

THE COMPARATIVE PATHOLOGY OF THE TRACHEAL AND BRONCHIAL LESIONS PRODUCED IN MAN BY *B. PERTUSSIS* (WHOOPIING-COUGH) AND THOSE PRODUCED IN DOGS BY *B. BRONCHISEPTICUS* (CANINE DISTEMPER).\*

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The work of Bordet and Gengou<sup>1</sup> and others upon the relation of *B. pertussis* to whooping-cough and that of McGowan,<sup>2</sup> Ferry,<sup>3</sup> and Torrey and Rahe<sup>4</sup> upon *B. bronchisepticus* in its relation to canine distemper has generally been accepted as establishing the etiological relation of these two organisms to the diseases with which they are associated.

When one studies the comparative bacteriological characters of these organisms one is struck with their general similarity: a similarity sufficiently pronounced to make a definite differentiation between them possible only by means of a few properties. The following points in the differentiation of the two organisms are important. *B. pertussis* is not motile; *B. bronchisepticus* is motile. The comparative reaction in litmus milk is important.

This similarity, taken in connection with the fact that the clinical aspect of canine distemper has a certain similarity to whooping-cough, led me to make a comparative study of the tracheal and bronchial lesions in the two diseases.

In the discussion of a paper on the pathology of whooping-cough, read by Dr. F. B. Mallory<sup>5</sup> before the Massachusetts Medical Society in the summer of 1913, I called attention to the similarity of the lesions found in the trachea and bronchi of human beings who had died from infection with *B. pertussis* and those in the trachea and bronchi of dogs suffering from or dead as the result of infection with *B. pertussis*.

My contribution to that discussion was based upon work done in Professor Councilman's laboratories in the Harvard

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\* Received for publication May 1, 1915.

Medical School. Since that time I have made a further study of the subject.

The material for study was obtained from dogs suffering with or dead as the result of distemper.

With the exception of the first case, a bacteriological study was made in order to determine the presence or absence of *B. bronchisepticus*. This organism was isolated from each case except the first one referred to above. The isolation of *B. bronchisepticus* was not difficult, provided proper media and careful bacteriological technic were employed.

I have found in dogs where the frontal sinuses were involved that not infrequently *B. bronchisepticus* was present in pure culture. The trachea, as it is more exposed to the possibilities of mixed infection, offered some difficulty in isolating the bacillus in question until a special technic was employed. As will be described below, the anatomical situation of the organisms, between the cilia of the lining mucous membrane, offered the suggestion that the bacillus in question might be sufficiently adherent to withstand washing that might remove most of the associated bacteria. With this possibility in view I ligated the trachea high in the neck and near its bifurcation, removed it, sterilized its outer surface by means of searing, and opened it with sterile instruments. The mucous membrane was then washed with warm sterile salt solution and gently scraped with a sterile knife. A portion of the material thus obtained was inoculated directly upon special medium, and a portion of it further washed in warm sterile salt solution and then inoculated. By this means no difficulty was experienced in obtaining pure cultures.

Mallory,<sup>6</sup> in his work upon whooping-cough, first called attention to the presence of minute organisms in large numbers between the cilia of the epithelial cells lining the trachea and bronchi. Morphologically the organisms found by Mallory correspond with *B. pertussis*. No similar organisms were found in a large series of sections of the respiratory system obtained from many different diseases other than whooping-cough. Besides the presence of these organisms

there were but slight lesions in the mucous membrane and submucous tissues.

The material for my histological study was preserved in various fixatives and stained with differential stains. The most satisfactory stain for *B. bronchisepticus* in sections is Mallory's modification of his eosin and methylene blue method.

In the trachea and bronchi of dogs ill or dead as a result of distemper there are present, between the cilia of the lining mucous membrane, varying numbers of small bacteria of bacillary and cocco-bacillary forms. Their number and distribution vary. In some instances practically every cell has great numbers of bacteria between its cilia. In some sections they are so numerous as to form a finely granular black mass in the anatomical situation of the cilia. In other sections they are absent or occur only in small numbers.

The epithelial cells themselves do not show any pathological lesions demonstrable by the technical methods employed. There is but little reaction in the sub-epithelial tissues. That present is similar to the lesions found in humans who have succumbed to whooping-cough: a mild inflammatory reaction.

One of the chief interests in the findings described above is their relation to the histological study of the respiratory system of dogs that have been inoculated with *B. pertussis*.

Smith<sup>7</sup> in a recent article has described the presence of *B. pertussis* between the cilia of the tracheal epithelium of guinea-pigs, and I have noticed a similar lesion in rabbits suffering from a disease, the clinical aspect of which resembles the so-called snuffles. In these rabbits the cilia of the epithelial cells of the trachea present an appearance similar to that in dogs with distemper. The organism in the rabbits referred to above was not studied bacteriologically.

The histological findings in the respiratory system of dogs, guinea-pigs, and rabbits, described or referred to above, have an important bearing upon the experimental inoculation of these animals with *B. pertussis*.

These findings are of importance for several reasons. First, the morphology of *B. pertussis* in stained sections and its anatomical situation in the respiratory system of man is so similar to that of *B. bronchisepticus* in dogs and guinea-pigs, and to that of an organism found in one of the diseases of rabbits, that it seems practically impossible to distinguish them by means of histological methods alone. Second, infection with *B. bronchisepticus* is common in dogs and guinea-pigs, and, as McGowan<sup>2</sup> and T. Smith<sup>7</sup> have shown, may be present in the respiratory system of guinea-pigs that have completely recovered from the disease it produces, and may even be present in some of these animals that have never shown symptoms of infection with it. It is most probable that dogs will be found to be carriers of *B. bronchisepticus*, as has been demonstrated for the guinea-pigs.

When the respiratory system of animals liable to harbor *B. bronchisepticus* is experimentally inoculated with *B. pertussis*, the accompanying irritation might be followed by acute symptoms resulting from *B. bronchisepticus* already present and not from *B. pertussis* injected.

For the above reasons the interpretation of the results following experimental inoculation of the respiratory system of dogs, guinea-pigs, and rabbits with *B. pertussis* cannot safely be based upon histological examination alone. *B. pertussis* must be recovered from the respiratory system of the inoculated animal and completely identified by bacteriological methods as well as agglutination reactions.

#### REFERENCES.

1. Bordet et Gengou. *Annal de l'Institut. Pasteur*, 1906, xx and xxi.
2. McGowan. *Journal Pathology and Bacteriology*, 1910-11, xv, 372.
3. Ferry. *Am. Vet. Review*, 1910, 499; *Vet. Journal*, 1912 (quoted by T. Smith).
4. Torrey and Rahe. *Jour. Med. Research*, 1913, xxvii, 391.
5. Mallory and Horner. *Jour. Med. Research*, 1913, xxvii, 115.
6. F. B. Mallory. *Boston Medical and Surgical Journal*, 1913, clxix, 378.
7. T. Smith. *Jour. Medical Research*, 1913, xxix, 291.