ENTERIC FEVER IN AMBALA, 1880-1905.

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Seeing that "prevention" rather than "cure" of disease is now recognised as the first and chief duty of the military medical officer, it must be a matter of personal concern to us all that a preventable disease, enteric fever, continues to hold, year after year, such a prominent position amongst the causes of sickness and mortality of the British Army in India. Although I cannot claim to have had any long experience of the disease in this country, my attention was drawn to the enteric fever problem almost from the day of my arrival (October, 1904), as not only did my station, Ambala, afford special facilities for its study, but also, being appointed a special sanitary officer for the district, I had the advantage of taking part in a strenuous campaign, which the Senior Medical Officer, Lieutenant-Colonel T. P. Woodhouse, R.A.M.C., had entered upon, with the express object of removing this long-existing cause of reproach from the otherwise fair (sanitary) fame of Ambala.

It would certainly have been difficult to find any station where a special effort of this kind was more urgently called for, or one, be it said, where the prospects of success were, at the time, less promising; nevertheless, the unexpected has happened, and the garrison which showed in 1903 the highest admission-rate (per mille), as regards British troops, for enteric fever in all India, is now practically free from the disease. The results obtained are, indeed, so striking, and form such an encouraging contrast to anything that the past history of this, or probably any, cantonment can show (thanks chiefly, it is only fair to say, to the great sanitary zeal and energy displayed by the present Senior Medical Officer), that I have been led to write this chapter of our medical history in the hope that this record of our past failures and recent success may give aid and encouragement wherever enteric fever still bids defiance to the forces of sanitation.

Before entering, however, upon a description of the sanitary methods employed at Ambala, it will be desirable to show to what extent and for what length of time enteric fever had been prevalent amongst the British troops, and to indicate the chief causes to which we attribute our frequent epidemics in past years. In this way not only will others be in a position to appreciate fully what

has been, and therefore can be, effected by appropriate sanitary means, even under the most unpromising conditions, but I shall also, I trust, escape all danger of being held guilty of presumption in having suggested that any such good thing as a successful system of prevention of enteric fever could come out of Ambala.

The subject will be most conveniently dealt with under the three following headings:—

A.—Period of disease prevalence, 1880 to 1904, inclusive; (*a*) period of special prevalence, 1895 to 1904.

B.—Period of disease reduction, or *contrast year*, 1905.

C.—Causes of enteric fever at Ambala and factors concerned in its propagation, together with the sanitary methods and measures by which a reduction in disease incidence has been effected.

TABLE OF ADMISSIONS AND DEATHS FROM ENTERIC FEVER AMONGST BRITISH TROOPS AT AMBALA FOR TWENTY-SIX YEARS (1880 TO 1905).

Year	Average strength	Admissions	Deaths	Ratio per 1,000 of strength		
				Admissions	Deaths	
1880	1,337	10	3	7·5	2·24	
1881	1,630	5	3	3·1	1·84	
1882	1,750	2	2	1·1	1·14	
1883	1,751	9	3	5·1	1·71	
1884	1,600	18	1	11·3	·63	
1885	1,474	12	2	8·1	1·36	
1886	1,958	38	11	19·4	5·62	
1887	1,914	8	3	4·2	1·57	
1888	1,947	15	3	7·7	1·54	
1889	1,999	37	2	18·5	1·0	
1890	2,036	27	8	13·3	3·95	
1891	1,632	26	10	15·9	6·13	
1892	1,921	42	9	21·9	4·69	
1893	2,176	78	23	35·8	10·57	
1894	1,911	68	20	35.6	10·47	
1895	**2,101**	**86**	**17**	**40·9**	**8·09**	Period of special prevalence
1896	**2,023**	**49**	**14**	**24·2**	**6·92**	
1897	**2,154**	**138**	**33**	**64·1**	**15·32**	
1898	**1,896**	**67**	**25**	**35·3**	**13·19**	
1899	**1,783**	**57**	**16**	**32·0**	**8·97**	
1900	**1,471**	**21**	**6**	**14·3**	**4·08**	
1901	**1,224**	**24**	**10**	**19·6**	**8·7**	
1902	**1,274**	**55**	**9**	**43·2**	**7·06**	
1903	**2,164**	**107**	**21**	**49·4**	**9·70**	
1904	**2,579**	**105**	**24**	**40·7**	**9·31**	
CONTRAST YEAR.						
1905	2,314	12	3	5·1	1·3	

Note.—I desire to thank Captain E. Blake Knox, R.A.M.C., Secretary to the Principal Medical Officer, India, for the above table.

A.—Period of Disease Prevalence.

As a matter of interest, and to show for what a length of time enteric fever has been continuously present, I attach a table (p. 124) giving the actual number of admissions and deaths, and also the ratios per 1,000 of the same, for each year from 1880 to 1904 inclusive. I shall not, however, attempt a detailed examination of the whole of this long period; it will be sufficient for my purpose to take the years (1895-1904) immediately prior to the contrast year, 1905, contenting myself with a general survey of the whole of the period of prevalence.

General Survey.—The first point of interest to note is that not a single year has passed in which the disease has failed to appear, nor one in which it has not caused the loss of at least one life. As regards actual cases and deaths, the following table shows the greatest and smallest numbers we have had and in which years.

Cases			Deaths		
Year	Maximum	Minimum	Year	Maximum	Minimum
1897	138	—	1897 ..	33	—
1882	—	2	1884 ..	—	1

The total admissions (1880-1904) number 1,104, or a yearly average of 44·16, and the deaths number 278, or a yearly average of over eleven, practically one a month.

The next point of importance is that, comparing the second half of this quarter century with the first, the disease has been, on the whole, increasing. This is accounted for in part, no doubt, by greater accuracy of diagnosis of late years; but even allowing for this, there is a distinct evidence of increased prevalence, with a higher case-mortality. Having taken this short survey, let us now pass to the more detailed examination.

Detailed Examination.—We notice that this period, 1895-1904, of enteric fever prevalence is roughly divisible into three sub-periods:—

(1) *A sub-period of five years* (1895-1899) marked throughout, with the exception of 1896, by great but unequal prevalence of enteric fever in spite of a decrease in the British garrison during the last two years. In the middle year (1897) the sick and death ratios reached their maximum, there having been no less than 138 cases and 33 deaths, equalling an admission ratio of 64, and a mortality ratio of over 15 per 1,000 of strength.

(2) *The second and shortest sub-period* (1900-1901), during which there was a sudden decrease in the sick-rate for enteric fever. The admission-rates per 1,000 show a remarkable fall from 32 per 1,000 in 1899 to 14·3 per 1,000 in 1900, and 19·6 per 1,000 in 1901. As regards 1901, however, it is noticeable that the death-rate was higher than for any other year of the whole series, there having been as many as ten deaths amongst 24 cases. It should be added that during this period the British garrison was much below the average strength.

(3) *The third and last sub-period,* comprising the years 1902, 1903 and 1904, is marked by a sudden and great recrudescence of the disease, especially in the years 1902 and 1903. During the latter, indeed, it increased so greatly that the admissions (ratio per 1,000 of strength) exceeded every previous year of the whole series except 1897.

The object of this examination of the table by sub-periods is to show that there was some exceptional influence at work during this period of ten years which affected the average sick-rate in two directions: (*a*) by reducing it far below the average figures in 1900 and 1901; (*b*) by raising it to a more than average height for the three subsequent years.

This outside influence was, of course, the South African War, and in any deductions drawn from enteric fever statistics in which the figures for 1900 and 1901 are included, the effect of the war on the returns must be taken into account. So far as Ambala is concerned, there is no doubt that the effect, considered as a whole, has been to lower the average sick-rate; the reduction it brought about in 1900 and 1901 not being counterbalanced by the increase in 1902 and 1903.

	Admission-rate per 1,000 of strength
1895-1899	39·3
1900-1904	33·4

The total war effect upon the average for the whole ten years was to reduce it to 36·3 per 1,000.

That the reduction in the enteric fever sick-rate in 1900 and 1901 was due to the war acting by means of the exceptionally weak British garrison here during those years, that is to say, to the absence of a large number of susceptible subjects, and not to improved sanitation, is, I think, sufficiently proved by two facts: (*a*) The rapid increase in the number of cases that occurred as soon as the British garrison returned to its normal strength; the old foci of infection by means of which the disease had been propagated

for years being, doubtless, reinforced by the introduction of fresh infection by men who were actually suffering from enteric fever, or who were convalescent from a recent attack of the disease in South Africa, and by Boer prisoners. (*b*) This fall in the sick-rate for enteric fever was general throughout India during the war years, as will be seen on looking at the chart on p. 255 of the Army Medical Department Report for 1904; consequently there must have been some general influence at work tending to reduce enteric fever, which affected Ambala in common with other stations.[1]

So far our examination of the enteric fever statistics of Ambala has been merely concerned with the local prevalence of the disease; in order to complete our review of the enteric fever history of this station, it is now necessary to show how Ambala compares with "all India" for the same period. As before, we shall first make a general survey, afterwards taking by sub-periods, so as to eliminate, as far as possible, the effect of the war on our figures.

On comparing the two records, it will at once be noticed that the admission and mortality ratios in enteric fever at Ambala have, on the whole, been far above those for "all India." Taking the averages for the whole ten years we find :—

	Admission ratio per 1,000 of strength	Mortality ratio per 1,000 of strength
Ambala	36·3	9·9
"All India"	22·5	5·4

There were, in fact, only three years—1896, 1898 and 1900—during which the disease incidence fell below the "all India" average, and during one year only—1900—was the death-rate per 1,000 of strength below the average death-rate in India.

Turning now to a comparison of the records by sub-periods, "all India" shows a steady rise in enteric fever incidence and mortality during the earlier years of the sub-period extending from 1895 to 1899, which reached its maximum in 1898; but in the fifth and last year the fall commences, which is such a marked feature of the "second" or "war" sub-period. The Ambala record, on the other hand, shows a fall in 1896 from the high level of the previous year, followed by tremendous rise in 1897, there having been no less than 138 cases and 33 deaths, equal to an admission ratio of 64 and a mortality ratio of 15·5 per 1,000 of the average annual strength. After 1897 the record shows a fall, beginning a year sooner than in the case of "all India," but continuing in a similar way throughout the two years 1900 and 1901 of the second sub-

[1] The chart has been omitted in order to save space.—EDITOR.

period; and just as the highest point was reached in 1897, one year before that of India as a whole, so our lowest point was reached one year before the "all India" averages showed the full effect of the war. In the third sub-period, the rebound after this artificial reduction can be seen in both records, but with the difference that, while in the case of "all India" there is only a moderate rise in the figures as regards the admission ratio, and but a trifling increase in the death ratio, the Ambala record shows an enormous increase in the admission ratio, and a well-marked rise in the mortality ratio throughout the whole of this last sub-period, 1902 to 1904.

B.—Period of Disease Reduction.

I have now, I trust, shown sufficiently fully the degree to which enteric fever prevailed amongst the British troops at Ambala during the years we have had under review, and so far the record has not been a very cheering or hopeful one. There remains, however, still one year's figures to examine, which are of a more encouraging character and give us hope of a brighter future. I have called 1905 the year of contrast, to distinguish it from the long series of years of prevalence, and the last four lines of the table given on p. 124. will show this difference.

It will be seen that in 1905 the British garrison was of average strength, and as regards composition there was nothing to distinguish the units from those of previous years, yet the reduction in the sick and mortality ratios is so great that one has to go back to 1889 to find a year during which the troops enjoyed so great an immunity from enteric fever; and out of the whole period extending from 1880 to 1904, there are only four years with equally low admission and mortality ratios. We find the admisson ratio of 36·3, and the mortality ratio of 9·9 per 1,000 of strength (average for the last ten years) have been reduced to ratios of 5·1 and 1·3 per 1,000 respectively. Not only is this far below anything known here for the period with which this table is concerned, but in the "all India" averages one has to go back for nearly the whole twenty-five years (to 1881) to find a year during which the admission- and death-rates stood at such low figures.

This concludes my examination into the enteric fever statistics of Ambala under headings A and B, by which the two following facts have been established: (1) For twenty-five years (1880 to 1904) the British garrison has never been quite free from enteric fever, and the combined figures for the past ten years give evidence of a formidable increase in both the admission- and death-rates

per mille; (2) during 1905 there was a most striking and unprecedented fall in both rates.

Without being blind to the danger of the *post hoc, propter hoc* fallacy, I attribute this immense reduction in disease to the introduction of the special sanitary measures to be presently described, for these reasons: (1) The diminution in the admission-rate is far too great to be due merely to epidemic variation dependent on obscure causes whereby we have "good" and "bad" fever years; (2) there was no difference, as I have already said, in the strength or composition of the garrison or any other exceptional circumstances to account for it. Further, there has been no relapse, as only one case of enteric fever has been admitted up to date (May, 1906). The disease in this case was clearly imported, and the patient recovered.

The continued absence of the disease favours the view that the reduction in 1905 was a genuine one, and brought about by sanitary reforms. I do not, of course, mean that our methods were absolutely original in themselves. Their value depends rather on the principle underlying them, which is embodied in the following articles of our sanitary faith: (1) To fight enteric fever with success at any station where it has been long endemic, it is necessary to employ sanitary measures of a more drastic and far-reaching character than has hitherto been considered necessary, or, at any rate, employed; (2) enteric fever being in several respects a more difficult disease to control than cholera, measures as thorough as those embodied in the anti-cholera regulations must be adopted if success is to follow.

The comparative failure to bring enteric fever under control that has been hitherto met with in India is, I believe, largely due to non-recognition of these facts.

C.—Causes of Enteric Fever at Ambala, and Factors concerned in its Propagation, together with the Sanitary Methods and Measures by which a Reduction in Disease Incidence has been Effected.

The various measures comprised in our present sanitary system were not, it will be understood, introduced in one day as parts of a complete scheme, but were gradually adopted as the sources of infection became manifest, and had often, indeed, to be modified or extended as practical experience suggested.

I shall first draw up a list of the chief known sources of enteric fever in India, and then show which of them have played the

most active part in the causation and spread of the disease at Ambala in the past, and lastly detail the special sanitary measures adopted to diminish or destroy their evil capabilities.

British troops in India are liable to contract enteric fever in the following ways: (1) By infection from specifically contaminated milk and water; (2 by infection derived from native bazaars; (3) by infection introduced from without by men joining or rejoining the garrison; (4) by infection drawn from locally existing foci (this includes latrine infection, camp and barrack infection, *i.e.*, localised and lingering infection of all kinds); (5) by infection from early and ambulant cases in barracks or camp; (6) by infection from mild and early cases in hospital prior to, or which escape, diagnosis; (7) by infection from convalescents from the disease after discharge from hospital; (8) by infection from ill-placed or badly managed trenching grounds.

Agents of propagation: *Wind, dust, flies.*

(1) *By Infection through Contaminated Water and Milk.*—The position of water at the head of the list is not to be taken as indicating the importance attached to it as a disease-bearing agent at this station; on the contrary, after impartial trial and examination, we have practically returned a verdict of "not guilty," and have dismissed both it and milk from the sanitary court of Ambala without a stain on their surfaces.

The characters of the epidemics that have occurred, at any rate of late years, negative the idea of water- or milk-borne disease, as, although there were generally a few sporadic cases scattered about cantonments, the outbreaks have been mainly localised in one set of lines, or in the camps of two closely adjacent battalions, while the married people and the families of officers have enjoyed marked immunity. As the whole of the garrison obtain their water and in a great measure their milk from the same sources, the epidemics would obviously have presented features of quite a different character had either water or milk been the agents of infection.

We do not on this account, however, neglect to take proper precautions to safeguard our water supply both at the source and during distribution, as the following will show: (*a*) The water for Ambala Cantonment is obtained from several deep wells situated some miles off. The well area is enclosed by high walls, so that chance of contamination at the source is practically impossible. (*b*) The water is pumped up and laid on everywhere by pipes, even to the standing camps, consequently contamination *en route* to consumers is highly improbable.

In addition, however, the following, to my mind somewhat exaggerated, precautions have also been taken to further ensure the purity of our water supply. In all the lines and camps water-boiling places are established near the standpipes. These places are enclosed by canvas screens as a protection against dust. Each unit is responsible for boiling its own drinking water. After boiling, the water is poured into galvanised iron receptacles (provided with taps and padlocked covers), after which it is further protected by "pinking" with potash permanganate.

No milk is supplied to the troops except from the Government Dairy Farm. It is sterilised before issue and sent out in locked cans.

(2) *Bazaar Infection.*—In spite of what is reported regarding bazaar infection from other stations, there is no evidence that enteric fever at Ambala has been derived from the native bazaars in the past to any great extent, although two cases were attributed to this cause last year.

When I was appointed District Sanitary Officer in November, 1904, I drew up a special enquiry form (appended) to ensure, so far as possible, systematic investigation of every case. The officer commanding station hospital had this form printed, and it has been in use ever since. At that time I thought that the bazaar frequenters might be found more often attacked by enteric fever than others. The answers received since then to Question 3 of the enquiry form have given no support to this idea, and as further evidence against the view that native bazaars are a common source of enteric fever, I quote the following from the Senior Medical Officer's report for 1904: "No doubt enteric fever is occasionally contracted by soldiers from the bazaars, but I do not think that this is a frequent cause. For instance, during the greater part of the past six months of this year (1904), all bazaars were placed 'out of bounds' for British troops on account of plague; it had no effect in mitigating the disease." He also adds "that there had only been one case of enteric fever in the Cantonment Hospital in two years," and, consequently, there is little probability that the specific germ can be widely distributed in the bazaars. So that, as far as Ambala is concerned, if a verdict of "not guilty" has not yet been returned against the bazaars, at least we consider them entitled to that Scotch compromise between guilt and innocence embodied in the verdict "not proven."

As we do not regard the bazaars as factors in causing enteric fever here, no particular sanitary measure has been introduced in respect to them.

(3) *By Imported Infection.*—This has been one of the most important causes of our epidemics in past years, and is, of course, the only cause of the appearance of enteric fever for the first time.

The annual exodus to the hills in April and return in October of a large part of the British garrison lays Ambala specially open to imported infection. In a report on an outbreak that occurred here in the autumn of 1904, I showed that the epidemic was undoubtedly due to imported infection. This had also been found to be the case as regards a previous epidemic in the spring.

There can be, I think, no reasonable doubt that this has been one of the great causes of the exceptional prevalence of enteric fever at Ambala; but there is another factor in the case of at least equal importance, viz., the insufficient barrack accommodation for the winter garrison, which necessitates our having two battalions of British infantry and two batteries of mountain artillery under canvas during the cold weather. The effect of tent life in spreading enteric fever will be considered in the next paragraph.

Imported Infection. Sanitary Counter-Measures.—As we regard imported infection as the most important of all factors in the causation of enteric fever outbreaks, a stringent system of quarantine has been introduced to safeguard the station as far as possible. All drafts and every individual non-commissioned officer and man coming or returning to Ambala are kept under observation for twenty-eight days in special camps. The isolation camps have their own conservancy arrangements, coffee shops, &c., and it is absolutely forbidden for any man under quarantine to enter any other latrine or intermix with the rest of the garrison. The men under observation are also visited daily by a medical officer, and every precaution taken to detect the disease in its earliest stage. Should a case of enteric fever occur, the quarantine time is sufficiently prolonged to ensure that the remainder have not contracted the disease. Such a large portion of the British garrison go to the hills for the summer and return for the cold weather that it is, unfortunately, impossible to protect the station completely against the chances of imported infection by extending this quarantine system to all the units of our winter garrison. This places us at a great disadvantage, and leaves a serious loophole for the entrance of disease.

(4) *By Infection from Locally Existing Foci, &c.*—It has long been known that enteric fever is liable to become established (or, as we say, "endemic") in certain localities; for this to be possible, however, it is necessary that the specific germ shall find conditions

favourable to its continued life and multiplication. Of recent years sanitarians in this country have become alive to the fact that in dry-earth latrines such conditions are liable to be existent. There is no direct evidence as to how far latrine infection has been responsible for the prevalence of enteric fever at Ambala in past years. It was, however, essential to guard against this danger, and, as I shall show presently, conservancy sanitation was made the basis of our system.

If it be doubtful what part defective conservancy methods have played in the spread of disease, there can be no reasonable doubt that the second most important factor in the exceptional prevalence of enteric fever here has been the favourable conditions provided by tent life for the persistence and spread of infection. The position of Ambala at the head of the list of enteric fever cantonments in 1903 and 1904 was due to the large number of admissions from battalions which, after spending the summer months at hill stations, returned to Ambala in the autumn, and were under canvas during the cold weather. The close personal contact of the inmates of tents, the impossibility of preventing fouling of the camp ground, especially at night, and the greater liability of contamination of food and drink by dust and flies, are so evident that there is no difficulty in understanding in what way camps become factors in spreading enteric fever. But it is evident that the infection becomes localised in some way in certain camping grounds, not necessarily in connection with the latrines; indeed, the elaborate sanitary precautions taken during 1904 to guard against this danger (when enteric fever was prevalent in the standing camps) seems to me to put latrine infection entirely out of court. These and all other measures, such as disinfection, segregation of contacts, &c., failed to check the outbreaks, which, nevertheless, stopped like magic when the affected battalions were moved to fresh camping grounds.

This has opened our eyes to the necessity of early change of camping grounds when enteric fever makes its appearance. In future this step will, I have no doubt, be taken much earlier than has hitherto been considered necessary. As, however, our system of standing camps rendered us specially liable to the introduction and spread of enteric fever, the following protective measures were introduced in 1904, and have now been officially recognised in this country :—

Instructions in Case of Enteric Fever Appearing in Standing Camps.—Whenever a man is admitted to hospital for enteric fever, or with a suspicious pyrexia, the officer commanding is to be at

once informed. The tent must be disinfected and then struck, the ground on which it stood being afterwards freely treated with lime. The contacts are to be isolated for fourteen days under medical supervision, being provided with separate latrines and urinals, and all their excreta sterilised by boiling, just as if they were actual cases of enteric fever; the bedding and kit of the man attacked, and of all contacts, being sent to the station hospital for disinfection. In the process of disinfection of the camp special attention was ordered to be paid to the latrines and urinals. I need not go into details concerning the process as they are now officially laid down; suffice it to say that disinfection is thoroughly carried out, the woodwork, receptacles, troughs of the latrines and urinals, as well as the ground on which they stand, being cleansed and sterilised. That the *Bacillus typhosus* can still survive appears to me quite incredible.

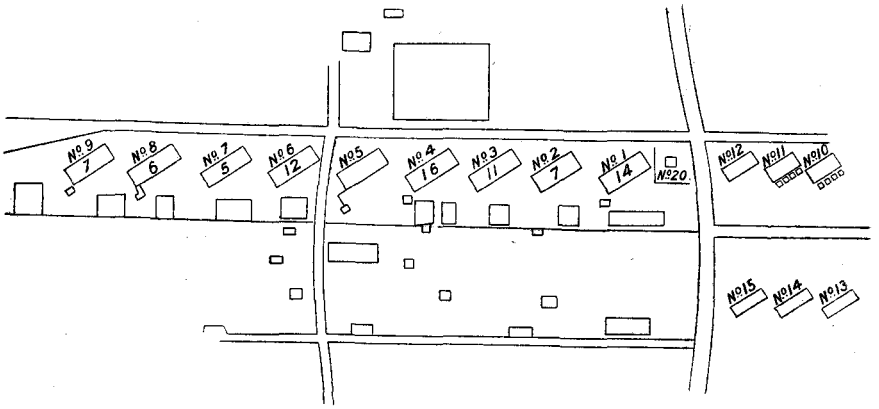
Localisation of Infection in Barracks.—An attempt is being made here to investigate the question as to the localisation of infection in barrack-rooms in the following way: Plans drawn to scale have been prepared for all lines occupied by British troops, on which each bungalow is depicted. Whenever a case of enteric fever is admitted the date is entered on the plans against the number of the bungalow the man had occupied. All cases of the disease admitted during the last four years have also been recorded in like fashion, as on accompanying plan.

The results so far obtained are decidedly interesting and give some support to the view that the infection may become localised in the barrack-rooms themselves as well as in the latrines. For example, from barrack-room No. 1 on the plan four cases were admitted in 1902 on the following dates: November 13th, 15th, 17th and 25th, suggesting infection from a common source. The same thing occurred in the following April, and in 1905 a case was admitted on August 25th, followed by two more on September 1st. From bungalow No. 2 five cases were admitted in 1903, four of them within one week of the same month. Bungalow No. 4 shows again a remarkable succession of cases in May and June, 1903.

Precautions against the Spread of Enteric Fever in Barracks.—The precautions already mentioned for camps are also, *mutatis mutandis*, taken whenever an occupant of a barrack bungalow is admitted either for a definite attack of enteric fever or with symptoms of a suspicious character; and the room is vacated for fourteen days after disinfection.

Let me here call special attention to the fact that we do not wait for an exact diagnosis before taking precautions against the spread of contagion. To my mind, this is a detail of great im-

PLAN OF THE BARRACK BUNGALOWS IN THE BRITISH CAVALRY LINES, AMBALA.
With the dates of admission of the enteric fever cases from among the occupants of each since 1902, and with the total numbers for the last four years marked upon the bungalow.



Bungalow No. 1.	*Bungalow No. 2.*	*Bungalow No. 3.*	*Bungalow No. 4.*	*Bungalow No. 6.*
13.11.02	14.11.02	14.11.02	12.11.02	29.10.02
15.11.02	26.12.02	20.11.02	20.11.02	13.11.02
17.11.02	3. 1.03	24.12.02	21.11.02	18.11.02
25.11.02	7. 5.03	29.12.02	20.12.02	20.11.12
12. 1.03	10. 5.03	16. 1.03	23.12.02	31.12.02
24. 1.03	12. 5.03	16. 3.03	15. 5.03	19. 1.03
1. 4.03	15. 5.03	25. 4.03	16. 5.03	2. 2.03
18. 4.03		1. 5.03	13. 6.03	10. 4.03
19. 4.03		10. 5.03	17. 6.03	5. 5.03
20. 4.03		25.12.03	18. 6.03	17. 5.03
27. 4.04		2. 1.04	19. 6.03	1. 4.04
25. 8.05			25. 6.03	2. 5.04
1. 9.05			26. 6.03	
1. 9.05			23. 7.06	
			25. 7.03	
			8. 8.05	

Bungalow No. 7.	*Bungalow No. 8.*	*Bungalow No. 9.*	*Band Room.*
24.12.02	25. 3.03	25. 3.03	8. 6.03
13. 5.03	27. 3.03	8. 4.03	30.10.03
27. 3.04	13. 2.04	21. 4.03	7. 4.03
10. 5.05	16. 2.04	7. 4.04	
6. 6.05	1. 5.04	15. 4.04	
	10. 5.04	23. 6.04	
		5. 2.05	

portance and one that must be strictly adhered to if the disease is to be stamped out.

Localisation of Infection in Latrines.—Among possible internal

centres of infection, none are so common and dangerous as insufficiently supervised dry-earth latrines infected by early or ambulant cases. The great liability that exists that enteric fever will become localised in these places unless a very thorough system of conservancy sanitation be enforced is now generally recognised. That latrine infection was at the bottom of the endemic persistence of enteric fever at Ambala we have good reason to believe, and this was one of the first things that Lieutenant-Colonel Woodhouse directed his attention to when he took up the task of stamping out enteric fever. As our conservancy methods form the basis of our system of sanitation, and as I attribute the successful results chiefly to them, I must devote a little time to their consideration.

The counter-agents against latrine infection employed at Ambala are of two kinds: (1) Indirect; (2) direct.

Indirect Measures of Latrine Sanitation.—I have placed the indirect measures first as two of them are among those already detailed, viz.: (1) The quarantining of drafts and individuals on arrival; (2) the isolation of contacts, even for a case of suspicious pyrexia, and the thorough disinfection of the latrines and urinals of the unit concerned; (3) the segregation of enteric fever convalescents, for whom special latrines and urinals are provided; all their excreta being sterilised before removal to the trenches.

It is obvious that these measures must have a real, thorough, indirect effect, in preventing the possibility or minimising the risk of latrine infection. In addition to these we have a regular sanitary organisation to ensure that the direct measures I am about to mention are efficiently carried out.

Direct Measures of Latrine Sanitation.—(1) The sanitary cadre; (2) the company or squadron latrine and urinal system.

About a year ago Lieutenant-Colonel Woodhouse inaugurated a reform in the old and, so far as I know, except at Ambala, the still existing system of regimental sanitation. By the new Ambala system the sanitation of a regiment, battalion, or other unit, is no longer centralised in the quartermaster's office, the Senior Medical Officer holding that the sanitation of a regiment is a matter of too great importance to be controlled from any but the commanding officer's office; the commanding officer acting, of course, through officers commanding companies so far as company sanitation goes. The only sanitary control left to the quartermaster is that of the married quarters. The medical officers in charge of units are directed, therefore, to deal directly with the commanding officer as regards sanitary matters, and not with the quartermaster.

There are several objections to having the regimental sanitation in the hands of the quartermaster, but it is beside my purpose to go into this subject now.

From each company, squadron, or battery, a corporal or bombardier and one private are selected to form the regimental sanitary cadre. These men are struck "off duty," and are first put through a course of instruction as to their new duties. The instruction is given partly by lectures and partly by practical demonstration. Each party is responsible for the sanitation of its own company latrines and urinals, for the supervision of the native sweepers, and the carrying out of the instructions regarding the sanitary details of latrine management, which I shall refer to presently.

One of the most important counter-measures against the spread of enteric fever by latrine agency is, to my mind, the institution of a strictly company latrine and urinal system. This method is adopted here in barracks, and after the autumn epidemic in 1904, the same system was introduced into the standing camps. It is obvious what a beneficial influence this system will have if strictly adhered to in limiting the spread of such a disease as enteric fever. On the other hand, supposing a man of a company, while in the incubation stage of enteric fever, uses the latrines and urinals of his unit indifferently, the whole unit becomes exposed to the chance of infection, instead of merely the men of one company.

Sanitary Detail of Latrine and Unit Management. — The sanitary cadre are directly responsible to the medical officer in charge of the unit for the carrying out of the following sanitary details in connection with the latrines and urinals of their unit: The urinal troughs are not to be tarred; they must, however, be kept quite clean, and no deposit of urates or other salts permitted. To ensure this, the interior is rubbed over daily with kerosene oil. This, of course, prevents any deposit of urinary solids and also renders the trough unattractive to flies, on account of the strong odour, and cleanliness of the surface. *Latrines:* A double set of "gumlahs" is provided, so that the same pan shall not be in use on two consecutive days. On the off day the "gumlahs," after being well cleaned out with kerosene oil and crude carbolic acid, are left exposed to the air, the open end being placed uppermost. The wooden seats are washed and then both surfaces are brushed with kerosene oil. Here, again, the chances of contagion becoming localised are reduced, and flies are no longer attracted, and consequently a blow is aimed at two sub-agents of infection at the same time. Great importance is attached to keeping the soil inside the

latrine enclosure firm and clean. To effect this the ground is watered with kerosene oil every day for one week; after that the oil is applied twice a week; by this means a firm, dust-free surface is obtained, thus depriving the wind of a chance of carrying contaminated dust on to the food, or directly into the bodies of the men. It should be added that no brushing of the ground is allowed; any soiled patches found must be scraped away and removed, kerosene being afterwards applied; pieces of paper, &c., being removed by hand.

The men of the sanitary cadre are held responsible for carrying out these details of sanitation, as well as for the general sanitation of the barrack surroundings.

I now come to the last detail of our anti-enteric fever conservancy sanitation. Lieutenant-Colonel Woodhouse has introduced a system of day, in place of night, removal of the soil to the trenching grounds. There is no need to dilate on the sanitary drawbacks of the night removal system, but that enteric fever has often found in it a useful "ally" there can be little doubt. The sewage polluted ground must only too often have afforded the *B. typhosus* a culture medium favourable to its continued existence, and dust, wind and flies have seldom been wanting to act as most efficient conveyers of the specific germ to the unfortunate British soldier. The objections to day removal are chiefly of a sentimental character, which cannot be allowed to out-weigh the practical advantage of doing such work in the daylight, when proper supervision can be exercised. The absence of flies at night is urged in favour of night removal, but as the chances of fouling the ground are so much greater at night and flies appear at daybreak, the advantage is illusory.

This concludes my account of the reformed conservancy sanitation introduced by Lieutenant-Colonel Woodhouse at Ambala. I have still to describe the sanitary measures by which we seek to close the other avenues and sources of infection enumerated under paragraphs 5, 6, 7 and 8. I have, however, spent so much time over the more important causes of enteric fever at Ambala that I must content myself with dealing very briefly with the relatively less important ones.

(5) *Infection from Early and Ambulant Cases.*—From the nature of the agency, no direct counter-measure can be introduced, but our method of quarantining drafts on their arrival, and especially the segregation of contacts for fourteen days, under daily observation, are efficient, though indirect, counter-measures; again, the isolation of all contacts (even in cases of suspicious pyrexia) aids

in the detection of the disease at its earliest stage, and therefore counteracts to some extent the danger of further spread.

(6) *Infection from Mild and Early Cases in Hospital Prior to, or which Escape, Diagnosis.*—I have already pointed out that we do not wait for a diagnosis, but take all precautions whenever a case of suspicious pyrexia is admitted. This is one safeguard against the spread of infection by early cases. In addition, the whole of the excreta of patients in the Station Hospital, Ambala, is sterilised by means of the portable army excreta steriliser, described by me in a previous number of the Journal, which effectually shuts off this source of infection.

(7) *By Infection from Convalescents after Discharge from Hospital.*—One of the earliest measures as regards anti-enteric fever sanitation, which was introduced here by the present Senior Medical Officer, was directed against the spread of the disease by convalescents discharged from hospital. A regulation was brought in by which all patients, after recovery from an attack of enteric fever, had to be segregated for two months, under medical observation. They are, of course, provided with a special conservancy, and are not allowed to use any latrines but those provided for them, and sterilisation of all sewage is compulsory. At first, each unit had a segregation camp for its own convalescents; for the last year, however, the system has been improved by the establishment of a central segregation camp for men of all units, and having its own special staff. All excreta are sterilised by means of the portable army excreta steriliser, mentioned in connection with the Station Hospital. The convalescents are treated with urotropine while undergoing this quarantine, or some other urinary antiseptic, and every precaution is taken to prevent the contamination of the camp soil.

(8) *By Infection from Ill-placed and Badly Managed Trenching Grounds.*—Although there is undoubted evidence that ill-placed and badly managed trenching grounds have caused enteric fever epidemics at other stations, I do not think this agent played any part in the late outbreak here, in spite of the fact that the cantonment filth trenches were, up to nearly the end of 1904, so ill situated that they very rightly fell under suspicion. At any rate, the change of site produced no apparent effect on the considerable prevalence.

With regard to the existing three great propagators of enteric fever—wind, dust and flies—I shall say little, having already indicated what the sanitary weapons are we employ against them. To attempt to attack these vehicles of infection more directly would

be an error in tactics, indeed, as regards the first-named, an impossibility. No flies are tolerated in or about our latrines, urinals or cookhouses, their mere presence being regarded as proof that the standing orders for the sanitary care of these places have been neglected. Our conservancy regulations, properly carried out, effectually deprive these potential "allies" of enteric fever of their capacity for evil, or render them non-existent.

Conclusion.—Although the number at the top of this page admonishes me that it is advisable to make this the concluding paragraph of my paper, I cannot, I fear, claim to have dealt in any way fully with my subject. Often, indeed, I have only been able to give an outline where I had intended to paint a complete picture. Concerning our sanitary regulations for cookhouses, the protection of food, &c., the excessive number of cookhouses, which is such a feature of military cantonments is, to my mind, an economical as well as a sanitary error. Many other sanitary details I have not been able to enter upon at all.

REPORT ON CASE OF ENTERIC FEVER.

Date of Admission.....

Name. Company (or Squadron). Regiment. Age. Service { *Total* / *Indian*

To be answered by the Commanding Officer

1.—Has the above-named man been absent from Ambala during the last three months? If so, where has he been? On what date did he return?

2.—Was he noticed by his comrades to be ailing for any length of time before reporting sick?

3.—What were his habits? Has he been known to frequent any particular drinking saloon in the Bazaar? If so, please give the address.

To be answered by the medical officer in charge of unit. If there is not sufficient space to answer any particular question, the reply should be written on a separate sheet, and attached to this form.

4.—Have the regulations regarding the sterilisation of the drinking water, contained in the Senior Medical Officer's Sanitary Circular, been strictly complied with?

5.—What is the source of the milk supply; especially as regards that used in the coffee bar?

6.—From whom are the mineral waters on sale in the canteen and coffee bar obtained? What system of supervision is there as regards their manufacture?

7.—What are the precautions, if any, exercised to prevent the sale of liquor in the lines by natives?

8.—Are the latrines and urinals in good order? Have the instructions regarding them, and the method of disposal of sewage, contained in the Senior Medical Officer's Sanitary Circular, and Sanitary Letter 3033, been strictly complied with?

9.—Have you had to report unfavourably on the sanitary condition of the lines of this unit during the past month? If so, in what particular?

10.—What are the arrangements in force in this unit to ensure the segregation of (1) drafts on arrival, (2) typhoid convalescents.

11.—Can you suggest any possible source of infection in this case?

12.—Has the diagnosis been confirmed bacteriologically? Has the man ever undergone anti-typhoid inoculation? If so, give date.

Date.....190.. *Medical Officer in charge.*

(To be completed with as little delay as possible, and returned to the Special Sanitary Officer, Ambala.)