

from anthrax to some workers, or at any rate made them less susceptible to an attack of this special form of blood-poisoning.

Now I know of only one way in which immunity against, or diminished susceptibility to, a specific contagion can be accidentally acquired—namely, by contracting the specific disease in question. If, therefore, the above extract has any meaning at all, it can only mean that these wool-workers acquire slight forms of anthrax which give them immunity; in other words, that the views I have been inculcating for the last half-dozen years are supported by the statistics of the incidence of anthrax.

Messrs. F. M. Rimmington and Son, Bridge Street, Bradford, keep a constant supply of Selavo's serum.

THE INFECTIVE GRANULE IN CERTAIN PROTOZOAL INFECTIONS, AS ILLUSTRATED BY THE SPIROCHAETOSIS OF SUDANESE FOWLS.

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PRELIMINARY NOTE.

At the first meeting of the Tropical Medicine Section of the British Medical Association in London last year I advanced the view that, in all probability, what might be called the "infective granule" would yet be found to play an important part in certain protozoal infections, and more especially in spirochaetosis and trypanosomiasis. I based this belief on the work of Leishman as regards the changes undergone by *Spirochaeta duttoni* in *Ornithodoros moubata*, and on the allied changes which I had found to occur in the Sudan fowl spirochaete when ingested by *Argas persicus*. I have been continuing the work on fowl spirochaetosis and have recently arrived at some most interesting and significant results, which may yet have considerable bearing on the view we must take of the pathology of this and other spirochaetal diseases, and possibly also on their treatment.

The full account of these later researches will be presented in the fourth report of these laboratories, which is now in the press, and is due to appear in the autumn of the present year; here I wish merely to place on record a few of the more salient features of the work.

It will perhaps be remembered that one found intracorporeal forms in this fowl spirochaetosis, and that, following Sambon, one had come to the conclusion that these endoglobular bodies represented a stage in the life-cycle of the spirochaete—constituted, in short, its stage of schizogony in the fowl. Sambon, however, who expressed this view from the study of a few slides I gave him, did not indicate how this red cell invasion occurred. For a long time I believed the spirochaetes themselves entered the red cells and broke up, or coiled up, within them to form these remarkable bodies. As the parasites can and do enter and leave the erythroblasts of the fowl, there was good ground for this supposition. Now, however, I know better.

By the use of the dark-field method, and more especially by practising liver puncture on chicks at the crisis or on chicks which have been given a sufficiently large dose of salvarsan, I have found that in the liver in particular, also in the spleen and lung, the spirochaetes undergo an astonishing change. They discharge from their periplastic sheaths spherical granules, and it is apparently these granules which enter the red cells, develop in them and complete a cycle of schizogony. The appearance is very remarkable. If a well-infected chick be given a dose of salvarsan, the peripheral blood is soon cleared, or nearly cleared, of spirochaetes. If then a drop of liver juice be examined by the dark-field method, it will be found swarming with spirochaetes and with highly refractile granules. The source of the latter is soon apparent, for attention will be directed to spirochaetes which are not moving in the usual way, but are in a state of violent contortion, or are, so to speak, shaking themselves to and fro. Indeed, I cannot give a more apt comparison than by likening their movements to those of dogs which have

been in water and are shaking themselves vigorously to dry their coats. The object of the spirochaetes, however, is to rid themselves of the bright, spherical granules which can be seen within them, and which may or may not be aggregations of the so-called chromatin core. These are forced along the periplastic sheath and suddenly discharged, so that they become free in the medium and dance hither and thither as tiny, solid, spherical, brilliantly white particles. In process of time the spirochaete loses its activity, becomes difficult to see, and eventually all that is left of it is the limp and lifeless sheath drifting aimlessly in the fluid and liable to be caught up and swept away by some still vigorous parasite. Such a sheath may still retain one or two of the granules which it has been unable to discharge.

As may be imagined, the process is most fascinating to watch, and my observations have been confirmed by Captain Fry and Mr. Buchanan, of these laboratories, and by Captain O'Farrell, R.A.M.C. I may also say that the first-named had previously seen a shedding-off of granules by trypanosomes in the peripheral blood of experimental animals, a phenomenon which he is now studying.

It is these spirochaete granules in the liver, spleen, and lung, and possibly also in other internal organs, which, I believe, invade the red cells. I think I have seen the penetration occur, but require to make further observations in order to be certain as to the mode of entry. Such a chain of events fully explains all the puzzling features which this intracorporeal infection has hitherto presented, and, moreover, brings it into line with the infective granules found in the ticks, for these very closely resemble those seen in liver juice films both when examined by the dark-field method and when stained by the Levaditi process. There are various other points, more especially as regards the peculiar staining reactions of these granules, into which I need not enter beyond saying that the fact that, when free, they do not appear to take on the Romanowsky stain may explain why they have not previously been noticed. The work is also not yet complete, as it is necessary to find out if the spirochaetes ingested by ticks behave in a similar manner and thereby produce the granules of Leishman.

I see that Jowett in South Africa has recently discovered what appears to be an identical form of fowl spirochaetosis, and I trust he will employ the dark-field method and endeavour by liver puncture and the use of salvarsan, for the purpose of creating an artificial crisis, to follow out the curious cycle I have indicated.

From these observations and others which will be fully detailed at a later date I have come to the conclusion that this fowl spirochaete must be classed as a specific entity, and I am proposing for it the name *Spirochaeta granulosa penetrans*, which, though lengthy, suitably indicates its more important peculiarities. At the same time it is quite possible—may, even probable—that other pathogenic spirochaetes behave in a similar manner. I have found these granules to be resistant forms, and their presence in countless numbers in the tissues might explain part of the mechanism of relapse and the difficulty of curing completely some of the more chronic spirochaetal infections, as, for example, syphilis and yaws.

In conclusion, I must thank Professor Ehrlich for most kindly placing at my disposal an ample supply of his new and valuable remedy.

AN Anticholera Congress has recently been held at St. Petersburg, under the presidency of the Minister of the Interior.

WE are informed that over 100,000 copies of the leaflets on "clean milk" published by the National League for Physical Education and Improvement (4, Tavistock Square, London, W.C.) have been distributed within the last few months mainly by officials connected with health authorities, and also through national and local health societies. The leaflets specially addressed to the householder have been supplied to many education authorities for distribution to the children when lessons on domestic hygiene are being given and for the instruction of the teachers themselves. The league is no doubt well advised in trying to influence the rising generation, and we are glad to congratulate it on the evidence of the good progress made in its useful campaign.