

THE EARLY STUDY OF BACTERIA.

Ever since Athanasius Kircher, mistaking blood and pus corpuscles for small worms, built up a new theory of disease and putrefaction, and since Lange, Professor of Pathological Anatomy in Leipzig, in the preface to Kircher's book (1671), gave it as his opinion that the purpura of measles and other fevers were the result of putrefaction caused by worms or animalculæ, a "*Pathologia Animata*" has from time to time been put forward to explain the cause of disease. The observations of these men, made as they were by means of simple lenses magnifying only one thousand times, were indeed wonderful, but more marvellous still were those of Anthony van Leeuwenhoek, a native of Delft, in Holland, who not only made the first really good microscope, but used it so well that he was able to place before the Royal Society of London a series of most valuable letters, giving the result of his study of living protoplasm. In water, in the intestinal canals of horses, flies, frogs and fowls, he discovered minute moving and living forms, while in 1683 he actually described minute organisms in material taken from the teeth that can now be recognized from his drawings as bacteria. His description of them is worth noting. "I saw," he says, "with very great astonishment, that there were many extremely small animals which moved about in a most amusing fashion; the largest of these showed the liveliest and most active motion, moving through rain-water or saliva like a fish of prey darts through the water; this form, though few in actual numbers, was met with everywhere. A second form moved round, often in a circle, or in a kind of curve. The form of a third kind I could not distinguish clearly; sometimes it appeared oblong, sometimes quite round. They were very tiny, in addition to which they moved forward so rapidly that they tore through one another. They presented an appearance like a swarm of midges and flies buzzing in and out between one another. Further examination of the material showed that, out of a large number which were of different lengths, all were of the same thickness. Some were curved, some straight, lying irregularly and interlaced. Here we have the first accurate account of rod-shaped bacteria or bacilli, of spiral-shaped or spirilla, and of the round-shaped or micrococci.

He afterwards considerably improved his descriptions, and, though not attempting to theorize as to the meaning of the presence of these organisms in the mouth, after finding them in the water of an aquarium he concluded that the organisms seen on the teeth were introduced into the mouth through the medium of the drinking-water that had been stood in barrels, and that in the teeth they found a nidus in which they might multiply. Thus was a new world opened up, which was rapidly entered upon by other observers. At last had been discovered the fountain of disease. The results of further study were received with much satire, and as Læffler points out, these "inconceivable" worms became the legitimate butts for the shafts of ridicule, and the germ theory of disease was completely discredited. Linnaeus, however, held to the theory that there might be small living beings, as yet insufficiently separated and examined, in which might lie not only the actual contagium of certain eruptive diseases, and of acute fevers, but also the exciting causes of both fermentation and putrefaction. The importance of these observations were fully recognized by Plenciz, a Viennese doctor, as explaining the causation of contagious diseases, and also of putrefaction. He it was who insisted upon the specific character of the infective agent in every case of disease; each disease had its own specific seed or germ, and the seed of one disease could never give rise to a different one. He explained the incubation stage of a febrile disease as dependent on the growth of a germ within the body previous to its presence being made manifest, and corroborated Linnæus' observations in regard to putrefaction.

Otto Müller, of Copenhagen, was the first to reduce to something like order the chaos of these observations. Although without fully recognizing the importance of his discovery, he also described in certain organisms little shining points, arranged in series at regular intervals, since known to be spores. Many advances were made as regards the morphology of these organisms after Müller's work was done, but the question as to whence these minute forms came still remained unanswered. For over a century scientists wrestled over the problem as to whether these forms were the result of spontaneous generation or were the progeny of pre-existing forms. Some held that they were the