

ing as quickly as is consistent with good work and that the intestines should be handled as little as possible. Every possible attention should be paid to technic, but he suggested the use of eserin as an additional prophylactic. Dr. Cannon, he said, has, by feeding a bismuth laden, and hence, to the fluoroscope opaque, pabulum, has been able to tabulate accurately the amount of material passing from the stomach into the intestine in a given time. In his experiments, in cooperation with Dr. Murphy, it was learned that simple exposure of the intestines to the air did not arrest peristalsis, but that the most gentle handling absolutely inhibited all motion for five hours. In more recent experiments this bismuth laden pabulum was given, the abdomen opened and the intestines manipulated and eserin was given, as detailed below. In control experiments it was learned that no material passed the pylorus for five hours, then, action beginning at the end of one hour 7 cm. had passed; at the end of two hours 34 cm. had passed, and at the end of three hours, that is, eight hours after the operation, 43 cm. had passed into the duodenum and jejunum. In the cases in which eserin was used an observation was made one hour and a second two hours after operation, and no material was found to have passed the pylorus. At the end of these two hours 1/60 of a grain of eserin salicylate was given subcutaneously, and at the end of one hour, three hours after operation and two hours earlier than the first passage of the pylorus begins without eserin, he found that 38 cm. of the opaque material had passed the pylorus, thus showing conclusively the action of eserin in overcoming (and preventing) postoperative intestinal paresis.

THE PRESENT STATUS OF THE TRANSMISSIBILITY OF BOVINE TUBERCULOSIS

AS ILLUSTRATED BY INFANTS AND YOUNG CHILDREN.*

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Koch, in his historic address before the British Congress for Tuberculosis in 1901, called the attention of the medical profession throughout the world to the question of the intercommunicability of bovine and humane tuberculosis.

That there was a distinct difference in the morphology of the tubercle bacillus of bovine and of human origin had been convincingly shown by Theobald Smith of Boston in 1898. Koch went further and denied the transmissibility from man to cow and *vice versa*. He was the first to state authoritatively that tuberculous cattle are not a source of infection to human beings.

Behring takes the opposite view and claims that all tuberculosis is of bovine origin, the bacilli entering the system during childhood and in most cases remaining latent for years. Such diverse opinions, held by eminent and scientific authorities, have aroused the widest interest and bred countless controversies.

No attempt will be made in this paper to review or analyze the vast amount of literature that is accumulating on this subject. Reference, however, to some of the more important papers is necessary to understand the present trend of opinion.

The Royal Commission in England, which spent several years in its investigations and whose report has just been published, cast some doubt on the theory of two sharply defined types of the bacillus. de Schweinitz and Salmon, in this country, have never accepted the existence of two distinct types. They believe the differences are due to the host and both have a common origin.

On the other hand, the German Commission and most of the French and German bacteriologists believe the existence of two types is proved and established. Theobald Smith, Ravenel and the great majority of American pathologists, most of whom have done experimental work to decide this very important point, agree that there are two types of tubercle bacilli, distinct in cultural characteristics, virulence and morphology.

The claim made by Koch that the human type will not infect cattle has been disproved by many observers. Ravenel in this country, Kossel in Germany, and the Royal Commission in England, have all produced bovine tuberculosis from the human bacillus. It must be stated, however, that this only rarely occurred in feeding experiments and was successful in a small number of instances after inoculation and injection. The experiments show that the human bacillus is not very virulent to cattle. On the other hand, the bovine bacillus is very virulent to cows and swine.

The question of greatest concern to us is whether the bovine bacillus is transmissible to man and, if so, to what extent? This is a question that can not be demonstrated experimentally and must be judged from inferences. But as inferences are not admissible in solving a scientific point, we must approach this question from a careful clinical study in conjunction with pathologic and bacteriologic examinations.

Two queries naturally suggest themselves in this connection. Do bovine bacilli occur in milk and, if so, are they pathogenic for children? Delepene found virulent tubercle bacilli in 17.6 per cent. of a series of specimens collected in Manchester. It is generally believed that the udders must be infected before bacilli are found in the milk. Adami, however, found bacilli in 60 per cent. of tuberculous cattle in which there was no lesion of the lacteal tract. Ravenel experimented with five cows with no physical signs of tuberculosis but reacting to tuberculin and later confirmed the diagnosis on autopsy. The milk of these cows was inoculated into guinea-pigs, of which number 18.7 per cent. became infected by a single dose of milk from cows having no disease of the udder. Rabinovitch of Berlin obtained similar results.

It is difficult to state the exact frequency of tuberculosis in cattle. This depends on the herd, surroundings, climate, etc.

In Massachusetts, in 1901, over 24,000 cattle were tested with tuberculin, and half, or 50 per cent., were positive, but these were suspected and selected cattle. In Connecticut 14 per cent of the cows were tuberculous and in New York 15 per cent.

The Wisconsin Experimental Station found 35 per cent. of suspected herds tuberculous and 9 per cent. of non-suspected herds. The statistics show that tuberculosis in cattle in the United States is far from an uncommon occurrence.

If bovine tuberculosis is transmissible to children, it must be through the milk, and if all milk containing tubercle bacilli was capable of producing tuberculosis, very few of us would escape.

In view of a very confusing literature, and wishing to establish a scientific clinical justification for the transmission theory, I addressed a circular letter with questions bearing on this point to the members of the American Pediatric Society, to teachers of pediatrics not members of the society, and to several prominent pathologists who have contributed to this subject.

Seventy-nine letters with a list of questions enclosed were sent and replies have been received from sixty-

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seven, and I wish to express my appreciation of the kindness and courtesy of these gentlemen.

The first question was: "Do you believe that bovine tuberculosis is transmissible to man?" Five replied in the negative and twenty-five would express no opinion. Of the thirty-seven answering "Yes," ten qualified their answers by saying that transmission occurred "in relatively rare cases," "exceptionally," "to a very limited extent," etc.

The second question was: "Have you in your personal experience seen cases which you believe to be such?" There were only nine affirmative answers to this question. The remaining twelve questions pertained to the clinical, pathologic and bacteriologic points. In the cases reported by six of the nine, infection by the bacilli of human type could not be excluded because no bacteriologic determination of the type of the tubercle bacilli had been made. Three men reported seven positive cases where the infection came clearly from the milk and the bacilli proved to be of bovine origin. These, with twenty-two cases collected by Bovaird in 1905 out of the medical literature of fifteen years previous, makes twenty-nine positive cases of bovine tuberculosis transmitted in the milk of tuberculous cows.

To summarize: Forty of the sixty-seven answers to the questions of bovine transmission were negative, non-committal or restricted. Nineteen simply answered yes, and nine were able to report cases, of which number only three recorded cases in which the bacillus had been proven to be of the bovine type. One well-known clinician of large experience wrote: "I have been trying to find some well authenticated case of transmission of bovine tuberculosis, but to my surprise I have been unable to do so."

In this connection I will quote from the letter of Dr. Ruhräh of Baltimore.

Of two institutions for children in this city, one has tuberculosis, the other none. In the one where tuberculosis exists there have been pre-existing cases for years and the source of infection is plain. Both use milk from a general dairy, and if the infection came through the milk there ought to be tuberculosis in both institutions. I know of two other institutions where there are children and no tuberculosis. Considering the frequency of tuberculosis in cattle, the transmission would be hard to avoid if it commonly occurred.

The importance of making a thorough examination of all the factors entering in the study of a clinical case is illustrated by the following personal experience:

In February of this year I was called to see a case of tuberculous meningitis in consultation with Dr. Turner of Ticonderoga, N. Y. The child was 14 months old, of healthy and well-to-do parents. There was absolutely no history of tuberculosis on either side of the family and the other children were strong and well. The parents lived in a large detached house about one-half mile from the village. None of the servants had tuberculosis or had friends or relatives with tuberculosis. The baby had been exclusively breast fed until it was 12 months old, when he was gradually weaned on milk obtained exclusively from two cows belonging to a neighbor.

In the absence of all apparent human contagion the milk was suspected and the local veterinarian was instructed to test both cows with tuberculin. The report came that one of the cows had reacted with a temperature of 103 F., while there was no reaction in the other. These facts were reported to the New York State Department of Agriculture and the suspected cow was condemned and brought to Albany for slaughter and au-

topsy. On arrival in Albany Dr. Kelly, the state veterinarian, made another tuberculin test with a negative result. Nevertheless, the cow was slaughtered and a most careful autopsy performed without revealing a single tuberculous lesion. The milk from the cow had previously been fed and injected in guinea-pigs with no resulting infection in any of the pigs after seven weeks. Dr. Hacker of the Bender Hygienic Laboratory went to Ticonderoga and performed the autopsy on the child, and the followings notes are taken from his report:

W. F., aged 14 months. Autopsy at Ticonderoga, N. Y.

Clinical Diagnosis.—Tuberculous meningitis.

Anatomical Diagnosis.—Tuberculous cerebrospinal meningitis. Tuberculosis of spleen. Tuberculosis of peritracheal lymph nodes. Fatty degeneration of liver. Hyperstatic congestion of lungs.

Microscopic Diagnosis.—Acute miliary tuberculosis of lung and liver. Fatty degeneration of liver. Cloudy swelling of kidney.

Specimens from several of the organs were sent to Dr. Theobald Smith, of Boston. Bacilli of the bovine type were not found in these specimens.

The source of infection in this case seemed at first glance to come directly and positively from the cow. The baby had been exclusively breast fed until receiving for about six weeks the milk from these cows. There was no hereditary tubercular taint and absolutely no known exposure. One cow was reported tuberculous and the chain of circumstantial evidence seemed conclusive. But the absence of any tubercular disease in the cow at autopsy and the negative results after feeding and inoculating guinea-pigs with the milk honorably acquitted the cow from any participation in this tragedy. The erroneous result after the first tuberculin injection was probably due to faulty technic or some other cause of temperature in the cow. I may state here that Dr. Kelly made a physical examination and two tuberculin tests on the cow that was reported healthy, but with negative results.

The point of entry of the bovine bacillus is through the alimentary tract. Raw, of Liverpool, would divide tuberculosis in children into two groups, the pulmonary form being the result of inhaling tubercle bacilli of the human type and the abdominal or glandular form being due to the bovine bacillus taken into the system through the digestive system.

Some authorities, notably Behring, Vallee and Calmette, deny that infection ever takes place through the lungs. Ravenel believes that tubercle bacilli can pass through the intestinal wall and be carried to distant parts without any involvement of the intestinal mucous membrane. The bacilli enter the thoracic duct and find their way into the lungs and mediastinal glands. There can be little doubt, however, in the mind of an unbiased observer, after a careful study of the literature, that infection takes place both through the air and the food.

Dr. Pearce, of the Bender Hygienic Laboratory, gave me permission to look over the autopsy records on file from 1896 to 1906. Out of 1,041 autopsies, 154 were under 5 years of age. Tuberculosis occurred fourteen times under 5 years. Of these, three were noted as primary intestinal tuberculosis, i. e., the involvement of the intestine was the oldest and primary lesion.

At St. Margaret's House for Infants, 157 have died among 935 admissions since 1901. A clinical diagnosis of tuberculosis was made in six cases, which was confirmed in three cases by autopsy. (These autopsies are included in those quoted above from the Bender Labora-

tory.) In no instance was there any primary intestinal tuberculosis. This institution admits only infants under 12 months and discharges them when they reach the age of 2 years. Raw milk obtained from untested cows has been the only milk used for six years.

Our experience in Albany is in accord with observations in this country and in France and Germany. Ho't found no case of primary intestinal tuberculosis in 119 children dying from tuberculosis. Bovaird found two cases in 125 autopsies; Northrup, three in 125; Hand, ten in 115 autopsies on tuberculous children.

In Great Britain the primary involvement of the intestine is much more frequent than in other countries. Shennan, in Edinburgh, found primary intestinal lesions in 28 per cent. of his autopsies, and the figures in London and other parts of England range from 18 to 30 per cent. No satisfactory explanation has yet been made to account for this great difference and no light was shed by the present investigation.

Primary intestinal tuberculosis in young children is claimed by many writers to be of bovine origin. Theobald Smith studied five cases of primary intestinal tuberculosis, and only one of the five was proved to be of the bovine type. The Royal British Commission studied sixty cases of human tuberculosis, but in the abstract of their report in the *British Medical Journal* no mention is made of how many of these were primary intestinal. Nevertheless, of these sixty cases, only fourteen were of the bovine type. Young children do not expectorate, but swallow all bronchial secretions and crawl around in the dust and dirt, placing every movable article in their mouths so that the chance of infection with the human bacillus is very great.

Comby, before the International Congress of Tuberculosis in 1905, made the emphatic statement that, from his observations, milk played no appreciable part in the spread of tuberculosis in children. Human or family contagion is the greatest danger and one that should not be minimized.

Sterilized milk is almost universally used for infant feeding in Paris, and, while it has resulted in a marked diminution in the death rate from intestinal diseases, yet the mortality from tuberculosis in young children has increased.

Statistics from all sources show that tuberculosis is relatively rare in the first six months of life and that the greatest number of cases occur between the second and sixth year. If tuberculous milk was such a great source of danger, the greater number of cases would appear before the second year.

It is feared that little has been said in this paper to bring this important problem nearer a solution. Authorities we all respect are at variance over this issue. Clinical evidence has been, in the main, negative. The literature is so voluminous and contradictory that it is impossible to make any definite declaration of the present status of the transmissibility of bovine tuberculosis.

That tuberculous cattle are a menace to public health and give the disease through their milk in rare instances has been proved. Efforts to stamp out the disease in cattle should be made, but the attention of the public should not be diverted from the great and very real danger of human contagion. Whether this takes place through the respiratory or digestive tract is immaterial.

In view of the practical bearing of this question from a sanitary, hygienic and dietetic point of view and the evident confusion and lack of positive knowledge, I

would earnestly urge that this Section take up a further and systematic study of bovine tuberculosis and its transmission through milk. A committee to consist of a pathologist, bacteriologist, veterinarian and two medical (clinicians) men could be formed to make a report at each meeting of the work that is being done in different countries and to urge and see that a differential bacteriologic examination be made in all suspected cases not alone of intestinal involvement, but of the bronchial glands, lungs and tonsils.

FURTHER EXPERIMENTS WITH THE WOOD-TICK IN RELATION TO ROCKY MOUNTAIN SPOTTED FEVER.*

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Experiments which I previously reported show that the adult male and female and the nymph of the Rocky Mountain woodtick (*Dermacentor occidentalis*) are able to acquire and transmit spotted fever.¹

In this paper experiments will be reported which show: 1, That the larva may acquire the disease and remain infective during the nymphal stage; 2, that the virus may be transmitted from an infected female to her young through the eggs; 3, that the virus exists in both the gut and the salivary glands of the infected tick.

I. INFECTION OF THE LARVA.

In these experiments the possibility of the larvæ having acquired the disease from the female parent through the egg was excluded by testing the females on healthy guinea-pigs before they deposited their eggs, and it is to be understood that all the larvæ used in these experiments came from females which had been tested in this way and found uninfected.

When from one-third to three-quarters of the eggs of one or more females had hatched, the bottle which contained them was placed in a tick-proof cage with a guinea-pig. As the eggs hatched, the living larvæ were removed from the bottle and placed on the guinea-pig, where they were left to feed or to drop off until ready to feed. Within a few days the guinea-pig was inoculated with spotted fever and the course of the fever and the condition of the animal were observed daily. When the larvæ had fed sufficiently they fell from the animal and crawled up on the canvas which covered the cage. From this location they were removed and placed in boxes to await moulting and the nymphal stage, and when a sufficient number had reached this stage they were placed in a fresh cage with a healthy guinea-pig on which they were allowed to feed.

It was considered preferable to carry on the experiments in this way, *i. e.*, to infect as larvæ and to test as nymphs, rather than to attempt both steps during the larval stage. The latter course would have involved serious difficulties, and, moreover, the results have a more practical bearing when it is shown that the tick, having acquired the disease as a larva, remains infective after reaching the nymphal stage.

Larval Infection 2.—On July 8 several thousand normal larvæ were placed with an infected guinea-pig (670). A large number fed, dropped off and were isolated, and when they began to moult were placed with a normal guinea-pig (717). After a period of six days the temperature of the latter rose to 105.7 F., and on

* This work has been supported by an appropriation made by the legislative assembly of the State of Montana, at the solicitation of the Montana State Board of Health, and aid has also been rendered by the University of Chicago, and by the Memorial Institute for Infectious Diseases, Chicago.

¹ From the Department of Pathology of the University of Chicago.

¹ THE JOURNAL A. M. A., Aug. 4, 1906, p. 358; Oct. 6, 1906, p. 1067; July 6, 1907, p. 24. Jour. of Infec. Dis., Jan. 1, 1907, p. 141.