

Some Unsolved Problems Concerning Bovine Tuberculosis

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ATTEMPTS to control any infectious disease are aimed at eliminating either the source of infection or the means of its transmission, or at altering the susceptibility of the host to the disease. Since in the treatment of bovine tuberculosis it has not been found practicable to alter the susceptibility of the animal by immunization, or to prevent transmission of the disease by isolating infected cattle, the disease has been attacked by removing the source of the infection. This consists of applying the tuberculin test and destroying all cattle that exhibit hypersensitivity to tuberculin.

In the United States, marked success has been attained in eliminating bovine tuberculosis. During the fifteen years from 1893 to 1908, the Bureau of Animal Industry of the Department of Agriculture tested 400,000 head of cattle. Of these, 37,000, or 9.25 per cent, were found to have tuberculosis as shown by a positive reaction to the subcutaneous test. As compared to that of other countries, this incidence was low. However, according to Stiles¹⁸ the percentage of positive reactions was much higher in certain localities. As the result of a vigorous campaign started in 1917 there has been a great reduction in the incidence of tuberculosis among American cattle. In 1918, of 134,143 animals tested, 4.9 per cent were found to have tuberculosis. In 1938, of 14,108,871 cattle tested, only 0.6 per cent exhibited a positive reaction to tuberculin. Mohler¹² states that at present the incidence of bovine tuberculosis in 99 per cent of all the counties in the United States is 0.5 per cent or less. In only fourteen counties, all of which are in California, is the incidence higher.

An interesting corollary that may be interposed here is the fact that the in-

cidence of extrapulmonary tuberculosis among human beings, which has been shown to be frequently caused by the bovine type of tubercle bacillus, has fallen from 23 per 100,000 in 1917 to 5 per 100,000 in 1935.

Present Status

The present status of bovine tuberculosis in the United States is encouraging to both the physician and the veterinarian and the veterinary profession may take pardonable pride in having achieved almost complete eradication of the disease. There are, however, some problems of major importance which have developed in the course of the program for controlling tuberculosis among American cattle. Formerly, when the percentage of tuberculin reactors was comparatively high, it was usually not difficult at necropsy to demonstrate gross lesions of tuberculosis. As the incidence of the disease became lower, it became increasingly difficult to find manifestations of tuberculosis among animals that had exhibited positive tuberculin reactions. Bruner¹ in 1920 showed that the percentage of so-called nonvisible-lesion reactors increased as the percentage of reactors decreased. Hastings, Beach and Weber⁹ reported in 1924 that of 30,010 cattle tested with tuberculin, only 1.12 per cent reacted. Of these reactors, 22.5 per cent at necropsy had no visible lesions of tuberculosis. They reported that of another series of 1,063 condemned cows from herds having only one reactor, 44 percent had no visible lesions caused by tuberculosis. In 1931, Hagan⁷ estimated that at least 10 per cent of all reactors to tuberculin show no lesions at necropsy. At present, it is believed by many that in Iowa, Minnesota and Wisconsin, at least half of the animals which have exhibited a positive

reaction to tuberculin will be found to have no lesions of tuberculosis at necropsy.

Nonvisible Lesion Reactors

Mohler¹¹ in 1931 suggested that the majority of these nonvisible-lesion reactors actually do have tuberculosis, but that the disease has not progressed sufficiently to be recognized grossly. Mohler's suggestion does not adequately explain, however, the appearance of such animals in herds which have no history of tuberculosis and in which no source of the infection can be found. The fact that the percentage of nonvisible-lesion reactors is not decreasing, while the percentage of bovine tuberculosis is, would suggest that perhaps other factors are operative.

A great amount of work has been done and reported in an effort to find the cause or causes of this condition, but nothing conclusive has been established. Avian tubercle bacilli have been isolated repeatedly from cattle. Feldman and Schlottbauer⁵, McCarter, Hastings and Beach¹⁰, Van Es and Martin¹⁹ and others have been able to demonstrate *Mycobacterium avium* in tissues of cattle that had reacted positively to mammalian tuberculin. Plum^{13, 16} reports that in Denmark the incidence of infection in cattle caused by the avian tubercle bacillus varies from a slight percentage to 50 per cent among different herds and that the positive reaction to mammalian tuberculin is inconsistent. He records that in some herds as many as 30 per cent of the animals infected with the avian tubercle bacillus will react positively to the subcutaneous test made with bovine tuberculin.

Avian Infections

Schalk, Roderick, Foust, and Harshfield¹⁷ concluded as the result of extensive investigations that spontaneous infection in cattle caused by the avian tubercle bacillus does not produce a hypersensitivity to mammalian tuberculin with appreciable constancy. Feldman⁴, who has reviewed rather completely the problem of infection in cattle caused by the avian tubercle bacillus concludes that this micro-organism has only a limited pathogenicity for the bovine species. He further states that sensitization to avian tuberculin may

be expected to develop in a large percentage of cattle in an infected environment. Such sensitivity, however, is transient and dependent on continued exposure. He believes, moreover, that only exceptionally will cattle exposed to the avian type of tubercle bacillus show hypersensitivity to mammalian tuberculin.

From this limited discussion, it may be concluded that the avian type of tuberculosis should be considered in attempting to solve the problem of the nonvisible-lesion reactor. It must also be recognized that since the avian tubercle bacillus is but slightly pathogenic for cattle, the role of this bacillus in sensitizing bovine animals to mammalian tuberculin is not a major one.

Other Acid-Fast Bacilli

The possibility that acid-fast bacteria other than tubercle bacilli might incite a hypersensitivity to tuberculin in cattle has not been overlooked. Frey and Hagan⁶ have shown that acid-fast saprophytes are ubiquitous in nature. It is probable that cattle come in contact with them in great numbers. Hastings, Beach and Thompson⁸ reported that they were able to render normal cattle hypersensitive to mammalian tuberculin by inoculating them with strains of saprophytic acid-fast bacteria. Hagan⁷, however, was not able to obtain similar results with cultures supplied by Hastings, Beach and Thompson or with other acid-fast micro-organisms from the soil. According to him, there is no direct proof that cattle are ever sensitized naturally by contact with these saprophytic acid-fast bacteria. It may be, however, that a hypersensitivity is produced which is transient and that a tuberculin test applied at the right time will result in a positive reaction.

Recently (1938), Daines³ reviewed the literature and reported the results of his own investigations on the significance of acid-fast bacteria other than tubercle bacilli, with special reference to what are called "skin lesions." These lesions are sometimes found in cattle that have reacted to the tuberculin test but in which tuberculosis cannot be demonstrated grossly at necropsy. Although previous workers had had little success in culturing

acid-fast bacilli from these "skin lesions," Daines and co-workers were able to recover many strains directly from the affected tissues.

These strains did not produce tuberculosis in any of the animals into which they were injected, but lesions similar to those from which they were isolated could be produced in cattle and laboratory animals. The animals injected, however, often gave evidence of possessing a hypersensitivity to tuberculin, but the reactions were always mild and atypical. The hypersensitivity was transient and could not be maintained. Daines thought that the microorganisms he studied may represent soil bacteria that had gained entrance into tissues through wounds and that they may be responsible for the "skin lesion" seen in animals that react to tuberculin, but in which there is no gross evidence of tuberculosis at necropsy.

Skin Lesions

Crawford² has recently (1938) pointed out that although there may be some relationship between "skin lesions" and hypersensitivity to mammalian tuberculin in cattle, there are also factors which detract from their significance. Not all animals exhibiting these lesions react to tuberculin, and there may also be animals in the same herd which do react to tuberculin but which have no skin lesions or in which lesions of tuberculosis cannot be found. Crawford further emphasizes that among animals having "skin lesions" the reaction to mammalian tuberculin usually is mild and atypical.

There is an apparent need for further investigation to make clear the roles played by the avian tubercle bacilli and the saprophytic acid-fast bacteria in producing a hypersensitivity to mammalian tuberculin in cattle. It is possible that the interpretation of positive tuberculin reactions in cattle may have to be altered, now that the incidence of bovine tuberculosis has become very low. It may be found necessary in the future to consider not only hypersensitivity to tuberculin but other factors as well.

Aside from the important problem of the nonvisible-lesion reactor, there is an-

other interesting relationship between avian tuberculosis and infections in cattle caused by the avian tubercle bacillus. Plum^{14, 15} in 1926 reported that in Denmark the avian type of infection has been found to be associated with abortion in cattle. He believes that these microorganisms have a predilection for the gravid bovine uterus, where they cause an exudative inflammation of the cotyledons which brings about premature expulsion of the fetus. The bacilli are able to survive in the uterus for a long time in submucous abscesses, from which source they may again invade the placenta and terminate subsequent pregnancies.

In the light of the present interest in infectious abortion among cattle in the United States, it would seem highly desirable to investigate the possibility of the avian origin of intra-uterine tuberculosis. It is well known that avian tuberculosis is widespread in the Middle West and that it constitutes a problem of extreme importance to the poultry industry, but there are no published reports of attempts to determine the role of avian tubercle bacilli in the production of infectious abortion among cattle in the United States.

The great success obtained in the fight against bovine tuberculosis in the United States is truly remarkable. The expenditure of effort and money entailed in its accomplishment is well repaid by the protection against this disease afforded human beings and animals. There are still some important problems which must be solved before it can be said that bovine tuberculosis is no longer of consequence in this country. Only by continued effort will the disease remain at a minimal incidence.

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Mercer at Iowa State

Mercer, the International Grand Champion Steer, was a visitor at Iowa State College from March 24 to 27. While at Ames he was stabled in the Veterinary Clinic.

This steer was calved Feb. 20, 1937 on the farm of Dr. R. C. Johnston, of Aledo, Illinois. Named for the county in which he was raised, Mercer adds fame to an already famous line of Aberdeen Angus cattle. He was purchased for \$60.00 from Dr. Johnston by David Brown, a neighbor, who presented him to his daughter, Irene, a 4-H Club girl.

He was fed for a time on a ration of cracked corn, ground oats, and oilmeal with alfalfa hay as roughage. Later he was put on a full ration of corn with oilmeal content increased to one pound. One and one-half pounds of Tarkio were added to the daily ration. A short while before being shown, the oats in his ration were supplanted by barley and his roughage reduced. This was to shrink the steer's mid section, to make it blend more perfectly with his quarters.

The steer acquired the titles of Grand Champion 4-H Club Calf and Breed Champion at Springfield, Ill. and Grand Champion 4-H Club Calf at Chicago, Ill. before entering the International Live Stock Exposition in Chicago. He was here judged International Grand Champion Steer by William J. Cumber of Theale, Berkshire, England.

Mercer is being toured by the Firestone Farm Service Bureau who purchased the steer at the exposition. His weight at the time was 1,160 pounds. Mercer brought Miss Brown \$5,000 through his sale and winnings in the show ring.

Phi Kappa Phi

During the latter part of winter quarter six senior veterinary students were elected to membership in the national honorary society of Phi Kappa Phi. They are Clarence E. Dee, Lester J. Gorman, A. Laurence McGrath, James D. Ramsey, Henry Paul Shoeman, C. Laurel Telleen.

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