A NOTE ON THE SPIROCHAETE PRESENT IN ULCERATIVE
GRANULOMA OF THE PUDENDA OF AUSTRALIAN
NATIVES.

By W. CECIL BOSANQUET, M.A., M.D., F.R.C.P.

(*From Prof. E. A. Minchin's Laboratory of Protozoology, Lister
Institute of Preventive Medicine.*)

(Five Text-figures.)

EARLY in January of the present year Professor Minchin kindly gave me for examination a portion of tissue and a mounted section taken from a case of the above disease and sent him by Dr J. Burton Cleland, then of Perth, W. Australia. The tissue was already embedded in paraffin, and both it and the section were stained by Levaditi's method and showed the presence of numerous spirochaetes.

These organisms were situated deeply in the tissue, 3 or 4 mm. from the surface, in the fibrous layer forming the base of the ulcer, and were most numerous in the immediate neighbourhood of the blood-vessels of this part. A few were visible within the vessels themselves. The longest forms seen measured on an average 12μ in length: they were so slender that their breadth was rather a matter of guess-work, but it may perhaps be put at $\frac{1}{2}\mu$ (Fig. 1). Shorter forms were common, ranging down to 3 or 4μ in length: these or some of them may have been due to division of longer forms in cutting sections of the tissue. There were a few individual organisms which were somewhat thicker than the average ($?\frac{1}{2}\mu$).

The spirochaetes were in some instances homogeneous throughout in appearance, but a considerable number presented at certain points in their length definite granules staining more deeply than the rest of the protoplasm (Fig. 2). In some cases these granules were distinctly greater in diameter than the rest of the organism. Terminal granules

of this latter kind were not uncommon: a few spirochaetes were seen possessing two well-marked granules near to one end (Fig. 3). In some specimens the whole protoplasm was granular throughout, so that the organism resembled a string of beads closely threaded: these were presumably degenerative forms. A few instances of abnormal forms were also seen—*e.g.*, a thick specimen with a well-marked loop or vacuole near to one extremity; a second in which a large terminal granule present was transparent and unstained, giving somewhat the appearance of a loop; and a few individuals coiled up into rings (Fig. 4). I found one or two instances of what appeared to be forked forms, suggesting longitudinal division, and Cleland also saw a few of these; but I do not feel at all certain that these specimens were really bifid, as it is difficult to eliminate possibilities of mere apposition of organisms when dealing with creatures of such tenuity.

The curls or waves in the spirochaetes were quite irregular, unlike the symmetrical curls of *Treponema pallidum*. Some organisms lay almost in straight lines: others were twisted on themselves, and others again were merely sinuous (Fig. 1). On the whole they resembled very closely the figures given by Castellani of his *Spirochaeta pertenuis* of yaws, though the illustrations of this parasite given by Levaditi and Nattan-Larrier make it closely resemble *T. pallidum*. In a piece of yaws-granuloma very kindly sent me by Dr Castellani, I was unsuccessful in finding the parasites by the silver-method, as I had hoped to do for the sake of comparison. The spirochaetes in the present case of ulcerative granuloma did not resemble, except in slenderness, the illustrations given by MacLennan of this organism: possibly those from which his figures are taken were derived from the surface of the ulcers and may have assumed a more curved appearance, when thus lying free, than they present when compressed into the interstices of the tissues. No illustrations are given by Wise who first discovered spirochaetes in this disease. He originally found them in smears from the diseased tissues—some of them taken from the deeper parts. He does not, however, speak of having stained the organisms in sections of the tissue.

So far as I am aware, Cleland is the first to supply this proof of the connexion of spirochaetes with the malady.

In the specimens which I examined, the spirochaetes were accompanied by large numbers of bacterial forms. These were found wherever the spirochaetes lay, and were absent where the latter were absent. The bacteria were very irregular in shape and size, ranging from granules about $\frac{1}{2}$ — 1μ in diameter and slender rods (2 or 3μ by $\frac{1}{2}\mu$) to large rod-shaped organisms, often pretty sharply curved, some 6μ in length and about 1μ in thickness (Fig. 5). The question of the relationship of the bacteria to the spirochaetes is of importance in connexion with that of the aetiology of the disease. Both organisms lay deeply in the tissues and were present in large numbers. The bacteria did not resemble, so far as I could judge, any of the known agents of infective disease: at the same time it seems unlikely that mere saprophytes could establish themselves in such numbers at a point so far from the surface. Hence there is a probability that either the spirochaetes or the bacteria are the causal agents of the ulceration. If this be so, the coexistence of the two forms might be explained either as an example of symbiosis or on the ground that they represent different stages in the development of the same organism. On the latter hypothesis transitional stages might be seen either in the small slender bacterial forms, corresponding as they do with the spirochaetes in thickness and possibly representing the results of transverse division, or in the spherical granules which resemble bacterial spores and may be the granules seen at the extremities and occasionally in the substance of the spirochaetes.

In this connexion it is interesting to recall that in Vincent's angina fusiform bacilli and spirochaetes invariably coexist, and that Ruth Tunnicliffe believed that the latter developed in cultures of the former; that rod-like bodies were found along with spirochaetes on the surfaces of ulcerated cancers by Hoffmann and by Loewenthal; that bacteria and spirochaetes were found together in onychia by Dutton, Todd and Tobey; that Levaditi states that vibrio-forms develop from spirilla in E. African tick-fever; and that Castellani in yaws and Leuriaux and v. Geets in syphilis found oval forms, which the latter authors regard as spores from which the *Treponema* develops. In several of these cases, the question of symbiosis or of varying forms of the same organism is undecided. Markham Carter regards the bacteria present along with the parasites (*Helcosoma tropicum*) in Oriental Sore as symbiotic. The need for such partnership might constitute one of the difficulties in

cultivating spirochaetes, which have so far proved practically insuperable. Cleland cultivated bacteria and cocci from the ulcers, but failed to inoculate animals with either of them. He was equally unsuccessful with inoculations of material taken directly from the sore. He has named the spirochaetes of ulcerative granuloma *Spirochaeta aboriginalis* as affecting the aborigines of Australia.

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