Preliminary Note ON THE CLINICAL ASPECTS AND DIAGNOSIS OF PARATYPHOID FEVER.

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In attempting to describe the diseases known as paratyphoid fever, it must be remembered that it is only within quite recent years that any considerable amount of work has been done on the subject; that very little has been published in this connexion, and that any statements now made are largely the result of impressions received while observing some three or four hundred cases of paratyphoid fever in hospital, and may require modification when the material is more fully investigated and scientifically collated at the end of the war.

Paratyphoid fever is a disease caused by one of two bacilli, and is therefore known as "para A" or para B," according to the particular organism present in any case. Both these bacilli resemble very closely the *Bacillus typhosus* in their morphology and general cultural characteristics, but in their behaviour with specific immune serums and in their reactions on certain nutrient media they differ so markedly from the *B. typhosus* and also from each other that there can be no doubt that they are specific micro-organisms and not varieties of the *B. typhosus* which have become modified by environment.

In 1898 N. B. Gwynne cultivated a "paracolonic bacillus" from the blood of a patient "presenting all the clinical features of typhoid fever," and this seems to be the first instance of the definite diagnosis of a case of paratyphoid fever. This case showed throughout negative agglutination reactions with the *B. typhosus*, but the various specimens of serum were kept and were found to give definite agglutination with the organism isolated from the blood.

Many cases of "paracolonic" and paratyphoid infections have been described since then, and also cases of infections by other bacilli supposed to be closely allied to these.

Some German writers have contended that food poisoning and paratyphoid B infections are identical, and others have certainly confused the two diseases in their descriptions.

Bainbridge and O'Brien, in 1911, showed that two distinct organisms had been described under the title of *Bacillus paratyphosus* B. Bainbridge, in his Milroy lectures of 1912, clearly showed that meat and food poisoning are due to *B. suisstifer* or *B. enteritidis*, which are conveyed to man and can be recovered from infected foodstuffs, whereas paratyphoid fever is due, and due only, to one of the paratyphoid organisms—that is to say, para A or para B. The same writer also showed that these last organisms are in practically every case disseminated by the human carrier, and that the other cases of so-called "allied infections" were almost without exception due to one of these four organisms and belonged to one or other of the two distinct diseases—paratyphoid fever on the one hand, and food poisoning on the other.

The incidence of paratyphoid fever is greater, owing to cases being missed or owing to incomplete laboratory examinations, than is generally supposed.

Paratyphoid A is well known in India, and the disease has been described and the methods of isolating the organism well worked out by officers of the R.A.M.C. (Grattan and Wood, Harvey, Firth, and others), whose work ought to be more widely known. In passing it may be noted that all these observers insist on the importance of the "carrier," and therefore on the importance of the clinical recognition of the disease.

Up to 1912 Bainbridge could find no record of para A in England. In America, Proescher and Roddy (quoted by Bainbridge) found that in 262 patients with "enteric fever" whom they examined 8 per cent. had paratyphoid A.

Paratyphoid B is better known in England. Boycott

some years ago suggested that 3 per cent. of the cases notified in Great Britain were really para B.

In Western Europe paratyphoid fever seems much more often due to the bacillus para B, and this is certainly borne out in so far as the statistics of the hospital from which this is written are concerned. In an extensive series of blood cultures made at Pretoria Statham found that 25 per cent. of the cases of continued fever investigated were "paratyphoid fever," both varieties of organism being isolated.

Thanks to protective inoculation and careful sanitary precautions the danger of typhoid fever proving any very serious menace to our troops in this campaign is, we believe, not great; but in so far as protective inoculation against paratyphoid is in its infancy and as yet not widely practised, though eminently desirable, the risk of our having to deal with large numbers of cases of paratyphoid fever is by no means negligible.

The possible modes of infection in paratyphoid fever are many, and, just as in typhoid fever, water, food and milk may all play an important part; but however the disease is ultimately conveyed, the primary and inevitable source of infection is some one who himself has or has had paratyphoid fever. Hence it is of paramount necessity not to overlook any cases of paratyphoid fever, both from the point of view of the immediate risks from improper bestowal of infective dejecta, and equally in order to avoid the possibility of letting loose a number of paratyphoid carriers, any or all of whom may initiate an epidemic of the disease.

It is especially in connexion with this question of carriers that it is hoped our remarks on paratyphoid may be of use. For the important thing is, not to differentiate paratyphoid fever from typhoid fever, but to recognize it or at least to suspect its presence in what appear to be much milder conditions.

These milder diseases are sure to be diagnosed again and again instead of paratyphoid if this latter name suggests to our minds only the classical symptoms of "typhoid," and this is rather the impression one might gather from reading the somewhat cursory remarks on the subject in many textbooks.

The matter, therefore, is not one which only concerns the bacteriologists, since they will not be given the opportunity of examining material unless it is sent to them, and the material cannot be sent unless the patients' medical officer suspects the presence of paratyphoid.

To give an instance of the truth that paratyphoid cannot be eliminated if the "carrier" is not eliminated, it is only necessary to refer again to the incidence of paratyphoid A fever.

A number of our troops at the front came from India. Since the arrival of these troops, paratyphoid A has occurred among other soldiers in France. The great majority of the patients with this fever in our series have either come from India themselves or have been in close association with the troops of the Indian divisions. Some of the cases have been Territorials or men of new battalions who in France have been attached to units from India. It seems fairly certain, therefore, that paratyphoid A has been planted amongst our troops out here by "carriers" from abroad.

How, then, is it possible to reduce to a minimum the risks of labelling paratyphoid fever, P.U.O., influenza, etc.?

It should be stated at once that in some few cases it is impossible even to suspect paratyphoid fever unless a thorough bacteriological examination is made; but in the great majority of cases, if one is alive to the possibility of these infections, one is enabled to exclude the negative cases, but only—and we cannot too much emphasize this point—by the aid of a thoroughly competent bacteriologist.

To put this in another way, it may be said that paratyphoid fever may be so mild and so atypical that only complete bacteriological investigation will reveal its presence; at the same time, even in these atypical cases there will often be some small point which is sufficient to justify one in treating them as suspects until the negative is proved, and happily it is possible to prove the negative in 99 per cent. of all cases, provided that the investigations are begun at a sufficiently early date. On the other hand, paratyphoid fever, whether A or B (but especially B), may in some cases be so severe as to simulate exactly the gravest and most toxic case of typhoid fever. Such cases are described in all textbooks and are familiar to every one.

It is the more typical and very mild cases that principally concern us in this paper, for they are the cases that are most likely to be confounded with influenza, simple chill, "trench" fever, rheumatism, and other diseases with similar titles which are really little more than confessions of ignorance.

In the first place it is more than unprofitable to attempt to discriminate clinically between para A and para B. A lucky guess may be made, but that is all. Suffice it to say that typically para B is a ten to eighteen day fever, while the average para A, as seen in this hospital, lasts three or four days longer. The temperature in both forms shows a characteristic disinclination finally to settle down, but the symptoms in para A tend to be even milder than in para B. If all the very mild cases were diagnosed, the average duration of fever would be found to be less than that above stated. This, we think, is especially true of paratyphoid A.

CLINICAL DIAGNOSIS.

The clinical phenomena which may lead to the classing of a case as "suspected paratyphoid" will now be considered in more detail.

To clear the ground it may be suggested that one fertile source of error seems to be the assumption that a case cannot be one of the enteric group which does not present a more or less "typhoid" appearance, or at any rate some abdominal disturbance in the direction of pain or diarrhoea.

The Onset.

This is usually by no means the gradual affair which one is accustomed to associate with the classical descriptions of typhoid fever. It is true that the majority of the cases when pressed will admit to feeling out of sorts for two, three, or more days, but for all practical purposes many of them are not ill until the day on which they are compelled to report sick.

Two main groups may be recognized. The first (60 per cent. of the cases) comprises those who feel increasingly ill for a variable number of days (the average being four) before they report sick. The second group (40 per cent. of the cases) comprises those who are bowled over in a few hours or collapse in the course of their ordinary duties.

A man develops a headache, has slight abdominal pain, with a couple of days' diarrhoea, but does not report sick, for, as he says, he "thought he would get over it." The diarrhoea does pass off, but backache with generalized aching pains and headache (especially the last) persist, and even get worse, till by the fourth day he is so weak and ill at ease that he reports sick. Such a case is typical of the first group.

In the second group a man may go to sleep feeling well, but he wakes up with abdominal pain, diarrhoea, and severe headache, feels feverish, and has a shivering attack, and in a few hours becomes so extremely weak that he is quite obviously too ill to carry on.

The similarity of this type of onset to that seen in many cases of influenza is worthy of note. If this sudden onset occurs while the man is on duty in the trenches or on the march, we get the history of sudden collapse, "legs giving way," fainting, etc.

As the result of an analysis by one of us of 100 cases of para B and 50 cases of para A taken without prejudice from our series it is found that there are eight symptoms which occur in at least 20 per cent. of the cases at the onset. In order of frequency these are:

1. Headache (85 per cent.).
2. Diarrhoea (55 per cent.).
3. Abdominal pain (35 per cent.).
4. Aching pains in the limbs (30 per cent.).
5. Shivering (25 per cent.).
6. Extreme general weakness (25 per cent.).
7. Backache (25 per cent.).
8. Epistaxis (20 per cent.).

Headache is usually vertical in distribution, though a migrainous type, especially severe behind the eyes, has been present in several cases of para A. Of course, headache may be a leading feature in practically every acute infection, but the predominant nature of the headache over the other symptoms is certainly worthy of notice. Eighty per cent. of all cases will voluntarily mention severe headache as a symptom of the onset.

Abdominal pain is rarely severe or colicky and is usually generalized, and does not often last more than two or three days. Sometimes in cases with very rapid onset it may be severe and associated with nausea and vomiting. Typically, it is not more than a general feeling of uneasiness in the abdomen.

The initial diarrhoea is in marked contrast to the constipation which is so common after the end of the first week. It is rarely severe, being usually limited to three or four loose stools per diem. If one is lucky enough to get the case in this initial stage, the motions will be found to be fairly typical of the "typhoid" variety of stool. Otherwise observation of the stools gives little help in diagnosis.

Pain other than abdominal pain or headache is usually referred to the back or limbs. "Pains all over" is a description often given. Joint pains reminiscent of acute rheumatism have been a feature of some cases, but no swelling of the joints has been detected.

Extreme general weakness is often very sudden in its onset, and sometimes this and headache are the only symptoms. It accounts for many of the cases of sudden collapse, though of course there is a suspicion in such cases that the case may have been ambulatory without previous symptoms.

Epistaxis is rarely volunteered by the patient as one of his symptoms. This is because it is usually so small in amount. Its value as a positive sign is very great and it occurs as frequently in paratyphoid as it does in typhoid fever. It may occur during sleep, and sometimes it may be found to have occurred in the earliest days of the onset or even before, when the patient was feeling quite well.

Shivering.—While it is liable to occur in the course of any infection with the liberation of toxins or bacteria into the blood stream, yet the occurrence of repeated shivering attacks seems of special significance at the onset of paratyphoid fever. This is especially true of paratyphoid A, in which shivering is met with in nearly 30 per cent. of cases at the onset, and in which it is liable to occur with rigors throughout the disease (Case vi). Two patients from whom the bacillus of paratyphoid A was isolated stated that they "thought they had ague."

Other symptoms which may not rarely be complained of or elicited are, in order of frequency, cough, nausea and vomiting, loss of appetite, dizziness, deafness, constipation.

Cough is complained of in nearly 20 per cent. of cases, and seems more common in para B, but is rarely troublesome. It is certainly much less frequent than is the case in "typhoid fever," and in view of the almost universal habit of smoking to excess in the British army it is probable that in a number of the cases the cough is not a manifestation of the paratyphoid fever.

Vomiting is far more common in paratyphoid fever than in typhoid fever. This is especially so in para B cases, in which vomiting occurred in 17 per cent. In association with severe abdominal pain and severe diarrhoea, it occurs in that type of para B which simulates food poisoning in its onset—that is, about 3 per cent. of all cases of this variety.

Dizziness and deafness occurred in 7 per cent. of all cases. Deafness would possibly have been found more commonly had it always been asked for, as it is usually transient.

Sore throat or hoarse voice as evidence of laryngitis or pharyngitis occurred only in 5 per cent. of the cases, all those being cases of para B. It was present only in those severe cases which tend to simulate the toxic type of true typhoid fever.

Temperature during the Onset.—As regards this we are not able to speak with great certainty as cases do not usually reach this hospital until the seventh day or later. Patients in whom the onset was rapid have said that their temperatures were 102° to 103° when first taken. Cases which have started in a hospital where the patient was being treated for some wound, and where the temperature was being taken as a routine measure show a rapid rise, the maximum usually being reached in forty-eight hours. Such a case is shown in Chart 7. It seems fairly certain that the "step-ladder" rise so frequently seen in typhoid fever is far from common in paratyphoid.

GENERAL COURSE.

Although a careful history is of the utmost importance, when all is said and done in this direction, the main data

for diagnosis are often only to be obtained by a thorough examination of the patient. The objective features which may be observed in an average case of paratyphoid fever in the second and third weeks will therefore be considered.

Aspect.

The aspect of the patient, if seen in the early days, will tell much. There is then a peculiar heaviness about any except the mildest cases. This is of considerable significance but is rather difficult to describe. One finds the terms "lethargic," "heavy," "drowsy," "inert," applied to the condition. This appearance, we imagine, can usually be distinguished from the bright-eyed, flushed appearance associated with most of the febrile states. The condition is, however, rarely so well marked as in typhoid fever.

The patient can, except in the quite severe cases, be roused up to give a clear history. In 40 per cent. of the cases the patient is flushed, but the eyes are dull, with the pupils often rather dilated. The chief complaint will be headache, or possibly backache. While about 60 per cent. are of this type, there are two extremes: on the one hand, there is the fairly large group of mild cases (25 to 30 per cent.), which often look and feel fairly well by the second week, and are certainly not at all suggestive of enteric fever. There is the other smaller group (10 to 15 per cent.) which are obviously ill—toxic-looking and mentally blurred. These are the cases that will probably be diagnosed as enteric fever in any case.

The Temperature.

During the second week, in the average case, the temperature ranges between 99.2° and 102.4°. This produces a "spiky" temperature chart which is very characteristic (see charts, especially Chart 2).

Sixty per cent. of the cases analysed showed this remittent type of fever, while about 20 per cent. were intermittent (see Chart 12). A "spiky" temperature chart with variations of at least 2° and more is therefore seen in 80 per cent. of all cases.

A really steady temperature in the second week was only seen in 5 per cent. of cases; 70 per cent. of all cases of para B and 40 per cent. of para A are of twenty days' duration or less. In about 30 per cent. of all cases of each form the pyrexia lasts fifteen days or less (see Charts 1 and 7). In the average case the temperature in the second week and at the beginning of the third week does not reach as high as 103° (see Charts 4 and 10). Only about 35 per cent. of all cases of paratyphoid fever ever reach 103°, and only about 12 per cent. reach as high as 104°.

Pulse.

The pulse is one of the most important aids to diagnosis. The rate is uniformly slow as compared with the temperature. While a relatively slow pulse in typhoid fever is common enough, this feature is still more marked in paratyphoid fever. A temperature of 102.5° with a pulse of 70 is characteristic and is more than significant of a group infection. The pulse, while almost always comparatively slow, varies in its slowness. Without any apparent change in the general condition, the rate may be at one time 65 and at another 85 or 90, and, curiously, a high temperature may coincide with a low pulse rate, and *vice versa*.

The quality of the pulse is characteristic and very important. There is a most marked softness or compressibility present. This is noted in quite 80 per cent. of the cases. About 15 per cent. only of the cases show dirotism, but when present it is almost pathognomonic of an enteric group infection. A slow dirotic pulse in a man without the typical general appearance of enteric fever strongly suggests paratyphoid fever.

The blood pressure in a small series of cases examined by one of us with the sphygmomanometer was found, as might be expected, to vary from 80 to 100 mm. Hg. Some of the lowest blood pressures were found when the temperature was just reaching normal. This phenomenon may therefore be of use in cases which are not met with till late in their course.

Spots.

Spots are present in as many as 75 per cent. of all cases at some time during the disease. They appear in crops, and last three to four days, as in typhoid fever. Owing to

the circumstances in which we get the cases it is difficult to find the average day of the disease on which they first appear. It is probably about the seventh to the tenth day; and they may continue to appear as late as the thirty-fifth day. In 20 per cent. of the cases spots are present after the temperature has reached normal. This is of importance in those rapid mild cases which are not seen until the stage of defervescence is reached, since the presence of spots does not seem to bear any close relation to the severity of the disease.

The spots are larger and much more irregular in outline and of a deeper red colour than those of true typhoid. If scanty they are seen only over the lower ribs in front and on the flanks and on the back of the shoulders. Fortunately paratyphoid spots are usually fairly definite things, and because a doubtful case does not suggest "enteric" it is most unwise to neglect examining for them. The spots may be very profuse, sometimes they may be minutely vesicular and occasionally acneiform. The rash of para A especially tends to be very profuse and may be rather morbilliform. Cases have been sent to the hospital with profuse paratyphoid rashes which have led to the diagnosis of measles, german measles, chicken-pox, and in one case even small-pox was suggested, without, however, much reason.

Gastro-intestinal Symptoms.

The tongue often gives valuable assistance. In nearly all cases it is dry during the acute stage, and in the severe cases it is exactly like the tongue of a severe case of typhoid fever—dry, brown, and cracked. Even in the milder cases the tongue is fairly characteristic. It is dry and furred, and the fur is distributed in two dorsal slabs, leaving a red tip and red edges, and often a red band up the centre. The red tip is often smooth and glazed, in marked contrast to the rough fur. The fur is not so persistently brown as in typhoid; it is frequently thick and dirty-white in colour. On the whole, the presence of a "typhoid" tongue without the other general appearances of typhoid fever is fairly frequent, and in these circumstances is very suggestive of paratyphoid fever.

The abdomen is not nearly so informative as in true typhoid. Frequently it is absolutely normal in appearance and feel. In over 60 per cent. of the cases there is no distension whatever. However, in a fair proportion of cases (about 35 per cent.) the belly can be described as "full," "tumid," or "slightly distended," and in these cases there is a suggestive soft elastic feel about it. Tenderness on palpation is rare and pain is rarely complained of by the time the patient reaches a base hospital. Gurgling on pressure in the caecal region is rare. Pain when feeling for the spleen or in the left lumbar region is suggestive and is present in about 10 per cent. of all cases. Marked distension is very rare and is only seen in the few very severe cases.

Enlargement of the liver and tenderness over the gall bladder, unless cholecystitis is present as a complication, are conspicuous by their absence.

The spleen is either palpable or enlarged to percussion in nearly 60 per cent. of cases; it can be felt in about 35 per cent. of all cases some time during the course of the disease. When felt the paratyphoid spleen seems to be firmer in consistence and remains palpable for a longer period (possibly by reason of this greater hardness) than it does in typhoid fever. On the whole, too, it seems less tender. The value of a palpable spleen is tremendous, and it is just as often present in the quite mild cases as in the more obvious ones, and therefore, like the spots, should be sought for always. Owing to the frequency with which it occurs in a quite undistended abdomen, the paratyphoid enlargement is comparatively easy to make out. It is easy to exclude malaria and the blood dyscrasias in the average patient, and other causes of enlarged spleen are very rare.

Examination of the heart is negative.

Examination of the lungs will show bronchitis in less than 30 per cent. of the cases. Severe bronchitis only occurs in about 5 per cent. of cases, and then only in that type of case resembling true typhoid which is not likely to be missed.

The central nervous system shows no constant abnormality. A very few cases have simulated meningitis, and from every point of view it is desirable to perform lumbar puncture to settle the question without delay.

Only once has a paratyphoid meningismus closely simulated cerebro-spinal fever, and in this case the spinal fluid was quite clear, sterile and free from pus cells.

Defervescence.

In the third week the temperature of the average paratyphoid case reaches normal, while even if fever continues beyond the end of the third week there is nearly always a decided improvement in symptoms. It is quite common to see a case of paratyphoid fever with a temperature ranging up to 102° or even 103° lying on his side reading the newspaper, quite clear mentally and ready for a joke (see Case 11). This, of course, is in marked contrast with true typhoid fever. It has been remarked that para B is a fever of about sixteen to nineteen days, while para A as seen in this hospital is longer. This is due to a characteristic tendency for the temperature in para A to take a long time to settle down, and a tendency to be remittent and to recrudescence just when settling down, although the patient's general condition is obviously improving. This is well seen in Charts 2 and 5. Most of the cases which are apparently rather severe and which simulate typhoid, characteristically take a sudden turn for the better and markedly improve after being in hospital from three to five days, and this quite apart from any measures other than dieting and nursing (see Chart 9). It is important to recognize this feature, otherwise it may be attributed to certain treatments adopted. The termination of the fever is often characteristic. The temperature tends to settle by modified crisis or by short lysis lasting little more than two days (see Charts 4, 7, 10, and 12). It is certainly rare to see the steady long-drawn-out defervescence so common in typhoid fever. The pulse is the chief and almost only reliable guide to the actual condition of the patient. As long as the pulse is regular, below 90, and not too soft in quality it matters not how high the temperature is. A pulse persistently over 100 nearly always means a serious infection. Distension and severe bronchitis are also apt to mean a serious case.

SUMMARY OF SYMPTOMS.

An endeavour has been made in the preceding remarks to describe the signs and symptoms which may be met with in paratyphoid fever.

To recapitulate, in a doubtful case the most important individual features are probably:

1. An onset of about four days with malaise, pains in head, back, and limbs, a tendency to shiver, and abdominal discomfort with a short period of looseness of the bowels.
2. A soft pulse which is strikingly slow in relation to the temperature.
3. An enlarged spleen (not necessarily palpable).
4. A fever lasting upwards of a week to fourteen days.

Now if a case can be observed from the onset, and a temperature chart kept from the commencement, it is comparatively simple to say at the termination of the disease that the patient has probably had either mild typhoid or paratyphoid fever, but unfortunately this is rarely possible. Of course by the tenth or twelfth day there will probably be spots or enlargement of the spleen, or other unequivocal evidence, but there may not be anything so helpful, and it is then that a careful history is so important. A typical case to treat as a suspect would be somewhat as follows:

A Typical Case.

The patient reported sick eight days previously with headache, pain in the limbs, and constipation. On questioning he will admit that for three or four days before reporting sick he had been off his feed and felt generally out of sorts, with a distinct tendency to shiver at odd times, and very probably there will have been about forty-eight hours' looseness of the bowels, perhaps not amounting to true diarrhoea, before he actually was ill enough to go sick. On examination the patient may very likely look a trifle lethargic, and may cerebrate somewhat slowly. His tongue will show dorsal furring, with pink or red edges and tip, but may be quite moist. The abdomen may be a trifle tumid and elastic. There may be vague discomfort in it, or even tenderness under the left costal margin. The splenic dullness will probably be elicited more readily than in a normal individual.

The stools will be constipated and the bowels only opened with enemata. The temperature will be about 101° or 102° at night, with a morning remission of about 2° or more. The pulse will be 70-80, of small volume, and very compressible. There may or may not be an occasional rhonchus in the chest. The patient himself will probably say that he is "in the pink."

Such a case is likely to be paratyphoid fever, and should be treated as such.

COMPLICATIONS AND SEQUELAE.

It is possible for paratyphoid fever to show all the complications and sequelae which are found in typhoid fever. There is, however, a marked difference, both actual and relative, in the frequency with which they occur in the two diseases.

They will now only be described in so far as they are liable to affect the clinical aspect of paratyphoid fever.

Bronchopneumonia and meteorism are perhaps the commonest complications of typhoid fever. Capillary bronchitis, or bronchopneumonia, has not occurred in more than 4 per cent. of our paratyphoid cases. While rare in both para A and para B, it seems relatively more common in the latter. Meteorism, due to paralytic distension of the large intestine, is very rare indeed, and has only occurred in some of those unusual toxic cases closely resembling typhoid infection. The rareness of this complication is surprising when one considers the tendency of para B to cause severe and extensive inflammation of the large gut.

Haemorrhage, on the contrary, seems almost as common in para B as it is in typhoid fever. Severe haemorrhage occurs in about 5 per cent. of all cases of para B, and was solely responsible for the death of one case, while it was a contributory cause in four other fatal cases. In two not fatal cases it was quite copious, but did not seem to affect seriously the patients' general condition. It is far less frequent in para A, occurring only in about 1 per cent. of cases. In para B it is liable to occur at a definitely earlier date in the disease than in typhoid fever.

Perforation (a distressing accident which no one can foresee or guard against) has occurred in 3 cases of para B and in 1 case of para A—that is to say, in about 1 per cent. of all cases of paratyphoid fever.

Thrombosis of the femoral vein occurred in 3 out of 100 cases of para B and once in a series of 50 cases of para A. A mild otherwise average case seems quite as liable to this complication as one of the more severe variety. It seems to begin at a relatively earlier date in the disease than it does in typhoid fever. Of 4 cases the left femoral was involved three times and the right once.

Amongst the other complications and sequelae that have been met with are:

Relapse,	Suppurative orchitis,
Recrudescences of fever,	Neuritis,
Pleurisy,	Meningismus,
Empyema,	Mental weakness in convalescence,
Abscess of lung,	Periostitis,
Pericarditis with effusion,	Pyelitis,
Tachycardia,	Cholecystitis,
Laryngitis,	Abscess of spleen,
Tonsillitis,	Peritonitis without perforation of the bowel.
Otitis media,	
Parotitis,	

We would like to call particular attention to what seem to be two definite idiosyncrasies of paratyphoid B:

The first is a tendency (of which mention has already been made) to involve the large gut, and secondly, the special liability to pus formation. The former peculiarity is shown by the fact that the three perforations which have so far occurred in our para B cases were all situated in the large intestine—namely, one in the sigmoid, one in the appendix, and one in the descending colon. Also, it is the usual thing at necropsies on cases of paratyphoid B to find the caecum and the colon as far as the splenic flexure severely affected, and in three or four cases the solitary follicles have been extensively involved nearly as far down as the rectum.

The second tendency of para B—namely, that to pus formation—is evidenced by the occurrence of the following complications. Three cases of suppurative orchitis, two cases of splenic abscess, one case of empyema, one of periostitis of a rib, one of abscess of the liver, one of abscess of the lung, and the case of suppurative peritonitis above

mentioned, all occurring in the course of paratyphoid B. The bacillus paratyphoid B was recovered from two of the cases of orchitis, both the splenic abscesses, and from the abscesses of the liver and the lung, and from the pus around the rib.

Relapses, Etc.

The disinclination of the temperature of paratyphoid A finally to settle has already been noticed. Sudden recrudescences of the temperature both during and after the primary period of pyrexia are fairly common in both para A and para B, but especially in the former. In para A these rises are liable to be associated with rigors, which occurred in 4 of the 50 cases. Over 25 per cent. of all cases of para A show one or more of these recrudescences, and half of these show two or three such rises (Chart 5). Similar rises, which have not, however, been associated with rigors, occur in about 15 per cent. of the para B cases. The duration of these pyrexial bouts is usually about three days.

Relapses—that is to say, more serious and prolonged rises of the temperature, associated with more or less of a return of the original symptoms, and frequently fresh enlargement of the spleen and reappearance of spots—occur in from 6 per cent. (of the B cases) to 10 per cent. (of the A cases). The relapse usually lasts from six to ten days. Examples of such cases are seen in Charts 3 and 6.

Irregularities of the Pulse.

Some interesting irregularities of the pulse are met with. Troublesome tachycardia, leading to prolonged convalescence, occurs in about 5 per cent. of the cases, being decidedly more common in para A. Bradycardia is still more common, but seems to be a favourable feature. It is especially frequent in para B, occurring in over 10 per cent. of the cases, sometimes starting before the temperature has settled. Lieutenant Marris has suggested that some of the cases of tachycardia are due to disturbances of the splanchnic vasomotor control, and certainly the application of a wide elastic belt has been found to do good in a number of them. He has also examined with the polygraph other cardiac irregularities, such as heart-block, auricular fibrillation and auricular flutter, which would appear to be by no means infrequent, but which are only temporary disabilities. It will be seen that the period of convalescence is sometimes attended by quite interesting clinical problems.

Mortality.

The death-rate of paratyphoid fever is very low compared with that due to *B. typhosus* infection. The mortality of para B is a little over 4 per cent. and that of para A under 1 per cent. It is hoped in a further paper to refer more fully to the fatal cases and to describe the morbid anatomy and *post-mortem* appearances.

A *post-mortem* examination has been made in all the fatal cases except one. The causes of death in paratyphoid B have been as follows:

One case from profuse haemorrhage.

Three cases from severe toxæmia combined with severe haemorrhage.

Two other cases from sheer toxæmia.

One case from gangrenous pneumonia.

Three cases from perforation.

One case from abscess of the spleen with peritonitis.

One case from peritonitis without perforation.

One case died after drainage of a localized abscess in the region of the caecum (? appendicular in origin), and showed abscesses in the liver and also an abscess in the lower lobe of the right lung.

Two cases died of intercurrent or associated disease, namely, one from lobar pneumonia and one from cerebro-spinal meningitis. This last was the only one in which no *post-mortem* examination was made, but during life the *B. paratyphosus* B was isolated from the blood and the meningococcus from the cerebro-spinal fluid, thus definitely proving the coexistence of the two diseases. In all the other cases the *B. paratyphosus* B was isolated from the bile, and in many of the other cases from the spleen as well. Only one case so far has died in this hospital of

paratyphoid A fever. This was a rather severe case in which a paratyphoid ulcer of the appendix perforated, causing general peritonitis.

ROUTINE OF DIAGNOSIS.

In the preceding remarks we have endeavoured to indicate the clinical phenomena which should lead a case to be classed as "suspected paratyphoid"; we will now mention briefly the routine measures which must be adopted in order to place the diagnosis of such a case on as sure a basis as is possible.

A positive diagnosis can be made in one of two ways. First, the specific bacillus may be recovered from the blood, faeces, or urine of the patient, and secondly, evidence may be discovered in his blood that he has acquired, or is acquiring, an immunity to a specific infection.

1. *Cultivation of Bacillus.*

Before accepting the identity of any bacillus it must conform rigidly to certain cultural characteristics, it must agglutinate with the appropriate high-titre immune serum, and it must satisfy the specific "absorption" tests first advocated by Castellani. If these requirements are not all rigorously exacted there will be many instances of faulty diagnosis, especially in the case of bacilli isolated from the stools.

The recovery of a bacillus from the blood is, unfortunately, not practicable so often as could be wished, for the bacillaemia of paratyphoid fever is often very transient, and cases are frequently not seen until too late.

The attempt should, however, always be made, for the bacilli may be present in the blood as late as the twenty-third day. It is best to do the venepuncture when the temperature is at its highest, and for this reason the evening is probably better than the morning; 5 c.cm. of blood should be removed from a vein and placed into about 10 to 15 c.cm. of sterilized ox-gall. This is incubated at body temperature for twelve hours before plating out, and reincubated and replated for the next three days. In a like manner, unless one is dealing with a carrier, the bacilli are most often found in the faeces and urine during the height of the disease. Hence it is advisable to send for examination three or four specimens of both faeces and urine during the first week that the patient is under observation; more can be sent later if the clinical phenomena continue to indicate a positive diagnosis.

2. *Agglutination.*

The second method of diagnosis is to search for the visible evidence of the immunity which the patient must have acquired or be acquiring if he has or has recently had the infection, and is of course the old Widal agglutination reaction. The only satisfactory method is to examine the blood for the specific agglutinins of typhoid, paratyphoid A and paratyphoid B on at least three separate occasions at intervals of four or five days, the first occasion being on the day of admission.

In each case the end-point, that is to say, the maximum dilution of serum in which agglutination occurs, is noted, and it is found that the strength of agglutination follows a definite curve in any recent infection. The macroscopic method is employed, standard emulsions of the micro-organisms must be used, and the result must be read after a constant interval has elapsed, which interval experience has shown to be sufficient for complete agglutination to take place. The technique and the correct interpretation of the resulting curves (especially in the case of typhoid fever where protective inoculation has been practised) are much more difficult matters than might be expected from the short description we have given, but the method adopted in this hospital is that elaborated and published by Captain Dreyer, professor of pathology in the University of Oxford.

In conclusion, we would say that, in view of the constant leucopenia which is present in all enteric group infections, a routine enumeration of leucocytes should be undertaken in all cases, though, of course, this does not help in the absolute diagnosis of paratyphoid fever.

We have not found the diazo reaction to be of diagnostic value in paratyphoid fever, since it appears to be absent or equivocal in all except the most severe cases.

CASE I.
Typical mild, short paratyphoid A with thirteen days' pyrexia.

Chart 1.—Case I.

On admission (seventh day): No distress, sallow complexion, soft small pulse, dry brown tongue, firm easily felt spleen in abdomen. A few typical spots. Stools "typhoid." Blood culture grows para A. No agglutination with *Bacillus paratyphosus* A. Fourteenth day: Feels well. Spleen just felt, no spots; agglutination with *Bacillus paratyphosus* A, 1 in 100.

CASE II.
• Mild but prolonged case of paratyphoid A, with thirty days' pyrexia. The patient was cheerful and quite undistressed from the thirteenth day onwards with nothing suggestive of a "typhoid" appearance. Blood culture on the tenth day of illness grew *B. paratyphosus* A.

On admission (thirteenth day): Sallow complexion, looks seedy but quite bright mentally. Soft, good volume pulse, more rapid than usual; moist, slightly furred tongue, abdomen negative and spleen not enlarged. A few big, well raised paratyphoid spots. Bowels constipated.

Thirty-fifth day: Feels and looks well. Many big spots. Chart shows well a characteristic "spikiness."

CASE III.
Rather severe paratyphoid A with pyrexia of average length (twenty days), but followed by relapse of fifteen days. Blood culture showed *B. paratyphosus* A on sixth day of disease and on seventh day of relapse (thirty-third day).

Chart 3.—Case III.

Sixth day: Flushed, very lethargic, very soft pulse, dry tongue with yellow dorsal fur, a tender "doughy" abdomen, spleen enlarged to percussion, a few typical spots.

Fourteenth day: General condition markedly improved. No spots. Spleen not felt. There were no fresh signs during relapse, which patient bore

Chart 4.—Case IV.

CASE IV.
Typical mild paratyphoid A with seventeen days' pyrexia.

On admission (ninth day): A little flushed, but otherwise fairly normal appearance. Good volume, but soft pulse. Dry tongue with brown fur in centre. Abdomen negative. Spleen not found enlarged. Several typical spots. Stools semiformal. Blood culture grows *B. paratyphosus* A. This case ran a typical mild non-toxic course without wasting or distress. The chart shows a typical remittency of the temperature.

CASE V.
Paratyphoid A of average severity in which the temperature reached normal on the twenty-third day. The pulse was rather more rapid than is usual, and there was some tachycardia in convalescence. The chart shows a rather characteristic disinclination of the temperature finally to settle.

On admission (thirteenth day): Looks flushed and heavy and is disinclined to talk, but is quite clear when roused. Pulse soft and diastolic; tongue dry, rough, and furred; abdomen negative except tenderness in left flank, but the

spleen is not made out enlarged. A few spots present. Bowels constipated. Blood culture shows *B. paratyphosus* A. The general condition rapidly improved.

CASE VI.
Paratyphoid A, severe up to third week and noticeable for great irregularity in temperature associated with rigors, and for a relapse with dry pleurisy. The primary period of pyrexia lasted twenty-six days. Blood culture (taken before admission) showed *B. paratyphosus* A.

On admission (thirteenth day): Flushed "typhoid" appearance, but mental condition good. Pulse small and very soft. Tongue dry and furred in centre. Abdomen a little distended; Spleen palpable. A few typical spots were present. "Typhoid" stools.

CASE VII.

Typical short paratyphoid B showing rapid rise of temperature at onset and quick fall to normal on the ninth day. At the time of onset the patient was in hospital for bruises, the result of a shell explosion. He was up and about, when he felt cold, had headache and pains in the back, and next day his temperature was 103°. He had a discharge from the ear, and it was thought at first that this local condition accounted for the fever. He was seen by one of us on the eleventh day, and sent in as probably paratyphoid.

On admission (eleventh day): Feels and looks fairly well. The pulse is slow and soft; tongue moist, but has brown fur; the abdomen is negative, and the spleen is not found enlarged. A few spots are present. Bowels constipated. Strong agglutination of *B. paratyphosus* B. Both stools and urine on this day were found to contain the para B organism.

Chart 7.—Case VII.

CASE X.

Typical mild paratyphoid B, in which the temperature reached normal on the seventeenth day.

On admission (eighth day): Looks seedy, feels weak, is quite clear mentally. Pulse very soft; tongue dry with thick brown fur. The abdomen is a little "full" and the spleen not enlarged. Blood culture negative.

Thirteenth day: Spleen felt. Stool culture grows *B. paratyphosus* B. Spots were never seen. The patient made an uneventful recovery.

CASE XI.

Very mild non-toxic case of paratyphoid B. On admission (tenth day): The patient looked debilitated, but otherwise nothing abnormal was found, and the blood culture and serum reactions were negative. During the next few days the temperature rose, and blood was again taken on the fifteenth day, and this time grew *B. paratyphosus* B, and the serum strongly agglutinated *B. para-*

Chart 8.—Case VIII.

CASE VIII.

Typical rather severe case of paratyphoid B, running rapid course with eleven days' pyrexia.

On admission (sixth day): Flushed and looks feverish, but is quite clear mentally. Pulse slightly dicrotic; tongue dry, with thick, dirty white fur; the abdomen "full," and spleen not enlarged. A few developing spots are present. Bowels constipated. Blood culture negative. Strong agglutination with *B. paratyphosus* B. A blood culture taken before admission grew *B. paratyphosus* B. The patient made a quick convalescence.

Chart 9.—Case IX.

CASE IX.

A severe toxic case of paratyphoid B, which began to improve rapidly at end of second week, the temperature reaching normal on the eighteenth day.

On admission (eighth day): Flushed, looks toxic, muttering, a little tremulous; is too ill to get history. The pulse is of big volume and very soft. The tongue is dry, with yellowish-

Chart 10.—Case X.

brown fur. The abdomen is not distended, and the spleen is felt. There are many big, well-raised spots. Bowels constipated. Diagnosed as severe paratyphoid B fever. Blood and stool cultures both grew *B. paratyphosus* B.

Twelfth day: Continues severe, with rapid grunting respiration, is restless and flushed, and has a dicrotic pulse.

Fifteenth day: Better. Quiet and undistressed. The patient continued rapidly to improve, and made a good convalescence.

Chart 11.—Case XI.

typhosus B. By this time, however, the stools sent for examination on the day of admission had grown *B. paratyphosus* B also. There were at no time any definite physical signs. Presumably the patient had a mild brief attack, accounting for the normal temperature and the organism in the stools on the tenth day, and the febrile period occurring in this hospital,

during which the organism was grown from the blood, was a relapse.

CASE XII.

Mild case of paratyphoid B fever showing the intermittent type of pyrexia.

On admission (fourteenth day): The patient looks poorly and feels weak. The pulse is of small volume and soft. The tongue is dry with brown fur. The abdomen is sunken, and

the spleen not enlarged. Several spots seen. Bowels constipated. Blood culture negative. Stool culture grew *B. paratyphosus* B.

Chart 12.—Case XII.

Twenty-fifth day: Fresh crop of spots. Spleen felt enlarged and remained so until thirty-first day. Uninterrupted convalescence.

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