RECENT FACTS AS TO ENTERIC INOCULATION AND THE INCIDENCE OF ENTERIC AND PARATYPHOID FEVERS IN INDIA.

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In continuation of a short note on this subject which appeared in this Journal in November, 1911, the following information may be of interest to officers of our Corps in anticipation of official returns, and to others who may not have access to official reports. The facts refer to the European Army in India for the whole year 1911.

From a return made on the last day of the year, we find the position as regards inoculation on that day to have been as follows :—

Branch of service	Number of inoculated men who have not had enteric fever	Number of inoculated men who have had enteric fever	Number of not inoculated men who have not had enteric fever	Number of not inoculated men who have had enteric fever
Cavalry	4,478	153	767	72
Royal Horse Artillery	1,397	47	357	43
Royal Field ,, ...	5,993	100	1,272	194
Royal Garrison ,, ...	2,958	38	660	114
Ammunition columns	658	20	116	36
Infantry	43,820	606	4,375	512
Attached troops	390	7	65	10
Royal Engineers	38	1	73	5
Staff and departments	903	15	792	89
Totals	60,635	987	8,477	1,075

The number of cases of enteric fever which occurred among European troops in India during 1911 is the lowest on record. Throughout the whole of India only 170 cases were returned, with twenty-two deaths; this is an admission rate of 2·3 per thousand of strength, and a death-rate of but 0·3. The case mortality was 12·9 per cent. Of these 170 cases of enteric fever, we find that 106 were inoculated and sixty-four were non-inoculated men. Eleven deaths occurred among the inoculated and eleven among those not inoculated. The ratio per thousand of strength of admissions for enteric fever among the inoculated was 1·7, and the corresponding ratio of deaths was 0·17. Among the non-inoculated the admission rate was 6·7 per thousand, and the death-rate was 1·15. As regards

case mortality the percentage figures are 10·37 for the inoculated, and 17·18 for the not-inoculated. The disparity between the two groups is very marked. The co-efficient of correlation in the series between inoculation and freedom from attack by enteric fever is 0·3212 ± 0·0068, and that between inoculation and recovery after attack is 0·7524 ± 0·0667.

As in 1910, a differentiation has been made during 1911 between the classical enteric fever and the disease known as paratyphoid fever. For 1911, the returns show 104 cases of paratyphoid fever with two deaths. From all the cases of paratyphoid fever the specific bacillus has been isolated, so that no ambiguity exists as to the accuracy of diagnosis. Of the total cases so diagnosed, 103 yielded the *Bacillus paratyphosus* A, and one is reported to have been the B variety. One of the fatal cases was the result of intestinal perforation, and the diagnosis was not made until after death, when the specific micro-organism of the A variety was isolated from the ulcer. In none of these paratyphoid cases could the source of infection be traced to water, milk, or any special article of food. The incriminating factor in all the cases appears to have been the initial presence of an undetected and unsuspected infected person, indicating that in this particular disease man himself is the most dangerous factor. We are still in doubt whether the more frequent source of infection is by acute carriers or by unrecognized cases. Probably both sources are responsible, and call for immediate investigation and detection whenever two or more cases of the disease occur in any unit.

Our experiences at the two Enteric Depots at Naini Tal and Wellington throw a suggestive light upon this point. Since those depots were opened in 1908-9, no less than 1,229 cases of true enteric fever have passed through them, and from among this number twenty-six carriers have been detected, or, roughly, 2 per cent. Thirteen, or half of these carriers, were classed as temporary carriers, as they ceased to excrete the enteric bacillus within periods varying from a few weeks to three months. The other thirteen were classed as chronic carriers as they continued to be infective for periods varying from six to nine months. During the same period, 124 cases of recognized paratyphoid fever have passed through the depots. These have yielded one persistent or chronic carrier and seventeen temporary carriers, or, roughly, 1 per cent of the one kind and 13 per cent of the other. These facts indicate that, while the disease known as enteric fever gives only some 2 per cent of carriers of varying degrees of

chronicity, the disease known as paratyphoid fever gives as many as 14 per cent of carriers, of which 1 per cent are potentially dangerous for long periods of time. We are forced to the conclusion, therefore, that in paratyphoid fever the dangers to be associated with undetected and imperfectly recovered cases are considerably greater than in enteric fever, and it behoves us to leave no means untried to detect these cases, as the dominant factor in the prevalence or spread of this infective disease is man himself.

The influence of anti-enteric inoculation against paratyphoid infection appears to be negative. Of the 104 cases of paratyphoid fever, no less than ninety-seven were inoculated men, while the other seven cases were non-inoculated men. The admission rate for paratyphoid fever per thousand among the inoculated was 1·57, and 0·73 among the non-inoculated. The co-efficient of correlation between inoculation and freedom from attack by paratyphoid fever is $0{\cdot}1994 \pm 0{\cdot}0073$.

Under the term *enterica*, we combine the incidence of the two diseases, enteric fever and paratyphoid fever. For purposes of comparison it is necessary to so group them, as all our records anterior to 1910 make no attempt to differentiate between the two. That such differentiation is necessary is obvious from the marked difference between their respective case mortality rates and the apparent absence of inhibitory effect on paratyphoid fever by means of anti-enteric inoculation. Taking both enteric and paratyphoid fever together, we have had 274 cases in all India among European troops during 1911, with twenty-four deaths. This is equivalent to an admission-rate per thousand of 3·8, and a death-rate of 0·33 per mille of strength. Ten years ago, the admission-rate was 12·8, and the death-rate 3·32.

From the point of view of inoculation, the admission rate for the two diseases, enteric fever and paratyphoid fever, together is 2·75 per mille among the inoculated, and 10·88 among the non-inoculated. The corresponding death-rates per mille are 0·17 and 1·15; further, the co-efficient of correlation between inoculation and freedom from attack is $0{\cdot}2527 \pm 0{\cdot}0071$ and the co-efficient between inoculation and recovery after attack is $0{\cdot}6579 \pm 0{\cdot}0684$. The whole series of facts indicate that against enteric fever the value of inoculation as now practised is most marked, and the case in favour of the procedure much strengthened by our experiences during 1911. The disturbing factor is the prevalence of paratyphoid fever, against which disease anti-enteric inoculation appears to have little influence. This view is not new but emphasizes the

plea for a bivalent emulsion with which inoculation could be carried out against both diseases.

The recognition of the widespread prevalence of paratyphoid fever in India is quite a recent circumstance, and materially affects any comparative interpretation of our statistical returns as between the past and the present. The dominant factor is undoubtedly the question of diagnosis, as accuracy in this matter is our only means of determining the exact prevalence of this disease. Our returns for the last two years show this clearly. In 1909, paratyphoid fever was regarded as an unusual occurrence, in 1910 we developed more critical methods of diagnosis of the pyrexias, with the result that thirty-nine cases were recorded. In 1911, still greater care has been taken and the number of paratyphoid fever cases has risen to 104. As this policy and practice is pressed we anticipate that the detection and presence of this disease will be still more marked. The only certain means of diagnosing paratyphoid fever is the isolation of the bacillus from the blood or dejecta of the patient during life, or from the spleen or other organs after death. The disease is a septicæmia, and blood cultures made during the first week of the illness give a positive result in the majority of instances. Practically, the whole of our knowledge of the epidemiological and clinical characters of this disease is due entirely to the work of certain officers of the Royal Army Medical Corps in India, more especially to Major Harvey, Major Grattan and Captain J. L. Wood. To them we owe much information as to the serum reactions in paratyphoid fever. In India, the diagnosis of this disease by the serum reaction of the patient is particularly complicated by the fact that nearly all of them have been inoculated against enteric fever. In such cases even when the actual *B. paratyphosus* has been isolated, the agglutination titre of the serum for the *B. typhosus* rises and is often higher than for *B. paratyphosus*. Even under the most favourable circumstances the patient's serum rarely gives a positive reaction for the A variety of the paratyphoid micro-organism in a higher dilution than 1 in 100. Not infrequently the agglutination of *B. typhosus* is marked, while the *B. paratyphosus* A is not agglutinated by a 1 in 10 dilution of the serum. Further, it is not unusual to find in cases of undoubted paratyphoid fever, from which the A variety of bacillus has been isolated, that the patient's serum agglutinates at one time only the *B. typhosus* and at another time only the *B. paratyphosus*. The earlier work of Major Harvey and Captain Wood, both of the Royal Army Medical Corps, by

which they showed that the use of the absorption method gives valuable information as to the true nature of the infecting micro-organism, has been confirmed and developed. In cases of paratyphoid fever (A), in which the patient's serum agglutinated both the enteric and paratyphoid bacillus, absorption with the A type of bacillus removes all the agglutinins present, whereas absorption with the enteric bacillus removes only the co-agglutinins for that micro-organism, leaving intact the specific agglutinins for the *B. paratyphosus* A. Another curious fact is that by the absorption method it can be shown that in cases in which the patient's serum agglutinates *B. typhosus* but not *B. paratyphosus* A, then absorption with the latter micro-organism removes all the agglutinins from the serum.

Our experiences during the past two years bring out most clearly the variable and comparatively feeble production of agglutinins in paratyphoid fever, and it seems to be particularly characteristic of infections by the A variety of the *B. paratyphosus*. This point has been specially brought to the notice of medical officers, and it cannot be too thoroughly understood that as a means of diagnosis of paratyphoid fever the serological observations are beset with many fallacies and sources of error. Taken alone, they cannot be relied upon as a trustworthy routine method of diagnosis.

In closing this note, we are impressed with the view that a very close analogy exists between paratyphoid fever and enteric fever, both from the clinical and epidemiological aspects. In general terms, they differ only in the higher mortality and greater severity of enteric fever and in the character of the causal micro-organisms.