SPIROCHÆTE OBERMEIERI.*

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PRELIMINARY NOTE.

The spirochete studied was obtained through the kindness of Dr. Norris of Bellevue Hospital, New York, who secured it from a case of relapsing fever by inoculating the blood into monkeys and white rats. The organism has been kept alive by successive passage through white rats for over two months. As a result of intraperitoneal injection the parasites appear in the blood in thirty-six to forty-eight hours after inoculation, disappear within the next twenty-four hours and do not reappear. The rats are then immune to subsequent inoculation. The disappearance of the spirochetes was shown to be due to the formation of anti-bodies. Spirochetal blood, when kept *in vitro*, retains its virulence for more than fifteen days.

The blood of rats which have been given repeated injections of spirochetal blood exerts a most marked preventive and curative action. When injections of such blood are made, before inoculation with spirochetes, the latter fail to appear. Similarly, when simultaneous injections of immune and spirochetal blood are made, no infection results. Even when the immune blood is injected ten, twenty-four and thirty-eight hours after inoculation with spirochetes, that is to say, at any time before the spirochetes actually should appear in the blood, they will fail to appear, whereas in the controls they become numerous.

The curative action of the immune blood is equally pronounced. In rats which have from 5 to 10 spirochetes per field of the one-twelfth inch objective, an injection of 2 c.c. of immune blood is followed *within one hour* by a total disappearance of the spirochetes from the circulation. After this, the parasites do not reappear, while in the controls they persist for twenty-four hours. This remarkable action of immune blood in the case of the white rat will form without doubt the basis of curative and preventive treatment in relapsing fever and in tick fever of Africa. It is the intention of the authors to work out the practical application of the principle discovered.

Spirochetal blood, which has been diluted with ten parts of salt-citrate solution, when filtered through a Berkefeld filter, under a pressure of 50 pounds, yields a filtrate which, when injected into white rats, produces typical spirochetal infection. This result was obtained in seven out of ten experiments. The spirochetes, as in the case of cultures of *Trypanosoma lewisi*, are filterable through a Berkefeld filter. Attention is called to the importance of this fact in its bearing on the so-called ultramicroscopic organisms.

All attempts thus far to cultivate the spirochete on blood agar have failed, but this subject will be followed further. The spirochetes multiply by transverse division and show other characteristics which belong to bacteria, notably, their behavior with reference to distilled water. When rat blood, which is rich in spirochetes, is placed in a thin collodium sac and dialyzed in running distilled water, the organisms do not undergo any change in form even after twenty-four hours. During the first five or six hours their motility is unimpaired, but after that they become more and more sluggish and finally come to rest. Even after a dialysis of eleven to twenty-four hours

such blood is infective. Under similar conditions the rat and nagana trypanosomes rapidly plasmolyze, within an hour or two, and become hardly recognizable. At the same time they lose their infectiveness.

This behavior of the spirochetes in distilled water, that is, absence of marked plasmolysis, corresponds to that of bacteria under like conditions. This test may, perhaps, serve as a more or less general means of differentiating between bacteria and protozoa. The transverse division of spirochetes, the absence of definite structure, such as the presence of well-marked nucleus and blepharoplast, and the absence of plasmolysis would indicate that the *Spirochæte obermeieri* belongs to the group of bacteria.

On the other hand, the transmission of spirochetal diseases by insects, the persistence of the organisms in such insect hosts for months, and the infection of their eggs are the main facts known at present which point to a possible protozoal nature of the parasites. The persistence of the spirochetes of tick fever in the blood of rats for three to eight days, as shown by Dutton and Todd, would indicate that their organism, though closely related, is nevertheless different from that studied by us. It goes to show that the tick fever of Africa and the relapsing fever of Europe are due to different species of spirochetes.

INDICATIONS FOR STRYCHNIN AND NITRO-GLYCERIN IN CIRCULATORY DISORDERS.

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The pharmacologic action of nitroglycerin is erroneously conceived by some physicians. I have heard practitioners remark that "even the use of nitroglycerin and strychnin is ineffectual in causing a weakening circulation to recover." To understand the therapeutic indications for these two drugs in circulatory symptoms, a thorough knowledge of a portion of the physiology of the circulation is absolutely necessary.

The heart is a muscular organ which pumps the blood into the aorta at a rate which normally maintains the blood pressure constant, within certain narrow limits. The control of the heart's rate is automatic. The vagus and sympathetic nerves carry impulses to the heart; the former is the inhibitory nerve and the latter the accelerator. A small nerve running in the same sheath as the vagus, called the depressor, is the sensory nerve to the heart. The small blood vessels, the arterioles, have their caliber controlled by the vasomotor nerves. The centers of these four sets of nerves functionally must be intimately associated in the central nervous system. A rise of blood pressure, due to a constriction of the arterioles, or to an increased amount of blood, normally causes a slowing of the heart's rate. A fall of blood pressure due to causes, the reverse of those just mentioned, brings about an increase of the cardiac rhythm. Both changes in the rate of the heart's action are attempts, through the reflex nervous system, to maintain the blood pressure at the usual height. Any slight alteration in the caliber of the arterioles, or in the amount of fluid, or in the rate of the heart, is readily compensated for by the necessary change in one or both of the others. For example, a loss of a small amount of blood may not cause a fall of blood pressure, for the reason that the arterioles will contract, or the heart will increase slightly in either rate

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