TYPHOID FEVER IN A MENTAL HOSPITAL.

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The cultural and Serological Characteristics of, and the Effect of Several Forms of Treatment on, 12 Chronic Carriers.

The Effect of Typhoid fever on the Mental States of Patients.

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THESIS

submitted by

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I desire to thank the Medical Superintendent for giving me permission to make the necessary investigations and also for the advice he gave me with reference to the mental side of the question.

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In May 1922 there died in Hawkhead Asylum, a patient who had been ill for some days with obscure symptoms. The post-mortem findings were strongly suggestive that the cause of death was typhoid fever and this proved to be correct. Previous to this event there had been several outbreaks of what was diagnosed as influenza of the gastric type. This diagnosis was probably influenced by the epidemic of influenza in 1918-21. The findings in the case first mentioned led to the suspicion that perhaps some of these other cases were also due to infection by the bacilli typhosi. Accordingly serological and bacteriological examinations were made in all such cases, and in several of them, the suspicion was proved to be well founded. Since then, and until a few months ago 72 definite and ~~21~~ 9 possible cases of typhoid fever have occurred in the Institution. This number includes fourteen carriers. Although I have included all the typhoid carriers in the number of cases of typhoid fever, ten of them had no recorded illness which was suggestive of this fever.

The outbreak gave me the opportunity of making some observations, bacteriological, serological, therapeutical and clinical, on undoubted cases of typhoid fever and on typhoid carriers. The purpose of this thesis is to use the observations made as a basis for the discussion of the following points:-

(1) The periodicity, if any, of the incidence of bacilli typhosi in the urine and faeces of twelve typhoid carriers,/

carriers, and, as arising from this, the difficulties encountered in dealing with an outbreak of typhoid fever in a mental hospital. Two different strains of B.Typhosi.

(2) The effect of several forms of treatment on the excretion of Bacilli Typhosi in the urine and faeces of these carriers.

(3) The post-mortem appearances of patients who suffered from Typhoid fever, and who died as a result of some other condition, at long intervals after their attacks of typhoid fever.

(4) The post-mortem appearances and cultural characteristics of two proved typhoid carriers.

(5) The effects of typhoid fever on the mental states of patients.

I shall now give a brief account of the literature bearing on the subject.

Muir and Ritchie (17) say that in the great majority of cases of typhoid fever, the bacilli disappear from the faeces in two to ten weeks of the convalescence. They put the proportion of carriers at from 2% to 5% of recovered cases. According to them, some carriers continue to excrete the causative organism for periods up to fifty years after the attack of the illness. Women, they hold, form the great majority of carriers. They remark on the greater prevalence of gall-stones among women and lay stress on the fact that,

as/

as women are more concerned in the preparation of food, they are more liable than men to spread their infection. Additional dangers arise from the fact that carriers may suffer no personal inconvenience or may have only slight symptoms referable to the gall-bladder, while there are others who may ingest the bacilli and in whom the bacilli may multiply without causing any symptoms of typhoid fever to the host. These people are either naturally immune to typhoid fever, or may have suffered from a previous attack, yet they act as sources of infection to others. Muir and Ritchie emphasise the difficulties which arise in tracing carriers. They recommend that the blood serum of all suspicions persons should be subjected to the Widal test, but, at the same time, they point out that some undoubted typhoid carriers may show a negative reaction to this test. They remind one that definite proof of a person being a carrier lies in the isolation of B. Typhosi from the faeces or urine and remark on the fact that several months may elapse between the times of the isolation of the organism from the excreta. They quote that several explanations of this periodicity have been put forward, and these try to ascribe the periodic excretion of the typhoid bacilli to symptomless re-infections, or to periodic auto-infections from some latent focus of the organisms in, for example, the gall-bladder.

Paul (26) writing on carriers generally, says that the apparent absence of disease in them may be due to one of the following causes:-

(1) The carrier may have a well marked general immunity, natural or acquired, to the disease caused by the organism he harbours;

(2) He may have a general but not a local immunity, thus causing local infection without general invasion;

(3) He may be too slightly infected to show any symptoms; or,

(4) He may be in the incubation period of the disease caused by the organisms; this period being prolonged to an unusual extent.

On page 11, (27) he refers to three kinds of typhoid carriers, faecal carriers, urinary carriers and pus carriers. The first group, he says, form 93%, the second nearly 7% and he states that the third group, the pus carriers, are exceedingly rare. He says that women and children form the large majority of typhoid carriers. The former, he declares, constitute 66% of the temporary and 80% of the chronic carriers, while only 0.8% of all male convalescents from typhoid fever become chronic carriers. With regard to the general population of England he states that 3 people in every 1,000 are chronic carriers of typhoid fever. Referring to the Widal reaction, he remarks that some chronic carriers may react negatively to this test, while some people, who have never suffered from typhoid fever, may show positive Widal reactions.

In this institution all the typhoid carriers were females. Mentally affected persons react very differently to physical/

physical symptoms and so it is difficult to judge the actual numbers of ambulatory cases of typhoid fever. Symptoms which, although mild, might make a sane person take to bed might never be a cause of complaint in an insane person.

In the numerous Widal reactions, which I performed, I discovered anomalies in the results. The Widal results will be referred to later.

From the findings in bacteriological examinations it will be seen that there was great variability in the periodicity of the incidence of Bacilli Typhosi in the excretions of the Typhoid carriers examined by me. (see results in appendix).

There were 72 known cases of typhoid fever in the institution. 63 females and 9 male patients were affected. There were 14 female typhoid carriers and no male carriers. The percentage of female carriers to known female cases of typhoid fever was 22%. The percentage of carriers to total known cases was 19.4% and the percentage of carriers in the total of 81 possible cases of typhoid fever was 17.28%.

Price (31) places the percentage of typhoid carriers at 5% of all convalescents from typhoid fever. He says that the carrier phenomena may last for months, or even for years, and that these carriers may manifest no symptoms or they may suffer from periodical attacks of intestinal trouble or from symptoms referable to the gall-bladder.

According/

According to him typhoid bacilluria occurs in 25% of cases of typhoid fever but he adds that this bacilluria is only temporary. He remarks that the direct influence of human carriers is responsible for most endemic cases of typhoid fever, although he admits that the organism of typhoid fever may exist for a long time, and may even multiply, in sewage contaminated soil. On page 73 (32) he goes on to say that, in convalescents from typhoid fever, an arbitrary period of 3 months should be allowed before the carrier condition can be said to become chronic. On page 74 (33) he lays stress on the dangers of typhoid carriers when they are working with foodstuffs. He suggests that such carriers should observe scrupulous care in washing their hands after defaecation or micturition and he advises the use of individual towels.

The detailed results given in the appendix show the different classes of carriers. Some of the carriers were only transitory, whilst some were very chronic. In the cases here most of the patients showed typhoid bacilli in in their urine during the course of their illness but this usually ceased in 4 to 5 weeks with the result that we had only three cases who were purely urinary carriers.

Masters (16) gives the proportion of female to male carriers as 5 to 1. He remarks on women having gall-stones oftener than men. According to him symptoms of gall-stones occur in 14% of recovered cases of typhoid fever. He gives as a cause of the increased carrier rate in women the fact/

fact that during the menstrual periods and puerperal periods there is a decrease in the alexins of the blood. In our epidemic we had no male carriers. We have had no recorded cases of symptoms referable to the gall-bladder in cases who have recovered from typhoid fever. I performed autopsies on 4 patients, who had recovered from typhoid fever, and who died of some other condition. In two of these cases I found gall-stones in the gall-bladders. One gall-bladder contained one stone and the other contained 7 gall-stones. The number of autopsies was small and so I was unable to form an opinion as to whether or not there was any definite increased tendency to gall-stone formation in patients who had suffered from typhoid fever; but from the figures at our disposal there appears to be an increased liability to gall-stone formation after typhoid fever.

McCallum (20) refers to the part played by bacteria in the formation of gall-stones, and of the finding of Bacilli Typhosi in the centres of the stones. The clumping of the bacteria is suggested by him as forming a nidus for the formation of gall-stones, while, on the other hand, he maintains that B. Typhosi can penetrate stones already formed. Cultures were made from the centres of stones obtained at post-mortems on the patients referred to above. Bacilli Typhosi were never obtained from any of the stones. In the greatest number (5) the cultures were sterile, but on 3 occasions/

occasions coliform organisms were obtained. These coliform organisms may have been due to contamination.

Beattie and Dickson (3) remark on the part played by B. Typhosi in the causation of cholangitis. They state that during the attack of typhoid fever, the gall-bladder frequently becomes infected with B. Typhosi, and they attribute recurring attacks of typhoid fever in the same individual to the causative organisms living for prolonged periods in the mucosa of the gall-bladder. The escape of these organisms, from time to time, is, according to them, responsible for out-breaks of typhoid fever in asylums, work-houses and similar institutions.

Rose and Carless (42) also refer to this lodgement of B. Typhosi in the mucosa of the gall-bladder, and speak of the periodic escape of the organisms. (43) In the same edition they remark on local affections such as abscesses being caused by B. Typhosi and they draw attention to the fact that these organisms may be latent for years before suppuration occurs.

Rose and Carless (44) also remark on the organisms having a special predileetion for the gall-bladder, where they have the power to remain for years after the primary attack of typhoid fever.

In a post-mortem, which I performed on a patient who died as a result of the perforation of a typhoid ulcer, I found that a swab taken from the gall-bladder contained huge numbers of B. Typhosi in pure culture.

Rose/

Rose and Carless go on to say that the periodic escape of B. Typhosi from the gall-bladder may cause epidemics of the disease and yet their saprophytic existence may cause no harmful effects to the host.

Parkes and Kenwood (22) say that in the United States of America 1 in 500 to 1 in 250 of the general population is a typhoid carrier. They say that female chronic carriers are about four times commoner than male carriers, and that gall-stones occur about four times more often in females than in males. They assert that the bacilli of typhoid fever have the power of precipitating cholesterin from the bile, and so cause the formation of gall-stones. They say that the focal deposits of B. Typhosi in the gall-bladder, the pelvis of the kidney and the tubules of the kidney, are probably determined by pre-existing lesions in these sites and, as these lesions are more common in middle age and in females, middle-aged female carriers are the more common.

In the same article they remark on the fact that carriers sometimes show negative Widal reactions. In this institution one of our typhoid carriers had a negative Widal. She was A.A., No. 1 in the list of carriers. Her Widal reactions are given in the appendix. The Widal reactions of the three urinary carriers were as undernoted.

(Table - next page)

Name.	Date.	Result.	Date.	Result.	Date.	Result.
No.2 (Ana A.)	26.4.23	T + 1/160	8.9.23	T + 1/80	22.1.25	T + 1/80
No.4 (A. C.)	10.8.23 15.6.26	T + 1/80 T + 1/80	19.9.23 23.11.27	T + 1/80 T + 1/40	22.1.25	T + 1/160
No.9 (Mrs O.)	28.3.23 23.11.27	T + 1/640 T + 1/80	22.1.25	T + 1/160	15.6.26	T + 1/80

It will be seen from these results that the three urinary carriers showed a fairly high positivity in their blood Widal reactions and that this positivity was greater than that of most of the faecal carriers.

Rolleston and Somers (36) refer to the high carrier rate in Asylums. They state that, in the Brooklyn State Hospital, the faeces of 576 female patients were examined for B. Typhosi owing to an outbreak of Typhoid fever, and that eight chronic carriers were discovered. In this asylum 14 chronic female carriers were discovered from a population of about 400 female patients. They strongly emphasise the advisability of inoculating all inmates of asylums against typhoid fever. Some time after the start of the epidemic here all nurses, handling active typhoid cases, recovered cases and typhoid carriers, were inoculated against typhoid fever, and, after this had been carried out, there have been no cases of typhoid fever among the nursing staff. The carrier rate here was higher than that given for the general population.

As regards the sources of infection let me quote extracts from some authorities on the subject. (34) Price remarks on the danger of fruits and vegetables being contaminated by the organisms of typhoid fever, and draws attention to the spread of the disease by the eating of oysters and other shell-fish from sewage contaminated water. He says that some persons have been infected by bathing in such water.

Stiff (48) states that, only with extreme rarity, have typhoid organisms been isolated from water supplies, and that the life of the bacilli in the water of streams is a very short one. He quotes Kayser as saying that, in Strasbourg during an epidemic of typhoid, 27% of cases were traced to raw milk, 17% to contact with typhoid fever and 10% to typhoid carriers while others were due to infected food, and 13% of cases were of origin impossible to determine. He does not attach the same importance to fly dissemination as do American authors.

Ledingham and Arkwright (14) say that Drigalski proved that bacilli Typhosi may lead a prolonged saprophytic existence in the human body. He (Drigalski) examined periodically the stools of 64 cases of typhoid fever, and recorded the following results:-

(Table - next page)

Time of the disease.	Typhoid bacilli present.	Percentage.
1st to 5th day.	10 cases	15.5
5th to 10th day.	15 cases	23.4
11th to 20th day.	21 cases	30.0
21st to 27th day.	8 cases	11.5
after 8 to 10 weeks	7 cases	11.0
after 3 months later	2 cases	4.7

In one of these cases B. Typhosi formed 50% to 60% of the total flora nine months after the attack of typhoid fever. They state that Drigalski recorded the first case of a female chronic carrier, who apparently gave no history of having passed through an attack of typhoid fever. 10 of our known carriers had no illness which was suggestive of typhoid fever.

Dyke (11) described the case of a woman who passed through an undiagnosed illness and then developed an abscess of the breast. This abscess had no apparent association with underlying bone. A pure culture of B. Typhosi was recovered from the pus, her stools also contained B. Typhosi and her blood Widal was negative.

Browning (4) remarks on carriers sometimes showing negative Widal reactions, and asserts that no other procedure can replace the extensive bacteriological examination of the faeces and the urine of suspected persons. He draws attention to/

to the possible danger of prophylactic inoculation being responsible for a greater percentage of chronic carriers among recovered cases of typhoid fever. It is impossible, he says, to determine how many negative examinations must be made after an attack of typhoid fever, before the patient is said to be unlikely to become a chronic carrier of typhoid organisms.

Parkes and Kenwood (24) say that, during the disease, the bacilli are most numerous in the stools during the 3rd and 4th weeks, and they quote cases of contacts who pass the organisms in their stools, but never seem to suffer in any way in health. They state that 75% of chronic carriers are women. It is pointed out by them that Dr Davies, M.O.H. of Bristol, noted that the months of May and June were those in which the bowel discharges of chronic carriers resumed infectivity.

In my examinations of twelve typhoid carriers I did not get any regular increased infectivity of the stools that could be assigned to any definite period of the year.

With reference to the viability of bacilli Typhosi I now quote some remarks of Greene. (12) He says that B. Typhosi may live for months in superficial soil, and in faeces, unless exposed to direct sunlight, and other conditions unfavourable to their viability. He also says that the bacilli may live for months in milk, butter and cheese. Outside the body, the bacilli resist cold and moderate dry heat; but fortunately

direct sunlight destroys them in a few hours, and they are readily killed by ordinary antiseptics. I personally had proof of these facts. I tested several antiseptics by means of the Reidal-Walker test and found that, whilst some of the commoner ones such as lysol and bactecine, had a marked lethal effect on B. Typhosi, certain new proprietory preparations were only effective in strong solution. Greene, in the same article, says that, if saprophytic organisms be present, Typhoid bacilli live but a few days in water. In ice they rarely live longer than 10 to 14 days, but, in rare instances, B. Typhosi have been recovered from surface ice after a period of nearly five months. I have had no experience of their viability in ice. Referring to the distribution of the organisms in the body, Greene says that almost any bodily fluid, secretion or excretion, may contain B. Typhosi during the attack.

Osler and McCrae (21) state that cultures of B. Typhosi are killed within 10 minutes by a temperature of 60°C. In my investigations, I found this to be the case. They say that sometimes B. Typhosi may live for 18 weeks at a temperature of -5°C; although most of them die in about 2 weeks at that temperature. According to them B. Typhosi can resist ordinary drying for months unless they are in very thin layers when they are killed in 5 to 15 days. They say that direct rays of the sun kill the organisms in 4 to 10 hours and buillon cultures are readily destroyed by 1/200 carbolic acid and by 1/2,500 corrosive/

corrosive sublimate. From experiments I got similar results.

As regards the pathogenicity of bacilli Typhosi Stift[49] says that, in experiments on higher apes, there was evidence that the bacilli eliminated by carriers are, in many instances, non-pathogenic. He says that about half of typhoid cases are believed to be due to contact infection, and that the water transmission factor is of less importance than was formerly thought. In our epidemic the water supply, milk supply and sewage were investigated and these were all proved to be free from typhoid contamination, and it was concluded that the origin and spread of the disease was due to direct contact with typhoid carriers or with an active case of the disease.

Park and Williams[22] give an account of "Typhoid Mary", and quote her as a case illustrative of the dangers of a chronic carrier of typhoid fever. This woman was a cook in America. When her history was traced, it was proved that she had been responsible for the infection with typhoid fever of, at least, sixty persons. When her condition was realised, she was placed under detention, but she broke her parole and infected a number of others before she was again apprehended and detained. During her first period of detention her excreta were examined every few days, and it was found that at times her faeces contained enormous numbers of typhoid bacilli while at other times, for days, no typhoid organisms could/

could be detected on her faeces. This history of "Typhoid Mary" extends from the year 1901 until 1905.

As regards the treatment of Typhoid carriers I shall give the statements of a number of authorities.

Parkes and Kenwood (25) state that sour milk treatment, (lactic acid bacilli and b. Bulgarici) urotropin and salol for the disinfection of urine and faeces, and the application of Rontgen rays have all been tried, without success, for the cure of carriers. They hold that autogenous anti-typhoid vaccines are of some value in certain cases which have not passed into the very chronic stages. According to them, no known medical treatment is of much utility in chronic cases. They say that the serum, of those who merely harbour B. Typhosi as saprophytes, has generally no agglutinative powers. In the appendix I give the bacteriological findings of the faeces and urine of three carriers to whom I gave courses of autogenous vaccines. The course of vaccines had the effect of reducing the numbers of typhoid organisms excreted, and apparently of decreasing the viability of these organisms, but the carrier state was not cured.

Paul (26) talking of attempts to cure carriers, advises Hexamine in full doses, combined with increasing doses of autogenous vaccines. He declares that this form of treatment often succeeds in curing urinary carriers. For faecal carriers he suggests that X-ray treatment of the gall-bladder may/

may be beneficial. However, like most modern authorities he does not place much reliance on the efficacy of any form of treatment.

Whitla (53) states that 3% of recovered typhoid cases become carriers. This, he says, would mean 108,000 carriers for England and 1,400 carriers for London. He states that the administration of urotropin, citrate or bi-carbonate of potassium etc. does no more than lessen for a time the number of typhoid organisms excreted, but is futile for the permanent sterilisation of the typhoid carrier.

Price (35) asserts that the medical treatment, surgical treatment and treatment by autogenous vaccines have all failed to solve the carrier problem. He says that preventive inoculation of contacts is the most effectual method of limiting the dangers of carriers. Some carriers, he states, give no history of ever having suffered from an attack of typhoid fever, yet they may themselves ultimately develop an attack of the fever, or may suffer from typhoid septicaemia after operations on the gall-bladder or kidneys.

Munro (18) holds that typhoid patients should be kept under observation until it is certain that they cannot act as carriers of the infection. He suggests that urinary carriers should be treated by 10 grain doses of Hexamine several times daily, and that typhoid carriers of both classes (faecal and urinary) should be treated with increasing doses of an autogenous vaccine/

vaccine and, if this fails, he thinks that in certain cases it may be justifiable to drain the gall-bladder.

Paul, (29) quoting from Cruikshank's article, "A Note of the Value of Prophylactic Inoculation in the Prevention of Chronic Carriers of Typhoid and Paratyphoid Bacilli," which appeared in the Indian Medical Gazette LIX, 1924, pp. 232-33, says, as regards the convalescent carrier state, that Cruikshank has found that it develops with less frequency in individuals who have been subjected to prophylactic inoculation with T, A and B vaccine than in those who have not been so inoculated, before they became infected with typhoid fever. In a series of 1886 cases of typhoid fever, he noted the carrier state arising in 3.2% of the uninoculated and in only 0.5% of the inoculated. Further, of those inoculated with typhoid vaccine 0.56% became carriers, while only 0.03% of those inoculated with T, A and B vaccine became typhoid carriers. In the same book, (28) Paul recommends the use of Hexamine, grams 15 thrice daily, from the third week right through the convalescence, to guard against the cases developing into urinary carriers. Further, he says that when, in a case of typhoid fever, pains arise in the region of the gall-bladder, steps should be taken to eradicate the infection from this viscus.

As regards operative treatment of carriers of typhoid fever, let me give the following facts taken from the literature on the subject.

Pomeroy/

Pomeroy and Shen (30) quote a case which was operated upon for acute cholecystitis without calculi. Bacilli Typhosi were obtained in pure culture from the gall-bladder. In this case, there was a definite history of typhoid fever forty-one years before the operation, and there was no history of gall-bladder trouble in the interim. They proceed to refer to other cases, where the organisms of typhoid were recovered from the bile many years after the original attack of typhoid fever. They quote Kher (Kher, Hans. Chirurgie der Gallenwege Stuttgart, Enke 1913, p. 195) as having advised cholecystectomy and drainage of the hepatic ducts until B. Typhosi are absent, and they say that he reported that, out of 10 cases treated in this manner, 8 were successful. Regarding the case they mention above, they say that the patient was attended by the father of one of them 47 years before, and his ailment, at that time, was undoubtedly typhoid fever. When the patient came to them he was suffering from cholecystitis. They operated on him but his physical condition did not permit of excision of the gall-bladder, so they inserted a drainage tube. On the day of the operation, and during a period of 31 days following it, B. Typhosi were recovered, in pure culture, from the bile. The blood, faeces and urine were persistently negative to b. Typhosus, b. para-typhosus A and b.para-typhosus B. They maintain that the ideal operation on typhoid carriers ~~to~~ is cholecystectomy combined with drainage of/

of the hepatic duct until no bacilli Typhosi are present in the discharge.

Vosberg and Perkins,(51) who report 7 illustrative cases, recommend that, in operations for the cure of typhoid carriers, the appendix as well as the gall-bladder should be removed. They point out that the appendix is usually the seat of acute inflammation during the course of the fever, and may be the source of continual pollution of the intestinal tract at other times. In six out of seven cases which they report, typhoid or paratyphoid bacilli, were found in the appendix as well as in the gall-bladder. In the remaining case the gall-bladder as well as the appendix were both negative to B. Typhosi.

Silk and Deist(47) are said to have reported the case of a girl aged 20 years, who excreted the bacilli of typhoid fever from one kidney. Specimens were taken by means of the uretral catheter. Urinary anti-septics were tried unsuccessfully, and only when the kidney and its ureter were removed, and the bladder repeatedly washed out with a urinary antiseptic, did she cease to excrete typhoid bacilli in her urine. They say, that when only one kidney is involved, removal of it and its ureter offers greater prospects of success than does cholecystectomy in a faecal carrier.

We could not get permission to have operations performed on any of our carriers and so I did not get any proof/

proof of the benefits of operative procedure.

Murstad (19) records the findings in necropsies on 22 typhoid carriers. In the majority the liver, as well as the gall-bladder, contained B. Typhosi. He maintains that the gall-bladder is the only permanent abode of the B. Typhosi in intestinal carriers, and therefore if the gall-bladder be removed, he says that the liver will soon cease to be contaminated. His observations lead him to recommend cholescystectomy in preference to cholecystotomy. In cases where the operation failed, there were other foci of infection in the intestinal tract. He has little good to say of vaccine treatment of typhoid carriers, but he allows that drugs of the formaldehyde group frequently sterilize urinary carriers of typhoid bacilli.

I performed post-mortem examinations on 2 proved typhoid carriers but I did not find typhoid organisms in the gall-bladders of either of them. One of them, No.1 in my list of typhoid carriers, had shown no typhoid organisms in her faeces or her urine in about 50 examinations for about 7 months prior to her death. The faeces and urine of the other case, No. 10 in the list of carriers, were examined twice weekly, for almost a year and were negative to B. Typhosi on all occasions except one, when, about a week before she died, both her faeces and her urine contained B. Typhosi. I performed a post-mortem on her, but permission for the necropsy/

necropsy was not granted until 2 days after her death, and her gall-bladder contained no living typhoid organisms. These organisms may have been present but, as there was an abundant growth of b. coli, they may have died before the post-mortem was performed. Unfortunately the appendix was not examined bacteriologically.

Rolleston, (37) says that in estimating the effectiveness of any method of treatment, the intermittent nature of the carrier state must be borne in mind, as well as its tendency to cease altogether spontaneously. He states that drug treatment, operative treatment and vaccine treatment have shown inconstant results. He admits that cholecystectomy was performed, with success, in several faecal carriers, but says that cholecystectomy is ineffective when the bile ducts are involved as well. In the case of urinary carriers, nephrectomy has been performed with good results. It goes without saying that, in those urinary carriers, only one kidney could have been involved.

The outbreak of Typhoid fever in this institution started early in the summer of 1922 and the last cases occurred early in the spring of 1927. Altogether there were 72 known cases. 63 cases occurred among female patients and 9 cases among the male patients. The total number of isolated carriers was 14. This gives a carrier rate of 19.4% of all cases of typhoid fever. All the carriers were females so that the percentage of carriers to females who suffered from definite/

definite typhoid fever was 22%. Of the 14 carriers I examined 12 in detail, and of these twelve carriers 3 were chronic carriers who excreted B. Typhosi in great numbers on frequent occasions, 5 were carriers who excreted the causative organisms in small numbers and on rare occasions, whilst the remaining four were patients who had their excreta examined twice weekly for about a year without B. Typhosi ever being isolated. Of these 12 carriers 9 were faecal carriers and 3 were urinary carriers. Of the latter three one, (A. S.), had bacilli typhosi in her faeces on 23.4.25, and on 16.11.25 she had these organisms present in her urine. The faeces on this latter date were negative to B. Typhosi. Therefore according to my results these were 10 faecal carriers and 2 urinary carriers. All carriers were removed to an isolation ward when they were discovered.

The methods of searching for carriers were as follows. In the early part of the outbreak all patients who were known to have suffered from disease of an influenzal type, were brought under suspicion and were subjected to blood Widal tests. A gastric type of influenza had been concurrent with the start of the typhoid epidemic. All the patients with positive blood Widals had their faeces and urine examined bacteriologically about 12 times. If their histories were suspicious, longer examinations were conducted. This method was responsible for some typhoid carriers being isolated. To augment this method, the faeces and urine of those having had/

had suspicious illnesses, but whose blood Widals were negative to B. Typhosus, were examined bacteriologically. This resulted in one carrier being discovered. Latterly, when a case of typhoid fever occurred in a ward, all patients in this ward had their blood examined for the Widal reaction. All those with positive Widals were brought under suspicion, and those patients also were subjected to a routine bacteriological examination of their faeces and urine. At an early stage in the epidemic, the blood sera, of all those handling foodstuffs and all those engaged in laundry work, were examined for the Widal reaction. This latter procedure yielded no positive results and the method previously mentioned was proceeded with. This method was responsible for the successful combating of the outbreak.

We were quite satisfied that the cases, which occurred among the male patiente, were cross infections from the female side. How this occurred we could not decide definitely. In the main dining hall at the asylum, and in the dining hall at the hospital, the different sexes were seated at different tables, but as the tables are fairly close together, a male patient, when he was passing out of the dining halls, could easily pick up a particle of food from a table reserved for female patients. On the other hand the infection could have been spread by flies, rats or cats carrying infection to food. The latter explanation is possible but is not probable.

During the examinations for the Widal reaction a few points of interest arose. One of the cases, which was clinically typhoid fever, and in whom the faeces and urine cantained bacilli Typhosi, never had a positive Widal reaction. The Widals were done against the antigen prepared at the Oxford Laboratories and also against an antigen which was prepared from the strain that was being isolated in this hospital during this epidemic. The results in her case were as follows:-

Blood Widal Reactions.

Date.	Result.
16.6.22	Negative in dilution of 1/20 to T.A. & B.
29.6.22	Negative in dilution of 1/20 to T.A. & B.
4.7.22	Negative in dilution of 1/20 to T.A. & B.

	Result.	
Date.	Faeces.	Urine.
3.7.22	B. Typhosus isolated	Negative
26.8.22	B. Typhosus isolated	B. Typhosus isolated
11.9.22	B. Typhosus isolated	Negative
20.1.23	Negative	Negative
29.6.23	Negative	Negative
18.8.23	Negative	Negative
18.12.23	Negative	Negative

This patient was H.H. or M.

Another case with a persistently negative Widal reaction was A.W. Her blood Widal was negative to T.A.& B. in a dilution of 1/20 on the following dates.

29.6.22
4.7.22
10.7.22

Bacilli typhosi were isolated from her urine on 3.7.22. An actual carrier always had a persistently negative blood Widal. She is the first carrier mentioned on the appendix and the data of her examinations are given there. A male patient during the course of his attack of typhoid fever, had a blood Widal which was strongly positive to B. Typhosus, and then, after about a week's interval the Widal was found to have become negative. His blood serum was examined on two subsequent occasions, at weekly intervals, and was still found to be negative to B. Typhosus in a dilution of 1/20. Prior to this alteration in the Widal reaction he had three large haemorrhages from the bowel on 11th, 12th and 13th February, 1924, and he was very collapsed. The blood Widal results were as follows:-

Date.	Result.
13.2.24	Positive 1/160 T. A.o. B.o.
3.4.24	Negative T.A. & B. 1/20
5.4.24	Negative T.A. & B. 1/20
7.4.24	Negative T.A. & B. 1/20

The great loss of blood may have been responsible for the alteration in the Widal reaction. His faeces and urine were examined 31 times each from 13.2.24 until 17.1.25 but on all occasions they were negative to B. Typhosus.

Another case of interest is that of I.G.,one of the carriers. During a routine examination of one of the wards, where a case of typhoid fever had occurred, she was found to have a negative blood Widal to T. A. & B. in a dilution of 1/40. However, as she was under suspicion because she had been a close contact of the patients who were suffering from typhoid fever, her faeces and urine were examined bacteriologically. By these examinations she was proved to be a faecal carrier, and she was accordingly isolated. At a later date her blood Widal was found to be positive to B Typhosus. Between these two dates she had shown no clinical symptoms which were even suggestive of typhoid fever.

Her Widal reactions were as follows:-

Date.	Result.
24.4.23	Negative to T.A. & B. in dilution of 1/40
14.7.24	Negative " " " " " " " "
22.1.25	Positive to T. 1/80 A.o. B.o.
28.1.25	Positive to T. 1/80 A.o. B.o.

The bacteriological results of her faeces and urine are given in the appendix.

This patient is a crippled mental defective, and it is possible that she had slight symptoms about which she did not complain and which were not observed during this time. A patient who as attacked by typhoid fever, just prior to the isolation of I.G. admitted that she was in the habit of helping I.G. to dress. In this way she undoubtedly contracted her infection from I.G.

The last two carriers isolated were interesting in the following respects. One had her faeces and urine examined by me on almost 100 occasions with negative results. She had a positive blood Widal and on this account her excreta were persistently examined bacteriologically. During these examinations I discovered, on several occasions, colonies on McConky's plates which showed acid and no gas with mannite. These colonies resembled typhoid colonies in appearance, they gave varying results with glucose, dulcite, sacchorose, maltose and litmus milk, but never at any time did they give a sequence of results which pointed to the colonies being composed of typhoid organisms. Neither did they suggest that they were either the "S" or "R" forms as described by Arkwright and to which I shall refer later. Nevertheless, I grew these organisms on agar-agar and bouillon and tried to agglutinate them with specific typhoid serum. I failed to

get/

get them to agglutinate although I sub-cultured them three times. However, after I ceased to work in the laboratory, bacilli typhosi were isolated from her faeces by the Glasgow Public Health Department.

The other carrier was J.G., who also was discovered by the Glasgow Public Health Department. She was a patient who had been, on several occasions, removed from one ward to another, and, as it happened, she was never in a ward when I was conducting a routine examination therein. I was in the habit of getting the names of all patients in a ward, from the sister in charge and I used her lists when I was examining the patients. When she was discovered she, like the other carriers, was isolated. After a few months this patient died but unfortunately permission for a post-mortem examination was not granted. Undoubtedly she had been responsible for several of the sporadic cases.

Whilst conducting the bacteriological examinations of the faeces and urine of typhoid cases and typhoid carriers I met with an interesting point regarding the naked eye appearances of typhoid colonies on MacConkey's medium. This occurred with the plates from the faeces of I.G., one of the chronic carriers. One day she had no typical typhoid colonies on the medium, but there were numerous non-lactose colonies which were about three times larger than the usual colonies for which I looked. Instead of the typical smooth, flat, greyish/

greyish "dew-drop" appearance they had brownish centres, greyish periphery, rough surface and irregular outlines. There was no areola round them and they had not a "heaped up" appearance, so in these respects alone did they agree with the appearance of typhoid colonies. I inoculated tubes of mannite with some of these colonies, and found that they gave an acid reaction and formed no gas. They gave the reactions of typhoid colonies with glucose, saccharose, dulcite, maltose and litmus milk. A growth from them on agar-agar agglutinated readily with specific typhoid serum. On several occasions I found similar colonies in the faeces of I.G. and also in the faeces of Mrs K. I endeavoured to find out if any alteration in the patient's diet, or in the media, caused this alteration in appearance but I failed to arrive at any explanation of this difference. On account of this I always examined, very carefully, any non-lactose colonies which were not heaped up, which did not have an areola and which were not very opaque. Lockhart (15) is quoted to have found that diet had no influence on the appearance of B. Typhosi in the excreta.

These results suggested that these colonies were composed of the "R" form of B. Typhosi as described by Arkwright (1) with reference to this he says;

Two similar forms have been obtained from four strains of B. Typhosi. These two strains are distinguished culturally from their manner of growth in broth. They are called the "S" form/

form and the "R" form. The "S" form makes stable emulsions in physiological salt solutions. The "R" form yields emulsions which agglutinate in salt solution (0.85% Va. Cl.) without the addition of specific typhoid serum. The two forms are distinguished culturally from their manner of growth in broth. The "S" form causes uniform turbidity and very slight deposit, while the "R" form causes large deposit and sometimes a surface film but leaves the broth clear. The appearance of the colonies on agar-agar is different. The "S" form appears as smooth, round, domed, shiny and translucent colonies and the "R" colonies have a more or less rough, jagged outline, have irregular rough or dull surfaces, are flatter and are slightly opaque. The two forms are identical as regards the effect with sugars, the absence of indol production and the presence of motility. Both seem to remain distinct when subcultured, but a change from one form to another may occur under special circumstances. Frequent sub-culture seems to favour the "S" form and prolonged periods without sub-culture seems to promote the appearance of the "R" form.

In another article Arkwright (2) again refers to the "S" and "R" forms of intestinal bacteria. He gives similar information about them and adds that they cannot always be distinguished by their 'naked-eye' appearance. He says that their behaviour, on agar-agar and in broth, must be examined. On p.40 he says that the source of the "R" form is almost invariably/

invariably old broth or agar-agar cultures. They are readily got if one plates out agar-agar or broth cultures which have been kept for about a month at room temperature or in an incubator at the usual temperature. On page 55 he says that occasionally colonies, suggesting the "R" form, occur on the first plates used for isolating organisms from faeces. On p. 57 Arkwright says that the "S" form, when agglutinated by specific serum, makes large clumps while in similar circumstances the "R" form makes small clumps and the deposit is readily shaken up into a turbid suspension.

The colonies to which I refer agreed in all respects with the "R" form, of B. Typhosi, as described by Arkwright. Dr Whitelaw prepared autogenous vaccines from these colonies and I inoculated I.G. and Mrs K. with these vaccines. This was in November 1926. Previous to this they had been inoculated with autogenous vaccines from the mixed "S" and "R" strains of B. Typhosi. They showed a slight increase in the agglutination titre. Their faeces were examined on about 8 occasions following their first injection with the vaccines. The organisms of typhoid fever were still present but they were few in number and were of lower vitality. Owing to a change in the staff I was unable to carry on with this treatment and with the bacteriological investigations. In the appendix I show the bacteriological results during this time. I feel, that if I had been able to continue with this treatment and

with/

with the necessary bacteriological investigations, that I might have met with more gratifying results. Still in the short time I did not find that inoculation with autogenous vaccines of the "R" strain acted as a cure for the carrier condition.

With regards to the treatment of typhoid carriers I came to the following conclusions:-

(1) Faecal carriers were not influenced by medicinal treatment. This agrees with the findings of most authorities on the subject. I cannot give a personal opinion on the affects of any form of treatment on urinary carriers as I was not working with definite urinary carriers when they were excreting B. Typhosi.

(2) Stimulation of the gall-bladder did not affect the excretion of B. Typhosi in any of the faecal carriers whom I examined. Five of the faecal carriers were given fel bovinum exiccatum in doses of 8 grains daily for 3 weeks. Two of these five excreted the causative organisms frequently and in large numbers, other two excreted the organisms infrequently and in small numbers and the remaining one had never excreted B. Typhosi during the year in which I examined them. According to authorities on Materia Medica and therapeutics this preparation increases the excretion and flow of bile. However, the administration of this preparation did not influence the excretion of B. Typhosi.

(3)/

(3) Three carriers, who excreted B. Typhosi in their faeces, were given weekly increasing doses of autogenous typhoid vaccines. A detailed account, of the bacteriological and serological findings during and subsequent to the treatment, is given in the appendix. Each patient was given 12 injections, starting with 0.25 c.c.. and increasing by 0.25 c.c. until each was receiving 1 c.c. at an injection. Altogether each had a total of 10.5 c.cs. of the vaccine. The vaccines contained 500 million organisms per c.c so that each received a total of 5,250 million organisms.

My findings in these three cases were:-

(1) There was a marked increase in the positivity of their Widal reactions to B. Typhosus.

(2) The numbers of bacilli typhosi excreted and the frequency of the excretion was markedly decreased by the treatment.

(3) The viability of the organisms was affected to such an extent that, when I tried to grow these organisms on agar-agar slopes from the sugar media, I was unsuccessful on several occasions. By growing these organisms in bouillon and agglutinating direct I got a positive reaction. By this means I proved that the organisms were B. Typhosi. After a period of about 17 months I again examined their faeces and urine bacteriologically. During the latter examination I found that the carriers did not excrete many typhoid organisms. When typhoid colonies were present on/

on MacConkey's medium, there were very few colonies but the viability of the organisms was quite good. This latter course of examinations was after they had had both the ordinary autogenous vaccines and after I.G. and Mrs K. had had autogenous vaccines prepared from the "R" strain of organisms. From my results I was led to believe that the autogenous vaccines did no more than decrease the numbers of typhoid organisms excreted and decrease their vitality temporarily. In the appendix will be found detailed results of these courses of vaccines.

An attempt was made to obtain permission to operate on the gall-bladders of typhoid carriers. However, we were informed that, as an insane patient could not give valid permission, and as their relatives' permission was not legal, we could not arrange to have operations performed. This was unfortunate, for according to certain authorities, operative treatment is successful in some cases.

The mortality in our epidemic was about 13.5% of the cases. This is higher than the average given for the general population. The average mortality in the general population is about 5%.

I performed autopsies on 4 patients who died of intercurrent illnesses a long time after their attacks of typhoid fever. In all there was evidence of healed typhoid ulceration at the lower end of the ileum. Swabs from their gall-bladders/

gall-bladders were negative to B. Typhosus. Two had gall-stones, which were opened with due antiseptic precautions, but no growth of typhoid organisms was got from their centres. The post-mortem findings of the two carriers are given in the appendix. In both cases the gall-bladders contained no B. Typhosi. One gall-bladder contained gall-stones. In this case the centres of the gall-stones were sterile.

I shall now give some references to the effect of typhoid fever on the mental states of patients.

Craig and Beaton (6) whilst discussing disorders of emotion and sentiments, state that convalescents from weakening illnesses, such as typhoid fever etc., are very often very "nervy", excitable and emotional, and again, on p. 157, they add that depression is not uncommon during convalescence from an illness such as typhoid fever. They also quote many nervous symptoms, including hallucinations, as occurring in the typical course of the deliria of acute infective illnesses such as typhoid fever etc. They refer on page 203, to typhoid fever as being one of the causes of Korsakow's disease. They remark on p. 276, on the liability of convalescents from typhoid fever to suffer from hysteria.

Rosanoff (38) declares that "Primary Mental Confusion" is sometimes brought on by typhoid fever, the eruptive fevers generally, influenza and cholera.

Dieffendorf, (8) talking of "Infectious Deliria", says that this group comprises psychoses which seem to stand in/

in intimate relationship to the specific toxaemia of certain infectious diseases, including the initial deliria of typhoid fever, small-pox, etc.. He also states that, of the infectious deliria, the initial delirium of typhoid fever is best known. He says that Nissel reported definite degenerative changes in one case of infection delirium. The changes were similar to those produced by experimental intoxication, and so they tend to prove that we have to deal with a psychosis depending on intoxication. He says that Aschaffenburg distinguishes two forms of initial delirium of typhoid fever. In the first the delirium is not accompanied by psychomotor activity, whilst the second is characterised by great activity of this nature. In the first there are numerous and pronounced hallucinations, and delusions of a threatening and persecutory nature.

White (52) says that, speaking generally, fevers may be said to be measures of the mental stability of an individual. While some persons may remain mentally clear with a temperature of 106°F., others will become delirious with only a slight rise in temperature. Some patients will go through an attack of typhoid fever with little or no delirium, while in others, delirium is an early symptom and continues throughout the course of the disease. Infection delirium is found associated with typhoid fever, typhus fever, etc.. It usually takes the form of an acute confusion, but there may be delusions of a consistently disagreeable character, generally persecutory.

Our/

Our patients, who suffered from typhoid fever, were really mentally unstable before they were infected with the fever but, as I say in my reference to the effect of the illness on the mental state, there was no marked alteration in the ordinary course of the psychosis.

Craig and Beaton,(7) referring to febrile conditions and insanity, hold that hyperpyrexia, of whatever origin, is often associated with a mental disturbance which, in general practice, is called a delirium. They point out that in some cases this disturbance is so marked as to overshadow the underlying physical condition. Accordingly, they advise medical practitioners to examine thoroughly every patient suffering from acute delirious excitement. They say that many patiemts have been certified as being insane, and have been removed to an asylum, when, in reality, they were suffering from lobar pneumonia, typhoid fever or some other acute infection. On this account, they advise the physicians to make sure that the febrile state and the acure delirium cannot be controlled by ordinary treatment, before he certifies the patient.

Dieffendorf(9) writing on Dementea Praecox, says, that in 10% of cases of this kind there is a history of severe acute illness, typhoid fever and scarlet fever being particularly mentioned. From the time of the illness the patients have exhibited some change, as increased irritability or susceptibility/

susceptibility to fatigue or impairment of full mental capacity.

When one considers how commonly acute infectious illnesses occur prior to adult life, one is not inclined to consider that these conditions have any great influence in the causation of Dementia Praecox. Certainly they may have a serious influence on a person who has a schizoid tendency.

Cole (5) points out that septicaemia, scarlet fever, typhoid fever and small-pox are infective conditions which occasionally cause a serious mental breakdown. The disorder is generally of the confusional type when the fever subsides, but occasionally a delirious attack occurs at the onset.

Rosanoff, (39) remarks on the case of a young man who, when recovering from a severe attack of typhoid fever, forgot completely the English language, which he had spoken fluently before the onset of his illness, while other impressions were quite well preserved.

Dieffendorf, (10) refers to mental disturbance occurring at three different stages of the infectious disease e.g. fever delirium, infection delirium and post-febrile psychoses. He says that fever delirium follows rather closely on the clinical course of the fever. He maintains that infection delirium corresponds rather closely to the initial delirium of other authors and appears independently of the fever, at or near/

near the onset of the infectious disease. According to him, the post-febrile psychoses develop during or after the fever, and are apt to lead to permanent mental enfeeblement. He disagrees with other authors who talk of typhoid delirium, pneumonic delirium, etc.. He holds that, as yet, the toxins of different infectious diseases cannot be sufficiently differentiated to permit of their being considered characteristic of the corresponding disease. He points out that it is still an open question whether the changes in the cortical neurones are due to the actions of the toxins produced by the micro-organisms, or to an auto-intoxication developing within the body as a result of the infectious disease.

One must not lose sight of the fact that a small percentage of those who suffer from syphilis and encephalitis lethargica develop fairly characteristic mental symptoms. Some authorities consider that dementia paralytica is due to a specific type of spironema pallida, whilst others think that the patient's central nervous system is specially vulnerable in cases of syphilis which develop mental symptoms. In both syphilis and encephalitis lethargica, when mental symptoms develop, one meets with quite distinct psychoses. Therefore, while one is led to agree in part with Dieffendorf's statements, one cannot agree with them entirely.

Greene (13) says that the mental symptoms which occur during the course of typhoid fever are essentially those of the/

the typhoid state and may be seen in any disease which is associated with overwhelming toxaemia. In a foot-note, on the same page, he asserts that, nowadays, many cases of true typhoid fever pass through the whole course of their illness without any marked mental disturbance.

Letheby Tidy (50) declares that, in all but very mild infective attacks, the mental state is practically always affected, and that this affection often lasts for a period subsequent to the attack. He also maintains that, at the onset, the patient's memory is usually deficient and that his or her record of the onset is usually unreliable. Subsequent to the attack sometimes, either all memory of the illness is lost, or only a hazy recollection may remain. Even during the convalescence, the memory may be impaired. In referring to typhoid psychoses, Tidy says that delusions arising in the febrile periods occasionally persist into the convalescence. He refers to the aesthenic psychoses of convalescence and says that they are more common after typhoid fever than after other fevers. Continuing, he says that some weakening of memory and even of intelligence may persist for many months, and that full mental powers are frequently not regained under twelve months. Referring to "post-typhoid insanity", he says that dementia and many forms of "mono-mania", may occur. Post-typhoid neurasthenia may continue for months or years, and may completely prevent mental/

mental application. This is more in neurotic persons, especially if their convalescence is shortened for any reason. He quotes various nervous symptoms which may arise, and remarks that the degree of these may bear no relation to the severity of the attack of typhoid fever.

Rosanoff (40) says, that in some cases of delirium tremens, visceral lesions are often dependent upon some complicating infection such as influenza, infection by the pneumococci or typhoid fever. He also states (41) that infection delirium is met with chiefly in typhoid fever, in variola and in typhus fever. The symptoms sometimes take the form of maniacal excitement, more often that of an acute confusional state, or of hallucinatory delirium.

The patients in this institution who suffered from typhoid fever were representative of the main groups of mental disorders, such as dementia praecox, manic-depressive insanity, epilepsy and the senile psychoses. No general paralytics were affected.

During the height of the fever, a few patients evinced a temporary mental improvement and were more in touch with reality, and more conversant with their surroundings than they had been previously. Unfortunately these patients relapsed into their former mental condition with the decline of the fever. Two patients definitely improved to such an extent that they were able to be discharged from the institution, when/

when convalescence from their attack of typhoid fever had been established. These patients, being cases of dementia praecox, the prognosis of their mental disorder was bad, and their improvement could be attributed to their bodily illness. This improvement, however, was only temporary, and both patients returned to the institution within a period of two years.

Acute confusional states and delirium, dependant upon the infection, were not encountered except in those cases which terminated fatally, when death was preceded by a dulling of consciousness amounting to coma. Most of the patients were unaffected mentally during their infection but, subsequently, mental deterioration occurred in a number more rapidly than was anticipated in the prognosis of their mental disorder, prior to their illness.

Referring to the effect of an increase of temperature on a mentally disordered patient, Rudolf, (45) points out that, from ancient times,a febrile condition, e.g. quartan malaria, was used as a therapeutic measure in general paralysis, epilepsy and melancholia. He states, that, for centuries, the natives of Cazamarca in Peru have treated American leashmaniasis by means of naturally inoculated malaria. He says that Hippocrates is reputed to have held that epilepties were often cured of their fits by malaria. He quotes Bernet as having said that Louis XI of France prayed that he might suffer from "la fèvre quarte" so that he might be cured from/

from epilepsy. This was in the 'middle ages'. He also says that Ménape, who died in 1561, wrote that quartan fever was a cure for convulsions and melancholia.

In recent times, considerable investigation along these lines was instigated by Wagner-Jauregg, who treated general paresis by means of infection with benign tertian malaria. A considerable number of cures have been claimed and the beneficial results are attributed, either to the specific action of the plasmodium on the treponema pallida, or to the effect of the increase of temperature stimulating the vital resources of the patient, or having a lethal effect upon the causative organism.

During the epidemic referred to above, it is note-worthy that no permanent mental improvement occurred despite the high temperature to which the patients were subjected during the course of their illness. Furthermore the majority of the general paralytics treated with malaria showed no marked mental improvement, while their physical condition did not deteriorate so rapidly after their attacks of malaria as it did in other cases previous to malaria therapy being practised. In quite a number of cases the physical condition improved very appreciably. One general paralytic showed marked euphoria with grandiose delusions previous to being treated with malaria. Shortly after the completion of one course of treatment his euphoria disappeared/

disappeared. He was comparatively well mentally for a good few weeks, and then he developed marked melancholia with activity suicidal tendencies.

Rudolf (46) refers to a female general paralytic at Claybury Asylum. This patient improved in all other respects after a course of malaria but she developed severe auditory hallucinations. During an attack of typhoid fever, some months after the malaria, the hallucinations vanished and the patient was discharged from the hospital.

A P P E N D I X.

Taking the isolated typhoid carriers in alphabetical order, I shall give the individual history of each. They were all female patients. There were no typhoid carriers, passive, temporary or chronic among the male patients.

No. 1, A.A., was examined because she had had a suspicious illness in January 1922. Her blood Widal was examined on the following dates and the results were as follows:-

Date.	Result.	Dilution.
27.1.22	Negative to T., A., and B.	1/40
10.8.22	Negative " " " " "	1/40
2.5.22	Negative " " " " "	1/40
23.8.23	T ? Negative A and B Negative	1/40
22.1.25	Negative to T., A., and B.	1/40

Her faeces and urine showed the following results:-

Date.	Result.	
	Faeces.	Urine.
22.7.23	Negative to B. Typhosus.	No specimen
6.8.23	B. Typhosus isolated.	Negative
13.8.23	No specimen	Negative
6.9.23	No specimen	B. Typhosus isolated. May have been contaminated from her faeces.
24.9.23	B. Typhosus isolated.	No specimen.

From 22.1.25 until 27.8.25 her faeces and urine were examined on 61 occasions, at half-weekly intervals. During this time I found that her faeces were persistently negative to B.typhosi and, with a few exceptions her urine was always sterile. When the urine was not sterile there were never any B.typhosi isolated.

She died on 5.9.25 and I performed a post-mortem examination on 7.9.25. The following facts were observed.

(1) Her gall-bladder was adherent to the liver and to the transverse colon.

(2) There were no gall-stones and the contents of her gall-bladder were sterile.

(3) Her duodenum was adherent to her pylorus.

(4) There were scars of old typhoid ulcers at the lower end of her ileum.

(5) There was pus in the left cavernous sinus and on the left lateral sinus.

(6) Her right literal sinus was thrombosed.

(7) There was pus in the circular sinus.

The pus in all these regions contained pneumococci but no B.Typhosi. The bone of her left middle ear was eburnated and there was evidence of an old-standing otitis media on this ear. There was pus in the middle ear but it contained no typhoid organisms. Her left jugular vein was thrombosed,/

thrombosed. The certified cause of death was, "Septic Sinus Thrombosis".

Now 2, (Ana A), was examined because her blood Widal was positive on 26.4.22. The result was positive to B.typhosus in a dilution of 1/320 and para.A and para.B were negative in a dilution of 1/40. Her faeces and urine showed the following results:-

Date.	R E S U L T	
	Faeces.	Urine.
14.5.23	Negative to B.Typhosus.	Negative to B.Typhosus.
28.5.23	" " "	" " "
9.7.23	" " "	" " "
12.7.23	" " "	" " "
17.7.23	" " "	B.Typhosi isolated.
23.7.23	" " "	Negative to B.Typhosus.
20.8.23	" " "	" " "

On 22.1.25 her blood Widal was positive to B.Typhosus in a dilution of 1/160 and was doubtful in a dilution of 1/320. To paratyphosi A and B her serum was negative in dilution of 1/40.

From/

From 22.1.25 until 28.1.26 her faeces and her urine were examined, by me, twice weekly, making a total of about 100 examinations each, and they were always negative to B.typhosi. In about 50% of the bacteriological examinations her urine was sterile.

No.3., Mrs B., was found, during a routine examination of the female pavilion ward, to have a positive blood Widal. Her Widal reactions, at this time, were as follows:-

Date.	Result.	
10.8.23.	Positive to T. 1/40	A negative 1/40. B negative 1/40.
19.9.23.	Positive to T. 1/40.	A negative 1/40. B negative 1/40.

Her faeces and urine were examined bacteriologically with the following results:-

Date.	RESULT	
	Faeces.	Urine.
24.9.23.	B.Typhosi isolated.	Sterile.
27.9.23.	Negative to B.typhosi.	B.typhosi isolated.
1.10.23.	" " "	Negative to B.typhosi.

From 22.1.25 until 28.1.26 her faeces and her urine were examined,/

examined, by me, about 93 times each, at intervals of half a week. On 7.5.25 her faeces contained bacilli typhosi and on 8.10.25 her urine contained bacilli typhosi. On all other occasions I found her faeces and urine negative to B.typhosi. In her case the urine was sterile in about 25% of these occasions.

Case No.4. (A.C.),had no history of a suspicious illness. During a routine examination of the blood sera of the patients in the female pavilion ward, she was found to have a positive Widal in a dilution of 1/40. Her Widal results were:-

Date.	Result.
10.8.23	Positive to T 1/80. Para.A.O.1/40.Para B.O 1/40
19.9.23	Positive to T 1/80 " " " " " "
22.1.25	Positive to T 1/160 " " " " " "

This apparent increase of the positivity was doubtlessly due to the fact that her Widal examinations were performed with different batches of antigen.

Her faeces and urine showed the following results:-

Date.	RESULT.	
	Faeces.	Urine.
30.8.23	Negative to B.typhosus.	Negative to B.typhosus
24.9.23	Negative " "	B.typhosi isolated.
27.9.23	Negative " "	Negative to B.typhosus
1.10.23	Negative " "	B.typhosi isolated.
4.10.23	Negative " "	Sterile
8.10.23	Negative " "	Sterile
11.10.23	Negative " "	Sterile

From 22.1.25 until 30.1.26 I examined her faeces and urine bacteriologically on about 100 occasions each. On every occasion her faeces and urine were negative to B.typhosus. In about 50% of these examinations her urine was sterile.

No.5., (I.G.), was a patient who evidently suffered from an ambulatory attack of typhoid fever. In routine examinations on 24.4.23 her blood Widal was negative to T.A and B., in a dilution of 1/40. In July 1924 all the patients in her ward had their blood examined for the Widal reaction. This was done because a case of typhoid fever had occurred in this ward. All the patients, who were found to have positive blood Widals, had their faeces and/

and urine examined for the presence of B.typhosi. As these examinations seemed to be yielding no positive results, the faeces and urine of patients who had been fairly recently transferred to this ward, were examined bacteriologically. This latter method was responsible for I.G. being proved to be a typhoid carrier. The following are the results of examinations in her case.

Her blood showed the following reactions to the Widal test:-

Date.	Result.
24.4.23	Negative to T, A & B in dilution of 1/40.
	The above result was found in a previous routine examination.
14.7.24	Negative to T, A & B, in a dilution of 1/40.

Below are given the results of the examinations of her excreta.

Date.	Result.	
	Faeces.	Urine.
1.9.24	Negative to B.typhosus.	Negative to B.typhosus.
8.9.24	B.typhosi isolated.	" " "
17.9.24	Negative to B.typhosus.	" " "
25.9.24	" " "	" " "
29.9.24	B.typhosi isolated.	" " "

She was transferred to the female isolation ward.

I/

I shall give a detailed account of the results which I found in her case, during the examinations which I made of the faeces and urine of the isolated typhoid carriers. Where the result was negative it is noted by "o", where B.typhosi were isolated by "+" and where the result was sterile by "o". The underlined dates give the dates of the menstrual periods. Before the start of these routine examinations the blood sera were examined for the Widal reaction. This was done in every case. I.G's blood serum was positive to B.typhosus on 22.1.25 in a dilution of 1/80. A similar result was got on 28.1.25. When B. typhosi were found in her excreta it was considered that she was a case who had a negative Widal although she was a typhoid carrier.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
22.1.25	0	0	23.2.25	o	o
26.1.25	o	o	26.2.25	o	o
30.1.25	+	o	2.3.25	+	o
2.2.25	+	o	4.3.25	+	o
5.2.25	+	o	9.3.25	+	o
9.2.25	+	o	12.3.25	no specimen	o
12.2.25	+	o	16.3.25	o	o
15.2.25	+	no specimen	19.3.25	21.3.25 +	o
19.2.25	17.2.25 o	o	23.3.25	+	o

Case I.G. continued.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
26.3.25	+	o	18.5.25	+	o
30.3.24	+	o	22.5.25	+	o
2.4.25	o	o	25.5.25	+	o
6.4.25	o	no specimen	28.5.25.	No specimen	o
7.4.25	no specimen	o	29.5.25	o	no specimen
9.4.25	o	o	29.5.25 1.6.25	+	o
13.4.25	+	o	4.6.25	o	o
16.4.25	+	o	8.6.25	o	o
20.4.25	+	no specimen	11.6.25	o	o
21.4.25	no specimen	o	15.6.25	o	o
23.4.25	o	o	18.6.25	+	o
25.4.25 27.4.25	+	o	18.6.25 22.6.25	+	o
28.4.25	no specimen	o	25.6.25	o	o
30.4.25	+	no specimen	29.6.25	+	o
1.5.25	no specimen	o	2.7.25	o	o
5.5.25	+	o	6.7.25	+	o
7.5.25	no specimen	o	9.7.25	o	no specimen
8.5.25	+	no specimen	20.7.25 3.8.25	+	o
11.5.25	+	no specimen	6.8.25	+	+
12.5.25	no specimen	o	10.8.25	o	o
14.5.25	+	o	13.8.25	+	o

Case I.G.continued.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
17.8.25	o	o	29.10.25	o	o
20.8.25	o	o	2.11.25	+	o
24.8.25	o	o	5.11.25	+	No specimen
27.8.25	+	o	6.11.25	No spec.	o
29.8.25					
31.8.25	o	o	9.11.25	+	o
3.9.25	o	o	12.11.25	o	o
7.9.25	+	o	16.11.25	No spec.	o
10.9.25	+	o	17.11.25	+	No specimen
14.9.25	o	No specimen	19.11.25	+	No specimen
16.9.25	No specimen	o	20.11.25	No spec.	o
17.9.25	+	o	23.11.25	+	o
21.9.25	o	o	26.11.25	o	o
28.9.25	+	o	30.11.25	o	o
			2.11.25		
1.10.25	+	o	3.12.25	o	o
1.10.25					
5.10.25	o	o	7.12.25	+	o
8.10.25	+	o	10.12.25	o	o
12.10.25	+	o	14.12.25	No spec.	o
15.10.25	+	o	15.12.25	o	No specimen.
19.10.25	+	o	17.12.25	+	o
22.10.25	+	o	21.12.25	+	o
26.10.25	+	o	4.1.26	+	o
28.10.25					

I.G. Continued.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
7.1.26	o	o	21.1.26	+	o
11.1.26	o	o	25.1.26	o	o
14.1.26	o	o	28.1.26	Plate destroyed	o
18.1.26	+	o	30.1.26	+ 2.2.26	o

In order that results can be conveniently compared I shall give below the detailed results of the findings in the faeces and urine of I.G. during and after her treatment by an autogenous vaccine and also in another table I shall give the results got when she was given the autogenous vaccine prepared from the "R" form of B.typhosus. The ordinary autogenous vaccine was started on 12.2.26 and was completed on 24.5.26. Details of the treatment by the autogenous vaccines and a summary of the results will be given later.

The bacteriological results, during and after inoculation with an autogenous vaccine, are given below. The start and end of the courses are marked by *.

Table next page.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
* 16.2.26	+	o	3.5.26.	Organisms which died on agar, grown on broth & agglutinated.	o
19.2.26	+	o	6.5.26	o	No specimen
23.2.26	+	o	13.5.26	o	o
25.2.26	+	o	17.5.26	o	No specimen
1.3.26	o	o	20.5.26	o	o
4.3.26	o	o *	24.5.26	o	o
8.3.26	+	o	27.5.26	o	o
11.3.26	+	o	31.5.26	o	o
15.3.26	o	o	3.6.26	o	o
18.3.26	o	o	7.6.26	+ (very few)	o
22.3.26	o	o	10.6.26	o	o
25.3.26	o	o	14.6.26	+ (50% of flora)	o
29.3.26	+	o	17.6.26	+	+
1.4.26	o	No specimen	21.6.26	+	No specimen
5.4.26	+	o	24.6.26	o	o
8.4.26	o	o	28.6.26	+	o
12.4.26	o	o	1.7.26	+	o
15.4.26	o	o	5.7.26	o	o
19.4.26	o	o	8.7.26	+	+
22.4.26	o	o	12.7.26	+	o
26.4.26	o	o	15.7.26	o	o
29.4.26	o	o	19.7.26	o	o

I.G.and Mrs K. were inoculated with autogenous vaccines of the "R" strain of typhoid bacilli. Unfortunately the course could not be finished. Details of these inoculations will be given later. The bacteriological results of the inoculations on the excretion of B.typhosi in the case of I.G. are given below.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
3.11.26	+	o	1.12.26	o	o
7.11.26	+	o	5.12.26	+(few)	o
10.11.26	+(very few)	o	8.12.26	o	o
14.11.26	o	o	12.12.26	o	o
17.11.26	o	o	15.12.26	o	o
21.11.26	o	o	19.12.26	+(few)	o
24.11.26	+ (few)	o	22.12.26	o	o
28.11.26	+ (few)	+			o

Below I shall give the bacteriological results from the faeces and urine of B.G. at a later date.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
5.12.27	o	o	15.12.27	o	o
8.12.27	o	o	19.12.27	o	o
12.12.27	+(very few)	o	22.12.27	+(very few)	o

This ~~first~~ final table shows that I.G. was still excreting B.typhosi but that their numbers were much reduced.

No.6. (Mrs.K.), was discovered during a routine examination of the blood Widal reactions of patients. Her blood was found positive to B.typhosi in a dilution of 1/160. On 22.5.23 her faeces and urine were examined bacteriologically, and on 5.7.23 B.typhosi were isolated from her faeces. Her urine on this date was negative. She was isolated as being a typhoid carrier. On 22.1.25 her blood Widal was positive to B.typhosus in a dilution of 1/160. Below are given my bacteriological examinations of her faeces and urine from 22.1.25 until 28.1.26.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
22.1.25	o	No specimen	19.2.25	o	o
26.1.25	+	o	24.2.25	No specimen	o
30.1.25	o	o	26.2.25	o	o
2.2.25	o	o	2.3.25	o	o
5.2.25	o	o	4.3.25	+	o
9.2.25	o	o	9.3.25	+	o
12.2.25	+	o	12.3.25	o	o
16.2.25	+	No specimen	16.3.25	o	o

Table continued overleaf.

Mrs.K. continued.

Date.	Result. Faeces.	Urine.	Date.	Result. Faeces.	Urine.
19.3.25	+	o	28.5.25	o	No specimen.
26.3.25	+	o	29.5.25	No spec.	o
30.3.25	+	o	1.6.25	o	o
2.4.25	o	o	4.6.25	o	o
6.4.25	o	o	8.6.25	o	o
9. 4.25	o	o	11.6.25	o	o
13.4.25	o	o	15.6.25	o	o
15.4.25	o	o	18.6.25	+	o
21.4.25	+	o	22.6.25	o	o
23.4.25	o	o	25.6.25	o	o
27.4.25	o	o	29.6.25	o	o
30.4.25	o	No specimen	2.7.25	o	o
1.5.25	No spec.	o	6.7.25	o	o
5.5.25	o	o	8.7.25	o	No specimen
7.5.25	No spec.	o	3.8.25	No spec.	o
8.5.25	o	No specimen	4.8.25	o	No specimen
11.5.25	o	o	10.8.25	o	o
14.5.25	o	o	13.8.25	o	o
18.5.25	o	o	17.8.25	No spec.	o
22.5.25	No spec.	o	18.8.25	o	No specimen
23.5.25	o	No specimen	20.8.25	o	o
25.5.25	o	o	24.8.25	o	o

Table continued overleaf.

Mrs K. Continued.

Date.	Result. Faeces.	Urine.	Date.	Result. Faeces.	Urine.
27.8.25	o	o	6.11.25	No.specimen	o
31.8.25	No specimen	o	9.11.25	+	o
1.9.25	o	No specimen.	12.11.25	o	o
3.9.25	+	No specimen.	16.11.25	+	o
7.9.25	o	o	19.11.25	+	No specimen
10.9.25	o	No specimen.	20.11.25	No specimen	o
14.9.25	No specimen	o	23.11.25	o	o
16.9.25	o	No specimen	26.11.25	o	o
17.9.25	o	o	30.11.25	o	o
21.9.25	o	o	3.12.25	+	o
28.9.25	No specimen	o	7.12.25	o	o
29.9.25	o	No specimen	10.12.25	o	o
1.10.25	+	o	14.12.25	o	o
5.10.25	+	o	17.12.25	o	o
10.10.25	o	o	21.12.25	+	o
12.10.25	o	o	4.1.26	+	o
15.10.25	o	o	7.1.26	o	o
19.10.25	+	o	11.1.26	+	o
22.10.25	+	o	14.1.26	+	o
26.10.25	+	o	18.1.26	+	o
29.10.25	o	o	21.1.26	+	o
3.11.25	+	o	25.1.26	o	o
5.11.25	o	o	28.1.26	+	o

The bacteriological results during and after inoculation with an autogenous vaccine are given below. The start and the end of the vaccine treatment are marked with *.

Mrs.K. (Continued.)

	Date.	Result. Faeces.	Result. Urine.	Date.	Result. Faeces.	Result. Urine.
*	16.2.26	o	o	29.4.26	o	o
	19.2.26	+	o	3.5.26	Organism which died on agar agar. Agglutin.from broth.	o
	23.2.26	+	o	6.5.26	o	o
	25.2.26	+	o	13.5.26	+(very few)	o
	1.3.26	+	o	17.5.26	+(very few)	o
	4.3.26	o	o	20.5.26	o	o
	8.3.26	+	o	24.5.26	o	o
	11.3.26	+	o	27.5.26	o	o
	15.3.26	o	o	31.5.26	o	o
	18.3.26	+	o	3.6.26	o	o
	22.3.26	o	o	7.6.26	+(very few)	o
	25.3.26	No specimen	o	10.6.26	o	o
	26.3.26	o	No specimen	14.6.26	o	o
	29.3.26	+	o	17.6.26	+(few)	o
	1.4.26	o	o	21.6.26	+(few)	o
	5.4.26	No specimen	o	24.6.26	o	o
	6.4.26	+	No specimen	28.6.26	o	o
	8.4.26	+	o	1.7.26	+(not many)	o
	12.4.26	+	o	5.7.26	o	o
	15.4.26	o	o	8.7.26	o	o
	21.4.26	No specimen	o	12.7.26	o	o
	22.4.26	o	No specimen	15.7.26	o	o
	26.4.26	o	o	19.7.26	o	o

On inoculation with autogenous vaccine prepared from "R" ~~serum~~. strain.

Mrs K. (Continued).

Date.	Results.		Date.	Results.	
	Faeces.	Urine.		Faeces.	Urine.
3.11.26	+ (few)	o	1.12.26	+(few)	o
7.11.26	o	o	5.12.26	+ (few)	o
10.11.26	+ (few)	o	8.12.26	o	o
14.11.26	o	o	12.12.26	o	o
17.11.26	+ (few)	o	15.12.26	o	o
21.11.26	o	o	19.12.26	o	o
24.11.26	o	o	22.12.26	o	o
28.11.26	o	o			

Below are given the bacteriological results from the faeces and urine of Mrs.K. at a later date.

Mrs K. (Continued)

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
5.12.27	+(very few)	o	15.12.27	o	o
8.12.27	+(few)	o	19.12.27	o	o
12.12.27	o	o	22.12.27	o	o

No.7., (H.McB.), is a patient who was found to have a positive blood Widal reaction during a routine examination of laundry workers on 7.8.22. Her blood at that date showed the following reaction to B.typhosus; T 1/40 + while to para-typhosus A and paratyphosus B it was negative in a dilution of 1/40. From 19.8.22 until 9.10.22 her faeces and urine were examined six times and were negative to B.typhosus. She was returned to the asylum on 19.2.23. She had been removed to the sick ward at the hospital while these examinations were being done. On 4.8.23 she was again in the sick ward as a possible carrier. From 13.8.23 until 18.10.23 her faeces and urine were examined four times and were found negative to B.typhosus. On 25.10.23 B.typhosi were isolated from her faeces and her urine was negative to B.typhosus. She was then examined on 13 occasions until 24.12.23 and her faeces and urine were found negative to B.typhosus. On 8.11.23 she was isolated as a carrier of B.typhosi. On 22.1.25 I found that her blood serum was positive to B.typhosus in a dilution of 1/160. From 22.1.25 until 28.1.26 her faeces and urine were examined by me on about 100 occasions, each twice weekly, and during this time her faeces were persistently negative to B.typhosus while on 21.9.25 I isolated B.typhosi from her urine.

The/

The urine during this time was negative to B.typhosus or sterile on all other occasions in about equal proportions.

No.8., (M.M.), had her faeces and urine examined bacteriologically because she showed the following result to the Widal test on 7.8.22; T.1/40 +. A 1/40 - and B 1/40 +. The results of the examinations of her faeces and urine were as follows:-

Result.

Date.	Faeces.	Urine.
18.8.22	+	+
23.8.22	o	o
31.8.22	o	o
6.9.22	o	o
18.9.22	+	o
24.9.22	+	o

On 22.1.25 her blood Widal reaction was: T 1/80 +, A 1/40, o and B 1/40 o.

From 25.1.25 until 28.1.26 I examined her faeces and urine bacteriologically twice weekly. In all about 100 examinations were made, and on all occasions her urine was negative to B.typhosus or sterile. The urine was sterile in about 50% of these occasions. During these examinations B.typhosi were/

were recovered from her faeces on the following dates.

Date.	Result.	
	Faeces.	Urine.
2.2.25	+	o
5.2.25	+	o
16.2.25	+	o
1.10.25	+	o
15.10.25	+	o

On all other occasions her faeces were negative to B.typhosus.

No.9 (Mrs O.), was removed to the female sick ward on 17.3.23. She was then suffering from vague abdominal pains. Her temperature was 102.5°F., her pulse was 98 per minute and her respirations 20 per minute. On 18.3.23 her temperature was 101.5°F., her pulse was 90 per minute and her respirations 20 per minute. Her tongue was covered with a white fur which showed red papillae. There were rose-spots on her abdomen and chest and she was constipated. On 20.3.23 her blood Widal was negative to B.typhosus, whilst on 28.3.23 it was positive to B.typhosus in a dilution of 1/640. She ran a normal course of an attack of typhoid fever. She was on a milk diet during her illness and her bowels were constipated throughout./

throughout. From 30.4.23 until 17.5.23 her faeces and urine were negative to B.typhosus on 4 occasions. After her convalescence was over, she was transferred to the asylum, but on 25.7.23 she was again removed to the sick ward at the hospital and she was investigated as a possible typhoid carrier. Her faeces and urine were negative to B.typhosus on four consecutive occasions, but on 27.9.23 bacilli typhosi were isolated from her urine, whilst her faeces were negative to this organism. Again, on 4.10.23, B.typhosi were isolated from her urine. She was transferred to the isolation ward. On 22.1.25, I found that her blood serum was positive to B.typhosus in a dilution of 1/160. From this date, until 28.1.26, I examined her faeces and urine, about 100 times each, but both were persistently negative to B.typhosus.

No.10, (Mrs.R), was discovered to have a positive blood Widal during routine examinations. This was on 24.4.23. Her serum was, at this time, positive to B.typhosus in a dilution of 1/80. On 3.5.23 B.typhosi were recovered from her faeces whilst her urine was negative to B.typhosus. Her excreta were examined for the presence of B.typhosi on the following dates and the results were as follows:-

	Result.	
Date.	Faeces.	Urine.
14.5.23	o	o
24.5.23	+	o
28.5.23	o	o

She was isolated as a typhoid carrier.

On 22.1.25 I found that her blood serum was positive to B.typhosus in a dilution of 1/160. From this date until 25.1.26 I examined her faeces and her urine twice weekly, making a total of about 100 examinations of each. All examinations were negative to B.typhosus except on 14.1.26. On this date both her faeces and urine contained B.typhosi. About 17.1.26 she was confined to bed with a general weakness. From this time until her death, on 26.1.26, she had a vague tenderness in her abdomen. Her mental condition made it impossible to localise the tenderness. The certified cause of death was "Terminal Pneumonia". On 28.1.25 I performed a post-mortem examination. There were evidences of healed typhoid ulcers at the lower end of the ileum. Swabs taken from her gall-bladder and from the pelves of both kidneys were negative to B.typhosi. The swab from the gall-bladder yielded a heavy growth of coliform bacilli, and as permission

for/

for a post-mortem examination was not granted until 2 days after her death, any B.typhosi which may have been present, possibly died owing to the presence of the other organisms. Twenty-seven small gall-stones were found and all these were opened antiseptically, but swabs taken from their centres were sterile. Unfortunately a swab was not taken from her appendix.

No.11 (A.S.), was found, on routine examination on 2.5.23, to have a positive blood Widal reaction to B.typhosus, This was in a dilution of 1/40. Her faeces and her urine showed the following results:

	Result.	
Date.	Faeces.	Urine.
14.5.23	o	o
28.5.23	o	o
9.7.23	o	o
12.7.23	o	o
17.7.23	o	+
23.7.23	o	o
20.8.23	No specimen	o

She was isolated as a typhoid carrier. On 22.1.25 her blood Widal reaction was positive to B.typhosus in a dilution of 1/80. From 22.1.25 until 29.1.26 I made bacteriological examinations of her faeces and urine.

Each/

Each was examined about 100 times at intervals of half a week. Her faeces and her urine were negative to B.typhosus on all occasions except on the following dates.

	Result.	
Date.	Faeces.	Urine.
23.4.25	+	o
16.11.25	o	+

Her urine was sterile in about 50% of the examinations.

No.12, (Mrs T.), was transferred to the sick ward on 25.4.22. She was considered to be suffering from influenza. On 30.4.22 her blood was negative to the Widal test, in a dilution of 1/40. Her blood Widal reaction on 7.6.22 was positive to B.typhosus in a dilution of 1/640, it was doubtful to B.paratyphosus A in a dilution of 1/40 and it was negative to B.paratyphosus B. in a dilution of 1/40. On 14.8.22 her blood Widal was positive to B.typhosus in a dilution of 1/320. Her faeces and her urine were examined bacteriologically on 7 occasions from 29.6.22 until 19.8. 22 and were always negative to B.typhosus. She again came under suspicion of being a typhoid carrier and the following results were recorded:-

	Result	
Date.	Faeces.	Urine.
17.7.23	o	o
9.8.23	o	o
16.8.23	o	o
23.8.23	+	o

She/

She was isolated as a typhoid carrier. When I examined the isolated carriers, she showed the following results:- Her Widal reaction was positive to B.typhosus in a dilution of 1/160. Below is given a detailed account of the bacteriological results which I found in her faeces and urine.

Mrs T.

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
22.1.25	o	No specimen.	2.3.25	o	o
26.1.25	+	o	4.3.25	o	o
30.1.25	o	o	9.3.25	+	o
2.2.25	+	+	12.3.25	o	o
5.2.25	o	o	16.3.25	o	o
9.2.25	+	o	19.3.25	o	o
12.2.25	+	o	23.3.25	o	o
16.2.25	+	No specimen	26.3.25	o	o
19.2.25	+	o	30.3.25	o	o
23.2.25	+	No specimen	2.4.25	o	o
24.2.25	No spec.	o	6.4.25	o	o
26.2.25	o	o	9.4.25	o	o

Continued overleaf.

Mrs. T. (continued).

Date.	Result.	
	Faeces.	Urine.
13.4.25	+	o
16.4.25	o	o
20.4.25	No specimen.	o
21.4.25	+	o
23.4.25	o	o
27.4.25	o	o
30.4.25	o	No specimen.
1.5.25	No specimen	o
5.5.25	o	+
7.5.25	o	o
11.5.25	o	o
14.5.25	o	o
18.5.25	o	o
22.5.25	o	+
25.5.25	o	o
28.5.25	o	No specimen.
29.5.25	No specimen	o
1.6.25	o	o
4.6.25	o	o
9.6.25	+	o
11.6.25	o	o
15.6.25	o	o
18.6.25	o	o
22.6.25	+	o
25.6.25	o	o
29.6.25	+	o
2.7.25	o	o
6.7.25	o	o
9.7.25	o	No specimen.
3.8.25	+	o
6.8.25	o	No specimen.
10.8.25	o	+
13.8.25	o	o
17.8.25	+	o
20.8.25	+	o
24.8.25	o	o
27.8.25	o	o
31.8.25	o	o
3.9.25	o	o
7.9.25	o	o
10.9.25	o	o
14.9.25	o	No specimen.
16.9.25	No specimen	o
17.9.25	o	No specimen.

COntined overleaf.

Mrs T. (Continued).

Date.	Result.		Date.	Result.	
	Faeces.	Urine.		Faeces.	Urine.
21.9.25	+	o	20.11.25	No specimen	o
28.9.25	o	o	23.11.25	+	o
1.10.25	+	o	26.11.25	+	o
5.10.25	+	o	30.11.25	o	o
10.10.25	o	o	3.12.25	o	o
12.10.25	+	o	7.12.25	o	o
17.10.25	o	o	10.12.25	o	o
19.10.25	o	o	14.12.25	o	o
22.10.25	o	o	17.12.25	o	o
26.10.25	o	o	21.12.25	o	o
29.10.25	o	o	4.1.26	+	o
2.11.25	+	o	7.1.26	o	o
5.11.25	o	No specimen.	11.1.26	o	o
6.11.25	No.spec.	o	14.1.26	+	o
9.11.25	+	o	18.1.26	o	o
12.11.25	o	o	21.1.26	o	o
16.11.25	+	o	25.1.26	o	o
19.11.25	o	No specimen.	28.1.26	o	o

Below are given the bacteriological results during and after a course of autogenous vaccines. The start and the finish of the inoculations are marked with an *.

Mrs.T. (continued.)

Date.	Result.	
	Faeces.	Urine.
16.2.26	+	No specimen
* 19.2.26	+	No specimen.
23.2.26	+	No specimen.
25.2.26	o	o
1.3.26	+	o
4.3.26	o	o
5.3.26	+	o
8.3.26	o	o
11.3.26	+	o
15.3.26	o	o
18.3.26	o	o
22.3.26	o	o
25.3.26	o	o
29.3.26	o	+
1.4.26	o	o
5.4.26	+	o
8.4.26	o	o
12.4.26	+	o
15.4.26	o	o
19.4.26	o	o
22.4.26	o	
26.4.26	o	
29.4.26	o	

Date.	Result.	
	Faeces.	Urine.
3.5.26	Sugar reactions for typhoid. No growth on agar agar. Growth on broth agglutinated.	
6.5.26	+ Similar to above.	
13.5.26	+ 2 colonies.	
17.5.26	o	
20.5.26	o	
24.5.26	o	
27.5.26	o	
* 31.5.26	o	
3.6.26	o	
7.6.26	o	
10.6.26	o	
15.6.26	o	
17.6.26	o	
21.6.26	o	
24.6.26	o	
28.6.26	o	
1.7.26	o	
5.7.26	o	
8.7.26	o	
12.7.26	o	
15.7.26	o	
19.7.26	o	

The following results were found 17 months later.

Mrs T. (Continued).

Date.	Result.	
	Faeces.	Urine.
5.12.27	Sugar reactions for typhoid. No growth on agar-agar. Grew in broth and agglutinated +.	o
8.12.27	o	o
12.12.27	o	o
15.12.27	o	o
19.12.27	+ (very few)	o
22.12.27	No specimen.	o
23.12.27	o	No specimen.

The details of the autogenous vaccines were as follows. I.G. and Mrs K. were started on 12.2.26 and their courses finished on 24.5.25. Mrs T's course started on 19.2.26 and finished on 1.6.26. In all the cases the dose started with 0.25 c.c. weekly, and increased by 0.25 c.c. weekly until 1 c.c. was being given. The 1 c.c. dose was continued at weekly intervals until a total of 12 injections had been given. This gave a total of 10.5 c.c. per patient. In units this equals 5,250 million organisms per patient, as there were 500 million units per c.c.

Before the administration of the autogenous vaccines the blood Widals of these patients were as follows:-

Date.	Name.	Result.
7.2.26	I.G.	Positive to B.typhosus in dilution of 1/80
7.2.26	Mrs K.	Positive " " " " " 1/160
7.2.26	Mrs T.	Positive " " " " " 1/160

After the completion of the course the results were:-

Date.	Name.	Result.
15.6.26	I.G.	Positive to B.typhosus in dilution of 1/120
15.6.26	Mrs K.	Positive " " " " " " 1/640
15.6.26	Mrs T.	Positive " " " " " " 1/320

J.G. and Mrs K. were given 2,250 million units of the "R" strain of B.typhosus. This was given in 6 injections starting on 10.11.26 and finishing on 15.12.26. The results of their blood Widal examinations were as follows:-

Date.	Name.	Result.
18.12.26	I.G.	Positive to B.typhosus in dilution of 1/160
18.12.26	Mrs K.	Positive " " " " " 1/960

Below I shall give a table showing the Widal reactions to B.typhosus of all the typhoid carriers whom I examined. I give the reactions on different dates in order to demonstrate the/

the decrease in the strength of the positivity. It will be seen that I.G., Mrs K., and Mrs T., showed an increase on account of their treatment by autogenous vaccines.

Name.	22.1.25 Result.	15.6.26. Result.	18.12.26. Result.	23.11.27. Result.
A.A.	Negative	Dead		
Ana A.	1/160	1/80		1/40
Mrs B.	1/80	1/40		1/20
A.C.	1/160	1/80		1/40
I.G.	1/80	1/120 (after vaccine)	1/160 after "R" vaccine.	1/140
Mrs K.	1/160	1/640 (after vaccine)	1/960 after "R" vaccine.	1/860
H.McB.	1/160	1/180		1/60
M.M.	1/80	1/40		1/20
Mrs O.	1/160	1/80		1/80
Mrs R.	1/160	Dead		
A.S.	1/80	1/40		1/20
Mrs T.	1/160	1/320 (after vaccine)		1/320

These results show that the blood widal reactions of the typhoid carriers tended to decrease in positivity after an interval of time. On the other hand the three who had had autogenous vaccines showed an increase. I.G. was not much affected by the autogenous vaccines except that the actual numbers of

B.typhosi/

B.typhosi excreted by her were decreased in number. During the period 8.4.26 to 3.6.26 her faeces and urine were free from B.typhosi except for a few suspicious colonies on 3.5.26. These colonies showed the sugar reactions of B.typhosi but they died on the agar-agar slopes. They grew in broth and agglutinated with antigen. After inoculation with an autogenous vaccine prepared from the "R" strain, growths from her faeces showed still fewer organisms of typhoid and their vitality was decreased. Subsequently her faeces again showed B.typhosi frequently, but the actual numbers of colonies were much fewer than before her vaccinations.

Mrs K. showed a somewhat similar reaction to her autogenous vaccines. On one occasion, on 3.5.26, I had to grow her typhoid organisms in broth because they would not grow on agar-agar slopes. From broth culture they agglutinated with typhoid antigen. Likewise, in her case also, the numbers of typhoid colonies on McConkey's plates, were appreciably reduced in number. Subsequent to her vaccine treatment the numbers of typhoid colonies were still very markedly reduced in number.

On 3.5.26 and 6.5.26 I recovered, from plates inoculated with Mrs T's faeces, organisms which grew in broth and agglutinated with typhoid antigen. These colonies died on agar-agar slopes. Mrs T. was more affected by the autogenous vaccine than were the other two.

I.G. and Mrs K. showed an even more marked reaction to inoculations by vaccines prepared from the "R" strains of their typhoid organisms. Their blood sera showed positive Widals in a higher degree of dilution than they did after inoculation with ordinary mixed autogenous vaccines. By 'mixed' I mean vaccines which contained both "S" and "R" forms of typhoid organisms.

As previously stated, these three patients were still excreting fever typhoid organisms about 17 months after their first inoculation with autogenous vaccines. At this time the viability of the organisms was quite good. This was in December 1927.

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CONCLUSIONS.

(1) Blood Widal examinations are of prime importance provided that anti-typhoid inoculation has not been performed. All ex-soldiers of the late war showed positive blood Widal reactions owing to their having been inoculated with T.A. and B. vaccines.

(2) Suspected persons must have their faeces and urine examined bacteriologically although their blood sera show negative reactions to the Widal test.

(3) A considerable number of bacteriological examinations of faeces and urine must be done in each suspected case. My results show that a number of months may elapse between the times when some typhoid carriers excrete the causative organisms in their faeces or urine.

(4) If one is suspicious of a person being a typhoid carrier all non-lactose colonies, in growths from their excreta, must be investigated provided that they are not too dense in appearance, too much "heaped up" and have no areola.

(5) Medicinal treatment of typhoid carriers is of no avail in affecting a cure, and the administration of autogenous vaccines, made both from "S" and "R" strains and "R" strains, does no more than limit the numbers of typhoid bacilli excreted and temporarily decrease the vitality of these organisms.

(6) The intervention of an acute infectious disease, in most psychoses, is more apt to cause an earlier mental deterioration than to ameliorate a patient's mental condition.

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