

ON THREE CASES OF CEREBRO-SPINAL MENINGITIS, ASSOCIATED RESPECTIVELY WITH BACILLUS ANTHRACIS, BACILLUS TYPHOSUS, AND BACILLUS ENTERITIDIS (GAERTNER).¹

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(PLATE XLI.).

CASE 1.—The first of these cases, namely, that *associated with the bacillus of anthrax*, was as follows:—

The patient was a woman, æt. 19 years. For five years she had “worked hair” in a local warehouse.

There is a history of six days' illness. On 4th August she noticed a bluish-red papule about the size of a split pea, situated on the left forehead, near the roots of the hair. This papule was intensely itchy. On 5th August there was some puffy swelling below the left ear and there were occasional twinges of pain along the left frontal region, referred by the patient to the small “boil” above mentioned.

On 6th August she felt nauseated (no vomiting), and was shivery, and also complained of pain in the lower lumbar region. On 8th August she was seen by Dr. R. Bryson Calwell. Her temperature was 101° Fahr., pulse 108. The pustule was now about $\frac{1}{4}$ in. in basal diameter, projected about $\frac{1}{4}$ in. above the surrounding skin, was dusky red, its apex was crater-like and covered by a small amount of moist, yellow exudate; there were no vesicles. There was pronounced œdema of the left side of the face and neck, and this extended downwards over the upper portion of the chest; moreover, the right side of the neck was also slightly œdematous. By 9th August her general malaise had increased, she vomited some greenish matter containing stringy, blood-stained material; there were two alvine discharges of blackish-green appearance and of very offensive odour. There was some slight difficulty of swallowing, but no distinct pain in the neck or throat. Dr. Calwell remarks that her general condition was one of very little suffering, notwithstanding her serious complaint. She was then (9th August) admitted to the Union Infirmary as a case of anthrax. Her temperature was 100° Fahr., her pulse racing at 130 per minute, she had several attacks of vomiting, severe headache, became extremely restless, then delirious, tossed about in bed and could with difficulty be controlled, ultimately becoming unconscious, and died on 10th August after a succession of marked convulsions. At no time was there any rigidity.

The pustule was excised thirty-six hours before death, and was found to contain numerous anthrax bacilli, microscopically and culturally.

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The post-mortem examination, twenty-four hours after death, in addition to the oedematous infiltration of the face, neck, and chest, revealed a marked catarrhal condition of the stomach and intestines, but no areas of hæmorrhage in these regions; the mesenteric glands were swollen and distinctly hæmorrhagic, being as large as haricot beans and dusky red, almost black in appearance. The solitary follicles in the lower ileum were swollen into prominent pin-head elevations; the spleen was enlarged, but not markedly so.

The brain, on removing the dura mater, was of a brilliant but somewhat dusky red colour over almost its entire surface, as if it had been smoothly and thickly smeared over with red paint. The hæmorrhagic covering was most marked about the Sylvian fissures and sides of the organ, so much so that the underlying surface of the cerebrum was completely obscured by the paint-like reddening of the pia arachnoid. Over the vertex there was somewhat less diffusion of the blood, so that the brain surface could be seen as a faint yellowish background appearing beneath a broken or reticulated veil of pial hæmorrhage, the reticulum being continued into a finer areolar network of engorged capillaries. The basal portions of the brain were similar in appearance to the vertical regions; the spinal cord showed no evident meningeal hæmorrhages, but was criss-crossed by congested capillaries. The cerebro-spinal fluid was abundant, was somewhat turbid, and furnished on culture media an enormous number of colonies of *Bacillus anthracis*, and no other bacteria. *B. anthracis* was also recovered in pure culture from the blood, but not in anything like the same abundance as in the case of the cerebro-spinal fluid.

Portions of the brain with the hæmorrhagic membranes were examined microscopically, the anthrax bacilli were present in great numbers, lying among an enormous accumulation of polymorpho-nuclear leucocytes, red cells and fibrin, the last present in abundance as fibrils and thin ribbon-like threads and flakes. The inflammatory deposit occupied the pia arachnoid space, and dipped into the cerebral sulci. The meninges were apparently alone affected, as there were no signs of change in the brain substance, and no bacilli were seen in the vessels thereof. Such pial vessels as were seen in transverse section were crammed with blood, the white cells being numerous, so much so that in places they seemed to equal the red cells in number. The bacillus was also found in other organs, e.g. the kidney, in which they were abundant, but were not seen in the glomeruli.

The anthrax bacillus was, in conclusion, recovered from the malignant pustule during life, and also from the blood, meningeal exudate and ventricular fluid after death. This bacillus agreed in every particular with a laboratory culture of *B. anthracis*, pathogenetically, morphologically, culturally, and also in its action on sugars and alcohols.¹

The figure of the brain on Plate XLI. shows well the characteristic congestion of the pial vessels; we owe Mr. H. R. Douglas our best thanks for the water colour drawing from which the plate is prepared.

CASE 2.—The second case—that due to *typhoid infection*—was as follows:—

A man (M.K.), æt. 37 years, was admitted to hospital on 23rd August with a history of having taken to bed, ten days previously, with a violent headache; within the next twenty-four hours he vomited repeatedly and became delirious, no diarrhœa—but continuation of vomiting and intermittent delirium until admitted to hospital.

On admission he was conscious, and complained of diplopia, but had no pains in the head. Temperature 103°·4 Fahr., pulse 104, and water-hammer in type. There was internal strabismus of the right eye, and slight purulent conjunctivitis of both eyes. Dried herpetic vesicles were present about the

¹ See J. H. Teacher, *Lancet*, London, 1906, vol. i. p. 1306, for a case of hæmorrhagic meningitis due to *B. anthracis*.

In similar tubes containing saccharose, lactose, arabinose, raffinose, inulin, dulcitol, and salicin no acidity was produced. Litmus milk was acidified.

AGGLUTINATION.—A sample of the patient's blood agglutinated the laboratory typhoid culture (TW) in dilutions of 50 and 100, and faintly in a dilution of 1 in 200, whilst it did not agglutinate the bacillus (M.K.) isolated from his spinal canal in dilutions of 1 in 50. This is in keeping with the well-known fact that pathogenic organisms recently isolated from the animal body are not readily agglutinated.

Two rabbits were now inoculated several times, one with the laboratory culture (TW) of the typhoid bacillus, the other with the bacilli recovered from the patient (M.K.). The effect of the blood serum of these rabbits on these organisms was then tried, using different dilutions. The results obtained are shown in the table on preceding page (Table I.).

CASE 3.—*Cerebro-spinal meningitis due to infection with the B. enteritidis* (Gaertner).

A child (H.), æt. 4 months; after an onset in which vomiting and diarrhœa were the outstanding symptoms, developed typical signs of cerebro-spinal meningitis. That the meningococcus had no part in this infection was shown by the following facts:—(1) His blood serum throughout his illness was found by Houston and Rankin to possess normal opsonic power as to the meningococcus; (2) twice during life and at the post-mortem examination we cultivated from the cerebro-spinal fluid an organism which subsequent investigation proved to be the *B. enteritidis* (Gaertner).

The cultures, but for the presence of a few colonies consisting of Gram-positive diplococci, were pure. The paucity of these diplococcal colonies seemed to indicate that they were possibly contaminations. These cocci had a moist raised opaque white growth on agar, liquefied gelatin, and were found eventually to present the ordinary morphology of staphylococci. No colon bacilli were found in the fluid from the meninges at any time.

POST-MORTEM EXAMINATION.—Body greatly emaciated. No petechial or other rash on skin.

Heart and lungs normal.

Kidneys normal.

Liver normal; it showed no trace of the whitish mottling so commonly found in cerebro-spinal fever.

Spleen normal in size and consistence.

Stomach normal.

Intestines showed no evidence of inflammation, there being no enlargement of Peyer's patches and solitary follicles; no ulceration. Mesenteric glands were enlarged, but not hyperæmic nor caseated; they showed all gradations in size, from a pin head to a large bean.

Brain.—Fibrinous exudate present at the base. The interpeduncular space and the anterior surface of the pons were covered with a thin layer of fibrin. There was a large amount of serous fluid present in the meninges and in the spinal canal.

From the spinal fluid cultures of a motile bacillus were obtained. The same organism was cultivated from the spleen, mesenteric glands, and the bile; the latter showed enormous numbers of blue colonies on Drigalski plates mixed with a few red colon colonies.

CHARACTERS OF THE BACILLUS.—*Morphology.*—A Gram-negative actively motile bacillus very similar to the *B. typhosus*.

Cultural characters.—On agar and gelatin a greyish faintly blue film of growth; gelatin was not liquefied. On potato a raised moist brownish growth. Litmus milk, at the end of twenty-four hours acid, after forty-eight hours the



acidity diminished, and on the third day the reaction was alkaline. Peptone water, uniform turbidity, no indol at the end of one week. Glucose neutral red agar, gas and yellowish-green fluorescence.

On testing its fermentative power it was found that acid and gas were produced in broth tubes containing respectively 1 per cent. of glucose, maltose, lævulose, galactose, dextrin, sorbite, dulcitol, arabinose, and mannitol, whilst in similar tubes containing lactose, saccharose, raffinose, salicin, and inulin neither acid nor gas was produced.

These reactions are identical with those given by the *Bacillus enteritidis* of Gaertner.

AGGLUTINATION.—The blood serum of the patient agglutinated the bacillus in dilutions of 1 in 30, but not in 1 in 50.

A rabbit was immunised by being inoculated subcutaneously several times with dead cultures of the organism. The agglutinative effect of the blood serum of this animal was then tested on the bacillus (H.) used in the inoculation, and also on agar cultures of the *B. coli communis*, *B. enteritidis* (Gaertner), and on Paratyphoid A and B (Schottmüller).

The result is shown in Table II. + + + indicates large clumps and no free bacilli, + + a well marked reaction, + small clumps.

TABLE II.

| Name of Organism. | Dilutions of Serum used. | | | | | |
|-----------------------------------|--------------------------|------|------|------|------|------|
| | 500 | 1000 | 1500 | 2000 | 2500 | 3000 |
| H. | +++ | +++ | +++ | ++ | ++ | + |
| Gaertner (Kral) | +++ | +++ | +++ | + | + | + |
| Paratyphoid B | +++ | +++ | + | ... | ... | ... |
| Paratyphoid A | ... | ... | ... | ... | ... | ... |
| <i>B. coli communis</i> | ... | ... | ... | ... | ... | ... |

This experiment shows that the agglutinins for the *B. enteritidis* (Gaertner) and this organism are very similar. The identity of the two organisms was demonstrated by a saturation experiment. A drop of the same rabbit's serum 2 days later was diluted with normal salt solution to the extent of 1 in 25, and then three loopfuls of an agar culture of the bacillus H. were thoroughly mixed with it. At the end of three hours the mixture was centrifugalised, and then it was found that the clear supernatant serum had no longer any agglutinative effect on the bacillus H., and also none on Gaertner's bacillus in dilutions of 1 in 50, 1 in 100, etc. (up to 500).

DESCRIPTION OF PLATE XLI.

Cerebrum from case of anthrax.