OUR PRESENT POSITION WITH REGARD TO ENTERIC FEVER IN INDIA.

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Of all the diseases that affect armies, the one that stands above all others in importance is enteric fever, and this especially in India. Wherever medical officers meet, this disease is certain to be discussed, and the problem of its prevention is by far the greatest source of anxiety to administrative medical officers in India. We have bestowed on the problem care unlimited, care such as is never given to the civil population of England, and indeed would be impossible in that country, and yet not only is enteric fever not reduced, but the contrary obtains, whilst cholera and dysentery have both been practically abolished as endemics among British troops in India. The following figures, calculated from the statistics in Army Medical Department Reports, show well how we have progressed, or otherwise, in the districts comprised in the old Bengal command. I take this command because it is included in the endemic zone of cholera, and because it comprises almost all the varieties of Indian climates and conditions.

<table>
<thead>
<tr>
<th>Decade</th>
<th>Remittent and Continued Fevers, including Enteric Fever</th>
<th>Dysentery</th>
<th>Cholera</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860-69</td>
<td>2.88</td>
<td>2.62</td>
<td>8.65</td>
</tr>
<tr>
<td>1870-79</td>
<td>3.71</td>
<td>1.86</td>
<td>3.25</td>
</tr>
<tr>
<td>1880-89</td>
<td>4.70</td>
<td>0.79</td>
<td>1.86</td>
</tr>
<tr>
<td>1890-99</td>
<td>7.81</td>
<td>0.88</td>
<td>1.25</td>
</tr>
</tbody>
</table>

In the earlier years quoted most deaths from malarial fevers were included among remittent and continued fevers. I have not included them among the figures for the years since malarial fevers were differentiated in the statistics. It is probable that, if malarial fevers were omitted from the figures in the earlier of the years I
have quoted, the increase of enteric fever in the districts under consideration would appear even more startling. So this is how we stand; we have, by our sanitation, reduced dysentery and cholera in Bengal, the latter enormously, and yet we have absolutely failed to touch enteric fever. How, then? We have been taught that enteric fever, dysentery and cholera are water-borne diseases; we have believed our teaching and have based our sanitation, as regards the prevention of these three diseases, practically entirely on this idea. For what is it that we do in this matter? We boil water, we add permanganate of potash to it, we watch soda water factories both in barracks and bazaars with the most jealous care, we establish piped water supplies from pure sources, dairies are established for the supply of pure milk and butter, and as far as possible the consumption of milk and butter from other than approved sources is prevented, wells are carefully steeled and protected from pollution, mussels are abolished and metal receptacles for the carriage of water are substituted, men are required when on the march to fill their water-bottles with boiled water or cold tea, and the water supplies of camps are carefully protected from contamination, every possible source of infection through water that human imagination can conceive is carefully guarded against; and the results are these, that cholera and dysentery have been reduced enormously and yet enteric fever is not only not reduced, but is on the increase.

There have been, and are, many explanations of this. We have introduced younger and more susceptible troops, but apart from the fact that enteric fever cannot arise without infection with the specific virus, the short service system has long ago had time to show its full influence in this direction and cannot be blamed for the present increase of enteric fever.

The bazaars are blamed, yet soldiers have frequented bazaars ever since we occupied India, and, moreover, young officers who never go near bazaars are affected almost equally with young soldiers.

The water-borne theory of enteric fever, which has dominated and still dominates our sanitation in India, was born in England, and it has been found to be true in so large a proportion of cases in that country that it has been elevated into a dogma universally applicable. England is a country covered with herbage, rarely free from rain for more than a week or two at a time; dust is a trifling factor and is almost absent except on the public roads during dry seasons; flies are comparatively few. India, on the
other hand, is a country free from rain for months at a time, and during that time it is covered with dust to a degree unimagined by those without tropical experience; flies and insect life of all descriptions constitute some of the chief inconveniences of life in that country. The conditions are different, and it is a fair presumption that the results will be different also—and they are.

Practical demonstration of the fact that enteric fever can be spread by other means than water has been given in the South African War, in the Spanish-American War, by Quill in the Ceylon epidemic among Boer prisoners, and in the Landi Kotal epidemic of 1898, of which the writer had personal experience. In this last epidemic a camp which was at first supposed to be a temporary one had gradually developed into a standing camp. The ground was dry and easily raised as a fine, almost impalpable, dust; on three sides of the camp were latrine trenches which in course of time had gradually approached the camp walls; the water supply was carried on mules from a spring some two miles away, which had its source in uninhabited country on the other side of the valley, and contamination of the spring by drainage from the camp was a physical impossibility. The water on arrival in camp was boiled and stored in galvanised receptacles provided with taps and tight fitting lids; moreover, the water was examined bacteriologically by Mr. Hankin, of Agra, and declared free from suspicion. After a few sporadic cases enteric fever broke out in epidemic form at the end of May, and during June and July it simply raged. Of the two British regiments present at the time, the Oxford Light Infantry, with a strength of 777 men, had eighty-four admissions and twenty-seven deaths from enteric fever; and the Royal Sussex Regiment, with a strength of 654 men, had sixty-two admissions and nineteen deaths, nearly all in less than three months. At the beginning of the epidemic the Oxford Light Infantry had almost twice as many admissions and deaths as the Royal Sussex Regiment. Towards the middle of July the Oxford Light Infantry were moved to another camp on a fresh site, about half a mile away, and the admissions for enteric fever from among them rapidly dropped. At the end of July the latrine trenches were shut down and a removal system started, the excreta being removed to a place about one and a half miles away from camp; by the middle of August the epidemic was practically ended. The following table shows the course of the epidemic.
The water supply remained the same throughout, and its treatment was not altered, yet the epidemic stopped short. To those who were present at the time there could not have been a more convincing proof of the fact that, in this case at any rate, it was the presence of the latrine trenches round the camp, across which dust devils played two or three times a day, that produced the epidemic, and that water-borne infection had nothing whatever to do with the matter.

Our experience of women and children in India also points to the fact that water is not the only, and perhaps not even the chief, carrier of typhoid infection in that country. They are by far the greatest consumers of water and milk in cantonments and, moreover, they generally prefer to take them unboiled; yet the incidence of enteric fever among them is infinitely less than it is among the officers and men.

The records, quoted above, of cholera and dysentery, both admitted water-borne diseases for the most part, show that our sanitary measures for the prevention of water-borne diseases have been well carried out, for cholera and dysentery have both been greatly diminished; yet enteric fever fails to respond to the same measures. The bacteria of cholera and enteric fever are killed with equal facility in water, but they have this difference, that whereas the cholera vibrio is easily destroyed by drying and exposure to the sun, the typhoid bacillus, on the other hand, resists these influences for a considerable time.

It has been demonstrated by Firth and Horrocks that in England the typhoid bacillus can live in dust for twenty-five days, and in dust exposed to the sun for fourteen days, during one hundred and twenty-two hours of which the bacilli were exposed to sunshine: the same observers also showed that the contagion can be carried by flies. Aldridge, later, has shown that in India typhoid bacilli can be recovered from earth contaminated with infected urine after nine days of drying. In some experiments made in India by Capt. L. W. Harrison, R.A.M.C., and myself, we found that typhoid bacilli survived in dust contaminated
with infected urine for five days, and in the same dust exposed to the June sun of India for nearly three days, during seventeen and a half hours of which the dust had been exposed to the direct rays of the sun, the average temperature shown by a thermometer buried in dust under similar conditions being 53° C. (127·4° F.). In the first of these experiments the dust was dry enough to be raised as a cloud after five and a half hours, and in the second experiment after two and a half hours, so that ample time is left in all cases for the wetted ground to be raised as dust and blown through and through camps and barracks, carrying infection. Latterly, Wasdin has demonstrated the presence of foci of typhoid infection in the lungs of patients, showing that the contamination of water and food-stuffs is not an absolute necessity for the production of the disease, but that infection can be brought about by direct inhalation of infected particles. And in any case, we all swallow quite enough dust in India to give it a fair chance of doing harm if it should happen to be infected.

The facts I have quoted above and a thousand and one others point, I think, to the fact that the continued prevalence of enteric fever in India, and its increase, cannot be accounted for by the purely water-borne theory of the disease, and that, indeed, the contamination of water probably plays only a small part in the matter, and I think that the system of conservancy among barracks and camps in India can be shown to be by far the largest factor in the continuance and increase of enteric fever in that country. We know that typhoid bacilli are excreted from the bowels of patients and, to a less extent, of convalescents from enteric fever; and it has been shown by Horton Smith and others that the urine of 20 per cent. of convalescents from enteric fever contains Eberth's bacillus, and that it may continue to be so contaminated for as long as six months—it has even been said for as long as eleven years—after the attack of the disease. In the years 1891-1900 the average number per 1,000 constantly sick with enteric fever was 3.43. If we take it that the period of convalescence and possible infectivity in each case was only as long as the stay in hospital, which is putting it on its lowest basis, and that 20 per cent. of the convalescents had infected urine, then the average number of men in barracks with constantly infected urine works out, for the years in question, to 0.68 per 1,000. In other words, for at least two hundred and forty-eight days of each year each regiment of 1,000 men was constantly "exposed to infection from the urine of one of its number. The
urine and faeces, then, are the chief sources of danger, and it is useless to seek for roundabout causes of the prevalence of the disease till we have dealt effectively with these which lie at our very doors. And how are we now dealing with them? In barracks the latrines have mud floors for the most part, the seats are without lids, and the faeces are passed into a row of conical earthenware pots, which are generally sufficiently far from the seat to ensure that the ground shall be soiled with urine at any rate; the pots are cleaned out superficially without the use of any disinfectant, and the faeces are supposed to be covered with dry earth when passed. A dust-strewn floor invariably contaminated, a row of contaminated pots open to the visits of flies, and a provision of carefully dried dust to pour on to the faeces and ensure a carriage for the typhoid bacillus if it be present; all this within a few yards of the barrack rooms. The pots are emptied into a receptacle, and this in its turn into a filth cart, a certain amount of the contents spilling on the ground in each process. The filth carts are drawn to a place a mile or so from barracks and there the contents are dumped into shallow trenches, and covered with a few inches of earth, dry as dust for the major portion of the year; there the filth is left to fertilise the ground in part, and also to be blown back as dust to barracks if it fits the wind to set that way. It is claimed for this trenching process that the faeces soon lose all faecal smell; unfortunately, typhoid bacilli have no smell and may exist in most innocent seeming dust. In camp, the faeces are passed into (or on to the sides of) shallow, open, dust-lined trenches, an even more ideal method for ensuring the carriage of any stray typhoid bacilli into the men's lines, whether attached to particles of dust, paper, the bodies of flies, or the soles of the men's boots. It is true that the trenches are on the side of the camp away from the prevailing wind, but, unfortunately, there are other winds, and there are dust devils, so it is a certainty that at some hour or hours of the day the wind will blow directly from the latrine trenches into the camp, and even if this does not happen, there are the flies which swarm in camps of any standing, and there is the fouling of the men's boots, carrying faecally contaminated dust into the very tents, there to be shaken into a cloud every time the men arrange their blankets.

But contamination from faeces is the smaller evil, faeces are at any rate deposited in one spot as a rule, and the chances of their containing infection are probably not as great as is the case with urine, and this, which is the greater source of evil, besides helping to contaminate the latrines, is spread broadcast through camps and
barracks alike; the provisions made for its disposal, and the unfortunate fact that it leaves neither visible trace or smell after a short while, ensure that this should be so.

In barracks the urinal is generally a lattice-built structure, with a mud, or rather dust, floor, on which droppings which do not reach the trough fall, there to be incorporated with the dust and blown into the adjacent barrack-room. Flies have free access to the trough and urinal at all times, the urine is caught in a receptacle innocent of all disinfectant, and from this it is poured into the filth cart, a certain amount being slopped on the ground in the process; the urine is then carted away and dumped, without any further treatment, along with the feces. The urinals are at the end of a long verandah so that at night they are practically not used, for the simple reason that men prefer to micturate on the nearest ground outside the barrack-room rather than to walk the length of a long verandah in their night clothes to the urinal. Officers and men alike are equally without conscience, or knowledge, in the matter of fouling the ground with urine. In camp matters are even better calculated to ensure this fouling of the ground. For day use there are a few urinals, pits dug in dry earth, outside the camp perimeter, and for night use a few receptacles near the camp, unmarked by any light and approached by a narrow, rough path. During the day a visit to the urinal entails a considerable walk over rough ground, and at night a series of stumbles in the dark over ropes and tent-pogs to an unmarked destination. What happens then is that, during the day, there is no more common sight than to see, after the men return to camp, practically the whole of them micturating on the ground outside the camp perimeter; protest is of no avail, it is outside the camp, and the mess will soon dry up; the average line officer's idea of an insanitary condition can be translated into the expression—"smell and visible dirt." If one explains that a proportion of the men are certain to have typhoid bacilli in their urine, one is looked upon, and treated, as a visionary. At night the urinals are practically not used, except by the men in the tents quite close to them; officers and men micturate on the ground outside their tents and no regulations in the world can stop it, because it is almost impossible to catch the offenders in the dark, and if they are caught, they will probably be dealt with by an officer who is guilty of the same offence himself and sees no harm in it.

The ground on the sides of the day urinals and around the night urinals is slopped with droppings, and on this the men stand,
soiling their boots and carrying possibly infected dust back to their
tents, the wind and flies help further to carry the infection if there
are any men in camp with infected bladders. This is a condition
of affairs which is, I think, in the experience of every medical officer:
it is deplorable, but not without remedy. Of first importance in
this direction it is essential that no man should leave hospital, after
having had enteric fever, until his bladder had been disinfected by a
course of urotropine (10 grains thrice daily for a week), or by wash­
ing out with some suitable antiseptic. I would suggest that this dis­
fection of the bladder should be done before the man is allowed out
of bed, otherwise there is a certainty that his urine will be passed
into the common urinal or latrine of the hospital, the contents of
which are treated in the same manner as, and along with, the
barrack excreta. In the second place it is necessary to ensure that
urine and faeces shall be deposited only in the places appointed for
them, and that they shall lie there till removed, free from all risks
of being carried through barracks or camps by flies, as dust, or on
the men's boots. In this regard the present dry earth system
stands condemned as the very worst system that could possibly
be devised, and the present arrangements for the disposal of urine
both in camps and barracks are no better. In the place of the
former it is necessary to substitute some form of water-closet, and
in place of the latter it is essential that such ample means of
disposing of urine be provided both in camps and barracks as will
ensure that it is as easy to micturate in the right place as in the
wrong one. The ideal system in barracks would, of course, be
some form of flushing water-closet and urinal; but these are
impossible in the majority of cantonments of India, both on account
of the difficulty of providing sufficient water and on account of
the difficulty of disposing of the consequent large bulk of sewage
in the almost dead flat stations in the plains.

For the latrines in barracks I would suggest those on the
trough principle, the troughs to be very wide at the top to avoid
fouling of the sides, and to be half filled with a solution of some
disinfectant and deodorant. The troughs could be cleaned out
daily, or twice a day, the contents being run through a very wide
trap at one end of the trough into a watertight receptacle and
carried away on a carriage frame for the receptacle, to be sterilised
by heat; the troughs after cleaning to be again half filled with
disinfectant solution, stored in a cistern at the upper end of the
trough. The floor of the latrine would be of flags with cemented
joints of cement, the seats of the latrine would be hinged for
purposes of cleaning and would be provided with lids closing automatically. The day urinals also would have impermeable floors which would be raised as a platform just under the troughs, so as to compel the men to stand close up to the trough and so avoid droppings on the floor; the building would be made fly-proof, and the receptacle into which the urine runs would be provided with some disinfectant, while the communicating pipe between it and the trough would be so arranged that no flies could enter it to get infected. The walls, floor and trough of the urinal would be swabbed daily with some disinfectant; the disinfectant for the trough flowing into the receptacle would serve to sterilise the whole of the urine collected in it. The urine would be carted away daily and, being already disinfected, it could be dumped in any convenient spot with perfect safety.

The question of night urinals is a more difficult one. If one leaves the men with only the present day urinals they will not use them and the ground will continue to be soiled; if one provides occasional urine tubs or other receptacles for night use, the same result will follow, plus a slop round the tubs. Urinals off the barrack-rooms would be objectionable on account of smell, and, moreover, unless sufficient were provided, say four to a company, the soiling of the ground would continue little abated. The simplest plan of all would be to provide each man with a chamber pot for night use, it is the best arrangement for preventing droppings on the floor, for the men would hold them close up when using them. If they had a quantity of disinfectant put in them the urine would be rendered harmless as soon as passed, they could be emptied and cleansed each morning, and a fresh supply of disinfectant could be put in them. The presence of non-commissioned officers in the room and the general feeling among the men would ensure their proper use, and the fact that they are used in the hospitals and cause no trouble there shows that they are practicable. The chief objection to them arises from the presence of drunken men, but if a man is too drunk to use a chamber-pot he is too drunk to be in the barrack-room; the guard-room is a more appropriate resting place for him.

For camp latrines I would suggest that, instead of the present open shallow trenches, the latrines should be made of a deep trench, say 5 or 6 feet deep and 18 inches wide, to avoid soiling of the sides; over this would be placed a row of dome-shaped seats of sheet iron, something like inverted porridge bowls without bottoms to them, 2 feet wide at the bottom, 1 foot wide at the top and 1 foot high.
W. S. Harrison

I suggest the dome-shape both for strength and to avoid soiling of the inner surface with diarrhoeal discharges or urine. The interstices between the seats would be filled with earth and stones. The faces in the trench would be covered twice daily with some of the excavated earth, and as lids would soon prove unserviceable, the visits of flies would be prevented by sprinkling the trench freely with kerosene oil or chloride of lime. An hour or two before camp was struck the seats would be sterilised by placing for a minute or two over a fire of camp rubbish; they would be packed when cool. As the seats of the shape I suggest would rest one into the other. I calculate that a sufficient supply of them for a regiment could be carried by one mule. For day urinals in camp I would suggest troughs of sheet iron supported on light metal trestles, the troughs would open at one end over a narrow deep pit, into which the urine would fall, the earth at the bottom of the pit would be loosened and a sufficiency of disinfectant dug into it, the ground under the troughs also would be impregnated with some disinfectant to receive droppings, and the trough, ground and pit would be sprinkled with kerosene oil to keep off flies. If the troughs were arranged radiating from the pit sufficient accommodation for a large number of men could be made with one pit. The troughs and trestles would be sterilised in the same manner as the latrine seats on striking camp.

For night use in camp a latrine on the same principle as the day latrine would be provided nearer camp, the contents of the latrine would be well covered each morning and the latrine closed during the day. The night urinals should be plentiful and as near to the men's tents as possible: they could best be arranged by putting tins with some disinfectant in them at intervals along the sides of the company streets at retreat; the sites for them would be specially arranged by having a plinth on which the tins could rest, so as to bring it high enough to prevent droppings as far as possible, and the ground round would have some disinfectant dug into it.

In all cases the roads to latrines and urinals should be wide and well made, and all night latrines and urinals should be provided with lights, both to distinguish their locality and also to prevent men accidentally fouling the ground in the dark. Having made these provisions, or similar ones, and having especially made it quite as easy to deposit excreta in the right place as in the wrong one, it should be looked on and treated as a most serious offence for officers or men to foul the ground of camps or barracks as they do at present.

I am well aware that the suggestions which I have made are
open to many criticisms and are susceptible of many improvements; this must of necessity be so when the ideal scheme is impossible, but I think, at any rate, that the facts I have quoted in this paper show the urgent necessity for a radical reform in the conservancy system of British troops in India. The measures to bring about that reform will cost money—they will probably cost a lot of money—but if the country has any care for the lives of the soldiers entrusted to it the money will have to be spent; and, after all, to put it on its most mercenary basis, if we only reduce the death-rate from enteric fever by 25 per cent., taking the present mortality at 6 per 1,000 and the value to the country of each soldier at £200, the annual saving to India would be £18,000. Surely a sufficient inducement to the finance department to open their pockets.