THE DISTRIBUTION OF TYPHOID AND PARATYPHOID INFECTIONS AMONGST ENTERIC FEVERS AT MUDROS,

OCTOBER—DECEMBER, 1915.*

BY

LIEUTENANT-COLONEL C. J. MARTIN, A.A.M.C., F.R.S.,
AND

MAJOR W. G. D. UPJOHN, A.A.M.C.,
PATHOLOGISTS TO NO. 3 GENERAL HOSPITAL, A.I.F.

THE early records from France of the incidence during the war of enteric fever upon inoculated and uninoculated British troops showed no significant difference. This was in contrast with results previously obtained, and notably with those patiently collected over three or four years by the War Office Committee appointed to examine into the virtues of antityphoid inoculation, according to whose report the incidence was about 1 to 5 $\frac{1}{2}$ respectively.¹

This discrepancy might obviously be accounted for if the prevailing type of enteric infection was not typhoid, but paratyphoid, for Kabeshima² has shown that inoculation against typhoid affords no protection against paratyphoid A or B. Accordingly, endeavours were made towards the end of 1914 to differentiate these latter fevers from typhoid.

Early in 1915, Dreyer, Walker, and Gibson³ published the results of the examination of a limited series of cases at the base hospital at Oxford. They concluded that no case of typhoid fever had occurred in the inoculated individuals of their series, and that, as found by Kabeshima, paratyphoid fevers had occurred with equal frequency among antityphoid inoculated and non-inoculated individuals. Dreyer, Walker, and Gibson (*loc. cit.*) were of opinion that the cases returned as typhoid fever amongst our troops were to a large extent paratyphoid infections.

A large portion of our work at No. 3 Australian General Hospital at Lemnos consisted in helping our medical colleagues to arrive at an accurate diagnosis of the various intestinal diseases, which bulked so largely in the medical practice of the hospital. To this end, in the case of the enteric fevers, we chose the serological method as our routine procedure. It would not have been possible, with the material and assistance at our disposal, to have made more than one-fifth the number of observations by blood culture, and at least half of these would have miscarried, as so many of the patients were past the first week of the disease on admission.

We were aware that the interpretation of agglutination results would, in the case of persons inoculated against typhoid, be a matter of some difficulty; but we had the advantage of working in close co-operation with our physicians, who kept us in touch with the subsequent history of the patients, so that repeated observations could be made if desirable. We therefore hoped that in the great majority of cases any ambiguity might be removed.

There is no one perfect method for estimating the distribution of the various enteric infections. Conclusions drawn from blood cultures alone are not free from error, for the proportion of successful cultivation is higher in typhoid than in paratyphoid B fever.

During the three months October to December, 1915, we gathered a considerable amount of data, which we shall proceed to deal with, in view of its bearing upon the distribution of enteric fevers at Gallipoli during this part of the campaign.

In carrying out the agglutinations we had from time to time valuable help from Sister Williams and Captains Bahr, Brennan, and Maclure. In scrutinizing the cases whose serums gave an agglutination to typhoid only, the importance of which scrutiny will be emphasized below, we had invaluable help from Lieutenant-Colonel Stawell, Lieutenant-Colonel de Crespigny, and Captain Ercole. To one and all we express our deep sense of gratitude.

METHOD EMPLOYED IN DETAIL.

The emulsions were, in the first instance, made from strains of typhoid, paratyphoid A, and paratyphoid B bacilli obtained from the Lister Institute. The first is a

readily agglutinable strain, which has been propagated in the laboratory for several years. The two last are descendants of Schottmüller's original strains. Subsequently we substituted a locally isolated strain of *B. paratyphosus* B, as the Schottmüller's strain did not form good emulsions. The bacilli were grown for twelve hours on nutrient agar, emulsified in saline by gently agitating the bottles, and diluted so as to show definite opalescence when placed in the tubes used for the agglutinations, which were about a quarter of an inch in diameter. Formalin was added to make a concentration of 0.1 per cent. Each brew of emulsion was tested against standard serums obtained from the Lister Institute, which agglutinated all three emulsions up to a dilution of 1 in 16,000. The agglutination was specific in a dilution of 1 in 50. Lower dilutions were not tried. As fresh emulsions were made from time to time, they were tested in the same way against the corresponding standard serum. No significant variation in agglutinability was observed during the course of the observations.

About a fifth of a cubic centimetre of blood was drawn from the patient into a sterile glass pipette and sealed. The blood serum was usually separated from the clot by centrifuging on the same day. For diluting the serum pipettes drawn out in the flame and cut off at a point where their orifice had an external diameter of 1.12 mm. were employed. Such a pipette drops 0.02 c.cm. of serum if held vertically. Two drops made up to 1 c.cm. affords a dilution of 1 in 25. For arranging the series of dilutions we used pipettes drawn so as to leave a small bulb intervening between the two capillary portions (see diagram), which latter should have thick walls. The content of the pipette is arranged so as to equal about half the volume it is desired to work with in the agglutination tubes. The exact content is not material if the same pipette is used throughout the series of dilutions and subsequently for adding the emulsions. For convenience, however, we made two stock sizes of pipettes, which contained 0.15 c.cm. and 0.25 c.cm. respectively. The pipettes in each series were then interchangeable.

The successive dilutions were made by the usual method, namely: Two volumes of the first dilution of serum were placed in tube No. 1 of the series, and into tubes 2, 3, 4, etc., was placed one volume of water. Thereafter, one volume was removed from tube No. 1, emptied into tube No. 2, and mixed. A volume of this mixture was withdrawn and emptied into No. 3, and mixed. One volume withdrawn from tube No. 3 was emptied into No. 4, mixed, and so on until the last tube of the series was reached, when, after mixing, the one volume removed was discarded. In this way each successive tube contained serum twice as dilute as the previous one. The procedure having been carried out in triplicate, to every tube in a series an equal volume of emulsion of typhoid, or paratyphoid A, or paratyphoid B bacilli respectively, was added and the contents mixed. The tubes were placed in the incubator at 37° C. for two hours, allowed to remain on the bench for one hour, and the results read.

The following conventional series of marks was awarded and will be employed in this communication:

Complete agglutination	+++
Agglutination visible to the naked eye	++
Agglutination visible with lens magnifying 4 diameters	+
No agglutination visible with lens magnifying 4 diameters	-

The serums of 350 patients were tested against *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B in dilutions of 1 in 100, 1 in 200, 1 in 400, and 1 in 800. In the remainder the 1 in 800 dilution was omitted to save labour, as it was found that the results could, in most cases, be equally well read without it. After the first two months a lower dilution, 1 in 50, was employed for the paratyphoid A series, as we found that we were missing some

* A paper read to the Anzac Medical Association, Cairo, on February 20th, 1916.

infections due to this organism by beginning at 1 in 100. For reasons which will be entered into later these cases were generally recorded as typhoid.

RESULTS.

Observations were made upon the serums of 627 patients and 151 normal persons. As we were functioning as the clinical laboratory of a large general hospital, the patients whose serums we examined were not all enterics. If the medical officer thought that a serological examination would help him towards a diagnosis, the blood was sent to the laboratory. The 627 patients consequently included a number who were suffering from other febrile diseases.

In Table I below are set forth the gross results:

TABLE I.

No agglutination (minimal dilution of serums 1 in 50 or 1 in 100)...	
Agglutination to <i>B. typhosus</i> ...	163
Agglutination to <i>B. paratyphosus</i> A ...	138
Agglutination to <i>B. paratyphosus</i> A and <i>B. typhosus</i> ...	66
Agglutination to <i>B. paratyphosus</i> A, <i>B. typhosus</i> , and <i>B. paratyphosus</i> B (last slight or transient)...	136
Agglutination to <i>B. paratyphosus</i> A and <i>B. paratyphosus</i> B (latter slight or transient) ...	9
Agglutination to <i>B. paratyphosus</i> B ...	2
Agglutination to <i>B. paratyphosus</i> B ...	19
Agglutination to <i>B. paratyphosus</i> B and <i>B. typhosus</i> ...	88
Agglutination to <i>B. paratyphosus</i> B, <i>B. typhosus</i> , and <i>B. paratyphosus</i> A (last slight or transient)...	5
Agglutination to <i>B. typhosus</i> and <i>B. paratyphosus</i> A (latter slight or transient) ...	1
	627

INTERPRETATION OF AGGLUTINATION FINDINGS IN PATIENTS PREVIOUSLY INOCULATED AGAINST TYPHOID FEVER.

Agglutination of *B. typhosus*.

Dealing, as we were, with a population almost entirely inoculated against typhoid within fourteen months, it is not surprising that 376 out of the 627 should show an agglutination to *B. typhosus* in a dilution of 1 in 100 or upwards.

Before we are able to draw any conclusions from our results, it is first necessary to ascertain, with the technique used, the amount of agglutination which occurs from inoculation only. To determine this, the blood of members of the staff and hospital orderlies, who had not been sick, was examined under similar conditions to those employed in the case of patients.

Agglutination Titre for *B. typhosus* of the Serums of 75 Healthy Persons Inoculated against Typhoid 7 to 14 Months Previously.

7 agglutinated in a dilution of	1 in 800
12 " " "	1 in 400
22 " " "	1 in 200
16 " " "	1 in 100
18 did not agglutinate in a dilution of	1 in 100.

That is, two-thirds showed an agglutination titre of 1 in 200 or upwards and in 10 per cent. it was 1 in 800 or upwards.

In addition to the above experiment, the pooled serums of twenty-eight men inoculated on the same day fourteen months previously was found to give a good agglutination at 1 in 200—a result in close agreement with the above.

It follows, therefore, that in an inoculated person an agglutination of *B. typhosus* by his serum, up to the limits observed by us in patients, is not necessarily significant of typhoid infection, and that in order to arrive at a diagnosis of typhoid fever in our cases other means must be resorted to.

When we commenced our observations we were under the impression that the progressive development of typhoid agglutinins during the course of illness, reaching sometimes a titre of 1 in 1,000 or upwards, might, in the absence of any discoverable agglutinins to *B. paratyphosus* A or B, be taken as evidence of typhoid fever.

We were strengthened in this belief by the conclusions arrived at by Dreyer, Walker and Gibson (*loc. cit.*), who pointed out, quite rightly, that a differential diagnosis may be arrived at by measuring the agglutination titre to typhoid and paratyphoid bacilli respectively over a period of a few days. This method is, however, beset with pitfalls.

Early in our observations, as we shall proceed to show, it became apparent that many serums agglutinating one of

the paratyphoid bacilli simultaneously agglutinated typhoid bacilli to an unexpected degree. Further, in a number of cases of paratyphoid fevers in which repeated observations were carried out, a progressive development of typhoid agglutinins preceded by one to two weeks the development of agglutinins to the paratyphoid bacillus. We give below examples illustrating this phenomenon in which paratyphoid bacilli were isolated. Unless the observations had been persisted in, all of these would have been diagnosed as typhoid fever. We ought to have been alert to this possibility, for in 1911 Grattan and Harvey⁴ described its occurrence in paratyphoid A fever in India. It was also drawn attention to by Firth,⁵ and later by Safford.⁶

No. 3729.

	1:100.	1:200.	1:400.	1:800.
Before illness:				
<i>B. typhosus</i> ...	++	—	—	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
After 1 week:				
<i>B. typhosus</i> ...	+++	+++	++	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
After 2 weeks:				
Agglutination the same.				
<i>B. paratyphosus</i> A was recovered from urine.				
After 3 weeks:				
Agglutination the same.				
After 4 weeks:				
Agglutination the same.				
After 5 weeks:				
<i>B. typhosus</i> ...	+++	+++	++	—
<i>B. paratyphosus</i> A ...	+++	+++	+++	++
<i>B. paratyphosus</i> B ...	—	—	—	—

B. paratyphosus A was isolated from the faeces in the fourth week.

No. 3681.

	1:100.	1:200.	1:400.	1:800.
First week of illness:				
<i>B. typhosus</i> ...	—	—	—	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Third week of illness:				
<i>B. typhosus</i> ...	+++	+++	++	+
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Fourth week of illness:				
<i>B. typhosus</i> ...	+++	+++	++	+
<i>B. paratyphosus</i> A ...	++	+	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—

B. paratyphosus A was recovered from the sputum and pleural exudate during the third week of illness. The patient died in the fourth week with gangrene of the lung and localized pleurisy. *B. paratyphosus* A was recovered in pure culture from the spleen. The bile was sterile.

No. 3778.

	1:100.	1:200.	1:400.	1:800.
First week of illness:				
<i>B. typhosus</i> ...	—	—	—	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Second week of illness:				
<i>B. typhosus</i> ...	++	+	—	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Third week of illness:				
<i>B. typhosus</i> ...	+++	+++	++	+
<i>B. paratyphosus</i> A ...	+++	+++	+++	++
<i>B. paratyphosus</i> B ...	—	—	—	—

B. paratyphosus A was recovered from the faeces during the third week.

No. 522.

	1:100.	1:200.	1:400.	1:800.
Second week of illness:				
<i>B. typhosus</i> ...	+++	+	—	—
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Third week of illness:				
<i>B. typhosus</i> ...	+++	+++	++	+
<i>B. paratyphosus</i> A ...	—	—	—	—
<i>B. paratyphosus</i> B ...	—	—	—	—
Fifth week of illness:				
<i>B. typhosus</i> ...	+++	+++	++	+
<i>B. paratyphosus</i> A ...	+++	+++	+++	+++
<i>B. paratyphosus</i> B ...	+++	+++	+++	+++

The patient died in the sixth week of illness. A pure culture of *B. paratyphosus* B was isolated from the spleen and bile. The blood taken post mortem agglutinated *B. paratyphosus* B in a dilution of 1 in 10,000.

In the instances detailed above infection with one of the paratyphoid organisms stimulated the production of typhoid agglutinins early in the disease, and it was not until as late as the third to fifth week that the titre for the infecting organism rose to 1 in 100. This occurred in about 2 per cent. of our cases, all, with one exception, paratyphoid A fevers.

As soon as we became aware of these facts we regarded the development of typhoid agglutinins in a patient previously inoculated against typhoid fever with suspicion, and he was only diagnosed as typhoid when *B. typhosus* was isolated, or, as being clinically a case of one of the enteric group of fevers, when no evidence of paratyphoid infection could be obtained. Even so, we have reason to believe that some cases of infection with *B. paratyphosus* A were returned as typhoid, for occasionally the development of agglutinins to this organism is slight and transient.

In order to throw some further light upon the interpretation of the rise in typhoid agglutinins in paratyphoid infections we inoculated healthy persons, some of whom had previously received antityphoid vaccine, with paratyphoid A and B bacilli. In about half of those who had been previously inoculated this was followed by the considerable development of typhoid agglutinins. The instances given below were amongst the most striking:

	1:100.	1:200.	1:400.	1:800.
No. 1001.				
Inoculated against typhoid six months previously:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	-	-	-	-
Eleven days after injection of 200 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	+++	+++	+++	++
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	+++	+++	+++	++
No. 1002.				
Inoculated against typhoid five months previously:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	-	-	-	-
Ten days after injection of 200 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	+++	+++	++	-
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	++	-	-	-
Fifteen days after above:				
<i>B. typhosus</i>	+++	+	-	-
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	++	-	-	-
No. 1003.				
Inoculated against typhoid twelve months previously:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	-	-	-	-
Seven days after inoculation with 50 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	+++	+++	+++	+++
<i>B. paratyphosus</i> A	+++	+++	+++	++
<i>B. paratyphosus</i> B	+++	++	+	-
No. 1010.				
Inoculated against typhoid six months previously:				
<i>B. typhosus</i>	++	-	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	-	-	-	-
Eleven days after second inoculation with 500 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	+++	+++	+++	+++
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	+++	+++	++	+
No. 1012.				
Inoculated against typhoid seven months before:				
<i>B. typhosus</i>	++	-	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	-	-	-	-
Fifteen days after inoculation with 50 million <i>B. paratyphosus</i> A:				
<i>B. typhosus</i>	+++	+++	+++	++
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	-	-	-	-
No. 1013. (Non-inoculated. No agglutination to typhoid or paratyphoid A or B bacilli in 1:100.)				
Ten days after inoculation with 200 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	+++	+++	+++	++
<i>B. paratyphosus</i> B	+++	+++	++	-

	1:100.	1:200.	1:400.	1:800.
No. 1014. (Non-inoculated.)				
Nine days after 200 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	+++	+++	++	+
<i>B. paratyphosus</i> B	+++	++	-	-
No. 1015. (Non-inoculated.)				
Ten days after 250 million each of <i>B. paratyphosus</i> A and B:				
<i>B. typhosus</i>	-	-	-	-
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	++	+	-	-

Harvey and Wood⁷ found, in the cases of paratyphoid A fever which they studied, that the agglutinins for both *B. typhosus* and *B. paratyphosus* A were absorbed by an emulsion of the latter, whereas an emulsion of typhoid bacilli only absorbed the homologous agglutinins. According to this observation, we are merely dealing with an example of group agglutinins. Co-agglutinins were certainly produced in some of our patients, but we doubt whether this is the whole explanation, as it did not occur when individuals not inoculated against typhoid were injected with a vaccine containing only *B. paratyphosus* A and *B. paratyphosus* B. We also tried to absorb the agglutinins for typhoid bacilli in two instances, where they were well developed, by shaking out with a strong mixed emulsion of paratyphoid A and B bacilli, but only succeeded in reducing them. The development of well-marked agglutination to typhoid bacilli weeks before the specific agglutinins arrived suggests another interpretation, namely, that in an inoculated person the mechanism for the manufacture of typhoid agglutinins being already laid down, the introduction of paratyphoid organisms stimulates this mechanism to further activity.

Agglutination of *B. paratyphosus* A or *B. paratyphosus* B, or both of these organisms.

The serum of 326 cases agglutinated *B. paratyphosus* A or B in dilutions of 1 in 100 and upwards. In 238 of these more or less agglutination of *B. typhosus* was exhibited also. Nevertheless, for reasons entered into above, in individuals inoculated against typhoid, these were returned as paratyphoid A or B fevers respectively, and whenever opportunity afforded to confirm this by isolation of the infecting organism the conclusion was found to be justified. With the dilutions we employed, in 95 per cent. of the cases the results were unequivocal, but in 17 out of a total of 326 the serum agglutinated both *B. paratyphosus* A and *B. paratyphosus* B. The agglutination generally occurred in considerably higher dilution with one than with the other, so as to leave little doubt as to the diagnosis. In a few cases this was not so, and it was impossible to say from one examination which was the infecting organism, and a second or third observation at intervals of about a week was made. At the same time efforts were made to recover the organism responsible for infection.

The following are examples illustrating how the diagnosis was cleared up by a second examination of the blood:

No. 533.				
	1:100.	1:200.	1:400.	1:800.
November 6th, 1915:				
<i>B. typhosus</i>	+++	+++	+++	+++
<i>B. paratyphosus</i> A	+++	++	-	-
<i>B. paratyphosus</i> B	+++	+++	+++	+++
November 18th, 1915:				
<i>B. typhosus</i>	+++	+	-	-
<i>B. paratyphosus</i> A	-	-	-	-
<i>B. paratyphosus</i> B	+++	+++	+++	+++
B. paratyphosus B was recovered from the faeces.				
No. 449.				
	1:100.	1:200.	1:400.	1:800.
October 23rd, 1915:				
<i>B. typhosus</i>	+	-	-	-
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	++	++	+	-
November 1st, 1915:				
<i>B. typhosus</i>	+	-	-	-
<i>B. paratyphosus</i> A	+++	+++	+++	+++
<i>B. paratyphosus</i> B	-	-	-	-
B. paratyphosus A was recovered post mortem.				

No. 548.

	1:100	1:200	1:400	1:800
November 7th, 1915:				
B. typhosus ...	++	+	-	-
B. paratyphosus A ...	+++	+++	+++	+++
B. paratyphosus B ...	+++	+++	++	+
November 16th, 1915:				
B. typhosus ...	+	-	-	-
B. paratyphosus A ...	+++	+++	+++	+++
B. paratyphosus B ...	+	+	-	-

No. 579.

	1:100	1:200	1:400	1:800
October 16th, 1915:				
B. typhosus ...	+	-	-	-
B. paratyphosus A ...	++	+	+	+
B. paratyphosus B ...	+	+	+	+
November 15th, 1915:				
B. typhosus ...	-	-	-	-
B. paratyphosus A ...	+++	+++	+++	+++
B. paratyphosus B ...	++	+	-	-

In making a diagnosis we have regarded the organism for which agglutinins persisted as responsible for the infection. In those cases in which we succeeded in isolating the causal organism this view was justified.

The amount of co-agglutinins present at an early stage of the illness in 5 per cent. of patients with paratyphoid fevers is noteworthy. Compared with our standard serums made by injecting rabbits with a laboratory strain of paratyphoid A or B bacilli it is considerable. It must be remembered, however, that the standard serums were made from strains selected on account of their specificity, whereas the "wild" strains occurring in nature are not always so specific. Further, it is probable that man is not as good an animal to use for the manufacture of highly specific serums for this group of organisms, in this respect resembling the horse rather than the rabbit.

ANALYSIS OF OBSERVATIONS.

We are now in a position to proceed to the analysis of our observations and see what indications they afford as to the distribution of different enteric fevers at Gallipoli. The 163 instances in which the serum gave no agglutination in the minimum dilution used—1 in 100—may be summarily dismissed, as they furnish no information. They comprise cases in which the serum was sent for examination too early in the disease, and others in which the subsequent clinical history indicated that the patient was suffering from some disease other than one of the enteric fevers.

The total number of cases in which agglutination with one or more of the bacilli of the enteric group was observed was 464.

Of these, 213 serums agglutinated *B. paratyphosus* A, and are, for reasons given above, regarded as significant of paratyphoid A infection. For parallel reasons we regard 113 as infections by paratyphoid B.

The determination of the number of typhoid infections is not so simple.

The 138 cases in whose serums only typhoid agglutinins were discovered were not necessarily typhoid fevers, for all but five of the patients had been inoculated. These five exceptions we place to the credit of typhoid infections on the agglutination findings. In seven other cases we succeeded in isolating *B. typhosus* from the blood or excreta either during life or after death, leaving 126 cases in which the serological observations might be interpreted either by previous inoculation or by recent infection.

Medical officers were in the habit of sending blood to the laboratory for serological examination whenever they suspected that they might be dealing with a case of one of the enteric fevers and sometimes irrespective of the time the patient had been ill. Consequently there are in this group a number of cases which subsequently proved to be dysentery, pneumonias, malaria, influenza, or relapsing fever. It also includes 35 cases of epidemic jaundice in which serological observations were deliberately made, as there was a widespread impression at first that the disease was associated with infection by a paratyphoid organism. We may eliminate these 35 cases of jaundice from further consideration, as whatever the infective agent may have been there was no evidence that it was due to a paratyphoid bacillus.

The remaining 91 cases were either investigated at the time or their records carefully scrutinized for us by Lieutenant-Colonel Stawell, consulting physician to our unit, and we take this opportunity of expressing to him our exceeding gratitude. Without his assistance in this matter it would not have been possible to draw what is perhaps the most important conclusion from our observations—namely, the relative prevalence of true typhoid fever at Gallipoli. After submission to his scrutiny, these 91 cases which might possibly have been typhoid infections were reduced to 13. This number includes all those which, on clinical grounds, might have been cases of one or other of the enteric fevers. It is certainly a maximal estimate, for, as mentioned above, we have reason to believe that some cases of paratyphoid A fever, which the method we employed failed to discover, are included in it.

The results of the analysis of our observations after this eliminative procedure had been applied to the cases whose serums agglutinated only *B. typhosus* are as follows:

Cases of typhoid fever...	25	7 per cent.
Cases of paratyphoid A fever ...	213	61 "
Cases of paratyphoid B fever ...	112	32 "
Total of enteric fevers ...	350	

The patients at No. 3 General Hospital, A.I.F., were derived from Gallipoli and the lines of communication. Imperial troops and Australians were indiscriminately admitted. As the sample covered by our observations was of fair size we shall not commit a serious error if we apply our conclusions to the distribution of enteric fevers at the Dardanelles.

From information kindly furnished us by Colonel Aldridge, R.A.M.C., there were 5,700 cases returned as enteric fevers from this area from the commencement of the campaign until the middle of December, 1915. According to a statement made by the Under Secretary for War in the House of Commons on December 23rd, the total medical casualties during the same period were 96,683.

If we further assume that the distribution we have arrived at is applicable to the whole of this period, the invaliding rate from typhoid fever represents less than $\frac{1}{2}$ per cent. of the total sickness during the period.

This highly satisfactory result must presumably be attributed to antityphoid inoculation, for the conditions were not unfavourable to the spread of enteric disease.

As soon as we became aware from our observations that the great proportion of the cases of enteric fevers amongst Australian troops was due to paratyphoid infections, we represented the facts to the Director Medical Services of the Commonwealth forces and advised that Australian troops should be at once inoculated with a vaccine containing paratyphoid and typhoid bacilli. This recommendation was approved by the Minister for Defence, and early this year all Australian units were so inoculated.

Henceforth, the interpretation of observations upon the agglutination of enteric organisms will, in the case of patients belonging to Australian units, be too difficult to possess any practical value, and the isolation of the infecting organism must be resorted to for diagnosis.

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E. P. R. RYAN, D.D.S., of New York, publishes a case in which seven unerupted teeth were detected by the use of the x rays in the upper maxilla of a woman aged 34 (*Journ. Amer. Med. Assoc.*, July 1st, 1916). She had suffered for several years from a fistula draining into the right nostril. A nest of six supernumerary teeth was detected, but extraction proved difficult, as they were tightly packed and embedded in bony tissue. The removal of a large unerupted central incisor proved even more troublesome.