

## PNEUMONIC LESIONS CAUSED BY BACILLUS MEGATHERIUM.\*

BY MARTHA WOLLSTEIN, M.D., AND S. J. MELTZER, M.D.

(From the Departments of Pathology and of Physiology and Pharmacology of  
The Rockefeller Institute for Medical Research, New York.)

### INTRODUCTION.

In previous communications<sup>1</sup> on experimental pneumonia we showed that there are fundamental differences in the character of the pneumonic lesions produced by intrabronchial insufflation of different microorganisms. The bacteria thus far used may be divided into two groups. The lesion produced by one group resembled that of lobar pneumonia, while the lesion produced by the other group resembled that of lobular pneumonia. We shall speak only of one organism, the main representative, of each group: thus the pneumococcus produced lobar pneumonia and the streptococcus lobular pneumonia. Besides the known differences in their gross appearance, the two kinds of lesions were found to differ in two important points: (1) the exudate of experimental lobar pneumonia contained a great deal of fibrin, while that of lobular pneumonia had comparatively little; (2) in lobular pneumonia the leucocytic infiltration invaded the framework of the lungs (the walls of the alveoli and the interstitial septa), while in lobar pneumonia the framework remained free from infiltration. In a further study of the subject it was found that the insufflation of non-virulent pneumococci gave rise to a pulmonary lesion which, in gross appearance, resembled lobar pneumonia. Microscopic examination showed a further resemblance to lobar pneumonia by the absence of leucocytic infiltration of the framework. Fibrin, however, was very scanty in the exudate of the lesions caused by a non-virulent pneumococcus. It differed further from the pneumonia produced by a virulent pneumococcus in that living bacteria were absent from

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<sup>1</sup> Wollstein, M., and Meltzer, S. J., *Jour. Exper. Med.*, 1912, xvi, 126; 1913, xvii, 353, 424.

the blood of the animals. Finally the pneumonic lesion produced by the avirulent pneumococcus generally progressed more slowly and its resolution began earlier than was the case with the lesions produced by the virulent pneumococcus.

The intrabronchial insufflation of a culture of virulent pneumococcus killed by heat produced a mild, patchy, superficial inflammation of the lung having no similarity to the lesions produced by the living pneumococcus, virulent or non-virulent.

The experiments have thus shown that while the character of the exudate varied materially with the virulence of the pneumococcus, the avirulent organism caused a lesion which has the gross appearance of a lobar pneumonia. However, an avirulent pneumococcus is still a pathogenic organism, and the question presented itself: Could unmistakable saprophytic organisms cause a pneumonic lesion, and what would be the nature of that lesion? This was the problem. We tried to solve it by introducing *Bacillus megatherium* into the lungs of dogs by the method of intrabronchial insufflation previously described. Ten experiments were made, the results of which are the subject of the present brief communication.

#### EXPERIMENTAL PART.

*Bacillus megatherium* is a Gram-positive, spore-bearing, motile bacillus which ferments glucose, lactose, saccharose, mannite, and maltose, without forming gas. We found that when injected intravenously into rabbits and intraperitoneally into guinea pigs and rabbits even large doses (one cubic centimeter of broth cultures twenty-four hours old) caused no discomfort to the animal. Guinea pigs killed twenty-four hours after an intraperitoneal inoculation of a whole agar slant one day old showed a very small amount (less than 0.2 of a cubic centimeter) of turbid peritoneal exudate. In smears made from this fluid there were many polymorphonuclear leucocytes but no bacilli. Fluid removed from the animal's abdomen within half an hour after the injection showed many bacilli and few leucocytes. Two and three hours after the inoculation there were more leucocytes and some phagocytosis. Cultures from the earlier specimens grew profusely but from the fluid obtained after twenty-four hours the growth was sparse.

Subcutaneous injections of large doses did not cause abscess formation. After twenty-four hours there was congestion and edema at the site of inoculation. In smears some polymorphonuclear leucocytes and many bacilli were seen, the cultures growing well.

The bacillus has been found in the intestinal tract of infants,<sup>2</sup> having been taken with food, and causing no ill effects. The only attempt to make *Bacillus megatherium* pathogenic for animals has been made by Vincent,<sup>3</sup> who inserted collodion sacs containing cultures of the bacillus into the abdominal cavity of guinea pigs, and he states that after the fourth passage it had become pathogenic for these animals.

The broth cultures of *Bacillus megatherium* which were introduced into the lungs of the dogs were twenty-four hours old and practically free from spores. Doses of fifteen to twenty-five cubic centimeters were given. None of the animals died, nor did they seem to be ill. Four dogs were killed in twenty-four hours after inoculation, two after forty-eight hours, two after three days, one after four days, and one after five days.

Within twenty-four hours after inoculation the lungs presented a lesion which was always limited to one lobe; in two cases it was the right posterior, and in the other two the left posterior. The greater part of this lobe was dark red, heavy, firm, but not swollen. There was no exudate on its pleural surface. On section blood-stained fluid exuded and the cut surface was found to be red, evenly consolidated, and very moist.

Microscopically the lesion was one of intense leucocytic exudation. Polymorphonuclear leucocytes, many with fragmenting nuclei, filled the alveoli and the small bronchi, whose walls, however, remained free from infiltration. The blood vessels were distended with blood cells, both in the alveolar walls and in the interlobular septa. At the periphery of the lesion some alveoli contained serum only. No fibrin was seen. The connective tissue framework was not infiltrated.

No bacilli were found free in smears made from the solid lung, nor was there any evidence of phagocytosis. In cultures no growth

<sup>2</sup> Wollstein, M., *Am. Jour. Dis. Child.*, 1912, iv, 279.

<sup>3</sup> Vincent, H., *Ann. de l'Inst. Pasteur*, 1898, xii, 785.

was obtained from the heart's blood in any case of the entire series, nor from the lungs in nine of the ten cases. In the tenth case two colonies of *Bacillus megatherium* developed from the consolidated left posterior lobe of an animal killed twenty-four hours after inoculation of a dose of fifteen cubic centimeters. The pneumonia in this series of experiments was strictly a local lesion. The animals had shown scarcely any rise of temperature; only in two cases did the rise reach 1° C.

Two days after insufflation of fifteen to twenty-five cubic centimeters of a broth culture of *Bacillus megatherium* the pulmonary lesion was no more extensive or intense than it had been in twenty-four hours. In the case of the smaller dose (fifteen cubic centimeters) resolution had already begun.

On the third day resolution had progressed so far that only small solid areas remained, and on the fourth day there was congestion but no consolidation.

#### DISCUSSION AND SUMMARY.

The essential points of our results are as follows: The saprophytic *Bacillus megatherium* produced a definite pulmonary lesion which in gross appearance resembled the lesion of lobar pneumonia. The lesion was one of intense leucocytic exudation which, as in some other cases of experimental lobar pneumonia, did not invade the framework of the lung. But the exudate contained no fibrin. There were practically no bacilli, either in the heart's blood or in the lung. The growth of two colonies from one of the cases hardly changes the rule. The lesion did not progress after twenty-four hours; nor did it show a definite increase in extent or intensity with the increase in quantity of the injected cultures. The resolution of the exudate began practically at the end of twenty-four hours and was far advanced on the third day. Although there was considerable leucocytic infiltration there was no phagocytosis apparent twenty-four hours after inoculation.

Taking all the facts into consideration one gains the impression that the lesion produced by the saprophytic *Bacillus megatherium* differs only quantitatively from that produced by an avirulent pneumococ-

cus. The fact stands out prominently that a saprophytic bacterium is capable of producing a pneumonic lesion similar in gross appearance to that of mild lobar pneumonia. It is not improbable that other saprophytes may be capable of producing pneumonic lesions which, in specific instances, may resemble lobular pneumonia.