

BERMANN (I.)

THE FUNGUS OF SYPHILIS

BY

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BALTIMORE



[Reprinted from the ARCHIVES OF MEDICINE, December, 1880]

NEW YORK
G. P. PUTNAM'S SONS
182 FIFTH AVENUE
1880

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I N the winter 1878-9 I received from Prof. Zeissl a freshly-excised prepuce, containing an indurated (Hunterian) chancre. I had previously discussed with him the nature of the syphilitic contagium, and hoped by microscopical examination of this absolutely fresh specimen to obtain further knowledge on this highly important subject. The results were far above my expectation, but before speaking of them in detail I would call attention to a very valuable paper by Prof. Klebs of Prague, published in the *Archives of Experimental Pathology and Pharmacology*, vol. x, p. 161, entitled: "The Contagium of Syphilis; an Experimental Study."

An account is here given of the results of inoculation of a monkey with schizomycetæ (or micrococci and bacteria), obtained by cultivating the tissue of an excised *non-ulcerated* hard chancre.

The method of cultivation is the usual one: A small fragment of the above, together with some cultivating fluid (such as Pasteur's), is brought into a perfectly clean glass tube, drawn out into fine points at both ends, which are then hermetically sealed over a flame. This tube is then kept in an ordinary breeding oven for several weeks, whence it is removed from time to time in order to examine its contents.

At last, in successful cultivations, a small film appears on the surface of the fluid, which the microscope shows to consist mainly of bacteria and micrococci. With the fluid thus obtained a female monkey, among many other animals, was inoculated, and in the usual time (about six weeks) an outbreak of genuine syphilis followed, accompanied with all the attendant phenomena. (For further particulars see original.)

Before the publication of Prof. Klebs' paper I had already, on examining microscopically the fresh prepuce obtained through Prof. Zeissl's kindness, discovered certain fungoid growths in its tissue, for which I could not find any other explanation than that they were in some way related to the disease.*

I have also to thank Dr. Woodward for calling my attention to an extract of an article on "The Low Organisms Found in the Hard Chancre," by Pisarewski, in No. 32 of the *Centralblatt für Chirurgie*.

This paper of Pisarewski describes small organisms found by him in all the specimens of hard chancres examined. Yet he failed to find the more highly developed forms of these organisms which enable us the better to understand what is the nature of syphilis. His failure can be, perhaps, attributed to the method used, or to the fact that he examined the tissue only in the immediate vicinity of the sclerosis. The paper being published in the Russian language, I have had to content myself with the extract as above mentioned.

Although there were many appearances in these sections

* Since the above was written, Dr. Woodward of the Army Medical Museum in Washington was kind enough to show me some specimens of dysenteric ulcerations of the colon, which contained, partly in the tissue and partly in the lymphatic vessels, certain fungi described by him in the second volume of the "Medical History of the War," page 473. As these fungi are in a great many respects different from those I found, and are very similar to those found in the wounds of persons having died of septicæmia, I can only regard this as a further proof of the specificity of the fungus found in syphilitic affections.

which indicated that these fungoid growths are the real causes of syphilis, I hesitated to publish my discovery without convincing proofs obtained by extended and corroborating investigations. The material being difficult to obtain, some time elapsed before I was enabled to continue my researches. What first attracted my attention, apart from those well-known changes taking place in the initial sclerosis, was a singular collection of micrococci and fungoid growths, firmly adhering to, and partly filling up, the lumina of most of the lymphatic vessels. How firmly they were fixed can be seen in the fact that they withstood all the different manipulations necessary to enclose them in glycerine after having had the sections lie in turpentine. Some of the arteries contained these growths in different stages of development and intermixed with blood corpuscles. In every one of the hundreds of sections I have made, and which were stained and prepared by various methods, have I found these same low organisms.

Dr. H. Knapp told me, after I showed him my specimens, that he has frequently found similar appearances in retinitis hæmorrhagica, and that he believed them to be coagulated fibrin. As this eye affection is also frequently to be observed in amyloid degeneration of the kidneys, this would perhaps be a further proof of my views. I need hardly say, that the fungoid nature of these organisms (apart from Klebs' experiments) has been sufficiently established by me through all different microchemical reactions, so that a mistake for anything else is to be quite excluded.

The micrococci are principally to be seen in the lymphatics, where they generally envelop the valves. They are small, strongly refracting spherical bodies, and resemble those illustrated by Klebs. The bacteria, as this author describes them, I only find in a few instances, and *only* in the arteries. The size of these organisms corresponds with the figures

given by Klebs. The principal changes have taken place in the lymphatic system and chiefly at some distance from the initial sclerosis, and this explains why others have been unsuccessful in discovering these fungoid growths, they, probably, having confined their researches to the limits of the induration. Wherever the fungi are most prevalent in the lymphatics, there we also find that the greatest change has taken place in the appearance of their tissue. This, in some instances, consists in amyloid degeneration of the endothelium as well as of the surrounding tissue, so that it becomes very difficult to find any nuclei, which latter are brought out with great distinctness by the method I use.

The walls of the vessels are covered by micrococci, disposed in thick layers, while the valves of the lymphatics are also thickly studded with these, and, by their swollen and hardened condition, show that they have undergone an inflammatory process. It is to be observed that the nearer to the original lesion the more prevalent are the micrococci or sporangia, while at some distance from the induration we find the higher developed forms. They consist of a network of fine thread-like filaments, most of which are much longer than the bacteria cultivated and described by Klebs. Many of them show node-like processes diverging at almost right angles from the original stem. In some of the vessels these branched filaments are so thickly interwoven that they stop the circulation more or less completely, or must, at least, act as a filter for the fluid passing through them, retaining the more solid parts of it, and eventually they must produce a stoppage in the vessels thus affected.

I do not feel ready to join Prof. Klebs in classifying these organisms with the schizomycetæ, as in a number of the specimens they appear to have the structure characteristic of the myxomycetæ. The branched filaments, penetrating partly the walls of the vessels and forming a fine network in them, especially indicate this relationship.

This seems to me, besides, to be of secondary importance, my object being to give an explanation of the *materia morbi* itself rather than its species, and how the infection occurs. The latter has already been satisfactorily proved by Prof. Klebs. My theory of the disease is as follows:

The infection takes place by reason of a few germs or micrococci being retained in a lesion of the skin. They are taken up by the lymphatics, and here they increase and multiply,



Section of an arteriole containing the branching fungus and spores described in the text. Drawn from a preparation of Dr. Bermann, by Dr. R. W. Amidon. Objective $\frac{4}{10}$ Tolles.

spreading principally in these, and soon begin to obstruct the circulation in them. The consequence is an infiltration of the tissue surrounding these, and thus the induration is produced. In course of time they develop more and more; small particles of them get into the circulation of the blood, and are carried into different parts of the body. They take root at those points where the conditions are most favorable for their growth, and cause there, eventually, the

same changes as before described. Thus, they produce metastasis in various organs, but especially, in the beginning (that is, between 4-6 weeks after infection has taken place), in the capillaries of the skin, where they effect an extravasation of blood by stopping the circulation. We cannot find a better explanation for the brown spots which remain after the exanthem has disappeared.

This also appears to me to furnish a very good theory for the frequency of syphilitic iritis in a relatively early period of the disease.

The mode of circulation in the eye being different, in many respects, from that of other organs, germs contained in the blood or lymph might find better conditions for development, while a general invasion of the body by these organisms has not yet occurred.

In all cases where a majority of the vessels of the body are invaded, a change in the proper nourishment of the surrounding tissue must necessarily follow; and we can readily understand that if the growth of these organisms, thus colonized, is not checked in time, their area of metastasis must greatly increase, and by an invasion of the fungi into the tissue surrounding the vessels a multiplication of symptoms is certain to follow. A strong confirmation of my theory seems to me to be that Dr. Otis, of New York, has come to the same conclusion, viz., that all the sequelæ of the initial sclerosis are to be explained by mechanical obstruction of the lymphatics, by a different route, that is, by clinical observations. The principal rôle in this drama is played, of course, by amyloid degeneration of the lymph and blood-vessels (caused, in the first instance, by the fungus above described), as I find it to occur already in the initial sclerosis six weeks after the infection has taken place. Thus, the practical results of my investigations would be as follows:

To prevent the development of the disease, with all its disastrous consequences, by means of cauterization, excision,—circumcision, if possible (as recommended by Auspitz and others),—is indicated. At the same time, since we have not any other therapeutic agent to destroy these fungi producing syphilis, mercury in some form must be resorted to at once. Since the lymphatic vessels are the principal seats of the fungoid growth, and since these are most readily reached by hypodermic injections, this mode of treatment seems to me to be the most efficient.*

I have tried to give the results of my investigations, thus far obtained, in as small a space as possible, and only drawn those inferences which to me appear to be most important. The only proof that appears to me to be still needed, the colonization of the fungus in all secondary syphilitic ulcers, I shall furnish in the next paper; the material having hitherto not been quite satisfactory, I hesitate before corroborative evidence is obtainable. Finally, I may be permitted to thank Dr. Clarke, of the Johns Hopkins University for the kind assistance given to me in revising the proof-sheets.

* When properly made, these injections are not painful, and never produce abscesses unless the syringes are unclean. Even in cases where a quick mercurialization had to be resorted to (for instance, in iritis specifica, where the gumma was touching the membrana Descemetii), I have had the most perfect results with them, never observing any relapses nor producing salivation. At the same time, we are thus enabled to derive the full benefit from any other kind of medicine (such as iron, etc.) given by the mouth, and do not run the risk of disturbing gastric digestion by giving mercury internally.

ARCHIVES OF MEDICINE FOR 1881,

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