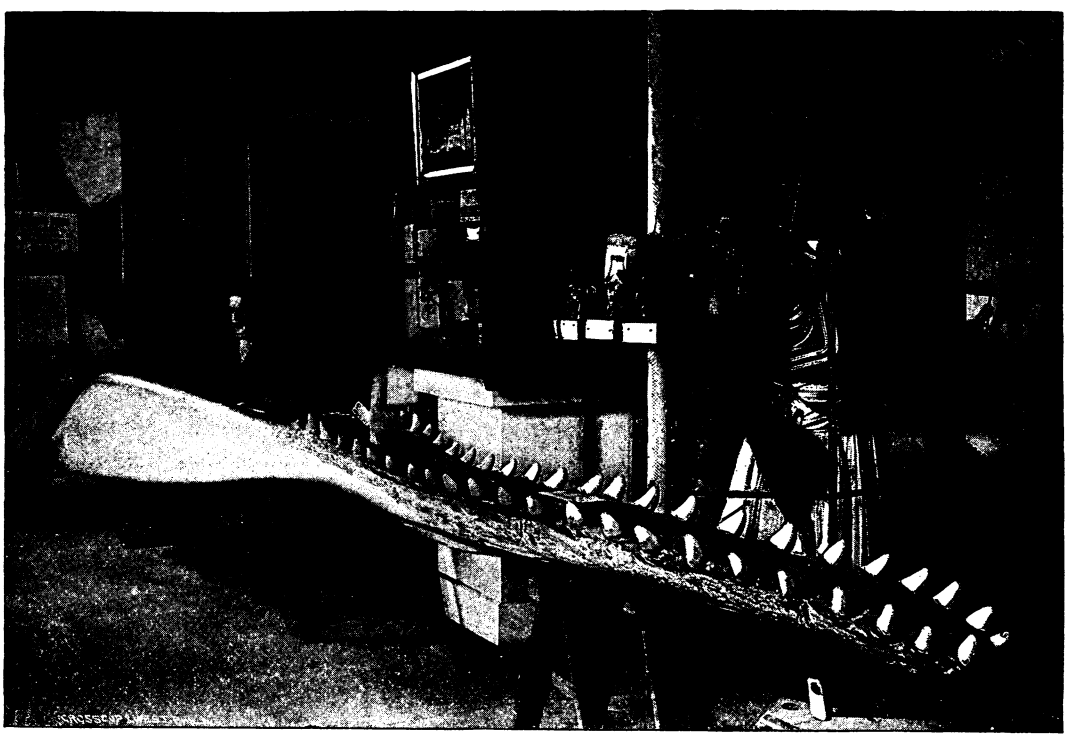
floor, are savage implements and curiosities, which cannot fail to interest the visitor, especially as they are all explained by the curator, Mr. Murphy, who has thrilling tales to tell of each separate piece; nor is the curiosity-hunter the only person who is likely to be interested in this museum. In its collection of tropical shells, there are many which cannot be numbered among the commonest; but, for the naturalist, the one thing which possesses an all-absorbing interest is the sperm-whale's jaw, which extends nearly across the exhibition-room. The curator, who considers this his special pet, is full of enthusiasm for it, and claims that it is the only full-grown jaw of a sperm-whale in America. It was taken in 1865 by a Nantucket whaler in the Pacific Ocean, from a sperm-whale which measured eighty-seven feet in length and thirty-six feet in circumference, and had the enormous weight of two hundred tons. The whale gave forty-five hundred gallons of oil. The jaw itself weighs eight hundred pounds, measures seventeen feet in length, and has forty-six huge teeth. These are badly worn, and prove that the animal must have been very old. In connection with the jaw, Mr. Murphy describes the animal, tells about its enemy the whale-killer, its parasites and other pests, explains the process of killing the whale and cutting up and trying out the blubber, illustrating his talk either with the apparatus itself or with ingeniously made models. On the other side of the room is a small jaw twisted in a spiral direction, and bearing plain evidences of having been injured at an earlier stage. The teeth are long and somewhat slender, partly from the youth of the animal, partly from disuse. When taken, the whale was alive; but the lower jaw was badly aborted, and the animal was in a poor state. It must have been in this condition for years, and have lived upon what chanced to come in its way. It is to be hoped that the collection may always be well cared for, and may become more than now the nucleus of a good collection of the natural objects of Nantucket itself.



THE 'COMMA BACILLUS' OF KOCH.

DR. KOCH has himself stated in precise terms the nature of the proof required in order to es-

tablish in a definite manner the specific pathogenic power of a micro-organism, which, by its presence in the blood, tissues, or alimentary canal, may be supposed, *a priori*, to bear a causal relation to the disease with which it is associated.

This proof depends upon the production of characteristic morbid phenomena by inoculating susceptible animals with 'pure cultures' of the parasitic micro-organism previously found under circumstances to justify the supposition that it bears an etiological relation to the disease under investigation. This final proof Koch has attempted to obtain with reference to the so-called 'comma bacillus,' which, according to his observations, is constantly associated with epidemic cholera, and, after numerous failures, claims finally to have succeeded. In a late number of the *Deutsche medicinische wochenschrift*, he says, —

"The experiments of Rietsch and Nicati have been lately repeated at the Imperial board of health; a pure cultivation being so far diluted, that the amount injected contained scarcely a hundredth part of a drop of the cultivation liquid. The liquid was injected into the duodenum without previously binding the ductus choledochus. With few exceptions, the animals so treated died within a space of time extending from a day and a half to three days. The mucous membrane of the small intestine was reddened: its contents were watery, colorless, or slightly reddish tinged, and at the same time flaky. Comma bacilli were found in the contents of the intestine in a pure cultivation and in extraordinary numbers, so that the same phenomena were visible here as are seen in the cholera intestine in its fresh state. Owing to the small quantity of infectious matter used for injection, the idea of a simultaneous intoxication from poisonous matters contained in the cultivation liquid used for injection is excluded."[1]

In face of the previously reported failures to produce cholera in the lower animals, we are disposed to receive the proof now offered with some reserve, inasmuch as the injections seem to have been made through the walls of the abdomen directly into the intestine. This method has, no doubt, been adopted upon the supposition that previous failures were due to destruction of the bacilli by the acid juices of the stomach when they have been introduced by the mouth. There is nothing improbable in this supposition; but, on the other hand, the possibility that when the material is injected directly into the intestine the puncture made may have been a serious complication and source of error, at once suggests itself.

That micro-organisms closely resembling the 'comma bacillus' are to be found in the healthy human mouth, and in the discharges of patients with other forms of intestinal flux, cannot be doubted; but that these are identical with the 'comma bacillus' cannot be established upon morphological grounds alone. If one 'comma bacillus' in pure cultures produces cholera, and another having identical morphological characters does not, we must admit an essential difference — physiological — which, if constant, must be considered a specific character, equal in value to a constant difference in form or in color. If such difference is not constant, it will at least establish a pathogenic variety of the ordinarily harmless organism. But this is not the state of the question as regards Koch's 'comma bacillus:' for in his answer to Prof. T. R. Lewis of the English army medical school, who asserts that a curved bacillus, identical with the 'comma bacillus,' is found in normal human saliva; and to Professors Finkler and Prior, who claim to find similar organisms in the discharges of patients with cholera nostras (sporadic cholera), — Dr. Koch shows very conclusively that the organisms referred to are not identical with the 'comma bacillus,' although bearing some resemblance to it. This conclusion is based both upon appreciable morphological differences, and upon the different behavior of the organisms when cultivated upon gelatine.

Through the courtesy of Dr. Billings of the army, I have recently had an opportunity to study the morphology of the 'comma bacillus,' having had in my possession for several days a slide sent by Koch himself to the Army medical museum. My laboratory assistant, Dr. A. C. Abbott, has made for me a camera lucida drawing, which, I think, fairly represents the organism as seen in this slide, and which is reproduced in fig. 1. Each separate cell was drawn under the camera lucida; but the field as a whole is an ideal one, as I desired to show in a single figure all of the forms found in the slide. As a matter of fact, the 'commas' as seen at *a* are by far the most numerous, and are found clustered in groups and masses; while the characteristic spirilla, such as may be seen at the centre of the field at *i*, are comparatively scarce. Still, in view of the intermediate forms, as seen at *c*, I cannot doubt that we have here a pure culture of a single organism, and that this organism is in truth a spirillum, and not a bacillus. If one saw only such forms as we have delineated at *e*, there would be no hesitation in pronouncing them bacilli; and the name 'comma bacillus,' from a morphological stand-point, applies very well to the prevailing form, as seen at *a*. It is not sur-

[1] Quoted from the *British medical journal* of Nov. 22, 1884, p. 1036.

prising that at the outset Koch spoke of the swarms of rods, straight or slightly curved, which he found in the intestines of cholera patients as bacilli; and, indeed, the fact that these rods were capable of developing into spiral filaments could only be determined by protracted observations and by making pure cultures. It seems to me that some of Koch's critics, and especially Ray Lankester (see his paper in *Nature*, Dec. 25, 1884), are making altogether too much of this very pardonable mistake, which has no special bearing upon the real question at issue, and cannot weaken our confidence in the candor and scientific accuracy of a man to whom we are so deeply indebted, and whose scientific reputation is established upon a firm foundation.

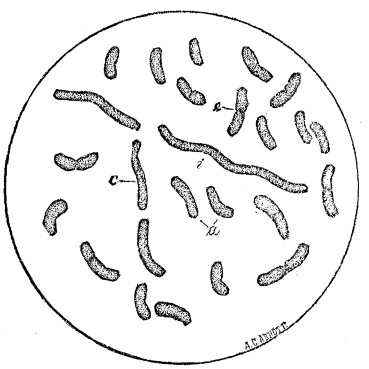


FIG. 1.—COMMA BACILLUS (Koch) × 2,500 diameters.

Ray Lankester is unquestionably right when he says that our knowledge of the bacteria is still in its infancy; but, so far as this knowledge goes, it is doubtful whether any man living can speak with more authority than can the discoverer of the tubercle bacillus.

The amplification in the figures illustrating this paper is exactly twenty-five hundred diameters, and was obtained with admirable definition by the use of Zeiss's one-eighteenth inch homogeneous immersion objective upon a Powell and Lealand's large stand, with a high eye-piece, and the draw-tube extended one inch. The measurement was made by projecting the lines from a standard stage-micrometer, ruled by Professor Rogers of Cambridge, Mass., upon a sheet of paper in the exact position in which the drawing was made, by means of the same objective, eye-piece, and camera lucida. Fig. 2 was made in the same way, and represents curved bacilli, which resemble the 'comma bacillus,' and which are, perhaps, identical with those described by Prof. T. R. Lewis as found in the healthy human mouth. The specimen from which the drawing was made was one of sputum from a patient with pneumonia. I think it hardly necessary to insist that the bacilli in fig. 2 are not morphologically identical with the 'comma bacillus' of Koch as shown in fig. 1; and I may say here, that, during my somewhat extended bacteriological studies, I have never encountered an organism which seems to me to be identical with that seen in the slide above referred to. Should such an organism be found, it would not in the least weaken the experimental evidence relating to the specific pathogenic power claimed for this spirillum. But we must insist, in any case, that this experimental evidence shall meet the most rigid exactions of science. Certainly, Koch fully appreciates this, and is doing his utmost to comply with the conditions which he has imposed upon himself. We are therefore not able to sympathize with the captious spirit of some of his critics. Nor, in the absence of a detailed report, are we prepared to admit that the English cholera commission has definitely settled the question as to the etiological *rôle* of the 'comma bacillus' during the comparatively brief time which has been devoted to the investigation; and, in view of the contradictory testimony now before us, we cannot do otherwise than consider the question still *sub judice*, and wait patiently for detailed reports and additional experimental evidence.

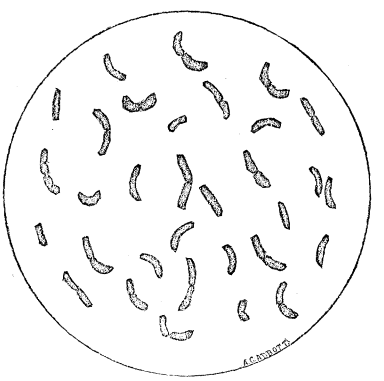


FIG. 2.—BACILLI FOUND IN PNEUMONIC SPUTUM × 2,500 diameters.

GEORGE M. STERNBERG,
Surgeon U. S. army.

LIGHTHOUSE ILLUMINANTS.

A PARLIAMENTARY document is not the place where one would naturally look for facts of scientific value: but, in a return published by the English house of commons on the 11th of December last, there is