A NOTE UPON THE MODES OF INFECTION IN BACILLARY DYSENTERY.

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In the autumn of 1916 there was a relative lull in the pressure upon the medical staff in Alexandria, and the opportunity was taken to investigate some of the methods by which the infection of bacillary dysentery was conveyed from one individual to another. The investigations were interrupted by press of work before they were completed, and no further opportunities have been available. They are thus incomplete, but as we have been unable to find any other data upon the subject in the literature that is available to us, we have thought it right to publish them even in their incomplete form.

Source of infection: Infected stools.

Possible methods of infection: (1) Water; (2) Sand; (3) Food; (4) Flies; (5) Fingers.

The source of the infection is the stools of an infected person. It has been stated that dysentery bacilli do not persist for long in the stools of patients who are suffering from the disease. In a general way the statement is true, for the organisms are most frequently isolated during the early days of the illness, and may not be detected even in cases where blood and mucus are still present. In one of our cases no dysentery bacilli were isolated after the fourth day, though blood and mucus persisted in the stools until the ninth day. In another blood and pus persisted until the eleventh day, though bacilli were absent after the ninth day. But, on the other hand, they may persist after the blood and mucus have disappeared, and even when the stools are normal.

In fifteen out of twenty-eight cases in which the stools were examined repeatedly, bacilli were found in the second week; and in three cases in the third week of the disease. In one case they persisted until the eighteenth day, and were found subsequently on the twenty-fifth day. In three cases they disappeared after the fourth day.

Their presence too, or, at any rate, their recognition, may be intermittent. We have found them present on the fourth and fifth days, absent on the sixth, and present on the eighth and ninth; present on the sixth and seventh days, absent on the eighth, and present again on the ninth. It is evident, then, that they may persist in the stools for a considerable period.

It seems probable, too, that the figures which we have just mentioned are below the maximum. We examined the stools of 100 patients at
Montazah, who had gone there when convalescent from an attack of dysentery, and were at the time in good health. The stools were only examined once, but in eight cases were found to contain dysentery bacilli. It is of course possible that a re-infection had occurred at Montazah, but it is probable that in some, at any rate, of these cases the infection had never been eradicated, and still persisted.

It must be borne in mind that diarrhoea may be the whole evidence of a dysenteric infection. A man was admitted into hospital on December 21, 1916, on account of diarrhoea which had ensued two days previously. He said that he had passed some blood and mucus on the morning that he was admitted, but the stools after admission were always fecal, and without addition, and after December 26, 1916, formed. The number of stools passed daily after admission was 3, 1, 1,—1, 1, 1, 1, but that of December 23 showed on culture the presence of dysentery bacilli.

It is also probable that, owing to the intermittency of excretion of these organisms in sufficient number to be detectable by the ordinary methods, the number of carriers among dysenteric convalescents is higher than the above figures indicate.

Dysentery bacilli may be present in the stools of men who have never had any symptoms of gastro-intestinal disturbance. A man in the steward's store at a general hospital was found to have a dysentery bacillus in his stools on September 20, 1916, and on October 11, 1916. He had been on the Peninsula from September until the evacuation, and subsequently in Egypt, and would not admit that he had ever had any diarrhoea or dysentery since he came East. He had only been off duty through ill health on one occasion, June 1916, when he was sick for a fortnight with "inflammation of the lungs."

The majority of the carriers whom we discovered had, however, suffered previously from diarrhoea or dysentery. In one case the patient stated that he had had diarrhoea for a couple of days immediately before the stool—a normal one—was examined. In another an attack of dysentery had occurred eighteen months previously, but no intestinal disturbance of any kind had been present in the preceding nine months. In most cases some history of antecedent diarrhoea or dysentery was obtainable, a history which is usual among all ranks in Egypt, though in most cases the illness is of a trivial character.

Dysentery bacilli, then, occur in the stools of men who are suffering from diarrhoea or dysentery, or who have in the past suffered from these diseases; and also in the stools of healthy individuals who have never had at any time symptoms of gastro-intestinal disorder.

The proportion of carriers is appreciable, and as their stools may be normal or abnormal, every stool is potentially infective unless proved not to be so, and the strictest precautions should be taken to ensure the complete disinfection of every stool at the earliest possible moment after it is passed.
We have found that, though dysentery bacilli tend to die within seven or eight hours in stools kept at ordinary temperatures, both the Shiga and the Flexner types may survive for twenty-four hours in dysenteric stools kept at room temperature. A stool must therefore be regarded as infective for a considerable period after it is passed.

The methods by which, in Alexandria, the infection is conveyed to the healthy individual are probably numerous, and vary in different cases. A general source seems unlikely, for the dysentery of the last eighteen months, though considerable, has never been of epidemic type. Patients coming from the same camp or unit are rarely from the same tent or mess, and in general we have conceived the impression that the personal habits of the individual are largely concerned with the incidence of the disease. This impression, which we obtained in the wards, seems to be strengthened by the results of our investigations.

(1) Water.—The water supply of Alexandria is derived from the Mahmoudieh canal, which is grossly contaminated above the point at which the supply is obtained. The detail can be readily seen by riding along the bank, especially in the early morning. The contamination is excessive in the vicinity of Nouzha Gardens, where the river boats tie up for the night.

The bacterial content of the water is large, particularly with regard to coliform organisms; but, on the other hand, the crucial experiment of experience has shown that no epidemic of dysenteric disease, such as would arise from contamination of the water supply, has ever occurred under the present regime. The numerous cultures which we have made have never revealed the presence of any dysenteric organisms.

In some experiments upon the viability of Bacillus dysenteriae we have found that these did not survive for more than forty-eight hours in the unfiltered water of the canal, which is grossly contaminated with coliform organisms.

(2) Sand.—The gross contamination of the open ground in and around Alexandria suggested that the sand might be infective. On reflection this seemed improbable, for the maximum incidence of dysentery is in the autumn, and does not coincide with the maximum incidence of Khamsin winds (in the spring) when dust storms are most frequent, and water and food most thoroughly impregnated with dust. We have procured specimens of sand from various places, including the filthy latrine grounds near the Catacombs, Pompey’s Pillar and the Anfouchy Catacombs, but the bacteriological examination has never revealed dysentery bacilli. We have found by experiment that sand artificially contaminated with B. Shiga and exposed to the sun was sterile after six hours. B. Flexner survived for twenty-four hours, but had died out before forty-eight hours.

It seems possible, however, that sand may occasionally convey the disease, as we have found B. coli in three specimens of sand, and B. fecalis alkaligenes in two.
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(3) Food.—The bacteriological examination of the ordinary foodstuffs seemed impracticable, and was not attempted. Our only information is with regard to the milk, which we have examined repeatedly, with uniformly negative results. It is, however, invariably grossly contaminated with coliform organisms, which in some cases, at any rate, are probably due to the addition of water.

The incidence of dysentery is, however, so frequently the sequel to a meal in town that the connexion between the two can hardly be ignored. On the other hand, many of our patients had had no opportunities of eating outside of their camp, so that infection must have occurred within it.

(4) Flies.—Considerable stress has been laid on contamination of food and drink by infected flies. Any one who has seen a plague of flies, such as obtained at Bloemfontein in the May of 1900, and on the Peninsula and Mudros in the summer of 1915, can readily understand that such a method of infection is possible if infected stools are exposed in the vicinity of food-stuffs. No real plague of flies has, however, occurred in Alexandria during the summers of 1916 and 1917.

We have made some experiments on this point. We fed flies upon dysenteric stools, and succeeded in isolating the corresponding organism from plates which the fly was allowed to walk on and contaminate by the same method that it would naturally contaminate food. The flies were enclosed in Petri capsules containing MacConkey’s medium, and retained there for one to two hours. (This method has been found satisfactory by one of us in the study of the infectivity of flies infected with B. typhosus and the paratyphoid organisms.) The proportion of successes was not great.

We have performed the same experiment, without success, with flies caught in the latrines of dysentery wards. Abundant contamination of the plates with coliform organisms, however, was generally observed; and in some cases colonies of B. Morgan, B. proteus and B. fecalis alkaligenes, the characteristic concomitants of B. dysenteriae, also developed.

We have also experimented in the same way with “wild” flies, caught in the native quarters. No dysentery bacilli were isolated.

We are not inclined to lay much stress upon infection conveyed in this way, more especially as the methods adopted to limit the numbers of flies in the vicinity of the camps, and to hinder their access to the food and drink of the troops, have been attended with relatively satisfactory results.

(5) The Personal Equation.—During the summer and autumn of 1916 a few cases of recurrence of dysenteric symptoms occurred in patients in the dysentery wards who had more or less recovered from their original attack. In some cases it seemed probable that the symptoms were due to a relapse of an imperfectly cured infection, but in two cases a fresh infection seemed the probable cause. In one of these the latter theory seemed
certain as the original attack had been amoebic. Our investigations were in consequence turned towards the conditions in the wards.

At first sight one might imagine that dysenteric wards and their annexes must be largely infected with the specific organisms. The contamination of the bedding, floors, bedpans, latrines etc., is continuous and considerable and difficult to disinfect. But the danger is recognized and combated, and to our satisfaction we found that the aerial flora of the wards and annexes did not comprise dysenteric organisms. They were, too, absent from the dust of the floors, the seats of the latrines, and the bedpan racks. The patients who suffered from fresh attacks were particularly helpful in the wards, removing bedpans, etc., after use, and it seemed probable that some defect in the disinfection of their hands had been the cause of their illness, the infection having been conveyed directly when smoking cigarettes, etc., or indirectly through the foodstuffs.

Some further investigations were made with regard to this same point. A certain number of cases of dysentery occurred in a small camp. Cultures were made from the dining-room tables, the cook house, meat safe, etc., but all with negative results. An inagglutinable Shiga bacillus was, however, isolated from a tin mug in use in the canteen. In this camp two out of fifty-three men examined proved to be carriers.

The personal equation requires further attention and investigation. The washing of hands after going to the latrines and before meals, though impossible in the field, is generally possible in standing camps. Men are often notoriously careless in the cleansing even of their own knives, forks and spoons, which, when dirty, afford excellent nutritive material for bacterial growth. We have found men brushing their teeth and shaving in the sluice rooms of the wards, where infectivity is likely to be maximal. Infected hands may convey the infection to an indefinite number of people, if employed in the cook house or the dining-room. Direct personal infection is a factor that requires more attention than it has received in the past.

Examination of stools of healthy individuals:

<table>
<thead>
<tr>
<th>Source</th>
<th>Number examined</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Hospital, orderlies</td>
<td>60</td>
<td>4</td>
</tr>
<tr>
<td>Army Service Corps, Motor Transport, personnel</td>
<td>53</td>
<td>(B. dysenteria M.F.)</td>
</tr>
<tr>
<td>Dysentery convalescents in convalescent hospital</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Native prisoners in Hadra jail</td>
<td>100</td>
<td>(B. dysenteria M.F.)</td>
</tr>
</tbody>
</table>

Specimens of sand from:

<table>
<thead>
<tr>
<th></th>
<th>Number examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Hospital: camp, tents, latrines, cookhouse</td>
<td>6</td>
</tr>
<tr>
<td>Standing camp: camp latrines</td>
<td>8</td>
</tr>
<tr>
<td>Latrine ground near Pompey's Pillar, catacombs, Anfouche catacombs</td>
<td>8</td>
</tr>
<tr>
<td>Standing camp: camp, baths, horse lines</td>
<td>6</td>
</tr>
<tr>
<td>Horse camp: camp, dining room, horse lines</td>
<td>34</td>
</tr>
</tbody>
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Published: 1 March 1919

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Swabs from—
- Standing camp: dining room, cookhouse, meat safe, tin mug... 7
- Dysentery wards: water closet, bedpan rack, bedpans... 10
- Dust—Morning sweepings of wards and latrines... 3

Aerial Flora—
- Plates exposed in dysenteric wards and latrines... 16

Flies—
- Fed upon dysenteric stools... 13
- Caught in latrines of dysenteric wards... 3
- Caught in Native quarters... 56

We must acknowledge our indebtedness to the late Colonel F. M. Sandwith, Consulting Physician, E.E.F., for his assistance in procuring us much of the material which we investigated.