Thesis on "Hygiene and Sanitation on Indian Railways under Construction."

Of the many adverse circumstances under which one has to work during the construction of a railway, there are probably none to speak as those connected with hygiene and sanitation.

The Medical Officer is always stationed at a place where the largest amount of "labour" is to be collected. He must be prepared with a small staff of native co-operators, to maintain as well as he can with the small amount of material at his disposal, not only the health of the people surrounding him, but also of the people of that portion of the line under his care, a task which may range from 120 to 250 miles. Depending on his success will depend the rapidity with which the line is completed; if this task is not to be attained merely by the laying down of drains, or the erection of latrines, but rather by dif-
Comancy, or in other words "fact", without which little may be hoped for, although the systems devised be most elaborate and inviting. Humanity on these works is in itself a study: men of all castes and creeds from all parts of India are there, each caste or creed, sect or tribe, with its own ideas of right and wrong must be studied in turn, and then one only may one hope to get a harmonious allegiance of the whole. The line is being built, and although a certain number of camps or camps are important as centres during construction they may not, after the completion of the line, be of any significance, or in the majority of cases are done away with altogether.

In the first place I propose to deal more especially with the foundation of the more important camps - in which any number from 500 to 10,000 may for a period be settled, if the period is usually from 3 to 14 years. Due to the fact that most if not all the camps
will be done away with after 3 to 4 years. Railway Companies are justified, and think rightly, in not laying out too much money on any work, which will last after the time I have indicated, be abandoned useless. As can now be understood the money allowed in the estimates for sanitation is never very much. Consequently the medical officer has - although considerably handicapped - to do the best he can under the circumstances.

For purposes of description the people on construction works are best divided into 3 classes viz. 1. Europeans & Eurasians.
2. Higher class natives.
3. Labourers or Coolies.

As the habits of Europeans & Eurasians are precisely the same they have been classed together.

Water supply for Europeans & Eurasians.

As Europeans & Eurasians are more intolerant of bad water than the natives,
Special precautions have to be taken in regard to the source from which their drinking water is supplied in consequence special arrangements have to be made for them. To obtain water from a river or tank would be for obvious reasons objectionable and dangerous, undoubtedly the best source is from a well: this should if possible be sunk in the "compound" of a European bungalow, or if this be not possible somewhere within sight. If the Euro-

The drinking water will hence be made "jucca" i.e. lined with brickwork of cement, have a high broad parapet at the mouth of the well covered with wood or other material with an opening sufficiently large enough to admit of the entrance of a bucket, or the entrance guarded by a door, which.
At sunset is locked, & the key left with one of the Europeans in the place at the time. The well is guarded until sunset by a "watchman" (a watchman) who has strict orders that no one is to use the well or wells except the "hastis" (water-carrier) in the service of the various Europeans or Euraeans. If the Euraeans wish to be at some distance they are supplied with wells of their own.

After the reception of the water in the house it is seldom necessary to remark the European or Euraean that all drinking water before use should be boiled or filtered. When asked as to the best form of filter, I have been in the habit of recommending a Berkefeld, and enforcing a promise that the brownies of the filter in question be boiled or thoroughly cleansed at least once a week & under the direct supervision of the European or Euraean himself. As is well known, all Europeans in India
Rather than run the risk of drinking the local water — although its purity and quality may be beyond question — drink soda water if procurable. This is to be commended, or if, even at the expense of much trouble soda water or condensation works is procurable I always advise its use, provided I am satisfied that the manufacture of the water is carried out on English principles.

On one occasion whilst on "construction" an entertaining local "Baba" (a higher class native or educated) procured a soda water machine, after some hints from me as to the clean method of manufacture blessed business; he did well for a time, but eventually thinking the method to be adopted too rigid got careless, and compelled him to close. After this experience I never encouraged local manufacture, but sent for all supplies to a reliable merchant in the nearest large town.

Water for cooking purposes is supplied from the private wells, and although
orders may be given that all water used in the preparation of food should preferably be boiled; it is very difficult to make sure that this order is always carried out. Since it is impossible at all times to directly supervise the cooking of the shady cook or his assistants.

By the side of the cook-houses I have always had built a small three-sided place (the fourth side being formed by one of the walls of the cook-house) with a fire placed in it for the heating of large quantities of water for a bath or cooking purposes.

Of food-stuffs brought to the table the European runs no little risk from uncooked vegetables (lettuce, ever so) hot because the vegetables are in a raw state but because of the water in which they have been cooked. In India at all stations & in fact everywhere there a few Europeans & Eurasians are collected together it is usual to have one large vegetable garden towards which all subscri. - every morning a basketful already
Apparently cleaned in delivery at each bungalow. The vegetables look clean, so the table servant usually puts them straight from the basket on to the table, wherein lies the danger — for, whether the vegetables come from a municipal, subscription or garden one may feel sure that the water in which they were washed was at least dirty, if not contaminated. And with this suspicion in my mind I have always requested Europeans to insist on having all vegetables brought to their bungalows washed again — this time in reliable water — before eating them. I call attention to this point since without doubt cases of enteric & cholera have been traced to water in which vegetables have been cleaned.

**Milk Supply.**

Milk should never be got from the bazaar or any native vendor, for from such it is always diluted.
with water obtained from anywhere, or has been drawn from unwatered wells by dirty hands. The only safety for Europeans, in regard to their milk supply lies in having their own cows, buffaloes, or goats, or seeing them milked themselves, or deferring some one they can implicitly trust. If any European lady be in the camp she will always gladly undertake the necessary supervision. The laiC servant has an order that all milk must be boiled, so that any milk put on the table when one sits down must be actually hot.

Animal and other meat.

Seldom is it possible for Europeans on construction to get mutton, beef, goats, and fowls—in other words, variety—At one place I was at only mutton was procurable; at another only fowls, at another only goat—beef never. Here again, as in the case of milk, it is not advisable to have any
dealing with the bazaar, but rather for the Europeans to combine or form a "mutton" goat, or foal, club of their own, to have the satisfaction of knowing that they are not eating what previously may have been diseased, or objectionable in other ways.

Tinned foods. These especially in warm countries, are best avoided, but I have never yet met a European or Eurasian on railway construction who could wholly do without them. The varieties of meat and other food are so limited that the craving for a change of menu is occasionally irresistible; it provided that the lions be got from a reliable European firm in a large city, little danger from their use need be apprehended. A native firm for such foods should never be dealt with, since all their tins are usually procured at auctions. When the contents of a tin are bad
In addition to the flattening or con-

densation, a sympathetic state of the tops and 
bottoms, the wrapper usually has a 
suspicious look: it may have changed 
colour, be separated from the tin in 
blisters, or have a speckled and 
mouldy appearance. Only once 
(this was in connection with a 
baby's patent food) have I come 
across a "blown tin" with the opening 
carefully soldered: this had been 
obtained through the agency of a 
native chemist.

As regards the amount of food to be 
taken, the daily amount of alcohol to 
be consumed, or the kind & quality of 
clothes to be worn by a European it is 
still more necessary to give advice; if 
true it is never taken seriously. The 
european looks upon these as parts of 
a personal equation, acts accordingly 
—he educates himself & his liver 
is his tutor! Sound reasons for his 
guidance are (1) Of meat take Spanishly
(2). Of exercise daily, but not lazily.
(3). Of alcohol cautiously.

Residences of Europeans.

The bungalows constructed are built on the principle that they last as long as the construction work lasts and not much longer. In consequence the money allowed for each house is never much prone has to rough it to a greater or less degree. However, irrespective of the kind of house to be provided, there are some points to be attended to in the comfort or health of the individual are to be maintained. Of these points it is wise to take into consideration (1) the nature of the climate; (2) the rainy season or monsoon; and (3) the nature of the ground or its surroundings.

1. The nature of the climate.

Speaking unsafely Europeans speak of a place as being either a "moist" or a "dry heat". These terms explain themselves, or are only preferable...
to the time before the beginning of and
after the cessation of the rainy season
(July to September) during which, of
course, a place with a dry heat loses
that appellation for the time being and
becomes 'moist'. According as a
place is moist or dry one decides
the direction in which a bungalow
should "face". In dry places where
the temperature from March to June
usually ranges from 100° F to 125° in
the shade, one, for reasons to be
presently stated is glad to take
advantage of the prevailing westerly
winds; these, almost without exception
blow daily, are strong, or incredibly
hot, or if passing through 'kus-kus'
(a species of deep underground
grassy root) keep constantly moist
with water. Cool air enters the bungalow
at the temperature thereby reduced to 80°
or even lower. Inasmuch then, as every
amelioration of discomfort to Europeans
in the tropics aids in the maintenance
of their health it is an advantage
to have the rooms which are used during the day facing west so the comfort of the individual and his family are assured for the most trying and unbearable month of the year. In stations with a dry heat I have known houses built north & south so have always felt a keen sympathy for the occupants who unable to minimize the heat appreciably yet irritable & nervous one glad at the first opportunity to change their house for one facing east & west.

Secondly, that side of the house which is exposed to the sun all day, or to the afternoon sun should always be protected by a verandah; otherwise, the rooms which have the exposed wall as one of its limits becomes intolerably hot. I have off construction known such a room & unless necessitily compelled never used it. Where a moist heat exists as particularly I saw need be laid onto the facing of a bungalow for beyond
"Makako" or other means for the reduction of heat are possible.

21. The rainy season or monsoon -

Almost throughout India there is what is called the "rainy season," or more briefly the "rains" - when, extending through a period of 3 months, more or less (July to September) tremendous downpours of rain occur at varying intervals. To counteract as much as is possible the effect of these rains I have always requested engineers or construction works to allow high platforms to the bungalows, or grass thatching on the roofs at least a foot deep. If these conditions be not complied with the house becomes exceedingly damp from above and below, to the detriment of the health of the occupants. I know nothing so annoying as a leaky roof, since in addition to the discomfort by day one is often up at night endeavouring to find a dry spot for one's bed.

3. The nature of the ground and its surroundings. The site for the European's bungalow should be as far away as possible
from the proposed site for the bazaar, the cootie lines, or any pre-existing native village, or for obvious reasons needs no explanation. If the ground be hilly or high a point as presents itself shall be chosen: this allows of good drainage and by not only obviates dampness, but prevents any accumulations of water in which mosquitoes may breed. The terrain is flat, some distance be well away from the bungalows, or is possible at a lower level, away swampy or marshy ground near filled in. The type of bungalow usually allowed a European is well shown in figure 4. By a glance at this, a knowledge of the number of rooms allowed, their size, of distribution, arrangement of verandahs, doors & windows, drains, we will be more easily gained than if I were to go into a detailed description of each point. The walls are actually of brick, so the roof of jungle grass supported on a bamboo framework & covered with open channel tile.
Drainage round Europeans' bungalows.

In connection with temporary houses, only small drains for the reception of bath-room (i.e. water only) & pantry water are provided. To build, in addition, a drain large enough to cope with monsoon water would be considered too expensive and superfluous. The small drain referred to are usually constructed of well burnt brick, laid lengthwise at various angles, so contorted as can always be arranged for all bath-room & pantry water to discharge into a common drain, which in its turn is led away, or emptied itself into a large "slope bark" tank as is depicted in figures 15 & 16. The contents of the tank are removed morning & evening by "sweepers" & discharged on a piece of ground previously selected. Sometimes, owing to the inclination of the ground or proximity of jungle, one may lead the water away into the jungle, there let it lose itself.
The disposal of excreta (European).

Outside the larger cities, Europeans use "commodes"—a compound name signifying a chair or two pans enclosed in a partitioned wooden box, provided with a lid. This is always placed in the bathroom or after near the pan is removed by a "sweeper" with contents emptied into a large iron receptacle with a closely fitting lid. The receptacle should always be at least 70 yards away from the bungalow, hidden from view by corrugated tin or other form of screen, or have placed by its side a large "gumbah" (earthenware vessel) containing some disinfectant powder. If a receptacle be not provided the sweeper will deposit the contents of the pan anywhere, but for choice usually behind the stables or servants' quarters. The contents receptacles with their contents are early next morning removed in a sanitary cart to the trenches found in after trans-
into the receptacle outside, the pan is washed out & this is necessarily followed by a good deal of offensive splashing. It is with the object of remedying the disagreeableness of this that a quantity of disinfecting powder is kept near at hand. By the side of the powder is another kettle containing water for the purpose already indicated.

Accommodation for Natives.

Natives on construction works are conveniently divided into 2 classes. (1) The higher class native (2) The labourer or cooly. Amongst the higher class natives are clerks, bridge or tunnel supervisors, accountants, storekeepers, sanitary inspectors &c. The majority of these are Bengali Brahms - educated, Hindoos by caste, speaking English &c. It is accommodation for these that I shall write first. Be the higher class native Musalman or Hindu he is, more for his own
...fares...er...more than anything else, almost invariably accompanied by his wife or family, and in consequence when accommodation is being provided special latrine arrangements have to be made - since their women folk being "fardah kachins" i.e. ladies of the zenana are not allowed outside their doors.

The accommodation provided consists of one or 2 living rooms (according to the official position of the man) - a verandah - a court-yard - in one corner of the court-yard is placed a small cook-house, in another the latrine (see figs 5 and 6).

The walls of the house are usually built of burnum bricks with a plastering of mud on either side, then in its turn is covered with chunam or white-wash - I have at times, however, all the walls to be made of unburnum brick, or another stone wall of burnum brick - the remainder of unburnum - "Estimate" will not always allow of all the walls being tiled...
I am convinced the whole thing is false economy, for houses out of number I have seen almost brick walls fall to pieces in the face of heavy rain or during the monsoon, the condition of the Babu's residence in consequence becomes unsightly. The court-yard should always be paved with one or 2 layers of bricks cemented over, & sloped towards the entrance door — for such a place to remain unpaved means that during the monsoon it becomes a regular miniature flood so to hold in solution any filth that had previously accumulated. It is almost unnecessary to state that the pelvis of the living room should be higher than that of the court-yard & that of the court-yard higher than the ground outside. To have a cook-house or latrine in the same court-yard does not sound correct, but taking into consideration the scanty accommodation
allowed I can suggest no alternative distribution of these 2 places. As a matter of fact I am led to believe that most of the cooking is done in the veranda, or the cook-house used only for minor purposes such as the freezing of vegetables. And, although the cook-house and kitchen are near one another, one must not lose sight of the fact that they are both in a well ventilated court-yard, so that the latter is not adjacent to any living room.

For the sake of extra privacy desired by Bebun, I always select a site some distance away from a public road, so then not much importance need be paid as to the relative positions of the living room and court-yard. But, should proximity to a public road be unavoidable it would then be well to face the living rooms towards the road, to provide an additional veranda in front. The court-yard being thus a sloped
all water falling into it runs into a grooved channel, which passes under the door and discharges itself into a drain.

Disposal of Excreta of higher class nations.

As no scavenger or sweeper may enter a courtyard or house in which a Jewish Thought woman lives, the builder of a Rabbi's quarters always arranges to have an intercepted low down in the outer wall of the courtyard, corresponding to the future position of the latrine, so that it is through this opening that the pai is pulled out. The opening is provided with a flap door which can be raised or let down, or better still with a sliding covering of wood or metal—preferably the latter. At both ends of the Rabbi's quarters, or at such places where one considers suitable are large iron receptacles (screened from view) but which the contents of all pails
from the latrines are emptied.

As all the buses & "theirs" in common with all horses prefer to "squat" or defecate directly on to the surface of the ground, one can understand how very objectionable this would be, if allowed, in a private latrine — in consequence a raised seat about 2 feet high is built in with bricks, or other material with the necessary opening above; below an interval large enough for the reception of a, ball is provided. Even then the habitue will not sit over the opening but "squats" i.e. plants the soles of his feet one on either side of the opening — thus being so, the urine is liable to be shot anywhere back into the "pail", & the disposal of that is then to be considered.

To meet the urine as it was shot forward & to "gather" it back into the "pail" I once had devised a few "pails" with sloping tongue-like projection in front — the projection of each pail came forward through the opening: its breadth was six
induces, at its highest point it was 15" from the seat. To prevent the urine escaping over its sides, the lateral edges were incurved. The experiment proved a failure, for some of the urine escaped over the lip, a little lateral splashing also occurred. Moreover, complaints were raised that the convenience was disadvantageous to the women-folk, in addition to being an impediment to getting on to the seat. The children didn't understand it was often as not defecated down the tongue and urinated against the outer wall of the latrine! The babies' own objections were that if they urinated forcibly they themselves got splashed! They got no sympathy for they were expected to use the modified Auber's latrines outside their quarters, not their private ones. But knowing that most (I won't say all) preferred their private latrines, I experimented with a new shaped jail as described above.
Well, as some of the rooms occasionally shoot beyond the back into the interval between it & the anterior wall of the latrine the only thing to be done is to have a communication between this interval & the space which holds the 

pail & this can always be arranged for during the construction of the seat.

The channels of communication must be large, for then the pail space & the interval beyond are the more easily flushed out by water forcibly thrown in by the sweeper from behind.

If practicable - but this is not always an easy matter - on completion I always arrange to have 2 or 3 low cache women on my sweeper's staff.

They have a free entrance into the private latrines & can be conveniently employed in washing up the interior of the latrine, applying the irontanto of brushing up & flushing the court-

yard.

The drainage system in connection with the quarters of the higher class relatives is
simple in the extreme.

The drain (brickwork & cement) to receive any water from the court yards & latrine is sufficient: this may be led into a slop-bucket or to a distance to discharge on to a miniature filter bed of broken stone, gravel & sand.

As the higher class natives derive their water supply from the same sources as the coolies, the remarks made later regarding water supplies for coolies will be applicable also to the better class men.

Acconmodation for Coolies.

As soon as any new construction work is sanctioned the first thing essential is to begin planning out & making arrangements for the housing of the labourers on Coolies, v.a rough estimate of the number expected at each place along the line may be gauged from lists supplied by the Engineers, or by European or native Contractors.
Having got an idea of the number expected the following principle, in regard to the houses, or "lines," as they are usually called, should be adhered to. (1) They should be-if area of ground taken up permit—at least ½ mile away from the European settlement. (2) Some attention should be paid to "castes," i.e., Hindus and Mohammedans, kept separate. Quite 90% of them are usually Hindus. (3) They should be at a safe distance away from any pre-existing bazaars or villages. (4) Should it be impossible, not be too near a river, or pre-existing tank or tanks.

I have the idea that the Hindus and Mohammedans should be kept separate—though differences of caste have no direct bearing on the subject of this thesis, yet indirectly they have. Since this matter be neglected, the hospital has sometimes to take in cases resulting from differences of opinion between two people. The fact of having the "lines" away from bazaars or villages will not prevent
The men going to such places, but it at least prevents them sleeping in them. Or thus, overcrowding a place which already probably harbours more people than it can comfortably hold: or the precaution against overcrowding is, as is well known, a great factor in preventing the starting of — or if it has already broken out — the propagation of plague.

And lastly to put a bend of cootie near a river means, with all their abominable practices, contamination of the water in a very short time. If cootie will, if allowed, go to the water's edge, or to any collection of water, which on subsidence of the river has been left, for nearly all his purposes, or them may be enumerated (1) bathing (2) washing his feet and paws (3) anal abolition after defecation. To tell anyone that cooties never go to the river — even when rules against it are in force — would be as absurd as to say that poisons was never in fashion, but to allow
a native full scope in his inclination, is one thing, to minimize a practice of danger, by doing the best one can, another.

If sometimes happens that proximity to a river is, in the interests of the work in hand, unavoidable (see figs 1 & 2) — but here the men were working at the erection of a bridge, which when completed measured short of a few yards — 2 miles. As the work progressed some of the men would be working at the other end of the bridge, so that in itself would entail on them a walk of 4 miles a day — a considerable tramp, especially as it have to be done through thick heavy sand, or at certain seasons of the year in a blazing sun. Although the major part of the bed of a large river may, for the greater part of the year, be dry, there is always a little running water in the scoured out portions of the bed, where the still collections.
In dealing with a large number of workers such as were employed on the bridge shown in figure 1 (the largest in India and 2nd largest in the world) one had to face the fact that some, if not most, of the workers, when desirous of attending to the cells of Nature, would rather than walk through a considerable portion - greater or less according to the spot at which they were working - of the bed of the river or then, at the Country in a latrine, relieve themselves at a comparatively near, spot. This they did do, or women do, so to have prevented them, some had no

recognised a small army of inspectors well knowing the nature, anticipating his methods, or recognising the futility of thwarting him. I determined to prevent to a greater extent as, I endeavoured to position of the river bed itself, so I proceeded as follows:- but here I have wandered from the subject of accommodation. I will keep the sanitation of the river bed like I speak of Conservancy.
Having decided on the site for the houses, the next matter is their construction or arrangement (hide figs 7 & 8). The houses are usually built in parallel rows or lines, with an interval between them varying from 15-30 feet. I have often seen the lines built back to back but for reasons to be presently stated never liked this method. I always advise that the front of one row should face the back of the next, & so on. When put back to back there is a tendency for the backs of each line to be almost touching, & the interval between them is never very great—usually 14 feet & here lies the objection. The interval being narrow & more or less private is a thorough space is a place for excellence for all children (and sometime, even men) who wish to be alone themselves, or the small in a short time becomes abominable—But, if the front of one row faces the back of the next this nuisance is avoided, for
some natives are always to be found sitting at their doors or moving about
in consequence no privacy is ensured
Between each row I like to see a
road (if it may be called such)
of at least 20-30 feet.
All the houses are of mud and water
i.e. huts built with a bamboo
framework interlaced with a peculiar,
dry absorbent & long grass. Over
all a thick covering of mud. The
roofs are of a bamboo framework
with a thatching of grass about 2"
thick laid on. tiles are not provided.
The plinths is about 6" high & made
of mud will be broken down & subsequently
"leped" i.e. sprinkled with cow dungs
water which has the power (according
to natives) of solidifying the mud by
its astrigent action, so to increasing
its lasting power. If the floor be
not leped for the cooly he will
invariably do it for himself.
I always build on one window for
each hut, so they should be high up in
the wall doors to be protected by the eaves during rain; at its best it is crude, not merely a portion of one wall where the bamboo framework remains uncovered with grass or mud. Cooling, or other relief, which ought to have better have an abhorrence of ventilation, or at the first opportunity, fill up with all sorts of materials, the window or windows provided for them: they state that during the cold weather it makes the house too cold in the hot weather too hot. However to have them is important for, in the event of an outbreak of plague, the window is there, or the necessity for breaking down a bit of wall is avoided when on "open line." I was on one occasion asked to inspect and report on a large bazaar in which plague had broken out, and in hot one of the living rooms attached to the shops was there a window, or in fact no means of ventilation beyond the small door through which one entered, or the in
the majority of cases had a thick heavy cloth - acting as a curtain - hanging down it!
No fire-places & chimneys are ever provided: the cooky prefers to make his own arrangements for cooking his food. The smoke finds its exit through the door or window, but if not the man has no objection to its presence. Since in addition to keeping away mosquitoes & other insects he maintains that "it is healthy."

Drainage runs on either side.

The only drains required here are one on either side of the so-called road, which slopes from its centre gradually incline towards the drain, in question (see fig 8). These drains carry away dirty water from the washings of pots & pans, & into what I have in the sketch termed a stop box, the contents of which are twice a day carried out & carried away by sweepers. If
the nature of the ground permit, so that
be a sufficiency of it, there is no reason
why each drain should not be contained
on & discharged into a filter bed—a
jet about 15 feet square, filled in
with chipped stone, gravel & sand.

Water supply for all natives.

Although a river may be in near prox-
imity to a camp, I have always ad-
vaocated the sinking of wells. Since,
better obtained from there is, under
proper supervision, always safer than
that from rivers.

River water in India is almost
without exception, (except during a late
period in the S.W. monsoon) Contaminated
one is hardly surprised when it is
known that uncontrolled villages &
towns lower stream use the waters
freely for all manner of nuisible
subliminal purposes.

On arrival at a new camping point
one often finds, old wells & tanks; to
fill up the former is an easy matter, but
in regard to the latter, especially if
they are large, the undertaking—by
reason of the expense involved—is
prohibitive: in consequence, means
have to be taken to prevent, if possible,
their use altogether.
As to the choice of type of well one
must be content with the ordinary shallow
well, according to the money available
or for the purpose required. Certain of
these are made “juegos” (lined with
brickwork etc) or “kucha” (crude and
unlined).
Shallow wells do very well, for if one
or 2 fail others can, in a very short
line be sunk at a low cost, if
provided their proper supervision be
attended to they serve their purpose
admirably. Having decided on
the number of wells, the very important
question of their safeguarding is next
to be considered; if this be thoroughly
done half the battle in connection
with the maintenance of the health.
If the people are solved.

The Indian labourer or cooly as ordinarily met with on railway construction work possesses not even the most elementary ideas on hygiene or sanitation, in consequence a good deal of argument or coaxing is required to shake the conservative he or his ancestors have followed for centuries.

If the wells be not supervised what happens? 1. Their immediate vicinity becomes the bathing place of all who care to come. 2. All dirty clothes, or dirty they emphatically always are, are washed at the mouth of the well. 3. Each native dips his own lota (vessel) into the well without thought as to what was in the lota at the time of its immersion without thought as to what the lota had previously been used for, or without thought as to where he picked it up from. The well, because of the proximity of the water, often becomes a pest where he resides.
a second vessel full for purposes of rail solution.

The first thing to be considered is the protection of each well from surface or other pollution, having done this, its further protection from contamination by the rainy season. As many wells as possible should 1. Be lined with brickwork or cement or hydraulic mortar. 2. Have a parapet 10 feet high and extended outward for 3-4 feet sloping away from the mouth of the well. 3. Have a wooden frame or covering with a sufficient opening in it to admit of a bucket, or the opening provided with a trap door which is closed at night (see fig 10) 4. Have a "chorkider" or "chorkiders" to carry out the orders of the Medical Officer. The wells having been constructed as described above the first imperative duty of every Medical Officer is to appoint for each a "watchman" who for preference should be a Hindu. This,
man is provided with a galvanized iron bucket - of capacity about 3 gallons - and a stout rope of the required length, it is given the following orders: 1. That nothing but the bucket supplied is to enter the well, or that the water be poured from the bucket into the various vessels brought by the cookier. 2. That no clothes are to be washed within at least 200 yards of the well. 3. That no bathing be allowed within the same distance. 4. That no "gossip" be allowed to congregate near (a common meeting place for the gossiping women of an Indian village is round the mouth of a well!) 5. That the door of the well is at 9 p.m. to be locked, and the key left at the Medical Officer's bungalow the next morning. The prospect may have one or more stories of steps, immediately below where the watchman stands, a ledge being constructed (see fig 10) on which the bucket shall be prepared for getting their supply of water: this
Arrangement prevents the possibility of any water entering the well, thereby reducing the risk of fouling.

If the well be ‘kucha’, which implies that it will not be locked at night, it will be necessary to appoint 2 chalkidas who for a set number of hours alternately watch the well day and night. (Chalkidas are plentiful, and as the wage is only 5 shilling per month per man, there is no excuse for not employing them). Though the well be ‘kucha’, it always continue for some arrangement round its mouth against surface pollution.

So that definitely off hand the number of wells required for a given camp would be absurd, for many factors have to be considered before an opinion can be given. Amongst these may be enumerated 1. The season of the year. 2. The depth of the subsoil water. 3. Nature of the soil. 4. The probable population. 5. The number of tanks in the vicinity. 6. The proximity of rivers. 7. Elevation
Generally speaking all Railway construction work in India begins in October, for at this time not only is the weather becoming cool but more important still the "rains" (with their concomitant flooding of the country) are just over, it will not recur for 9 months. From October onwards March the ground water is usually within striking distance, so one may as a preliminary measure in a very short time sink 2 or more wells for the people to go on with — and this enables one to proceed more leisurely in regard to site for better types of well calculation on the lasting power of the number of wells which will in view of the probable population expected be eventually required.

As to the power of a well — by this, I mean its capability of supplying water through — to the end of the hot weather — much information may at times be obtained from Europeans who have been
a survey work in that particular district at a previous date, or from villagers. I found that the well,
will fail — say in May or June — other arrangements will then have to be made.
Some of our camps — 4 miles from my head quarters — at an elevation of 1200 feet
the water in the well was said never to
fail (it this was confirmed) so a small
artificial lake was constructed in the
course of a small river, and satisfied
all wants till the break of the monsoon.

The lake, it might be thought, would be
an ideal place for the breeding of mos-
quitoes; but, it was not — the place was
too exposed & windy.

As regards the distribution of wells there
is one important fact to be borne in
mind, that is, to have the wells or wells
— compatible with safety — as near the men
as possible; if not, they will, from their
inherent indifference & laziness, go to the
nearest collection of water — irrespective
of its condition — for their supply.

One is aware of the conditions to be followed
in selecting sites for wells that these
not be to any further extent touched upon
of one be doubtful regarding the circle
of influence, the doubt should stimulate
one to extra care.

The wells being in working order extra
precautions may from time to time be taken
of chemicals used for purification
I have always been satisfied with
the Permanganate of Potash: of this,
I threw in as necessity arose, about
3 ounces per well — owing to the con-
stant presence of frogs in all wells
thanks, too much permanganate must
not be thrown in at one time, otherwise
the frogs are killed, more, in a short
line been floating on the surface.
The chemical was always thrown in
between 9 to 10 p.m. & Early next mor-
ning examined; if any fungus con-
tinued this was expelled by the addition
of a little lime. If the air coloration
caused by the permanganate be
not removed the cozy at once in-
cludes the water has been poisoned
it may not be that particular well again for days or weeks! Once in six months, each well should be dredged, or they may safely be left in the hands of the Engineering Department.

Tanks.

Of these there are thousands, scattered throughout India, some very old, others recent (famine relief works) - wherever one goes one usually comes on a tank, or an Eupura fortuch. The native loves a tank, inasmuch as it has associations, & attraction for him which nothing can break. For he was not in his earlier days played for hours round one, drank of it, fished in it, & fouled it in every conceivable way? The guarding of a tank then is essential, for do what one will the native is intent on going to it.

Well, to begin with, all tanks should be fenced in & have their banks raised, & that surface of the bank looking towards the well should be made as steep as possible so that in the darkness
at least the barrel will be a price to

go down it. To defer the use of the

tank for so long as possible, or al-

together it is always sound practice
to make a well by its side to build

its up, provided it be (vide fig. 10) as

already described, or put a man in

charge. If the tank be water-tight

or almost so - whether artificial or a

result of natural agencies - it be-

comes a simple matter (it is cheap)
to siphon off the water from the

tank into the well (see figs. 9 & 10):

the Engineering Department can always

supply metal piping of some kind,

to as long as this is water-tight it will

do. To prevent interference with the

piping it should be covered over.

I have heard or read of wells being
driven by the side of tanks, or the

water from the well or tank being lifted

by means of a pump to a covered

metal tank on pillars, or the tank

supplied with a discharging pipe of a

tub, would do, but for simplicity and
cheaper is not to be compared with the syphon method just described.

Before leaving the question of water, I may here remark that I have always been in the habit of allowing the European "Dobees" or washermen, a well to themselves for the cleansing of the 'Sabirs' clothes. Two men always suffice to do all the "washing" & the arrangement I made for them are well shown in figures 11 & 12. What I have termed a "water chute" (built into the ground with brick & cement) runs from the well into a small reservoir tank in which the men stand (surrounded at any point between their ankles, knees in water) to beat the clothes on the "beating stone" in front of them. The clothes of European & Indian, only are allowed to be washed at the "Dobee's Ghat." The men are "private" & are not allowed to take in washing from any herent, he be rich or poor. The ironing & starching are done in a special room.
provided for the purpose.

Disposal of Excreta (Cootie).

It sometimes happens that no sooner has the site of a camp been chosen than an influx of "labours" takes place — it then becomes necessary to improve temporary arrangements to minimize fouling of the site and its surroundings. And as a preliminary measure and before the erection of the permanent latrines, to be described in course, trenches may here or there be dug. The length of these varies — 20 feet is a common length — width 2-3 feet & depth 3 feet. The men "squats" across this facing the length of the trench. The Earth thrown up in preparation is seldom sufficient to act as a screen all round. So other means for privacy have to be adopted, or this may readily be done by means of bamboo, grass or leaves. The trench should be divided off into partition, & in each partition...
there should be a plentiful supply of earth, disinfecting powder (usually Chloride of lime). To expect every heli to cover up his Excreta would be expecting too much, as a scavenger is told off to do this, or with orders that disinfecting powder is occasionally to be sprinkled on the deposits. When the trench is nearly full i.e. a foot from the surface, a good thick layer of powder is laid on, the trench filled in with earth and abandoned. While these trenches are in use, one is given over for the erection of permanent latrines, of the type always preferred by me, was a modified Borking (see figs 13 & 14). These were of corrugated tin, arrived in pieces, and were easily put together. The number of partitions—according to requirements—varied. Each had a raised seat, and under the seat was a pipe, which when partially full was extracted through a door at the back or lower part of each partition. Each latrine
with partitions from 6 to 12 - was placed on a solid brick or masonry platform by each of which was always to be found a vessel or barrel of disinfecting powder, a large quantity of water, and a covered receptacle for the contents of the pails. As mentioned before the native squats on the seat with the result that some of his urine is shot forward: to meet this objection I always arrange that the platform be built with an inclination towards its drain at the back (figs 13 + 14). The drain may if conditions permit be led away into jungle, or other uncared ground or be made to discharge into a slop-bowl, the contents of which are transferred into the large receptacle. It is never advisable in view of the present or probable population of the place engaged or to be engaged on the works to form a rigid estimate of the number of latrines required; since the number of helives using them will vary
very much in different places. The number using them or other conveniences will vary according to 1. The part of India they have been imported from 2. Their habits of all methods, European 3. Sex 4. Castle. 5. Their previous railway work amount of European supervision. The same applies to the provision of sanitary cars to sanitary staff. Rather I would say, proceed cautiously, appoint staff, order latrines, etc. as necessary demands. Those who refuse to use latrines have no alternative but to go into the surrounding country; provided they be made to go outside a certain area marked off by flag posts, I see no great objection to the system. There is almost invariably an enormous track of country near, so that precludes the collection of any large amount of excreta in a small and limited area so offensiveness is produced. If, as sometimes happens the camp is situated in an area tur-
rounded on all sides by dense and
dangerous jungle (see fig. 3) the system
of flags referred to above does not
answer to write, for, as there is never
much clear ground beyond the camp
the flags have to be nearer habitation
than one wishes. There is never any
trouble during the day, for all will
go into the jungle, but it's quite a
different matter after sunset when
the dangers of entering the forest
are more real than imaginary.

It might be argued that even in
the absence of jungle, the people
would once it became dark not
go beyond the flags—but here, in
the absence of danger, there was
no excuse, if at any time I
noticed that the people had been
committing a nuisance within the
area I insisted on my Sanitary
Inspectors doing a round after su-
day, & reporting all offenders—
even then unable to go into the jungle


in the evening the Officemen, excepted
is never very great, for the majority
believe themselves once more only
in the morning — those doing so a 2nd
time usually while it is still light,
or they go into a latrine. Many natives
have told me that they always use
the latrine in the evening or at night,
since they had no desire to foul
their own huts; so to speak, within
the flags, i.e., certainly had no
desire to go into the jungle!
A very favourite place for a cooly
to go to is a brick-kiln. Here he
usually finds ample room between
the stacks of bricks, so is protected
from the wind; in this case, it is
usually the brick-contractor's choice,
who are at fault, or if the nuisance
persists I hold the contractor responsible
for any further trouble, or put my men
on to clear up to debits with him with the
cost.
And how to revert to the sanitation
of a large river bed — a subject of
left abruptly on page 31.

Downstream 400 yards away from the fringe of workers a series of flags were laid out, inside which no

pavement of any description was

allowed — immediately beyond these

a number of 6-partitioned huts

were distributed here and

there. The sand underlying the

future site of a latrine was pri-

marily well rammed down, and

next, a platform of brick, or rubble and

cement, 18" high, of larger dimension

than the latrine, was erected. On

each platform, outside of which the

latrine stood a receptacle with

handles — of about 8-galons capacity,

of a saucer-shaped vessel containing

disinfecting powder held in position

by a depression in the platform.

Immediately below the platform stood

an enormous earthenware vessel filled

with water, covered in a held station

by a bed prepared for it in the sand.

Abortion waters of urine were let into
A small drain let into the platform, discharged into a "jumlah" immediately below it. The contents of the pails of "jumlahs" were periodically emptied into the "receptacle" which when nearly full had its lid tightly adjusted, carried away to be emptied into a larger receptacle on shore, which in its turn was dealt with by a sanitary cart. As it was impossible to get carts into the rains, each receptacle was slung on a bamboo pole and carried away by 2 men. With the object of having the rain work done efficiently I engaged "sweepers" who did no other work whatever. With a little personal supervision I found the System worked satisfactorily. At the onset of the South-West monsoon each latrine was dismantled if necessity arose. If rain made or shore during the "rain" all bridge work is suspended.

Sanitary carts.

Of these there are many varieties. Others: done or
simple, other compound—whenever the arrangement I have not yet seen—
even in the largest stations of India—

a "cart" perfect in every detail.

In construction works the roads are

not so one meets with in a well laid

out station, or defined district, where

the District Engineer has little else to
do than attend to their condition; they

are instead usually laid out in a

hurry & are improved with the result

that in a few months they become

"rutty" or in the rainy season almost

unpassable. Under these conditions

the lighter the cart the better, nothing

answers better than one made almost

entirely of bamboo. These carts are

light & strong & will stand any amount

of knocking about, & these are few

places they can't go. They can often

be hired from the brick or timber con-

tractors, or if not can easily be

made up in the carpenter's section

of the local work shops. When ordering

to measure the platform of the cart
was made oblong 5'1/2 feet long and 4 feet broad. To prevent some of the contents of the receptacles - when splashing occurred - passing between the layers of bamboo constituting the platform & sides of the car & to or to the road, I always arranged for the provision of a light tin box (without the lid) which fitted the interior of the car accurately. The side of the box which allowed of the admission of the receptacles worked on a hinge & could be raised or lowered as will. The box was held in position by two rope passing through the tin & lining the any convenient rib of bamboo.

As each car came round it deposited a clean receptacle for each fouled one removed, so when it had its full complement returned to the trenching ground it handled over the consignment to the men on the spot, who after emptying the receptacles, into the trench, washed
them, just in some Mr. Poggs's jarder [lime-carbolic], just on the lid and
left them till next morning when they
were picked up by the cart-men.
Each cart was drawn by 2 bullocks.
Although it would have been pre-
ferrable for all concerned to have
had all the carting done late in
the evening, yet I found the un-
practicable. Since 1. The supervision
of the cart-men at that time could
not be satisfactorily attended to.
2. The men hurried over their work
because it was late. 3. Did the
work carelessly, blaming the darkness
—a very common excuse was that
the oil in their lanterns had given
out, so in consequence could not
see what they were doing.
One may be given the services of an Eastern
Sanitary inspector, whose chief business
is to attend daily to the installation of
receptacles, to visit the trenching ground
so that the drains round all quarters
are regularly flushed. It water-carries
is specially engaged to attend to all water supplies, fortent, and trenching ground.

It may arise that the country is so undulating, or "nulla-field" (i.e. mullaho-
portions of ground scoured out by heavy rain) - or they was the case in the
the camp shown in figure 3 - that the employment of carts is impossible.
Then, if I know of no alternative method - the receptacles must be
be carried by hand to such place
selected as a trenching ground,
or remote jungle, or the men are
pitched out certain paths along which
they must travel.

Trenching ground.

If possible

A piece of ground of about 4 acres in
extent, 1 or 2 mile away from
railway limits, should be looked
or land may still be subsequently
described (vide fig 2) - fitted
with the ground is suitable, or will away
from any supply of water, it will not
in its relation to the land prove offensive
tive to any community, orders are
given for the formation of trenches, and
there are dug a few at a time (especially
in the rainy season) according to requirements.
The trenches are dug in parallel rows
with an interval of 2 feet between
each row. The measurements I give
are 6' long, 3' deep, & 3' wide. As
toon as the entire length of the trench
is filled to within a foot of the surface
the whole is covered in with earth, a
continuous hill a grave-like appearance
is produced. Barrels of disinfectant
powder are always to be seen on the
ground. During the rains each
trench as it is dug is protected by
a sheet of corrugated tin.

Baggers.

If by chance there be a
bazaar near, the necessity of a railway
bazaar does not arise. But it may be
said that to attract railway employees

to a bazaar under control, would surely be better than allowing them to go to one uncontrolled, or perhaps the centre of an epidemic disease. True, but no power on Earth will ever in the presence of a railway bazaar prevent them going from one to the other. The absence of a railway bazaar is an advantage, than otherwise, much as 1. There are fewer people to make arrangements for. 2. There is no attraction for villagers to bazaars, so in consequence the lesser likelihood of the outbreak of disease.

If a bazaar be a necessity (vide p93) the one great essential in its construction is allowance for the free permeation of air everywhere. Tales of Indian bazaars - with their narrow streets, high houses, overcrowding, unmanageable insanitary conditions, want of light, air and space are familiar with. To counteract these then, in the planning of a railway bazaar, one has every opportunity.

Once a week there is always a big market day, when in addition to the permanent
Residents of the bazaar arrangement have to be made for the sitting and standing accommodation of scores or hundreds, who swarm in from the surrounding country—some to buy, others to sell. And with this object in view the bazaar is best built in 14 rows enclosing a square (vide fig. 3): this square confines the people to the bazaar and prevents them roaming here or there outside it. To allow of the free ventilation of this square, it itself should be totally uncovered. The houses should at their highest point be never more than 12 feet high, and in the rows bounding the square there should be interruptions to allow of a free draught. The houses, built provide a front room used as a shop or a back one corresponding to a private bed sitting room; to the back of this again is a fenced in courtyard, a mere excuse for one or nothing more. The shops or rooms made either of burnt brick, or mud or wattle with a thatched roof are let out to vendors, who under sanction may make
any additions or improvements they desire, often they generally do. A "head man of the bazaar" corresponds to a police-man at home—strong and reliable—is appointed to supervise the bazaar generally: he hears all complaints, makes notes of any insanitary condition or sickness in any house, and reports daily to the Medical Officer. For the prevention of losing or committing of nuisance at night another policeman—or more—is always on duty.

People coming in to "bazaar day" often bring their merchandise or food-stuffs on pack animals. Arrangements for the temporary segregation of these is delicious: a cattle pen may be erected, or better still a series of tethering-posts—away from a well or river—erected. The "deposits" left by these animals are carried away either by the people to whom the animals belong, or by the residents in the bazaar—kept they seldom are, for cattle dung is held in high esteem by all, who after drying it in cakes use it as fuel. On the departure of the
Animals disinfectant powder is purposely laid on round the lettering posts.

In regard to the water supply of a bazaar the well or wells should be conveniently near, never in the bazaar, and the same precaution enumerates in speaking of wells generally taken.

In figure 3 the ground inclines from the bazaar to the river, was a consequence the 2 wells were sunk at a higher level than the bazaar itself.

I have not yet touched on the subject of refuse pits: there are simply large pits dug in the ground—usually circular of diameter 6-10 feet & 4 feet deep. Into them is thrown—by the house holders themselves—ashes, vegetable parings, fruit skins, broken bottles, & such like.

Segregation camps.  

In construction the only 3 diseases which cause the Medical Officer much anxiety are (1) Plague, Cholera, & small-pox. And to avert a panic amongst the labour the
must as regards segregation, other means proceed with the utmost tact of discretion—otherwise, the loss to the Railway Company or contractors may be from depression of the same labour enormous!

Plague.

It is, now common knowledge that the Government of India after adopting every conceivable plan for the arrest of propagation of plague, met with so little sympathy from the people—in fact, usually strong opposition—that they gave up the matter as hopeless, and came to the conclusion that it would be wise to give up all interference, and let the people educate themselves—so, at present stand, very little compulsory action can be taken on the outbreak of the disease. However, with a little tact, a good deal to which the native has no objection, can be done.

1. The position of the segregation huts. These should never be too far away; otherwise they will remain unoccupied!
Once when an "open line" plague broke out in a bazaar close to railway ground I was ordered to seek huts at a safe distance for the railway native employees, the majority of whom lived quite near the bazaar in question. I erected thirty a mile away. What was the result? Not one of them was occupied although every persuasion was used. Persuasion failing the man jumped to the conclusion that conclusion would next be tried, with the result that within 4 days every hut was burnt to the ground! I then had built 10 more in a field not more than 50 yards away from the infected area: there were occupied at once or others had to be built. Many others in India have had the same experience. As it is well recognised that the pre-determining factors in plague are overcrowding, insufficient ventilation, rats and flies, I am of opinion that the distance of the segregation huts from the infected area is of little consequence.
provided the preceding factors are remedied — Plague — due to the importation of infected blankets from the Bosphorus — broke out in the bazaar depicted in figure 3 — in the row immediately in front of where the dormitory huts are shown. It's sufficient to accommodate, without overcrowding, the whole of that row were put up 10 yards away it in the shops in the row closed for 3 weeks. The people willingly went into their temporary shelters, taking with them the little allowance — knowing that no one would buy from them for a considerable time to come — they did not look upon my action of closing their shops as compulsory — Not a man, woman or child left the place, what may have involved the whole bazaar and others outside, died or after 6 cases. Thirty miles away 60 deaths a day were being recorded! To allow of a free play of air round & through the huts there were made of grass & grass only.
Under the promise that all things destroyed or burned would be paid for no difficulty was experienced in destroying everything suspicion. The inspected ships & boats were morning & evening thoroughly sprayed with a strong aceticulated corrosive sublimate solution (1:1000) & the drain, covered with a strong solution of phenyl. Any rats caught (scores of cheap wooden traps were laid throughout the bazaar) were at once drowned in their traps in the same solution & their bodies, thrown into a lime-kiln furnace. There seems to be little doubt now that rat fleas play an active part in the dissemination of plague & it is known that on the death of their host they immediately leave it, & in their transmigrations often bite & infect man.

Rats are caught & killed by the hundred throughout India, & their bodies thrown anywhere. Therein from what I have already said regarding
the fleas) lie, the danger, I am inclined to think, from the remarkable instance of a large native railway coal colony in Lower Bengal which, though surrounded on all sides by plague infected villages, escaped entirely; these the system consisted in the immediate immersion of the rat in its coach (i.e. which still alive) in the corrosive sublimate solution and subsequent disposal in a furnace—burning of the bodies was carried out in case any of the fleas escaped destruction in the chemical solution.

Having burned the people into their huts or burnt or chemically treated their things more than extra care required to be paid to sanitation viz clearance of all rubbish heaps, attention to latrine, drains and destruction of all discharge, fomites, etc. As the disease may be communicated through the medium of the fomites, urine, etc., special attention was paid to the disposal of these infected
were supplied with earthenware vessels, to receptacle into, or with bed-pans of the same material for their urine or feces - after use each was sprinkled with Carbolic acid solution (1-20) or undiluted Phenyle, or deeply buried at a distance, or if opportunity offered - vessel itself thrown into a brick-kiln furnace.

Before the Multanwal disaster in the Punjab from diphtheria following inoculation with staff-kine serum - one seldom had any difficulty in inoculating hundreds of all classes employed on the works - but after the disaster all attempts were futile.

The manner of disposal of these dead from plague will depend on whether the victim was a Hindu or Mohammedan: if the former the body is burnt if the latter buried in a deep grave carefully covered with Chloride of lime (large quantities of which can always be had on construction works).
Cholera.

Here so in plague the sepa-

gation but to are built contiguously near
the centre of the outbreak - the patient
will those who have been in contact
with him are isolated, a particular
attention paid to the destruction or dis-
fection of fomites - it is usually a
simple matter to save the cause of the
outbreak, in my experience it has
never been a well, but usually some
foul collection of water lying in a
barrow-pit, or remaining somewhere
after the subsidence of heavy rain
or it may be a slowly running water, the
by-wash or edge of a stream.
Cases of cholera occurring in the
bazaars or costly houses, were isolated
with those in attendance on them, &
no one else was interfered with
This I know is against all doctrines
of management of infection, believe
but as the one great thing where many
natives are collected together - the avoid-
ance of panic it is in my opinion
The only course open... of an anxiety be thrown by the medical man, and drastic measures adopted such as
one reads of in text-books. Every man, woman, & child will leave the work,
not return for weeks or months. This means heavy loss to the con-
trac'tor, while more important retards all work for a very considerable
time. My advice then is keep the
men together as long as possible
for once they go they will spread
the news that the place they have
come from is Choleraic & no return
of labour need be expected for
at least 3 months. It may be
said that with the meagre methods
adopted the disease may become
epidemic - But with due attention to
the water supply, appropriate disposal
of all saline discharges, disinfection
or destruction of fomites, segregation
of those infected & early this
One can understand how in the
large cities of India an epidemic of.
Cholera soon became established, but here—by reason of the borders to be
dealt with, or the work involved—it is
impossible for a mere handful of
Europeans & Sanitary inspectors to
satisfactorily cope with the disease.
On construction works, on the other
hand it is possible—in regard to
the numbers—or there is no excuse for
failure to check the spread of the
Disease.

If the collection of wells, from which the
patients derived their supply be large (e.g.
a borrow-pit) the collection is fenced
off on a day or night guard and over it;

If it be small (pools remaining after
the rainy season) undiluted sewage is mixed
with the water, which is then ladled out
and depression which held the water
filled in with earth. Those infected
could not, or the convalescent were not
allowed to go to get their own water.

An earth-mound raised with a covering
clad outside the bank of this was filled
2 or 3 times a day through bamboo piping
(from 20-30 feet long) on supports. The attendants lived in separate huts, and had separate vessels for their drinking water, in addition to water especially reserved for the ablation of hands and feet after attendance on the patient. All vomiting, waters and discharges were collected in quarrels (open earthenware vessels costing a fasting each) — one cannot have too many of these distributed through the infected huts — thoroughly mixed with strong carbolic water or jumble or deeply burned or burned. During an outbreak it is always well to go round the shops and condemn all unripe or overripe fruits, mouldy rice, or in fact anything which strikes one as a danger to the community — its favourite meal for a coolly when hard up or saving money is some cheap fruit (ripe or unripe he cares not) followed by clean drink of water! The digestive organs are upset so if cholera be about he falls an easy victim — after the segregation huts have served their purpose they are
burnt, this should be done by myself and not left to a native.

Small-pox.

The Government of India have vaccinators throughout the country. These men at fixed periods go from town to town or village to village vaccinating infants of the unprotected. In addition to the few men there are many, who after qualification make vaccination (or inoculation as they call it) a business. And one can at once decide whether a native has been vaccinated or inoculated: in the former case he usually shows 3 or 4 cicatrices on the upper arm, or in the latter, one large cicatrix on the posterior aspect of the forearm. There is as a rule no difficulty in vaccinating the people, for extraordinary as it may seem, the majority actually believe in its beneficial action, and the 'conscientious objectors' are far and far between. In consequence one seldom sees many cases of variola.
not the number one is led to believe on first going to the country.

one has never met with an epidemic of small-pox in the same sense as cholera or plague. sporadic cases only are met with now again, occurs chiefly in children who through ill health have had their vaccination jil-

pended. One much always be on the look out for such cases on large works. Once occasion when doing a round along the bridge shown in fig. 2 noticed a woman carrying a bundle coming towards me! as she saw me she slipped down a step began to fret. special care was on the covering up of the bundle in question, my suspicions being aroused insisted on her taking off the cloth from wherever she had in her arm. She did so reluctantly, revealing an infant literally covered from head to foot with small-pox pustules! I made inquiries regarding her I learnt that she was not expected on railway ground, but belonged to a village shown on the extreme right.
of Figure 1. She had been given temporary work on the bridge the day before, so she came to work with the intention of leaving the child on the river bed whilst she earned her daily wage! Necessary precautions were taken in regard to the village, so as further cases were at any future time seen on the works. As the disease never causes a panic (unlike cholera or plague) amongst the natives, one may with impunity follow our sanitary measures. Conformable with one, another - These, remembering that the virus can be carried by the air for long distances - consists in legis-

regulation at a far point from the outbreak, or the keeping off of attendants who have already had the disease, or are 'protected.' The patients are put into grass huts, or put on 'cheaps' (cheap rope beds with a wooden framework) covered with a mattress of soft grass, which during the stage of incubation dozing was, with the sheets removed
daily & burned. To construct the offensive odours always to noticeable when small-pox is, & also for the benefit of the patient himself, weak carbolic acidline was daily smeared over the patient's body, & 5% carbolic freely sprinkled everywhere. The patient was not allowed to mix with others until all scabbing following intubation had ceased, & no evidence of crusts remained.

Of other diseases one construction which may fate the medical man tumbe are malaria & dysentery.

Malaria.

Against this any big measures such as the formation of mosquito brigades are, on account of the expense involved, prohibitive. All one can do is to have all unnecessary collections of water removed & in fact anything in which mosquitoes may breed, such as water held in broken bottles, jars &c. These bottles, jars, should be collected & thrown with refuse pits.

All swampy ground, such as shown in fig 3,
Shall be drained or filled in. 

Dozens of packets of quinine (12 grains in each) were made up in the hospital, and all were invited to come for a packet every morning if they desired.

For a European the avoidance of malaria is comparatively simple matter—since at night he invariably sleeps under a mosquito net, or in the evenings sits in a mosquito room, i.e., a room in which a mosquito curtain large enough to hold a chair and small table is placed. The native cannot afford curtains; in consequence he covers up the whole of his body except the head with kitch sleeping.

Dysentery.

This probably is almost always water-borne, and I am inclined to think so from the fact that men for men, I internally got a larger number of cases from my smaller camps, where it was impossible to supervise the water supply as satisfactorily as it was in the larger camps. The disease never produced any
Of all amongst the men, each case was treated on its own merits, due attention being paid to the disinfection & disposal of the discharge. Sanitation was necessary. I zal i per excellence the drug in this disease - I not only use it diluted as a spray for the disinfection of the rooms & furniture, but also gave it per os in doses of 25-30 minims, always with the best results.

Rail-head disinfection.

By rail-head I mean the point to which the rails have for the time being reached - the 1st day it may be 1/2 mile away from the base of operations, the 2nd day a mile & so on. While this process of laying the rails & progressing one is always anxious in regard to the health of the 'gangs' employee - gangs ranging from 200-500 men. The whole problem how to solve itself into that of a small army on the march, & necessary precautions -
Always a most difficult matter here to be taken. Changing country with its varying supplies of water, or with its villages, good, bad, or indifferent as passed through every day, so it is essential that one's energies must be directed.

On either side of the line—for the nearer part of its extent—are "bore-pits" (pits left after the excavation of earth for the railway embankment), in these water is usually to be found—water which one may even without a cursory examination forthwith condemn. To these pits then, because of their proximity, all the men will go for their drinking supplies. To discourage this practice then, the only thing to be done is to arrange for a good & plentiful supply of potable water & put it under their very noses. This is easily done. "Tank tenders", filled at the base from a reliable source are twice daily taken out by the engine to rail-head: the water
is tippet off from these tenders, & put into buckets, which are placed out on the line in 2 rows, one for Hindus, the other for Mohammedans. The men were usually housed in 'shanka' tents. To prevent fouling of the ground near the line, the 'flag system' was invariably in vogue.

In conclusion I may state that of my 12 years experience on Indian railways, 9 were spent on lines under construction.

The sketches submitted with the thesis were kindly done for me by Mr. C. E. L. Atkinson, Architect, Bradford, entirely under my guidance & suggestions. Mr. Atkinson has never been abroad.

M'B.