The active phase of the disease had lasted, respectively, 2 years, 3½ years, 4 years, and 6 years before this degree of recovery had been reached.

Each case was under my observation for a year at least and most of them for several years after the recovery, so that it would appear to be permanent.

There are other cases in which after long-continued treatment a sort of *modus vivendi* is reached, which, though it cannot be called recovery, might perhaps be described as permanent improvement.

I had almost described it in the late Sir James Goodhart's words as "Safe, but not sound," but I doubt if it can be regarded as altogether free from risk. The child's nutrition has steadily improved, it is able to take an ordinary diet with little or no special restriction. The stools, though normal in colour, are seldom formed and easily become loose; moreover, growth, though taking place, is unduly slow, and the child, though taking her part in ordinary child life, does so with more effort and is more easily fatigued than other children. Three of my series had recovered to this extent; one of them already referred to when last seen was 17½ years old.

Is there ever complete recovery in the sense of attaining eventually average height and acquiring normal puberty development?

With the exception of the one case which I was able to see at the age of 17½ years, in which neither of these conditions was fulfilled, I have not been able to watch any case sufficiently long to answer this question. I can only mention from hearsay two instances, one a boy and the other a girl, under treatment, I believe, by Dr. Gee and Dr. Cheadle for coeliac disease in early childhood, who in adult life were of at least average stature and seemed normal in every way. I have no knowledge, however, of the girl's menstrual history.

Two cases which I was able to feed on human milk have made so much better progress in growth than is usual in coeliac disease that they bid fair to reach at least an average height.

STUDY OF AN OUTBREAK OF BACILLARY DYSENTERY.

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AN outbreak of bacillary dysentery in an institution in the eastern counties in December and January last, described below, presented the following features which seem worthy of record: (a) sudden onset and brief duration; (b) evidence that the infection was water-borne; (c) the infecting agent was in all cases *B. Shiga*; (d) evidence of the persistence of *Shiga* bacillus when experimentally introduced into water and food; (e) noteworthy results of agglutination tests when applied both to dysentery convalescents and to those who had presumably been exposed to infection but had escaped illness.

Account of the Outbreak.

The institution in question was occupied by men engaged mainly in agricultural work in the neighbourhood.

At Christmas, 1917, there were about 360 men in this institution, all but three of whom had been there for two months, most of them since the building was taken into military use in August, 1917. The men had been selected as fitted for farm work; they were well nourished and in thoroughly good physical condition, and the sickness among them before Christmas, 1917, was negligible. The three later arrivals were healthy men, and no suspicion of previous dysentery arose in their case.

This institution stands in open country a mile or more from the nearest village. First built as a local workhouse, it was afterwards used as a home for inebriate women, and later for imbecile children. Its accommodation and arrangements were ample for the number of men for which it was used; it had fairly recently been supplied with a water-carriage system of drainage, and had its own water-supply from a deep well situated close to the main building, drawing water from the chalk at a level of about 100 feet from the surface. The institution was kept in a very cleanly condition, and sanitary discipline was well maintained.

As soon as the outbreak in question was reported, expert inquiry was arranged for and was carried out by Captain B. Sweeten, R.A.M.C. (S.S.O. of the area), Captain J. D. Benjafield, R.A.M.C. (bacteriologist of the area), Captain S. Shephard, R.A.M.C. (T.) (appointed to act as resident medical officer in view of his special experience of dysentery), and Captain A. C. Inman, R.A.M.C., who undertook a series of special investigations on agglutination tests by arrangement with the Medical Research Committee at the No. 1 Research Laboratory, St. Bartholomew's Hospital. Measures for prevention, treatment, and research were most thoroughly carried out by these expert officers, while the unsparing activity shown by Captain L. Cranmer-Byng in taking all the

measures which were advised or were practicable to deal with the outbreak and trace its cause was of the greatest value.

Occurrence of cases.—Setting aside a few merely suspicious or slight cases, definite dysentery symptoms occurred in 38 cases at dates which may be grouped as follows:—

4 days, Dec. 27th to Dec. 30th	...	...	...	...	12
4 " " 31st " Jan. 3rd	...	...	...	...	12
4 " Jan. 4th " 7th	...	...	...	...	7
Between " 8th and " 16th	...	...	...	...	7

Clinical characters and treatment.—The cases, particularly those which occurred in the first eight days, were of considerable severity, two dying among those first attacked.

Clinically they were typical of bacillary dysentery. At the outset the civil medical practitioner in charge thought that the men were suffering from some form of food-poisoning, and it was not until some days later, when the outbreak had been reported to the A.D.M.S. of the district, that the diagnosis of dysentery was made on clinical grounds and specimens were forwarded for bacteriological examination to Captain Benjafield at the district laboratory. On Jan. 10th Captain Benjafield telegraphed that *Shiga* bacillus had been isolated from the faeces of two cases, and later this bacillus was recovered from seven other cases. In all instances the bacillus was typical *B. Shiga*, no other dysentery or dysentery-like organism or entamoeba cysts being present.

The cases were treated in a special section of the institution, with separate latrines and washing arrangements. Nursing orderlies were provided. Milk, stimulants, and other special medical requirements were requisitioned and supplied. As stated above, a medical officer with special experience of dysentery was put in charge of the cases; for a brief period before his arrival another medical officer had been sent to assist the local practitioner who is in medical charge of the institution. Antidysentery serum was used where required.

All the 36 non-fatal cases had completely recovered by March and no relapses occurred. The cases were kept in the separate section of the institution until satisfactory bacteriological reports had been received. These related to three specimens of faeces taken during January, February, and March. By April the examinations made in Captain Benjafield's laboratory showed that all the 36 cases had given three consecutive negative results, including those in which *B. Shiga* was originally found.

Causation of the Outbreak by Water-infection.

Two circumstances attracted special attention—the sudden onset and short duration of the outbreak (24 cases within 8 days and 31 out of the total of 38 within a fortnight), and its widespread distribution among the men.

The institution is a two-storey brick building enclosing two main courtyards. It comprised 18 dormitories, 16 of which were occupied. Cases occurred in no fewer than 12 dormitories. There are several different mess-rooms and cases occurred in each mess. The 12 cases which occurred in the first four days were as scattered as the subsequent ones. There were three sets of latrines in different parts of the building, but the cases were not restricted to the users of any one of these latrines.

These facts made it certain that there was some one cause operating in regard to the whole institution about the end of December, the infecting agent persisting at most some two or three weeks. No source of infection was to be traced in the district. *Shiga* dysentery is unknown in this part of the country, and inquiry at farms where the men had been employed gave no indication of any local prevalence of suspicious diarrhoea or illness. It had to be assumed that infection had either been accidentally introduced from outside and had caused one or more unrecognised cases which had subsequently infected their fellows, or that a similar general infection had been started through some one or more of the men having suffered from dysentery before their arrival in England and remaining *Shiga* bacillus carriers.

These alternative hypotheses of the initial introduction of infection will be discussed later on, but in either case it was necessary to find a common distributing agent, such as food or drink, by which, given the initial infective agent or person, the outbreak itself was produced. Mere case-to-case infection contracted from latrines, or infection locally operating in particular dormitories or messes, were ruled out. There were no flies about at this time of year.

The various articles of food and their preparation and temporary storage were gone into in detail. The cooks, who cooked for the whole institution, were five men who had been there from the beginning, were perfectly healthy throughout, denied ever having had dysentery, and in all cases gave negative agglutination reaction. There were no

other men who handled all the food supplied to the different messes. Moreover, there was a control population, 80 in number, living separately from the institution, but receiving food from the same bulk supplies, all of whom escaped attack.

The facts, on the other hand, were consistent with a general infection of short duration through a temporary specific contamination of the water-supply.

Investigation of water-supply.—The liability of the well to contamination of excretal origin, and the special risk to which this water was exposed just before the outbreak began, is shown by the following considerations:—

1. Leaks were found in drains laid close to mouth of well, some leaks between 6 feet and 13 feet from the well being in a drain which served one of the principal latrines. The soil about these leaks was much blackened, and the possibility of this sewage reaching the water could not be excluded, although it is right to state that the drains themselves traversed a cap of clay which overlies the chalk and that the inside of the well did not show a point of leakage in any part of its wall near the surface.

2. On Dec. 14th the main pump of the well broke down, and it was necessary to use a small auxiliary pump at the bottom of the well just about the water level. As a result the man in charge of the water-supply had frequently to go down the well to see to the engine. This man has also the duties of supervising the sewage disposal plant, and so there was some opportunity of his contaminating the water with sewage-contaminated soil on his boots. This possibility, to which Lieutenant-Colonel D. Harvey first drew attention, was confirmed on detailed inquiry. It was also possible that dry refuse brought to the fire of the pumping-engine might have been swept into the well.

3. The water from the well is probably in underground communication with a disused well in the neighbouring courtyard (a capstan well which could be worked by hand). This capstan well was taken into use as a supplementary supply on one day only (Dec. 16th), following the breakdown referred to. It was clear from subsequent examination, however, that its water was subject to gross pollution from the drain of the laundry adjoining it and also from other badly-laid drains in the same courtyard. Thus, on the days immediately preceding Dec. 27th, when the outbreak began, there had been much disturbances of the water in this ordinarily disused well, sufficient, in all probability, to influence the quality of the underground water being drawn upon by the main well.

4. Analytically the water gave evidence of sewage contamination. On Jan. 8th coliform bacilli were found present in 0.1 c.cm. and absent in 0.01 c.cm. in the water of the main well; a previous examination on August 6th, 1917, had given the same result. After the uncovering and reconstruction of all the leaky drains referred to, another sample was taken on April 26th, 1918, with result of finding coliform bacilli greatly reduced, being present in 10 c.cm. but absent from 5 c.cm. Similar contamination and similar improvement as a result of the drainage work were established in the case of the capstan well.

Thus, looking at the matter generally, it is clear that, given a person at the institution who was excreting *B. Shiga*, there were several ways in which the general water-supply could have become specifically contaminated at the time in question, although the exact manner cannot be conclusively proved.

Duration of the infectious ability of the water.—It should be added that the water-supply was chlorinated towards the end of January, when the epidemic was shown to be probably due to water. The introduction of chlorination did not coincide with the cessation of the epidemic, which had ceased before this. It was, however, to be expected that if the specific infection of the water had been acquired only on a few days at the end of December and had not been renewed, its infecting property would naturally disappear in a comparatively short time. In this connexion some experiments were made by Captain Benjafield by purposely contaminating some of the well water in question from *Shiga* bacillus cultures and observing the time during which they could be recovered. The bacilli were present, though in greatly reduced numbers, on the tenth day after the contamination, when the observation ceased.

Source of the Initial Infection.

Details of the very thorough and careful search made for an original carrier case, or for evidence of an original introduction of infection from outside, need not here be given, as the results were negative. Only four of the men gave any history of past illnesses pointing to dysentery. In each case the attack had occurred more than a year previously. In none of them was there any history of relapses or any indication from the agglutination test that they had suffered from dysentery.

Incidentally to these inquiries it became necessary to test whether *B. Shiga* could survive for a few weeks on food which had been handled by a dysentery case or carrier.

Some experiments were made on this point by Captain Inman. The freshly cut surfaces of two pieces of bacon and four pieces of various kinds of sausage were lightly streaked with a camel-hair brush wetted with a saline suspension of *B. Shiga*, so diluted as to appear just turbid to the naked eye when held against a dark background. After this artificial infection the foodstuffs were left at ordinary temperature for three weeks. At the end of that time the *Shiga* bacillus was readily recovered from one portion of bacon and two of the sausages.

Agglutination Results.

Towards the end of January it was arranged that specimens of blood from all the convalescent cases of dysentery then being isolated at the institution should be sent to No. 1 Research Laboratory for examination.

Throughout these investigations the bloods were tested with standard agglutinable cultures of *B. dysenteriae Shiga* prepared at the Department of Pathology, University of Oxford, on behalf of the Medical Research Committee. The technique employed was that outlined in the directions issued with the standard cultures. In each test the end-point of agglutination (standard agglutination) was arrived at by the use of the reduction table published by Dreyer and Inman.¹ The reaction was regarded as positive if the serum contained 10 or more agglutinin units per c.cm. of serum.

The results of these tests, which are shown in Table 1, are striking. A positive agglutination reaction was obtained in every one of the 35 cases in which blood could be examined, and the high dilution in which the reaction was obtained in nearly all cases is noteworthy.

Serum Agglutination Reactions (Capt. A. C. INMAN, R.A.M.C., Medical Research Committee).

TABLE 1.—Actual Dysentery Cases.
35 cases examined. Reaction in no cases negative.

No. of case.	Onset on—	Positive 1 in—	S.A. units.	No. of case.	Onset on—	Positive 1 in—	S.A. units.	No. of case.	Onset on—	Positive 1 in—	S.A. units.
1	Dec. 28	727	303	13	Jan. 1	727	303	25	Jan. 5	376	157
2	Dec. 29	500	208	14	"	55	22	26	"	187	78
3	"	67	27	15	"	220	91	27	Jan. 6	250	104
4	"	440	183	16	Jan. 2	182	76	28	"	220	91
5	Dec. 30	29	12	17	"	182	76	29	Jan. 12	74	31
6	"	250	104	18	"	147	61	30	Jan. 14	440	183
7	"	282	117	19	"	194	80	31	Jan. 15	220	91
8	"	250	104	20	Jan. 3	155	65	32	"	155	65
9	"	657	273	21	"	250	104	33	Jan. 16	322	134
10	"	302	125	22	Jan. 5	171	71	34	"	125	52
11	Dec. 31	67	27	23	"	128	53	35	"	155	65
12	"	388	161	24	"	707	295				

S.A. units = Standard agglutinin units per c.cm. of serum.

In addition, blood specimens were taken from a considerable series of men who had not suffered from dysentery (all the dormitories and messes being represented), with the somewhat striking result that as many as 21 out of 114 of such men (18 per cent.) showed an agglutinating power of more than 10 standard units per c.cm. of serum (Table 2). In this 18 per cent. the titre was lower than that of the actual patients, but nevertheless was of an order which is obviously of significance and requires explanation.

TABLE 2.—Men who Escaped Dysentery.

114 men examined. I. Reaction negative: 93 men, including cooks (5). II. Reaction positive: 21 men (18 per cent.).

No. of man.	Positive 1 in—	S.A. units.	No. of man.	Positive 1 in—	S.A. units.	No. of man.	Positive 1 in—	S.A. units.
C.1	69	28	C.8	38	16	C.15	35	14
C.2	58	24	C.9	125	52	C.16	70	29
C.3	31	13	C.10	38	16	C.17	36	15
C.4	50	20	C.11	38	16	C.18	125	52
C.5	36	15	C.12	25	10	C.19	35	14
C.6	69	28	C.13	84	35	C.20	50	20
C.7	61	25	C.14	80	33	C.21	84	35

TABLE 3.—Men from Similar Institutions where No Dysentery Occurred.

104 men examined. I. Reaction negative: 103 men. II. Reaction positive: 1 man (0.9 per cent.) in dilution 1 in 37. Standard agglutinin units per c.cm. of serum, 15.

In view of the possibility that the reaction of these 21 men might in some way have been determined by a previous inoculation, inquiries were made on the point both in their case and in the case of a similar number of controls showing no reaction.

¹ THE LANCET, March 10th, 1917.

The facts in each group, however, were practically identical. No special history could be obtained pointing to any of them having been inoculated with an antidyentery vaccine. All had received what appeared to have been an antityphoid inoculation early in 1917, the 21 cases in no way differing from the controls in this respect.

By way of further test, arrangements were made to supply Captain Inman with corresponding blood specimens from healthy men under comparable conditions in other institutions where no dysentery had occurred. 104 such blood specimens were taken, with result that in one case only was there any evidence of a high agglutination—namely, a single case showing 15 standard agglutination units per c.c.m. of serum.

These results suggest the explanation that the 18 per cent. of the healthy men at the institution had acquired the ability to agglutinate *B. Shiga* as a result of exposure to the same infection which had produced dysentery in the 38 men who suffered from the outbreak—presumably the infected water-supply. But in the case of this 18 per cent., either because the local multiplication of the bacilli after infection was insufficient, or because of the existence of some factor of insusceptibility of the men, no symptoms of illness were produced.

Similar observations might usefully be made in other outbreaks of dysentery, or of enteric fever, where a generally operating cause like water or milk infection is suspected.

THE "INSTINCT-DISTORTION," OR "WAR NEUROSIS."

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In a paper published some little time ago¹ it was pointed out that functional nervous disorders could be divided into two groups, according as to whether they were or were not determined by environment. Hysteria, and the neurosis about to be considered, belong to the former of these two groups, both being influenced by environment, while neurasthenia or the functional nerve disorder brought about by exposure of the nerve cells to prolonged poisoning by micro-organismal products, and certain of the reflex neuroses, belong to the latter.

The group of cases now to be considered resembles the hysterics in that environment plays a dominant part in their formation, but they differ from them in two respects: (1) in hysteria the rôle of environment is indirect, whereas in these cases it is direct; (2) hysterical phenomena are based on a physiological reaction, while the group under consideration is not so based; the phenomena are pathological and subserve no useful function in the shielding of the conscious mind from unpleasantness. For all practical purposes it is a product of modern warfare; it occurs in people correctly adapted for the requirements of civilised life when such people have been, for a length of time that varies with the individual, made to live in the utterly abnormal environment produced by the war. A functional breakdown of the kind to be described is liable to happen to everyone under these conditions, the variable element being the length of time that elapses before the symptoms become manifest.

The Primary Instincts.

Our normal behaviour under conditions of civilised life is to a great extent the result of the development, inhibition, and combinations of the primary instincts among each other. McDougall describes seven such instincts:

The instinct to run away under the emotion of fear,	
" " fight	" " anger,
" " of repulsion	" " disgust,
" " curiosity	" " wonder,
" " self-abasement	" " subjection,
" " self-assertion	" " elation,
and the parental instinct	" " tenderness.

These instincts should not be looked upon as hard-and-fast and rigidly defined from each other. Nor can we imagine that in an ideally primitive organism such instincts exist in a state of elemental purity; it is almost certain that they have evolved from a functionally undifferentiated nervous system, and that their development has been determined by environment. Generally speaking, the environment in which animal and vegetable life has developed through the ages has been the same for all forms—an environment of ceaseless stress and strain, of unending activity and

competition; therefore all animal life met with on this planet manifests the presence of some or all of these instincts, their combinations and associations. But they are essentially labile, and their relative strengths depend on the minor differences in the conditions of life brought to bear upon any genus or species. But in that these instincts have developed from some undifferentiated form of nerve activity, the reactions manifested when for any cause the normal play of emotion and conation is disturbed need not be distinct and specific for each instinct involved. As a matter of fact, there is, I think, a tendency for certain of these instincts to show their "resentment" under such circumstances in a characteristic manner; but this is no more than a tendency, and need not necessarily obtain.

Now, if we consider the above seven primary instincts, we see that in that their relative strengths are the result of our customary environment, and are, in such strengths, useful for our customary environment, then, given a sudden and sufficiently radical alteration in our surroundings, the developed instincts in their relative powers may be utterly inefficient for the fresh environment. Modern civilisation tends to the safety of the individual without any very great trouble on his part, and the emotions of fear, anger, and repulsion are not, in such a state, called very frequently into action—at any rate, with any great intensity of tone. Much of the nerve force associated with these emotions is transferred to other conative activities, with results that are useful to the individual as long as he is living under the conditions of civilised life to which he is accustomed.

The Emotions in Warfare.

But under the conditions of modern warfare the emotions of fear and disgust particularly are called into frequent and violent activity. And not only is there a sudden and intense evocation of unaccustomed emotions, but the end-results and conative aspects of such emotions, so far from being given free play, are expressly forbidden, both by the idealistic conceptions acquired during childhood and early life and by vigorous punishment from fellow-men. Thus in modern warfare men are daily put into positions of imminent danger; the danger to life under certain conditions of military duty may be so great as to render death a practical certainty. In such situations men, if they are normally constituted, experience fear, and, under ideal conditions of such a position, would run away. As it is, self-respect and military discipline prevent this normal end-result, and such men proceed to fight in direct disobedience to their instinct. The helpful influence of the emotion of savage anger against their adversaries is not felt with any intensity. The disgust at the unaccustomed sights and sounds of conflict is not allowed to manifest itself in the normal way by repulsion, so that under these conditions three of the most powerful instinctive activities are distorted.

How utterly abnormal from the biological standpoint such a situation is may be inferred if we take analogous cases in the lower animal world and imagine a rabbit confronted by a hungry fox. If we further imagine the rabbit to be an idealist he might be tempted, for abstract reasons, to fight the fox, and the result would be obvious, and from the point of view of natural selection wise. Such a situation between two such animals is inconceivable, but if in place of abstract reasons the rabbit was fighting in defence of its young, then, whatever the result, the incident would be natural and the animal would probably fight more efficiently.

If we consider the above seven primary instincts we see that they are divisible into two groups, members of each reinforcing each other and antagonising those of the other group. Into one of these groups fall the emotions of fear, disgust, and self-abasement, with their associated impulses; into the other anger, self-assertion, wonder, and tenderness felt for offspring. A sense of inferiority combined with disgust reinforces the feeling of fear and renders the impulse to fly more powerful, whereas fear may be diminished by anger, a sense of superiority, and especially by the activity of the tender emotion. Unfortunately the tendency of modern warfare is to give play to the emotions of the first group without developing those of the second, and also to produce emotional tone without allowing the associated impulses to come into action. The elaborate inculcation of a hatred for the enemy and of a conviction that he is fighting in defence of his hearth and home are undoubtedly useful in lessening the destructive emotions of the first group in the case of the fighting man.

¹ THE LANCET, 1918, i., 365.