

## REPRINTED ARTICLES

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### X SPEDALSKHEDENS ARSAGER<sup>1</sup> (CAUSES OF LEPROSY)

BY G. ARMAUER HANSEN

Nodules were examined in large numbers immediately after extirpation with scissors washed clean in alcohol. When there was superficial ulceration of the nodules with incrustation, there was always found a mass of bacteria in and under the crusts; therefore I have constantly chosen nodules with the cuticle entire. The microscopic preparations were made partly by picking up the fluid oozing out of the cut surface upon squeezing, partly by incision and scraping of the base of the node.

Depending on the age of the nodule, there are obtained preparations in which there are found, besides blood, either only round cells, fragments of capillary vessels, and small bundles of connective tissue, or also larger cells and large and small brown elements. If the preparations are examined without any admixture, there can be detected here and there rod-shaped bodies either at rest or in slightly oscillating movement. When the cells are preserved entire, their number is small. If now a drop of water is added to the preparation, the rods move more quickly, and little by little more and more rods appear; the older the nodule is, the more numerous the rods become.

The cells, but not the brown elements, swell considerably in water, and if one examines them with strong lenses. . . . one detects in many cells, besides granules, also rod-shaped bodies which do not take part in the dancing movements of the granules, but swing more slowly from one side to the other; the rods are partly found together in bundles, crossing one another at very sharp angles. If now the cover glass is moved, whereby many of the swollen cells are burst, the number of the rods in the preparation becomes extremely large, and they move very briskly. The size differs greatly, varying from 0.006 to 0.015 mm.

It goes without saying that I have carefully examined the distilled water which I added to the preparations. Even if perhaps one or a few

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<sup>1</sup> From the *Norsk Magazin for Laegevidenskaben* 4 (1874) 76-79. Translated at the National Institutes of Health, Bethesda, Maryland, by Mr. Pierre Pallamary, for Dr. George L. Fite. This material was not in the form of a separate article, we are informed, but was a part of Hansen's annual report for 1873, thus establishing that year as the time he made the observations recorded.—EDITOR.

bacteria were present in the water and escaped my attention, the water in any case could not have brought in the mass of rods which were found in the preparations.

As regards the movement of the rods, I must admit that I am unable to diagnose its nature. Whether I have these rods or undoubted bacteria before me, I find in an adequately thin menstruum all possible transitions from a lively swinging and dancing movement, which looks like a molecular movement, to a slow, twining-like movement. If, on the other hand, an albuminous liquid or glycerin is added, all the movements become slower or stop completely; but they can be aroused again by addition of water.

If a piece of fresh nodule is teased in a drop of 1 per cent osmic acid, or if the nodule is preserved in osmic acid and examined the next day or on the second day (later the preparations become less clear because of the strong staining), the rods lying within the cells, which are colored more intensely by the osmic acid than the remaining content of the cells, are detected with far greater ease than in fresh preparations. In some cells there are found bundles of rods, while some cells are only slightly speckled with them. If brown elements are found in the preparation, they become dark-brown to black. If one knocks slightly on the cover glass, the cells go to pieces. There then appear in the preparation a quantity of rods which dance around in the liquid as lively as in the fresh preparation, and this makes the movement in the latter very suspicious-looking.

That rod-shaped bodies exist in the leprotic nodes, and that the majority of them are, in any case, without the cells, must be regarded as beyond doubt after what was said above; but whether these rods are bacteria and the large brown elements perhaps cells which include zoogloeic masses, is another thing. If the sketches that I have drawn (*Nord. Med. Arkiv*) of these brown elements, which occur constantly in leprosy and which are reproduced in "Leprous Diseases of the Eye" by O. B. Bull and G. A. Hansen, Christiania, 1873, are compared with Klebs's pictures of zoogloeic masses in the first part of *Zeitschrift für experimentelle Pathologie und Pharmakologie* (Beitrage zur Kenntniss des Micrococcus), the resemblance is striking.\*

I then tried to get something decisive with cultures made of nodules in the same manner as those of the blood preparations, but as yet I have only had the same uncertain results as before. It happens comparatively less frequently that the culture fails, but it is also more difficult when making preparations from extirpated nodules to exclude the possibility of contamination. For example, I cannot be sure whether or not, on preparations

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\* I must not fail to remark here that I also had the occasion to demonstrate to Dr. Carter from Bombay some of the things described here. Dr. Carter knew well the brown elements from the leprosy in India, but he had never seen such splendid specimens as those which I was able to show him. Thereby my assumption was corroborated that these brown elements are a property of leprosy, even though I dare not regard them as signs of specificity of the disease, anyway not yet.

which lie in a humid room and are examined every day, *Penicillium* will grow along the edge of the cover glass. I have had many preparations in which this has been the case, but in which nothing grew under the cover glass. In the nodule preparations, as in the blood preparations, I found that a dried margin of the preparation along the edge of the cover glass is the best means of protection against penetration of *Penicillium* in any case, and the preparations can keep for 14 days so well that no person will have any doubt that he has a completely fresh preparation before him if he sees it for the first time on the 14th day. In the nodule preparations there appear now chains of monads and zoogloic clumps as in the blood preparations; they grow to a certain point and then remain unchanged.

I once had occasion to obtain preparations in the following manner: A patient had a strong eruption; his nodules became large and semi-fluctuating; upon perforation there flowed out, either spontaneously or through pressure, a pus-like drop which, however, proved to contain fragments of capillary vessels and connective tissue. Such a drop could be picked up on the cover glass like a drop of blood. In these preparations, also, zoogloic clumps appeared, as usually, in the middle of the preparations, not at the edge.

Finally, I must remark that the rods in the fresh preparations, or at least a large part of them, as well as the brown elements, are not attacked by potash-lye, and that they are stained by osmic acid with the same intensity as bacteria and zoogloea.

Since the results of the examinations are still uncertain and I intend to continue the research, I did not want at this time to mention in reports the details of my records. Many things are still lacking for the direct demonstration of specificity for leprosy, but I also thought I should give in this report an account of my examinations, which I had intended to do.

*Comment.*—About the movements of objects observed in wet preparations, Hansen mentioned at one point, rather dubiously, "molecular movement;" and later he pointed out that the fact that the same movement could be seen in preparations of osmic-fixed material as in fresh preparations made the movement "very suspicious-looking." There is no suggestion that he regarded the rods as actually motile. They were observed in both the fresh, unstained condition, and colored by osmic acid; there is of course no mention of staining in the sense that the term is now used.

As for the "brown bodies" mentioned repeatedly, they were an inheritance from his father-in-law, Danielssen. In the atlas that accompanied the treatise of Danielssen and Boeck, published in 1847, there are in Plate XXIV three drawings showing what Danielssen at that time spoke of as "cellules," but also called brown bodies; undoubtedly globi.—G. L. FITE.