

A DIPHTHERIA-LIKE BACILLUS CAUSING CELLULITIS  
IN THE REGION OF A SPONTANEOUS FRACTURE  
IN A CASE OF TABES DORSALIS.

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*Preliminary.*

THE interest of this case is due to the fact that the patient from whom this bacillus was isolated was a tabetic in whom a spontaneous fracture of his femur had occurred, and cellulitis developed at the level of the lesion due to a diphtheria-like bacillus. This organism was isolated and obtained in pure culture from the cellulitis and was found present in the films of the pus; also the patient's serum gave a complement fixation reaction with his own bacillus and for syphilis.

*Clinical History.*

The patient was an adult man, suffering from tabes dorsalis and a fracture of the lower end of the left femur which occurred spontaneously as he was walking across the room. A sub-acute cellulitis developed at the level of the fracture and extended upwards towards the thigh. There was no external wound. The pus was obtained by puncture of the soft tissue with a sterile glass syringe. The patient's leg was amputated, but he died shortly after the operation.

The only point of interest concerning the result of the autopsy is that the heart muscle and diaphragm, when stained with Scharlach R., were found to show diffuse fatty change.

Cultivations from the splenic juice gave a negative result.

*Examination of the Pus.*

The pus obtained by puncture from the area of cellulitis was collected in a sterile tube. Film preparations showed pus cells and bacilli morphologically resembling the diphtheria bacillus in large numbers, chiefly extra-cellular, although many were intra-cellular. Cultivations on ox serum agar gave an almost pure growth of delicate semi-transparent colonies which proved to be a bacillus closely resembling the true diphtheria bacillus—morphologically. There were also a few colonies of a staphylococcus albus. The bacillus was found to grow well on solidified blood serum; the colonies were larger and more numerous than on serum agar. It grew badly on agar and any medium which did not contain blood serum. It stained well with Loeffler's methylene blue and was Gram positive. Young cultures on blood serum were tested with Neisser's stain and also films taken direct from the tissues, but with uniform negative results. Cultures of the true diphtheria bacillus were tested at the same time so as to control the results with Neisser's stain.

*Cultural Characters.*

The "sugar" reactions of the bacillus isolated from the patient's tissues were tested both before and after passage through guinea-pigs with similar results.

The bacillus grew in litmus milk with a slight production of acid after 48 hours, but no formation of clot and no increased production of acid at the end of ten days at 37° C. was noted.

It slightly, but distinctly acidified lactose, maltose and mannite without gas formation, but dextrose, cane sugar and raffinose were unaffected.

Graham-Smith, writing on this subject in the standard work on diphtheria<sup>1</sup>, quotes experiments to show that true diphtheria bacilli, whether virulent or non-virulent, invariably produce acid in the presence of glucose, generally with maltose and lactose, occasionally with cane sugar, but never with mannite.

The organism tended to die out unless frequently subcultured on a medium containing blood serum. The size of the colonies and general naked eye appearances of the cultures have not altered since the organism was originally isolated from the tissues. It grows slowly on gelatine at 22° C., without liquefaction of the medium.

<sup>1</sup> *The Bacteriology of Diphtheria*, edited by G. H. F. Nuttall and G. S. Graham-Smith, Cambridge University Press, 1908, p. 225.

*Blood Serum Reaction.*

The patient's serum gave a positive Wassermann reaction for syphilis and also a positive complement fixation reaction with his own bacillus.

The organism was taken up by normal leucocytes in the presence of normal serum very unequally, but with greater readiness in the presence of the patient's own serum.

*Pathogenicity.*

A young culture of this bacillus cultivated direct from the patient's tissues on ox serum agar (15% serum) when inoculated into guinea-pigs produced a fatal result within four days. There was local necrosis, but no lesions elsewhere in the body. The bacilli were seen in film preparations and were isolated from the tissues at the lesion and from the spleen.

The inoculation of the sub-cultures into two guinea-pigs produced death in these animals in 48 hours with similar post-mortem changes; a pure growth of the bacillus was obtained from the local lesion and from the spleen. The heart muscle of all the guinea-pigs was stained with Scharlach R. for fatty change, but with a negative result. This form of "degeneration" of the heart and diaphragm is now known to be the most common microscopical lesion met with in diphtheritic toxæmia and as I have shown elsewhere<sup>1</sup> occurs within sixteen hours of injecting the toxin.

Subsequent subcutaneous inoculation of guinea-pigs with this bacillus failed to produce a fatal effect, only a local abscess at the level of the lesion with ulceration of the tissues. Numerous diphtheria-like bacilli could be seen in films of the pus and were obtained in pure culture.

*The Action of a Prophylactic Dose of Diphtheritic Anti-Toxin  
on the Activity of the Bacillus.*

A guinea-pig, inoculated with a  $\frac{1}{4}$ th c.c. of a broth emulsion of a 24 hours' growth of the true diphtheria bacillus on blood serum, died

<sup>1</sup> "A Study of the Various Changes which occur in the Tissues in Acute Diphtheritic Toxæmia, more especially in regard to 'acute cardiac failure'," *Brain*, Part CXIV. p. 227.

within 36 hours. At the autopsy, spreading oedema near the seat of inoculation was present together with a sloughing local lesion. Morphological diphtheria bacilli were seen in films from the pus, and a pure growth of the bacillus was obtained. The usual post-mortem phenomena—adrenal congestion, hydro-pericardium and bilateral hydro-thorax were present.

Two guinea-pigs received 500 units of diphtheritic anti-toxin and twenty-four hours later a similar dose of the *true* bacillary emulsion as employed in the case of the control guinea-pig, but showed no ill effects. In the guinea-pig which was inoculated with the test bacillus a local abscess developed at the seat of inoculation; similar abscesses were found in two guinea-pigs which previous to the inoculation with the test bacillus had received 500 units of diphtheritic anti-toxin. In each case the bacillus was isolated from the abscesses at the level of the lesion, but not elsewhere, and no fatal effect occurred.

#### *Production of Toxin.*

The bacillus was grown for one week at 36° C. in peptone broth free from glucose. The culture was then filtered under pressure through a Doulton candle, and when found to be sterile, 2 c.c. were injected subcutaneously into two guinea-pigs without any immediate effect being produced and the animals' tissues were free from disease when examined a week later.

#### *The Comparative Relationship of this Bacillus with the Bacilli met with in the Tissues of General Paralysis, Diphtheria, and certain other Infectious Conditions.*

The argument for and against the relationship of diphtheroid bacilli in the tissues of general paralytics to the disease itself does not concern us here, but the presence of a diphtheria-like bacillus in an acutely spreading suppurative lesion in a patient suffering from a disease so closely allied to general paralysis is of very great interest. This bacillus differs, however, from that described by Ford Robertson in that it does not stain with Neisser's stain, it fails to ferment dextrose and is markedly pathogenic for guinea-pigs<sup>1</sup>.

<sup>1</sup> Abstracted from the article by Dr Graham-Smith, *loc. cit.* p. 444.

*Diphtheria.*

The bacillus, when it was first isolated in the pus from the cellulitis, closely resembled the true diphtheria bacillus both morphologically and culturally.

It killed the first two guinea-pigs within four days, and the sub-cultures proved fatal to two guinea-pigs within 48 hours; since that time the bacillus has proved much less pathogenic, as referred to elsewhere.

There was, however, an absence of the common post-mortem phenomena associated with fatal diphtheria in guinea-pigs, which have been already referred to.

It failed to stain by Neisser's method, did not give rise to an extra-cellular toxin when growing in sugar free broth, and the action of the bacillus on the tissues of guinea-pigs was unaffected by diphtheritic anti-toxin. Other points could also be mentioned, but these are sufficiently important differential tests.

*Diphtheria-like Bacilli.*

Graham-Smith refers to various cases of suppuration produced by diphtheria and diphtheria-like bacilli, but I cannot find any reference to cellulitis, while even in the abscess cases there is no record of an organism similar to that under discussion.

In conclusion, this bacillus must be classed as an organism belonging to that large group of bacteria usually known as diphtheroid bacilli or diphtheria-like bacilli,—a group of organisms which every day appear to be assuming greater importance in the bacteriological world.

## ABSTRACTS OF OFFICIAL PUBLICATIONS, ETC.

*Many investigations relating to Hygiene and Public Health, possessing permanent scientific value, appear in Annual Reports of Medical Officers of Health, Blue Books and other Publications of Official Bodies within the British Empire. These are not easily available and as a rule no record of them appears in scientific journals or in an accessible form ; consequently much valuable work is lost sight of. To obviate this difficulty the Editors of the "Journal of Hygiene" propose to publish from time to time abstracts of such publications, or parts of them, as appear of sufficient permanent interest. They will be glad to receive full authors' abstracts of Reports coming under the above description.*

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### ON THE BLEACHING OF FLOUR AND THE ADDITION OF SO-CALLED "IMPROVERS" TO FLOUR.

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*(Abstract of a Report to the Local Government Board, England. Food Reports No. 12.)*

#### 1.—BLEACHING PROCESSES.

THE practice of flour bleaching originated in this country about ten years ago ; bleaching, however, is said to have been attempted in France two or three years prior to this. The practice was rapidly adopted by millers in the United Kingdom, in America, and elsewhere. Such bleaching is applied only to roller-milled flour. Numerous patents have been granted for bleaching appliances and for the application of various chemicals to the bleaching of flour. Ozone, chlorine, oxides of chlorine, bromine, nitrogen peroxide and other oxidising substances have been suggested and tried as bleaching agents. Of these substances nitrogen peroxide is the only one which has given satisfactory results, and all commercial bleaching of flour at the present time depends on the use of this substance. It can be produced in various ways and from a variety of materials. Two methods of production, which may conveniently be termed the chemical and electrical methods, are in use commercially at the present time. In the first of these nitrogen peroxide is produced by the action of nitric acid on ferrous sulphate, the amount of gas formed being controlled by regulating the supply