THE OPHTHALMO-TUBERCULIN REACTION IN CATTLE.*

By EUGENE F. McCAMPBELL, S.B.,

Instructor in Bacteriology, Ohio State University, Columbus, Ohio.

With the collaboration of

DAVID S. WHITE, D.V.M.,

Dean of the College of Veterinary Medicine, Ohio State University.

von Pirquet1 has recently made use of the local reactions sometimes elicited in individuals affected with infectious diseases when the toxin from the microorganism causing the infection is injected into the body. He has applied the phenomenon to tubercular infections and has found that when tuberculin is introduced into the dermis that a local reaction results in tuberculous subjects and no reaction of any consequence in the non-tubercular. This local cutaneous reaction lasts at least eight days. von Pirquet has applied this test in infants and children and finds that it is of diagnostic value especially in the beginning of the disease.

Vallée2 has applied the cutaneous tuberculin test to cattle, horses and guinea-pigs. He finds that the reaction is positive in the majority of tuberculous animals and conversely does not occur in normal animals. It is not within the province of this paper to consider in detail the cutaneous reaction for tuberculosis. This subject will form the basis of a later communication.

Calmette3 has made use of the foregoing principle, but has modified the method of applying the test. He instills the tuberculin into the eye instead of into the skin. He finds in cases of tuberculosis, after six to sixteen hours, that the conjunctiva, particularly

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3Calmette, *Presse médicale*, 1907, xv, 388, 443.
the palpebral conjunctiva, becomes markedly congested, that there is lachrymosis and finally the whole conjunctiva is covered with a serofibrinous exudate. In the non-tubercular there may be a slight conjunctivitis, but usually there is no reaction whatever.

Olmer and Terras have found that the ophthalmic-tuberculin test in man is more accurate than the cutaneous test. They obtained some conflicting results, however, as in a few cases there was a reaction in non-tuberculous individuals whereas in a small proportion of those clinically showing tuberculosis there was no reaction.

In the light of the recent results which have been obtained by the use of tuberculin in the eye for the diagnosis of tuberculosis in infants and to a limited extent in adults, it has seemed possible that the ophthalmic-tuberculin test may be applied successfully to cattle. It is a fact, disputed by some, that bovine tuberculosis can be transmitted to man and especially to infants. This transmission takes place through the milk of tuberculous dairy cattle. It is important that an easily applied and accurate means for the diagnosis of tuberculosis in cattle be available in order that dairy herds be kept free of tuberculous animals. Animals showing the least suggestion of tuberculous infection should be isolated and if the diagnosis proves correct destroyed. It must be borne in mind that the tuberculin test as it is ordinarily made has many objectionable features.

With a view of investigating the efficiency of the ophthalmic-tuberculin reaction in cattle we undertook a series of experiments.

DESCRIPTION OF EXPERIMENTS.

Cattle.—The cattle used in these tests were divided into three classes as follows: Class A, five animals which reacted to the tuberculin test in February, 1907; Class B, five animals which reacted to the tuberculin test in September, 1907; Class C, twenty animals which were used as control and to which the tuberculin test was applied in November, 1906, no reactions resulting.

Class A.—These animals were fancy cattle and appeared to be in the best of condition with the exception of No. 2A, which was beginning to show clinical signs of tuberculosis.

Olmer and Terras, *Presse médicale*, 1907, xv, 593.
Ophthalmo-tuberculin Reaction in Cattle.

Class B.—These five animals were from a herd of thirty-four dairy cattle, twenty-seven of which reacted to the tuberculin test. They are in the advanced stages of tuberculosis. Bacillus tuberculosis was found in the feces of No. 2B.

Class C.—These animals were from a large dairy herd, nineteen of which had been repeatedly tested with tuberculin and had shown no reaction. Cow No. 2C is a two-year-old Jersey heifer and has a temperature (103°-104° F.) which is continually too high to be made use of in a usual tuberculin test. This cow will be tested as soon as possible.

Tubercular Cattle.

<table>
<thead>
<tr>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A. Polled Angus</td>
<td>1B. Jersey</td>
</tr>
<tr>
<td>2A. Jersey</td>
<td>2B. Jersey</td>
</tr>
<tr>
<td>3A. Short Horn</td>
<td>3B. Jersey</td>
</tr>
<tr>
<td>4A. Short Horn</td>
<td>4B. Jersey</td>
</tr>
<tr>
<td>5A. Short Horn</td>
<td>5B. Jersey</td>
</tr>
</tbody>
</table>

Non-tubercular Cattle. Controls.

<table>
<thead>
<tr>
<th>Class C</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1C. Grade Short Horn</td>
<td>11C. Guernsey</td>
</tr>
<tr>
<td>2C. Jersey (heifer)</td>
<td>12C. Guernsey</td>
</tr>
<tr>
<td>3C. Grade Short Horn</td>
<td>13C. Jersey</td>
</tr>
<tr>
<td>4C. Grade Short Horn</td>
<td>14C. Jersey</td>
</tr>
<tr>
<td>5C. Grade Short Horn</td>
<td>15C. Red Polled</td>
</tr>
<tr>
<td>6C. Dutch Belt</td>
<td>16C. Red Polled</td>
</tr>
<tr>
<td>7C. Jersey</td>
<td>17C. Grade Red Polled</td>
</tr>
<tr>
<td>8C. Jersey</td>
<td>18C. Red Polled</td>
</tr>
<tr>
<td>9C. Jersey</td>
<td>19C. Grade Holstein</td>
</tr>
<tr>
<td>10C. Jersey</td>
<td>20C. Red Polled</td>
</tr>
</tbody>
</table>

Technique.—The method first tried was the administration of the tuberculin as prepared by Calmette. A one per cent. solution was made by dissolving the precipitate, obtained by treating tuberculin with absolute alcohol, in sterile water. The solution was sterilized by steam at 100° C. One-tenth (0.1) to one-fifth (0.2) cubic centimeter of the above solution was placed in the conjunctival sac of each cow. No results were obtained by the use of this method. There is a possibility that the amounts used were too small.

The tuberculin which proved to give the most successful results was procured from the Bureau of Animal Industry, United States Department of Agriculture. It was used full strength and twenty-
five-hundredths (.25 c.c.) of a cubic centimeter was placed in the conjunctival sac of each cow with a sterile eye dropper. The right eye was used, its condition being noted and compared with the left at the time of injection. Accurate data were recorded in regard to the temperature before and after the instillation of the tuberculin into the eye.

Reaction.—In the right eye, beginning from six to eight hours after the instillation of the tuberculin (.25 c.c.) the lids appear slightly swollen. Photophobia and lachrymosis are present. Within from sixteen to eighteen hours there appears upon the conjunctiva, a thin layer of whitish gray membrane. This is particularly marked on the bulbar conjunctiva covering the sclera and on the membrana nictitans which is reddened. Thin films of this membrane are constantly being washed down over the cornea, where they appear as movable opacities, passing downward to the lower lid. The eye-lashes are agglutinated with greyish yellow exudate. The episcleral blood vessels are dilated. From the inner canthus is a discharge of straw-colored exudate, which dries to form crusts of dried exudate below the inner canthus. The left eye is perfectly normal.

Statement of Results.—The reaction above described was found in all the tubercular cattle, i.e., Classes A and B, and a slight reaction in Cow 2C. It will be recalled that 2C had not been tested with tuberculin regularly on account of her continued high temperature. The fibrinous exudate in this case was very slight. Class A showed the most profuse exudate and the most typical reaction. These cattle had not been tested with tuberculin since February, 1907. This point should be noted: Class B showed the reaction, but not in so typical fashion as Class A. These cattle were tested with tuberculin only four weeks before the ophalmo-tuberculin test was administered. This point should also be noted: All the control cattle, i.e., Class C, with the exception of 2C, which showed a slight reaction, gave no reaction whatever. Cows 1C to 7C inclusive, were tested twice and showed no reactions. No rise in temperature or other constitutional disturbance was noted in any of the cattle.
CONCLUSIONS AND SUMMARY.

The conclusions to be deduced from this brief series of experiments are as follows:

1. The ophthalmo-tuberculin reaction is of some value for diagnosis of tuberculosis in cattle. A characteristic conjunctivitis with fibrinous exudation coming on from six to eight hours, reaching a maximum in from sixteen to twenty-four hours and disappearing in forty-eight hours, is noted in tubercular animals.

2. The reaction is more pronounced in those animals which have not been recently tested with tuberculin. With this reaction as with the usual tuberculin test one injection and reaction probably inhibit a second reaction during a period from six weeks to a year. The ordinary tuberculin test does not seem to interfere to any great extent with the ophthalmo-tuberculin test at least within four weeks. Class B, though recently tested, showed the reaction, although not to the extent of Class A, which was tested some time ago. The tuberculin test occasionally prevents absolutely a second reaction, and usually no second reaction occurs within six weeks to a year, as before stated.

3. In cattle recently tested with tuberculin by the subcutaneous method the ophthalmo-tuberculin reaction is only slightly reduced in its intensity. The ophthalmic test may possibly serve as a means of diagnosis of tuberculosis in cattle which have been tested with tuberculin by the ordinary method and will not react a second time, or where tuberculin has been injected into cattle in order that they may clear a second test.

Another possibility must not be overlooked in this connection. It is well known that animals which have a slight tubercular infection often show a very marked and typical reaction to the tuberculin test as it is usually made, and those animals which show themselves clinically to be in the advanced stages of tuberculosis often show only a very slight reaction. The animals in Class B are in the advanced stages of tuberculosis and this fact might perhaps account for the lower intensity of the reaction. The exact cause of the lower reaction in these cattle can only be determined by further experimentation.

4. No constitutional disturbance being noticed in any of the cattle
tested, that is, no rise in temperature, loss of appetite or falling off in the production of milk, it is evident that the instillation of tuberculin into the eye does not produce the general reaction which attends in some cases the subcutaneous injection of tuberculin, and is therefore decidedly advantageous. The exudate disappears and leaves the eye perfectly normal in forty-eight hours after injection.

5. If the ophthalmo-tuberculin test proves as efficacious as the foregoing experiments seem to indicate we have in it a comparatively rapid and easy means of diagnosing tuberculosis in cattle. Such being the case the method cannot fail to come into general use superseding the present laborious method of applying the test. Cattle can be injected and then inspected sixteen to twenty-four hours afterward.

There are many problems in connection with the reaction which must necessarily be studied. The following are a few of the propositions:

1. Is it possible to tell by the reaction how far the tubercular process has progressed in the body?

2. Is there any relationship between the intensity of the reaction and the number and severity of the tubercular lesions?

3. Will the test prove to be more accurate than the ordinary tuberculin test which is said to reveal all but four per cent. of the cases?

4. Will the test reveal tuberculosis after a subcutaneous tuberculin injection?

5. Will animals react a second time if the first tuberculin is placed in the eye and the second given by the ordinary subcutaneous method and conversely?

These and many more points must be thoroughly investigated before the efficiency of the test is proven.

The ophthalmo-tuberculin test will be repeated on other cattle, and also on the cattle used in these experiments. Experiments are being made to determine the efficiency of the cutaneous tuberculin reaction in cattle. We wish in this paper to give only the preliminary findings.