

[reprinted from THE MEDICAL NEWS, April 29, 1899.]

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BACILLUS ICTEROIDES AND BACILLUS CHOLERÆ  
SUIS.—A PRELIMINARY NOTE.

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JUL 20 1910

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IN the course of a comparative study of bacillus  $x$  (Sternberg) and bacillus icteroides (Sanarelli) which has engaged our attention as opportunity would permit during the past eighteen months, we have had occasion to observe the effect produced by the intravenous injection in dogs of other micro-organisms, such as the bacillus coli communis and the bacillus cholerae suis. Without entering into details in this preliminary note we may state that the same clinical symptoms, *vis.*, vomiting, increased action of the bowels, and profound prostration, which are produced in dogs by the intravenous injection of *B. icteroides*, are also brought about by a like inoculation of the hog-cholera bacillus. When death occurs, the stomach contains a considerable quantity of fluid blood and extensive hemorrhagic lesions are present in the small intestine. We have not found fatty degeneration of the liver, since our dogs, few in number, injected with the hog-cholera bacillus, have died too early for this change to occur. We have also failed to discover any fatty degeneration in the liver of dogs that have died within a few days after the intravenous injection of *B. icteroides*. This change has only been met with in two instances, when the animals had survived until the ninth day after inoculation with *B. icteroides*. In neither of these cases, however, was the degree of fatty degeneration at all comparable with that present in the human liver in yellow fever.

In addition to the experiments upon dogs, we have compared the course of the infection and the lesions produced in guinea-pigs and rabbits inoculated with small quantities of *B. icteroides* and *B. cholerae suis*, and have been much im-

pressed with the similarity of the results obtained. The same cyclical course of the infection described by Sanarelli for guinea-pigs inoculated with *B. icteroides* is seen in these animals when injected with like quantities of *B. cholerae suis*. The greater susceptibility and shorter course of the infection in rabbits applies equally to both micro-organisms. Theobald Smith has called attention to the extreme susceptibility of these animals to inoculation with minute quantities of the hog-cholera bacillus.<sup>1</sup> We have succeeded in killing rabbits with  $\frac{1}{1000000}$  c.c. *B. icteroides* injected subcutaneously. The lesions produced in rabbits and guinea-pigs inoculated with *B. icteroides* and the hog-cholera bacillus are practically the same, the most constant change consisting of multiple necroses in the liver. Sanarelli does not appear to have made any mention of this most striking lesion. We have found these punctate necroses of the liver especially prominent in guinea-pigs that have survived the inoculation more than five days.

Observations have shown that pigeons are not very susceptible to inoculation with the hog-cholera bacillus. We have also found these birds to be tolerably resistant to infection with *B. icteroides*. A fatal result has been produced by injecting 3 c.c. of a bouillon-culture into the breast muscle. Hemorrhage, swelling and extensive necrosis of the muscle are present, under these circumstances, as has been described by Welch and Clement, for the hog-cholera bacillus.<sup>2</sup>

We desire also to record in this preliminary note that bacillus *icteroides*, when fed to young hogs, produces an acute infection which may be followed by a fatal result, and that the chief lesion is confined to the large intestine. This lesion consists of an inflammation of the mucous membrane accompanied by fibrinous exudate, together with numerous small and large superficial ulcerations affecting the colon and cecum. These ulcerated areas are covered by an abun-

<sup>1</sup> Bulletin No. 6, U. S. Department of Agriculture, 1894.

<sup>2</sup> "Hog Cholera and Swine Plague," Welch and Clement, 1894.

dant, thick, bile-stained exudate. The "cork-lining" appearance mentioned by Smith would apply to the description of the intestinal mucosa. A portion of the viscera of a young hog that had been fed with 25 c.c. of a 24-hour bouillon-culture of Sanarelli's bacillus and which had died on the sixth day of the disease was fed to a second animal. The latter after exhibiting symptoms of sickness, such as fever, shiverings and loss of appetite, for a few days appeared to have fully recovered from the inoculation. It was killed on the 18th day. At autopsy numerous ulcers in various stages of cicatrization were found in the large intestine.

As regards the morphologic and biologic character of *B. icteroides* and *B. cholerae suis* we have been unable to observe differences other than may be met with in varieties of the same species. Both are small, quite active, motile, non-liquefying bacilli whose slow rate of growth is the same in bouillon and in gelatin; likewise on agar, potato, and in litmus milk the growth presents the same appearances. Milk is not coagulated by either of these bacilli.

The action of *B. icteroides* and *B. cholerae suis* upon the three sugars has been the same in our hands. Both ferment glucose. If the bouillon is free from muscle glucose no fermentation takes place in lactose or saccharose bouillon. Exceptionally we have recorded a very slight fermentation of saccharose with both organisms. Both of these bacilli, when cultivated in Dunham's solution, give a faint indol reaction.

We desire further to record the marked agglutinative reaction exhibited toward the hog-cholera bacillus by the serum of an animal immunized with *B. icteroides*. As long ago as May, 1898, we had observed that the blood-serum of a dog which was being immunized with *B. icteroides* would in dilutions of 1 to 5,000 promptly arrest motility and agglutinate the hog-cholera bacillus. After testing various dilutions of this serum from 1 to 100 to 1 to 5,000 we could observe no difference in its agglutinative reaction

upon *B. icteroides* and *B. cholerae suis*. We have recently obtained, through the kindness of Surgeon-General Sternberg, a specimen of icteroides serum, which, in dilutions of 1 to 120,000, promptly arrests the motility and agglutinates bacillus icteroides. In the same dilution this serum immediately arrests the motility of the hog-cholera bacillus, but does not bring about agglutination of the bacilli until at the end of about three hours. In a dilution of 1 to 30,000 agglutination commences within ten minutes and is complete at the end of one hour. The groups of bacilli are smaller than occurs with *B. icteroides*.

In rejecting *B. icteroides* as the specific cause of yellow fever Novy emphasizes the extreme resistance of this bacillus to low temperatures.<sup>1</sup> We have found Sanarelli's bacillus to preserve its vitality and virulency after twenty days' continuous freezing at 10° C. (14° F.). That the hog-cholera bacillus is also quite resistant to low temperatures has been proven by the observations of Smith, and by the fact of its survival, notwithstanding the extreme severity of winter in our Northwestern States.

Putting together, therefore, the remarkable cultural resemblances of these two bacilli, and the similarity of their pathogenic action as shown in guinea-pigs, rabbits, pigeons, dogs and hogs, we venture to express the opinion that the bacillus icteroides (Sanarelli) is a variety of the hog-cholera bacillus, and that it should be considered only as a secondary invader in yellow fever. We find that the bacillus  $\alpha$  (Sternberg) presents marked differences from the foregoing micro-organisms, both as regards its biologic character as well as its pathogenic action toward animals. Reserving for future publication a more detailed description of our observations, it will suffice to here state our opinion that bacillus  $\alpha$  should be placed with the colon group.

<sup>1</sup> "The Etiology of Yellow Fever," MEDICAL NEWS, p. 368, September 17, 1898.