarids from swine. Aside from the fact that the average efficacy of oil of chenopodium for the removal of these pests is only about 70 percent, the administration of this drug presented the usual difficulties encountered in medicating swine individually, and involved, moreover, risks of producing more or less severe intoxication. The early enthusiasm over phenothiazine as a substitute for oil of chenopodium—especially because the former could be administered with the feed—could not be sustained by the results of subsequent investigations. The latter showed that phenothiazine was about as toxic to swine as oil of chenopodium and much less efficacious as an ascaricide.

In an effort to find a treatment that might prove less toxic and more efficacious than oil of chenopodium and phenothiazine, and that would lend itself to administration with the feed, parasitologists of the Federal Bureau of Animal Industry tested in 1944 and 1945 a number of flourine compounds. Sodium fluoride, a cheap and readily available chemical, was found to measure up rather closely to the most rigid requirements that might be drawn up for an ideal ascaricide.
the first place, it was determined that when admixed with feed in the proportion of 1 part by weight of the chemical to 99 parts of feed, sodium fluoride was not very distasteful to swine and was nearly always readily consumed. It was determined, moreover, that one day's feeding with this medicated feed, using the customary amount that would ordinarily be consumed in a day, was sufficient in the vast majority of the cases to remove in the course of about six days nearly all the ascarids harbored (15, 16, 17). Whether given to pigs individually, to pairs, or to groups ranging from 10 to 30 animals, feed medicated with sodium fluoride resulted in the expulsion of 90 to 100 percent of all the ascarids harbored. For the most part, the failure to attain a 100 percent efficacy in all cases was due apparently to the retention by one or more pigs in nearly each series tested of all or a relatively large number of these worms, due perhaps to the failure of the pigs in question to ingest sufficient quantity of the medicated feed.

Although sodium fluoride is known to be a toxic substance, it was not found to be significantly toxic to pigs when used for one or even two days in the manner outlined. Most of the symptoms observed, principally vomition and diarrhea, could not be definitely ascribed to the treatment because similar symptoms, especially diarrhea, were observed as frequently in control pigs as in those treated.

The almost uniformly successful results in expelling ascarids from about two hundred pigs of different ages and varying degrees of vigor that were treated experimentally with feed medicated with sodium fluoride, augurs well for the successful use of this drug by swine producers. Considering its ready availability everywhere in this country, its cheapness, ease of administration, and effectiveness in removing ascarids, sodium fluoride will undoubtedly become the drug of choice for removing from swine the most injurious of their internal parasites.

SKIM MILK AND WHEY PROTECT SWINE FROM INTERNAL PARASITES

The final item on this agenda relates to a wartime research accomplishment on the control of swine parasites by certain nutritional practices. This work, carried out in the Zoological Division of the Bureau of Animal Industry at Beltsville, Maryland, involved the feeding to pigs of either fluid or powdered skim milk, or whey. Either these dairy products were fed to pigs for three days in succession at intervals of two weeks, in lieu of all other feed, or they were fed once daily in lieu of the regular afternoon feeding of grain. When not fed skim milk or whey, the pigs received a balanced ration consisting of grain, tankage, and minerals. Even though pigs fed skim milk or whey as outlined were kept under conditions that favored the acquisition of heavy loads of gastrointestinal parasites, they escaped, for the most part, from acquiring any significant numbers of stomach worms, ascarids, nodular worms, and whipworms. Control pigs fed only the balanced ration aforementioned became rather heavily parasitized when kept in worm-ridden hog lots. Although the available evidence showed that pigs fed whey or skim milk developed pulmonary ascariasis under conditions of constant exposure to this parasitic infection, the migrating worms that reached the alimentary canal were evidently swept out, as were also the other species of parasites already mentioned, by the purgative action of the dairy products ingested.

It has been known for several decades, however, that cathartics of various kinds
are devoid of anthelmintic action and it cannot be concluded, therefore, that the purgative action of the dairy products used was solely responsible for the removal of the parasites. Whatever the underlying causes of the anthelmintic action of skim milk and whey might be, the patent fact is that, when used in the manner indicated, these products prevented the accumulation in the alimentary canal of pigs of various species of nematode parasites.

The growth rate of pigs kept free of worms through the nutritional management just outlined was significantly better than that of their litter mates not fed skim milk or whey and, therefore, more or less heavily parasitized. The differences in the weight gains in litter-mate pigs subjected to the two regimes of nutrition was at times very striking and afforded rather conclusive evidence of the important role of parasites in the economy of pork production.

Because of limited supplies of milk during the war, the facts here presented were published only in a scientific journal (18, 19) and not disseminated in the agricultural press. Although the feeding of dairy products to pigs is not recommended as a substitute for sound management to control swine parasites, this method of control should have a useful application in places where skim milk or whey is available and where other practices designed to control parasites are not or, for special reasons cannot be instituted.

**SUMMARY**

This rather sketchy and somewhat incomplete account of the progress made during the war in discovering new and improved methods of controlling livestock parasites, and implementing these discoveries in the interest of more efficient livestock production, brought out the following salient points.

1. The backlog of knowledge brought to light through peacetime research in agricultural parasitology was used extensively by livestock producers in meeting the heavy wartime demands for food, fiber, and other animal products.
2. Under the stress of war, deficiencies in existing information on parasite control were rather rapidly made up by the intensive application of the talents of research workers in parasitology to the solution of practical problems.
3. Because of wartime needs, attention was focused on chemotherapy for the control of livestock parasites and on developing labor-saving devices for medicating livestock to destroy external parasites and remove internal parasites.
4. The shortage of leather during the war focused attention on parasites injurious to the skin of cattle; the known methods of medicating cattle with rotenone-containing materials for the destruction of grubs were reexamined and improved in the interest of attaining a higher percentage of efficacy, and for the conservation of rotenone—a critical wartime chemical.
5. Considerable progress was made during the war in controlling, through the use of rotenone-containing substances, cattle grubs and lice and in improving methods for eradicating sheep ticks.
6. Phenothiazine was used extensively for the control of internal parasites of domestic animals, especially for the expulsion of roundworms from horses, cattle, sheep, and goats.
7. A labor-saving method of controlling roundworms of sheep was developed
WARTIME DEVELOPMENTS IN PARASITE CONTROL

during the war, the method consisting of a free-choice ingestion of a phenothiazine-salt mixture in a ratio of 1 to 9.

8. A suspension of hexachlorehane and bentonite was developed for medicating cattle to remove liver flukes.

9. Through experimentation with fluorine compounds, it was determined that 1 per cent sodium fluoride in the feed, given for one day, removed from pigs nearly all ascarids—the most injurious parasites affecting these animals.

10. Skim milk and whey fed to swine daily, or intermittently as outlined, prevented the acquisition of the most injurious gastrointestinal parasites.

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REPORT OF COMMITTEE ON PARASITIC DISEASES


The total meat production in 1944, estimated on a dressed-weight basis, will probably exceed twenty-five billion pounds, according to an estimate made by the Bureau of Agricultural Economics, United States Department of Agriculture. This estimate is about 50 percent higher than the average animal production of meat in the period, 1935-1939.

That our livestock growers and meat industry have met such unprecedented requirements for animal foods, in the face of a labor shortage and other obstacles, is a tribute to their resourcefulness. It is, moreover, a tribute to livestock sanitarians whose labors over a period of several decades have so reduced the risks from diseases as to make such production possible.

Among the factors that militate against efficient and economical production of livestock are zooparasites—protozoa, helminths, and arthropods. The damage that parasites inflict results in death losses; impairment of growth; decreased vigor; impairment of reproductive capacity; waste of food; enormous damage to hides; lowered production of fiber; and decreased supplies of intestines for sausage casings and absorbable sutures.

Research has provided efficient chemical and other weapons to cope with many of the most damaging parasites that stand in the way of essential goals in livestock production. That the offensive and defensive weapons developed through scientific research are being used to step up the production of livestock is amply attested by the increasing interest shown by our livestock producers in parasite prophylaxis and by the unprecedented marketing of drugs and chemicals developed for combating external and internal parasites of livestock and poultry.

**DDT IN THE CONTROL OF PARASITES**

Probably for the first time in our national life, the most significant developments of the year affecting the control of livestock parasites have come about in consequence of the termination of war rather than as a result of immediate investigative activity. The insecticide DDT, which played so important a role during the war, has now become available for civilian livestock uses; the rotenone-containing products such as derris and cube, pyrethrum, and other materials that were scarce have also become generally available for all indicated uses after some five or more years of restriction. Some of the other parasiticidal materials whose increased availability has come about with the end of the war are phenothiazine, the chlorinated hydrocarbons, arecoline, and barium antimonyl tartrate. The future of livestock parasite control is therefore brighter than it has been for many years.

DDT promises to become a preferred weapon in the control of many species of parasites and pests. Suitable preparations are destructive to lice, fleas, houseflies, stableflies, and brown dog ticks. This chemical does not offer promise of usefulness
for the control of cattle grubs or heel flies, screwworms, or mange mites, and the results of tests against most species of ticks have not been entirely satisfactory.

Dusting powders containing up to 10 percent of the chemical, and sprays, dips, or washes containing somewhat lower concentrations in non-absorbable forms, do not appear to present serious risks of intoxication to animals. In most instances, lower concentrations are adequate to achieve the desired action. Thus, dusting powders containing about 4 percent DDT, sparingly used, appear to be quite efficacious against fleas and lice, while sprays, dips, and washes containing less than 1 percent of the chemical in aqueous suspension appear to be about equally efficacious. For controlling flies, residual 5 percent sprays are very effective. Studies of the toxicity of DDT show clearly that careless, indiscriminate, or other unwise use of the chemical may lead to serious intoxication of man and animals, or to the destruction of certain useful insects and plants. Large doses internally, or very small doses, given repeatedly or continuously, are likely to be especially injurious. Symptoms of intoxication are referable in large measure to the nervous system.

A newer insecticide, called gammexane, has been developed by the British. This is of chief interest not because of its alleged superiority to DDT but on account of its possible complementary action. Gammexane, unlike DDT, appears from limited tests to be effective in destroying mites. It seems possible, therefore, that this new agent may prove useful in combating sheep and cattle scab, poultry mites, and various forms of mange in dogs and other animals. The chemical is not generally available in this country, and, of course, the time is not ripe for considering recommended uses and formulations.

USE OF ROTENONE AND OTHER DRUGS

Rotenone is still uniquely effective among treatments against cattle grubs. Dipping to destroy these parasites has not been a common practice, but investigations have shown that this method may be used to advantage in areas where the winters are not unduly severe. Solutions containing 10 pounds of derris or cube powder, of 5 percent rotenone content, in each 100 gallons of water kill at times from 90 to 95 percent of the grubs, and, at the same time, destroy all of the lice that are on an animal at the time of dipping. Moreover, some of the dip remains on treated animals and continues to kill some of the newly appearing grubs and to keep the animal free from lice for some time, depending upon rainfall and other factors.

Dilute rotenone dips have proved effective against sheep keds. Suspensions prepared with 6 ounces of derris or cube powder in each 100 gallons of water kills all of the active "ticks," or keds, and remains on the skin and in the wool for a sufficient length of time to destroy all the new "ticks" as they emerge from their pupal cases. Sheep must be held in the suspension for about one minute or until the fleece is thoroughly wetted, and desirably the heads should be immersed twice.

Fleeceworms, ranking next to screwworms in the injuries caused by their infestations of sheep, can be killed by a new remedy known as Formula M.S. 793F. The remedy consists of a proper mixture of benzene as a killer, diphenyl as a protective chemical, Triton 770 as a wetter, and normal butyl alcohol as a combining agent. The mixture is safe, effective, readily available, and inexpensive. It penetrates the wool, thereby eliminating the necessity of shearing before treatment, killing the
grubs upon contact, and coating the wool and skin to give protection against reinfection.

In treatments for the removal of internal parasites, there are relatively few new developments in the use of phenothiazine, although this drug continues to be the most widely used of all livestock anthelmintics. Experience with the free-choice administration of phenothiazine in salt as a measure for controlling gastrointestinal roundworms of sheep and goats emphasizes that healthy stock, clean pastures, the early institution of the free-choice regimen, and the exercise of responsible surveillance are indispensable requisites to the success of the method. Limited trials with goats suggest that a system of weekly salting with loose mixtures of phenothiazine and salt in the proportion of 1 to 7 affords considerable protection against internal parasites. The results with this regimen are somewhat inferior to those generally achieved by continuous self medication, but the measure is sufficiently preventive of serious gross parasitism to warrant trials by stockmen who habitually salt their animals about once weekly. The principle may also be applicable to the control of parasitism in range sheep, for which it is not feasible to provide continuous therapy on account of the fixed location of the salt feeders. Finally, a review of the suitability of phenothiazine for hogs indicates that this drug removes only about half of the large roundworms from these host animals and is comparatively toxic; oil of chenopodium, on the other hand, is more efficacious, but lacks the advantage of easy administration and exhibits comparable toxicity. These considerations have indicated the need for a more satisfactory drug for use as an ascaricide for swine.

Trials with sodium fluoride under experimental conditions have shown that this chemical merits consideration as a swine ascaricide. Suitably administered, it appears to compare favorably with either phenothiazine or oil of chenopodium as to safety, and is more efficacious than either of these drugs. Moreover, the chemical may be administered in feed to a group of pigs at one time, in which respect this treatment possesses the particular advantage of phenothiazine. Present information indicates that the administration of sodium fluoride at the rate of one percent of the feed for one day may be expected to remove over 90 percent of the large roundworms without risk of injury to the animals.

**SODIUM BORATE IN CONTROL OF POULTRY COCCIDIOSIS**

Of all the treatments that have been tested for prophylactic or curative action in poultry coccidiosis, only sulfur and a few of the sulfonamides have, until recently, shown indication of beneficial action. Preliminary trials with a technical grade of sodium borate suggest that the feeding of a mash containing 2 percent of the compound, or the provision of a 0.3 percent solution in place of the regular drinking water, may afford some measure of control of coccidiosis. The treatment should not be continued for a longer period than 4 or 5 days on account of its very definite toxicity, but it is of particular interest because the treatment appears to be protective if its administration is begun as late as the fourth day after exposure. This suggests that considerable practical benefit might result from prompt use of this chemical when an outbreak of coccidiosis is clearly imminent, as might be indicated, for example, by the appearance of bloody droppings and a scattering of sick birds. This consideration is founded upon the premise that outbreaks of the disease are often sufficiently devastating to warrant relatively heroic measures of control.
PITCH POISONING IN SWINE


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Pitch poisoning of swine results from the consumption of substances contained in the residue of the fractional distillation of coal-tar. The mortality rate is very high. Coal-tar, pitch poisoning and clay-pigeon poisoning are other terms used to designate the disease.

While pitch poisoning is not a condition that occurs with epizootic-like proportions, nevertheless its occurrence in a drove of swine often presents characteristics usually associated with infectious and contagious diseases. For this reason it seems desirable to bring attention to certain pathological changes that are usually present when pigs die as a result of pitch poisoning. During the past decade pitch poisoning in swine has been diagnosed in our laboratories on twelve different occasions, and each was from a different geographic location.

The literature contains but few references to this very interesting condition. In 1940, Graham, Hester and Henderson (1) record studies of coal-tar pitch poisoning in swine. They described its occurrence on four different places during the period between 1935 and 1940. It was not until their fourth case came for observation that they began to associate its occurrence with the ingestion of expended clay-pigeons. Further investigation of their earlier cases revealed that the first of their cases did have access to some expended clay-pigeons. It was not possible to obtain definite evidence in the second and third cases which came to their attention. These authors point out that the most prominent gross lesion in all the pigs examined was a degeneration of the liver. The symptoms were also said to be quite similar in all cases, and the bacteriological studies of these cases yielded negative findings.

The findings in these cases brought about further investigation. Graham et al mixed powdered clay-target remnants with the feed that was given a series of five nine-week old pigs. The test substance was fed at the rate of fifteen grams per pig per day. On the fourth day of the trial the pigs refused the feed mixture whereupon each was given six grams of the powdered clay-targets in a capsule. This was done for two days. All five pigs died eight to twenty days later. At autopsy four of the pigs showed evidence of liver injury whereas no gross hepatic changes were observed in the remaining pig. In a second experiment five more pigs were fed as in the earlier trial but received in addition five grams of lead shot administered by capsule. Thus, a total of twenty-five grams of lead shot and fifty-seven grams of powdered clay-targets was received by each pig. Four of the pigs died in eight to twenty-two days, and hepatic lesions were found in each case. The surviving pig was destroyed after sixty days, but no gross hepatic injury was observed at autopsy. A third experiment designed to note the part that lead shot might have in the development

1 Paper No. 2264, Scientific Journal Series, Minnesota Agricultural Experiment Station.
Fig. 1. Photograph of lobule of liver of pig showing toxic degeneration due to pitch poisoning. The necrosis usually begins near the center of the lobule; occasionally it may develop mid-way between central vein and boundary of lobule (×90).

Fig. 2. Higher magnification of a portion of a liver lobule of pig. The central degenerative area is packed with erythrocytes, red cells undergoing lysis, and particles of hemosiderin (×250).
of this picture indicated that the liver disturbance apparently was not related to the effects of lead. One of this group died within thirty days, and the others were destroyed on the fifty-eighth day. The death was reported due to a marked hemorrhagic gastritis, and the shot was recovered from the area in the stomach where they had accumulated. No evidence of disease was observed in those that were sacrificed and none of the shot was recovered. These pigs each received a total of twenty-five grams of lead shot over a five-day period. In a fourth experiment, liquid coal-tar was administered in capsules. Three grams were administered to each of three pigs for five successive days. All died within ten to eighteen days. Diffuse degenerative hepatic changes were pronounced in each of the three pigs. Two more pigs were given the same sized dose, but for only two days. One died about a month later; the second was sacrificed after another month, but no gross liver injury was found in either of these two pigs.

Giffee (2) reported several cases of pitch poisoning in swine observed by different veterinarians. He tells how one of the veterinarians wished to reproduce the condition for demonstrational purposes before a regional clinical conference. Two pigs were selected to receive portions of clay-pigeons with their feed, but since neither manifested any untoward signs of illness on the morning said conference was to convene, they therefore were left behind. However, during the day one of the pigs died and when examined at autopsy, it manifested changes in the liver which were characteristic of the disease. The second pig of the group remained well. Mention is made of a farmer who no longer attempts to raise swine in a certain pasture because of the many expended clay-pigeons found lying about. Giffee described a case in which the history pointed to some coal-tar pitch used in sealing a gas pipeline as the most likely source of the offending material.

Quin and Shoeman (3) described a disease in swine which they designated idiopathic hemorrhagic hepatitis. The specific etiology of the cases they observed was quite obscure except to add that the examinations of some of the typical cases failed to disclose a specific bacterial cause; and, in some respects, viral agents could be excluded. The pathologic picture, however, is very similar to that which has been observed by the writers in pitch poisoning. However, it was later ascertained that the pigs in this case had been exposed to expended clay-pigeons and in all probability was the basis for the condition they observed.

SYMPTOMS

Death is about the only physical manifestation of an impending ailment in most instances. The immediate history merely is that the pig was dead when found. It appears that there are no particularly noticeable symptoms displayed until the disease approaches its final stages, and this covers only a short period of time. Careful inspection may reveal signs of icterus, manifested by a yellow discoloration of the visible mucous membranes and skin, especially in animals with a white skin and haircoat. The rate of respiration may be increased, and it may be "thumpy." The rectal temperature is not elevated as a rule. There are signs of weakness and depression.
POST-MORTEM FINDINGS

Icterus, although not always present, is usually the first indication of an abnormal condition when performing a post-mortem examination on a pig dead from pitch poisoning. There is a diffusion of the bile pigments from the blood into the tissues causing them to take on the yellowish and characteristic jaundiced color. There is generally an excess amount of fluid in the pericardial sac and abdominal cavity. This too may have a yellowish tinge. The lymph nodes are usually swollen and hemorrhagic.

The outstanding lesion, usually noted as soon as the abdominal cavity is opened, is a greatly enlarged liver and its signs of degenerative changes. The liver is engorged with blood and is quite friable. It has a peculiar color arrangement, giving it a speckled appearance. Many of the lobules are distinctly outlined and one is impressed with its architecture. The center of the lobules appear as red dots that are slightly larger than the head of a common pin. This is surrounded by a lighter colored zone. When the liver is sectioned with a knife and pressed or squeezed, a thick, red ink-like material will exude. These liver changes have always been observed in those animals which have died suddenly. Pigs that were ill for several days and then sacrificed for autopsy purposes do not as a rule show the extensive liver damage; but, instead, the area about the margins of the lobes may be the only part of the liver to show the change. It would appear that these changes are almost definitely characteristic of pitch poisoning since they have not been seen in the livers of many hundreds of other pigs that were sick or died from other causes.

From the standpoint of microscopic changes in the liver, the lobules are either partially or almost completely filled with blood. Generally the hemorrhage begins at the center of the lobule and extends toward the periphery, but not infrequently it is mid-zonal between the central vein and periphery. Not all lobules are involved since in some areas only one lobule in a low power field is involved, and the others appear quite normal. On the other hand, all the lobules within the entire field are involved as a rule. High magnification shows the hemorrhagic infiltration to be of more recent occurrence in some areas and of longer standing in others. In case of the former the red cells are intact and not packed tightly together, whereas in other areas there is much evidence of red cell destruction and lysis with particles of hemosiderin being present.

BACTERIOLOGICAL FINDINGS

Many attempts have been made to isolate organisms from the liver and other organs of pigs dead from pitch poisoning, but thus far the results have been consistently negative.

FACTORS PERTINENT TO ITS OCCURRENCE

A short discussion of some factors pertinent to the cases of pitch poisoning that have come to our notice will serve to show some of the circumstances that surround its occurrence. In one case in which the pathologic picture of pitch poisoning was unquestionably typical of the disease, we were assured by the owner that such a diagnosis was a bit far-fetched because it was definitely known that trap-shooting
had never been performed in the pasture occupied by the affected swine. He had lived on his present location for twenty years and was certain that trap-shooting had not occurred there during that period. He left our laboratory in a spirit of disappointment but returned a few days later to inform us that after reaching home he learned that a small gun club operated in this pasture approximately fifteen years prior to his occupancy. This suggests that a pasture or field containing fragments of clay-pigeons or other coal-tar pitch containing material may be a potential source of danger to the life of swine for many years.

In one instance we were able to obtain rather precise information with regard to the matter of time elapsing between what could be first contact with expended clay-pigeons and the occurrence of lethal cases. The history disclosed that three of a group of a dozen spring gilts died from pitch poisoning. The entire group had been placed in the particular pasture on a particular day. The first death occurred twenty-one days from the date they were placed in this pasture; the second death occurred on the twenty-second day, and the third on the twenty-third day. The pigs were then moved to another pasture. Inspection of the pasture revealed that along the fence row of one side pieces of clay-pigeons could be picked up without much searching. This was especially true of the side without the pasture and where the grass was several inches tall. This was the side toward the skeet and straight-away traps. It was much more difficult to find pieces of clay-pigeon targets within the pasture even a short distance from the fence. We, of course, had no knowledge of the time when the affected pigs ate some of the offending material nor of the amount they may have consumed. This they may have done the first day they went on to the pasture, or it may have been but a few days previous to their death.

Another interesting case history shows the necessity of continuing the search for the likely source of the coal-tar pitch containing material in order to have a greater supporting evidence for the diagnosis. The pig when examined at post-mortem, revealed lesions that are characteristic of pitch poisoning; and, when the suggestion was made with regard to its relationship to the ingestion of clay-pigeons, we were immediately informed and assured that such a situation was entirely impossible under the present circumstances. Further questioning revealed that the pig in question had developed a habit of eating tarred roofing paper that had been placed around the base of several farm buildings to protect against frost. The death occurred suddenly without previous signs of illness, according to the owner.

**DISCUSSION**

Pitch poisoning is a disease entity of swine that may occur where pigs have access to coal-tar pitch or coal-tar pitch containing substances. Its occurrence should always be traceable to some rather definite source of this sort of material. One of the more common sources appears to be the clay-pigeon targets used in skeet and trap-shooting. Our experience with the condition coincides very closely with others who have encountered this disease. While most of our cases have been in swine from three to six months of age, there should be no reason to suspect greater susceptibility among this age group to the exclusion of others. In fact, one of our cases was that of a more mature female, eleven to twelve months of age.
Just what particular substance or substances in the pitch is responsible for the marked liver destruction is not known. Clay-pigeons for example contain many ingredients and to determine the particular toxic portions may entail considerable study. There is good reason to believe that whatever this may be, it remains a potential danger for many years even when exposed to natural climatic changes.

In view of the fact that skeet-shooting and trap-shooting are likely to continue as a popular sport with many persons, it seems advisable that we as guardians of livestock health and disease control keep mindful of the fact that premises where this sport is engaged in should never be used as pasture for swine.

It is believed that this sport will increase in popularity, since many veterans of World War II, and especially those that received instruction and practice in this sport as part of their training, will wish to continue. Furthermore, many of the gun clubs that were inactive during the war-time period will most likely be revived and, no doubt, new clubs will be formed. Reports on the sale of hunting licenses in some of the states, especially the north-central states, show that there has been a great increase in the numbers of licenses issued. This is just another indication of the possible increased use of clay-pigeon targets to improve the hunter's shooting ability.

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SWINE ERYSIPELAS

BY C. C. MERRILL, D.V.M., M.S.

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The scope of this presentation is necessarily restricted to first-hand observations in the diagnostic laboratory, time limitations not permitting the compilation of data from other sources by questionnaire or other method. Such information as I may be able to present—or, at least, that portion of it which may be in any sense original—is based upon observations made at the Department of Animal Pathology and Hygiene, University of Illinois. It is recognized that, at best, general conclusions for application to the overall picture may be drawn only with care from such information and my presentation is made therefore with the admonition that it be regarded at face value only in appraising the problem in various localities and with the hope that some profit may result.

In 1937, Dr. Frank Breed reported to this association the results of a survey of the incidence of swine erysipelas and presented convincing evidence of the growing importance of the disease. If any practicing veterinarians, laboratory diagnosticians or regulatory officers in the great swine-producing areas were left unconvinced at the time, it seems probable that subsequent developments may have added the persuasion necessary to the establishment of a healthy respect for this disease and its profit-destroying propensities. The slow but relentless spread of swine erysipelas has indicated to us in Illinois that in the absence of any effective sanitary barriers against the disease, the sooner we learn how to accurately diagnose the disease and effectively curb the losses due to it, the better for the swine industry and for all of us.

Occasional cases of swine erysipelas have been diagnosed in Illinois since 1920 when the first significant outbreak was brought to the attention of the Illinois Agricultural Experiment Station. This graph indicates the relative frequency with which the disease has been diagnosed in our laboratory during the decade, 1935-1944 inclusive. You will note a decided increase in the number of cases beginning in 1941. While this indicates only those outbreaks diagnosed at the laboratory, I believe it is a fair expression of the trend in this state. You will note that there is no apparent tendency toward a decline as yet. I might say that, with but a few exceptions, these diagnoses were based upon isolation of the causative organism by direct culture or pigeon inoculation. In those few cases in which this was not true, the diagnoses were established beyond reasonable doubt on the basis of history, and clinical, post mortem and serological findings.

Swine erysipelas is generally described as occurring less frequently in winter than in spring, summer, or fall. Our records support this idea. We noted a tendency toward a high spring and summer incidence and a rather definite peak in October. This is also born out in the record of the diagnoses made during the decade, 1935-44. Here also we find the higher spring and summer incidence and the October peak.

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The age incidence of swine erysipelas (fig. 2) in Illinois as based upon the approximate average age in months of pigs involved in the definitely diagnosed out-

Fig. 1. Swine Erysipelas, 1935-1944. Annual incidence as encountered in Laboratory Diagnosis Department of Veterinary Pathology and Hygiene, University of Illinois.

Fig. 2. Swine erysipelas. Age incidence in outbreak diagnosed at Department of Veterinary Pathology and Hygiene, University of Illinois, July 1, 1943 to October 1, 1945.

breaks between July, 1943, and September, 1945, on which the information was available is shown in this graph. Note that it is during the first four months that the majority of outbreaks appear. The fact that the incidence is high (nearly
16 per cent) even during the first month of life emphasizes the need for early pro-
phylactic treatment on farms where the disease has proved to be a problem. The
meaning of the slight upturn of the curve at the seventh month is not clear. It may
be purely fortuitous, or it could represent in part the breakdown of a declining
active immunity which had been engendered by the culture-serum method of
inoculation, although the number of instances in which there was a definite history
indicating the latter condition was very, very few.

There appears to be no definite relationship between the incidence of swine
erysipelas and the presence or lack of immunity against hog cholera. At any rate,
of those outbreaks among pigs over two months of age after which one might
expect a majority of pigs to have been immunized against hog cholera, 58 percent
occurred among pigs which had been inoculated against hog cholera, while 42 per-
cent occurred among pigs which had not.

No attempt is made here to divide for statistical purposes this disease into what
are often considered its several types. The insensible merging and overlapping of
the various manifestations in many cases make the value of an attempt at such a
division into clear-cut types questionable. The diagnostician, whether he be
practitioner or laboratory worker, however, must be aware of all the manifestations
of this disease as well as similar manifestations of other diseases from which it
must be differentiated.

The various symptoms have many times been very ably described in the literature
and many of you are familiar with them from first-hand experience. However,
it may be worth recounting a few of our experiences in the laboratory with respect
to the differential diagnosis of swine erysipelas. It may be said by some that the
laboratory diagnostician with the various laboratory aids at his disposal should
seldom err in his diagnosis; on the other hand, he is often at a distinct disadvantage
in that the clinical manifestations in the one or two animals submitted for diagnosis
are not representative of the herd condition. It is often very helpful, therefore, if
the veterinarian will take the time to write down a brief summary of the symptoms
and history to send to the laboratory with the animal when he is too busy to come
himself. If he sends the owner in, it is still very desirable that he send a brief
description of the symptoms as he sees them. While the owner may in some
instances be able to give a fairly accurate description, too often his untrained eye
will not observe some things which are really significant. To point out some of the
problems of diagnosis and at the same time review some of the symptoms and
lesions of swine erysipelas I should like to review a few cases. First is a case of
acute swine erysipelas, typical enough that the practitioner who has observed even
a few cases probably would not hesitate to make a diagnosis after observing the
soreness of joints, bright clear eyes, and temperatures of 107° to 108° F. in several
animals. I remember one case in particular though which showed much the same
clinical picture when brought to the laboratory except the body temperature was
not so high. Thinking the fever has passed its peak, which is generally maintained
only a short time in swine erysipelas, we made a tentative diagnosis of swine erysip-
elas. Upon bacteriologic examination, we were unable to isolate the causative
organism of that disease, but instead obtained a pure culture of Salmonella chol-
Swine Erysipelas

From the joints. The history in the case had not been particularly helpful as a guide, and, in my estimation, the clinician might have been misled early in the outbreak as were we.

Case number two was submitted with a body temperature of 107°F., showing rather marked depression and posterior weakness. Post mortem findings were not conclusive, suggesting only the probability of a septicemia. Even though there was a history of hog cholera virus and antiserum inoculation at three weeks of age, the clinical picture suggested cholera so strongly that it was still considered a likely possibility. Bacteriologic examination, however, revealed Erysipelothrix and thus formed the basis of a diagnosis of swine erysipelas. These have been examples of acute swine erysipelas.

A third group of animals was submitted showing a scurfy skin, stiffness, arched backs, walking on toes and, in one case, refusal to stand on the hind legs at all. All but one animal reacted to the agglutination test for swine erysipelas. Body temperatures were within the normal range. There was little visible enlargement of joints. The history indicated a good possibility of a disturbance of mineral metabolism, since they had been without a mineral supplement for some time and when, recently, such a supplement had been set before them they had partaken very freely of it. One animal died quite suddenly and, upon post mortem examination, a ruptured stomach was found, the rupture having been preceded by a severe gastritis which appeared to have been due to some corrosive material. Bacteriologic examination failed to reveal the presence of Erysipelothrix. A second animal appeared to be failing, so it was sacrificed for post mortem examination. Again we failed to isolate the causative organism of swine erysipelas, so we decided to set up a feeding trial with the remaining five animals in an effort to determine whether the condition could be relieved or aggravated by various rations. One animal was given corn alone; the second, corn and tankage; the third, corn, tankage and a simple mineral mixture; the fourth, corn, tankage, mineral and cod liver oil at a therapeutic level; the fifth, corn, tankage, mineral and an excess of vitamins A, D, E, C, and B complex. The results of this trial were inconclusive except for the fact that ultimately all animals either died or became definitely unmarketable. In no case was the causative organism of swine erysipelas isolated. The problem: a correct diagnosis.

Fortunately, not all cases are so complex. The arthritic or joint form generally causes distinct enlargements. One of the more common sites of the enlargement is the lower anteromedial aspect of the tarsus; also frequently involved is the carpus. In some cases the condition might perhaps be more properly termed a periarthritis, being characterized by thickening of the joint capsule, with fibrotic changes and later even exostoses, while the articular surfaces remain intact. In other cases the articular surfaces are affected with adhesions forming between opposing surfaces, limiting movement very markedly. In other words, ankylosis may occur.

Among the cases brought to the laboratory the classical lesions of diamond-skin disease are not commonly seen. However, we have seen cases which were observed after slaughter. Occasionally pigs are brought in with curled ears or with slough-
ing of the tips of ears or of tail. We seldom see cases with an extensive sloughing of the skin; however, the history obtained when specimens are brought in indicates that such a process may occur not infrequently.

The vegetative endocarditis so often mentioned is observed only occasionally. In our laboratory it has been recorded in less than 2 percent of the swine erysipelas cases. The left atrio-ventricular valve is probably the most frequently involved as in this case; however, the next slide shows a case in which both the atrio-ventricular valve and the semi-lunar valves of the pulmonary artery were affected. We have also observed one case in which only the semi-lunar valves of the pulmonary artery were involved. I can confirm the warning of Doctor Kernkamp in 1941 to the effect that not all such growths represent swine erysipelas. Streptococci may cause lesions grossly indistinguishable from these. Although it may sometimes be necessary to culture such lesions, we have frequently been able to differentiate between the two etiologic factors by direct examination of Gram-stained smears made from the growths.

Although on occasion we have been unable to isolate Erysipelothrix when everything seemed to indicate that it should be present, the isolation is usually accomplished with little difficulty. We have recorded the relative frequency with which it has been isolated from those tissues proving most fruitful in this respect in our laboratory in the period from July, 1943, to September, 1945. The kidney has yielded the organism most frequently, with spleen, liver, and affected joints following in that order. In our experience the kidney has seldom been selected by veterinarians sending in tissues only for bacteriologic examination. However, our data indicate that it is the organ of choice. Erysipelothrix has been isolated from other tissues—even from the brain on one occasion. However, the brain is not usually cultured unless evidence of an encephalitis or a meningitis is present. It is probable that lymph nodes would, if properly selected, provide a good source of the organism. On some occasions we have isolated the organism from the skeletal lymph nodes when the rest of the carcass was in a rather advanced state of decomposition. In these cases we believe we have been able to use to good advantage the Edwards medium with its bacteriostatic effect on the common contaminants, although we have not made many direct comparisons of this with other media.

When it was evident that swine erysipelas was becoming a problem in Illinois, the Department of Animal Pathology cooperated in an experimental project with the state and federal authorities in an attempt to curb the disease following the plan initially employed in Nebraska. This project involved the production and distribution of the living culture of *Erysipelothrix rhusiopathiae* to practicing veterinarians for the simultaneous inoculation of pigs with serum and culture for swine erysipelas prophylaxis. Between March 1, 1942, and June 30, 1944, 120,563 pigs were vaccinated in infected herds or on contaminated premises. Of 1056 herds on which reports were received, erysipelas developed subsequently in 36 herds or 3.41% while the results were reported as satisfactory in 1007 herds or 95.36%. These results suggest that, in spite of certain disadvantages to the employment of the living culture, this procedure constitutes a relatively satisfactory method of curbing
the disease on infected premises, confirming in a measure the results obtained in Nebraska. It should be emphasized, however, that the success of its use depends upon a correct diagnosis.

Before concluding, I should just like to remind those who may have a tendency to grow careless in the handling of either live or dead infected animals or the living culture of Erysipelothrix that this organism is quick to cause troublesome infection in man when introduced through a slight cut, needle prick or other wound. While most such infections terminate favorably, the course of infection may be long drawn out, or may in a few cases be complicated by arthritis, extensive cutaneous eruptions, heart valve lesions, or even death.
REPORT OF COMMITTEE ON TRANSMISSIBLE DISEASES OF SWINE


Your committee has again surveyed the swine producing section of this country for the purpose of ascertaining pertinent information on transmissible diseases of swine. The inquiry was directed to the livestock sanitary officials of the states comprising this section and sought knowledge concerning the increased or decreased prevalence of the more important contagious bacterial, viral, parasitic and protozoan diseases.

The survey conducted a year ago was reported to the 48th annual meeting of this Association. At that time the committee was privileged to announce that the transmissible diseases of swine in 1944 were not prevalent to an extent that could be considered of pandemic proportions or even approaching such proportions. This, the committee recognized as a very satisfactory situation and gave as their reason for it the fact that the year previous the swine population of the region was the largest ever known and therefore constituted a greater potential source of infectious vectors that might have been carried over to the next crop of pigs. The results of the survey for the present year are even more gratifying. In general, the prevalence of the transmissible diseases for the region as a whole, shows a declination over the prevalence in 1944.

More specifically we are able to state that all the reporters indicated a decrease in the amount of hog cholera in 1945 over 1944. With the exception of two states, there was a lesser amount of swine erysipes this year than last. Swine influenza is said to have increased in prevalence in one state, remained static in occurrence in one state but had decreased in prevalence in all others.

The one infectious disease that practically all reporters indicated was increasing in their states is brucellosis. This was also the case a year ago. The significance of this suggests that more precise surveys be made on brucellosis in swine in the hope of obtaining information that can be useful toward evaluating the probable amount of this disease that exists and of its geographic distribution. Tuberculosis is reported as occurring in greater amount in five of the states surveyed and in another five, it is said to be on the decrease.

The "enteritis complex" (necrotic enteritis, infectious enteritis, Salmonellosis, dysentery, "bloody scours"), according to the reply of a majority of the reporters, has neither increased or decreased in 1945 over 1944. This is also the case with those diseases due to parasites.

While we appear to be in a very favorable position at the present time with respect to the decreasing prevalence of some of the diseases of swine which tend to reduce their population quite readily it would do well to bend our efforts toward maintaining this position and work to make it even more favorable.

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EXPERIMENTAL AND FIELD STUDIES OF CANINE RABIES VACCINATION

BY HARALD N. JOHNSON, M.D.

Rabies Laboratory, State Board of Health, Montgomery, Alabama

A series of experimental studies designed to determine the effectiveness of canine vaccination for the prevention of rabies has been completed. Some of these studies have been published(1)(2)(3). Additional information as to the duration of immunity following the single injection method of vaccination and the effectiveness of the three injection method of vaccination is presented. The rabies control program in Alabama has furnished further information about canine rabies vaccination. Vaccination of dogs for rabies has not been practiced in all counties. The statistics on rabies are given for active and nonactive counties and the problems of enforcement are discussed.

EXPERIMENTAL STUDIES OF CANINE RABIES VACCINATION

The studies that have been reported previously are summarized in Table I. The vaccines tested were from commercial sources. Each vaccinated dog received a single 5 ml. dose of vaccine by subcutaneous injection. The test inoculation was given at one month after vaccination. The vaccinated and control dogs each received 0.5 ml. of a 1:10 suspension of dog brain street virus given into each masseter muscle. The animals were observed for a period of three months after test inoculation.

Experiment 1 was a test of a phenolized vaccine of ovine origin containing 20 per cent brain tissue. Of 105 vaccinated dogs, twenty-six, or 25 per cent, died of rabies compared to sixty-six of 120 control dogs, or 55 per cent. Experiment 2 was a test of a chloroformized vaccine of equine origin containing 334 per cent brain tissue. Of fifty vaccinated dogs only two, or 4 per cent, died of rabies compared to thirty-four of fifty-five control dogs, or 62 per cent. Experiments 3, 4, and 5 represent a study of the effect of prolonged storage on the antigenicity of a chloroformized vaccine of equine origin containing 334 per cent brain tissue. A single lot number of vaccine was tested after 4.5, 10.5, and 16.5 months' storage at 4°C. In the first test of this vaccine after 4.5 months storage, two of the thirty-two vaccinated dogs, or 6 per cent, died of rabies compared to twenty of thirty-six control dogs or 56 per cent. In the second test of the vaccine after 10.5 months storage, four of thirty-eight vaccinated dogs, or 11 per cent, died of rabies compared to twenty-seven of forty-one control dogs, or 66 per cent. In the third test, after 16.5 months storage, six of forty vaccinated dogs, or 15 per cent, died of rabies compared to twenty-five of thirty-nine control dogs, or 64 per cent. Summarizing the data for the three groups of dogs vaccinated with this single lot number

1 The studies and observations herein reported were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation and the Alabama State Board of Health.
of vaccine, twelve of 110 vaccinated dogs, or 11 per cent, died of rabies compared to seventy-two of 116 control dogs, or 62 per cent. Experiment 6 was a test of a phenolized vaccine of equine origin containing 33\% per cent brain tissue. Of thirty-one vaccinated dogs, three, or 10 per cent, died of rabies compared to twenty of thirty-six control dogs, or 56 per cent.

The experiments noted above have shown that dogs vaccinated by the single injection method have a high degree of immunity to rabies at one month after vaccination and that rabies vaccine does maintain its potency for at least one year after preparation. It was then decided to investigate the duration of immunity following the single injection method of vaccination. In view of the failure to obtain a 100 per cent mortality for control dogs inoculated intramuscularly with rabies street virus, a large group of dogs was used in this study in order to obtain significant results. Fifty-two dogs were designated for the vaccine group and fifty-two dogs of the same age were selected for the control group. The dogs were from nine to thirty-eight months of age at the beginning of the experiment. A single lot number of phenolized vaccine of ovine origin, containing 20 per cent brain tissue, was selected for this study. It is of interest to note that this vaccine was of the same type and source as that used in Experiment I. Improved methods of production have been adopted and preliminary tests of the product in mice showed it to be of comparable antigenicity to that of chloroformized vaccines. In March, 1944 each of fifty-two dogs was given 5 ml. of this vaccine by subcutaneous injection. The vaccinated and control dogs were held for observation for one year. Studies were made also of the development and persistence of virus neutralizing substances in the blood serum of the vaccinated dogs. In reporting the studies of the single injection method of vaccination given above, it was noted that the test virus inoculation was very severe as compared to what one might expect with natural exposure. In order to simulate natural exposure a standard street virus suspension was prepared from the submaxillary salivary gland tissue of a dog dying of furious rabies. This has been kept in sealed glass ampoules in a carbon dioxide dry ice chest and has maintained its virulence over a two year period. For test inoculation, this material is diluted so as to approximate the maximum virulence of naturally infected dog saliva. Intramuscular titration of this virus in dogs revealed that a high mortality could be obtained by this method. In

<table>
<thead>
<tr>
<th>EXPERIMENT</th>
<th>VACCINATED DOGS</th>
<th>CONTROL DOGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of dogs</td>
<td>Died of rabies</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>3</td>
</tr>
</tbody>
</table>
March, 1945 the fifty-two vaccinated and fifty-two control dogs were tested for susceptibility to rabies by intramuscular inoculation with the standard salivary gland street virus. Each dog was given an injection of 0.125 ml. of a 1:100 dilution of the virus suspension in each masseter muscle. Normal saline was used as a diluent and the test virus had a consistency similar to that of dog saliva. Vaccinated and control dogs were injected alternately. Serial ten-fold dilutions of the test virus were injected intracerebrally into Swiss white mice after all the dogs had been inoculated. This titration showed that each dog received approximately 4,700 intracerebral mouse MLD. The dogs were held for observation for three months after inoculation. The mortality rates for vaccinated and control dogs are given in Table II.

Of the fifty-two vaccinated dogs, six, or 11.5 per cent, died of rabies compared to forty-one of fifty-two control dogs, or 79 per cent. The neutralization test study showed that 75 per cent of the vaccinated dogs developed virus neutralizing sub-
month following the first dose of vaccine the vaccinated and control dogs were tested for susceptibility to rabies. The test virus and method of test inoculation were the same as that described in the duration of immunity study. The dogs were held for observation for three months after inoculation. The mortality rates for vaccinated and control dogs are given in Table III.

None of the vaccinated dogs died or rabies compared to seventeen deaths among the twenty-five control dogs, or 68 per cent.

**THE FIELD STUDY OF CANINE RABIES VACCINATION**

The Alabama Dog Control Act for the suppression of rabies has been in force since 1937. This act specifies that all dogs allowed the freedom of the streets must be vaccinated for rabies each year. Enforcement is relegated to Rabies Inspectors who are to be appointed annually by each County Board of Health. Information as to the number of counties enforcing vaccination and the number of dogs vaccinated each year in Alabama is given in Table IV.

**Table IV.—Summary of canine rabies vaccination data for Alabama, 1937–1944**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF COUNTIES ENFORCING VACCINATION</th>
<th>NUMBER OF DOGS VACCINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1937</td>
<td>63</td>
<td>177,038</td>
</tr>
<tr>
<td>1938</td>
<td>62</td>
<td>155,092</td>
</tr>
<tr>
<td>1939</td>
<td>61</td>
<td>159,578</td>
</tr>
<tr>
<td>1940</td>
<td>44</td>
<td>100,652</td>
</tr>
<tr>
<td>1941</td>
<td>39</td>
<td>87,950</td>
</tr>
<tr>
<td>1942</td>
<td>31</td>
<td>67,031</td>
</tr>
<tr>
<td>1943</td>
<td>19</td>
<td>41,211</td>
</tr>
<tr>
<td>1944</td>
<td>26</td>
<td>68,817</td>
</tr>
</tbody>
</table>

There are sixty-seven counties in Alabama. It is estimated that there are at least 300,000 dogs in the state. In those counties where vaccination of dogs was enforced consistently the disease disappeared or was limited to sporadic cases among dogs, cats, and other domestic animals, usually traceable to dogs entering from other counties or to rabid foxes. Repeated epizootics of fox rabies have complicated the rabies control work. In counties where fox rabies was present and dog vaccination was enforced there were many cases of infection of live stock but dogs were seldom affected. The cases that did occur were for the most part among dogs under six months of age. There were repeated instances of infection of puppies kept with older vaccinated dogs who failed to develop the disease. During 1943 only six cases of dog rabies were identified in the nineteen counties enforcing vaccination of dogs. During 1944 there were twenty-seven identified cases of dog rabies in the twenty-six counties enforcing the vaccination program. It will be noted that a number of these counties reinstituted the vaccination program upon recurrence of the disease. During 1943 and 1944 there were only nine cases of dog rabies identified among vaccinated dogs. This includes dogs that had been vaccinated at least thirty days and not more than one year prior to the onset of the
disease. During the five year period 1932-1936, seventeen persons died of rabies in Alabama and 21,782 persons were given the rabies vaccine treatment. During the five year period 1940-1944, only two persons died of rabies in this state and only 5,355 persons were given the rabies vaccine treatment.

It is well known that the incidence of rabies is apt to be high in thickly settled areas. This has been true in Alabama. There have been repeated epizootics of dog rabies in the major cities of Alabama. In intervals between epizootics the disease remained present in endemic proportions. During the past eight years we have had the opportunity of observing the effectiveness of vaccination of dogs for rabies as compared to other means of rabies control as two of the three largest cities in Alabama did not require vaccination of dogs. The incidence of rabies in three metropolitan areas as determined by laboratory studies is compared to that of the state as a whole in Table V.

The city of Mobile is located in Mobile county and here the status quo was maintained until 1945. Rabies control work was limited to stray dog control by

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MOBILE COUNTY</th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
<th>1940</th>
<th>1941</th>
<th>1942</th>
<th>1943</th>
<th>1944</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>183</td>
<td>63</td>
<td>57</td>
<td>101</td>
<td>91</td>
<td>157</td>
<td>85</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>Jefferson County</td>
<td>419</td>
<td>437</td>
<td>119</td>
<td>58</td>
<td>7</td>
<td>13</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Montgomery County</td>
<td>23</td>
<td>29</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Entire State</td>
<td>927</td>
<td>677</td>
<td>237</td>
<td>202</td>
<td>168</td>
<td>220</td>
<td>137</td>
<td>248</td>
</tr>
</tbody>
</table>

the city pound and the local Humane Society. An epizootic of fox rabies developed in this county in 1940 and during the first three months of the outbreak over 100 cases of fox rabies were reported. Few of the foxes were examined for rabies as their behavior left little doubt as to their having the disease. Many domestic animals died of rabies but here again but few were submitted for examination. Following the outbreak of fox rabies most of the people living in the rural part of the county had their dogs vaccinated. This was done on a voluntary basis as no Rabies Inspector had been appointed. Vaccination of large domestic animals was also practiced on a considerable scale as the disease continued in the foxes through 1943. There was no organized program of reducing the number of foxes but the farmers destroyed many of these animals and the disease in time killed many others. At present there are few foxes in the county and no cases of fox rabies have been identified this year. Vaccination of dogs was not enforced in the city of Mobile and relatively few dogs were vaccinated on a voluntary basis prior to 1945. During the first few months of 1945 rabies became very prevalent.
in the city of Mobile. Over 175 dogs are known to have died of rabies in Mobile county during the first ten months of this year and one person succumbed to the disease after having been bitten by a rabid dog. There have been relatively few cases of dog rabies in rural sections of the county. In July, 1945 a Rabies Inspector was appointed by the County Board of Health and 20,136 dogs had been vaccinated by November 1, 1945.

The city of Birmingham is located in Jefferson county. This is the largest metropolitan area in Alabama and rabies was highly prevalent in this county during 1937 and 1938. A constant dog quarantine provision was adopted by the Health Department of the city of Birmingham in 1938. A census conducted during that year revealed that 5,906 dogs had been vaccinated for rabies on a voluntary basis but the vaccination provision was not enforced. Many dogs were vaccinated on a voluntary basis in the rest of the county during 1938 and 1939 and stray dogs were impounded and killed. This work was conducted by the officials of other towns in the county as an emergency measure but was not coordinated under a county

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DOGS IMPOUNDED AND KILLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1938</td>
<td>6,117</td>
</tr>
<tr>
<td>1939</td>
<td>3,996</td>
</tr>
<tr>
<td>1940</td>
<td>5,319</td>
</tr>
<tr>
<td>1941</td>
<td>5,512</td>
</tr>
<tr>
<td>1942</td>
<td>5,799</td>
</tr>
<tr>
<td>1943</td>
<td>5,205</td>
</tr>
<tr>
<td>1944</td>
<td>5,026</td>
</tr>
</tbody>
</table>

Rabies Inspector. The disease abated during 1940 and rabies control work was relaxed in the small towns but the dog quarantine ordinance was kept in force in the city of Birmingham. The number of dogs impounded and killed each year in Birmingham for the period 1939-1944 is given in Table VI.

As can be determined from the number of dogs destroyed, the dog pound work was efficient. Nevertheless, in December, 1944 rabies again became highly prevalent in Birmingham. During the first ten months of 1945 there have been 148 known cases of dog rabies in the city as determined by laboratory examination. The true incidence of the disease is probably much greater as over 1,000 dead dogs have been removed from the city streets by the sanitary department trucks each month during 1945 and in May a total of 2,287 dead dogs were collected. This can be compared with a monthly average of 200 dead dogs collected during 1938. Ninety-seven cases of dog rabies have been identified in the rest of the county this year and most of these occurred near the city of Birmingham. One child died of rabies following exposure to a rabid dog during the beginning of the outbreak. More than 700 human rabies treatments have been given in Jefferson county during the first ten months of 1945. In July, 1945 a Rabies Inspector was appointed by the County Board of Health and 39,899 dogs had been vaccinated by November 1, 1945.
The city of Montgomery, the capitol of Alabama, is located in Montgomery county and here vaccination of dogs has been enforced since 1937. Table VII gives the rabies control statistics for this county for the period 1936-1944.

No quarantine was enforced at any time and many dogs are allowed the freedom of the streets. Specimens from cases of suspected rabies have been studied at this laboratory since 1939. Three cases of rabies have been identified and these were all traced to dogs coming in from other counties or states. No secondary cases occurred except among domestic cats. During 1945 there has been one proved case of rabies. This was a dog that had been brought in from a county where rabies was present in foxes. No secondary cases have occurred.

As will be noted from the information given above, the vaccination program was kept in force in the majority of counties until 1940. Many counties then stopped enforcing vaccination as rabies ceased to be a problem and Rabies Inspectors were criticized for enforcing vaccination under such conditions. During the war many veterinarians entered the armed services and those that remained were so busy with

TABLE VII.—Dog Control Activities and Incidence of Rabies in Montgomery County, 1936-1944

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DOGS VACCINATED</th>
<th>DOGS IMPOUNDED</th>
<th>DOGS KILLED</th>
<th>POSITIVE ANIMAL HEADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1936</td>
<td>6,012</td>
<td></td>
<td></td>
<td>74</td>
</tr>
<tr>
<td>1937</td>
<td>6,778</td>
<td>2,033</td>
<td>1,801</td>
<td>29</td>
</tr>
<tr>
<td>1938</td>
<td>7,770</td>
<td>1,048</td>
<td>684</td>
<td>0</td>
</tr>
<tr>
<td>1939</td>
<td>6,646</td>
<td>886</td>
<td>631</td>
<td>0</td>
</tr>
<tr>
<td>1940</td>
<td>5,809</td>
<td>675</td>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td>1941</td>
<td>5,809</td>
<td>806</td>
<td>466</td>
<td>0</td>
</tr>
<tr>
<td>1942</td>
<td>6,646</td>
<td>852</td>
<td>547</td>
<td>1 (cat)</td>
</tr>
<tr>
<td>1943</td>
<td>6,932</td>
<td>713</td>
<td>538</td>
<td>1 (cat)</td>
</tr>
</tbody>
</table>

routine practice that they did not want to take the position of Rabies Inspector unless the disease was prevalent and they had the backing of other enforcement agencies. During 1944 and 1945 rabies recurred in several counties that had discontinued the vaccination program. Vaccination of dogs was enforced again and the disease abated within a few months.

In May, 1945 a Public Health Veterinarian was appointed to coordinate the rabies control work in Alabama. This is a joint project of the Alabama State Board of Health and the State Department of Agriculture. This has given new impetus to the rabies control work. It is now possible to investigate promptly new foci of rabies and to assist in enforcing the required provisions.

The problem of fox rabies has been reported elsewhere (4). The disease has been identified among gray foxes in seven counties of Alabama during the past two years. One person residing in Coffee county, Alabama was bitten by a rabid fox this year and later died of rabies. Fox rabies is still active in Clarke county, Alabama although 955 gray foxes have been killed. The Federal Wild Life Service, Division
of Predatory Animal Control, has supervised the fox control program in two counties.

DISCUSSION

The experimental studies of the single injection method of canine rabies vaccination conducted at this laboratory have shown that vaccination of dogs can be an effective means for rabies control. It is evident that the disease could not maintain itself among vaccinated dogs. The effectiveness of vaccination under field conditions is well exemplified by the experience cited for Alabama.

It is obvious that vaccination of owned dogs as a means for rabies control must be supplemented by other dog control provisions so that unvaccinated dogs found at large can be impounded and destroyed if not claimed. Dog owners should be responsible for the maintenance of dog pound facilities because they are the source of the problem. Enforcement of a dog license regulation is the only satisfactory method of obtaining revenue for dog pound work. Given adequate dog pound facilities, rabies control is a matter of organization. A state rabies control program should be under the supervision of a full time Public Health Veterinarian. Rabies will continue to be a serious public health problem until control work is coordinated on a national basis.

We know that strict quarantine of all dogs will eliminate rabies where it is not present in wild life but this is extremely difficult to enforce and maintain for the extended period necessary to achieve the desired end. Though vaccination of all dogs allowed at large has been found to have the same result it would be advantageous to require a thirty day quarantine for all dogs in any new focus of rabies. This would expedite the elimination of ownerless dogs and would stop the spread of the disease quickly. The quarantine provision should stipulate that a dog must be confined for at least thirty days following vaccination.

It is essential to obtain the cooperation of the public in any program of rabies control. This can be accomplished by means of an educational program. The public should be given the salient information about the disease and the necessary control procedures by the use of pamphlets and posters and through newspaper articles. Pamphlets can be distributed to dog owners when they obtain a dog license or when they have their dogs vaccinated. In beginning a program of rabies control it is advantageous to distribute notices to each home, giving the reasons for the program and the required provisions.

SUMMARY

A series of experimental studies of canine rabies vaccination is reported. It has been shown that the single injection method of vaccination does produce a high degree of immunity to rabies and this immunity persists at a satisfactory level for one year following vaccination. The three injection method of vaccination produces a more solid immunity.

The field experience with canine rabies vaccination in Alabama is presented. It has been shown to be effective where properly enforced.
BIBLIOGRAPHY


The increased importance of rabies of animals and man in the United States and the need for more information to be used for the formulation of satisfactory measures for control and eradication have prompted the preparation of this paper for presentation to this group. In a paper presented at the 1944 meeting of this Association, it was pointed out that Maryland was virtually free of rabies from 1931 to 1942, but that in 1943 and 1944 the disease had appeared in ten counties and the City of Baltimore, with the most extensive outbreak in Montgomery and Prince George's Counties adjacent to the District of Columbia. It was also pointed out that the ordinary quarantine restrictions had failed to control the disease in the last-named counties and that the use of prophylactic vaccination on a voluntary basis had markedly reduced the incidence of the disease in these areas. This was particularly so in Montgomery County, where an excellent system of licensing and removal of unlicensed dogs had been put in force prior to and following vaccination.

During the early months of 1945 one rabid dog, bearing a license tag of the District of Columbia, was found in Montgomery County. Several dogs, known to have been exposed, were destroyed. No further evidence of the disease has been seen through the end of October. During the early months of 1945 in Prince George's County the incidence of the disease began to increase until in March and April six cases were found in each month. In other counties in the State and in Baltimore City sporadic cases appeared.

It was decided to repeat vaccination in Montgomery and Prince George's Counties. This was accomplished on a voluntary basis without cost to the owner, the expense of veterinary service being borne by the County Commissioners and the cost of vaccine being met by the Live Stock Sanitary Service. These programs were set up with clinics scattered throughout the areas and were conducted during the month of May for approximately two-week periods in each case. The number of dogs injected amounted to about 95 per cent of those in Montgomery County and 75 per cent in Prince George's County.

The accompanying table presents the cases of rabies in dogs in the several counties and the City of Baltimore during 1944 and 1945, with an indication as to the month during which vaccination was conducted in Montgomery and Prince George's Counties. The results in Montgomery County have already been mentioned. In Prince George's County there has been a marked reduction again this year in the number of cases found following the completion of the vaccination period.

The results in these two counties rather clearly indicate what can be expected from a complete program of dog control and vaccination, as in Montgomery County, and a program composed virtually of vaccination alone, as in Prince George's
County. No one need expect under practical conditions, where all dogs cannot be satisfactorily immunized, that vaccination alone will prove sufficient. It may be

*Positive Rabies Diagnoses in Dogs, Maryland, 1944 and 1945*

**Note:** Records for 1945 through October, only.

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* Vaccination periods during this month.

well to point out also, in this connection, that rabies was present in the District of Columbia extensively during the early months of 1945 and that the greatest incidence of the disease was in that section adjacent to Prince George's County.
The large number of rabies cases in the District of Columbia over a period of several years led to the use of vaccination in the control program by the District Commissioners during the latter part of August and the first part of September, 1945. There had been a decline in the number of cases during the summer months in the District, as shown by the fact that in May there were twenty rabid dogs; in June, eight; in July, four; and in August, three. Following completion of the injection, there was one case in September in an ownerless and unidentified dog, and no case during October. It is well to point out, also, in this connection, that a large number of stray and ownerless dogs were picked up and destroyed.

Reference to the table will show that in Anne Arundel County, where no vaccination was conducted, the disease has appeared in virtually each month in 1945. Apparently the placing of a quarantine with the restriction of at least part of the animals in the area has been influential in keeping down a widespread outbreak. During the last several months the County Dog Warden in the northeastern section of the County has been extremely active and control can be expected to be much more complete.

In Baltimore City only certain sections had been put under quarantine when each case of rabies was found; but toward the end of August and early in September cases appeared in several sections of the City almost simultaneously, and the entire City area was put under quarantine for 90 days. Stimulus was given to the licensing of dogs by the Police Department, and large numbers of unwanted and ownerless animals have been picked up and destroyed by the S.P.C.A. Violations of the quarantine have been referred to the police courts with convictions in some of the cases.

The original law under which the State Board of Agriculture placed quarantines called for a minimum fine of fifty dollars. This penalty appeared to some magistrates and justices of the peace to be rather severe and consequently was rarely imposed. The law was changed during the last meeting of the State Legislature, making the minimum fine ten dollars and allowing the maximum to remain at one hundred dollars. Enforcement is seriously interfered with when violators receive suspended sentences.

The table presents rabies in dogs only. In addition, there was one rabid cat in Montgomery County; one cat, two cows, and one fox in Prince George's; and four foxes in Anne Arundel. In the latter instance it should be mentioned that the foxes were found in March, April, September, and October, introducing an ever-present source of rabies exposure for man and animals. No cases of rabies in man have been found, despite the large number of persons bitten and exposed by rabid animals. There is constant danger that the injection of rabies vaccine may not ward off the disease or that some person may be bitten without the knowledge of health and control officials and thus not be advised of the danger.

There has been indication that the immunity from the single dose method will last under field conditions for as long as one year. This is based upon the fact that only two vaccinated dogs have died of rabies where exposure was shown to have taken place after resistance should have been developed. One dog died in December 1944, and one in May, 1945, each of these having been injected during July, 1944.

The Maryland regulations covering the importation of dogs will be changed to include prophylactic vaccination against rabies within six months of shipment.
SUMMARY

1. Rabies in animals has been present in some areas in Maryland during 1945.

2. In Montgomery County where a control program, including vaccination of dogs, has been in force in 1944 and 1945, the disease has been eradicated.

3. In Prince George's County where a vaccination program without good dog control measures has been in force during 1944 and 1945, the disease showed an inclination to build up between the injection periods and to subside immediately after the prophylactic treatments.

4. In Anne Arundel County the disease has not been well controlled with the usual quarantine restrictions.

5. In Baltimore City quarantine restrictions in small areas furnished means of control until in recent months when cases appeared in several sections at once, leading to the quarantine of the entire City, with extra efforts by local enforcement officers.

6. A control program containing vaccination has been instituted in the District of Columbia within recent months, reducing the danger of exposure to the adjoining counties in Maryland.

7. Vaccination of large numbers of dogs with the one dose method appears to produce an efficient barrier to the spread of the disease; but used without other control measures, it cannot be depended upon to eradicate the disease.

8. Vaccination can be depended upon to be an efficient aid in rounding out a program of control and eradication.
REPORT OF THE COMMITTEE ON RABIES


Statistics collected by the Bureau of Animal Industry of the U. S. Department of Agriculture for the calendar year 1944 have been made available to this committee through the courtesy of the Chief of Bureau, A. W. Miller. These statistics again show more cases of rabies reported for that year than any previous year since statistics have been collected by the Bureau. There was a total of 10,540 cases. (See the attached map.) Table 1 gives the incidence of rabies in the United States as collected by the Bureau of Animal Industry since 1938.

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<th>SHEEP</th>
<th>SWINE</th>
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The continued presence and the alarming increase of rabies in certain areas has forced the employment of more active control measures. In certain States and in certain communities, aggressive programs have been inaugurated within the past several years to control the disease. In these programs large scale vaccination of dogs, either on a voluntary or compulsory basis, has played a very prominent part. The results have been very gratifying and have made available sufficient information on which to build further programs or measures for the control of the disease.

Vaccination of dogs is a prominent feature of these programs. It is important that the status of vaccination be clearly defined, since some health officers and others engaged in the control of rabies, including some veterinarians, as well as dog owners and others, still have doubts as to the efficacy of canine rabies vaccines. Many of these individuals are not cognizant of the progress made in the improvement of canine rabies vaccines. In many cases these doubts are based on opinions formed some years ago. It is highly desirable that the present status of vaccination
be publicized, not only to the veterinary and medical professions, but to the dog-owning public and the public in general, as well.

Commercial canine rabies vaccines have been proved by experimentation and by field use to be of definite value. With the development of the Habel test and the requirement of the Bureau of Animal Industry of the U. S. Department of Agriculture that all commercial rabies vaccines marketed must pass the Habel test, it has been possible for biological establishments in recent years to market vaccines of a superior and uniform quality. Field use of the vaccines in rabies control programs in the past two years has definitely shown the value of vaccines in such programs.

The success attained in controlling rabies in a number of communities through the use of vaccination procedures, together with other standard methods of control, has been outstanding. By these methods the disease has been brought under control in a comparatively short time, in contra-distinction to other areas in which long quarantines are necessary and in which little progress is made in controlling the disease. It should be recognized that proper plans and proper organization be effected at the start of a campaign. Vaccination has been used in these control campaigns on a voluntary or compulsory basis.

As used on a voluntary basis, all dogs in an area, community, or county must be vaccinated within a designated period or kept in rigid quarantine. The vaccine is furnished by the community, which also provides veterinary service for the vaccination of the dogs. The vaccination is done at stated times and designated places. The owner of the vaccinated dog is required to keep the dog in quarantine for 30 days, during which time a very active campaign to control stray and unvaccinated dogs is in progress. This serves two purposes; first, it gives the vaccinated dogs sufficient time to develop immunity following vaccination, and second, it keeps all dogs off the streets for that period of time. In other words, it is a very tight quarantine for 30 days. After 30 days, the vaccinated dogs, which are properly tagged, may have the freedom of the streets, but unvaccinated dogs at large and strays are impounded. The general quarantine on the area is vigorously enforced until 90 days following the last diagnosed case of rabies. This method has given good results in certain counties in Maryland, Arizona, and other States. Some people are opposed to compulsory vaccination, and this procedure gives them the option of having their dogs vaccinated, with the freedom of the streets after 30 days, or keeping the dog in strict quarantine until the general quarantine is lifted.

Compulsory vaccination of all dogs, in conjunction with collection and impounding of stray dogs and the enforcement of quarantine measures, has been reported with good results. This method has been employed in some areas on a county and municipal basis and also is a State-wide requirement in several States, notably Georgia, Alabama, and Arkansas.

When a program of either type is established, the organization and the effective carrying out of the program will determine its success. The feature of the programs followed has been the short period during which the area was under quarantine, in contra-distinction to procedures of older days when quarantines extended over years. The public will go along with a strict, short quarantine, but will become
irked and lose interest when the quarantine period is continually extended, and cooperation then ceases.

In connection with this report, the paper of Dr. Johnson reported in 1943, the paper of Drs. Brueckner and McDaniels reported in 1944, and the papers of Drs. Brueckner and Johnson prepared for this meeting should be very carefully considered, since they contain pertinent information on the control of rabies.

The results of laboratory and field trials on canine rabies vaccination with the one-injection method warrant the strong recommendation that this procedure be adopted extensively in programs of control and eradication as an adjunct to other proved measures.

Nothing has been heard during the year from the National Rabies Committee.

The Committee on Animal Health of the National Research Council has appointed a subcommittee on rabies, the purpose of which is to issue a comprehensive report on rabies and its control. The committee consists of the following:

Dr. A. L. Brueckner, Director of Animal Disease Control, University of Maryland, College Park, Maryland.
Dr. Karl Habel, Surgeon, U. S. Public Health Service, National Institute of Health, Bethesda, Maryland.
Dr. H. W. Schoening, Chief, Pathological Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.
Dr. T. F. Sellers, Director of Laboratories, Georgia Department of Public Health, Atlanta, Georgia.
Dr. Harald N. Johnson, Director of Rabies Research Study, International Health Division, Rockefeller Foundation, Montgomery, Alabama—CHAIRMAN.

A meeting of the committee was held in the National Academy of Sciences Building, Washington, D. C., on November 26, 1945.

It has been pointed out in previous reports that, in order for the Bureau of Animal Industry of the U. S. Department of Agriculture to participate in a rabies control program on a national basis, it would be necessary that some of the Acts governing the activities of the Bureau be amended. A bill, H. R. 3289, was introduced in the House of Representatives May 22, 1945, amending certain acts under which the Bureau of Animal Industry operates to include within their provisions dogs and other domestic carnivora. This bill has been referred to the Committee on Agriculture. A copy of the bill has been presented to the Committee on Legislation of this Association.

Mr. Rees of Kansas introduced the following bill; which was referred to the Committee on Agriculture:

A BILL

To amend the Act of May 29, 1884, as amended; the Act of February 2, 1903; and the Act of March 3, 1905, as amended; to include domestic animals within their provisions

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuropneumonia and other contagious diseases among domestic animals," approved May 29, 1884, as amended; the Act entitled "An Act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of livestock and for other purposes," approved February 2, 1903; and the Act entitled "An Act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of livestock and for other purposes," approved March 3, 1905, as amended, are hereby further amended to include within their provisions dogs and other domestic carnivora, and wherever in the said Acts, as amended, except in section 11 of the said Act approved May 29, 1884, the term "livestock and/or live poultry" or the term "domestic animals" of the word "animals" alone is used, the term "domestic animals and live poultry" shall be substituted therefor; and all the penalties, terms, and provisions in said Acts, as amended, are hereby made applicable to domestic animals and live poultry.

Sec. 2. Section 3 of the aforesaid Act of May 29, 1884, as amended, is amended to read as follows:

"Sec. 3. It shall be the duty of the Secretary of Agriculture to prepare such rules and regulations as he may deem necessary for the speedy and effectual suppression and extirpation of contagious, infectious, and communicable diseases of domestic animals and live poultry, and to certify such rules and regulations to the executive authority of each State, Territory, and the District of Columbia, and invite said authorities to cooperate in the execution and enforcement of this Act. Whenever the plans and methods of the Secretary of Agriculture shall be accepted by any State or Territory or the District of Columbia in which any such disease is declared to exist, or such State, Territory, or the District of Columbia shall have adopted plans and methods for the suppression and extirpation of said diseases, and such plans and methods shall be accepted by the Secretary of Agriculture, and whenever the governor or other properly constituted authority of any State, Territory, or the District of Columbia signifies his readiness to cooperate for the extinction of any such disease in conformity with the provisions of this Act, the Secretary of Agriculture is hereby authorized to expend such sums as may hereafter be appropriated in such investigations, and in such disinfection and quarantine measures as may be necessary to pre-
### Table 2.—Rabies in the United States by States during the Year 1944

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<th>State</th>
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<th>Cattle</th>
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<th>Sheep</th>
<th>Swine</th>
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<th>Goats</th>
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*A few of these may be other species*
vent the spread of the disease from one State or Territory or the District of Colum-
bia into another."

Sec. 3. Section 11 of the aforesaid Act of May 29, 1884, as amended, is amended
by inserting, after the phrase "dourine in horses," the following: "rabies in domestic
animals."

It is recommended that the Committee on Rabies be continued.

Table 2 gives the number of cases of rabies in each State by species. According
to the reports received by the Bureau on the incidence of rabies for the calendar
year 1944, there were 9,067 cases in dogs, 561 in cattle, 32 in horses, 40 in sheep,
43 in swine, 419 in cats, 14 in goats, 311 miscellaneous, 53 in man, making a grand
total of 10,540 cases.

REPORT OF THE AUDITING COMMITTEE
JEAN KNAPP, J. R. SNYDER, AND C. C. FRANKS

Gentlemen: Your Auditing Committee has completed its examination of the
books of the Treasurer and has found everything in good order and wish to com-
mend Dr. Hendershott for the businesslike manner in which the accounts of this
association are handled.
PROGRESS AND STATUS OF COOPERATIVE TUBERCULOSIS ERADICATION AMONG LIVESTOCK

BY A. E. WIGHT, M.D.V.

In Charge, Tuberculosis Eradication Division, Bureau of Animal Industry, Washington, D. C.

TUBERCULOSIS IN CATTLE

During the fiscal year ended June 30, 1945, progress in locating and removing any remaining centers of tuberculous infection was considerably hampered because of wartime conditions. Due to the shortage of veterinarians, many of whom are in the armed forces or have left the Bureau's service for more lucrative employment, an insufficient number were assigned for regular employment. Veterinarians in private practice were unable to devote as much time as necessary because of the great demand for their services in treating livestock for other diseases or injuries. Due to the shortage of labor, herd owners were very busy with farm and ranch operations and found it difficult to assemble their cattle for testing. In view of these handicaps, the results obtained were as satisfactory as could be expected.

The necessity of continued follow-up work in tuberculosis eradication was further demonstrated during the year. Since 1941 there has been a diminution in the number of cattle tuberculin tested each year. Despite this decrease in testing, however, the number of reactors has increased during the past two years. The percentage of infection disclosed by testing rose from 0.18 in the fiscal year 1943 to 0.24 in the fiscal year 1945, an increase of approximately one-third during the two-year period. In one of the Eastern States, as a result of the location of new centers of infection, it was necessary to remove a county from the list of modified accredited areas. Since the establishment of the area plan, this is the first time such action has been necessary. I am happy to say, however, that the required retesting is progressing in this county and results so far are very satisfactory. Now that the war is over, when more veterinarians are available, the work will be expanded in many States in order to bring the testing schedules up to date and locate any remaining centers of infection.

During the fiscal year ended June 30, 1945, a total of 8,105,480 cattle, located in 484,749 herds, were tuberculin tested in the official work; and as previously stated, the percentage of reactors found was 0.24.

During this period approximately $1,445,000 was expended by the Federal Government for operating expenses and indemnity. The combined State, territory, and county expenditure was about $2,870,000, of which about $2,250,000 was for operating purposes and the remainder for indemnity. The average appraisal of reactors was $161.32; and the average salvage, $59.78. The owner also received an average indemnity payment of $22.71 from the Federal Government and $40.31 from the State. Of the reactors slaughtered, 10 percent were registered pure bred cattle.

A large percentage of the tuberculin testing during the year was conducted under
the area plan. Due to lack of manpower and other conditions existing because of the war, it was impossible to remodify all the counties at the time they were due for reaccreditation. However, considerable work was done in this connection, and it is sincerely hoped that testing schedules will be brought up to date during the present fiscal year. At the meeting of this Association two years ago, the uniform methods and rules were changed to provide that areas in which the incidence of infection on the last complete test of all cattle in the county did not exceed 0.2 percent could remain in the modified accredited status for a period of six years, provided all infected herds were quarantined and retested in accordance with the regulations. A considerable amount of testing has been eliminated by the application of this provision.

Considerable interest continues to be displayed in some States in accrediting herds of cattle as tuberculosis-free. At the close of October, approximately 235,500 herds, containing about 3,757,000 cattle, were in this classification in 44 States. Only 4 States and Puerto Rico are not engaged in this feature of the program.

The requirement that herds in which infection occurs shall pass three successive negative tests not less than 60 days apart before lifting quarantine and that such herds shall not be fully accredited until they pass a further test without reactors not less than 12 nor more than 14 months following the last test which disclosed infection, has been of great value. I am glad to say that this Association adopted this measure at its meeting in 1940.

During the month of October, 567,529 cattle were tested in the various States and Puerto Rico, disclosing only 1,203 reactors, or 0.21 percent. No reactors were found in 15 States, in which 1,564 herds, containing 28,558 cattle, were tested. Compared with the results of testing during the previous year, this is a very good showing, and indications are that reports just as satisfactory will be received in the future.

Although the records show that the cattle in the United States are now comparatively free from tuberculosis, some centers of infection are continually being found, sometimes in places where there has been no reason to believe the disease existed. This shows the importance of making use of every method available to locate infection. Reports received from the meat inspection service of the Department of Agriculture have been of much value.

Reports from packinghouses operating under Federal inspection continue to show a reduction in the incidence of tuberculosis in cattle. During the last fiscal year, of 14,504,806 cattle slaughtered at these establishments, exclusive of reactors to the tuberculin test, only 5,830, or 0.04 percent, showed any evidence of tuberculosis; 1,539, or 0.01 percent, entire carcasses being condemned or sterilized.

An interesting comparison showing the saving in beef in the livestock markets in three large Eastern cities due to the decrease in tuberculosis, was reported in a press release of the Department dated August 7, 1945, which received considerable publicity. It stated that of all the cattle slaughtered under Federal supervision at these markets during the year ended June 30, 1945, only 59, or about 1 in 7,300, were condemned for food because of tuberculosis, whereas in 1925, just 20 years before, the proportion was about 1 in every 80 animals slaughtered. Had the ratio been as great in 1945 as it was in 1925, there would have been a loss of more than 5,000 animals or about 2,000,000 pounds of beef in these three cities alone.
Tuberculosis: Percentage found in slaughtered cattle by Federal Inspection, 1917-1945 (not including reactors to Tuberculin Test). In 1917 about 1 animal in 48 slaughtered showed lesions of the disease, in 1945 about 1 in 2,488. Prepared by Bureau of Animal Industry, Agricultural Research Administration, U. S. D. A.

Slight increases in the percentages of swine carcasses retained and condemned for tuberculosis in packinghouses operating under Federal inspection were noted during the past year. During that period, 49,468,458 hogs were slaughtered, of which 3,556,582 or 7.19 percent, showed some evidence of tuberculosis; 22,841, or 0.046 percent, being either condemned or passed for food after sterilization. It is interesting to note that only about 49,500,000 hogs were slaughtered under Federal supervision during the fiscal year 1945, compared with about 75,000,000 during the fiscal year 1944.

**JOHNE'S DISEASE**

Of 3,896 cattle tested for Johne's disease in 10 States during the past year, 6.2 percent reacted to either johnin or avian tuberculin. These reactors were condemned, and the owners received State and Federal indemnity in some instances. Studies of this disease are being continued at the Regional Animal Disease Research Laboratory at Auburn, Alabama. Dr. Howard W. Johnson, Acting Director of that Laboratory, has made some valuable contributions to this work, and we are fortunate in having him on the program to discuss this disease.

**AVIAN TUBERCULOSIS**

About 12 veterinarians of the Federal Bureau of Animal Industry devoted their entire time during the past year to the eradication of tuberculosis in poultry. They visited over 9,500 farms and inspected more than 1,460,000 fowls. Infection was disclosed on 621 farms. The tuberculin test was applied to about 270,000 fowls, of which about 7,750 or 2.8 percent, reacted.

The distribution of information regarding this disease in order that flock owners may know as much about its nature as possible, is of much importance, and it is gratifying to learn that this is being continued. Special attention is invited to the poster, about 14 x 20 inches, entitled "Pullets for Profit", made available by the National Livestock Loss Prevention Board, an organization that has been so helpful in our tuberculosis work during a long period of time under the able direction of Professor H. R. Smith of this city and his associates.

**NO-VISIBLE-LESION CASES**

The study of the problem of no visible lesions of tuberculosis among reactors to the tuberculin test, has been continued. Most of us are aware of the many angles to be considered. The percentage of such cases among the reactors slaughtered during the past year was the lowest it has been since 1938.

**CONCLUSION**

It is of paramount importance that tuberculosis eradication work among livestock be continued. That the State and Federal Governments are in agreement as to its necessity is indicated by the increasing appropriations provided for the work by these agencies. While it is true that the work has been slowed perceptibly during the past four or five years, it must be remembered that our efforts, both physical
and financial, have been devoted to another great undertaking. Now that hostilities have ceased, it is hoped the lost ground will be rapidly regained.

The usual pamphlet containing statistical information on the progress of tuberculosis-eradication work among livestock, as well as the cooperative bovine brucellosis work, has been prepared and is available for distribution at this meeting. The Agricultural Research Administration is now preparing a Research Achievement Sheet on tuberculosis in livestock, with special reference to the preparation of tuberculin. When completed, it will be available to anyone interested.
A STUDY OF THE RESULTS OF RETESTS ON TUBERCULIN REACTORS

ALEXANDER ZEISSIG, D. V. M., Associate Professor of Bacteriology, New York State Veterinary College at Cornell University, Ithaca, New York

I do not wish any remarks which I may make to be construed as indicating that the tuberculin test is not a satisfactory diagnostic procedure for detecting animals affected with tuberculosis. It is still the most useful and most accurate procedure which we possess for this purpose. As the incidence of tuberculosis has been reduced, however, a situation has been unmasked which probably has always existed. When the incidence of tuberculosis was much higher than now the comparatively few animals which reacted to the tuberculin test, but which showed no lesions on post mortem examination, were looked upon as true No Visible Lesion cases of the disease. Today, the situation is different. A greater portion of reactors slaughtered now-a-days either show no lesions whatever or show a so called "skin lesion". I think it is generally accepted that the subcutaneous granuloma which we call a skin lesion is not caused by the tubercle bacillus. Therefore, we regard it in the same category as the NVL case, namely, non-tuberculous. Table 1, which shows the post mortem findings on reactors slaughtered in New York State will indicate the present situation.

Thus, while the percentage of reactors is considerably less than it formerly was, the total number of animals slaughtered annually in a state like New York is considerable. The replacement value of these animals as conservatively estimated also runs into a sizeable sum of money annually. Any reduction either in the incidence of tuberculosis through elimination of open cases of the disease or modification of the testing procedure so as not to slaughter non-tuberculous animals unnecessarily will represent an economic saving to the state.

I am only familiar with the conditions in New York State. The situation in other parts of the country may be entirely different. The NVL problem has reached such serious proportions with us that livestock owners are becoming concerned about losing animals which show no lesions. Furthermore, since the bulk of reactors in this category represent single animals or a pair in a herd which has been accredited over an extended period of time, a large number of cattle owners are affected. If the herd loses its accredited status there are additional complications.

In New York State, we still have herds in which tuberculosis is a problem. The problem exists because animals extensively infected with tuberculosis may fail to react to the intradermal test. Since these extensively infected animals are also apt to be open cases of tuberculosis they quite often are left in the herd as non-reactors while the crop of recent secondary infections caused by them is harvested. This situation, too, is the source of a great amount of owner dissatisfaction. The problem cannot be ignored any longer and steps to improve the situation should be taken even though they may be based on empirical findings. The studies which are to be reported here were begun almost three years ago as a cooperative project.
RESULTS OF RETESTS ON TUBERCULIN REACTORS

between the New York State Veterinary College and the Bureau of Animal Industry of the Department of Agriculture and Markets. We were assisted in the beginning by the present Assistant-Commissioner, Dr. E. V. Moore, who at that time was Cortland County Veterinarian.

There are three factors which may play a part in the tuberculin test, the man, the tuberculin, and the cow. In our opinion, the man, that is the testing veterinarian, has the least effect upon the resulting reaction. Too many reactions in cattle, which later show no lesions on post mortem examination, are reported by veterinarians who are good technicians to justify any explanation of them on the basis of carelessness. Too many of them occur as single reactions in a large herd to account for them on the basis of an unclean needle, or improper cleansing of the skin. If these factors played a part there should be more animals involved in a series of injections made with the same dirty needle or when the skin was improperly cleansed by the same man. It is my opinion that the man can be dismissed as playing a part in bringing about these troublesome reactions. In the matter of interpretations of reactions there are some who claim they are able to differentiate, on the basis of the

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TUBERCULOUS</th>
<th>$ECONOMIC VALUE</th>
<th>SKIN LESIONS</th>
<th>NVL's</th>
<th>TOTAL NON-TUBERCULOUS</th>
<th>$ECONOMIC VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1941</td>
<td>2853</td>
<td>$570,600</td>
<td>574</td>
<td>1427</td>
<td>2001</td>
<td>$400,200</td>
</tr>
<tr>
<td>1942</td>
<td>2052</td>
<td>$410,400</td>
<td>385</td>
<td>992</td>
<td>1377</td>
<td>$275,400</td>
</tr>
<tr>
<td>1943</td>
<td>1735</td>
<td>$347,000</td>
<td>244</td>
<td>860</td>
<td>1104</td>
<td>$220,500</td>
</tr>
<tr>
<td>1944</td>
<td>1385</td>
<td>$277,000</td>
<td>302</td>
<td>784</td>
<td>1086</td>
<td>$217,200</td>
</tr>
</tbody>
</table>

* Estimated at $200 per annum.

...character of the reaction, between those in which the animal will eventually prove to be an NVL case and true tuberculosis. The reaction which is produced when an animal which has been recently infected (within 3-6 months) is injected with tuberculin is unmistakeable. It is characterized by an extensive turgid swelling, in which there usually appears an area of hemorrhage at the injection site. This hemorrhage may be observed within twenty-four hours after injection. At this time also the reaction may have reached its greatest size. Within another day or so necrosis of the tissue at the injection site may take place. In our experience such a reaction in an animal is invariably associated with a post mortem finding which we have come to describe as "25 lesions in the mediastinal or bronchial lymph gland". In other words, when an animal is recently and fairly extensively infected with tuberculosis it is in a high state of allergy and the response to the injection of tuberculin is profound. Prior to the development of this peak of allergy the tuberculous animal will give a reaction of lesser magnitude. Likewise, if the disease progresses beyond this point and either becomes very extensive or active or, on the other hand becomes arrested, then the magnitude of the tuberculin reaction also is less than that described above. From my limited experience I find myself unable to differentiate between these lesser reactions of the tuberculous animal and those in animals
sensitized because of a subcutaneous lesion or whatever is responsible for the sensitization of the NVL cases.

Since the human element in the equation is of little significance and also unalterable we first attacked the problem by studying the tuberculin factor. It was thought that possibly the cross reactions between tuberculin and such a sensitizing agent as that which caused the skin lesion and the NVL reactor might be due to impurities in the tuberculin. We, therefore, obtained some of Seibert's Purified Protein Derivative through the courtesy of Sharp and Dohme. As far as we are aware this material represented the fraction of tuberculin involved in the intradermal test in its purest form. Since the amount of this material available to us was limited and since, furthermore, large numbers of animals might have to be tested before any reactors might be found Dr. Moore suggested that we make arrangements to retest animals which had already been branded as reactors. Thus, we could obtain more information on the relative merits of PPD and Standard Bureau Tuberculin. Accordingly, arrangements were made to consign tuberculin reactors to a nearby slaughterhouse at which Federal Inspection was maintained.

The first group of reactors consisted of four animals. They were injected on one side with Standard Bureau Tuberculin and on the other side with PPD. Readings were made 72 hours later. Only one of the four animals showed a reaction to both products. The other three were negative. The animals were slaughtered and post mortem examination was made. The three animals which reacted negatively on retests were NVL cases. The reacting animal had tuberculosis. We should have stopped the experiment right there, since our subsequent results did not give such perfect differentiation. We realized that it would be necessary to make such comparisons on large numbers of animals, and to date have done several thousand of them. This initial attempt did, however, accomplish two things for us. One was that we had stumbled upon what appeared to be a promising method of differentiation between reactions due to tuberculous and non-tuberculous sensitization. The other was a means of evaluating two products which I would like to discuss further before considering the first application.

In a previous communication (1) the results of some of these comparative tests were reported. Table 2, taken from that communication, indicates virtual agreement between the two products. Thus, it appears that the second element of the equation, the tuberculin, now supplied almost exclusively by the Bureau of Animal Industry for field use, cannot be held responsible for the variations. The reactions obtained with it compare favorably with those obtained when the most highly purified tuberculin known was used on the same animals and under the same conditions as nearly as we would provide them.

There remains the third element in the equation, the cow. Briefly, the results of the retests which we have made during the last several years indicate that there lies the source of the variability in the reactions. While we have tested several thousand animals in the course of our studies they do not all lend themselves for inclusion in the tables which follow.

We believe that there are two distinct problems facing the testing veterinarian in the field. He is faced with the extremely difficult one of deciding whether a swelling which has been produced in response to the injection of tuberculin is due to
RESULTS OF RETESTS ON TUBERCULIN REACTORS

Infection with tuberculosis or to some other cause. If he condemns the animal and she shows NVL's on post mortem examination he is apt to be criticized by the owner. If this happens too often he will probably be criticized by the Livestock Sanitary Official in his state. On the other hand, if he fails to condemn a tuberculous animal which has shown a reaction she will remain in the herd and may in time become a spreader. She then infects other animals in that herd or may be sold to another herd. Thus, the testing veterinarian, in New York State at least, may be said "to be between the two horns of a dilemma." We believe that the results which we have obtained in retesting reactors offer some hope of improving this situation. They are not perfect, however.

Table 2.—Results of intradermal retests on 281 animals neither "plugged" nor showing skin lesions

<table>
<thead>
<tr>
<th>Tuberculin (B.A.I.)</th>
<th>Lesions of Tuberculosis Found</th>
<th>Lesions of Tuberculosis Not Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction +</td>
<td>Reaction -</td>
<td>Reaction +</td>
</tr>
<tr>
<td>77</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>P.P.D. (Sharp &amp; Dohme)</td>
<td>73</td>
<td>43</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Size of Reactor Groups</th>
<th>Tuberculous</th>
<th>Non-Tuberculous</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>1</td>
<td>59</td>
<td>21.97</td>
<td>58</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>18.60</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>21.92</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>27</td>
<td>38.02</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
<td>54.83</td>
<td>3</td>
</tr>
<tr>
<td>Total or average</td>
<td>170</td>
<td>26.15</td>
<td>130</td>
</tr>
</tbody>
</table>

In interpreting tuberculin reactions the herd history should be taken into consideration. It should not, however, be allowed to out-weigh other evidence. If one is dealing with a herd which has been accredited and encounters a slight deviation the chances are that such deviation was not caused by sensitization with tubercle bacilli. Such an animal probably could safely be left in the herd. Our results indicate that, if such an animal be subjected to retest in say sixty days, her status will be more clearly established. In a herd in which no tuberculosis has been found and a visible skin lesion can be detected on physical examination in a reacting animal we believe that it is safe to allow that animal to remain in the herd. The size of the reactor group may also be taken into consideration in interpreting individual reactions in that, as table 3 indicates, the chances of finding tuberculosis on
post mortem examination increases with the size of the reactor group. Our experience would indicate that in applying this information the group should be handled as a unit. For instance, if one of a group of three animals shows an unmistakable reaction, such as is obtained at the peak of the allergic state, and one or more other animals show reactions, but of lesser extent, then all should be condemned. Not infrequently, under such circumstances, the animal with a slight reaction proves to be the most extensively infected of the two, and may indeed be the open case responsible for the infection. In a herd known to be infected with tuberculosis all animals which show any reaction whatever should be condemned, even those with skin lesions, because under such circumstances it is not safe to leave any reacting animal. On post mortem examination there may be some animals which show skin lesions only and some which show no lesions whatever. These animals may be looked upon as overhead. It is necessary to take them in order to be sure that no extensively infected animal, which is apt to give only a slight reaction, is left behind. We realize that it is difficult to compare reactions observed on several occasions on an objective basis. However, this method is the one which is commonly employed in the field and we have tried to make our observations under similar conditions. To facilitate the comparison of reactions we have assigned a reaction score on the following basis:

\[
\begin{array}{c}
O---1 \\
X--2 \\
XX--3 \\
XXX--4 \\
XXXX--5
\end{array}
\]

In studying the behavior of the various categories of animals it will be observed that in each case there is a drop in the reaction score. The average for the tuberculous cows approaches the original score most closely, being about one-half of the original. Those non-tuberculous animals with skin lesions show a retest score one-quarter as great as the original, while the NVL's have dropped almost to one-eighth. We have interpreted this to mean that sensitization of cattle by tubercle bacilli is maintained on the average over a more extended period than where such sensitization is due to a skin lesion or some factor which does not produce lesions (table 4)

### Table 4.—Average difference between original and retest reaction scores

<table>
<thead>
<tr>
<th>SIZE OF REACTOR GROUP</th>
<th>TUBERCULOSIS</th>
<th></th>
<th>SKIN LESIONS</th>
<th></th>
<th>NO VISIBLE LESIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Orig.</td>
<td>Retest</td>
<td>%</td>
<td>Orig.</td>
<td>Retest</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>6.27</td>
<td>3.35</td>
<td>53.46</td>
<td>6.08</td>
<td>1.63</td>
<td>26.80</td>
</tr>
<tr>
<td>2</td>
<td>6.58</td>
<td>3.41</td>
<td>51.82</td>
<td>5.97</td>
<td>1.66</td>
<td>27.80</td>
</tr>
<tr>
<td>3</td>
<td>7.00</td>
<td>3.92</td>
<td>56.00</td>
<td>5.53</td>
<td>1.30</td>
<td>23.50</td>
</tr>
<tr>
<td>4</td>
<td>6.29</td>
<td>3.03</td>
<td>48.15</td>
<td>6.10</td>
<td>2.30</td>
<td>37.70</td>
</tr>
<tr>
<td>5</td>
<td>6.79</td>
<td>3.17</td>
<td>46.68</td>
<td>5.66</td>
<td>0.66</td>
<td>11.66</td>
</tr>
<tr>
<td>Average........</td>
<td>6.58</td>
<td>3.37</td>
<td>51.22</td>
<td>5.86</td>
<td>1.51</td>
<td>25.49</td>
</tr>
</tbody>
</table>

The table shows the average difference between the original and retest reaction scores for different categories of animals. The data indicates that the tuberculous cows show the least drop in reaction score, followed by those with skin lesions and non-visible lesions. This suggests that the sensitization of cattle by tubercle bacilli is maintained over a longer period compared to skin lesions or other factors.
RESULTS OF RETESTS ON TUBERCULIN REACTORS

ONE COW REACTOR GROUPS

Let us now consider the tuberculin reactors by groups. The one cow groups, if they appear in a herd which has previously been clean, probably constitute the most perplexing problem with which the testing veterinarian is faced. This group comprised 270 animals of which 59 proved on post mortem examination to be tuberculous, 58 had skin lesions, and 152 were NVL's. In each category there were some animals which reacted a second time, and some which did not. It will be noted that more than three-quarters of the tuberculous cattle (46) reacted again, whereas one-quarter (13) failed to react. At the other extreme slightly more than two-thirds of the NVL's (105) failed to react on retests, whereas one-third (47) reacted a second time. The skin lesion group was almost equally divided into those which reacted a second time and those which did not. When the lesions found in these animals are classified on the basis of their severity we find that eight tankers and one sterilized carcass came from animals which reacted on retests. No animal in either of these two categories was missed on retest. With respect to localized lesions we have assumed that any lesions in the lungs represented a potentially open case or spreader. Lesions in lymph glands we have considered to be closed lesions. In this category we find five animals with lung lesions which reacted a second time and thirty-two with closed lesions. One animal with localized lung lesions failed to react and twelve with closed lesions did likewise (table 5).

TABLE 5.—One cow reactor groups (270 individuals)

<table>
<thead>
<tr>
<th></th>
<th>Tuberculous 59</th>
<th>Skin lesions 58</th>
<th>N.V.L. 152</th>
</tr>
</thead>
<tbody>
<tr>
<td>† 46</td>
<td>† 30</td>
<td>† 47</td>
<td></td>
</tr>
<tr>
<td>− 13</td>
<td>− 28</td>
<td>− 105</td>
<td></td>
</tr>
<tr>
<td>Av. days between test and retest</td>
<td>20.5</td>
<td>24.0</td>
<td>23.3</td>
</tr>
<tr>
<td>Av. test score</td>
<td>6.39</td>
<td>6.10</td>
<td>6.17</td>
</tr>
<tr>
<td>Av. retest score</td>
<td>4.28</td>
<td>3.13</td>
<td>2.78</td>
</tr>
</tbody>
</table>

Lesions of tuberculosis

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanked</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sterilized</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Localized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open (lungs)</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Closed</td>
<td>32</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

77.97% positive 48.27% negative 69.07% negative

TWO COW REACTOR GROUPS

The two cow reactor groups totaled 129 individuals of which 24 were tuberculous, 33 had skin lesions and 72 were NVL's. Of the 24 tuberculous individuals 19
reacted again and 5 did not thus 80% of the tuberculous animals reacted again. Of the animals with skin lesions only a little over one-third (12) reacted negatively on retest. On the other hand 60 of the 72 NVL's or better than four-fifths gave negative reactions on retest. A study of the lesions shown by this group of animals reveals that among the reactors on retest there was one tanker and one sterilized carcass, two animals with lung lesions, and fifteen with closed foci of infection. The five animals which failed to react all had closed lesions (table 6).

THREE COW REACTOR GROUPS

There were 119 individuals in the three cow reactor group, of these 26 were tuberculous, the same number showed skin lesions, and 67 were NVL's. Of the 26 tuberculous cattle 22 (84.62%) reacted on retest. Of the skin lesion animals 16

<table>
<thead>
<tr>
<th>Table 6.—Two cow reactor groups (129 individuals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retest Results</td>
</tr>
<tr>
<td>Tuberculosis 24</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>Av. days between test and retest</td>
</tr>
<tr>
<td>Av. test score</td>
</tr>
<tr>
<td>Av. retest score</td>
</tr>
<tr>
<td>Lesions of tuberculosis</td>
</tr>
<tr>
<td>Generalized</td>
</tr>
<tr>
<td>Tanked</td>
</tr>
<tr>
<td>Sterilized</td>
</tr>
<tr>
<td>Localized</td>
</tr>
<tr>
<td>Open (lungs)</td>
</tr>
<tr>
<td>Closed</td>
</tr>
<tr>
<td>79.17% positive</td>
</tr>
</tbody>
</table>

(61.53%) were negative, whereas 56 (83.58%) of the NVL's failed to react on retests. The lesions of tuberculosis in this group was distributed as follows:—there was one tanker which reacted on retest as did also three animals with lung lesions and eighteen with closed glandular lesions. The four animals which failed to react all showed closed glandular lesions (table 7).

FOUR COW REACTOR GROUPS

Of the 72 animals in this category 27 were tuberculous, 10 showed skin lesions and 34 were NVL's. Of the tuberculous animals 20 of the 27, or 74.08%, reacted again, on retests. One of the 10 animals with skin lesions failed to react again, whereas 24 of the 34 NVL's gave negative retest reactions. There were no generalized cases of
RESULTS OF RETESTS ON TUBERCULIN REACTORS 133

tuberculosis in this group of animals. Of the localized cases two with lung lesions and eighteen with closed glandular lesions reacted again. Of the seven animals

TABLE 7.—Three cow reactor groups (119 individuals)

<table>
<thead>
<tr>
<th>Lesions of tuberculosis</th>
<th>Tuberculous 26</th>
<th>Skin lesions</th>
<th>N.V.L. 67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ 22</td>
<td>- 4</td>
<td></td>
</tr>
<tr>
<td>Generalized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanked</td>
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<td></td>
</tr>
<tr>
<td>Sterilized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open (lungs)</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Closed</td>
<td>18</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Av. days between test and retest
20.3 19.5 19.8 25.8 20.5 24.3
Av. test score
7.04 6.75 5.50 5.66 5.63 4.73
Av. retest score
4.59 0.25 3.30 0.06 4.45 0.08

84.62% positive 61.63% negative 83.58% negative

TABLE 8.—Four cow reactor groups (72 individuals)

<table>
<thead>
<tr>
<th>Lesions of tuberculosis</th>
<th>Tuberculous 27</th>
<th>Skin lesions 10</th>
<th>N.V.L. 34</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ 20</td>
<td>- 7</td>
<td></td>
</tr>
<tr>
<td>Generalized</td>
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<td></td>
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</tr>
<tr>
<td>Tanked</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sterilized</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Localized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open (lungs)</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Closed</td>
<td>18</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Av. days between test and retest
23.4 20.8 23.1 17 26.5 20.8
Av. test score
6.30 6.28 6.11 6.00 6.10 5.75
Av. retest score
4.15 0.00 2.55 0.00 3.10 0.00

74.08% positive 10% negative 70.58% negative

which failed to react two had lung lesions and five had closed glandular lesions (table 8).
FIVE COW REACTOR GROUPS

The five cow reactor groups totaled 62 individuals of which 34 were tuberculous, three had skin lesions and twenty-five were NVL's. Of the tuberculous cattle 24 or 70.89% reacted positively on retest. Two of the three skin lesions were negative and 17 of the 25 NVL's or 68% were negative on retests. In this group two tankers, four animals with lung lesions and eighteen with closed glandular lesions reacted on retests. One tanker and one sterilized carcass, one animal with a lung lesion and seven with closed glandular lesions failed to react (table 9).

In the above tabulations each animal was considered as an individual without taking into account any knowledge of the herd from which it came or the size of the reactor group of which it was a member. It should also be pointed out that the interval between test and retest was quite variable. The extremes were from a minimum of 14 days to a maximum of 60 days. The average retesting interval, as can be observed from the tables, was fairly uniform for each group and was approximately three weeks. Admittedly, the retest results indicated above are not perfect. We believe, however, that since they were recorded under the conditions just indicated they could be improved upon, if herd history and the size of the reactor group were taken into consideration. The chief criticism of the retest results is that we occasionally missed a tuberculous animal. In a few instances, the animals missed might have been the source of infection. For this reason, we believe that in the practical application of these results groups of more than one animal should be handled as a group. That is, if even one member of it gives an unquestionable reaction on retest the whole group should be condemned as tuberculous.

We have studied the groups of reactors reported, herein, on this basis as well as the
RESULTS OF RETESTS ON TUBERCULIN REACTORS

herd history. If these factors had been taken into consideration in interpreting the results we would have missed only one tuberculous animal. We, therefore, feel that under actual conditions the retesting of suspicious reactors at an interval of say 60 days will enable us to leave in the herd a great many cattle which would prove on post mortem examination to be NVL cases. There would be some risk of leaving a tuberculous animal, but if the factors mentioned above are taken into consideration in interpreting the reactions the risk of leaving such an animal would not be very great.

PROBLEM HERDS

In the course of the work just described we often noticed that the animals presented for post mortem examination all showed recent tuberculous infection. It was only occasionally that a spreader animal was detected. In our experience, such an animal, when she did appear, was apt to give a small reaction or she might even fail to react on retest. While we do not know this to be the case we have often wondered if such animals were not condemned on the basis of factors other than a swelling induced by the injection of tuberculin. We have repeatedly observed the harvesting of a new crop of tuberculin reactors in certain herds over an extended period of time, without the open case being among the reactors. There is ample evidence that the extensively infected tuberculous animal frequently does not react to the intradermal test. This phase of the tuberculosis eradication problem seems to us, at least as important as the no visible lesion phase. In fact, from the standpoint of the eradication of the disease, it is probably the more important of the two.

We have used several methods of trying to detect this spreader animal which failed to react to the intradermal test. These have included the Complement Fixation reaction, examination of sputum for tubercle bacilli, and the subcutaneous test. Our experience up to this time has been somewhat limited, but we have discarded the first two methods since they are not as satisfactory as the latter. In using the subcutaneous test we have observed that the spreader animals reacted at varying intervals following the injection of tuberculin. In one herd in which we had been trying to find the open case of tuberculosis we had subjected the animals to several intradermal tests at 60 day intervals. The animal which later proved to be the source of the infection consistently gave a negative reaction. As a last resort we subjected the entire herd, including the intradermal reactors which had not yet been removed from the premises, to a subcutaneous test. The animals which showed recent infection when finally examined post mortem reacted relatively early. This particular spreader, however, did not begin to react until about 12 hours after she had been injected with tuberculin. On the other hand, the spreader animal may be among the first to react. In addition to an elevation of temperature there may also be a physical reaction. For instance, in another herd an animal with extensive lung involvement which, like the preceding one had failed on several occasions to react intradermally, began to react about two hours after the injection of tuberculin subcutaneously. This febrile reaction was accompanied by fits of coughing which we have interpreted as being evidence of a focal reaction at the infection sites.

The technique which we have used, therefore, consists of hourly temperature readings over a period of at least 14 hours following the injection of tuberculin. We
have been taking two pre-injection temperatures but in order to save time these could probably be eliminated. Under our experimental conditions we have felt that the knowledge which they provided was worth the extra effort. We have used a dose of from 3 to 4 cc. of intradermal tuberculin, injected subcutaneously.

Presumably most of the tuberculous infection in cattle is derived from a spreader animal in the herd. We have encountered several herds, however, where the infection was derived from a human being suffering from pulmonary tuberculosis caused by the bovine type of tubercle bacillus. In one such case (2) the owner has infected 5 successive herds of about 20 cows each over a period of 2½ yrs. Bovine tubercle bacilli have been recovered both from lesions in the cattle and from the sputum of the owner. In another instance, the evidence is presumptive but very highly so, in that the disease appeared with a hired man and disappeared after he left. Of about 20 cattle which reacted during this time, all those which proved tuberculous had been recently infected. The herd has tested clean for a year since. The human being as a vector of bovine tubercle bacilli has been frequently reported in the European literature. While this situation occurs less frequently with us it apparently is a factor to be reckoned with in certain parts of New York State.

Both of the procedures outlined here seem to us to be promising enough to warrant their application in a limited area as a sort of pilot experiment. Arrangements have, therefore, been made to attack this problem in a single county with the cooperation of the accredited veterinarians, the county veterinarian, and the Department of Agriculture and Markets. The work in this area has just begun so that no data is available. In time, however, we hope we will be in possession of information which will enable us to say whether or not, by retesting suspicious tuberculin reactors we can reduce the incidence of NVL's without too great a risk of leaving a tuberculous animal in the herd. We will also be in a position to say whether or not an intensive effort to determine the source of infection in those herds where we know tuberculosis exists will rout out the disease where it still continues to be a problem.

LITERATURE CITED

THE JOHNE'S DISEASE PROBLEM, AND RELATION OF JOHNE'S DISEASE TO THE TUBERCULOSIS NO VISIBLE LESION PROBLEM

BY HOWARD W. JOHNSON, B.S., M.S., D.V.M.

Regioncral Animal Disease Research Laboratory, Bureau of Animal Industry,
Agricultural Research Administration, U. S. Department of Agriculture, Auburn, Alabama

Johne's disease is a widespread chronic infection of cattle and sheep. The recognized clinical symptoms of this disease are emaciation and diarrhea. These symptoms, when present, appear in advanced or terminal stages of an infection that may be latent for several months or years. It has been estimated that this disease causes an annual loss in cattle in this country of about $5,000,000 and evidence indicates that the disease which is already widespread, is increasing. If the increase is in accordance with the experience in other countries it may reach a position of major economic importance in this country.

Let us take a check and balance inventory of the knowledge we have at hand and the information which we need in order that we may determine what can be or what should be done to be masters of this livestock disease problem.

We know: (1) that Johne's disease is caused by the organism Mycobacterium paratuberculosis. This organism is of the same genus and is similar in certain cultural and immunological characteristics to the acid-fast organisms of avian, bovine, and human tuberculosis as well as other acid-fast organisms. (2) That this organism is viable for prolonged periods of time. Workers in Russia (1) state that its numbers are undiminished in soil and water after 11 months and a report from England (2) states that M. paratuberculosis was still viable in water after 13 months and in infected feces for at least 246 days. (3) From reports by Hagan (3) and Hagan and Zeissig (4) and in our experience, we know that young animals are the more susceptible and that extreme measures must be taken to prevent the spread of infection to this age group. (4) That infected herds may be classified into the following three types, (a) herds in which 10-25% of the mature animals annually show gradual emaciation and diarrhea, and die, (7-10% of all herds containing reactors are of this type); (b) herds in which only an occasional animal will show clinical symptoms of Johne's disease and die (9-15% of all herds containing reactors are of this type); (c) herds in which there are animals which are sensitive to intradermal johnin and upon postmortem show positive bacteriological and pathological evidence of Johne's disease but in which there has been no clinical evidence of Johne's disease. A large majority of herds containing reactors are of this type. (5) That pathological changes observed at autopsy may be either localized in the mucosa or distributed throughout the intestinal wall. These two types of pathology observed in different infected herds show that some strains of the Johne's organism are much more invasive than other strains. (6) That intradermal johnin with a potency for M. paratuberculosis artificially sensitized cattle equal to
that shown by mammalian tuberculin when tested on \emph{M. tuberculosis} (bovis) artificially sensitized cattle is now being prepared. (7) That Johne's disease is widespread in this country having been reported from every section.

Let us now examine the "must know" side of the ledger. (1) That the johnin to be used in the future must be maintained at a sufficient potency to detect the animals which have been sensitized by \emph{M. paratuberculosis} organisms and that a continuous effort is being made to improve the specificity of the testing agent. It should be noted that in the past there has been no guarantee of uniform potency in the batches of johnin used and that the whole literature on the subject gives little indication of the potency of different preparations. In many instances the johnin used was not highly potent. (2) A survey must be conducted to determine

<table>
<thead>
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<th>TUBERCULOSIS</th>
<th>JOHNE'S</th>
<th>NO. CATTLE</th>
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<tr>
<td>+</td>
<td>+</td>
<td>2</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>D</td>
<td>-</td>
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**Total** ................................................. 6,931

\textit{Code:} + = Positive; D = Deviation; - = Negative; P2 or 2X or better = positive; Less than P2 or 2X = Deviation.

In a total of 83 lots tested there were 44 cattle in 22 lots that showed some degree of reaction. Observations were made 72 hours after injection.

the extent and distribution of Johne's disease in this country. Six thousand nine hundred thirty-one cattle in one milk shed of Alabama have been tested.\textsuperscript{1} The results of this test are given in table I. Two additional milk sheds in Alabama are to be tested to determine whether or not a survey on one milk shed in a given section will give a reliable index of infection for a section. Based on the results of such a survey one could formulate a program for a comprehensive country-wide study of the Johne's disease problem. (3) An expanded study of the possibilities of eliminating Johne's disease from herds which are economically unsound as the result of this infection's presence must be undertaken. We wish to report that in two infected herds in which the test and slaughter method was used the reactors to

\textsuperscript{1} Cooperative work with the Tuberculosis Eradication Division, U. S. Bureau of Animal Industry.
intradermal johnin and the animals showing clinical evidence of the infection were eliminated and neither have reappeared after two years of testing and observing.

It will be appreciated that in any discussion of the Johne's disease problem there will be brought to mind its possible relation to the tuberculosis eradication no visible lesion problem. The extent and distribution of Johne's disease and the possibility of cross or nonspecific reactions in the testing for either Johne's disease or tuberculosis are two factors that need to be considered in a discussion of this no visible lesion problem. The measures suggested for obtaining information on the extent and distribution of Johne's disease have been discussed earlier in this paper.

Although agglutination, complement-fixation, precipitin, and many variations of allergin tests have been studied by many investigators it is generally considered that all may sometimes be in error because of nonspecific or cross reactions. Only

<table>
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<th>TABLE II.—Results of N.V.L. Studies</th>
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<td>175 intestinal tracts from N.V.L. tuberculin reactors examined for presence of acid-fast organisms indistinguishable from M. paratuberculosis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>NO. POSITIVE*</th>
<th>PERCENT POSITIVE</th>
<th>NO. SUSPICIOUS†</th>
<th>PERCENT SUSPICIOUS</th>
<th>NO. NEGATIVE</th>
<th>PERCENT NEGATIVE</th>
<th>NO. FROM EACH SECTION</th>
<th>PERCENT FROM EACH SECTION</th>
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<tr>
<td>N. E. States</td>
<td>9</td>
<td>21</td>
<td>16</td>
<td>27</td>
<td>63</td>
<td>43</td>
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<td>24</td>
</tr>
<tr>
<td>Middle West</td>
<td>11</td>
<td>12</td>
<td>1</td>
<td>81</td>
<td>87</td>
<td>93</td>
<td>39</td>
<td>53</td>
</tr>
<tr>
<td>South</td>
<td>11</td>
<td>28</td>
<td>8</td>
<td>25</td>
<td>64</td>
<td>39</td>
<td>39</td>
<td>23</td>
</tr>
<tr>
<td>Grand total</td>
<td>31</td>
<td>17</td>
<td>11</td>
<td>7</td>
<td>133</td>
<td>76</td>
<td>76</td>
<td>175</td>
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</tbody>
</table>

* Positive = clumps of acid-fast organisms indistinguishable from M. paratuberculosis.

† Suspicious = a few scattered individual or paired acid-fast organisms indistinguishable from M. paratuberculosis.

the intradermal allergen testing procedure employing allergens (tuberculin or johnin) of like specific potencies will be discussed at this time.

Johnin will usually produce a positive skin reaction in cattle infected with Johne's disease the same as tuberculin usually produces a positive skin reaction in cattle infected with tuberculosis. However, both products have proved to be unsatisfactory for differential diagnosis. Tuberculous cattle will sometimes show a positive reaction to intradermal johnin. Also, tuberculin tests may give positive reactions in cattle that are infected with Johne's disease even though no tuberculosis infection is present in the animal. This lack of specificity of tuberculin and johnin presumably results from the fact that the organisms of tuberculosis and Johne's disease are closely related and consequently sensitize the host to allergens common to both tuberculin and johnin.

In the use of mammalian tuberculin to assist in the eradication of bovine tuberculosis false skin reactions sometimes bring about condemnation and destruction of animals in which no evidence of tuberculosis can be demonstrated by visible lesions at postmortem examination. Thus, out of
8,105,480 cattle tested last year, 5,926 reacted but exhibited no visible lesions and about 1,000 showed skin lesions only. The intestinal tracts from 175 no visible lesion reactors were examined for acid-fast organisms with the results shown in table II. We feel that the lower percentage of positive findings in the material from the Middle West may be due to the reactions having been caused by avium sensitization, as this area is known to have a rather high incidence of avium infection.

As has been stated, the present johnin or tuberculin while disclosing nearly 100% of animals homologously sensitized artificially as reactors also give positive reactions in some animals which have been artificially sensitized to other members of the acid-fast group of organisms. Studies on groups of cattle and guinea pigs, individuals of which had been sensitized with some one member of the genus Mycobacterium, show that *M. paratuberculosis* and *M. avium* sensitizations are potentially the more likely factors in "no visible lesion" reactors to the tuberculin test.

There are three approaches to the improvement of our present testing procedures.

First, reverting to a less potent johnin or tuberculin which would lessen the numbers of no visible lesion cases but would obviously risk the failure to disclose true reactors. The paramount problem is control of the disease, and therefore, the maximum number of true reactors must be detected to accomplish the purpose of the test.

A second modification of our present procedure could be the use of mammalian tuberculin and avian tuberculin or johnin simultaneously at two sites on each animal as a comparative test. If these materials were of like specific potencies then the one more likely to elicit a greater response would be the allergen homologous to the organism causing the infection. It can readily be seen that this comparative test is very cumbersome in use and would very seriously limit the amount of testing which a veterinarian could undertake.

The third, an entirely specific allergen which would be perfection, is elusive but a challenge to research workers.

Related species of animals and plants, including microorganisms, commonly have identical allergens. The same related species also have allergens that are distinctive and characteristic to each species and variety of organism. The presence of identical allergens in johnin and tuberculin is implied by the failure of these products to induce uniformly specific skin reactions in animals infected with Johne's disease or tuberculosis. However, by many experimental tests on homologously and heterologously sensitized cattle, johnin and tuberculin have been shown to possess a substantial though variable degree of specificity. This observation would seem to justify the inference that johnin and tuberculin contain nonidentical allergens which are specific for *M. paratuberculosis* and *M. tuberculosis* (bovis) sensitizations, respectively. (7) If an allergen characteristic of *M. paratuberculosis* alone could be isolated from johnin this allergen would serve as a specific testing agent for Johne's disease. If an allergen characteristic of the organism of bovine tuberculosis alone could be isolated, this allergen would serve to distinguish infections of bovine tuberculosis from infections of other types of acid-fast organisms as well as the Johne's organism. Efforts are being made to accomplish this end.
REFERENCES


REPORT OF COMMITTEE ON TUBERCULOSIS


The Committee on Tuberculosis has considered some of the more important problems pertaining to the control and elimination of tuberculous infection in livestock including poultry, and presents for the consideration of the Association the following comments and recommendations:

1. In the Report of the Committee on Tuberculosis for 1944 it was recorded that Federal regulations were being contemplated to correct certain weaknesses in the existing regulations governing the importation of cattle for purposes other than immediate slaughter. The Committee notes with much satisfaction that the necessary regulatory changes were drafted and became effective on and after February 1, 1945 (B.A.I. Order 379).

2. In the report for 1944 the Committee on Tuberculosis expressed skepticism regarding the policy followed in certain areas of the United States whereby only a small percentage of the herds are retested annually. As a result of this practice many herds have not been retested for as long as twelve years. The Committee reiterates its disapproval of this, a policy which if persisted in can lead only to serious consequences. The Committee is of the opinion that long intervals of time between retests has in some areas resulted in an increase in the incidence of tuberculosis, and strongly urges that the situation be corrected as soon as possible. It is recognized that during the exigencies of the war certain deficiencies in control measures developed and were allowed to continue. However, the peculiar difficulties that existed on account of war can no longer be advanced as reasons for continuing sub-standard tuberculosis control practices. Retesting herds at intervals considered most likely to prevent the transmission of the disease must be insisted upon.

3. During the entire history of the testing of cattle with tuberculin, one of the most perplexing problems has been that created by the animal that reacts positively to a diagnostic dose of tuberculin but in which concomitant evidence of tuberculous infection cannot be established. To those who believe the specificity of tuberculin to be infallible, the failure to find lesions of tuberculosis in an animal that had reacted to tuberculin is due to the fact that the search was not sufficiently complete, or that the infection was in the incipient stage.

An honest approach to this problem requires that we admit that experience of the past twenty-five years incites in the minds of many a reasonable doubt as to whether or not tuberculin is a diagnostic substance of absolute specificity. While we are familiar with the many ideas that have been advanced in explanation of the non-visible lesion reactor, candor requires that we admit that at the present time there are no explanations supported by an adequate amount of evidence.

The Committee does not wish to weaken confidence in tuberculin as a substance of tremendous and proved value in detecting tuberculous infections. By its use, man's greatest conquest over tuberculosis has been accomplished. We must how-
ever recognize that at the present time a very high percentage of cattle reacting to tuberculin are without other demonstrable evidence of infection with tubercle bacilli. If agents other than tubercle bacilli are capable of sensitizing cattle to tuberculin, one must accept the fact that even though tuberculosis be eliminated entirely from the herds of this country a considerable percentage will continue indefinitely to react to tuberculin. If progress in the solution of this problem is to be made we must maintain an open-minded attitude. To insist without confirmatory evidence that a positive reaction to tuberculin is unequivocal proof of the presence of a tuberculous infection is prejudicial to the best interests of all who are seriously concerned with this perplexing situation.

The answer to the question “can cattle be sensitized naturally to a diagnostic dose of tuberculin by agents other than tubercle bacilli?” can only be secured by research and more research. Therefore the Committee strongly recommends that investigators be urged to explore this problem and where work is contemplated that adequate funds and competent personnel be provided to insure a thoroughly satisfactory investigation. The answer to the question previously stated would be welcomed by cattle owners and control officials alike and would enhance the confidence so essential to the continued success of the tuberculosis eradication program, the primary objective of which is to detect and eliminate from the herd those animals infected with tubercle bacilli.

The Committee was exceedingly fortunate in securing for the program this year Dr. Alexander Zeissig and Dr. Howard W. Johnson. These investigators are to be congratulated for having undertaken an inquiry into this important and difficult problem. Their reports are definitely provocative and reveal sufficient information to warrant ample financial support for insuring the continuation and expansion of the work.

4. With the marked reduction of the incidence of tuberculosis in cattle and the general acceptance of pasteurization as an effective safeguard in the production of a safe milk supply there is likely to be an undesirable tendency to forget that bovine tubercle bacilli are capable of producing in man every variety of tuberculosis of which the human type of the bacilli is capable. It is perhaps useful occasionally to review briefly the pertinent facts concerning the transmissibility of bovine tubercle bacilli to human beings. These facts are (1) Incomplete data from investigators in different parts of the world indicate that approximately 10 per cent of tuberculous infections in man were due to the bovine type of the organisms. Therefore the organism of cattle tuberculosis must be considered an important pathogen for human beings. (2) The highest incidence of bovine type of infection in man occurs in Great Britain, with Denmark next in order of frequency. (3) Children are more commonly affected by the bovine type of the organism than are adults, the highest incidence of infection occurring in children under five years of age. (4) The usual portal of entry of bovine tubercle bacillus in human beings is the alimentary canal. (5) While most of the reported cases of bovine tuberculosis infection have been extrapulmonary in character, several hundred cases of pulmonary tuberculosis in man due to bovine tubercle bacilli have been recorded. (6) The transmissibility of the bovine type of infection from man to cattle has been established. (7) The possibility of the transmission of bovine tubercle bacilli from one person to another
is impressive, especially from persons with pulmonary tuberculosis of the bovine type. (8) There is no reason for believing that the bovine type of the tubercle bacillus is less virulent for human beings than is the human type of the organism.

The foregoing constitute sufficient evidence to justify the conclusion that tuberculous cattle are a serious menace to human health and should not be tolerated by an informed society. It follows, therefore, that no laxity be tolerated which will make less effective the methods or policies designated to control and eradicate the disease.

5. While the seriousness of infection due to the avian tubercle bacillus has been generally recognized for many years, the problem remains. To quote from the report of the Committee on Tuberculosis for 1944,—"The measures designed to reduce or satisfactorily control the disease in those sections of the United States where it is rampant, have not, in our opinion been effective." In many areas avian tuberculosis is one of the major diseases of poultry. Furthermore the bacillus of avian tuberculosis is capable of infecting other species of livestock. Therefore we recommend that the methods now being followed in the attempt to control avian tuberculosis be subjected to a critical examination by a special subcommittee charged with the responsibility of obtaining an accurate and comprehensive understanding of the situation and to formulate plans for an effective attack against the disease.
COMMUNICABLE ANIMAL DISEASE PROBLEMS
ENCOUNTERED IN ITALY

BY ROWLAND W. RUSHMORE, D.V.M.

Lt. Col., Veterinary Corps, Army of the United States

It has been my privilege to serve in the Army's Civil Affairs Organization for Italy during the past two years. I was assigned to control the Italian Civil Veterinary Service. Communicable animal diseases were among the problems encountered there and for me these made up the most interesting phase of the work.

Before discussing these diseases, I believe it worthwhile to briefly outline the organization of the Italian Veterinary Service and to point out the more important handicaps under which that service was called upon to function during the war.

There are approximately 4,000 graduate Italian Veterinarians. Practically all have been trained at one of the ten major schools in Italy. With somewhat less that 21 million food animals, exclusive of poultry, the service is overcrowded. Very few free practitioners are to be found because most all are in the direct employ of the National, Provincial or Communal Government. The chief of the service and his staff serve as a part of the Public Health Division in the Ministry of the Interior. This means the service is socialized and is separated from the Ministry of Agriculture. Each province, which is comparable in size to one of our mid-western counties, has a provincial veterinarian with some 20 to 50 communal veterinarians. The latter are not only responsible for the care and treatment of livestock in the communes, but they are also obligated to inspect all meats. Biological production and experimental work is done within one of eleven government owned and controlled institutes with the exception of three small private concerns. As these laboratories were not producing every biological required we furnished these in the amount of approximately $60,000. They served to control Hog cholera at a time when food was needed most.

The war created conditions which at times made it almost impossible for Veterinarians to function. In most areas there were no means of transport other than the horse and buggy or motor cycles, both of which were most expensive. The few drugs and little equipment available were to be found only on the black market at exorbitant prices. However, this problem has recently been alleviated by the shipment of drugs and equipment in the amount of $75,000, mostly from this country. Communication was most difficult in all sections and in some areas there was no means available for months. Some communes were without veterinary service at times because of the numbers in the military service or because it became necessary to take refuge while the fighting passed through a section. There were a few ardent fascists in the service who were removed from office. Law enforcement agencies were inactive which helped to make it impossible to properly enforce livestock sanitary police regulations. The value of livestock reached an astoundingly high figure, with an average horse selling for $1200, beef was $4.00 and pork $5.00 per pound.

The diseases which most commonly occurred during the two years I was there

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which I believe to be of most interest here, were Foot-and-Mouth Disease, Anthrax, Trichomoniasis, Brucellosis, Tuberculosis, Piroplasmosis, Sheep Pox, Swine Erysipelas, Hog Cholera, Equine Glanders, Equine Epizootic Lymphangitis, Dourine, Equine Infectious Anemia, Pseudo-pest of chickens or Newcastle Disease, and Rabies. Since time is limited I shall discuss briefly the more interesting features of each.

**Foot-and-Mouth Disease** appeared in the occupied zone during May, 1944, and it rapidly spread through an area of approximately 15,000 square miles in about four months time. Two methods of control were employed—first, infected farms were quarantined. However, the degree to which this was effective was left to the farmer—secondly, as much vaccine as possible was produced and administered. The above two methods served to delay the spread of the infection temporarily. Vaccinated animals were immune for six months. Soon after Rome was liberated Waldmann Vaccine was produced in the Rome laboratory. This proved to be of help in that it reduced the tremendous economic losses suffered by dairy farmers. The overall mortality rate among infected animals was about two per cent but it was considerably higher among dairy stock and especially dairy calves. Milk production fell to thirty per cent of normal for periods of two to four weeks or more and abortions were very numerous. The Waldmann Vaccine is of a very voluminous nature and requires large quantities of distilled water to produce it. This plus the facts that production of it could not safely be started until the disease became active and only enough virus for sixty bovine doses could be obtained from one slaughter animal, greatly limited the amount which could be produced. The great disadvantage of this vaccine appeared to be that it is most difficult if not impossible to produce enough of it in a short time so as to permanently halt the spread of the disease.

There were two types of virus active. Type O was most prevalent at the onset of the outbreak, but later in Sardinia Type A became active. This necessitated the air shipment of the virus from Sardinia for vaccine production as the Merent types are not immunologically the same.

This disease is active in one or more parts of Italy at most all times. The losses incurred from it over a period of years are very great. After seeing many infected animals and the results of only one general outbreak, I am thoroughly convinced that we are most fortunate in not having it here and I sincerely hope that it never gains a foothold in the United States.

**Anthrax** was and has been a constant threat in Italy. However, due to an obligatory vaccination program carried on prior to the war and reactivated during the period of occupation, there were only scattered cases during that time.

**Trichomoniasis** became quite prevalent in several central provinces during the spring of this year. Of 1,000 cattle examined in one province during April, approximately 800 were suspected of having this infection. Abortions at 8 to 12 weeks were very prevalent as were vaginitis and pyometria. Artificial insemination activity was markedly increased in Central Italy as one of the control measures employed to limit the spread of this infection. Bovine and equine artificial insemination in Northern Italy is well advanced and is under the complete control of Veterinarians. Bovine sterility work is commonly practiced in conjunction with bovine insemination.
Brucellosis was prevalent in cattle, sheep and goats resulting in considerable economic loss to owners and in numerous cases of undulant fever among civilians. Brucella Melitensis was common in both sheep and goats. A diagnostic agent called Mirri’s Brucellin proved to be of real value in helping to control the infection in sheep and goats. This was developed prior to 1937 by Mirri in Palermo, Sicily. 1 c.c. was injected subcutaneously into the lower eyelid and in positive cases there was a large painful swelling at the site of injection. It appeared to be an excellent means of diagnosing Brucella infection in sheep and goats. Unfortunately there is no organized campaign to reduce Bovine infectious abortion in Italy. Brucella abortus strain No. 19 with instructions for vaccine production as furnished by the Bureau of Animal Industry was made available there last year. However, veterinarians and farmers are very skeptical of it and have produced only a few thousand doses.

The incidence of Bovine Tuberculosis is extremely high in Italy. It is estimated that, were all cattle to be tuberculin tested, some 50 to 80 per cent would react. No eradication program is in effect. Bacillus of Calemette and Guerin (B.C.G.) Vaccine is produced and administered in many communes of Northern Italy, but it appeared to be merely a “last resort measure.”

Piroplasmis of cattle, and equines, is and has been for years very prevalent in most parts of Central and Southern Italy and in Sardinia. I saw no sign of any preventive measures against Piroplasmosis. A German product called “Acaprin” was used in treating infected animals. “Acaprin” is made by Bayer and was developed to prevent losses among German military animals in Piroplasmosis infected areas. It proved to be an excellent treatment curing a very high percentage of those infected animals to which it was administered. It is indeed unfortunate that no effective preventive measures are employed against this disease in Italy.

Sheep Pox was first reported in the fall of last year along the Adriatic Coast in Southern Italy. Reports from that area in June of this year indicated that spread of sheep pox had been prevented by means of rigidly enforced quarantines and limited vaccination.

Swine Erysipelas was quite prevalent but did not create a major problem because veterinarians and farmers were quite accustomed to its presence. The most commonly reported form of Erysipelas was “Diamond Skin.” They have been using an avirulent living culture vaccine for Swine Erysipelas since 1941. While I was there more than 250,000 vaccinations were made with it and the results appeared to be comparable to those following the simultaneous method. As this vaccine may prove of great value here I was able to bring information and material with which experiments can be made.

Cost of vaccination with such a product in my opinion would be about one half that of the simultaneous method. Furthermore, all possibility of spreading the disease through vaccination would be eliminated as well as any danger to the veterinarian administering it. The main disadvantage would be that it is not effective when used on exposed or infected herds as is the case with the vaccines for Hog Cholera.

The appearance of Hog Cholera in Southern Italy during the Spring of 1944 created quite a problem due to the fact that no biologicals were available. The only plant...
equipped to produce anti-serum is located in what was at that time enemy occupied territory. This necessitated our bringing supplies with which to combat it. It was decided to requisition only enough anti-serum for use on infected and exposed herds and to use crystal violet vaccine on non-infected and non-exposed ones. During the period June, 1944 to August, 1945, 500,000 vaccinations were made with this vaccine. The results following its use on non-exposed and non-infected herds were uniformly excellent. There was every indication that the Italian veterinarians intend to use large quantities of it in the future.

_Equine Glanders_ was quite common in Italy prior to the war and there was a marked increase in 1944 and '45. Only those animals showing symptoms were destroyed and very little Mallein testing has been done. They use subcutaneous Mallein for the few tests which are made. A few thousand doses of intradermic mallein were furnished from here but there was little indication that any change will be made in the near future. Under war time conditions it was impossible to instigate and enforce glanders eradication measures.

The most typical case of acute glanders observed was a mule brought to the Rome abattoir. There was a purulent unilateral blood-tinged nasal discharge. The submaxillary lymph glands were swollen, dyspnea was prominent, and the temperature was elevated to 105. When autopsied, numerous large ulcers with prominent edges were found in the nasal passage. The epiglottis was coated with greyish yellow ulcers, the edges of which appeared to be necrotic. In the lungs there were a great many reddish-brown nodules of varying size which when incised exuded a greyish-yellow caseous pus.

_Equine Epizootic Lymphangitis_ was routinely reported and we were able to see many cases. In lieu of slaughtering infected animals, treatments of various types were attempted. It appeared as though about fifty per cent of those animals in which the lymphatics were only partially involved when treatment was started made a recovery. However, many of these did recur.

_Dourine_ was introduced during May, 1945 in the Venice area. There were at least 17 infected stallions and more than 60 exposed mares by mid-August. The control measures being employed there now are not comparable to those used here partially because of the entirely different circumstances prevailing at this time. There are too few laboratories available and an acute shortage of transportation, which makes a large scale complement fixation testing program impossible. The previously mentioned inflation of the lire is another major limiting factor.

_Equine Infectious Anemia_ is prevalent in Northern Italy resulting in serious losses. They have found no effective means of controlling it.

_Newcastle Disease or Pseudo-Pest_ has probably been widespread in Italy during the past four or five years. Chicken losses during that period have been very great. Many of the Italian veterinarians believed this to be Laryngotracheitis because infected birds there almost invariably exhibit a larynigitis and tracheitis. Only recently was it definitely established as Newcastle Disease.

The virus was easily cultivated on chick embryos and was not difficult to isolate from infected birds at the onset of the disease. It appeared as though turkeys, ducks, geese, guinea fowls or pigeons were not highly susceptible when exposed to infected birds. However, pigeons injected with virus cultivated on chick embryos
invariably died within two to five days. Chickens of all ages were susceptible. The incubation period varied from three to seventeen days and the virus appeared to vary greatly in virulence from farm to farm. Losses ranged from ten to one hundred per cent.

At the onset of the disease infected birds showed gasping for air but there was little or no exudate. The wheezing sound so often heard around birds infected with laryngotracheitis was noticeably absent. After two or three days the birds usually developed a hemorrhagic diarrhea. This was commonly followed by death within a few days. In some flocks a large percentage of the birds developed nervous symptoms several days following the onset of the disease.

Post mortem findings were somewhat variable but those most consistently found were as follows:

1. Laryngotracheitis;
2. Hemorrhagic enteritis with petechial hemorrhages almost invariably present in the mucous membrane of the stomach and at the ileo cecal orifice;
3. The spleen was usually swollen to about twice its normal size.

The Italians are using large quantities of a chick-embryo-aluminum hydroxide vaccine as a preventive. It is produced by first cultivating the virus on chick embryos following Burnets' method and later mixing with aluminum hydroxide solution. More than five million vaccinations were made during 1944. This vaccine appeared to produce a good immunity of very limited duration. Re-vaccination was recommended every six weeks and the dosage was .5 to 2 c.c. intramuscularly.

Rabies had seldom been observed in Italy prior to the war according to reports on file. However, in some areas it became quite prevalent during 1943, '44 and '45. For example, in Rome during the summer of 1944 there were 57 clinical cases which were confirmed in the laboratory. Three civilians in Rome who refused to take the Pasteur treatment died of Rabies. The control measures employed consisted mainly of impounding stray dogs and forcing all owners to leash or muzzle their dogs. Vaccination was not employed because there was no vaccine available and no place where it could be produced in a short time. Furthermore, dog owners were not educated to the use of vaccine.

In conclusion please allow me to emphasize the following points:

1. The communicable diseases now active in Italy of which we have little or none are Foot-and-Mouth Disease, Pseudo-Pest of chickens or Newcastle Disease, Equine Infectious Lymphangitis, Equine Glanders, Dourine and Sheep Pox.
2. Under the present conditions there is little evidence that most of these will be effectively controlled or eradicated.
3. Veterinary medicine in Italy is socialized and is separate from the Department of Agriculture. From the report I have given you today you will undoubtedly agree that the results with such a system are not the most desirable.
4. Avirulent Living-Culture Vaccine for Swine Erysipelas has been used in some parts of Italy in lieu of the simultaneous method with good results.

If there are any questions I shall be happy to answer them to the best of my ability.
OBSERVATIONS ON THE NATURAL HISTORY OF WESTERN EQUINE ENCEPHALOMYELITIS

BY W. C. REEVES, PH.D.¹

HISTORICAL REVIEW OF WESTERN EQUINE ENCEPHALOMYELITIS, 1930–1940

Most of our knowledge of this disease has been gained in the past 15 years. In 1930 the etiological agent, Western equine encephalomyelitis virus, was first isolated from the brain of a horse, in California, by Meyer, Haring, and Howitt (1). Each following year federal, state and private organizations have reported additional isolations of virus. The virus is now believed to be active in all states west of the Mississippi River, although virus strains still have not been isolated from several of these. Western equine virus has also been isolated from several of the Central States and from as far east as Alabama. You are familiar with the explosive horse epizootics which have occurred annually in various Western States from the early 1900’s to the present time. In the early 1930’s several persons advanced the hypothesis that an insect was the vector of this disease, and in 1933 Kelser (2) experimentally transmitted the virus with laboratory infected Aedes mosquitoes. By 1940, nine species of Aedes had been reported as laboratory vectors (3). In addition, Syvertson and Berry (4) had announced that Dermacentor andersonii Stiles, the Rocky Mountain Spotted Fever tick, was a laboratory vector. Repeated attempts by various workers to demonstrate that Aedes mosquitoes or ticks were infected during epizootics yielded negative results (5, 6, 7).

In 1933 and 1934 formalinized brain tissue vaccines were first used and in 1938 an effective chick embryo vaccine was developed (8) and put into common use. This offered a method of protection for horses and it was believed in many quarters that the answer to control, or even elimination of the disease had been found. A more complete discussion of this will come later.

In 1938 the Western equine virus was first isolated from a fatal case of human encephalitis (9) and today the potential geographical distribution of the human infection is believed to be the same as that for the horse disease.

In 1940 came the announcement of the first isolation of virus from a naturally infected insect. Kitseleman and Grundmann (10) demonstrated virus in the kissing bug, Triatoma sanguisuga LeConte, collected in Kansas. Because of the limited distribution of this bug it was believed by the above authors and others to be of importance as a vector only in a restricted area; certainly its geographical distribution did not coincide with that of the disease.

From 1941 through 1944 many advances were made in our knowledge of the epizootiology of this disease. It has been my good fortune during this time to be a member of a research unit which has carried out field studies on the encephalitides of man and of horse, in Washington, California, Nebraska, Texas, Arizona and Okla-

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homa, and I would like to review our findings through these studies in some detail, as well as to speak of certain reports made by other workers during this period.

**FIELD STUDIES ON WESTERN EQUINE ENCEPHALOMYELITIS, 1941-1944**

In our studies, over 195,000 blood-sucking arthropods have been tested for virus infection, and Western equine encephalomyelitis virus has been isolated 89 times. In a search for the vertebrate reservoir host, more than 1,000 sera from normal animals have been tested for immunity to the Western equine virus.

The first mosquitoes infected in nature were found in the Yakima Valley, Washington in the summer of 1941 during an epidemic and equine epizootic. Five isolations of Western equine virus were made from *Culex tarsalis* Coq. (11, 12). This mosquito, since it only occasionally bites man, had never before been suspected of being a disease vector. During the same season, strong evidence was collected which implicated fowl as important "reservoirs" of the virus in this area (13). The following year, while working in the same valley experiments were begun which proved that *C. tarsalis* became infected if permitted to feed on laboratory inoculated ducks or chickens (14). Some of these infected mosquitoes, if held 8 to 30 days at high summer temperatures, were then shown to be capable of infecting other chickens by their bite. *At no time did the infected fowl appear ill.* A viremia was demonstrated by intracerebral inoculation of the bird's serum into mice; the mice subsequently developed typical encephalitis. In the Yakima Valley during 1942 (15) forty-four isolations of Western equine type virus were made from mosquitoes, forty-one of them from *C. tarsalis*, and one each from *Culex pipiens* Linn., *Culiseta inornata* Will., and *Anopheles freebormi* Aitken. In Kern County California during 1943 (16) thirty-one isolations of Western equine virus were made from mosquitoes, 28 of the 31 isolations from *C. tarsalis*, 2 from *Aedes dorsalis* Meigen, and one from *Culex stigmatosoma* Dyar. Most of the infected mosquitoes were collected from or near chicken coops. Studies of the feeding habits of this vector in both areas (16, 17) showed that it fed principally on birds, next in order of choice was the cow, and then the horse. These studies were made by application of the precipitin ring test to over 600 wild-caught, blood-engorged specimens. Thus, in three successive years, in two widely separated, hot, irrigated valleys, *C. tarsalis* was found infected 74 times. As a further indication of the rôle played by fowl, it was found that from these epidemic and epizootic areas 26 to 50 per cent of all chickens sampled by serum neutralization tests showed evidence of past infection with the Western equine virus (13, 16). Howitt (18) made similar surveys of chickens in the San Joaquin Valley, California, and found evidence of widespread infection, 57 per cent positive where epizootics occurred. As a result of these studies, it appeared to be well established that the fundamental biologic cycle of this virus in the regions surveyed, was *fowl to mosquito to fowl* and that occasionally an aberrant infection occurred in horse or in man through the bite of one of these infected mosquitoes.

*Reservoir animal is used here and elsewhere in this paper when in quotation in a restricted sense. All known vertebrate sources of this virus are not reservoirs in the sense of an animal having a latent or chronic infection which may serve as a source of infection over a long period of time. No such true reservoir of this virus is as yet known. Such a reservoir if it exists might be vertebrate or invertebrate.*
Surveys were made in the lower Rio Grande Valley of Texas (19) and the Gila River Valley, Arizona (20) in 1942, following an epizootic in each of these areas in 1941. During these two surveys no infected arthropods were found but equine and human infections were also lacking that year.

During 1943 studies were made in Eastern Nebraska (21) during a horse epizootic. A total of 12,366 blood-sucking arthropods were tested for virus. Only one Western equine virus was isolated and that was from a pool of Culex tarsalis.

During 1944 the worst horse epizootic ever reported for Oklahoma (22) attracted us to that state. However, by the time word had reached us and necessary arrangements had been made to work there, the outbreak was on the decline and cold weather had set in. It is highly probable that those few cases we saw had received their infection before the studies were begun. Mosquitoes were few in number, and those that were collected and tested for virus were negative.

The only two isolations of the Western equine virus from Aedes mosquitoes (A. dorsalis) collected in the San Joaquin Valley in 1943 deserve some further consideration, because interest has centered on this genus since Kelser in 1933 effected the first mosquito transmission with Aedes aegypti. We have tested over 25,000 Aedes mosquitoes from 6 Western, Midwestern, and South Western states, and have isolated the Western equine virus only twice. In contrast during the same period 21,833 Culex tarsalis have been tested from the same areas and 83 isolations of virus have been made. Our precipitin test feeding habit studies on Aedes help to explain these findings, if we accept the evidence incriminating birds as sources of mosquito infection. Fifty to 90 per cent of the sample of engorged Aedes tested by precipitin test from these areas were found to have fed on cows or horses and altogether about 98 per cent on mammals (16, 17). Virus is found so much more readily and in so much higher titer in the blood of chickens and ducks than in that of the horse, cow or man (23), that at present these large mammals appear to be of negligible importance as a source of mosquito infection. No one has reported successful infection of a mosquito from a horse, and experimental bleedings of infected horses, when occasionally positive for virus, do not show titers nearly as high as do chickens or ducks. We have tested calves and at no time following subcutaneous inoculation with Western equine virus was virus isolated from the blood, though the infection resulted in antibody production (23). These calves had no demonstrable antibodies prior to inoculation.

The following findings substantially support the great importance of the rôle played by fowl and Culex mosquitoes in the infection chain of this virus: the large amount of virus in the blood of infected birds; transmission by the bite of Culex tarsalis from fowl to fowl in the laboratory; finding up to 50 per cent of the domestic fowl with antibodies to the Western equine virus in certain epidemic and epizootic areas; knowledge of the special predilection that C. tarsalis has for the blood of fowl; and finding this mosquito naturally infected 83 times in three widely separated states. Added to this, the known distribution of this vector fits quite well the known distribution of the virus in the United States.

The possible range of mosquito vectors is great, and it could be that in future studies species other than Culex tarsalis will be proven to be important vectors.
We have found 5 other species of mosquitoes (4 genera) infected one or more times, and 13 species (3 genera) have been shown capable of experimental transmission.

Data which we have collected from involved areas in Texas, Arizona, Nebraska and Oklahoma throw doubt upon the importance of the host rôle played by domestic fowl for the Western equine infection in these states. From 0 to less than 10 per cent of the chicken bloods tested from these areas had antibodies to the Western equine virus. This is in marked contrast to 25 to 50 per cent positive in enzootic areas of Washington and California. Neither does our scanty data on wild birds from Mid Western areas give any important clue. We tested 27 pheasant sera from Nebraska for antibodies with negative results. From a series of 38 bloods collected from wild birds in Oklahoma only 2 had detectable antibodies; of a series of 28 wild bird bloods from Texas none had antibodies. However, Cox, Jellison and Hughes (24) found a prairie chicken and a deer infected with Western equine virus in North Dakota in 1941, and McNutt and Packer (25) isolated the virus from an infected hog in Iowa in 1943.

A finding which has aroused much interest and speculation is the recent report by Sulkin (26) of the demonstration of chicken mites *Demanyssus gallinae* DeGeer infected in nature with Western equine virus. Final evaluation of this finding awaits more detailed study. At present no announcement has been made that this mite is capable of acting as a vector from chicken to chicken. In the laboratory we have completed a large scale experiment in which a colony of *Demanyssus gallinae* from California were fed three times on infected chickens with demonstrated viremia at the times of feeding. Over 4,000 of these mites have been ground up and tested for the presence of virus at various intervals after feeding. The results were all negative. Normal chickens have been fed on by thousands of mites which have been “infected” in a way similar to those just described. None of the test birds developed a demonstrable viremia following the feedings (27).

In the past, several mosquitoes (*Anopheles freeborni* and *Culex pipiens*) were found infected in nature with Western equine virus (15) but these species have been proven to be incapable of acting as vectors (14). These mosquitoes apparently were infected by feeding on an animal with virus in its blood but would never have been infective by their bite. It is possibly significant to note that we have tested thousands of mites collected from chicken houses where the mosquitoes were proven to be infected. From one endemic area we have tested over 80,000 of these mites with negative results (27, 28). Also in Kern County, an area where epidemics and enzootics of encephalitis occur annually no mites of this species have been found during the past three years, indicating the mite is not essential to maintain an enzootic focus of infection in this area (16).

With the exception of the above mentioned isolations of virus from the kissing bug and chicken mite no isolations of Western equine virus have been made by us or by others except from mosquitoes. We have now tested over 98,000 specimens of blood-sucking arthropods other than mosquitoes, including ticks, mites, fleas, lice, bedbugs and flies, all with negative results.

From the above findings it seems likely that the vertebrate hosts and possibly the invertebrate vectors differ from one area to another. Most of our intensive
survey work has been done in hot, irrigated valley areas of the Pacific Coast states, less in open dry farming lands of the Middle West. Much further study is required in these latter areas. Epidemics or epizootics, however, occur in such an unpredictable and sporadic manner, and in such varied locations that it is extremely difficult to carry out proper surveys.

One of the most important problems remaining to be answered is the mode by which the Western equine virus carries through the winter period in those areas where it is epizootic. Birds and mammals inoculated by dermal routes show no evidence of ability to serve as chronic or latent carriers of the virus (23). Hibernating adult *Culex tarsalis* collected during winters in Washington (15) and California (16) have not been found infected. In addition we have tested the eggs and progeny of experimentally infected mosquitoes and found no evidence of transovarian passage of the virus (27). Syverton and Berry (4) found that experimentally infected ticks were capable of transmitting the infection by their bite, and also that transovarian infection passed the virus to their offspring (29), thus suggesting a potential vector and reservoir. However, no naturally infected ticks have been found, and *Dermacentor andersoni* is unlikely at any stage of its development to infect birds. *Argas persicus* (Oken) the chicken tick, has not been found infected in endemic areas although thousands have been tested from buildings where the mosquitoes were proven to be infected (16). In the laboratory this species has been proven incapable of transmission (16). If the chicken mite *Dermanyssus gallinae* is proved to be a vector, and is also capable of transovarian infection, it could well be the reservoir and a vector in certain areas. However, there are regions where the disease occurs in which this mite is not found.

It must be admitted at this time that the true reservoir or means of winter carryover is still unknown.

**CONTROL OF THE WESTERN EQUINE ENCEPHALOMYELITIS**

In considering the control of this disease we should not lose sight of the fact that not only does it affect the horse, but constitutes also a very important disease in man, and records show that serious epidemics often occur simultaneously with epizootics. At your Association's meeting in 1941, General Kelser presented an excellent paper (30) giving his recommendations for the possible methods of controlling the encephalitides and a review of the recent developments in our knowledge of this group of diseases. The following section is largely in agreement with his recommendations.

**VACCINATION OF EQUINE POPULATION**

As mentioned earlier the development of an effective vaccine for horses gave rise to the hope that extensive use of the vaccine would result in control of this disease and possibly its elimination. Subsequent findings have altered our evaluation of the benefits of a vaccination program. There is no question that great benefit has been derived. Proper immunization of a horse offers protection against that specific virus for at least one season, and this rarely breaks down. However, virus isolations should be made as frequently as possible from horse cases in all areas of infection to determine the type of vaccine to be used. It must be stressed that unless the type
of virus epizootic in each area is frequently determined, vaccination can be applied only on presumptive grounds. The appearance of a second type of encephalomyelitis virus in an area where only Western equine virus has been found previously can result in a catastrophic epizootic.

It was estimated in 1942 (31) that almost one million of the four and one half million equine population in this country had been vaccinated in 1941. Such vaccination has undoubtedly been responsible for a lowering of the annual number of cases reported. However, this measure has not protected the unvaccinated horses and mules nor checked the apparent spread of infection. Many times I have seen instances in which a single unvaccinated animal from a well isolated, vaccinated herd or a single unvaccinated horse not associated with others developed infection. Such cases serve as excellent selling points on the value of vaccination. However, even if vaccination were practiced on a much wider scale the disease could not be eradicated by this means for the horse does not appear to be an essential "reservoir" of infection and there will always be susceptible "reservoir" animals. The virus will persist in nature until the more important animal hosts or arthropod vectors are eliminated or controlled.

**CONTROL OF "RESERVOIR" ANIMALS**

Little consideration has been given to the control of encephalomyelitis through a program directed at the animal "reservoirs" although such a possibility was mentioned by Hammon (32). In those areas where domestic fowl are believed to be important sources of mosquito infection a vaccination program could conceivably be carried out, but would be prohibitive in cost. This virus does not produce clinical disease in birds so most poultry raisers would be unwilling to bear the cost or to submit their birds to vaccination. Any successful vaccination program would have to be carried out by a local, state, or federal organization, backed by law, and this does not seem justified at this time.

In most areas where horse epizootics occur, wild birds are numerous and may be shown to play an important rôle in the infection. The only possible type of control program would be one aimed at reduction of these populations and this is out of the question because of economic, esthetic and wildlife conservation factors.

**CONTROL OF ARTHROPOD VECTORS**

The one approach which seems to offer the most hope of success, and one that is still practical, is a program directed against the arthropod vectors. As soon as sufficient research work has been completed in an area so that the particular arthropod vector or vectors of the region are determined, immediate steps should be taken to develop and carry out control measures aimed at these vectors. Since I am primarily a medical entomologist, I would like to consider this problem very briefly and point out some of the possible methods of attack.

In several large sections of the United States local or county-wide mosquito abatement districts have been organized. Many of these districts have directed their efforts principally against mosquitoes as pests. These districts should now increase the intensity of control measures directed against those mosquito species which are known to be important vectors of encephalomyelitis. In several areas of California
this has already occurred. In many regions where the encephalomyelitides are common in man and horse similar measures could readily be established at relatively little cost to the taxpayers.

There are of course regions in which specialized agencies are not available or feasible, for this type of work. A state or county financed educational program in those areas could inform people of the importance of mosquitoes and explain and demonstrate simple methods of controlling them. Such programs are often worth while. An explanation of the importance in handling water in such a way as to prevent mosquito breeding or a simple explanation of ways in which to treat waters to stop mosquito breeding will frequently be adopted by lay persons with gratifying results.

One of the newest developments in mosquito control and one which gives great promise is the use of the new insecticide DDT. There are several ways in which this material is being used for mosquito control, but the one method which appears to offer particular promise in the control of encephalitis is its use as a residual spray in buildings and shelters for the control of adult mosquitoes which use the structures as resting places. An emulsion or solution of DDT sprayed upon surfaces is effective for a period of several months after application, in killing mosquitoes as well as flies which alight upon such sprayed surfaces. Residual spraying of the inside walls of chicken coops, barns, houses etc. can be carried out by private individuals; the necessary material is now available. If a sufficient number of persons carry out such a program it should help to reduce the number of mosquitoes found in these buildings and this includes a large part of the Culex population. In many areas where C. tarsalis has been proven to be an important vector this measure should be of value in the control of encephalitis.

This past season an experimental demonstration of this technique and a study of its effects were carried out in Kern County, California by the Hooper Foundation in cooperation with the California State Health Department and the Federal Security Agency, United States Public Health Service, Malaria Control in War Areas. The data from this study are not sufficiently complete at this time to be reported. However, it can be said that for several months after buildings were sprayed mosquitoes and flies were greatly reduced in numbers. In many sprayed buildings none could be found while hundreds of specimens were found in unsprayed buildings in the same area.

CONCLUSIONS

In bringing this paper to a close, I might make the following conclusions:

1. Western equine encephalomyelitis is a virus disease for which the important mode of transmission, in certain areas which have been studied, is through the agency of mosquitoes.

2. Culex tarsalis has proven to be the mosquito most commonly found infected and is an excellent vector. This mosquito must be put at the top of the list of mosquito vectors.

3. Aedes and Culiseta mosquitoes have rarely been found infected but must be considered as vectors of potential importance in any Western equine encephalomyelitis outbreak.

4. The source of mosquito infection in far Western areas is a huge inapparent "reservoir" among vertebrate animals, particularly domestic fowl and possibly wild birds.
5. Those hosts which show encephalitic symptoms of their infection (man and horse) are believed to be accidental entrants into the usual infection chain of this virus.

6. The infection chain is diagrammed in the following fashion

\[ \text{bird} \rightarrow \text{mosquito} \rightarrow \text{bird} \]

\[ \downarrow \text{man and horse} \]

7. The true reservoir or winter carry-over mechanism is still unknown but may very likely be an ectoparasite of fowl or other birds, such as a mite or tick.

8. It seems likely that the vertebrate hosts and possibly the invertebrate vectors differ from one area to another and much further study is required.

9. Control of the disease involves immunization of susceptible horses by vaccination, as a prophylactic measure; and control of the arthropod vector, on a permanent basis as a preventive measure.

REFERENCES


DISCUSSION

BY M. S. SHAHAN, D.V.M.

Washington, D. C.

I feel sure that we have all derived much pleasure and information from Dr. Reeves' first hand account of some of the extensive work on equine encephalomyelitis that has been carried on by George Williams Hooper Foundation, under the direction of Dr. Karl F. Meyer. Undoubtedly these workers have accomplished as much, if not more, than any other one group in the country in this field. As veterinarians, we may learn much from their methods, which coordinate the special knowledge of epidemiologist, entomologist, zoologist, veterinarian, and other specialists in study of a problem of common interest. Dr. Reeves has very ably summarized present information, and shown how great have been the advances and yet how much remains unknown. The Bureau has repeatedly urged frequent samplings in the field, in order that the types of virus operating in each area might be definitely known. We certainly endorse heartily Dr. Reeves' plea for more extensive laboratory examinations of equine and other specimens for this purpose.

Equine encephalomyelitis has been reported to the Bureau from all except 3 of the 48 States during the past 15 years. Yet, virus isolations and typings have been accomplished in only 31 States, and in many instances typings have not been accomplished for several years. Information on the types of virus should be kept more current, not only as a guide in effective vaccination, but also as an essential part of epizootiological studies. On at least two occasions in recent years, eastern type virus has been discovered belatedly in areas where only the western type had been suspected. Prior to these determinations, western type vaccine had been presumptively used with the result that considerable losses occurred. Such occurrences might be avoided to a great extent by systematic sampling in various involved areas, especially early in the epizootic season.

Dr. Reeves has outlined the almost overwhelming evidence against Culex tarsalis in certain areas. However, surveys elsewhere, both as to prevalent species of arthropods and as to prevailing types of virus, are certainly indicated. The viruses have been found to vary from one season to another in some localities. And, as has been pointed out by Dr. Reeves, other species than Culex tarsalis may be major vectors in some areas. For example, Rees has found the predominant species of mosquitoes in Utah to be Aedes dorsalis. This, as well as Aedes nigromaculis, was shown by Madsen in 1934 to be a potential vector of western virus. Salt marsh mosquitoes of the genus Aedes have been implicated by Ten Broeck and co-workers in the case of the eastern disease along the Atlantic coast.

It is interesting to note that the eggs of some species of Aedes have been found by the Bureau of Entomology and Plant Quarantine (1940) to remain viable in the soil under certain conditions for as long as six years. This again brings up the question of hereditary, or as Dr. Reeves has referred to it, transovarian, transmission of
encephalomyelitis virus in mosquitoes. The failure of *Culex tarsalis* to transmit western virus from one generation to the next, as reported by Dr. Reeves, is in accord with the Bureau's findings in the case of *Aedes aegypti*. Probably more work should be done in this field to exhaust the possibilities. Because of its proven power of hereditary transmission, the Rocky Mountain spotted fever tick, *Dermacentor andersoni*, may eventually be determined to play a part in the cycle as a permanent or sustained carrier of the virus in those areas where the tick is prevalent. This and other ticks which may convey the virus could theoretically assume important roles in interseasonal perpetuation of the disease. With the advent of spring, feeding on rodents and other mammals could then establish the infection in these species for later dissemination by mosquitoes.

Although it seems reasonable to assume that a permanent interseasonal reservoir for this virus exists, none has as yet been discovered in either arthropods or vertebrates, as Dr. Reeves has stated. While there is no evidence to indicate that horses become permanent or chronic carriers, the Bureau's experiences indicate strongly that virus does occur very regularly in the blood of this species in the early stages of the disease. The blood may be demonstrably infective for as long as three days, a period comparable to that in fowl or wild birds. It is our present opinion, therefore, that equines as well as birds constitute important transitory virus reservoirs available to blood sucking arthropods.

Experiences at Hooper Foundation with cattle are in agreement with those of the Bureau. We failed to find virus in the blood of either cattle or goats following subcutaneous or intravenous inoculation. There appears to be slight possibility of these animals playing a role in harboring or spreading the virus.

In concluding these remarks, it seems appropriate to inquire of Dr. Reeves whether the following investigations might not help materially in eventual solution of the equine encephalomyelitis problem. First, should not searches be made for virus in the blood of presumably naturally infected birds? Second, should it not be determined whether species of mosquitoes other than *Aedes aegypti* are capable of transmitting the disease to horses?
REPORT OF COMMITTEE ON MISCELLANEOUS TRANSMISSIBLE DISEASES


This Committee wishes to point out that there is no formal source for either morbidity or mortality statistics on miscellaneous diseases of livestock from which authoritative data might be gathered. We were impressed with the urgent need for standard nomenclature and the accurate compiling of vital statistics. The subject is not new and it would seem that we should lend vigorous support to the existing special committees of the American Veterinary Medical Association on "Nomenclature of Diseases" and "Vital Statistics." In 1944 the Committee on Vital Statistics of the American Veterinary Medical Association summarized its report in part with the statement "... development and establishment of a working organization (for collecting vital statistics) is beyond the scope of the volunteer committee, or, in fact, beyond the facilities of the present American Veterinary Medical Association office and personnel. The entire problem is one unquestionably related to sound agricultural economics and it appears advisable that the American Veterinary Medical Association should formally petition the Secretary of Agriculture to establish within the Federal Bureau of Animal Industry a 'Division of Vital Statistics on Animal and Poultry Diseases.'"

Unfortunately, vital statistics are not available to be collected even though an agency were established to assemble them. In an effort to learn disease trends, we prepared a questionnaire which was distributed to 125 Livestock Sanitary Officials and University and Experiment Station Laboratories, listing those diseases which are not generally included in the reports of other committees. We asked for such pertinent information as:

(1) Number of outbreaks; (2) Number affected (morbidity) with incidence; (3) Number of deaths (mortality); (4) Age groups affected; (5) Species affected; (6) Specific cause (positive laboratory isolation and identification of the infectious agent); (7) Whether the disease was new to the territory; (8) Whether the reporter believed disease existed previously undiagnosed; (9) Increased or decreased incidence; (10) Economic importance. In addition, we asked whether or not the agency reporting had (a) a diagnostic laboratory and (b) a Veterinary diagnostician to operate the laboratory.

The following direct quoted responses to these questionnaires are typical. "... We do not have a system of collecting and compiling vital statistics on animal diseases ...", "... No one in the Department of Veterinary Science nor myself has data in respect to the number of animals lost in the state ...", "We do not have sufficient information," "We do not have a diagnostic laboratory." "I am not in possession of sufficient information to make an intelligent report." "We do not
have a diagnostic or pathological laboratory in connection with our departmental work. Most of our practitioners depend on obtaining diagnostic services . . . from commercial laboratories." "This (questionnaire) has been completed as accurately as possible from the reports in this office from practicing veterinarians. I am sure that it does not cover all of the diseases listed which have occurred in the state." "Our practicing veterinarians do not report occurrences of transmissible diseases unless they are requesting the assistance of this office; therefore, our answers to this questionnaire are very meager and certainly do not reflect the prevalence of such conditions as actinomycosis, anaplasmosis, botulism and Aujeszky's disease, which from common knowledge, we know exist and are at times of some economic importance." "We find it impossible to supply you with the information in accordance with the enclosed questionnaires. This state has no service or organization which is engaged in the collection of data pertaining to the diseases of livestock. Without such a service, any statements pertaining to the nature and prevalence of our livestock diseases or their statistics would be merely guesswork, unreliable and hence without value. I am sorry that such is our situation and quite probably in many other states as well."

We are playing godfather to every other country in the world today—setting up animal disease laboratories abroad for diagnosis and disease prevention through the UNRRA. Yet we find that few of our own states maintain even one legitimate diagnostic laboratory capable of determining cause of death in animals. All aid possible must be given to our needy neighbor countries but some charity must be shown our own livestock industry which is suffering from an acute shortage of adequate diagnostic service. The disease picture in domestic animals is as surely changing as it is in man. Today we must concern ourselves with many new diseases—viral, parasitic and nutritional, not just those reportable diseases which have had and which are presumed to have greatest economic importance today. In addition to acute fatal disease, we must be concerned with chronic incapacitating diseases. Existing County, State, Federal, University and private laboratories do not have adequate personnel to give routine diagnostic service to the average practitioner. It became apparent from our findings that in excess of 99% of all diagnoses are clinical.

This Committee has been unable in a single state or community to learn:
(1) The number of outbreaks of even the more important miscellaneous diseases.
(2) The number of deaths.
(3) The incidence of the diseases.
(4) The specific causes (laboratory isolation of the causative organism). The cause, with few exceptions, was a field guess on the part of the reporting practitioner.

Unlike human medicine, a complete postmortem examination on an animal is always possible and highly profitable to the livestock owner, the veterinarian and the livestock official. Good statistics will indicate disease trends and permit better control.

It is generally agreed that laboratory findings reported by a competent diagnostician, are essential for an honest disease picture. We propose, therefore, the establishment of diagnostic laboratories strategically located across the country, the
number and location being dependent on the animal units (animal concentration) in the area and accessibility to good transportation to guarantee delivery of fresh material to the laboratory. These laboratories should be equipped to conduct all routine and special diagnostic procedures to learn the cause of death. Each laboratory should be under the immediate direction of a specially trained, career, veterinary diagnostician supported by an adequate staff of technicians and recorders responsible for reporting vital statistics to a central office. Standard laboratory methods, approved by the United States Bureau of Animal Industry or a similar National agency, should be adopted to avoid confusion in reporting.

It would seem that the final accumulation and tabulation of vital statistics originating at these laboratories is not the business of animal disease diagnosticians, but should be compiled by a unit or branch of government service such as the Department of Agriculture or the Department of Vital Statistics, Bureau of Census, Department of Commerce that now prepares vital statistic reports for man. Such an organization could readily set up morbidity and mortality statistics if the causes of death were furnished by an authoritative agency—National diagnostic laboratory service.

It is obvious that such a program would quickly bring about honest treatment and control of disease in the field. Unbiased vital statistics would eliminate the treatment of nonexistent diseases and tend to limit the sale of questionable drugs and biologicals by demonstrating statistically their worthlessness. The veterinarian is scholastically equipped to interpret the findings of the laboratory and if given an accurate diagnosis, could and would institute specific treatment.

We recommend:

(1) That this Association give its full weight and support to the establishment of diagnostic laboratories throughout the United States, pointing out to the Secretary of Agriculture the importance of establishing laboratories for the good of the livestock industry, agriculture, and the nation as a whole. They should be so operated that they follow standard laboratory methods approved by the United States Bureau of Animal Industry and should cooperate fully with the practitioner, the state and local Livestock Sanitary Officials. Their number and distribution should be determined by the animal unit concentration in the area serviced.

(2) That these laboratories be the starting nuclei of Vital Statistics reporting. At present any other source is questionable if not totally inaccurate.

(3) That a list of causes of death be compiled and be published by the Department of Agriculture or the Department of Commerce, under the guidance of the committees on nomenclature of diseases of the American Veterinary Medical Association with the approval of the United States Bureau of Animal Industry, adopting the best features of the official manual of the International List of Causes of Death for Man, 1940, distributed by the Department of Commerce, Bureau of Census, and the International List of Animal Diseases, compiled by the Veterinary Staff of the Veterinary Research Institute, Onderstepoort, Pretoria, South Africa, 1938.

(4) That the disease name listed in this official manual be used by diagnostic laboratories, veterinarians and animal disease workers for purposes of accurately reporting vital statistics of animals.

(5) That a Division of Vital Statistics for Animals be established directly as part
<table>
<thead>
<tr>
<th>DISEASE</th>
<th>NUMBER OF STATES REPORTING</th>
<th>DEATHS OR DESTROYED</th>
<th>ECONOMIC IMPORTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Abortion (Vibrio Fetus)</td>
<td>4</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>2. Abortion (Equine Virus)</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3. Actinobacillosis</td>
<td>13</td>
<td>102</td>
<td>5</td>
</tr>
<tr>
<td>4. Actinomycosis</td>
<td>21</td>
<td>352</td>
<td>3</td>
</tr>
<tr>
<td>5. Anaplasmosis</td>
<td>14</td>
<td>232</td>
<td>10</td>
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<tr>
<td>6. Anemia (Equine Infectious)</td>
<td>10</td>
<td>52</td>
<td>2</td>
</tr>
<tr>
<td>7. Anthrax</td>
<td>16</td>
<td>147</td>
<td>3-9</td>
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<tr>
<td>8. Aujeszky's Disease (Pseudo-Rabies)</td>
<td>5</td>
<td>19</td>
<td>1</td>
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<tr>
<td>9. Black Disease (Sheep)</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>10. Botulism</td>
<td>15</td>
<td>185</td>
<td>6</td>
</tr>
<tr>
<td>11. Coccidiosis (Ovine, Bovine)</td>
<td>21</td>
<td>485</td>
<td>3</td>
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<tr>
<td>12. Corynebacterium <em>equi pyogenes renali</em></td>
<td>13</td>
<td>115</td>
<td>2</td>
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<tr>
<td>13. Dourine</td>
<td>20*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Ecthyma (Ovine contagious)</td>
<td>6</td>
<td>3,013</td>
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<td>15. Encephalomyelitis (Equine E &amp; W)</td>
<td>11</td>
<td>787</td>
<td>8</td>
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<td>16. Erysipelas (Swine)</td>
<td>23</td>
<td>3</td>
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</tr>
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<td>17. Exanthema (Coital)</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>18. Foot Rot</td>
<td>3</td>
<td>48</td>
<td>2</td>
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<td>19. Gas Gangrene (Blackleg Malignant Oedema)</td>
<td>27</td>
<td>451</td>
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<td>20. Glanders</td>
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<td>3</td>
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<td>21. Hemoglobinuria (Bovine Bacillary)</td>
<td>8</td>
<td>46</td>
<td>5</td>
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<tr>
<td>22. Influenza (Equine)</td>
<td>9</td>
<td>48</td>
<td>5</td>
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<tr>
<td>23. Influenza (Swine)</td>
<td>13</td>
<td>180</td>
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<tr>
<td>24. Johnes Disease</td>
<td>12</td>
<td>131</td>
<td>4</td>
</tr>
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<td>25. Leptospirosis (Bovine)</td>
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<td>26. Listeriosis</td>
<td>9</td>
<td>32</td>
<td>2</td>
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<td>27. Lymphadenitis (Caseous of sheep)</td>
<td>2</td>
<td>6</td>
<td>3</td>
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<td>28. Mycosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Mycotic Stomatitis</td>
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<td>54</td>
<td>7</td>
</tr>
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<td>b. Coccidiomyctosis</td>
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<td>29. Necrobacillosis</td>
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<tr>
<td>30. Pasteurellosis (Shipping Fever)</td>
<td>14</td>
<td>585</td>
<td>5</td>
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<td>31. Periodic Ophthalmia</td>
<td>8</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>32. Pox (Cow) (Swine)</td>
<td>15</td>
<td>111</td>
<td>4</td>
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<td>33. Salmonellosis (Except Poultry)</td>
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<td>2,092</td>
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<tr>
<td>34. Scabies</td>
<td>8</td>
<td>127</td>
<td>7</td>
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<tr>
<td>35. Strangles (Equine)</td>
<td>10</td>
<td>250</td>
<td>2</td>
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<td>36. Tetanus</td>
<td>6</td>
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<tr>
<td>37. Trichinosis</td>
<td>3</td>
<td>22</td>
<td>3</td>
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<tr>
<td>38. Tularemia</td>
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<td>1</td>
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<tr>
<td>(Calf)</td>
<td></td>
<td></td>
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<tr>
<td>39. Vesicular Exanthema (Swine)</td>
<td>1</td>
<td>96</td>
<td>10</td>
</tr>
<tr>
<td>40. Vesicular Stomatitis</td>
<td>1</td>
<td>26</td>
<td>8</td>
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</tbody>
</table>

* Federal Report.
MISCELLANEOUS TRANSMISSIBLE DISEASES

of the Department of Agriculture, United States Bureau of Animal Industry. If this cannot be done, it should be made a subdivision of the existing Division of Vital Statistics, Bureau of Census, Department of Commerce, working in cooperation with the United States Bureau of Animal Industry.

(6) That these statistics be readily available and distributed at least annually to all those concerned in animal disease control so that they may know current disease trends from an authoritative source.

(7) That there be established a Committee on Vital Statistics. This committee might then cooperate with the similar committee now functioning in the American Veterinary Medical Association and bring to the attention of this Association authoritative disease trends including those diseases not covered in special committee reports.

The statistics (table 1) for the year July 1944 to July 1945 indicate the trend in thinking and reporting but are not a true picture. The material was gathered from 37 states and two territories, only 16 of which had state diagnostic laboratories and employed veterinary pathologists. Many states have the facilities of University Laboratories at their disposal but this use is for special purposes. The least important disease, economically, is recorded as 1 and the most important, 10.

Reports were not received from Arizona, Arkansas, Delaware, Maryland, New Hampshire, New Mexico, Rhode Island, South Dakota, Utah, Virginia and West Virginia. We are indebted to those who cooperated and gave their support to this program.

Other diseases reported included:

(1) Balantidiosis—declared by some to be a cause of death and by others as being a nonpathogenic ciliate in the normal swine gastro-intestinal tract.

(2) Enteritis, infectious, of Swine—this was not included in the original questionnaire because it was presumed it would be discussed in the section devoted to the diseases of swine. Furthermore, the statistics on this symptom complex would be too indefinite and unwieldy to be reliable.

(3) Enterotoxemia—this condition was not included since it was only reported in a single instance and the problem is not yet solved.

(4) Keratitis—infectious, of cattle and sheep—The etiology is still to be determined. There is too great a difference of opinion to permit the treatment of this condition as a specific disease.

(5) Malignant Catarrhal Fever—There is some question about the accuracy of diagnosis by present methods.

(6) Mastitis—It is apparent that the incidence (morbidity) of this disease can not be ever approximately approached. The present listing recorded here, however, only deals with fatalities. This disease, likewise, is discussed at greater length in another section.

(7) Sarcosporidiosis—The incidence is reported by many to be entirely dependent on the industriousness of the pathologist to look for this parasite in tissues, histologically. The parasite apparently causes no great pathological change.

(8) Scours—(a) Infectious, of calves, is still a major problem but little understood, and good statistics are not available. Presumably this symptom is commonly as-
associated with nutritional inadequacies in addition to viral and bacterial infectious agents. (b) Winter dysentery or Black Scours, presumably caused by *Vibrio jejuni*; requires further study and its accurate diagnosis is difficult.

(9) Toxoplasmosis—this mycotic disease, first thought to be due to a protozoan, is causing much interest because of its increasing incidence in man. It is reported to be found in cattle as well and is frequently confused with T. B.

With few exceptions, specific causes— isolation of the specific infectious agent— was not recorded.
REPORT OF COMMITTEE ON RESOLUTIONS


WHEREAS: Dr. A. W. Miller, long an active member of this association, retired from the position of Chief of the Bureau of Animal Industry on October 31st, 1945, after nearly forty-five years of service with the Bureau, therefore,

Be It Resolved: That we hereby express our appreciation of his distinguished and efficient service as Chief of the Bureau and for his willing cooperation and helpful attitude toward the members and purposes of this association at all times, and we further express the hope that he may live to enjoy his well merited retirement for many years.

WHEREAS: A resolution was adopted by the 1944 session of the United States Livestock Sanitary Association, which resolution embodied a suggested outline of Uniform Interstate Health Requirement governing the admission of Livestock, and

WHEREAS: Several states have already adopted these uniform regulations, and

WHEREAS: Breed associations, commercial livestock associations, agricultural cooperative agencies and groups have expressed their interest and approval of uniform regulations among states, therefore,

Be It Resolved: That the subject matter of the 1944 resolution is worthy of continued study and serious consideration. That the association commends the livestock sanitary officials of the eleven states that have adopted the recommendations of the association, and further, that the uniform interstate livestock sanitary regulations be adopted by the remaining states in so far as their laws and policies will permit.

Be It Resolved: That the United States Livestock Sanitary Association is opposed to any relaxation of import regulations that would subject the livestock industry of the United States to the introduction of any diseases that are not indigenous to this country.

WHEREAS: The Pan American Sanitary Bureau has given consideration to the need of establishing a section of the Veterinary Medicine within the Pan American Sanitary Bureau, therefore,

Be It Resolved: That the United States Livestock Sanitary Association endorse and encourage the move which will provide for better international veterinary relations.

WHEREAS: The United Nations Organization has appointed a committee to form an internal health organization,

Therefore: The United States Livestock Sanitary Association believes it proper to suggest to this committee that a section of Veterinary Medicine should be an integral part of such an organization.

WHEREAS: In the presentation of the program of the United States Livestock Sanitary Association, the services of men known to be qualified in their respective fields of activity are required, and
WHEREAS: These gentlemen receive no compensation for their labors, but contribute graciously of their time and effort, therefore,

Be It Resolved: That the United States Livestock Sanitary Association convey its sincere thanks and assurance of appreciation to each speaker on the program for his service.

Be It Resolved: That the United States Livestock Sanitary Association hereby express our appreciation to the manager and employees of the La Salle Hotel for the satisfactory accommodations they have provided for our convention. We are particularly grateful of the services rendered at this meeting, in view of the difficult situations confronting all hotels at this time.

Be It Further Resolved: That the president and secretary-treasurer of this association be and are hereby authorized to supply copies of the foregoing resolutions to the appropriate persons and by letter direct their attention to these resolutions.
REPORT OF COMMITTEE ON POLICY
W. J. BUTLER, Chairman, Helena, Mont.; W. F. GUARD, Columbus, O.;
J. G. HARDENBERGH, Chicago, Ill.; W. A. HAGAN, Ithaca, N. Y.;
R. W. SMITH, Concord, N. H.; V. S. LARSON, Madison, Wis.

The following statements of Policy are recommended additions to previously adopted statements of Policy. We realize that several of these recommendations may have been covered in previous reports but they are repeated so that they may be more forcefully brought to mind.

Your committee recommends that it shall be the Policy of the United States Livestock Sanitary Association:
1. To foster, promote and protect the Livestock Industry and sponsor the advancement of Veterinary Science.

2. To act as a medium for the dissemination of knowledge pertaining to the control of diseases of Livestock and Poultry and to strive to obtain uniformity of measures employed in the control and eradication of such diseases and the interstate movement of Livestock and Poultry.

3. To endeavor to correlate the activities of the United States Bureau of Animal Industry and the activities of the Livestock disease control authorities in the various states.

4. To strive for the advancement of Research in diseases of animals and poultry.

5. To have its committees commissioned with the duty of following up their adopted recommendations and in conjunction with the officers of the Association. Its committee shall endeavor to have their adopted recommendations brought to the attention of and put into active effect by the members of the Association.

6. To co-operate with State and Federal Departments of Health and Agriculture and to invite Secretaries and Directors of Health and Agriculture to participate in the discussions of the Association in an endeavor to correlate activities for the benefit of Public Health and the Livestock Industry.
THE PRESENT STATUS OF BUREAU CONTROL OF BRUCELLA VACCINE AND ANTIGEN PRODUCTION


Animal Disease Station of the Pathological Division, Bureau of Animal Industry, Beltsville, Maryland

At the 1939 meeting of this Association a paper on Brucella diagnostic antigen² was presented by a representative of the Bureau. This paper referred to the acceptance by the Bureau of requests from this and other interested associations that it produce all antigen, both plate and tube, used in the diagnosis of brucellosis in the Federal-State program, and to the various steps in the production and standardization of this antigen. A year later at the 1940 meeting a paper was presented on Brucella vaccine³ in which were described the various steps taken by the Bureau in the testing of commercially prepared strain 19 Brucella abortus vaccine.

Since these papers were presented the most expansive and devastating war in world history has occurred. Fortunately, the research institutions in this country were not directly affected as were those in some countries, but indirectly these various institutions felt the effects of the war, chiefly in the scarcity and rapid turnover of qualified personnel and the difficulty in obtaining necessary materials for carrying on research essential to the war effort. At the Bureau's Animal Disease Station, two of our responsibilities were in connection with Brucella vaccine and antigen. The demand for vaccine increased materially during this period and there was very little decrease in the demand for antigen. Each serial batch of vaccine and antigen produced by the Bureau was subjected to the customary requirements before distribution. With few exceptions, we were able to supply these products when requested.

CHANGES IN STRAIN 19 VACCINE PRODUCTION AND DISTRIBUTION

During this period a number of steps were taken to improve the vaccine. As previously reported, samples of each serial batch of Brucella vaccine produced commercially are collected by Bureau inspectors and sent to the Animal Disease Station. Tests are immediately made for viability, purity, density and pH. A second test for viability is now made of the remaining samples, which have been kept under refrigeration, about 70 days after date of production. Commercial vaccine is released for sale or distribution only if it meets the rigid test requirements of the Bureau. If the second test for viability shows a product to contain less than 5

¹Dr. Crawford is in charge of the Animal Disease Station, Dr. Anderson is in charge of antigen production, and Dr. Love is in charge of vaccine production.


billion live organisms per cubic centimeter, the remainder of the serial batch is collected and destroyed under Bureau supervision.

Dissociation of strain 19 in vaccine samples submitted for test was not an uncommon cause of rejection in the early years of licensed production. In 1941 the Bureau began the practice of furnishing all commercial producers with fresh, smooth cultures about every two months. This has materially reduced the number of rejections resulting from this cause.

Also in 1941, the Bureau ordered that strain 19 vaccine should be bottled in single-dose containers. This action was necessitated by the fact that the product in multiple-dose containers often became contaminated in the withdrawals of portions of the vaccine. The use of a pure product in all vaccinations is thus assured by this change.

In 1944, tests of some commercial vaccines, the viability of which was questioned during the latter part of their permitted period of use, showed that the number of viable organisms present was less than the standard minimum of 5 billion per cc. Tests were then made of vaccines prepared by each of the licensed producers at 2, 3, 4, 5, and 6 months from date of preparation. As a result of these tests the expiration date was reduced from 6 to 3 months. This has had a salutary effect on the efficacy of this product. Under the 6-month expiration date producers and distributors tended to keep a level quantity of vaccine on hand; thus when vaccine was ordered old vaccine would be shipped and the replacement stock placed on the back of the shelf. Under the present expiration date of 3 months, licensees anticipate their needs more closely with the result that vaccine is now shipped to the user almost as soon as it is released by our Bureau. We wish to state that the various commercial producers have cooperated fully with the Bureau in its efforts to improve vaccine, although the various directed changes have obviously offered increased difficulties in production and distribution.

Another change of interest is the production of a dry vaccine by lyophilization, or dehydration under high vacuum while frozen. It has been known for years that many disease-producing micro-organisms may be maintained viable and virulent for long periods when prepared in this manner. Research has shown that Brucella vaccine, when properly lyophilized, is more resistant to subsequent temperature changes than liquid vaccine and will remain viable for a much longer period when held under similar conditions. One factor which should be mentioned is that in the present method of lyophilization, Brucella vaccine suffers an immediate but variable loss in the number of viable organisms present, following which the viability is only slightly affected in one year. This loss is compensated for by increasing the initial density. Based on this research, the Bureau provisionally licenses the production of lyophilized vaccine and has placed a tentative expiration date of one year on this product. It is subjected to the same tests as the liquid vaccine during this period. In our opinion, lyophilized Brucella vaccine is still in an experimental stage and there is need for continued research on the subject.

Table 1 shows the production of Bureau and commercial strain 19 vaccine for the fiscal years ending June 30, 1941; 1942; 1943; 1944; and 1945. It will be noted that commercial production has markedly increased during this period. Experimental production by the Bureau has likewise increased, but the amount that will be pro-
duced is now stabilized at approximately 200,000 doses per year. The demand for its use in the Federal-State program is greatly in excess of our production, so the Bureau product is pro-rated among the various States and the States' supplemental needs are acquired from the commercial market.

In connection with the shipment by express of Bureau strain 19 vaccine, much delay in arrivals was encountered during the latter part of the war period. Shipments which previously had been received within 2 or 3 days were often 5, 6, and 7 days in arrival. Shipments by express were discontinued in August of 1944 and all shipments have since been made by parcel post, special delivery. This change has resulted in the arrival of the vaccine in our field offices as quickly as first-class mail.

Beginning in January of this year, a study was made of various methods of shipment under refrigeration. These trials lasted for about 4 months and a method was evolved that would maintain a satisfactory temperature range for the product over a period of at least 3 days. The shipping container used experimentally during this past season consists of a double-walled cardboard box containing one-inch separator strips to provide the necessary dead-air space. Refrigeration is secured by packing a thoroughly insulated container holding from 3 to 7 lbs. of dry ice with each shipment of vaccine. Final wrapping with heavy paper and sealing with adhesive strips completes the packaging. Shipments have been made to the far West during the summer months and although the dry ice had disappeared at the time of arrival, the product was almost uniformly reported to be cool when received. In shorter shipments, some of the dry ice is still present on arrival. Steps are now being taken to have a satisfactory container made commercially which should simplify shipping and reduce the expense of individual box preparation. All shipments of Bureau vaccine during the warmer months of the year will hereafter be made under refrigeration.

**TABLE 1.—Yearly Production of Strain 19 Brucella Abortus**

<table>
<thead>
<tr>
<th>Fiscal Year Ending</th>
<th>Bureau of Animal Industry Doses Supplied</th>
<th>Licenses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>BUREAU OF</strong></td>
<td><strong>Offered for test doses</strong></td>
</tr>
<tr>
<td>June 30, 1941</td>
<td>42,737</td>
<td>1,425,000*</td>
</tr>
<tr>
<td>June 30, 1942</td>
<td>110,833</td>
<td>1,458,780</td>
</tr>
<tr>
<td>June 30, 1943</td>
<td>174,244</td>
<td>2,057,610</td>
</tr>
<tr>
<td>June 30, 1944</td>
<td>205,544</td>
<td>2,610,539</td>
</tr>
<tr>
<td>June 30, 1945</td>
<td>192,215</td>
<td>3,238,675</td>
</tr>
<tr>
<td>Total</td>
<td>725,573†</td>
<td>10,790,604</td>
</tr>
</tbody>
</table>

* Estimated.
† Proportionate amount of the total for sale or distribution—7%.

CHANGES IN CONNECTION WITH BRUCELLA DIAGNOSTIC ANTIGEN

Since the previous report on Brucella antigen the only changes of interest have been in connection with the plate antigen. It has been recognized that a lack of
agreement existed between certain commercial plate antigens and that prepared by
the Bureau. Diagnostic antigen, however, is not covered by the Virus-Serum-Toxin
Act, under which licenses are issued by the Bureau for the control of biologics used
in the treatment of animal diseases. However, in 1931 the Bureau obtained
a patent on stained diagnostic antigen, under which it has licensed the commercial
production of pullorum stained antigen, subject to specified conditions of control.
Steps have been taken, therefore, to license in like manner the production of Brucella
abortus stained antigen in commercial establishments operating also by license
issued under the Virus-Serum-Toxin Act. Each serial batch produced by licensed
establishments will be subjected to the same tests for sensitivity, purity, and density
as the Bureau standard plate antigen. This should lead to greater uniformity in
test results. This action will become effective on January 1, 1946.

We are often asked if the plate test is a dependable agent for the diagnosis of
brucellosis. In our hands a very close approximation of tube test results can be
reached with it. In other hands, however, divergent results have been obtained and
some publicity has been given to these results. The reason for these variations can
be readily appreciated if it is understood that the tube test is a direct ratio of 1:25,
1:50, etc., between serum and antigen, whereas the plate test is an arbitrary and
delicate adjustment of serum to antigen. In the tube test close approximation of
results is usually obtained in comparative tests. The possibilities for variations
are only slight and obtain mostly from variations in an individual’s reading and
interpretation of results. In connection with the plate test research has shown that
differences in the technique in conducting the test may appreciably affect the re-
sults. For instance, the completeness of stirring the mixture on the plate, the
method of dropping the serum and antigen, that is, whether the pipette or dropper
is held diagonally or vertically, and other seemingly inconsequential variations in
technique can vary the results. The speed of delivery of the drop of antigen can
make a difference in its size. A dropper should deliver 0.03 cc. of antigen on the
plate. When these possible variations are considered in connection with the minute
quantities of serum delivered (from 0.08 to 0.005 cc.) it can be readily appreciated
why a variation in results may be obtained between two different technicians using
the same serum and same antigen but different equipment and procedures.

The plate test is also called the rapid test. This is unfortunate because some
technicians, through association of the name “rapid” with the test perhaps uncon-
sciously make it a rapid sequence of procedures at a sacrifice of accuracy. Con-
trary to popular opinion, the plate test requires much more skill and uniformity of
procedures than the tube test. Any operator can determine by the plate test if an
animal is negative or a high reactor. Divergence in results is most apparent in
serums having a titer of 1:50 to 1:200, and most of the criticism of the plate test
results is based on tests in this range. Fortunately only about 4 percent of
all serums tested fall within this range.

The Bureau has prepared a publication describing exactly the method it has
evolved in the conduct of the plate test to obtain results equivalent to those obtained
with the tube test. A copy of these printed procedures will be furnished free on
written application and it is suggested that all persons using the plate test obtain a
copy of this publication and practice and apply the exact procedures indicated.
This is especially urged now that commercial Brucella stained antigen will be standardized by the Bureau beginning January 1, 1946.

We believe the plate test, if accurately applied is a satisfactory test in the diagnosis of brucellosis of cattle, but even when not so accurately applied, it is still a valuable agent in indicating the presence or absence of bovine brucellosis on a herd basis. In expert hands it is a reliable diagnostic agent; in unqualified hands it is merely an indicator.

It is the purpose of the Bureau to offer assistance to the livestock industry. It is not only willing, but most anxious, therefore, to receive merited criticisms of established procedures and suggestions for improvements, and at this time we refer specifically to Brucella vaccine and antigen. It is our desire, in this connection, to make these products as uniform and efficient as possible, that through their use or application the greatest possible benefit may result to farmers and livestock owners in the control of brucellosis.
DATA RELATED TO EXTENT OF POST-VACCINATION AGGLUTINATION REACTION IN CALVES—THE NEW YORK PLAN OF CONTROL OF BRUCELLOSIS

BY ASA WINTER, D.V.M.


There have been many sources of records as to the time required for calves to return to negative titres following injection of Strain 19 vaccine. While these reports have varied in some degree, a comparison of uniformly conducted experiments and field trials, in which relatively large numbers of animals have been closely observed over a sufficient period of time, will show quite close results.

Records obtained during the time Strain 19 was still under fire as to its right to membership in good society, usually provided titre readings at regular frequent intervals beginning soon after vaccination, and were continuous. We believe this type of record, only, can answer the question of post-vaccination titre behavior.

In our discussion of the New York State Brucellosis control program, which will also be a part of this paper, related sidelights on this same question will receive comment—but with respect to the question of post-vaccination titre expectancy, I will draw largely from the records which cover six years of work with 25 New York State herds that cooperated under the Federal calf vaccination field experiment.

As background for the data to be offered here—the New York State herds averaged 52 animals, with a minimum of 15 percent and a high of 47 percent infection at the time work was begun. All reacting animals were retained in the original herds for three years, or longer if economically possible. Infection continued sufficiently heavy to provide for physical abortions in the unvaccinated portions of the herds throughout the experiment—24 having been recorded during the last year, at which time about 30 percent of the total cattle population was still made up of non-vaccinated members (many being additions from outside herds). Three percent of calves tested not earlier than the fourth month of age, preparatory to vaccination, showed reacting titres. Subsequent tests—before the calf had completed the seventh month of age—eliminated all but one-half percent as still positive. These animals were allowed to remain as unvaccinated members of the herds. In the beginning, blood tests were made very soon following vaccination—in some instances as early as the fourth day, and with few exceptions not later than 30 to 60 days. The immediate post-vaccination blood titres in our experimental herds were very similar to the average reported for the several states by the Federal Bureau. A few of our vaccinated calves did not show reacting titres on the first test made at 15 to 30 days following vaccination, but within another similar period were reacting and followed a normal course of titre recession. It would seem possible that this idiosyncrasy in certain individuals may have given rise to the thought from some sources, where consistent records may not have been maintained, that an appreciable number of vaccinates do not demonstrate post-vaccination blood titres. While a review of these early post-vaccination blood pictures are interesting, they are not
vital at this stage in the progress of calf vaccination, so for our discussion the ques-
tion is being approached on the premise that we are concerned principally with later
post-vaccination titres as they may affect our decisions in the classification of herds
for approval, or individuals for membership in approved herds and as eligible for
interstate movement. The titre seldom becomes a matter of concern before the first
year of age—and then chiefly for the breeder of purebred beef cattle who normally
makes consignments at about this age. Of animals vaccinated at the sixth month
of age, our records indicate that not more than 60 percent can be considered as nega-
tive and likely to remain so, when they reach the yearling stage. At the 12th month
following vaccination—or about 18 months of age, at least 80 percent of these vac-
cinates should be negative and in many herds this will climb to 90 percent or better.

During the six month period following the 18th month of age our breeders and
regulatory officials really become interested in titre behaviors. The final ten to
twenty percent which are still carrying reacting titres at 18 months constitute a
group about which we may be concerned for different reasons. As an answer to one
of these, the several states of the North East have through mutual interest provided
for tolerance of movement of vaccinates up to this 18 month age period from
herds under official supervision. These animals may move interstate without the
requirement of a blood test—or if blood tested and still positive. After 18 months
of age the individuals must present evidence of negative titre to be eligible for inter-
state shipping. Also, in connection with titres at this period some breeders still
cling to the thought that vaccinates should not be considered for breeding until nega-
tive. We in New York though do not feel that the course of a vaccinal titre will be
sufficiently altered through conception at this period to consider this as any barrier
to the regular breeding program—and advise breeding practices in keeping with the
needs of the herd, rather than with respect to the titre of the heifer. This practice
has been followed with complete success in all of the experimental herds, the New
York State Institutional herds which are under this program, and information from
the field indicates the same general practice. And from the standpoint of the regu-
lar official this animal—approaching the 24th month of age, presents a problem
as to her eligibility for membership in a brucellosis free herd. Our records tell us
that three and one-half percent of calf vaccinates will still be carrying reacting titres
when they reach two years of age and as a result must be eliminated from herds
classed as free from infection. But the records further show that these animals will
continue to recede in titre during the first lactation period with less than one percent
still reacting at the time of the second freshening. In the course of our field experi-
mental work there was no record of delayed estrum or conception, nor was there any
abortion in that group of vaccinates of this type.

These are the actual records obtained from a group of 1315 vaccinates maintained
under average farm conditions, and closely followed for information which might
prove of value in building a brucellosis program with definite control benefits, simple
and economical in administration, and sufficiently flexible to be adapted to the
needs of every New York State dairyman, or breeder of purebred cattle.

In building the New York State program, we have benefited from other control
plans which preceded our present practices, both in our state and others. We have
drawn from any source of research which seemed to offer answers that were appli-
cable to our local conditions—and shall continue to borrow as we may be able to improve our control services by so doing. In the same manner New York State is most happy to contribute any thoughts which may assist other states in meeting their like situations. It is appreciated, however, that the brucellosis problem may be very different in other sections of the country, for we recognize even within our own state boundaries, the individual herd and sectional conditions which call for flexibility of control procedures if any single program is to be successful.

New York State has been alive to the importance of brucellosis control and the official recognition of uniform control practices for a period of years. An officially recognized semi-private plan of control, in which the individual breeder provided reports of herd tests applied at regular intervals through the service of local practitioners—but supervised by the State, was operated for some time before the inauguration of the Federal Test and Slaughter program in 1934. This, known as the Recorded and Approved herd plan, is still in operation on a limited number of herds.

The Test and Slaughter Plan also still includes a few active herds—something under 200 at the present time. At the peak some 2800 herds received service of this type—but there has been a marked decline in the popularity of this plan, both with the breeders and our department. New York State breeders including most of the original group of Test and Slaughter cooperators, feel that something more than elimination of reactors is necessary under the conditions which prevail in this State.

The original vaccination program was started in New York State at about the same time, September 1941, that calf vaccination was openly accepted by the Federal Bureau as a safe and efficient supplement to our control measures. The New York program developed gradually but soundly—and by January 1944, had earned its place in the State as the one plan “most likely to succeed.” Even so, there were still some obstacles to overcome in order to popularize it with all breeders—so a joint meeting of Farm Bureau representatives, breeders, extension men, members of the Cornell research staff and the State Department was held to discuss further improvement of the services.

As a result of this meeting—and other later conferences, the spade work was laid for the present program which provides free service to any New York State cattle owner, through local accredited veterinarians, under either of two plans, “A” or “B.” Each plan is entirely of a service nature, no indemnities are allowed, nor are any binding restrictions imposed on the owner. It is our policy to treat each case individually, providing the type of service that seems at the time best suited to the particular problem, but always with the understanding that this can be shifted if conditions change.

It is the policy of the New York State Department of Agriculture to decentralize direct administration of disease control services—placing the responsibility and authority in the hands of local county disease control committees. These committees are usually named by the Chairman of the County Board of Supervisors—frequently in consultation with local officials of other interested agencies such as the Farm Bureau and Grange, and they may include as members representatives from such groups. These men are in close contact with local conditions, and needs of the breeders, and work in cooperation with the State Bureau of Animal Industry and
the accredited veterinarians of the county in promoting better county disease control programs. In order to assure official service to all cattle owners, the disease control committee divides the county into districts and recommends a local veterinarian for each district. Then upon these recommendations blanket authorizations are provided by our department to accredited veterinarians to perform official services—both tuberculin testing and brucellosis control, in their assigned territory at State expense. The county committees act also to secure the necessary county appropriations for maintenance of county records—which are duplicates of that portion of the State records—for the payment of the county veterinarian’s salary and a portion of the compensation allowed accredited veterinarians. Not all counties have full time salaried county veterinarians—but more are being obtained now that the veterinary manpower shortage is becoming less serious. The county units—which are comprised of the county committee, county veterinarian, and the several accredited veterinarians, work with the State Department through supervising state veterinarians assigned to districts usually made up of several counties. These State veterinarians act to standardize services in the field and in the county record offices, assist the county committees, and serve in any needed capacity as administrative assistants. It is through this type of organization that the provisions of our brucellosis program are being extended to the cattle owners as rapidly as the accredited veterinarians can supply service in their respective territories. An occasional owner may desire the services of a veterinarian other than the one assigned to the territory in which his herd is located. A special individual authorization being provided in such cases upon personal request by the owner.

Plan “A” services include vaccination of calves as they become of proper age, and herd blood tests at annual intervals. Owners are encouraged to have calves vaccinated at not under six months of age. Fourth and fifth month vaccinations are accepted, but the trend is quite definitely away from these ages in our work. We feel that this slight shift in age—even though it does require closer observance and an occasional extra trip to the farm to provide for vaccination within the reduced age limits of six to eight months, should improve the degree of resistance sufficiently to make it well worth the extra cost. While annual herd retests are provided without expense, veterinary service for any other blood testing is the owner’s responsibility. Laboratory service, however, is free at all times.

Herd operating under Plan “A” of the Calf Vaccination Program may be approved as “Bang’s-disease-free” for a period of one year when the herd has had two tests one year apart in which all unvaccinated animals over six months of age and all vaccinated animals over two years of age are negative. Owners of herds already approved under the Test and Slaughter Plan, which in New York State does not permit calf vaccination as a regular procedure, are encouraged to transfer to Plan “A” of this program and receive regular blood testing services while also benefiting from the added resistance induced through vaccination of calves. These herds are certified, upon transfer, as “Approved” under Calf Vaccination and are accorded the same recognition as those herds in which initial services were inaugurated under the regular program. We in the New York State Department feel there is no better time to start calf vaccination than while the herd is free from brucellosis.
As we follow the later records of herds which have been approved in our State without building any added resistance against reinfection, we are more encouraged to discount certain real or possible limitations of calf vaccination which are still occasionally stressed as of major importance. It is true that some vaccinated herds will show physical results of Brucella exposure—but from our experience the Brucella stimulus in properly vaccinated herds results in most instances only in a temporary titre build up in certain individuals. This picture may be the only indication of Brucella exposure, with history of an uninterrupted herd breeding program and should clear within a period of a few months, although on the other side of the ledger we have some herds in which calf vaccination has not provided the expected benefits.

From the results of recent work done at the Beltsville station and in our own State laboratory on the viability counts of Strain 19 vaccine at different periods following production, and under varying conditions of preservation—we are pleased that the general vaccination picture of our earlier work has been even this good. Now, as further protection to the New York State breeders in connection with the services offered since July 1, 1944, all vaccine furnished to the accredited veterinarians for official use is rechecked for viability in our own State laboratory before being approved for shipment. Veterinarians are required to preserve the product under refrigeration and transport to the farm in the same manner. While the use of a type of product with a known high organism count may induce titres of somewhat greater duration—we believe the resistance induced is prolonged in the same proportion. We like to think of the vaccinate with a duration titre as an animal most likely to withstand future exposure, and believe she possesses real value under those conditions in which blood titre is not the deciding factor. We try to think first in terms of vaccination and immunity—with the course of vaccination titres a resulting condition which must be fitted into our program in a manner that will provide for herd status which will meet accepted standards, and justify the confidence of our neighboring breeders and regulatory officials.

I personally feel though that the persistent titre vaccinate which has been maintained under an environment presumably free from brucellosis might be given more favorable consideration as an eligible member of herds otherwise entitled to certification as brucellosis free. I would be glad to be furnished with more evidence as to the herd danger from the persistent high titre vaccinate which was raised and is being harbored in an otherwise negative herd.

While Plan “A” might be termed the sales unit of the New York program, Plan “B”, which provides for calf vaccination only, may be considered the initial approach to brucellosis control in heavily infected herds. Prior to inauguration of Plan “B”, considerable work of a semi-official nature was done in several hundred New York State herds which adopted a system of consistent calf vaccination as the only control procedure. All of these herds were located in a heavy dairy cattle district in which dealing was every day practice and brucellosis was common. Vaccine from the Cornell Research Station was provided for the experiment and records were kept on the breeding performance of the individuals and the herds. Following a period of from three to five years complete herd blood tests were made, with the test results and physical records carefully observed. This first test of these herds...
uncovered such a generally satisfactory blood picture—which also checked so closely with the breeding records, that further study was given to this procedure as an official practice in heavily infected herds. Our advice to owners of such herds has been to live with the infection temporarily, follow consistent vaccination together with general good herd practices and not remove valuable producing or breeding stock until properly vaccinated animals are available to take their places. In too many instances in New York State owners have attempted to eliminate the trouble while infection was still acutely progressive—by selling reacting animals and replacing with other susceptible individuals. The temporary retention of reactors of known value, coupled with Brucella vaccination, serves both as good herd economy and disease control procedure. Under Plan “B” such other control practices as may seem indicated, including adult vaccination, may be employed by the owner—while at the same time calves are being officially vaccinated by the State and recorded for future certification when the herd has reached a point where infection has subsided and some culling can be started. It is at this point that the owner is encouraged to transfer to Plan “A” and have regular herd blood tests provided for study in this culling process. While there is no official program in New York State which provides for vaccination of animals over eight months of age—we of the Bureau are very sympathetic toward this practice during the early period of control in heavily infected herds. We recognize that the owner who adopts this procedure, under these conditions, is eliminated from interstate trade channels—but, his herd is very definitely out of the picture from this angle—regardless of what he may or may not do. The first consideration for the owner of an acutely infected herd should be to subdue the effects of brucellosis as rapidly as possible in order to salvage his production and breeding lines.

If it is important that a brucellosis free group be established before the normally infected, and adult vaccination reactors, can be removed through gradual elimination,—and it is possible to establish a second unit away from the infected premises, we advise such a procedure. This second unit can be built on family blood lines from the parent herd through calf vaccination and the owner will soon be back in business with a clean calf vaccinated herd. In fact, under the vaccination program we feel that the two unit herd is our ideal. This is not always possible—but where it can be operated, provides a place for removal of persistent titre vaccinates of high value while the course of the titre is being determined—can be used as a holding unit for purchased animals until a satisfactory health status has been established, and for any other animals which may present questionable titres on herd retests. This practice has made possible, without undue sacrifice of basic stock, the continuation of long established breeding herds—and provides at the same time for the building of clean units from which sales can be made of desirable blood lines for additions into other clean herds.

Owners and veterinarians who have cooperated along such lines are agreed that the combination practices of calf and adult vaccination, where properly employed, have provided a means for subduing and controlling brucellosis during the critical period. Plan “B” might be said to be our most simple yet versatile plan of control because of the unlimited possibilities for the practice of veterinary and breeder
POST-VACCINATION REACTION IN CALVES

initiative in the early control practices to be employed, and the privilege of later requesting Plan "A" services for the establishment of an approved herd.

Something over 30,000 herds are receiving service under one of these two plans with a ratio of three to one in favor of Plan "A". We believe this is about a normal proportion—although the shift may be even more to Plan "A" as the veterinary situation improves. More than 260,000 animals have been vaccinated as calves in these herds. During the past 18 months—since the present program has gotten under way, an average of over 800 herds have been accepted each month and a monthly average of 9,000 calves have been vaccinated.

The privileges offered the breeders of New York State through open discussion of their problems—and a liberal approach to the solution through application of such official and private practices as may seem advised, have created a relationship of mutual understanding and confidence which we believe is essential in any brucellosis program. It is on this confidence with our New York breeders and also the breeders and disease control officials of other states that we hope to further develop the New York State brucellosis plan.
STATUS OF COOPERATIVE BOVINE BRUCELLOSIS WORK IN THE UNITED STATES

By A. E. Wight, M.D.V.

In Charge, Tuberculosis Eradication Division, Bureau of Animal Industry

Cooperative brucellosis work among cattle during the last fiscal year has continued to be reduced in volume to some extent. When sufficient veterinarians are available to participate in this activity and other factors caused by the war have been eliminated, it is hoped this work may be carried on to a greater extent. There is much to be done in connection with the testing of cattle, removal of reactors, and vaccination of calves, not only in individual herds but in groups of herds under what is known as the area plan.

During the fiscal year 1945, 5,213,458 cattle were tested and 243,050 reactors were found, 86,738 of which were held in herds where the calves are vaccinated, and the others were slaughtered. The percent of infection found was 4.7, slightly higher than that of the previous fiscal year, which was 4.3.

At the end of October, there were 45,314 accredited herds containing 881,496 cattle, an increase of 2,645 herds and 43,188 cattle since October of last year.

There are now 524 counties in 22 States in the modified brucellosis-free area. Eighty-five such counties, in 10 States, have been removed from the list recently, mostly due to the lack of veterinarians to do the testing. There are other counties overdue for remodification.

STATE AND FEDERAL FUNDS

Provision for indemnity is made in all States except California, Colorado, Massachusetts, Nevada, Oklahoma, Texas, and Utah. For the present fiscal year the legislatures of the various States have provided more than $5,900,000, of which approximately $3,400,000 is available for indemnity purposes. Federal funds for use during this period approximate $6,000,000, of which it is estimated about $2,375,000 will be required for indemnity and the balance will be available for operating expenses.

During the past fiscal year, State indemnity payments amounted to approximately $2,500,000, while an additional $1,250,000 was expended by the States for operating expenses. During the same period, Federal expenditures included in indemnity payments of more than $2,200,000 and operating expenses of about $1,900,000. The average appraisal of reactors was $139.35; average salvage, $56.63; average Federal payment, $19.25; and average State payment, $22.14. Approximately 10 percent of the reactors slaughtered were registered purebred cattle.

BRUCELLA VACCINE

We are fortunate today in having a paper which includes this subject, prepared by Dr. A. B. Crawford, in charge of the Animal Disease Station of the Bureau of Animal Industry, and his associates, Drs. Wayne A. Anderson and E. Leland Love.
The volume of calfhood vaccination conducted under official supervision has increased considerably since our last meeting. It is carried on to some extent in all the States, as well as Puerto Rico. During the fiscal year ended June 30, 1945, over 500,000 calves were vaccinated, compared with about 392,000 the previous year. Since January 1, 1941, a total of about 1,500,000 calves have been vaccinated. About twice as many are vaccinated under Plan C where the reactors may be held as under Plan B where they are slaughtered.

Many of you here today I think will be interested in knowing that the paper presented by Dr. A. W. Miller, former Chief of our Bureau, at this meeting last year, had a wide distribution as a result of requests. We received much favorable com-

Route of Brucellosis Germs in their Attack on Cattle

The consumption of feed and water, soiled with brucella organisms, is the greatest single factor in the spread of the disease.

The presence of numerous germs in the pregnant uterus frequently results in death and premature expulsion of the fetus.

Millions of brucellosis germs pass from the uterus with the dead fetus and subsequent discharges.

From the heart, the germs are carried, through the blood vessels, to various parts of the animal’s body.

From the digestive tract the germs enter the blood stream and are carried to the heart.

The udders of a large percentage of infected cows harbor brucella germs and discharge them more or less continuously with the milk.

Prepared by Bureau of Animal Industry, United States Department of Agriculture.

This paper contained some material pertaining to the use of Brucella vaccine in cattle over 8 months of age. There is not much that can be added on this subject at this time except to say that when properly used, the results as a whole continue to be encouraging. About 56,000 adult cattle have been reported vaccinated in the official work from January to October, inclusive, of this year, in 26 States.
Two rather special means of giving information to the public with reference to brucellosis in cattle, have been prepared by the Department of Agriculture. The first is an Achievement Sheet of the Agricultural Research Administration, issued August 14, 1944. The other is a drawing of a cow showing the route of brucellosis germs in their attack on cattle, released November 5 of this year. It was suggested by Dr. J. B. Reidy, inspector in charge of the Bureau of Animal Industry at Harrisburg, Pa. The chart was made by Mr. R. S. Allen of the Information Division of the Bureau. The demand for this drawing has far exceeded our expectations, but it is hoped all requests may be filled. Then, of course, we release news items through the Department's Press and Radio Service in order that timely information may reach the public through the agencies of the press and radio. 

There are a number of other factors that have developed in connection with the cooperative work during the past year, but time will not permit me to mention them. However, we do have the usual statistical tables containing information regarding this work. Some are available here, or they may be obtained by writing to the Bureau of Animal Industry, Washington 25, D. C.
THE CONTROL AND ERADICATION OF BRUCELLOSIS IN ANIMALS FROM THE STANDPOINT OF HUMAN HEALTH

CARL F. JORDAN, M.D., M.P.H.

Director Division of Preventable Diseases, Iowa State Department of Health, Des Moines, Iowa

The 4-year period 1942–1945 witnessed an all-time high level in the reported occurrence of brucellosis of man in Iowa. In 1942, official reports numbered 333, with 418 cases in 1943 and 295 cases in 1944. Reports totalled 474 in 1945 (through Saturday, November 24), a number higher than in any previous year of record. The marked increase in human infection is attributed in large part to stepped-up production of livestock during World War II. Many patients undoubtedly suffered illness resulting from the War Effort.

The estimated number of cattle on Iowa farms in 1944 was 5,525,000. During the same year the swine population approximated 20,000,000 and sheep about 3,000,000. These figures, supplied through courtesy of C. C. Franks, D.V.M., State Veterinarian, Iowa Department of Agriculture, are regarded as being about 20 per cent higher than in pre-war years.

During the 12-year period 1930–1941, reported cases of brucellosis of man or undulant (Malta) fever in the United States totalled 20,594, an average annual morbidity rate of 1.87 per 100,000 population. In Iowa the total was 1,887 cases for the same period, an average annual morbidity rate of 6.25 per 100,000. The annual morbidity rate from brucellosis in Iowa for the 5-year (pre-war) period 1935–1939 was 5.31 per 100,000, compared with 13.00 per 100,000 for the 5-years 1940–1944, the corresponding period of World War II.

EPIDEMIOLOGICAL FACTORS IN THE TRANSMISSION OF BRUCELLOSIS FROM ANIMALS TO MAN

Direct contact with animals and use of raw dairy products are considered the usual means of spread of infection due to brucella. Direct contact with infected animals and their tissues permits organisms to invade the human body through the skin, doubtless facilitated by recent injury and by friction (with consequent abrasions) which attends the seizure of struggling animals. Organisms are also ingested with milk from infected dairy cows or goats.

Undulant fever is ordinarily of sporadic occurrence, when resulting from direct contact with animals. The disease is also sporadic, affecting but one or several individuals among many who are exposed, when unpasteurized milk is contaminated with Br. abortus. On the other hand, multiple cases and epidemic prevalence are from past experience inevitable when the more virulent porcine variety, Brucella suis gains access to a milk supply. Three milk-borne outbreaks of this type have been investigated in Iowa since 1933, at least 110 persons having suffered illness or showing positive agglutination reactions.
Seasonal Prevalence:

Brucellosis in man is usually characterized by gradual rather than sudden onset. Symptoms such as fever, weakness, chills, sweating, loss of weight may be present for some time before the patient consults his attending doctor. The insidious nature of the disease may render it difficult to determine with certainty the month of onset of symptoms.

The accompanying table shows the distribution of cases according to month of onset of illness, based on 1,791 case reports completed through courtesy of Iowa physicians over the 16-year period 1930-1945 (through November 24).

It will be noted that more patients have first complaints of illness during June, July and August than in any other quarterly period of the year. Approximately

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NUMBER OF CASES</th>
<th>PERCENTAGE DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>105</td>
<td>5.9</td>
</tr>
<tr>
<td>February</td>
<td>109</td>
<td>6.1</td>
</tr>
<tr>
<td>March</td>
<td>127</td>
<td>7.1</td>
</tr>
<tr>
<td>April</td>
<td>149</td>
<td>8.3</td>
</tr>
<tr>
<td>May</td>
<td>171</td>
<td>9.5</td>
</tr>
<tr>
<td>June</td>
<td>191</td>
<td>10.7</td>
</tr>
<tr>
<td>July</td>
<td>232</td>
<td>12.9</td>
</tr>
<tr>
<td>August</td>
<td>204</td>
<td>11.4</td>
</tr>
<tr>
<td>September</td>
<td>142</td>
<td>7.9</td>
</tr>
<tr>
<td>October</td>
<td>122</td>
<td>6.8</td>
</tr>
<tr>
<td>November</td>
<td>127</td>
<td>7.1</td>
</tr>
<tr>
<td>December</td>
<td>112</td>
<td>6.3</td>
</tr>
<tr>
<td>Totals</td>
<td>1791</td>
<td>100.0</td>
</tr>
</tbody>
</table>

60 per cent of all patients have onset during the 6 months from April through September, the remaining 40 per cent from October through March.

Brucellosis of Man in Rural and Urban Areas:

The accompanying table (Table II) summarizes information contained on 1,338 case reports for the 3-year period 1942-1944 and 1945 (through Nov. 15). Of the total number, 768 patients were farm residents, of whom 611 or nearly 80 per cent were male farm workers; the remaining 157 or 20 per cent included children under 12, young people of teen-age and adult females. It will be noted that while the attack rate from brucellosis in farmwives and persons under 20 was low (0.9 to 2.2 per 100,000 population), male farm workers showed a morbidity rate over six times as high as that among adult females. Although a high percentage of all groups classed as farm residents have occasion for casual contact with hogs and
cows, the morbidity rate among male farm workers is much higher, probably because special types of contact (as in marketing, castrating, butchering, handling of new-born animals) are more significant and constitute a greater hazard of exposure to infection.

Table II.—Brucellosis of man or undulant (Malta) fever in Iowa

Distribution of reported cases according to occupation, with information regarding contact with hogs and cows and use of dairy products—based on 1,338 case reports supplied by Iowa physicians for the period 1942-1945 (405 cases through 11/15).

<table>
<thead>
<tr>
<th>OCCUPATION OR GROUP</th>
<th>AREA</th>
<th>CONTACT WITH HOGS AND COWS</th>
<th>USERS OF UNPAST. MILK</th>
<th>TOTAL CASES 1943-1945 THRU 11/15/45</th>
<th>POPULATION IN GROUP</th>
<th>3 year average 42-44</th>
<th>Annual rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child (12 yrs. and under)</td>
<td>Rural</td>
<td>19 65.6</td>
<td>29 100.0</td>
<td>29 (a) 916,768</td>
<td>8.0</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Teen age</td>
<td>Rural</td>
<td>26 72.2</td>
<td>36 100.0</td>
<td>36 916,768</td>
<td>8.3</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Farm wife (adult female)</td>
<td>Rural</td>
<td>56 60.9</td>
<td>92 100.0</td>
<td>92 916,768</td>
<td>20.0</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Farm worker (adult male)</td>
<td>Rural</td>
<td>611 100.0</td>
<td>611 100.0</td>
<td>611 (b) 311,776</td>
<td>134.0</td>
<td>*43.0</td>
<td></td>
</tr>
<tr>
<td>Child (12 yrs. and under)</td>
<td>Urban</td>
<td>5 27.8</td>
<td>18 100.0</td>
<td>18 (c) 1,621,500</td>
<td>5.7</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Teen age</td>
<td>Urban</td>
<td>6 31.6</td>
<td>16 84.2</td>
<td>19 1,621,500</td>
<td>4.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>House wife (adult female)</td>
<td>Urban</td>
<td>3 .3.2</td>
<td>77 81.9</td>
<td>94 1,621,500</td>
<td>22.0</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Merchant-professional</td>
<td>Urban</td>
<td>57 26.0</td>
<td>159 72.6</td>
<td>219 1,621,500</td>
<td>52.7</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Packing house worker</td>
<td>Urban</td>
<td>205 98.1</td>
<td>69 35.0</td>
<td>209 (d) 20,000</td>
<td>54.3</td>
<td>*27.1</td>
<td></td>
</tr>
<tr>
<td>Veterinarian</td>
<td>Urban</td>
<td>11100.0</td>
<td>8 72.7</td>
<td>11 (e) 800</td>
<td>2.0</td>
<td>2.0</td>
<td>*250.0</td>
</tr>
<tr>
<td>Total</td>
<td>Rural and urban</td>
<td>999 74.7</td>
<td>1,115 83.3</td>
<td>1,338 2,538,268</td>
<td>311.0</td>
<td>12.3</td>
<td></td>
</tr>
</tbody>
</table>

(a) farm population, Census 1940; (b) male farm workers, Census 1940; (c) urban and non-farm population, Census 1940; (d) estimated number; (e) approximate number.

* Specific rates per 100,000.

Of the total series of 1,338 cases covering the past four years, 570 were individuals residing in urban communities. Children 12 years and under numbered 18, teenage boys and girls 19, adult females 94, and adult males of the merchant-professional group, 219. The records show that approximately 25 per cent of these urban residents gave the history of direct contact with farm animals prior to onset of illness. On the other hand use of unpasteurized milk varied from 73 per cent in the merchant-professional group to 100 per cent among children of 12 years and under.
Among the 570 brucellosis patients in the urban area, 209 (37 per cent) were by occupation packing house employees. While but 35 per cent of these persons used unpasteurized milk during the weeks preceding onset of illness, all but four (98.1 per cent) had direct contact with animals at the time of slaughter. The illness rate in this group of workers, based on an estimated 20,000 such employees, is 271.5 per 100,000.

As far as professional pursuits are concerned, veterinarians as a group are in the urban community but not of it. Week by week and year by year, there are innumerable occasions for direct contact with domestic animals.

In January, 1945, in cooperation with officers and members of the Iowa Veterinary Medical Association at the time of the Organization's annual meeting, blood specimens from 132 veterinarians were forwarded to the Iowa State Hygienic laboratory, where agglutination tests were performed on the blood serum. Three serum specimens showed positive agglutination of brucella antigen, two in a dilution of 1–40 and one 1–80. These titers, although not strongly positive are considered definite evidence of exposure to brucella. The incidence of positive agglutination in diagnostic dilution in the survey, was 2 per cent. In a similar study of the blood serum of Iowa veterinarians made in January 1930, four of 120 specimens showed reaction in a dilution of 1–40, a positive agglutination incidence of 3 per cent.

Due to their repeated contacts with infected animals, veterinarians are believed to acquire a high degree of immunity against brucella. However, records for the past four years show that at least eleven veterinarians of Iowa suffered clinical manifestations of brucellosis. Information is not at hand to determine whether infection was caused by Brucella abortus, Brucella suis or possibly by Brucella melitensis.

Recognition of Brucella Melitensis in Iowa:

Brucella suis and Brucella abortus were for years believed to be the only species of brucella to occur in Iowa. Although Brucella melitensis was isolated from the blood of a patient hospitalized in Iowa in 1930, this individual was a Mexican; the melitensis infection was probably acquired in Mexico, since onset of illness developed only a few days after the patient had left his native country.

Infection due to Brucella melitensis, of relatively frequent occurrence in Mexico and southwestern states, was always considered foreign to this section of the Midwest. However, Brucella melitensis is now known to be endemic in Iowa; between December 1943 and to December 1, 1945 the melitensis species of brucella was isolated from the blood of 32 Iowa persons.

For the successful isolation of brucella strains in Iowa, particularly of Brucella melitensis, full credit must go to I. H. Borts, M. D., Director, State Hygienic Laboratory. Since July 1944, Dr. Borts has employed a tryptose broth medium modified from that devised by Sellers and Morris and by Bohls and Schuhardt, a technique which renders possible the isolation of brucella strains not alone from blood cultures but also from the blood clot contained in the specimen which the physician forwards to the laboratory for the agglutination test.

In a series of 20 Brucellosis melitensis cases investigated in Iowa during 1945,
ten were packing house workers; the remaining ten were farm workers or visitors on farms. Only seven of the 20 patients gave a history of contact with sheep, and none with goats. Twelve, or 60 per cent of the patients were in direct contact with hogs only, prior to onset of illness and gave no history of contact with sheep. Epidemiological findings render it highly probable that hogs, in addition to serving as the usual reservoir for Br. suis will prove to be susceptible also to Br. melitensis. Huddleson has presented evidence that hogs are susceptible to Brucella melitensis. In a personal communication to Dr. Borts in December 1944, Huddleson states: "Melitensis is pathogenic for the hog. While I was in Malta in 1938, I saw evidence of its pathogenicity. A considerable amount of left-over unpasteurized goat's milk was fed to a group of pregnant sows. All of them aborted. Melitensis was recovered from the fetuses. For some reason this observation was never reported in the literature."

Isolation of Brucella from Patients:

During the period from September 1927 to December 1, 1945, brucella strains totalling 358 were isolated at the State Hygienic Laboratory from the blood and tissues of brucellosis patients in Iowa. Of these strains, 238 were Brucella suis, 88 were Br. abortus and 32, Br. melitensis.

Latent Infection in Brucellosis:

Agglutination and skin test surveys have been carried out in a number of Iowa counties, during epidemic or sporadic occurrence of brucellosis. Such surveys reveal that infection is much more widespread in a community or group than is indicated by recognized clinical cases. For each clinical case, a number of persons who have been exposed to the same source of brucella infection will show positive agglutination in moderate or diagnostic dilution; also a positive skin reaction to brucellergen and at times a positive blood culture. All of these positive findings may exist in the entire absence of clinical manifestations. Nature seemingly attempts to protect many persons who are subject to exposure; however, it is important to rely on all known methods for safeguarding individuals against possible illness.

An Outline of Measures for the Control and Eradication of Brucellosis:

A. General Measures.

1. Calfhood vaccination.
2. Continuance of the program of agglutination testing for Brucellosis.
3. Agglutination tests on hogs, particularly brood sows, since these animals are so often found to be the source of human infection.
4. Cooperative program essential between animal and human health agencies. In Iowa, the Bureau of Animal Industry and the State Department of Agriculture have during past years cooperated fully with the State Department of Health in measures for the control of brucellosis. Excerpts of all human case reports and signed requests for testing of animals, are sent to the Bureau and Department of Agriculture. A veterinarian is authorized to collect specimens from animals concerned in human illness. Work of this
kind is all-important in revealing and controlling sources of infection whether in cows, hogs, sheep or goats.

5. Search for sources of newly recognized Melitensis Infection.

B. Measures designed to reduce the hazard of direct contact with animals.
   1. On farms:
      a. Reducing direct, special types of contact to a minimum.
      b. Care and discrimination in purchase of hogs, cows, sheep.
      c. Sanitation.
   2. In Packing Industry:
      a. Pre-employment examination, including agglutination test with brucella antigen.
      b. Repeat agglutination tests from time to time.
      c. Development and use of a satisfactory antigen or vaccine for active immunization.
      d. Special surveys.
      e. Sanitation.

C. Measures to prevent milk-borne disease.
   1. Discrimination in buying of dairy cows from farms, sale pavilions.
   2. Sanitation.
   3. Pasteurization an essential safeguard.
   4. Special surveys.
   5. Small communities supplied with pasteurized milk from nearby distributor plants.

SUMMARY

1. Epidemiological factors in the transmission of Brucellosis from animals to man are discussed, including the occurrence of human cases in the United States and Iowa, seasonal prevalence, rôle of occupation, direct contact and dairy products.
2. Brucella melitensis is now known to be endemic in Iowa.
3. Measures for the control and eradication of brucellosis are outlined.
4. Pasteurization of dairy products is an essential bulwark against milk-borne transmission of brucellosis.
A VACCINATION PROGRAM FOR THE CONTROL OF SWINE BRUCELLOSIS

By G. C. Holm, D.V.M., W. B. Ardrey, Ph.D., and W. M. Beeso, Ph.D.*

Idaho Agricultural Experiment Station, Moscow, Idaho

This report is taken from data of nearly five years' research on swine brucellosis. In the original investigation of test and slaughter and later of test and segregation, a total of 1181 animals were involved during a five-year period. On the original herd test of breeding animals, numbering 86 sows and boars, 29 reacted. Five new reactors were found the next month. During the first year a total of 49 of the original 86 sows and boars reacted. A total of 85 animals developed reactions during the five year period. Twenty of these were slaughtered or destroyed with the majority coming from the original 29 reactors. By following this test and slaughter program, it was felt that important blood lines were being destroyed. This feeling was aptly stated by H. C. Smith (1) last year when he said, "The disease was eradicated and so was the herd." A system of test and segregation was then instituted. All breeding animals were tested just prior to the breeding season. The sows were again tested before going into the farrow houses and the sows and their pigs were tested at weaning time.

Sows that reacted at breeding time were placed in the reactor group and were bred to boars that could be disposed of after the breeding season. None of the pigs farrowed by these sows reacted to the test at weaning time (2). Of the 85 reactor animals, 22 sows and 3 boars were kept. The sows required an average of 6 and a fraction months to become negative. Even though these animals became negative they were kept in the reactor lots. These animals were being exposed to new reactors as they were found in the main herd. Not one of the sows that had returned to negative ever showed by blood test or farrowing that she had picked up a new infection (3, 4). The reactor boars were given sexual rest and required an average of 9 months to become negative. None of the three boars saved showed clinical orchitis or lameness. Those boars showing orchitis were always destroyed. After the blood titres of the boars returned to negative, the boars were bred to negative gilts without transmitting brucellosis (3). These boars were later used on the regular negative herd without disease spread.

Sows and gilts that reacted just prior to farrowing were segregated and given special care. It was found (3) in 1943 that pigs born to sows developing the disease can carry the infection from birth and at a later date may infect other pigs on range. All sows and pigs were tested at weaning time. This test gave an idea on the breeding program to be followed for the next crop of pigs and also made possible the detection of infection in the last pig crop. The only reactor weaner pigs saved and isolated were outstanding individuals. Those showing clinical symptoms and le-

1Published with the approval of the Director as Research Paper No. 250.
2Veterinarian, Animal Pathologist, and Associate Animal Husbandman, respectively.
3W. M. Beeson resigned, October, 1945.
sions were disposed of regardless of breeding and conformation. It was found that young reactor pigs became negative much quicker as a rule than did sows that contacted the disease later in life.

The incidence of the disease by pig crops is of interest both from a seasonal and from a control standpoint. There were no reactors in the 1940 fall pig crop at 5 months but 2 developed during the first year. In the spring 1941 pig crop 10 reactors were found in the first 5 months and a total of 26 during the year. The fall 1941 pigs had no reactors at 5 months and 1 during the first year. The spring 1942 crop had 2 reactors by 5 months and a total of 6 during the year. The 1942 fall pig crop had 1 reactor during the first 5 months and no more during the year. No reactors were found in succeeding pig crops, including the 1945 litters. It took approximately two and one half years to eradicate swine brucellosis from the herd and it was not necessary to eradicate the herd to do it. The incidence of brucellosis in fall pig crops was 4 and 32 were found in the spring litters. Only 5 crops of pigs developed brucellosis during a 5 year period.

From the above data the following facts indicate that if a satisfactory antigenic agent could be found, it might be possible to make young susceptible pigs refractive to swine brucellosis. The important facts are: (1) All reactors kept became negative, (2) young pigs became negative in a short time, (3) old reactors did not transmit the disease after their blood titres returned to negative, (4) nor did they have recurrence of the disease.

It was felt that since Br. abortus and Br. suis are quite similar antigenically there was a possibility of an immune response from Br. abortus vaccine. It was also assumed that the reaction would be more lasting from a live culture vaccine, therefore the commercial vaccine was tried. Since 1942 a total of 261 gilts and boar pigs have been vaccinated with Br. abortus strain 19 vaccine. The immune response appeared to be satisfactory so no further search was made for other antigenic agents.

One factor that had a bearing on the peak titre and the length of the reaction was the age of the animal at time of vaccination. Pigs vaccinated at weaning time gave an average peak titre of 1:25. Pigs in this group were between 54-69 days of age. Several in this age group gave no immune response. Those pigs vaccinated between 70-99 days of age gave an average titre of 1:80 while pigs 100 days and up reacted at an average of 1:125. Gilts vaccinated between 110-130 days of age gave good reactions and had time to return to negative before being bred for gilt litters. The peak titre was always reached at 20-21 days and approximately 2 months were required for the titre to drop to negative (3, 4, 5).

Early in the vaccination study (4) a group of vaccinated gilts were bred and placed in the reactor lots with reacting sows. None of these animals developed the disease but there was some doubt as to the value of this type of data. Since that time three different groups of vaccinated and control animals have been studied under controlled exposures. The number that could be used on each series was limited to 9, with 3 of each group serving as nonvaccinated controls. Each group was bred by negative boars and after enough time had elapsed to practically insure conception 6 vaccinated and 3 control gilts were placed in isolation. They were then each exposed to approximately 10 billion viable Br. suis organisms. The culture used was obtained from the U. S. Bureau of Animal Industry and was desig-
CONTROL OF SWINE BRUCELLOSIS

nated B.A.I. 5451. Only natural atria of infection were used. In the first series one group of 3 received an oral challenge, the second group conjunctival and the third was exposed through the vagina. Since more severe reactions were noted from the conjunctival challenge, that method was used on the following two series. The results of all three series were practically the same. Table I gives the results on the 27 animals studied. All control animals reacted in dilutions of 1:50 or higher after exposure to Br. suis while only 25 percent of the vaccinated gilts showed a challenge response of 1:50. Eighty-eight and eight tenths percent of the vaccinated gilts farrowed normal litters and 11.2 percent aborted pigs that were positive to culture. Twenty-two and two tenths percent of the controls farrowed normal litters, 44.4 percent aborted, 33.4 percent farrowed weak and stillbirth pigs that were positive to culture, 22.2 percent developed spondylitis and an equal percentage developed arthritis. The average litter size for the vaccinated gilts were 7 pigs and 2.44 for the controls.

Typical titre curves are given in Table II, which shows the control aborting and the 2 vaccinated gilts farrowing normally. Table III gives a similar set of curves in which the control farrowed both weak and stillbirth pigs that were positive to culture. Table IV shows the results of still another pen of gilts in which the control

<table>
<thead>
<tr>
<th>Table I.—Farrowing and clinical results of controlled exposures to Brucella suis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PERCENTAGE</strong></td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>NORMAL FARROWINGS</td>
</tr>
<tr>
<td>ABORTIONS</td>
</tr>
<tr>
<td>WEAK PIGS POSITIVE CULTURE</td>
</tr>
<tr>
<td>SPONDYLITIS</td>
</tr>
<tr>
<td>ARTHRITIS</td>
</tr>
<tr>
<td><strong>LEGEND</strong></td>
</tr>
<tr>
<td>VACCINATED</td>
</tr>
<tr>
<td>CONTROLS</td>
</tr>
</tbody>
</table>

...
TABLE II.—Blood titre curves on a pen in which the vaccinated gilts farrowed normally and the control aborted

TABLE III.—Blood titre curves on a pen of gilts in which the control farrowed dead and weak pigs that were positive to culture for Brucella suis
TABLE IV.—Blood titre curves on a pen of gilts in which all farrowed normally but in which the control gilt later developed arthritis

TABLE V.—Blood titre curves on a pen of gilts in which the control and one vaccinated gilt aborted
did not abort nor could *Br. suis* be isolated from the pigs. This animal did develop arthritis but cultural study on the animal was not possible. Table V gives the titre studies on a group in which the control as well as one of the vaccinated gilts aborted.

While these data are on only a limited number of animals it should be remembered that similar results were obtained on three separate series of exposures, also that the methods of exposure were controlled and severe. Results of the methods of challenge compare favorably with those of Hutchings and his associates (6) and the clinical manifestation obtained by us would indicate that our gilts were more susceptible than those used at Purdue or that our strain of *Br. suis* was more virulent. We did observe that the strain used increased in virulence with each series of gilts challenged.

For approximately a year a cooperative study has been under way in a purebred Poland China herd in southern Idaho. The original test showed all breeding animals to be reactors and all but 21 of 140 fall pigs reacted. The negative pigs and all open sows were vaccinated. It was feared that the titre response might be poor in these gilts because of the possibility of inherited resistance or refractiveness as noted by Cameron et al. (7). However, all gilts developed peak titres that compared favorably with the previous findings. All spring pigs were negative to the blood test at the time of vaccination. The sows and boars of the original breeding herd have reached or are nearing negative reactions and no abortions or other clinical disturbances have been reported from this herd. These results were obtained in a period of one year.

At the present time, in cooperation with practitioners, three other infected herds, which are composed of Durocs, Chester Whites, Hampshires, and Herefords, are being studied. Data will be obtained from these herds for future recommendations.

REFERENCES


REPORT OF COMMITTEE ON BRUCELLOSIS


Your Committee on Brucellosis sees no need to repeat the detailed recommendations which have been adequately described in previous reports to this Association. We do feel, however, that it is timely to point out that with the close of the war, there necessarily must come greater efficiency in production methods, for success in our livestock industry, and that Brucellosis still ranks as one of the most important disease handicaps to the livestock industry in our country.

With the close of the war, there comes an even greater need for increased efforts in the control and eradication of all contagious diseases in domestic animals. Furthermore, it should be apparent that the wartime need for maximum production of livestock and livestock products may be expected to subside. If this is true, then it provides an opportune time for the livestock industry to put its house in order.

It has been estimated that the economic loss due to Brucellosis in the United States in farm animals amounts to more than $60,000,000 annually. Your Committee recognizes the importance of Brucellosis as a major public health problem, therefore, any program formulated for the control and eradication of this disease must take into consideration both the economic and human health aspects of the disease. The livestock industry and the veterinary profession should be conscious of the fact that the medical profession, the general public and the health officials of our country are taking an increased interest in the subject of Brucellosis control from a human health standpoint.

Your Committee recommends that the Bureau of Animal Industry and other agencies continue investigations and research on all phases of Brucellosis. We further recommend that definite information be procured so far as possible as to the efficiency of the intradermal method of vaccination with Strain 19, and its advantages or disadvantages over the subcutaneous method.

CALF VACCINATION

Your Committee recognizes the value of vaccinating calves between the ages of 4 and 8 months with Strain 19, as an important factor in Brucellosis eradication. We would, however, call your attention to its limitation. We recommend that research and investigation be continued to the end that a better and more desirable vaccine be made available for use in this work.

ADULT VACCINATION

In a few states, adult cattle are being vaccinated with Strain 19, as a regular procedure under official supervision. Recognizing the advantages and disadvantages of such a policy, your Committee has made a careful analysis of the report of the American Veterinary Medical Association on Brucellosis as it pertains to adult
vaccination and adopted by that association in August of this year. We can find no reason to disagree with said report, therefore, we include same in this report.

There is yet much to learn regarding adult vaccination. Information at hand indicates that systematic vaccination of adults will, in some herds, hold down the abortion rate, but its value in herds into which brucellosis recently has been introduced is less clear. Probably it fails to change the status of cows already infected or those that are destined soon to acquire the infection, but in those destined to take up the organisms months after vaccination, there is reason to believe that valuable, though by no means complete protection will be provided. Adult animals that overcome the vaccination-reaction are more likely to be protected than are calves showing a like recovery, but in adults the recovery is much less likely to occur.

Your committee is aware that adult vaccination is practiced far more extensively than its proved advantages justify; that it is used extensively as a substitute for effective sanitary measures, and more extensively than it would be if its known advantages and disadvantages were carefully explained in advance to breeders contemplating its use.

Your committee, therefore, recommends that the following statement be presented in writing to all cattle breeders contemplating the use of adult vaccination in their herds.

1. Animals vaccinated as adults, when open, if they overcome the vaccination-reaction, acquire valuable protection. A high percentage, however, continue as persistent reactors. Some protection against actual abortion is provided even among those that continue to react.

2. There is no way of distinguishing between a vaccination-reaction and a reaction caused by exposure; hence, following vaccination of the adult herd, sanitary measures based on the agglutination test must be postponed indefinitely.

3. Raw milk from all reactors, vaccinated or not, represents a degree of danger to man; hence board of health requirements and attitudes, as well as the safety of the individual farm family, are to be considered, prior to vaccination.

4. Failure to obtain beneficial results from the vaccination of adult animals is frequently due to a lack of good sanitation and provision for the isolation of infected animals at the time of parturition. Intense exposure to infection can break down the acquired immunity.

5. Animals from reacting herds, vaccinated or not, sell at a disadvantage in their native states, and their interstate shipment is restricted or prevented altogether.

6. Vaccination of pregnant cows causes some abortions and the danger increases as pregnancy advances. Vaccination applied shortly before calving does not have time to produce actual abortion but uterine infection may take place.

7. Adult vaccination cannot be depended on to check the usual "abortion storm." It helps in some herds, it appears to help in others in which the storm already has spent its force, but it frequently fails completely.

8. Adult vaccination has a wider application in beef herds than in dairy herds, but the objections, except those relating to danger in milk consumption, apply to beef herds.

9. Eradication, or near eradication, or Brucellosis will be delayed or prevented altogether by the extensive and indiscriminate use of adult vaccination."
Your Committee approves the rules and regulations for establishing a Brucellosis-free accredited herd as printed on page 76 of the 1944 report of this Association.

Your Committee recommends the following changes in the uniform methods and rules of the establishment and maintenance of modified accredited bovine Brucellosis-free areas, as adopted by this Association December 2, 1943, and approved by the Bureau of Animal Industry December 14, 1943.

By inserting in Section 8, after the word “test” in the 9th line, the following: “If a test of all the cattle in the area discloses more than the above percentages, the infected herds shall be quarantined and retested within 30 to 90 days, and if the results of any such retest made within six months from date of last complete test of the area, discloses not more than 1% cattle infection, nor more than 5% herd infection, such computation of percentages to be based on the total herds and cattle tested in the area, then such area may be declared a modified accredited Brucellosis-free area.” So that said section, as amended, shall read as follows:

“Section 8-a

If, as a result of a test of all the cattle required to be tested, according to provisions of Section 7 above, the number of reactors does not exceed 1%, nor the herd infection exceed 5%, the area may be declared a modified accredited Brucellosis-free area for a period of three years by the State and Federal cooperating agencies in charge of the work; provided that all infected herds shall be placed in quarantine and the cattle in them retested for Brucellosis at intervals of from 30 to 90 days, until all of them have passed two consecutive negative tests, and passed a further negative test not less than 6 months from the date of the second negative test.

“Section 8-b

If a test of all the cattle in the area discloses more than the above percentages, the infected herds shall be quarantined and retested within 30 to 90 days, and if the results of any such retest made within 6 months from the date of any last complete test of the area, discloses not more than 1% of cattle infected, nor more than 5% herd infection, such computation of percentages to be based on the total herd and cattle tested in the area, then such area may be declared a modified accredited Brucellosis-free area for a period of three years.

C. And further provided that herds in which Brucella vaccine is being employed and in which any cattle 6 months of age or over are positive to the test for Brucellosis, shall be maintained under strict quarantine, except calf-vaccinated herds in range and semi-range areas where it is not practicable and for purposes of herd percentage, shall be classed as infected herd.

Amend Section 9, by adding the following: “In areas that become accredited under paragraph b, Section 8, reaccreditation must follow the same procedure as in Section 8, so that said section as amended will read

“Section 9. At the expiration of the 3-year period, the area may be reaccredited for an additional 3-year period if all previously infected herds and such other herds as are designated by the cooperating Federal and State officials are retested, and the percentage of reactors among the cattle retested does not exceed 1% of all the cattle so tested in the area. In areas that become accredited under paragraph b, Section 8, reaccreditation must follow the same procedure as in Section 8.”
BRUCELLOSIS IN SWINE

Brucellosis in swine is of much importance, especially in the hog-raising states. Its importance with respect to efficient hog production, public health and as a potential source of infection for cattle, is becoming increasingly apparent. Your Committee strongly urges that an extended and intensified program of research be carried on and if, and when such research warrants, definite recommendations as to proper procedure be made.

RULES AND REGULATIONS

In view of the fact that there is apparently much confusion relative to State rules and regulations governing the interstate movement of livestock, insofar as Brucellosis is concerned, your Committee recommends that, so far as State laws and State conditions will permit, the uniform rules and regulations governing the interstate movement of livestock approved by this Association last year be adopted.
In the report of last year, a number of recommendations were made, and it is now possible to report action on some of these.

The sheep conservation program has been issued in two forms—one for farm flocks, the other for range flocks. The swine conservation program has been completed, and is in press, with an uncertain status because of paper shortage. The horse program has been completed, but has not been published, because there was no critical need for it.

**UNIFORM REGULATIONS FOR INTERSTATE SHIPMENT**

This problem was discussed at a meeting in August and again in December. The United States Livestock Sanitary Association has given extensive consideration to the problem, and has a committee actively at work on it.

**PROGRAM BEING CONSIDERED**

The program, entitled "Protecting and Promoting the Welfare of the Livestock Industry," was favorably accepted during the annual meetings of the American Dairy Science Association, the Poultry Science Association, the American Veterinary Medical Association, and the American Society of Animal Production. The executive board of the United States Livestock Sanitary Association examined the program, but considered that more time was necessary, to review it in detail. Activation of the program on the part of the Council must await favorable action by this association.

**NEW BREEDS OF ANIMALS**

Further consideration was given to this question, but the information available was insufficient to permit preparation of definite recommendations.

**RECOMMENDATIONS**

1. That a comprehensive survey and review of the entire Brucellosis problem be made, including all phases—dairy cattle, beef cattle, swine, and public health.
2. That programs of the symposium type be encouraged at the annual meetings of the various member organizations. Such programs provide an exchange of viewpoints by veterinarians, animal husbandmen, bacteriologists, and livestock sanitarians, and lead to a better understanding of the problems. Such discussions have been popular in meetings where they have been used.

A complete report of activities during the year is presented herewith.
Several changes have occurred in the membership of the Council during the past year. Dr. W. E. Petersen was appointed in June, 1944, to represent the American Dairy Science Association. Dr. O. V. Brumley was appointed to represent the American Veterinary Medical Association, following Dr. H. W. Jakeman's resignation. Dr. Brumley's untimely death in January, 1945, left a vacancy until Dr. R. C. Klussendorf was appointed in March, 1945. Following the resignation of Dr. M. F. Welsh, in December, 1944, the United States Livestock Sanitary Association appointed Dr. R. A. Hendershott to fill the unexpired term. Dr. W. V. Lambert was reappointed as representative of the American Society of Animal Production. Dr. L. E. Card continues to represent the Poultry Science Association.

Further progress has been made with regard to the animal production programs. As reported by Dr. Leinbach of the National Livestock Conservation Program, the sheep program was issued in two forms; one of which was applicable to farm flocks and the other to range flocks. The swine program was in press, but considerable difficulty was being encountered in obtaining paper and the services of artists. The horse program was completed, but the need for it was not critical so publication was being postponed.

The Council held meetings in August and December. The August meeting was preceded by attendance at a meeting of the Committee on Animal Health of the National Research Council. The latter group, in turn, was invited to attend the Council's meeting in order that the activities of the two groups could be coordinated. At the December meeting, Dr. Lambert was elected chairman and Dr. Card vice-chairman of the Council.

At their annual meeting in June, 1944, the American Dairy Science Association passed a resolution requesting the Council to consider the problems presented in the interstate shipment of livestock due to the lack of uniformity between states in the interpretation and application of the calfhood-vaccination plan for eliminating brucellosis from herds. This matter was discussed at both meetings of the Council. Dr. Ragsdale, president of the American Dairy Science Association, attended as a guest and participated in the discussions during the December meeting. In view of the fact that the United States Livestock Sanitary Association has given extensive consideration to this problem, the Council transmitted a resolution to said association suggesting joint consideration by the livestock sanitarians and appropriate members of the animal production societies. Subsequently, the Council was informed that, during 1944, the United States Livestock Sanitary Association had appointed a committee, including livestock producers, to study the rules and regulations governing the interstate movement of livestock. Regional meetings were held and progress toward more uniformity was made. The Council was advised that the problem is complicated, because the regulations in some states are established by legislative action, in others by an agricultural board, and in still others the regulations may be promulgated by the state livestock sanitary officer. A regional approach toward obtaining greater uniformity of laws and regulations was considered progress in the right direction because the varying incidence of brucellosis in cattle,
the status of the state as to whether it was an importer or exporter of cattle, as well as the nature of the elimination program all influenced the problem.

Since brucellosis occurs in other animals as well as in cattle and since programs are in operation for the control of brucellosis in cattle alone at this time, and in view of the fact that brucellosis is a definite public health problem, the Council passed and transmitted a resolution to the newly formed Agricultural Board of the National Research Council for their consideration, suggesting a comprehensive review of the situation.

The program, entitled "Protecting and Promoting the Welfare of the Livestock Industry," was favorably accepted during the annual meetings of the American Dairy Science Association, the Poultry Science Association, the American Veterinary Medical Association, and the American Society of Animal Production. The Executive Board of the United States Livestock Sanitary Association examined the program, but considered that more time was necessary to review it in detail. The Council was advised that further consideration will be given the program at the next annual meeting. Activation of the program on the part of the Council must await favorable consideration by the latter association.

Further consideration was given to the question of recognizing new breeds of animals, but the information available was insufficient to permit the preparation of definite recommendations. The Council considered that the encouragement of the symposiums at the annual meetings of the various member associations would be desirable. It was pointed out that symposiums on mastitis were presented before the American Dairy Science Association and the United States Livestock Sanitary Association, a symposium on bloat before the American Society of Animal Production, and one on poultry before the American Veterinary Medical Association. Such symposiums provide for an exchange of viewpoints by the animal husbandmen, veterinarians, and livestock sanitarians, and lead to a better understanding and appreciation of the various aspects of the problems.

Financial contributions to provide for secretarial assistance to the members of the Council were reported last year. Because of legal difficulties, it was not possible to open a bank account and make use of these funds until appropriate resolutions had been passed at a formal meeting. A bank account has been duly opened and the financial status of the Council is included in this report. The first check from the Poultry Science Association expired because a new treasurer was elected, so the contributions of this association are indicated among the contributions received. The American Dairy Science Association not only forwarded a contribution but authorized the payment of the expenses of their representative to one meeting each year. The Council now has some funds in reserve, because at the December meeting the representatives unanimously voted to refuse reimbursement for the expenses as reported in the second annual report, in order that funds would be available for emergency purposes.

**Financial Statement**

**Assets**

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American Society of Animal Production .............................................. 25.78
American Veterinary Medical Association ........................................... 104.07
Poultry Science Association (2 years) .............................................. 50.00
United States Livestock Sanitary Association ..................................... 25.00

Total ........................................................................................................ $386.55

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Grand Total ........................................................................................ $248.91
Balance on Hand .............................................................................. $137.64

I recommended that this report be presented in the Executive Board for approval; motion seconded; then approved by the Executive Board, December 7th, 1945.
REPORT OF THE NOMINATING COMMITTEE

R. W. SMITH, Chairman; I. S. McAdory, and W. J. Butler

Your nominating committee wishes to propose the names of the following members for the respective designated positions for the ensuing year:

President—Dr. William Moore, Raleigh, North Carolina
1st Vice President—Mr. Will J. Miller, Topeka, Kansas
2nd Vice President—Dr. Jean V. Knapp, Tallahassee, Florida
3rd Vice President—Dr. T. O. Brandenburg, Bismarck, North Dakota
FIFTIETH
ANNUAL MEETING
TO BE HELD
HOTEL LA SALLE
Chicago, Illinois
Dec. 4, 5, 6, 1946