In mortality tables the young infants show nearly always a comparatively high death-rate. I believe that this is largely, if not entirely, due to the greater difficulty in making the diagnosis in the infant, and the consequent longer average duration of the illness when they come under treatment. The diagnosis in an infant of a few months old is, of course, most difficult; also there is greater opposition to the sending of young infants into hospital. Of the 15 cases in this series under 5 years of age 9 were treated within five days of the onset. Amongst these 9 there was only one death; mortality 11.1 per cent. Whereas of the 6 first treated later than the fifth day 3 died; mortality 50 per cent. When the serum treatment is commenced early, my experience is that these very young children do very well.

Included in this series were 12 military cases. Ten of these made good recoveries and rejoined their units, one admitted on the sixth day of illness died on the sixteenth day, and one, who also had pulmonary phthisis, recovered so far as to show sterile cerebro-spinal fluid and to be allowed up, but he then developed very rapidly progressive tuberculosis in both lungs, and he died two months later.

The average number of injections given in these 48 cases was 4, and the average amount of serum injected was 90 c.cm. The largest amount in any one case was 280 c.cm.

One infant of six months, which lived, admitted to hospital on the fifth day of illness, was punctured thirty times, had 250 c.cm. of serum, and had 1,948 c.cm. of cerebro-spinal fluid drained off from the canal.

Another infant of five months was admitted on the eighth day of disease. Lumbar puncture on admission gave only a few drops of fluid. There was considerable bulging of the fontanelle, puncture was therefore made through the fontanelle, and the serum given by this route. The puncture was repeated five times, and 72 c.cm. of serum given. The infant made slow progress at first but completely recovered, and was discharged after nine weeks. It left hospital last September, and I have recently heard from Dr. Currie of Ballymena, who sent the case in, that the child has remained well since, and appeared to be developing quite normally.

This case is of interest, as the number of cases so far recorded of recovery after treatment by injections given through the fontanelle, rendered necessary by the failure to obtain drainage by lumbar tapping, is very small. I have only been able to find three.

Two years ago, when the results of the serum treatment were in many instances disappointing, other methods of treatment were advocated as follows:

Simple Puncture and Drainage.

This mode of treatment was, before the introduction by Flexner of the intrathecal injection of serum, extensively tried in America and elsewhere, and although it was recognized as useful the results were very far from satisfactory. I have watched the published records of treatment in this disease, and, so far as I know, no one has ever by this method obtained in any considerable number of cases a mortality under 40 per cent., and often it was only practised in more or less selected cases.

Subcutaneous Injections of Antiserum.

At that time also attempts were made, here and elsewhere, to obtain better results by subcutaneous injections of antiserum with at the same time drainage by lumbar puncture, in the hope that the serum would thus more effectually reach the seat of infection, but without any noteworthy success.

It has never been claimed, I think, by those who doubt the value of the intrathecal injections of serum that the serum reduced the patient's chances, but it has been claimed that the results obtained are due to the drainage and not to the serum. If that were so, the method just referred to should have effected as good results. Also the brand or quality of the serum should be of no importance, and the results two years ago should have been as good as those at other times obtained by puncture and the injection of serum.

Puncture and the Injection of Disinfecting Solutions.

Fifteen years ago treatment by puncture and the injection of 1 per cent. lysol was advocated and practised in Lisbon during an extensive outbreak. This method was followed in America, but the results were disappointing, and it was abandoned. Later Wolff recommended the

injection of 0.2 per cent. protargol into the canal, and more recently several other disinfectants have been recommended—dilute solutions of carbolic acid, of chloramine-T, of eusol, etc.

Last year Flexner and Amoss carried out at the Rockefeller Institute an elaborate series of experiments to determine the power of lysol and protargol to counteract the effects of meningococcal infection artificially produced in monkeys and young guinea-pigs. They found that:

"Neither protargol nor lysol proved to have any curative action on the experimental infection thus produced in these animals. On the contrary, both lysol and protargol exert antileucocytic and antiphagocytic effects, and are also potent protoplasmic poisons, and the leucocytes with which they come in contact are injured and made to degenerate. According to the extent to which these harmful properties are exerted these chemicals promote the advance, rather than restrain the progress, of meningococcal infection."

"Recovery from meningococcal infection in man and animals is accomplished chiefly through the process of phagocytosis. . . . Any means which interfere with and reduce these essential processes retard or prevent recovery. Both lysol and protargol interfere with and diminish the emigration of leucocytes and the phagocytosis of meningococci, and neither possesses antitoxic power. It follows, therefore, that whatever theoretical advantages might accrue from a bactericidal activity exerted by these chemicals independently of the type of meningococcus causing epidemic meningitis is more than offset by the harmful effects which they cause."

These experiments of Flexner and Amoss prove that the use of lysol and of protargol in guinea-pigs and monkeys infected with meningococcal meningitis do harm and not good. There is no reason to believe that their use in man would be more beneficial than in the monkey. They also raise grave doubts as to the justification for the employment of similar chemical agents, at least until much further experimental research has been done.

All the recent work on cerebro-spinal fever goes further to prove that the most hopeful line of treatment is by lumbar puncture, drainage, and the intrathecal injection of carefully prepared polyvalent antimeningitis serum; and that the most important factors which make for success are early treatment and sufficient dosage.

NOTES ON THE ETIOLOGY OF DYSENTERY.

I.—*Types of Dysentery Bacilli Isolated at No. 3 Australian General Hospital, Cairo, March–August, 1916, with Observations on the Variability of the Mannite-fermenting Group.*

BY

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(Abstract.)

ATTEMPTS to isolate dysentery bacilli from 217 cases in which the stools contained mucus with or without blood were made. In many cases the amount of mucus in the stool was very small.

B. dysenteriae Shiga was recovered on forty-seven and mannite-fermenting dysentery bacilli on seventy-six occasions. *Amoebae histolyticae* or their cysts were present in 63 cases and in 36 no causative organism was discovered.

The method employed was to wash the mucus, break it up in sterile broth, and plate out some drops on the surface of a MacConkey plate. Next day likely colonies were picked off, sown into warm broth, and incubated for a few hours. They were examined for motility, and, if motile, discarded. The non-motile broth cultures were sown into glucose and mannite peptone water, and on to an agar slope. If glucose or both glucose and mannite were fermented with the formation of acid only, an emulsion was made from the agar slope and tested as regards agglutinability against a Shiga or Y serum respectively. Macroscopical methods were employed.

In about fifty instances the further biochemical characteristics of the strains were investigated immediately.

The Shiga strains of dysentery bacilli isolated were all true to type.

The organisms of the mannite-fermenting group were, on the contrary, very variable, both as regards their

biochemical activities and agglutinability. Forty-nine of them were tested upon a variety of carbohydrates. They all failed to form acid in lactose, dulcitol, inulin, and adonite. They all produced acid in glucose, mannite, and galactose, and turned milk first acid, then alkaline. Their action upon maltose, saccharose, dextrin, raffinose, arabinose, isodulcitol (rhamnose), sorbitol, and glycerin, and their power to form indol varied with different strains.

The sugar reactions of thirty of the cultures were re-examined for us by Miss Rhodes of the Lister Institute about six months after isolation. Meantime they had been subcultured at intervals on agar slopes. Out of the 3 originally fermenting saccharose 2 had lost this property. Of the 21 which originally fermented maltose 5 had lost the power and other 5 had acquired it; 4 out of 13 had lost the power to split sorbitol, and other 2 had acquired it. In 6 cases the action upon raffinose was reversed, 3 ceasing to ferment this sugar and 3 gaining this faculty.

The production of indol was the most variable, the property being lost in 9 cases and acquired in 4.

The instability in biochemical activities manifested by these Egyptian strains other than in the action upon lactose, dulcitol, glucose, and mannite, is in accordance with observations upon organisms of this group isolated in different parts of the world, and a survey of the voluminous literature on this subject [see more particularly Hiss (1904), Twort (1907), Müller (1908), Morgan (1911), Penfold (1911), Fraser (1916), and Hehewerth (1916)] convinces us that any attempt to separate the mannite-fermenting dysentery bacilli into groups on the ground of their action upon carbohydrates is unsound.

II.—The Value of Agglutination in the Identification of Members of the Mannite-fermenting Group of Dysentery Bacilli.

The serological reactions of strains isolated from cases of dysentery in various parts of the world have been studied by Hiss (1904), Kruse (1907), Rüffer and Willmore (1909), Morgan (1911), Winter (1912), Hutt (1913), and others. The position may be summed up by saying that the mannite-fermenting dysentery bacilli comprise a number of strains serologically distinguishable by the absorption method, but overlapping considerably as regards agglutination. For diagnostic purposes no one serum is adequate; serums made with a member of each of Kruse's groups A, D, and E, would embrace most of the German strains. Of univalent serums Y serum seems to be least specific and covers the greatest range.

From Morgan's work Y serum seemed to be particularly indicated for diagnosis work in Egypt, and we used it exclusively. Nevertheless, nearly one-sixth of the bacilli we recovered in 1916 were not agglutinated by Y serum directly after isolation. The titre of our serum against the homologous organism was 1 in 4,000 at the time of using.

Eight of these strains were kindly re-examined by Miss Rhodes six months later. Four of them were then agglutinated by the same Y serum in dilutions varying from 1 in 400 to 1 in 1,600, so that in the meantime they had acquired some sensitivity by cultivation. Two of the four strains which still failed to be agglutinated were clumped by the polyvalent curative serum of the Lister Institute* in a dilution of 1 in 250.

In eight of the cases we were able to test the organism isolated against the patient's own serum, and in four of them it was agglutinated in dilutions above 1 in 100, indicating that he had been infected by the microbe recovered from his stool. Two of the strains which did not acquire agglutinability on culture are included amongst those which were agglutinated by the patient's serum.

It would be wrong to assume that a bacillus with the morphological, cultural, and biochemical characters of the Flexner group of dysentery bacilli is discredited as an etiological factor because it is not agglutinated by Y or any other univalent serum. This group of organisms is clearly in an unstable condition, and records frequently occur of strains which are not agglutinated by serums

prepared from the common type-strains. A recent instance, which is interesting on account of the unusual toxicity of the strain for rabbits, is given by d'Herelle (1916). This organism, which possessed the usual characteristics of the Flexner group, was isolated in five cases during a small epidemic amongst a troop of Dragoons, and was not agglutinated by the polyvalent Flexner-Y serum of the Pasteur Institute.

In conclusion, we express our indebtedness to Miss Rhodes of the Lister Institute for retesting many of the cultures in London, in January, 1917, and convey to her our grateful appreciation of her kindness in so doing.

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III.—Epitome of the Results of the Examination of the Stools of 422 Cases admitted to No. 3 Australian General Hospital, Cairo, for Dysentery and Diarrhoea, March to August, 1916.

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No. 3 Australian General Hospital being a base hospital, in a large proportion of the 422 cases examined the acute stage of the illness was over and the patients were passing normal or merely loose motions, but in 217 cases the stools contained mucus in some amount, with or without blood, at the time of the examination. All specimens were examined for protozoological parasites, but only when mucus was present was the isolation of dysentery bacilli attempted.

TABLE OF RESULTS.

Total cases 422.			
<i>Amoeba histolytica</i> or its cysts	...	...	72
<i>Amoeba coli</i>	...	...	29
<i>Giardia intestinalis</i>	...	...	33
<i>Tetramitus mesnili</i>	...	...	14
<i>Trichomonas intestinalis</i>	...	...	16
<i>Coccidia</i> (Isospora)	...	...	1
217 Cases passing mucus with or without blood:			
<i>Amoeba histolytica</i> or its cysts	...	...	63
<i>Bacillus dysenteriae</i> , Flexner group	...	...	64
Bacilli indistinguishable culturally from Flexner group	...	...	12
<i>Bacillus dysenteriae</i> , Shiga	...	...	47

No grounds were discovered for supposing that any of the protozoological parasites present, except *Amoeba histolytica*, were responsible for ill health. Twelve organisms isolated resembled the Flexner group of bacilli culturally and biochemically, but failed to agglutinate with any Y or Flexner serum at our disposal; 8 of the strains were re-tested against the same serum six months later, when 5 of them agglutinated quite well. These non-agglutinable strains will be described in detail and their significance discussed in another communication.

* In the process of immunization the horses furnishing this serum had been injected with a number of Egyptian strains received from Sir Armand Rüffer some years ago.