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BACILLUS DYSENTERIAE OF FLEXNER IN RELATION TO ASYLUM DYSENTERY.

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IN this country observers are familiar with dysentery as occurring on the one hand in asylums, where it is common [see Mott (1905), Knobel (1906), Candler (1907)], and on the other as scattered sporadic cases (often known as "ulcerative colitis") among the general population with an occasional small epidemic. The bacteriology of these conditions does not appear to have yet been placed upon an altogether satisfactory footing. Of the sporadic English cases little seems to be known beyond the fact that Foulerton (1902) found that the serum of several cases agglutinated Shiga's bacillus. In the case recorded by Saundby and Hewetson (1906) no evidence is adduced that the organism isolated was a dysentery bacillus at all. There is however clear evidence that the institutional disease is associated with *B. dysenteriae*. Hewlett (1904) obtained positive agglutination results with Flexner's bacillus in two cases which were negative with the Shiga type. Eyre (1904) in an important research examined nine acute cases from a London County asylum and isolated Shiga's bacillus from the faeces of 4 out of 5 examined during life, and from 2 out of 4 examined only post-mortem. He further showed that the patients' serum agglutinated Shiga's bacillus while it was without action upon the Flexner organism. Dr Eyre has been good enough to inform us that he met with Flexner's bacillus in 6 of the 9 acute and in 15 of 35 chronic cases. The chronic cases in no instance yielded Shiga's bacillus, and their serum did not agglutinate Shiga or Flexner, which latter organism at the time he regarded as of doubtful import. Finally, McWeeney (1906) isolated from a case of acute fatal asylum dysentery in Ireland an organism which appears to be the *B. dysenteriae* of Flexner

though it is stated to have produced no indol and to have been pathogenic for rabbits. The work of Morgan (1906, 1907) has shown that no sort of *B. dysenteriae* is responsible for the summer diarrhoea of children in London as is the case in America and elsewhere.

The present investigations have been carried out on material derived from patients in the Somerset and Bath Asylum at Cotford, near Taunton. The material was of necessity not quite fresh when received in London, but the results indicate that dysentery stools may be subjected to a satisfactory bacteriological examination when they have been passed for fully 24 hours.

In all cases surface plates of MacConkey's bile-salt-lactose-neutral-red agar were used for the separation of the organisms. It is more satisfactory to plate directly when the stool is mucous in character, or from a fresh emulsion when faecal, than after a preliminary incubation in a fluid medium. It was for example found in one of the early cases that plates made directly from the stool showed colonies of *B. dysenteriae* and of *B. coli* in the proportion of 100 to 16, while plates made from an 18 hours culture of the same stool in glucose-bile-salt peptone-water or in ordinary broth showed ten times as many *B. coli* as *B. dysenteriae*. From such plates the non-lactose-fermenting colonies were picked off and tested by cultural and agglutination methods. The colonies of *B. dysenteriae* on MacConkey's agar are to some extent characteristic in that each white colony is surrounded by a clear zone distinctly more yellow (i.e. more alkaline) in colour than the rest of the medium. Of the cultural tests most use was made of the fermentations of various sugars and alcohols, of the reaction in litmus-milk and of the production of indol. Practically, however, it is most convenient to make broth cultures of any suspicious colonies, examine for motility after four to six hours, and, if found non-motile, immediately apply the agglutination test. In this way a reasonably certain diagnosis may be arrived at in 24 hours, and afterwards confirmed by culture.

The serum used for agglutination in these cases was a horse serum prepared for therapeutic use with a number of strains of dysentery bacilli. These included the types of Shiga, Kruse and Flexner, those isolated by Eyre from asylum dysentery and several from cases of infantile diarrhoea in America. It agglutinated the homologous organisms of the Shiga and Flexner types up to a dilution of 1 : 10,000 and was generally used diluted 1 : 1000, the observations being made microscopically at room temperature; in all cases a positive result was reached in two hours if at all.

Clinically the cases examined on the whole conformed to the usual type of acute asylum dysentery. As a rule the onset was sudden with headache, pains in the back and limbs and malaise ending in vomiting: then a rigor or an abrupt rise of temperature to 102°—104° F. Diarrhoea then begins: at first the stools appear normal, then loose and generally after 24 hours small containing blood and slime. Epigastric pain is complained of during the first few days, later pains in the region of the large intestine aggravated by palpation. The stools have a characteristic sour odour and contain greyish-white, tenacious slime intimately mixed with blood: six or eight motions in 24 hours is about the average for the first few days. The average duration under treatment was about 8 days, the temperature reaching normal about the third day, after which the number of stools diminishes. Slime persists in the stools after blood has ceased to be passed.

Working in this way, material from 44 inmates of the asylum was examined: 20 of them had dysentery at the time. The results may be grouped as follows:

(*a*) Of the cases of clinical dysentery, the stools were examined in 19 and *B. dysenteriae* of the Flexner type was in all isolated from 17. In one fatal case the spleen and mesenteric glands were alone available: *B. dysenteriae* was found in both. Three of the positive cases died: in one *B. dysenteriae* was isolated from the stools 14 days before, and also on the day of death, but was not found in the ulcerated coecum post-mortem; in the second it was found in the stools four days before death and also recovered from scrapings of the mucosa of the coecum; in the third death occurred $2\frac{1}{2}$ months after dysentery bacilli had been found in the stools and they were not recovered from the spleen. The stools of five of the positive cases were examined during convalescence: one was negative 13 and 28 days after the attack, one negative after 8 and 30 days, one negative 14 days after, and two negative 25 days later. One case was examined as a normal control two days before the onset of symptoms with a negative result; on the third day of illness *B. dysenteriae* was found in large numbers. Two others had also been previously examined with negative results two and three months respectively before the onset of acute illness. In three acute cases the stools failed to yield dysentery bacilli: in one however these were found 28 days later during convalescence but not 41 days after the acute attack. In another case the symptoms of dysentery continued for $4\frac{1}{2}$ months; the stools were examined three times and the spleen and mesenteric glands post-mortem—all with negative results.

(*b*) The stools were examined in 26 cases which were not clinically dysentery though five of them had diarrhoea. Twelve had had previous attacks of dysentery, in two 5 weeks before examination, in four

2 months, in two 3 months and in three 12 to 14 months. In one case scrapings from small ulcers found in the upper third of the rectum of a patient dying of nervous disease, who had had diarrhoea for three months before death, were examined. In none of these 27 cases was *B. dysenteriae* found. Most of them were contacts in the same wards with cases of dysentery which had been verified bacteriologically. There were for instance at one time three cases of dysentery so verified in one ward; while these persons were ill, stools from ten other patients in the same ward were examined: the results were all negative though three of them subsequently developed clinical dysentery and *B. dysenteriae* was found in their faeces.

The organisms isolated conformed in all respects to the *B. dysenteriae* of the Flexner type[1]. They fermented dextrose, laevulose, galactose and arabinose with the production of acid without gas, did not change the reaction in lactose, dulcite, erythrite, salicin or inulin, caused an initial acidity with a terminal alkalinity in litmus-milk, produced a slight to a moderate amount of indole (paradimethylamidobenzaldehyde test), were not motile and agglutinated with the multivalent anti-dysentery serum up to 1:1000 and, when so examined, up to 1:10,000. In no instance were any bacilli of the Shiga type found, and a few agglutination tests with the blood of the patients showed no reaction with Shiga's original strain or with Eyre's cultures, while with the bacilli isolated from the corresponding and other cases and with Flexner's strain a good reaction up to a dilution of 1:200 or 1:500 was sometimes obtained.

In the differentiation of dysentery bacilli further than into the broad divisions of Shiga type (not fermenting mannite) and Flexner type (fermenting mannite), some importance has been attached by Hiss and others to the reactions in media containing maltose and cane-sugar. These authors note that to some extent the reactions are inconstant, especially as to the time at which the acid reaction may appear. The following tests were made simultaneously on 24 cultures from seven cases of the present series. The test sugars were in 1 % solution in a mixture of one part peptone beef broth with three parts peptone-water; incubation was at 36° C. The number of cultures which were acid at different times was as follows:

	Cane-sugar				Maltose			
Days incubated	1	7	14	28	1	7	14	28
Number of cultures acid	0	0	1	4	2	3	13	24

[1] See the papers of Hiss (1904), Torrey (1905), Shiga (1906) and Dopter (1907).

There can be little doubt that all these cultures must be regarded as being essentially the same bacillus. Even if that were not the case, it is difficult to believe that all the cultures from any one case are not the same. Yet the variations of fermentative power in the whole series of cultures do not in any way correspond to the distribution of the cultures among the cases. Thus the four cultures which eventually produced an acid reaction in the cane-sugar medium came from four different cases, and the three which fermented maltose in seven days also from three different cases.

SUMMARY.

1. *B. dysenteriae* of Flexner has been found in the stools of 17 out of 19 cases of asylum dysentery; no evidence of the presence of the Shiga type was obtained.

2. In 18 cases examined one week to 14 months after an attack of dysentery, *B. dysenteriae* was found only once (3 weeks).

3. No evidence has been obtained of the presence of *B. dysenteriae* in the faeces of ward contacts (26 cases) with either normal or diarrhoeic stools.

4. The fermentative reactions of *B. dysenteriae* of Flexner towards maltose and cane-sugar are variable.

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