

Revenue (1897) Department.

PRESS SERIES.

G.O., No. 540

Dated 7th July 1897.

[Despatch Abstract.]

Dr. King's Memoranda on Conservancy, an
Water-supply on Famine-relief Works
and Cholera Preventive Measures.

Forwarding, with remarks, to the
Famine Commissioner—

BACK PAPERS.

GOV.	No.	Department	Date	GOV.	No.	Department	Date

FURTHER PAPERS.

GOV.	No.	Department	Date	GOV.	No.	Department	Date

Revenue (1897) Department.

The Hon: Mr. Collector CURRENT No. 5366
The Hon: Mr. Henry Pollock Esq.
to the Governor



From

The Sanitary Commission
for Madras

No. 1309

3-Orders

The memorandum may be
approved generally. It is
doubtful, however, whether
~~the cost of the apparatus~~
the costly apparatus recom-
mended at ^{of 1st} 4-7 ^{being} should
be purchased ^{same} in very
such ^{other} circumstances;
regarding the ^{other} instructions
given will prove ^{benefit} - the
ficial. It is presumed ^{that} the
collectors may be ^{informed} of the
to sanction the ^{sanitary} relief works and preventive
the conservancy staff ^{measures} during Cholera.

Dated 28th June 1897

Received 29.6.97.

Registered 30.6.97

Enclosures Three.

Spare copies

SUBJECT

Forwards for information of
the Government copies of Corres-
pondence and two memoranda
on the subjects of water supply
and conservancy on ^{Fluorine}
the ^{sanitary} relief works and preventive
measures during Cholera.

The is much that is of

12-7-97 two papers submitted herewith

27/97

BACK PAPERS.

E.g. his instructions as to latrine accommodation on works which are thoroughly practical but his instructions for the protection of water supply and for the treatment of cholera on works are too expensive and elaborate. He doubts with mounted Sanitary Inspectors ^{highly} to mounted ^{highly} whether this work will be done better than it is now but but better having regard to the enormous increased cost. All he says on the origin of cholera and on the methods of propagation is too doubtful correct but if the energies of the local authorities be directed to enforcing a change of water supply known not to be infected and the disposal & destruction of the faecal matter much better success will be obtained. I know by experience that natives will fall in with measures for the above purposes but will resist and multiply more elaborate efforts.

G.O.	No.	Department.	Date.

FURTHER PAPERS-

G.O.	No.	Department.	Date.

Doctor King has already sent these. Enclosed are also to Collector.

They had now be sent to the Famine Commissioner for report, with the intimation that the sanitary officials absolutely needed may be authorized in anticipation of sanction, & with observations to the effect of those recorded by the Sec.

2/7/97.

Sept. 10.

15/7/97.

11/7/97.

28 3/7/97

20/7/97

A.S.H.

5-7-97

301

CONSERVANCY AND WATER-SUPPLY ON FAMINE RELIEF WORKS, WITH REFERENCE TO THE APPROACH OF CHOLERA.

Conservancy.

It is now held that cholera is conveyed by a specific microbe propagated in the intestinal tract of persons suffering from the disease, and that hence the vomit and excreta contain the causative agent. Whilst this broad fact is now universally recognized, it is often not understood that persons passing to all appearance healthy excreta may be the medium of spread, in that the cholera microbe may be present without necessarily causing profound disturbance of the system. Indeed, in certain individuals, instead of the presence of the microbe being followed by the typical profuse diarrhoea and exhaustion, the symptoms may be of a trivial nature, and the affected person may continue his ordinary occupation. Again, convalescents from the disease may continue to pass cholera microbes with their stools up to 10 days after the acute attack. These facts taken together point to the importance of limiting, as far as feasible, the careless disposal of excreta, whether they be derived from a person to all appearance in health or actually suffering from typical cholera. In short, as a first step towards prevention of cholera, it is requisite that arrangements be made for the correct conservancy of night-soil on famine works and in the neighbouring villages.

2. It is a common opinion that the taking of any trouble in the matter of conservancy on works situated, say, on a trunk road and out-of-sight villages is an unnecessary refinement. The fact that the 'open fields' are resorted to, and that the sun is ever ready to effect desiccation and disinfection is regarded as an all-sufficient reply to such a suggestion. But a very little reflection and a very little observation of what occurs on ordinary famine works, should convince most that leaving this important matter solely to the kindly intervention of the sun is injudicious. Although habits doubtless differ in different localities, it may be looked upon as a very frequent custom for famine workers to arrange that morning easement shall occur after arrival at the work or in its vicinity, whilst waiting for roll-call. This implies that any stagnant pool of water in the neighbourhood of the work becomes the place for ablution after defaecation, for the washing of the mouth, and the cleaning of eating and drinking vessels. There is hence room for extensive contamination of pools of water by the cholera microbe, and its conveyance to man direct in the process of teeth-washing or, indirectly, by adhering to vessels used for cold food or water, or, again, on the occurrence of rainfall, by faecal matter being washed bodily into water sources.

3. On the above grounds, it would be advisable that no gang should be without a recognized place for defaecation, provided with water for ablution, and that means should be employed to ensure that such sites be uniformly used. It is not asserted that this arrangement could be accomplished without difficulties being encountered; still they are not insuperable and, in consideration of every gang having a special organization for its correct working, it ought to be possible by exercising a certain amount of supervision to surmount any obstacle there may exist.

4. The want of toties is a matter that must be allowed for, as it certainly would be impossible, in most places, to provide one toty per gang; hence, measures that would ensure disposal of faecal matter without handling must be employed. This can be arranged for either by the use of the trench system or the Jewish conservancy system. With the former method, all officers are familiar; but, as a result of adopting principles now found to be erroneous, the tendency is to make trenches of absurd depths and breadths. Thus, a very common size for a trench is 3 feet wide and 3 feet deep. Yet such trenches can only be employed by persons squatting at the edge, and it has time after time occurred that the earth has given way, or the persons have overbalanced themselves with very dire consequences. But safety and convenience are not the only reasons why these huge

excavations should be abandoned; it has been found of recent years that nitrification proceeds actively only within the first 18 inches of soil and that, indeed, the most active change occurs within the first 6 inches from the surface. Consequently, it is well, where final burial of the faecal matter is contemplated, to use at no time a depth exceeding 18 inches and, preferably, not to go deeper than 1 foot. As regards breadth, trenches should not be broader than 9 inches, this being the usual span from heel to heel of a native squatting. With this limited breadth, instead of the person using the trench sitting at the side, the position assumed should be that of *squatting direct across* the shallow trench; the result is that both faeces and urine are received into the trench and consequently the surroundings are kept dry, whereas in the case of the old form the approach or pathway became unusable on account of soakage from urine and washings for ablution. Diagram A shows a trench latrine formed on this system. It will be noticed that the space afforded within the latrine is extremely narrow, the object being to ensure that it shall be comfortable to squat in no other place than that appointed for the purpose.

5. The use of trenches should get rid of the objection on the part of low caste men who are not professional toties undertaking superintendence. All that is required is that after defaecation the person concerned, or at least the attendant, should cover the mass with dry earth derived from the excavation. As soon as the trenches are filled, the bamboo tatty sides can be shifted to another position.

6. Where toties are obtainable, the trouble of constantly shifting the tatties may be got over by using the form shown in diagram B. Here a small filter is arranged for disposal of urine and washings, whilst the trench may be made to serve a considerable period by causing it to be partially filled with dry earth daily, which should be removed from time to time as defiled. In both forms of latrine, it is essential that faecal matter deposited be instantly covered with dry earth, so that it should be neither offensive to sight nor smell. Unless this is seen to carefully, no form of latrine will be willingly resorted to by natives.

7. In the opinion of the undersigned, however, the method that is easiest to work and is received with the least opposition by natives is that referred to above as the Jewish conservancy system. This is conducted as follows (diagram C):—A place is marked off in a field conveniently close to the works—say, not exceeding 100 yards distance—by means of four flags. Within the square space so selected are made pits at distances of 3 feet from each other. These pits measure 6 inches in diameter and 8 inches deep. On one side of each pit is placed the earth excavated from it, and a piece of split bamboo 2 feet or so high having a small coloured rag at the end is fixed at the same side as the piled earth. On the side nearest the work is placed so as to preserve the sitters from observation a movable screen, that may be made of branches of jungle tree branches intertwined with any foliage that will secure protection from sight. On the site, it is necessary to retain a man on duty throughout working hours. Persons on arrival will be permitted to select any hole they may choose—an arrangement which gives all the privacy an ordinary native requires. The man on duty sees that defaecation occurs in the holes *only*. *The moment a person retires,** it is the attendant's business to proceed to the hole used, and remove the split bamboo—showing that the hole is not to be again used—and with a movement of his foot to throw the earth piled as stated above into the pit. If the attendant be too 'nice' to do this himself, there is no reason why, without much pressure, he should not be able to convince the famine worker who has used a pit that it is his duty to move the earth with his foot and thus cover the excreta. This system is absolutely odourless and when properly worked a spot, when it is in progress, can be visited at any time without either eye or nose having cause for offence. To make these holes of an uniform size and depth requires, however, the consumption of much time, and is not often satisfactorily accomplished, as ideas of size differ enormously in individuals of the cooly class, hence, I have asked Messrs. Sultan & Co., Royapettah, Madras, to make for sale special spades for the purpose. These by two movements rapidly make the pits of the exact size demanded.

* The tendency in working this system is for the attendant to allow several holes to remain open, so as to make a one job of the whole and thus prevent the trouble of many journeys. If this be permitted, the advantage of quick deodorization and concealment from sight is frustrated, and the arrangement must prove a failure. Strict discipline on this point must, therefore, be maintained.

8. As regards ablution water (which is, of course, requisite whatever form of latrine be employed), unless the expense of providing at latrines small iron tanks, such as kerosine drums of Best & Co., Madras, with taps attached, be undergone, it is sanitarily advisable that, when on the work water of a quality fit to drink is available in sufficient quantity, ordinary demands for ablution after defaecation should also be satisfied from the same source. In this case, no water should be placed at the latrine; the famine worker should be expected to bring it with him in his lotah from the works where, as afterwards shown, its method of distribution should be such as to protect it from contamination.

9. The above remarks presume an attempt at rigid economy, by the employment of famine workers of low caste as latrine attendants who have been given the assurance that they will not be required to handle the excreta; such a system would be applicable to small works. But where a large number of gangs are assembled, it ought not to be a difficult matter to arrange for the employment of the following conservancy staff with orders to perambulate from gang to gang for the accomplishment of their work. It would probably rarely be possible to get the number of toties that would suffice for this standard, but, as far as possible, undersigned would advise its employment:—

For two sub-maistry charges, i.e., 800 famine workers	... 1 male and 1 female toty.
For one head-maistry's charge, i.e., 1,600 famine workers	... 1 male sweeper and 1 sanitary peon.

10. In regard to the duty expected of the sweeper, it would, of course, not be required of him that he should sweep roads in the vicinity of works. He would find sufficient and useful occupation by destroying by fire accumulations of destructible matter brought thither by famine workers—more especially of rags. These should be carefully gathered at convenient spots and burnt.

11. The duty of the peon would be to see as to general cleanliness of the works and their vicinity, see the latrines are correctly prepared and worked, regulate the work of toties and sweepers, see that rules as to protection of water are correctly observed, report all cases of illness from any cause and suspicious cases of diarrhoea. An intelligent man on good pay would be required for the work.

12. Where a medical subordinate is attached to the work, it is advisable that this conservancy staff be placed under his orders; where not, the staff should be under the revenue official responsible for the work.

13. On appearance of cholera in villages supplying workers, Certificated Sanitary Inspectors should be appointed for sanitary supervision of the work and of villages within a radius of 5 miles, in addition to any medical subordinate detailed for the treatment of patients (*Vide Memorandum "Cholera Preventive Measures on famine relief works"*).

Protection of Water-supplies.

14. Whatever be the source of supply, the end aimed at is the prevention of entrance into water of the cholera microbe, as it can, not only exist several days in this, but increase enormously.

15. The cholera microbe being very readily killed by desiccation, cholera-infected matter in the condition of dust is not likely to be causative of harm; nevertheless, experiment has shown that particles of infective matter can be borne by dust should the whole not have been fully deprived of moisture. Flies that have been in contact with choleraic matter undoubtedly can convey cholera germs to water and food. Birds that are unclean feeders may drop infective particles from their claws or from their beaks. The feet and mouths of animals, such as the cow and the dog, may also secure introduction of the cholera germ to water-supplies, and it can be easily understood that the buffaloes of the Ceded Districts would be specially dangerous animals in this respect.

16. But, probably, the most common method of specific contamination is by means of the hands and feet of men, chatties, ropes and rags in the act of drawing water.

17. To secure that water-supply sources shall be so arranged as to prevent contamination by any of the methods enumerated above should, therefore, be diligently attempted on works; for it must be remembered that if but the most minute atom of infective matter gain access, this may contain living microbes that would shortly multiply by lakhs and render the whole bulk of very extensive water-supply sources the medium of cholera spread. In this connexion, it should be borne in mind that the physical condition of the famine-stricken and the nature of their environment are such as to present less chances of resistance to the cholera, or any other pathogenic microbe, than may be expected of a population in a normal state of nutrition and living under ordinary hygienic conditions. Thus, during the great famine of 1877-78 no less than 404,597 souls were reported to have died of cholera, and the bulk of this mortality was certainly on famine works.

Wells.

18. A typically sanitarily safe water may be held to be an under-ground water derived by filtration through a clean soil at such a distance from habitations as to be beyond risk of contamination through the soil or sub-soil. To obtain this water and so deliver it that it shall be as free of contamination as when it has reached its supporting impervious stratum after filtering through the pervious earth—a splendid microbe obstructionist—is, therefore, an object well worth attempting. Bored wells being financially out of the question in this instance, this aim can best be secured by the use of Norton's tube wells (otherwise known as Abyssinian wells) which are iron tubes varying in diameter from one to four inches. They are made in lengths which can be screwed together; one length is provided with a sharp point, and above this are numerous openings. The object aimed at is the forcing of the iron tubing into pervious soil until the water stratum is reached. To accomplish this, special driving apparatus is used which any overseer would readily understand how to employ. Water having been struck—as can easily be ascertained by using the little plumb supplied with the apparatus—a pump is screwed on the end of the tube protruding from the ground. The water first obtained by pumping is usually muddy, and looks an unsavoury mixture. Hence, it is worth while remembering that the tube being sunk within more or less loose earth it is but reasonable to expect that for a certain time this should be delivered with the water. Continuous pumping and, in bad cases, washing out by means of the "cleaning pipes" with water derived from elsewhere, until the debris cease appearing at the pump should be pursued. The longer such a well is used the better becomes the reservoir, which is formed round the tube point in the earth. When the tube is much choked by sand it may be withdrawn, cleared and then re-inserted through a mass of pebbles previously rammed down the hole made, or dropped through a tube into position so as to surround the perforations. These wells are cheap, their average cost, *Burns & Co., Calcutta*, being as follows:—

	Tube 1½" pump barrel diameter 3"	Tube 2" pump barrel diameter 4"
Tube well 30 feet	Rs. 50	Rs. 100
Extra tube per foot	2	3
Field pump (extra strong) .. .	30	..
Complete set of combined driving and withdrawing apparatus, complete ..	200	250

19. In respect to the "driving apparatus," &c., it must be remembered that one will suffice for the sinking of any number of wells. The yield of Norton's tube wells may be taken as follows:—

Size of tubes in inches.	Gallons per hour.
1½"	150 to 600
2"	300 to 1,200
3"	600 to 2,400
4"	1,200 to 4,400

20. These wells are, therefore, cheap, and thoroughly efficient in that they deliver water direct at the surface in a manner that forbids contamination, especially if leakage along the tube from above downwards be frustrated by a small concrete ring at the surface. Although it is possible to use them under special conditions in impervious strata by using boring, for all practical purposes, the employment of these wells should be confined to pervious strata and to depths not exceeding 50 feet. There are large tracts in the Ceded Districts where these wells would not be of utility, on account of the presence of rocky strata, but, on the other hand, there are also numerous places where the sub-soil water is found within strata easily penetrable by driving. One merit worthy of being held in mind is that they can be shifted from place to place, and this is often of great use in tracts where sweet and brackish water are so often found in close proximity. They are, therefore, useful also in exploring for a suitable quality of water previous to sinking ordinary dug wells. If the water is within 25 feet of the surface, the common suction pump sold with the tube wells suffices to effect lifting; if beyond this, deep well pumps must be employed—when the subsidiary arrangements requisite are not worth the trouble of abiding by this description of well. A further sphere of utility for them would be found in attempting to get water from ordinary dug wells or tanks that have run dry. Provided the bottom of the well or tank be pervious, a Norton's tube can readily be sunk within it, with the result of obtaining water at a depth that may require its being pumped up; or, it may chance that water struck being under pressure it will rise within the limits of the old dug well through the tube, no pump being necessary.

21. *Wells with pumps.*—The next best approach to security is obtainable by the use of ordinary dug wells provided with an impervious lining and backing and covered in so as to prevent either light or dust entering, and furnished with a suction pump at the side—not immediately over it—a condition that is easily attainable by using a bend on the suction pipe if the depth is not over 25 feet (*vide* diagram D). The cost of common suction pumps suitable for this purpose is as follows:—

Revolving top cistern pump (*Burn & Co., Calcutta*).

Diameter of cylinder.	Capacity per stroke.	Price of iron pump.
	GALS.	RS.
2	1½	15
2½	2	17
3	3	21
3½	4	24
4	5	34
4½	6	43

22. A very good modification of this arrangement is obtainable in dealing with an unlined well newly sunk by placing an iron water-pipe, or glazed stoneware or cement pipe with perforations at the end, so as to make a continuous shaft from the bottom to the top of the well. The well space surrounding this shaft should then be filled in with clean metal, gravel, and sand in successive layers from the bottom. Through the shaft left communicating with the water should then be placed the ordinary suction tube of a pump.

23. As regards expenditure for this system it must be remembered that, as in the case of the Norton's tube wells, if it be found in shifting camp that the cost of leaving the apparatus *in situ* cannot be undergone, there is nothing to prevent the pump being moved, and, for the matter of that, if it be thought worth while on account of lining the shaft being formed of pipes, these also could be removed at the cost of a little excavation in loose soil.

24. *Re-modelling old wells.*—The well most commonly found in the Ceded Districts is a huge square structure provided with steps leading down to the water. This description of well is of course absolutely dangerous as to infection by cholera in that the water is exposed to contact with chatties, ropes, hands and feet—very

often of hundreds of persons per day, irrespective of the occasional washing of clothing and of the person for which these wells are also employed. The very least sanitary precaution that should be taken in the case of such wells is to insist upon the abolition of the use of the steps by effectually blocking them up, so as to render approach impossible, and fixing at the surface level some form of pulleys. A guard of a caste that will satisfy all ordinary persons as to caste requirements should be stationed at the well. Where this is feasible he alone should be permitted to draw water with metal buckets provided for the purpose; but when this will not be tolerated, or where the number of persons to be served would render it impossible on account of the labour involved, a waterman per caste, or a suitable number of buckets per caste and ropes—preferably light chains—should be available.

25. Occasionally such wells are so built that it would not be possible to make use of pulleys fixed at the surface at the ground level. In this case, it is often feasible to erect within the well a platform that would at least prevent feet and hands being put into the water, or a platform may be made so as to project slightly over wells. In both instances, these platforms should be made impervious, and with a slope if on the ground surface to a suitable outlet, and, if within the well, to a cistern whence drippings and foul water can be removed by hand or pump. Such platforms may be devised of wooden supports with wooden flooring caulked and tarred, or of bamboo matting supported on sound frames and covered with clay having gravel above it, or corrugated iron may be employed with or without a layer of concrete above it.

26. In dealing, however, with a 'step well' that is likely to be long in use, it is advisable that a modification of the principle mentioned in the close of the last paragraph be adopted: that is, by building a new round well within the old structure, or by placing in it a shaft of iron water pipes, or stoneware sewage pipes, or by even employing the common earthen rings used for pot wells, so that the danger of direct approach by steps can be got rid of by the simple device of contracting the area by filling with clean material. If the depth is such as will permit of the use of a common suction pump, this should be employed.

27. But this method need not solely be followed in re-modelling wells already made; it may be usefully applied in dealing with the huge unlined excavations now frequently found at the sides of roads on which famine works are situated. One excuse for making these excavations after the manner of the country instead of forming small circular wells is that labour is provided for famine workers, but, if this method of filling in with clean material be adopted the labour in making the useless area could still be permitted, whilst the enormous cost necessary to line such wells with masonry—plus steps to make them easy of defilement—would be avoided. As a fact, unless some such mode of contracting the area be followed, the majority of these excavations never will be lined, and consequently will soon be filled in with debris. As an allied subject undersigned would point out that it would be of much advantage, if the object lesson of wells, being made in this manner, could be afforded ryots. The main expense in making wells, which are so much needed in the Ceded Districts, is the great cost of the masonry lining. This, in the method described, is reduced to a minimum. The only contention against this mode can be that in the large wells, the rate of withdrawal by 'môts' can be quick, for the reason that friction to which the water is subjected in passing through the earth pores to fill up the loss of the amount already collected in what is virtually a reservoir, is diminished. But by arranging to have a bottom layer of rubble or boulders, friction is reduced when compared with what it would be were undisturbed strata to be passed through, so that, beyond the effects of displacement on storage, the ryots would be as well off as with the enormous open and expensive wells now employed.

28. *Protection of tanks.*—A very common impression is that where a large mass of water is concerned, it is not necessary to go to the trouble of special means of protection. Yet, the only safe practice to follow as to tanks of the ordinary description found in this Presidency is to regard them solely as sources of water-supply—not as part of the system of distribution. Usually a readily adaptable procedure is to fence the tank, and to sink at the sides one or more wells in the banks

which will be supplied sufficiently by percolation. If the use of pumps is out of the question, these wells may be formed in accordance with the usual mode pursued by natives in sinking pot wells, except that a backing of clay should be used above the lowest water level and an impervious platform of concrete—cement-plastered—or of slabs on concrete with cement pointing may, if the structure is likely to be used for any length of time, be employed with advantage. But at times tanks may be of a character where this mode may not be easy of adoption. In this case, impervious platforms should be erected on the same principle as mentioned in paragraph 25 *supra*, but so arranged as to pass into the water the required distance.

29. Where, in connection with tanks, the washing of clothing is requisite, it should be arranged that the water be withdrawn with all the care insisted upon in the case of drinking water and the cleansing of clothing be proceeded with at a spot distant from the tank.

30. *Wells with beams across.*—It is a common practice for beams to be thrown across wells on which persons stand to draw water. Contamination from drippings from the feet must therefore occur. Beams should be removed in such instances, and ordinary drawing be insisted on.

31. *Lifting to tanks.*—It need hardly be said that both in the case of tanks and wells a far better way than any described above is to lift the water to covered tanks by pumping,* and thence let the water be drawn for distribution by taps; but it is not likely that expenditure by such methods would be tolerated, and the system need therefore not be more than alluded to. Nevertheless, it should be employed wherever financially feasible in preference to all others. The most reasonable field for this mode would be in connection with "poor houses."

32. *Rivers.*—In a famine-stricken district, it is not likely that many instances of flowing water will present themselves for notice; but where this is so, portions should be marked off by flags (and if the stream is small, by wires stretched from bank to bank) for drinking purpose, for bathing, washing, and for cattle, in the order named going with the current, that is, the drinking ghât should be fixed up stream. It must be remembered, in respect to small streams and rivers, that there is no more dangerous time as to conveyance of cholera than with the first freshes after rainfall. Hence it is advisable, if there be reason to know that cholera is in any part above stream not to allow famine workers to use such water. Where compulsion cannot be used, the advice to boil the water should at least be given by tom tom at frequent intervals. Beyond this it would be advisable to sink pot wells or Norton's tube wells on the bank, and require that these be employed, at any rate, so far as distribution on works by public agency, is concerned. Some degree of safety may also be attained by causing the water to undergo rough filtration through gravel; or, still better, if the rate of withdrawal will not render this out of the question by requiring an area that renders the whole proceeding too expensive, sand may be used above the gravel—it being held in mind that both gravel and sand must be obtained from sources free of suspicion of contamination by human beings. This can be effected by making an excavation in the bank, and filling this in after the manner of a filter bed. Within this filter bed could be sunk pot wells in which the water would arrive after filtration, on admission of the river water to the surface of the filter bed. It may happen in making such an effort that sufficient good sub-soil water would be reached to prevent it being necessary to look to the river as a source. In this event, there would be no object in using the sand layer—the sub-soil water would simply percolate through the gravel to the pot wells.

33. Where the sandy bed of a river is dealt with if the native had his own way, he would make a huge excavation—a so-called 'spring' in which he would wash and withdraw his water. Instead of allowing this, numerous pot wells should be sunk in the sandy bed.

* The "Sultan lift" offers a cheap alternative. It can be adapted so as to offer a considerable measure of sanitary safety.

Distribution of Water-supply on Relief Works.

34. It should be arranged that the supply for drinking purposes be ample.

35. It is advisable, with reference to paragraph 8, to prevent dangerous defilement of pools, &c., in the neighbourhood, that sufficient water should also be on the spot for ablution purposes of, say, fifteen per cent., of the workers. The amount of water required per day would, therefore, be:—

For every gang of 100 adults of a mixed population		50 gallons.
15 per cent. ablution water for a mixed population		3 gallons.
Waste		1 gallon.
Total		54 gallons (=one sherry-caskfull).

If cooking is conducted 60 gallons per gang *extra* should be supplied.

36. It is not advisable to use chatties carried by workers, as contamination by means of their hands and clothing may occur. Wherever possible casks, mounted on wheels and drawn by men or bullocks, should be employed.

37. The capacity of these casks should be carefully estimated, and be painted on them in large characters.

38. The number of trips per day necessary for the supply of each gang should be definitely settled.

39. The following is a useful formula (Hurst) for calculating the capacity of casks:—

D, d = inside diameters at the heads.
 M = inside diameters at the bung, and L = the length, all in inches: then
 the capacity in imperial gallons = $\frac{0.014162 L (Dd + M^2)}{1728}$

or,

"Take the bung diameter in inches, by measuring the circumference at the bung, and making an allowance for the thickness of the staves: square the bung diameter, and multiply by 39. Take the head diameter in inches by direct measurement, and square it, and multiply by 25. Multiply one diameter by the other, and multiply by the length of the cask in inches, then multiply by .00031473, and the result is given in gallons" (Nisbit).

40. Each head cooly should be made to sign a receipt form in acknowledgment of receiving the required supply each time of delivery.

41. Carts should be fitted with cast-iron taps. Their cost is as follows:—

1 inch = Rs. 1-8; $1\frac{1}{2}$ inch = Rs. 2; $1\frac{3}{4}$ inches = Rs. 2-12; 2 inches = Rs. 4. If these cannot be employed, on no account should any methods adopted be supplemented by the use of old rags, and the like, to stop leakage.

42. If it be arranged that three trips per day be taken, it will follow that if two be made in the morning and one in the afternoon, the storage capacity for each gang, if no cooking is pursued, should be about 18 gallons. This would be secured by the use of 4 chatties of ordinary size, or 3 kerosine tins. These are about the only methods of storage that can be economically arranged, but Best & Co.'s kerosine oil drums with taps, or small casks with taps might prove more economical (as they certainly would be better sanitarily) than the alternatives mentioned, if famine were long continued.

43. With both chatties and kerosine tins, well-fitting covers must be employed. In the case of old kerosine oil tins this can be managed by using a tin cover with handle at the top and, in the case of chatties, by the ordinary earthen 'chippa.'

44. It should be insisted that head coolies be responsible for seeing that the water for their respective gangs is kept correctly covered as soon as water has been withdrawn by any person.

45. It would be advisable to select a respectable man of good caste, whose whole time should be devoted to guarding the gang water, and seeing that orders as to it are carried out.

46. On no account should workers be allowed to dip their own utensils or hands into the storage vessels. A cheap and effective arrangement is to use tin 'Burmese spoons.' [These can be obtained at a cost of 8 annas each from Messrs. Sultan & Co., Royapetta, Madras.] Simple as the device is, it should go a great way towards securing protection from pollution of water. It has been suggested that large cocoanut ladles would do as well; these, however, are of a structure and present a surface far less safe bacterially.

If the man appointed under paragraph 45 be of sufficiently good caste to satisfy requirements of the workers—and every effort should be made to arrange that this is so—the 'Burmese spoon' should be touched by no one except him.

After use, the 'Burmese spoon' should not be placed on the ground, but should invariably be hung up near the storage vessel by the hook on the handle.

47. The storage vessels should be placed on a pyal slightly raised, and sloped with gravel or metal to one side, so that spilt water can readily drain from this to a clay-lined gutter. The gutter should be led to a sufficient distance into a pit for disposal by soakage or for the use of trees.

48. If there be no suitable shade from trees, the water should be protected by a few slabs if at hand; or a rough thatch of grass, jowari stalks or branches of trees intertwined, may be employed.

49. The head cooly should particularly see that no water left from the day before is retained in any storage vessels, when fresh water is placed in.

50. Once weekly during the prevalence of cholera* in the neighbouring villages, and more frequently—at the Sanitary Inspector's or Medical subordinate's discretion—if it has occurred on the works, the water barrels should be disinfected by pouring into them milk of lime (1 part fresh slaked lime to 4 of water) which should be left to soak throughout the night and be washed thoroughly next morning with water from a safe source and that has been rendered pink by permanganate of potash. The storage vessels should be disinfected with a solution of permanganate of potash of a strength sufficient to maintain a pink colour for half an hour after the vessel has been agitated, or be placed on a fire till too hot to touch.

W. G. KING, M.B., C.M., D.P.H., Surgeon-Lt.-Col.,
 Sanitary Commissioner for Madras.

* Further instructions as to treatment of water will be found in the memorandum referred to in paragraph 13.

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MEMORANDUM ON CHOLERA PREVENTIVE MEASURES ON FAMINE RELIEF WORKS.

The advent of cholera on Relief Works may be defined as the period when any village supplying labour has reported a single attack, or in the opinion of any Medical officer 'a suspicious case of diarrhoea' has occurred in any of such villages, at a period of the year when cholera is usually epidemic in the district concerned.

The Sanitary Staff required.

2. Whether there be a Medical subordinate attached to the work or not, the appearance of cholera should be followed by the appointment of a Certificated Sanitary Inspector who should assist the Tahsildar by affording advice on sanitary matters on the works, and as to the sanitary condition of all villages within five miles radius of the work.

Note.—Certificated Sanitary Inspectors have received the special class of training that should enable them to deal with the practical sanitary requirements of the situation, and therefore have on this account an advantage over the ordinary Medical subordinate in this respect; at the same time, it must be remembered that the Medical subordinate is no less necessary for medical treatment of patients, which should, on no account, be delegated to the Certificated Sanitary Inspector, even if he happen also to be a trained Medical subordinate—it being impossible for a man to attend to the medical requirements of patients suffering from so severe a malady as cholera, otherwise than perfunctorily if also called upon to fulfil sanitary work. A register of Certificated Sanitary Inspectors is maintained in the office of the Sanitary Commissioner, and men can usually be provided on short notice if fair salaries are offered. If, however, Certificated Sanitary Inspectors are not available, a Medical subordinate should be specially detailed for sanitary duty. Failing the latter arrangement also, an intelligent person—preferably a Revenue subordinate—should be placed on this duty. It will therefore be understood in the following remarks that the term 'Sanitary Inspector' is meant to cover any person detailed for the special duties described.

3. Under the Sanitary Inspector should be placed the staff mentioned in paragraph 9 of the Memorandum on 'Conservancy and Water-supply on Famine Relief Works, &c.,' and in addition two peons should be allowed him to enable messages to be rapidly carried.

4. The Sanitary Inspector should be mounted, and if it can be managed at least one of his peons should also be mounted.

The following would therefore be a typical minimum staff:—

For two sub-maistries charges=800
famine workers.

For one head maistry charge of
1,600 men.

For Sanitary charge of famine relief
works and villages within a radius
of five miles.

() Toties—1 male and 1
female.
1 male sweeper and 1 Sanitary peon.
1 Certificated Sanitary Inspector.
1 Mounted Orderly.
1 Peon.

5. The Sanitary Inspector and all peons of the staff should be caused to wear a mark that would easily distinguish them, such as the Red Geneva Cross on a white band round the arm, or other simple device.

Arrangements in villages.

6. The Village Head should be provided with the following instructions printed in the vernaculars:—

To the Village Reddi of ———.

(1) On the occurrence of a case of cholera, or of diarrhoea which you suspect to be of the nature of cholera, in addition to the action required of you under Revenue Board's Standing Orders of No. 195—1, you should at once send a report stating the full facts to the Certificated Sanitary Inspector in charge of Famine

Relief Works within five miles of your village, or at any greater distance if you know any person from your village resorts to them for any purpose whatsoever. If you have not ascertained that a Sanitary Inspector has been appointed, you should address the officer in charge of the Relief Works.

(2) You should enquire of each patient with great care as to the place or places where the first as well as subsequent motions or vomit were passed, and you should arrange to have places so soiled searched for, whether these be within the house, premises, in the fields or elsewhere. When found, the soiled earth should be covered with the disinfectants supplied by the Tahsildar, and be then removed and buried at a depth of five feet covered with two inches of disinfectants in a place far removed from water supplies, and not less than 800 yards from the village at a depth of five feet. Persons engaged on this duty should disinfect the instruments used by heating the metal on a fire till they cannot be touched: wooden shafts of instruments should have boiling water poured over them: their bodies should be cleansed as advised in paragraph (7).

If no disinfectant is available, freshly-slaked lime mixed with water till of the consistence of cream may be used for covering the soiled earth before removal and during burial. If even lime is not available the earth should be covered with straw which should be burnt. Similarly if there be no disinfectants for covering the faeces and vomit when passed, these should be mixed with saw-dust or paddy husk and, if available, with a little kerosine oil and the whole be burnt outside the house.

(3) Any clothing that has been in the slightest degree touched with the faeces or vomit of the patient, should be destroyed by fire as well as any ropes of cots, mats, bedding or other destructible articles.

(4) When the soiled clothing is valuable, it may be placed in a chatty and be thoroughly boiled for use in a place distant from the village. In conducting this work, the water requisite for the purpose should be drawn from the water-supply source by a person who has not been in contact with the clothing, or in any sort of personal attendance upon the patient. The chatty after use should be broken.

(5) You should *directly*, if a person has been attacked with cholera, arrange that all persons living in the same house should not draw water from any source. It should be supplied to them by others pouring water into their chatties from a safe source.

(6) During the illness of a person, arrangements should be made for receiving all faecal matter and vomit in a 'chippa' containing disinfectants to be disposed of as stated in paragraph (2). This should be continued for a period of at least ten days after the person's complete recovery.

(7) All persons attending upon the patient during his illness should be warned of the danger of eating or drinking anything from the same vessels or handling the patient and then eating anything, or placing their hands near their mouths, until purification has been carefully conducted by washing the hands and feet and preferably the whole body with water as hot as the body will bear. If obtainable, soap should also be used. If the Sanitary Inspector be communicated with, he will furnish disinfectants for purifying the hands, and will give instructions as to their method of use.

(8) When the illness is over, the earthen chatties should be broken and buried in the pit described in paragraph (2). All chatties, metal or earthen, the house should be placed over fire and heated till the hand cannot bear it. Wooden articles of furniture that are not valuable should be burnt. If it is desired to retain them, boiling water may be poured over them, should be dried in the direct rays of the sun for two days before re-entrance to the house. Any stains of vomit or faeces on the floor or in the latrines should be treated as stated in paragraph (2). The drains or any place where the sullage from the house should be covered with disinfectants. Rooms should be white-washed with freshly-slaked lime, and doors should be kept open till thoroughly dry.

(9) So as to make sure that persons from infected houses do not bring their infected chatties, ropes, &c., for use in the village water-supply, you should place a constant watch on the sources of water-supply, for drinking and domestic purposes.

Note.—The reason for all the above precautions is that the poison of cholera is in the vomit and faeces of patients, and the smallest particles conveyed to the mouth from the hands or from chatties would cause infection. If the smallest particle reaches water, it will multiply in the water just as from a single seed of paddy much grain is obtained. If the poison gets into the water, all partaking of it may be infected. Hence the greatest care is necessary to preserve all water-supplies both for drinking and for domestic purposes from being contaminated. Should the infective matter reach the water, it can be destroyed by boiling the water and thus it becomes harmless to man. Hence it is essential that the following command of the Hindu Shastras be carefully obeyed:—"In every case when disease is suspected, it is best to use boiled water, boiled down to tenths, six-tenths, or hundredths, and cooled down as such will cure the disturbed humors of the body, and correct digestion."

But for this advice of the Shastras to be of benefit, it is necessary that boiled water be used not only for drinking but for washing all vessels employed for cooking, eating, or storing fluid or solid articles of food.

7. The following instructions should also be proclaimed by tom-tom in the village daily during the continuance of cholera:—

The Person.

(1) The body and clothing should be kept scrupulously clean. Persons should use warm, not cold, baths.

(2) The food should be plain, nourishing and of good quality.

(3) All vegetables, or leaves, or fruits, likely to cause diarrhoea, should be abandoned.

(4) All forms of drinking to excess, debauchery, late hours and exposure to wet and cold should be avoided.

(5) Cold cooked food should never be used. Care should be taken not to allow flies to settle upon food. Vegetables and leaves should never be eaten otherwise than after cooking. Before being cooked, they should be well washed in water that has been purified by boiling. Salt should be freely used with the diet—but, on the other hand, it must not be used in such unusual amounts as to excite uneasiness or looseness of the bowels.

(6) An inferior quality of water should not be kept in the house; only the cleanest available should be employed.

(7) Water for drinking purposes and for washing the mouth or eating and drinking vessels, and milk, should be boiled before use.

(8) No purgatives should be taken.

(9) Any tendency to diarrhoea should at once be checked by the taking of appropriate medicines; any person having more than two motions in twenty-four hours should take this precaution.

(10) No fear should be felt, nor should the subject of cholera be constantly thought or spoken of.

Arrangements on the Works.

8. A place should be appointed as near the centre of the works as feasible, which should be known as the 'ambulance station'. If it can be so arranged this should be the head-quarters of the Medical subordinate, and all the sanitary staff. Here should be the store for disinfectants and stretchers, or other arrangements for transport of sick or injured persons. This place should be marked by a red cross flag, or other suitable device of the character used as a badge by the sanitary staff.

9. Suitable stretchers can be made from 'chensu cots' provided with bamboo poles at the sides. Cadjan leaves or gunny bags could be arranged as an awning.

10. If there is a Medical subordinate attached, it would be suitable that he should visit this site at hours that should be made known by tom tom, when persons requiring medical aid might find him.

11. At a spot so situated that persons can readily be brought from any part of the works, a cholera shed should be erected. The question of suitable plan for this building, staff and appliances for nursing are matters that would be dealt with by the District Sanitary officer, or other officer deputed by him.

12. Diagram affords an idea of the arrangement of sheds that is considered advisable. The nursing and cooking staff should be in numbers and quality sufficient to make sufferers completely confident as to care being exercised. Of course, compulsion cannot be employed, but it would be most desirable that a person attacked on the works should not return to his village. The best way to get this result is to gain the confidence of the sufferers by seeing that their comforts are really looked after.

Duties of the Sanitary Inspector.

13. The Sanitary Inspector should be subordinate to the Tahsildar, and will look to him for executive orders. That officer will be responsible that the time of the Sanitary Inspector is efficiently employed. In professional matters, the Sanitary Inspector should be subordinate to the District Sanitary officer, or any Medical officer of not lower rank than of Assistant Surgeon in charge of the area to which he is appointed.

14. The Sanitary Inspector should understand that he is responsible for the sanitary condition of the villages within five miles radius of the work, but that his special duty is not so much bringing the villages up to a standard of permanent vancy and water-supply, into a condition better fitting them to resist invasion by cholera. Measures for improvement that he advises must therefore be of an indirect benefit in the prevention of cholera will be obtained. The Sanitary Inspector is also responsible for advising the officer in charge of the works as to all sanitary questions in reference to conservancy, water-supply and the checking of contagious diseases. It must be distinctly understood by the Sanitary Inspector that his duties do not end with advising, but that as far as time is at his disposal he should supervise the effecting of urgent sanitary improvements, and that he is responsible for the correct effecting *under his personal supervision of measures for prevention of spread of infectious diseases, both in the village and on the works.*

15. If the Tahsildar be within the five miles radius, of which the Sanitary Inspector has charge, he will make his recommendations as to villages in a report book. One half page of this will be arranged for the Sanitary Inspector's recommendations, and on the other half the Tahsildar will state what action has been taken by him. If the Tahsildar is not within the five miles radius, the recommendation should be carried out in the usual manner by letter.

16. In communicating with the officer in charge of the works the separate report book arranged as above stated should be used.

17. On a visit of inspection by any superior officer of the works, the Sanitary Inspector should lay the book before him and explain what sanitary precautions have been taken.

18. The Sanitary Inspector should maintain a diary, in which he should state distinctly the nature of duties performed by him daily and the number of attacks and deaths from cholera in the area and on the works in his sanitary charge. A copy of this diary should be sent to the District Sanitary officer daily during prevalence of any epidemic disease and weekly otherwise. This book should also be placed before any superior officer during his inspection of the works.

19. Before making any recommendation involving heavy expenditure, the Sanitary Inspector should communicate with the District Sanitary officer. If the question be of importance, it will rest with the District Sanitary officer to take such action thereon as he may think fit.

Duties of Sanitary Peons.

20. One peon will act as mounted orderly to the Sanitary Inspector, and will obey all reasonable orders in aiding and effecting all sanitary duties under the orders of the Sanitary Inspector.

21. One peon will, during work hours, be at the ambulance station, and will be available for general duties such as the bringing in of the sick, the despatching and

carrying of disinfectants, and the superintending of the temporary disinfection of any spot in the absence of the Certificated Sanitary Inspector.

22. The remaining peon will undertake the usual routine of attending to latrines, and seeing that the menial staff of toties and sweepers are present at the required hours and effect their work correctly. In the absence of the Sanitary Inspector he will, in reference to conveyance of sick and disposal of infective matters, together with the staff of sweepers and toties under him, obey the orders of the 'ambulance station peon.'

23. Each peon shall in turn take care of property at the ambulance station during the night, and be liable to proceed with the Sanitary Inspector to villages, if required on urgent cholera duty.

Duty of Head Coolies in charge of Gangs.

24. The head cooly should carefully watch all workers under his charge as to going for purposes of nature. He should instruct the toty or sweeper on duty at the latrine to at once inform him, if a person goes to stool more than twice during the day or has suspicious stools. Such persons if not in a weakly state should be sent to the 'ambulance station' in charge of a trustworthy person. If in a weakly state, the head cooly should send for a stretcher from the 'ambulance station' and cause the person to be carried there with the aid of the sanitary peon.

25. The head cooly should carefully observe where motions have been passed, and should cover them with disinfectants obtainable at the 'ambulance station' or from the head maistry, till the arrival of the sanitary peon or Sanitary Inspector, under whose orders they will be disposed of finally.

26. Head coolies should be informed of the site chosen for the ambulance station, and it shall be required that failing his finding a sanitary peon on the work, he should *personally* report attacks there.

Note.—After receiving temporary medical treatment and the case being considered one of cholera, the patient should be removed to the cholera hospital. If the distance be too great for hand transport, the cart employed must be thoroughly disinfected with perchloride solution 1—1,000 by the Medical subordinate receiving the patient before dismissing the cart.

Disinfectants.

27. Each peon should be provided with a tin canister of the pattern as per diagram, which should be slung on the shoulders and be worn at all times when on duty. A similar tin canister should be provided for each head maistry who should be required to keep it at a place made known by him to all head coolies, and who should have access to it with reference to the duties required in paragraph 25.

28. This canister should be filled with lb. 5 of carbolic saw-dust, carbolic lime, or MacDougall's powder.

29. The Sanitary Inspector will personally superintend the distribution of the carbolic saw-dust or carbolic lime from stores supplied to him on indent through the District Medical and Sanitary officer, or, failing these being so obtained in due time, the Tahsildar should make arrangements for supply from such sources as he may find available.

30. The following disinfectants should be at all times available:—

In charge of the Reddi in each village, within five miles radius of the works, or supplying relief workers.	Carbolic saw-dust	...	...	lb. 10
To be retained at the ambulance station for every thousand relief workers.	Crude Carbolic acid	...	...	" 2
As a general reserve, for every five thousand inhabitants of neighbouring villages.	Do.	...	...	" 4
For each Sanitary Inspector's charge.	Bazaar perchloride of mercury	oz.	8	
	Fuschine (red-ink powder)	...	grs. 80	
	Commercial hydrochloric acid	...	oz. 8	
	Permanganate of potash	...	lb. 2	
			2	

The Use of Disinfectants.

31. The crude carbolic acid should be used in the proportion of 1 part to 10 of saw-dust or, failing it being possible to obtain saw-dust, old stale lime may be employed.

32. Perchloride of mercury should be employed by Certificated Sanitary Inspectors and Medical subordinates *only*. It should be prepared as follows:—

Perchloride of mercury, oz. $\frac{1}{2}$; Hydrochloric acid, oz. 1, Fuschine, grs. 5; Water, 3 gallons.

Note.—The fuschine is added simply to colour the solution which might otherwise be taken for water—the perchloride being very poisonous.

33. Under their superintendence the solution should be employed for the disinfection of walls, flooring/wooden furniture/and soakage of infected clothing—previous to boiling.

34. When freshly-slaked lime can be obtained it may be economically employed for disinfection of fæces and vomit-stained ground, and for the disinfection of water casks by using it in proportion of 1 part of lime to 4 of water.

Disinfection of Wells and Tanks.

35. As a matter of precaution when cholera is prevailing in the neighbourhood of the works, the water-source supplying the works, if a well, should be disinfected at intervals at the discretion of the Certificated Sanitary Inspector.

36. If it be known that a well or tank has actually been infected with cholera, it would be advisable to bale out the whole water where feasible having regard to size, and where not feasible, simple disinfection must suffice.

37. All unguarded or suspicious water-supply sources should be closed by mechanical means so as to render withdrawal of water *impossible*.

Disinfection by the Alum Process.

38. If the water-source is too large to be disinfected within reasonable cost by the permanganate of potash, the alum process may be employed in lieu.

39. Alum (Hind. Phitkari, Tam. and Tel. Pati-karam) is obtainable in ordinary bazaars at cheap rates. If the water is soft, the use of alum should be preceded by the use of stale lime or chalk in the proportion of one grain to the gallon. The amount of alum required is from 4 to 6 grains according to the amount of organic matter/*alias* 'dirt' with which the well seems charged. A ready reckoner for four grains per gallon is subjoined:—

Table I.—Quantity of water contained in Wells and Circular Tanks per foot in depth with the quantity of Alum required.

Diameter.		Contents.	Quantity of Alum required per foot.			Diameter.	Contents.	Quantity of Alum required per foot.		
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Feet.	Gals. per foot.	lb.	oz.	Grains.
1	0	034	0	0	0.136	14	962	...	8	96
1	1	076	0	0	0.304	15	1,104	...	9	224
1	2	135	0	0	0.540	16	1,256	...	10	392
2	0	212	0	0	0.848	17	1,418	...	11	120
2	1	305	0	0	1.22	18	1,590	1	1	368
2	2	412	0	0	1.66	19	1,772	1	2	172
3	0	54	0	0	2.16	20	1,963	1	4	272
3	1	85	0	0	2.64	25	3,068	2	1	392
3	2	122	0	0	3.18	30	4,418	3	3	52
4	0	166	0	0	3.76	35	6,013	4	2	216
4	1	217	0	0	4.38	40	7,854	5	5	400
4	2	275	0	0	5.04	45	9,940	6	10	120
5	0	339	0	0	5.74	50	12,272	8	6	360
5	1	412	0	0	6.48	55	14,850	10	3	124
5	2	491	0	0	7.26	60	17,671	12	3	20
6	0	575	0	0	8.08	65	20,740	14	5	212
6	1	667	0	0	8.94	70	24,053	16	8	44
6	2	767	0	0	9.84	75	27,611	19	2	...
7	0	872	0	0	10.78	...	...	...	...	...
7	1	984	0	0	11.76	80	31,416	21	9	384
7	2	1104	0	0	12.78	90	39,758	27	7	152
8	0	150	0	0	13.84	100	49,088	34	1	32
8	1	196	0	0	14.94	110	59,396	41	2	464
8	2	248	0	0	16.08	120	70,685	49	1	20
9	0	307	0	0	17.26	130	82,956	57	7	144
9	1	371	0	0	18.48	140	96,211	66	9	364
9	2	442	0	0	20.74	150	110,447	76	8	188
10	0	511	0	0	22.04	160	125,664	87	3	96
10	1	582	0	0	23.38	170	141,862	98	6	88
10	2	650	0	0	24.76	180	159,044	110	6	176
11	0	725	0	0	26.18	190	177,006	123	...	344
11	1	804	0	1	27.64	200	196,350	136	4	120
11	2	887	0	1	29.14	250	306,796	218	...	304
12	0	974	0	1	30.68	300	441,788	306	9	272
12	1	1064	0	1	32.26	350	601,322	417	7	8
12	2	1158	0	2	33.88	400	785,400	545	5	...
13	0	1256	0	2	35.54	500	1,227,190	852	2	280
13	1	1358	0	2	37.24	600	1,767,150	1,227	2	120
13	2	1464	0	2	38.98	700	2,405,290	1,670	4	40
14	0	1574	0	3	40.76	800	3,141,600	2,180	...	...
14	1	1688	0	3	42.58	900	3,973,750	2,760	11	120
14	2	1806	0	4	44.44	1,000	4,908,750	3,408	...	120
15	0	1928	0	4	46.34	...	...	...	...	...
15	1	2054	0	5	48.28	...	...	...	...	...
15	2	2184	0	6	50.26	...	...	...	...	...
16	0	2318	0	...	52.28	...	...	...	...	...
16	1	2456	0	...	54.34	...	...	...	...	...
16	2	2598	0	...	56.44	...	...	...	...	...
17	0	2744	0	...	58.58	...	...	...	...	...
17	1	2894	0	...	60.76	...	...	...	...	...
17	2	3048	0	...	62.98	...	...	...	...	...
18	0	3206	0	...	65.24	...	...	...	...	...
18	1	3368	0	...	67.54	...	...	...	...	...
18	2	3534	0	...	69.88	...	...	...	...	...
19	0	3704	0	...	72.26	...	...	...	...	...
19	1	3878	0	...	74.68	...	...	...	...	...
19	2	4056	0	...	77.14	...	...	...	...	...
20	0	4238	0	...	79.64	...	...	...	...	...
20	1	4424	0	...	82.18	...	...	...	...	...
20	2	4614	0	...	84.76	...	...	...	...	...
21	0	4808	0	...	87.38	...	...	...	...	...
21	1	5006	0	...	90.04	...	...	...	...	...
21	2	5208	0	...	92.74	...	...	...	...	...
22	0	5414	0	...	95.48	...	...	...	...	...
22	1	5624	0	...	98.26	...	...	...	...	...
22	2	5838	0	...	101.08	...	...	...	...	...
23	0	6056	0	...	103.94	...	...	...	...	...
23	1	6278	0	...	106.84	...	...	...	...	...
23	2	6504	0	...	109.78	...	...	...	...	...
24	0	6734	0	...	112.76	...	...	...	...	...
24	1	6968	0	...	115.78	...	...	...	...	...
24	2	7206	0	...	118.84	...	...	...	...	...
25	0	7448	0	...	121.94	...	...	...	...	...
25	1	7694	0	...	125.08	...	...	...	...	...
25	2	7944	0	...	128.26	...	...	...	...	...
26	0	8198	0	...	131.48	...	...	...	...	...
26	1	8456	0	...	134.74	...	...	...	...	...
26	2	8718	0	...	138.04	...	...	...	...	...
27	0	8984	0	...	141.38	...	...	...	...	...
27	1	9254	0	...	144.76	...	...	...	...	...
27	2	9528	0	...	148.18	...	...	...	...	...
28	0	9806	0	...	151.64	...	...	...	...	...
28	1	10088	0	...	155.14	...	...	...	...	...
28	2	10374	0	...	158.68	...	...	...	...	...
29	0	10664	0	...	162.26	...	...	...	...	...
29	1	10958	0	...	165.88	...	...	...	...	...
29	2	11256	0	...	169.54	...	...	...	...	...
30	0	11558	0	...	173.26	...	...	...	...	...
30	1	11864	0	...	176.98	...	...	...	...	...
30	2	12174	0	...	180.76	...	...	...	...	...
31	0	12488	0	...	184.58	...	...	...	...	...
31	1	12806	0	...	188.44	...	...	...	...	...
31	2	13128	0	...	192.34	...	...	...	...	...
32	0	13454	0	...	196.28	...	...	...	...	...
32	1	13784	0	...	200.26	...	...	...	...	...
32	2	14118	0	...	204.28	...	...	...	...	...
33	0	14456	0	...	208.34	...	...	...	...	...
33	1	14798	0	...	212.44	...	...	...	...	...
33	2	15144	0	...	216.58	...	...	...	...	...
34	0	15494	0	...	220.76	...	...	...	...	...
34	1	15848	0	...	224.98	...	...	...	...	...
34	2	16206	0	...	229.24	...	...	...	...	...
35	0	16568	0	...	233.54	...	...	...	...	...
35	1	16934	0	...	237.88	...	...	...	...	...
35	2	17304	0	...	242.26	...	...	...	...	...
36	0	17678	0	...	246.68	...	...	...	...	...
36	1	18056	0	...	251.14	...	...	...	...	...
36	2	18438	0	...	255.64	...	...	...	...	...
37	0	18824	0	...	260.18	...	...	...	...	...
37	1	19214	0	...	264.76	...	...	...	...	...
37	2	19608	0	...	269.38	...	...	...	...	...
38	0	20006	0	...	274.04	...	...	...	...	...
38	1	20408	0	...	278.74	...	...	...	...	...
38	2	20814	0	...	283.48	...	...	...	...	...
39	0	21224	0	...	288.26	...	...	...	...	...
39	1	21638	0	...	293.08	...	...	...	...	...
39	2	22056	0	...	297.94	...	...	...	...	...
40	0	22478	0	...	302.84	...	...	...	...	...
40	1	22904	0	...	307.78	...	...	...	...	...
40	2	23334	0	...	312.76	...	...	...	...	...
41	0	23768	0	...	317.78	...	...	...	...	...
41	1	24206	0	...	322.84	...	...	...	...	...
41	2	24648	0	...	327.94	...	...	...	...	...
42	0	25094	0	...	333.08	...	...	...	...	...
42	1	25544	0	...	338.26	...	...	...	...	...
42	2	26000	0	...	343.48	...	...	...	...	...
43	0	26460	0	...	348.74	...	...	...	...	...
43	1	26924	0	...	354.04	...	...	...	...	...
43	2	27392	0	...	359.38	...	...	...	...	...
44	0	27864	0	...	364.76	...	...	...	...	...
44	1	28340	0	...	370.18	...	...	...	...	...
44	2	28820	0	...	375.64	...	...	...	...	...
45	0	29304	0	...	381.14	...	...	...	...	...
45	1	29792	0	...	386.68	...	...	...	...	...
45	2	30284	0	...	392.26	...	...	...	...	...
46	0	30778	0	...	397.88	...	...	...	...	...
46	1	31276	0	...	403.54	...	...	...	...	...
46	2	31778	0	...	409.26	...	...	...	...	...
47	0	32276	0	...	414.98	...	...	...	...	...
47	1	32778	0	...	420.74	...	...	...	...	...
47	2	33276	0	...	426.54	...	...	...	...	...
48	0	33778	0	...	432.26	...	...	...	...	...
48	1	34276	0	...	438.04	...	...	...	...	...
48	2	34778	0	...	443.84	...	...	...	...	...
49	0	35276	0	...	449.58	...	...	...	...	...
49	1	35776	0	...	455.34	...	...	...	...	...
49	2	36276	0	...	461.14	...	...	...	...	...
50	0	36776	0	...	466.88	...	...	...	...	...
50	1	37276	0	...	472.64	...	...	...	...	...
50	2	37776	0	...	478.44	...	...	...	...	...
51	0	38276	0	...	484.18	...	...	...	...	...
51	1	38776	0	...	489.94	...	...	...	...	...
51	2	39276	0	...	495.74	...	...	...	...	...
52	0	39776	0	...	501.48	...	...	...	...	...
52	1	40276	0	...	507.26	...	...	...	...	...
52	2	40776	0	...	513.04	...	...	...	...	...
53	0	41276	0	...	518.78	...	...	...	...	...
53	1	41776	0	...	524.54	...	...	...	...	...
53	2	42276	0	...	530.34	...	...	...	...	...
54	0	42776	0							

40. In dealing with very large tanks where even the cost of alum disinfection would prove excessive, much good may be obtained by calculating for disinfection the mass of water included within twenty-five feet all round the tank,* or, if even this be expensive, *one side*—the side where water is drawn by the people.

41. The correct distribution of lime and alum in tanks can be arranged by suspending two new cooly baskets between two poles as floats, and by dragging them backwards and forwards by means of ropes till the contents of the baskets are dissolved.

Disinfection by the Permanganate of Potash Process.

42. The subjoined table gives the proportion in which permanganate of potash should ordinarily be used for wells and tanks:—

Table I.—Quantity of water contained in Wells and circular tanks per foot in depth (Hennell) with the quantity of Permanganate of Potash required.

Diameter.					Diameter.				
Contents.					Contents.				
Quantity of Permanganate of Potash required per foot.					Quantity of Permanganate of Potash required per foot.				
Inches.	Gals. per foot.	lb.	oz.	Grains.	Feet.	Gals. per foot.	lb.	oz.	Grains.
1	0.034	0	0	0.03950	14	1.062	0	3	371.00000
1 1/2	0.076	0	0	0.13300	15	1.104	0	4	184.00000
2	0.135	0	0	0.23025	16	1.256	0	5	10.50000
2 1/2	0.212	0	0	0.37100	17	1.418	0	5	294.00000
3	0.305	0	0	0.53375	18	1.590	0	6	157.50000
3 1/2	0.412	0	0	0.94500	19	1.772	0	7	38.50000
4	0.54	0	0	1.48750	20	1.963	0	7	372.75000
4 1/2	0.685	0	0	2.13500	25	3.008	0	12	119.00000
5	0.85	0	0	2.90500	30	4.418	1	1	293.50000
6	1.22	0	0	3.79750	35	6.013	1	8	22.75000
7	1.63	0	0	4.81250	40	7.854	1	15	182.00000
8	2.17	0	0	5.93250	45	9.940	2	7	332.50000
9	2.75	0	0	7.21000	50	12.272	3	1	38.50000
10	3.39	0	0	8.59250	55	14.850	3	11	175.00000
11	4.12	0	0	10.06250	60	17.671	4	6	299.25000
12	4.91	0	0	11.67250	65	20.740	5	2	419.50000
13	5.75	0	0	13.42250	70	24.053	6	0	93.75000
14	6.67	0	0	15.26000	75	27.611	6	14	174.25000
15	7.67	0	0	19.32000	80	31.416	7	13	290.50000
16	8.72	0	0						
18	11.04	0	0						
Ft. In.									
1 1/2	19.6	0	0	98.95000	100	99.756	9	10	140.00000
2	24.8	0	0	134.30000	110	59.396	14	13	156.00000
2 1/2	30.7	0	0	164.92500	120	70.685	17	10	255.50000
3	37.1	0	0	193.50000	130	82.959	20	11	323.75000
3 1/2	44.2	0	0	220.25000	140	96.211	24	0	360.50000
4	51.1	0	0	244.50000	150	110.447	27	9	369.25000
4 1/2	58.9	0	0	266.75000	160	125.664	31	6	341.75000
5	66.7	0	0	287.00000	170	141.862	35	7	287.00000
5 1/2	74.5	0	0	306.795	180	159.044	39	12	196.50000
6	82.2	0	0	325.00000	190	177.208	44	4	77.00000
6 1/2	90.0	0	0	341.75000	200	196.350	49	1	362.50000
7	97.7	0	0	357.50000	250	306.795	76	11	174.50000
7 1/2	105.5	0	0	372.75000	300	441.788	110	7	80.52000
8	113.2	0	0	387.50000	350	601.322	150	5	67.00000
8 1/2	121.0	0	0	402.25000	400	785.400	196	5	126.00000
9	128.7	0	0	417.00000	450	993.750	247	12	262.50000
9 1/2	136.5	0	0	431.75000	500	1,227.190	306	12	332.50000
10	144.2	0	0	446.50000	550	1,480.625	372	12	262.50000
10 1/2	152.0	0	0	461.25000	600	1,753.125	441	12	70.00000
11	159.7	0	0	476.00000	650	2,044.625	513	6	175.00000
11 1/2	167.5	0	0	490.75000	700	2,354.125	593	15	...
12	175.2	0	0	505.50000	750	2,681.625	681	3	...
12 1/2	183.0	0	0	520.25000	800	3,027.125	776	...	...
13	190.7	0	0	535.00000	850	3,390.625	878	...	...
					900	3,772.125	987	...	...
					950	4,171.625	1,093	...	...
					1,000	4,589.125	1,207	...	...

* 1 cubic foot of water = 6.24 gal'ons.

Table II.—Quantity of water contained in square cisterns or tanks per foot in depth with the quantity of Permanganate of Potash required.

Length of side.		Contents.			Quantity of Permanganate of Potash required per foot.			Length of side.		Contents.			Quantity of Permanganate of Potash required per foot.		
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Feet.	Gals. per foot.	lb.	oz.	Grains.	Feet.	Gals. per foot.	lb.	oz.	Grains.
1	0	6.25	0	0	10.93750	30	5.625	1	6	218.75000					
1	6	14.05	0	0	21.60500	35	7.656	1	14	273.00000					
2	0	25.00	0	0	43.75000	40	10.000	2	8	273.00000					
2	6	39.06	0	0	68.35500	45	12.656	3	2	218.75000					
3	0	56.25	0	0	98.48750	50	15.625	3	14	218.75000					
3	6	77.56	0	0	135.73000	60	20.500	5	2	218.75000					
4	0	100.00	0	0	175.00000	70	30.625	7	10	218.75000					
4	6	126.56	0	0	221.48000	80	40.000	10	0	218.75000					
5	0	156.25	0	0	273.43750	90	50.625	12	10	218.75000					
5	6	225.00	0	0	393.75000	100	62.500	15	10	218.75000					
6	0	306	0	1	498.00000	125	97.656	24	6	273.00000					
6	6	400	0	1	625.00000	150	140.625	35	2	218.75000					
7	0	506	0	2	787.50000	200	250.000	62	8	...					
7	6	625	0	2	984.37500	300	562.500	140	10	...					
8	0	756	0	3	1,218.75000	400	1,000.000	260	0	...					
8	6	900	0	3	1,481.25000	500	1,562.500	390	10	...					
9	0	1,106	0	5	1,781.25000	600	2,250.000	562	8	...					
9	6	1,369	0	10	2,106.25000	700	2,906.250	736	15	...					
10	0	1,650	0	15	2,475.00000	800	3,600.000	864	...	...					
10	6	1,956	0	15	2,887.50000	900	4,350.000	996	...	...					
11	0	2,281	0	15	3,331.25000	1,000	5,150.000	1,124	...	...					
11	6	2,625	0	15	3,806.25000	1,100	6,000.000	1,256	...	...					
12	0	2,988	0	15	4,312.50000	1,200	6,900.000	1,392	...	...					
12	6	3,369	0	15	4,850.00000	1,300	7,850.000	1,532	...	...					
13	0	3,768	0	15	5,418.75000	1,400	8,850.000	1,676	...	...					
13	6	4,185	0	15	6,018.75000	1,500	9,900.000	1,824	...	...					
14	0	4,612	0	15	6,648.75000	1,600	11,000.000	1,976	...	...					
14	6	5,059	0	15	7,300.00000	1,700	12,150.000	2,132	...	...					
15	0	5,516	0	15	7,981.25000	1,800	13,350.000	2,292	...	...					
15	6	5,983	0	15	8,693.75000	1,900	14,600.000	2,456	...	...					
16	0	6,460	0	15	9,437.50000	2,000	15,900.000	2,624	...	...					
16	6	6,947	0	15	10,212.50000	2,100	17,250.000	2,796	...	...					
17	0	7,444	0	15	11,018.75000	2,200	18,650.000	2,972	...	...					
17	6	7,951	0	15	11,855.00000	2,300	20,100.000	3,152	...	...					
18	0	8,468	0	15	12,721.25000	2,400	21,600.000	3,336	...	...					
18	6	8,995	0	15	13,627.50000	2,500	23,150.000	3,524	...	...					
19	0	9,532	0	15	14,563.75000	2,600	24,750.000	3,716	...	...					
19	6	10,079	0	15	15,539.00000	2,700	26,400.000	3,912	...	...					
20	0	10,636	0	15	16,554.25000	2,800	28,100.000	4,112	...	...					
20	6	11,203	0	15	17,609.50000	2,900	29,850.000	4,316	...	...					
21	0	11,780	0	15	18,704.75000	3,000	31,700.000	4,524	...	...					
21	6	12,367	0	15	19,839.00000	3,100	33,650.000	4,736	...	...					
22	0	12,964	0	15	20,993.25000	3,200	35,700.000	4,952	...	...					
22	6	13,571	0	15	22,177.50000	3,300	37,850.000	5,172	...	...					
23	0	14,188	0	15	23,391.75000	3,400	40,100.000	5,396	...	...					
23	6	14,815	0	15	24,636.00000	3,500	42,450.000	5,624	...	...					
24	0	15,452	0	15	25,910.25000	3,600	44,900.000	5,856	...	...					
24	6	16,100	0	15	27,214.50000	3,700	47,350.000	6,092	...	...					
25	0	16,757	0	15	28,548.75000	3,800	49,900.000	6,332	...	...					
25	6	17,424	0	15	29,913.00000	3,900	52,550.000	6,576	...	...					

43. Although this table fixes the proportion of permanganate of potash (1 to 40,000) as sufficing in dealing with water of ordinary degrees of purity, it very often happens that the water dealt with may require more than that stated, on account of its being contaminated with an excess of organic matter. In this case, after the amount fixed has been used, it should be observed whether the water has an unchanging pink colour for half an hour; if not, additions must be made cautiously till this results. The addition of permanganate should be made by mixing it with water withdrawn from the source to be disinfected in any convenient vessel, and in convenient proportions. As soon as dissolved, the contents of the vessel (e.g., a kerosine tin or chatty) should be poured into the well, and by sinking the vessel into and withdrawing it rapidly the whole should be put into a state of commotion so as to promote general mixing.

44. It is very rarely when the reason for using the 'medicine' has been explained to natives that they object to its use. The precaution of explaining should always however be taken, as any discovery of alteration of colour is liable to be followed by panic. The colour usually fades within twelve hours completely, so that it is best to disinfect in the evening, and next morning all is found as usual. If it is necessary to get rid of the colour quickly, alum may be used after the permanganate as above described.

Personal Hygiene of Relief Workers.

45. The rules quoted in paragraph 10 should be proclaimed by tom tom daily during the prevalence of cholera. All subordinates in charge should be repeatedly warned that it is their duty to impress on the people the desirability of using only water supplied to them, and that both this and the supplies used by them in their villages should be boiled and cooled before use for drinking or any domestic purpose.

Action required of the officer in charge of the work.

46. When no Sanitary Inspector or medical subordinate is attached, the officer in charge of the work, on a case of cholera coming to his notice either in villages from

fulfil the duties laid down in this memorandum generally, and more especially should take measures in the spirit of the instructions conveyed in paragraphs 6 to 12, 24 to 26 and 35 to 44.

47. The medical subordinate on receipt of such information, unless he be able to prove subsequently to the satisfaction of the District Medical and Sanitary officer that by so doing he would endanger the life of any person actually at that time under treatment should proceed with the least possible delay to the locality indicated, and advise the officer in charge of the works and neighbouring village officials as to the effecting of urgent sanitary measures.

48. In the case of a medical subordinate holding charge of an in-patient hospital, he shall proceed to his head-quarters after having fulfilled his inspection, and having given full instructions to the officer in charge of the works and to the Reddi of the villages concerned, but shall return to perform this duty daily until the arrival of a medical subordinate from an out-patient dispensary under paragraph 48, or Certificated Sanitary Inspector, or he be otherwise relieved by the District Sanitary officer.

49. When a medical subordinate in charge of an in-patient hospital receives notice of the appearance of cholera with reference to paragraph 48 he shall, on proceeding to cholera duty under paragraph 48, dispatch a message by the quickest possible method to the medical subordinate in charge of the out-patient dispensary nearest to the works, and require him to proceed without delay to his relief.

50. When a medical subordinate is required to perform urgent cholera duty under paragraph 48, he shall inform the District Medical and Sanitary officer of the circumstances under which he is leaving his head-quarters, and as soon as feasible after making his inspection shall write to that officer a full professional report of the sanitary and medical requirements of the locality.

51. When a medical subordinate in charge of an out-patient dispensary undertakes under paragraph 48 or 48 urgent sanitary duties, he shall not return to his head-quarters until he has been relieved under the order of the District Sanitary officer, or has received orders from that officer directing him to proceed elsewhere.

W. G. KING, M.B., C.M., D.P.H., Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

No. 1304
3

From

Surgeon Lieut.-Col. W. King M.B., C.M., D.P.H.
Sanitary Commissioner for Madras.

To,

The

Sir,

I have the honour to forward herewith certain rules that I think might be adopted with advantage on the Famine relief works in your district. As the rules have not yet been placed before Government for approval, they must be regarded simply in the light of recommendations from this office.

2. I would take this opportunity of urging upon you the importance of energetic action being taken in the matter of cholera prevention on Famine relief works and in their neighbourhood. You are, of course, aware that from the commencement of the South West monsoon onwards is the period for chief anxiety in your district as to persistence of cholera prevalence.

I have the honor to be,
Sir,

Your most obedt. Servant

(Signed) W. G. King

Surgeon Lieut. Col.
Sanitary Commissioner for Madras.

(True copy) *W. G. King*

Surgeon Lieut. Col.,
Sanitary Commissioner
for Madras.

No. 1309
S.OFFICE OF SANITARY COMMISSIONER,
Fort St. George, 28th June, 1897.

110

From

SURGEON-LIEUT.-COL. W. G. KING, M.B., C.M., D.P.H.,

SANITARY COMMISSIONER FOR MADRAS;

To

THE

Secretary to Government
Revenue Department.

Enclosure.

SIR,

I have the honour to forward herewith copies of correspondence and two memoranda on the subjects of water-supply and conservancy or famine relief works and preventive measures during cholera, for the information of government.

2. As, having regard to the seasonal conditions governing cholera prevalence, it is desirable that increased attention be paid urgently to these subjects in relation to famine works, I have issued the Rules to Collectors and District Medical and Sanitary officers with the intimation that they are to be regarded only in the light of recommendations. As, however, it is desirable a code of Rules should exist, it would be advisable, should any or all of the Rules meet with the approval of Government, that they should be issued with its authority.

I have the honor to be,
Yours most ^{Sci.} Obedt. Servant.
W. G. King
Sanitary Commissioner for Madras.

J. W. (Comp.)

(L. G. S. M. S.)

J. W. King

Sanitary Commissioner for Madras

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G.O., No. 540, 7th July 1897.

JULY.

**Dr. King's Memoranda on Conservancy and Water-supply on
Famine-relief Works and Cholera Preventive Measures.**

Forwarding, with remarks, to the Famine Commissioner—

GOVERNMENT OF MADRAS.

REVENUE DEPARTMENT.

READ—the following letter from Surgeon-Lieutenant-Colonel W. G. KING, M.B., C.M., D.P.H., Sanitary Commissioner for Madras, to the Secretary to Government, Revenue Department, dated Fort St. George, 28th June 1897, No. 1309-S. :—

I have the honour to forward herewith copies of correspondence and two memoranda on the subjects of water-supply and conservancy on famine-relief works and preventive measures during cholera, for the information of Government.

2. As, having regard to the seasonal conditions governing cholera prevalence, it is desirable that increased attention be paid urgently to these subjects in relation to officers with the intimation that they are to be regarded only in the light of recommendations. As, however, it is desirable a code of rules should exist, it would be advisable, should any or all of the rules meet with the approval of Government, that they should be issued with its authority.

ENCLOSURES.

No. 1304-S.

OFFICE OF SANITARY COMMISSIONER,
Fort St. George, 25th June 1897.

From

Surgeon-Lieutenant-Colonel W. G. KING, M.B., C.M., D.P.H.,

To

Sanitary Commissioner for Madras,

Sir,

The

I have the honour to forward herewith certain rules that I think might be adopted with advantage on the famine-relief works in your district. As the rules have not yet been placed before Government for approval, they must be regarded simply in the light of recommendations from this office.

2. I would take this opportunity of urging upon you the importance of energetic action being taken in the matter of cholera prevention on famine-relief works and in their neighbourhood. You are, of course, aware that from the commencement of the south-west monsoon onwards is the period for chief anxiety in your district as to persistence of cholera prevalence.

I have the honour to be,
Sir,

Your most obedient Servant,

(Signed)

W. G. KING, Surgn.-Lt.-Col.,
Sanitary Commissioner for Madras.

CONSERVANCY AND WATER SUPPLY ON FAMINE-RELIEF WORKS, WITH REFERENCE TO THE
APPROACH OF CHOLERA.

Conservancy.

It is now held that cholera is conveyed by a specific microbe propagated in the intestinal tract of persons suffering from the disease, and that hence the vomit and excreta contain the causative agent. Whilst this broad fact is now universally recognized, it is often not understood that persons passing to all appearance healthy excreta may be the medium of spread, in that the cholera microbe may be present without necessarily causing profound disturbance of the system. Indeed, in certain individuals, instead of the presence of the microbe being followed by the typical profuse diarrhoea and exhaustion, the symptoms may be of a trivial nature, and the affected person may continue his ordinary occupation. Again, convalescents from the disease may continue to pass cholera microbes with their stools up to ten days after the acute attack. These facts taken together point to the importance of limiting, as far as feasible, the careless disposal of excreta, whether they be derived from a person to all

appearance in health or actually suffering from typical cholera. In short, as a first step towards prevention of cholera, it is requisite that arrangements be made for the correct conservancy of night-soil on famine works and in the neighbouring villages.

2. It is a common opinion that the taking of any trouble in the matter of conservancy on works situated, say, on a trunk road and out-of-sight villages is an unnecessary refinement. The fact that the "open fields" are resorted to, and that the sun is ever ready to effect desiccation and disinfection is regarded as an all-sufficient reply to such a suggestion. But a very little reflection and a very little observation of what occurs on ordinary famine works, should convince most that leaving this important matter solely to the kindly intervention of the sun is injudicious. Although habits doubtless differ in different localities, it may be looked upon as a very frequent custom for famine workers to arrange that morning easement shall occur after arrival at the work or in its vicinity, whilst waiting for roll-call. This implies that any stagnant pool of water in the neighbourhood of the work becomes the place for ablution after defaecation, for the washing of the mouth, and the cleaning of eating and drinking vessels. There is hence room for extensive contamination of pools of water by the cholera microbe, and its conveyance to man direct in the process of teeth-washing or, indirectly, by adhering to vessels used for cold food or water, or, again, on the occurrence of rainfall, by faecal matter being washed bodily into water sources.

3. On the above grounds, it would be advisable that no gang should be without a recognized place for defaecation, provided with water for ablution, and that means should be employed to ensure that such sites be uniformly used. It is not asserted that this arrangement could be accomplished without difficulties being encountered; still they are not insuperable and, in consideration of every gang having a special organization for its correct working, it ought to be possible by exercising a certain amount of supervision to surmount any obstacle there may exist.

4. The want of toties is a matter that must be allowed for, as it certainly would be impossible, in most places, to provide one toty per gang; hence measures that would ensure disposal of faecal matter without handling must be employed. This can be arranged for either by the use of the trench system or the Jewish conservancy system. With the former method, all officers are familiar; but, as a result of adopting principles now found to be erroneous, the tendency is to make trenches of absurd depths and breadths. Thus, a very common size for a trench is 3 feet wide and 3 feet deep. Yet such trenches can only be employed by persons squatting at the edge, and it has time after time occurred that the earth has given way, or the persons have overbalanced themselves with very dire consequences. But safety and convenience are not the only reasons why these huge excavations should be abandoned; it has been found of recent years that nitrification proceeds actively only within the first 18 inches of soil and that, indeed, the most active change occurs within the first 6 inches from the surface. Consequently, it is well, where final burial of the faecal matter is contemplated, to use at no time a depth exceeding 18 inches and preferably, not to go deeper than 1 foot. As regards breadth trenches should not be broader than 9 inches, this being the usual span from heel to heel of a native squatting. With this limited breadth instead of the person using the trench sitting at the side, the position assumed should be that of *squatting direct across* the shallow trench; the result is that both faeces and urine are received into the trench and consequently the surroundings are kept dry, whereas in the case of the old form the approach or pathway became unusable on account of soakage from urine and washings for ablution. Diagram A shows a trench latrine formed on this system. It will be noticed that the space afforded within the latrine is extremely narrow, the object being to ensure that it shall be comfortable to squat in no other place than that appointed for the purpose.

5. The use of trenches should get rid of the objection on the part of low caste men who are not professional toties undertaking superintendence. All that is required is that after defaecation the person concerned, or at least the attendant, should cover the mass with dry earth derived from the excavation. As soon as the trenches are filled, the bamboo tatty sides can be shifted to another position.

6. Where toties are obtainable, the trouble of constantly shifting the tatties may be got over by using the form shown in diagram B. Here a small filter is arranged for disposal of urine and washings, whilst the trench may be made to serve a considerable period by causing it to be partially filled with dry earth daily, which should be removed from time to time as defiled. In both forms of latrine, it is essential that faecal matter deposited be instantly covered with dry earth, so that it should be neither offensive to sight nor smell. Unless this is seen to carefully, no form of latrine will be willingly resorted to by natives.

7. In the opinion of the undersigned, however, the method that is easiest to work and is received with the least opposition by natives is that referred to above as the Jewish conservancy system. This is conducted as follows (diagram C):—A place is marked off in a field conveniently close to the works—say, not exceeding 100 yards distance—by means of four flags. Within the square space so selected are made pits at distances of 3 feet from each other. These pits measure 6 inches in diameter and 8 inches deep. On one side of each pit is placed the earth excavated from it, and a piece of split bamboo 2 feet or so high having a small coloured rag at the end is fixed at the same side as the piled earth. On the side nearest the

work is placed, so as to preserve the sitters from observation, a movable screen, that may be made of branches of jungle tree, branches intertwined with any foliage that will secure protection from sight. On the site it is necessary to retain a man on duty throughout working hours. Persons on arrival will be permitted to select any hole they may choose—an arrangement which gives all the privacy an ordinary native requires. The man on duty sees that defæcation occurs in the holes *only*. The moment a person retires * it is the attendant's business to proceed to the hole used, and remove the split bamboo—showing that the hole is not to be again used—and with a movement of his foot to throw the earth piled as stated above into the pit. If the attendant be too "nice" to do this himself, there is no reason why, without much pressure, he should not be able to convince the famine worker who has used a pit that it is his duty to move the earth with his foot and thus cover the excreta. This system is absolutely odourless and when properly worked a spot, when it is in progress, can be visited at any time without either eye or nose having cause for offence. To make these holes of an uniform size and depth requires, however, the consumption of much time, and is not often satisfactorily accomplished, as ideas of size differ enormously in individuals of the cooly class; hence I have asked Messrs. Sultan & Co., Royapettah, Madras, to make for sale special spades for the purpose. These by two movements rapidly make the pits of the exact size demanded.

8. As regards ablution water (which is, of course, requisite whatever form of latrine be employed), unless the expense of providing at latrines small iron tanks, such as kerosine drums of Best & Co., Madras, with taps attached, be undergone, it is sanitarly advisable that, when on the work water of a quality fit to drink is available in sufficient quantity, ordinary demands for ablution after defæcation should also be satisfied from the same source. In this case, no water should be placed at the latrine; the famine worker should be expected to bring it with him in his lotah from the works where, as afterwards shown, its method of distribution should be such as to protect it from contamination.

9. The above remarks presume an attempt at rigid economy, by the employment of famine workers of low caste as latrine attendants who have been given the assurance that they will not be required to handle the excreta; such a system would be applicable to small works. But where a large number of gangs are assembled, it ought not to be a difficult matter to arrange for the employment of the following conservancy staff with orders to perambulate from gang to gang for the accomplishment of their work. It would probably rarely be possible to get the number of toties that would suffice for this standard, but, as far as possible, undersigned would advise its employment:—

For two sub-maistry charges, i.e., 800 famine workers ... 1 male and 1 female toty.
For one head-maistry's charge, i.e., 1,600 famine workers ... 1 male sweeper and
1 sanitary peon.

10. In regard to the duty expected of the sweeper, it would, of course, not be required of him that he should sweep roads in the vicinity of works. He would find sufficient and useful occupation by destroying by fire accumulations of destructible matter brought thither by famine workers, more especially of rags. These should be carefully gathered at convenient spots and burnt.

11. The duty of the peon would be to see as to general cleanliness of the works and their vicinity, see the latrines are correctly prepared and worked, regulate the work of toties and sweepers, see that rules as to protection of water are correctly observed, report all cases of illness from any cause and suspicious cases of diarrhoea. An intelligent man on good pay would be required for the work.

12. Where a medical subordinate is attached to the work, it is advisable that this conservancy staff be placed under his orders; where not, the staff should be under the revenue official responsible for the work.

13. On appearance of cholera in villages supplying workers, certificated Sanitary Inspectors should be appointed for sanitary supervision of the work and of villages within a radius of 5 miles, in addition to any medical subordinate detailed for the treatment of patients (*vide* Memorandum "Cholera preventive measures on famine-relief works").

Protection of water-supplies.

14. Whatever be the source of supply, the end aimed at is the prevention of entrance into water of the cholera microbe, as it can, not only exist several days in this, but increase enormously.

15. The cholera microbe being very readily killed by desiccation, cholera infected matter in the condition of dust is not likely to be causative of harm; nevertheless, experiment has shown that particles of infective matter can be borne by dust should the whole not have been fully deprived of moisture. Flies that have been in contact with choleraic matter undoubtedly

* The tendency in working this system is for the attendant to allow several holes to remain open, so as to make a one job of the whole and thus prevent the trouble of many journeys. If this be permitted, the advantage of quick deodorisation and concealment from sight is frustrated, and the arrangement must prove a failure. Strict discipline must therefore be maintained.

can convey cholera germs to water and food. Birds that are unclean feeders may drop infective particles from their claws or from their beaks. The feet and mouths of animals, such as the cow and the dog, may also secure introduction of the cholera germ to water-supplies, and it can be easily understood that the buffaloes* of the Ceded Districts would be specially dangerous animals in this respect.

16. But, probably the most common method of specific contamination is by means of the hands and feet of men, chatties, ropes and rags in the act of drawing water.

17. To secure that water-supply sources shall be so arranged as to prevent contamination by any of the methods enumerated above should, therefore, be diligently attempted on works; for it must be remembered that if but the most minute atom of infective matter gain access, this may contain living microbes that would shortly multiply by lakhs and render the whole bulk of very extensive water-supply sources the medium of cholera spread. In this connexion, it should be borne in mind that the physical condition of the famine-stricken and the nature of their environment are such as to present less chances of resistance to the cholera, or any other pathogenic microbe, than may be expected of a population in a normal state of nutrition and living under ordinary hygienic conditions. Thus, during the great famine of 1877-78, no less than 404,597 souls were reported to have died of cholera, and the bulk of this mortality was certainly on famine works.

Wells.

18. A typically sanitarly safe water may be held to be an under-ground water derived by filtration through a clean soil at such a distance from habitations as to be beyond risk of contamination through the soil or sub-soil. To obtain this water and so deliver it that it shall be as free of contamination as when it has reached its supporting impervious stratum after filtering through the pervious earth—a splendid microbe obstructionist—is, therefore, an object well worth attempting. Bored wells being financially out of the question in this instance, this aim can best be secured by the use of Norton's tube wells (otherwise known as Abyssinian wells) which are iron tubes varying in diameter from one to four inches. They are made in lengths which can be screwed together; one length is provided with a sharp point, and above this are numerous openings. The object aimed at is the forcing of the iron tubing into pervious soil until the water stratum is reached. To accomplish this, special driving apparatus is used which any overseer would readily understand how to employ. Water having been struck—as can easily be ascertained by using the little plumb supplied with the apparatus—a pump is screwed on the end of the tube protruding from the ground. The water first obtained by pumping is usually muddy, and looks an unsavoury mixture. Hence, it is worth while remembering that the tube being sunk within more are less loose earth it is but reasonable to expect that for a certain time this should be delivered with the water. Continuous pumping and, in bad cases, washing out by means of the "cleaning pipes" with water derived from elsewhere, until the debris cease appearing at the pump should be pursued. The longer such a well is used the better becomes the reservoir, which is formed round the tube point in the earth. When the tube is much choked by sand it may be withdrawn, cleared and then re-inserted through a mass of pebbles previously rammed down the hole made, or dropped through a tube into position so as to surround the perforations. These wells are cheap, the average cost, *Burns & Co., Calcutta*, being as follows:—

	Tube 1½" pump barrel diameter 3"	Tube 2" pump barrel diameter 4"
Tube well 30 feet	Rs. 50	Rs. 100
Extra tube per foot	2	3
Field pump (extra strong)	30	250
Complete set of combined driving and withdrawing apparatus, complete.	200	

19. In respect to the "driving apparatus," &c., it must be remembered that one will suffice for the sinking of any number of wells. The yield of Norton's tube wells may be taken as follows:—

Size of tubes in inches.	Gallons per hour.
1½"	150 to 600
2"	300 to 1,200
3"	600 to 2,400
4"	1,200 to 4,400

20. These wells are, therefore, cheap, and thoroughly efficient in that they deliver water direct at the surface in a manner that forbids contamination, especially if leakage along the tube from above downwards be frustrated by a small concrete ring at the surface. Although it is possible to use them under special conditions in impervious strata by using boring, for all

practical purposes, the employment of these wells should be confined to pervious strata and to depths not exceeding 50 feet. There are large tracts in the Ceded Districts where these wells would not be of utility, on account of the presence of rocky strata, but, on the other hand, there are also numerous places where the sub-soil water is found within strata easily penetrable by driving. One merit worthy of being held in mind is that they can be shifted from place to place, and this is often of great use in tracts where sweet and brackish water are so often found in close proximity. They are, therefore, useful also in exploring for a suitable quality of water previous to sinking ordinary dug wells. If the water is within 25 feet of the surface, the common suction pump sold with the tube wells suffices to effect lifting; if beyond this, deep well pumps must be employed—when the subsidiary arrangements requisite are not worth the trouble of abiding by this description of well. A further sphere of utility for them would be found in attempting to get water from ordinary dug wells or tanks that have run dry. Provided the bottom of the well or tank be pervious, a Norton's tube can readily be sunk within it, with the result of obtaining water at a depth that may require its being pumped up; or, it may chance that water struck being under pressure it will rise within the limits of the old dug well through the tube, no pump being necessary.

21. *Wells with pumps.*—The next best approach to security is obtainable by the use of ordinary dug wells provided with an impervious lining and backing and covered in so as to prevent either light or dust entering, and furnished with a suction pump at the side—not immediately over it—a condition that is easily attainable by using a bend on the suction pipe if the depth is not over 25 feet (*vide* diagram D). The cost of common suction pumps suitable for this purpose is as follows:—

Revolving top cistern pump (Burn and Co, Calcutta.)

Diameter of cylinder.						Capacity per stroke.	Price of iron pump.
2	..	..	..	..	..	GALS.	RS.
2½	..	..	..	..	..	1½	15
3	..	..	..	..	..	2	17
3½	..	..	..	..	..	2½	21
4	..	..	..	..	..	3	24
4½	..	..	..	..	..	3½	34
5	..	..	..	..	..	4	43

22. A very good modification of this arrangement is obtainable in dealing with an unlined well newly sunk by placing an iron water pipe, or glazed stoneware or cement pipe with perforations at the end, so as to make a continuous shaft from the bottom to the top of the well. The well space surrounding this shaft should then be filled in with clean metal, gravel, and sand in successive layers from the bottom. Through the shaft left communicating with the water should then be placed the ordinary suction tube of a pump.

23. As regards expenditure for this system it must be remembered that, as in the case of the Norton's tube wells, if it be found in shifting camp that the cost of leaving the apparatus *in situ* cannot be undergone, there is nothing to prevent the pump being moved, and, for the matter of that, if it be thought worth while on account of lining the shaft being formed of pipes, these also could be removed at the cost of a little excavation in loose soil.

24. *Re-modelling old wells.*—The well most commonly found in the Ceded Districts is a huge square structure provided with steps leading down to the water. This description of well is of course absolutely dangerous as to infection by cholera in that the water is exposed to contact with chatties, ropes, hands and feet—very often of hundreds of persons per day, irrespective of the occasional washing of clothing and of the person for which these wells are also employed. The very least sanitary precaution that should be taken in the case of such wells is to insist upon the abolition of the use of the steps by effectually blocking them up, so as to render approach *impossible*, and fixing at the surface level some form of pulleys. A guard of a caste that will satisfy all ordinary persons as to caste requirements should be stationed at a well. Where this is feasible he alone should be permitted to draw water with metal buckets provided for the purpose; but when this will not be tolerated, or where the number of persons to be served would render it impossible on account of the labour involved, a waterman per caste, or a suitable number of buckets per caste and ropes—preferably light chains—should be available.

25. Occasionally such wells are so built that it would not be possible to make use of pulleys fixed at the surface at the ground level. In this case, it is often feasible to erect within the well a platform that would at least prevent feet and hands being put into the water, or a platform may be made so as to project slightly over wells. In both instances, these platforms should be made impervious, and with a slope if on the ground surface to a suitable outlet, and, if within the well, to a cistern whence drippings and foul water can be removed by hand or pump. Such platforms may be devised of wooden supports with wooden flooring caulked and tarred, or of bamboo matting supported on sound frames and covered with clay having gravel above it, or corrugated iron may be employed with or without a layer of concrete above it.

26. In dealing, however, with a "step well" that is likely to be long in use, it is advisable that a modification of the principle mentioned in the close of the last paragraph be adopted: that is, by building a new round well within the old structure, or by placing in it a shaft of iron water pipes, or stoneware sewage pipes, or by even employing the common earthen rings used for pot wells, so that the danger of direct approach by steps can be got rid of by the simple device of contracting the area by filling with clean material. If the depth is such as will permit of the use of a common suction pump, this should be employed.

27. But this method need not solely be followed in re-modelling wells already made; it may be usefully applied in dealing with the huge unlined excavations now frequently found at the sides of roads on which famine works are situated. One excuse for making these excavations after the manner of the country instead of forming small circular wells is that labour is provided for famine workers, but, if this method of filling in with clean material be adopted the labour in making the useless area could still be permitted, whilst the enormous cost necessary to line such wells with masonry—*plus* steps to make them easy of defilement—would be avoided. As a fact, unless some such mode of contracting the area be followed, the majority of these excavations never will be lined, and consequently will soon be filled in with debris. As an allied subject undersigned would point out that it would be of much advantage, if the object lesson of wells, being made in this manner, could be afforded to ryots. The main expense in making wells, which are so much needed in the Ceded Districts, is the great cost of the masonry lining. This, in the method described, is reduced to a minimum. The only contention against this mode can be that in the large wells, the rate of withdrawal by "mots" can be quick for the reason that friction to which the water is subjected in passing through the earth pores, for the loss of the amount already collected in what is virtually a reservoir, is diminished. But by arranging to have a bottom layer of rubble or boulders, friction is reduced when compared with what it would be were undisturbed strata to be passed through, so that, beyond the effects of displacement on storage, the ryots would be as well off as with the enormous open and expensive wells now employed.

28. *Protection of tanks.*—A very common impression is that where a large mass of water is concerned, it is not necessary to go to the trouble of special means of protection. Yet, the only safe practice to follow as to tanks of the ordinary description found in this Presidency is to regard them solely as sources of water-supply—not as part of the system of distribution. Usually a readily adaptable procedure is to fence the tank, and to sink at the sides one or more wells in the banks which will be supplied sufficiently by percolation. If the use of pumps is out of the question, these wells may be formed in accordance with the usual mode pursued by natives in sinking pot wells, except that a backing of clay should be used above the lowest water level and an impervious platform of concrete—cement-plastered—or of slabs on concrete with cement pointing may, if the structure is likely to be used for any length of time, be employed with advantage. But at times tanks may be of a character where this mode may not be easy of adoption. In this case, impervious platforms should be erected on the same principle as mentioned in paragraph 25 *supra*, but so arranged as to pass into the water the required distance.

29. Where, in connection with tanks, the washing of clothing is requisite, it should be arranged that the water be withdrawn with all the care insisted upon in the case of drinking water and the cleansing of clothing be proceeded with at a spot distant from the tank.

30. *Wells with beams across.*—It is a common practice for beams to be thrown across wells on which persons stand to draw water. Contamination from drippings from the feet must therefore occur. Beams should be removed in such instances, and ordinary drawing be insisted on.

31. *Lifting to tanks.*—It need hardly be said that both in the case of tanks and wells a far better way than any described above is to lift the water to covered tanks by pumping, * and thence let the water be drawn for distribution by taps; but it is not likely that expenditure by such methods would be tolerated, and the system need therefore not be more than alluded to. Nevertheless, it should be employed wherever financially feasible in preference to all others. The most reasonable field for this mode would be in connection with "poor-houses."

32. *Rivers.*—In a famine-stricken district, it is not likely that many instances of flowing water will present themselves for notice; but where this is so, portions should be marked off by flags (and if the stream is small, by wires stretched from bank to bank) for drinking purpose, for bathing, washing and for cattle, in the order named going with the current, that is, the drinking ghât should be fixed up stream. It must be remembered, in respect to small streams and rivers, that there is no more dangerous time as to conveyance of cholera than with the first freshes after rainfall. Hence it is advisable, if there be reason to know that cholera is in any part above stream not to allow famine workers to use such water. Where compulsion cannot be used, the advice to boil the water should at least be given by tom-tom at frequent intervals. Beyond this it would be advisable to sink pot wells or Norton's tube wells on the bank, and require that these be employed, at any rate, so far as distribution on works by public agency is concerned. Some degree of safety may also be attained by causing the water

* The "Sultan lift" offers a cheap alternative. It can be adapted so as to offer a considerable measure of sanitary safety.

to undergo rough filtration through gravel; or, still better, if the rate of withdrawal will not render this out of the question by requiring an area that renders the whole proceeding too expensive, sand may be used above the gravel—it being held in mind that both gravel and sand must be obtained from sources free of suspicion of contamination by human beings. This can be effected by making an excavation in the bank, and filling this in after the manner of a filter bed. Within this filter bed could be sunk pot wells in which the water would arrive after filtration, on admission of the river water to the surface of the filter bed. It may happen in making such an effort that sufficient good sub-soil water would be reached to prevent it being necessary to look to the river as a source. In this event, there would be no object in using the sand layer—the sub-soil water would simply percolate through the gravel to the pot wells.

33. Where the sandy bed of a river is dealt with if the native had his own way, he would make a huge excavation—a so-called “spring” in which he would wash and withdraw his water. Instead of allowing this, numerous pot wells should be sunk in the sandy bed.

Distribution of Water-supply on relief works.

34. It should be arranged that the supply for drinking purposes be ample.

35. It is advisable, with reference to paragraph 8, to prevent dangerous defilement of pools, &c., in the neighbourhood, that sufficient water should also be on the spot for ablution purposes of, say, fifteen per cent. of the workers. The amount of water required per day would, therefore, be :—

For every gang of 100 adults of a mixed population ...	50	gallons.
15 per cent. ablution water for a mixed population ...	3	”
Waste ...	1	gallon.
Total ...	54	gallons (= one sherry-caskfull).

If cooking is conducted 60 gallons per gang *extra* should be supplied.

36. It is not advisable to use chatties carried by workers, as contamination by means of their hands and clothing may occur. Wherever possible, casks mounted on wheels and drawn by men or bullocks should be employed.

37. The capacity of these casks should be carefully estimated and be painted on them in large characters.

38. The number of trips per day necessary for the supply of each gang should be definitely settled.

39. The following is a useful formula (Hurst) for calculating the capacity of casks :—

D, d = inside diameters at the heads.

M = inside diameters at the bung, and L = the length, all in inches: then the capacity in imperial gallons = $\cdot 0014162 L (Dd + M^2)$

or,

“Take the bung diameter in inches, by measuring the circumference at the bung, and making an allowance for the thickness of the staves: square the bung diameter, and multiply by 39. Take the head diameter in inches by direct measurement, and square it, and multiply by 25. Multiply one diameter by the other, and multiply by the length of the cask in inches, then multiply by $\cdot 000031473$, and the result is given in gallons” (Nisbit).

40. Each head cooly should be made to sign a receipt form in acknowledgment of receiving the required supply each time of delivery.

41. Carts should be fitted with cast-iron taps. Their cost is as follows :—

1 inch = Rs. 1-8-0; $1\frac{1}{2}$ inches = Rs. 2; $1\frac{1}{2}$ inches = Rs. 2-12-0; 2 inches = Rs. 4. If these cannot be employed, on no account should any methods adopted be supplemented by the use of old rags, and the like, to stop leakage.

42. If it be arranged that three trips per day be taken, it will follow that if two be made in the morning and one in the afternoon, the storage capacity for each gang, if no cooking is pursued, should be about 18 gallons. This would be secured by the use of four chatties of ordinary size, or three kerosine tins. These are about the only methods of storage that can be economically arranged, but Best & Co.’s kerosine oil drums with taps, or small casks with taps might prove more economical (as they certainly would be better sanitarily) than the alternatives mentioned, if famine were long continued.

43. With both chatties and kerosine tins, well-fitting covers must be employed. In the case of old kerosine oil tins this can be managed by using a tin cover with handle at the top and, in the case of chatties, by the ordinary earthen “chipa.”

44. It should be insisted that head coolies be responsible for seeing that the water for their respective gangs is kept correctly covered as soon as water has been withdrawn by any person.

45. It would be advisable to select a respectable man of good caste, whose whole time should be devoted to guarding the gang water, and seeing that orders as to it are carried out.

46. On no account should workers be allowed to dip their own utensils or hands into the storage vessels. A cheap and effective arrangement is to use tin “Burmese spoons.” (These can be obtained at a cost of 8 annas each from Messrs. Sultan & Co., Royapettah, Madras). Simple as the device is, it should go a great way towards securing protection from pollution of water. It has been suggested that large coconut ladles would do as well; these, however, are of a structure and present a surface far less safe bacterially.

If the man appointed under paragraph 45 be of sufficiently good caste to satisfy requirements of the workers—and every effort should be made to arrange that this is so—the “Burmese spoon” should be touched by no one except him.

After use, the “Burmese spoon” should not be placed on the ground, but should invariably be hung up near the storage vessel by the hook on the handle.

47. The storage vessels should be placed on a pyal slightly raised, and sloped with gravel or metal to one side, so that spilt water can readily drain from this to a clay-lined gutter. The gutter should be led to a sufficient distance into a pit for disposal by soakage or for the use of trees.

48. If there be no suitable shade from trees, the water should be protected by a few slabs if at hands; or a rough thatch of grass, jowari stalks or branches of trees intertwined, may be employed.

49. The head cooly should particularly see that no water left from the day before is retained in any storage vessels, when fresh water is placed in it.

50. Once weekly during the prevalence of cholera* in the neighbouring villages, and more frequently—at the Sanitary Inspector’s or Medical subordinate’s discretion—if it has occurred on the works, the water barrels should be disinfected by pouring into them milk of lime (one part fresh slaked lime to four of water) which should be left to soak throughout the night and be washed thoroughly next morning with water from a safe source and that has been rendered pink by permanganate of potash. The storage vessels should be disinfected with a solution of permanganate of potash of a strength sufficient to maintain a pink colour for half an hour after the vessel has been agitated, or be placed on a fire till too hot to touch.

(Signed) W. G. KING, M.B., C.M., D.P.H., Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

MEMORANDUM ON CHOLERA PREVENTIVE MEASURES ON FAMINE-RELIEF WORKS.

The advent of cholera on relief works may be defined as the period when any village supplying labour has reported a single attack, or in the opinion of any medical officer “a suspicious case of diarrhoea” has occurred in any of such villages, at a period of the year when cholera is usually epidemic in the district concerned.

The Sanitary Staff required.

2. Whether there be a medical subordinate attached to the work or not, the appearance of cholera should be followed by the appointment of a certificated Sanitary Inspector who should assist the Tahsildar by affording advice on sanitary matters on the works, and as to the sanitary condition of all villages within five miles radius of the work.

Note.—Certificated Sanitary Inspectors have received the special class of training that should enable them to deal with the practical sanitary requirements of the situation, and therefore have on this account an advantage over the ordinary medical subordinate in this respect; at the same time, it must be remembered that the medical subordinate is no less necessary for medical treatment of patients, which should, on no account, be delegated to the certificated Sanitary Inspector, even if he happen also to be a trained medical subordinate—it being impossible for a man to attend to the medical requirements of patients suffering from so severe a malady as cholera otherwise than perfunctorily if also called upon to fulfil sanitary work. A register of certificated Sanitary Inspectors is maintained in the office of the Sanitary Commissioner, and men can usually be provided on short notice if fair salaries are offered. If, however, certificated Sanitary Inspectors are not available, a medical subordinate should be specially detailed for sanitary duty. Failing the latter arrangement also, an intelligent person—preferably a Revenue subordinate—should be placed on this duty. It will therefore be understood in the following remarks that the term “Sanitary Inspector” is meant to cover any person detailed for the special duties described.

3. Under the Sanitary Inspector should be placed the staff mentioned in paragraph 9 of the memorandum on “Conservancy and water-supply on famine-relief works, &c.,” and in addition two peons should be allowed him to enable messages to be rapidly carried.

4. The Sanitary Inspector should be mounted, and if it can be managed at least one of his peons should also be mounted.

The following would therefore be a typical minimum staff :—

For two sub-maistries charges = 800	Toties—1 male and 1 female.
famine workers.	
For one head maistry charge of 1,600	1 male sweeper and 1 sanitary
men.	peon.
For sanitary charge of famine-relief	1 Certificated Sanitary Inspector.
works and villages within a radius	1 mounted orderly.
of five miles.	1 peon.

* Further instructions as to treatment of water will be found in the memorandum referred to in paragraph 13.

5. The Sanitary Inspector and all peons of the staff should be caused to wear a mark that would easily distinguish them, such as the Red Geneva Cross on a white band round the arm, or other simple device.

Arrangements in villages.

6. The village head should be provided with the following instructions printed in the vernaculars:—

To the Village Reddi of —.

(1) On the occurrence of a case of cholera, or of diarrhoea which you suspect to be of the nature of cholera, in addition to the action required of you under Revenue Board's Standing Orders of No. 195-1, you should at once send a report stating the full facts to the Certificated Sanitary Inspector in charge of famine relief works within five miles of your village, or at any greater distance if you know any person from your village resorts to them for any purpose whatsoever. If you have not ascertained that a Sanitary Inspector has been appointed, you should address the officer in charge of the relief works.

(2) You should enquire of each patient with great care as to the place or places where the first as well as subsequent motions or vomit were passed, and you should arrange to have places so soiled searched for, whether these be within the house, premises, in the fields or elsewhere. When found, the soiled earth should be covered with the disinfectants supplied by the Tahsildar, and be then removed and buried at a depth of five feet covered with two inches of disinfectants in a place far removed from water-supplies, and not less than 800 yards from the village at a depth of five feet. Persons engaged on this duty should disinfect the instruments used by heating the metal on a fire till they cannot be touched; wooden shafts of instruments should have boiling water poured over them: their bodies should be cleansed as advised in paragraph (7).

If no disinfectant is available, freshly-slaked lime mixed with water till of the consistence of cream may be used for covering the soiled earth before removal and during burial. If even lime is not available the earth should be covered with straw which should be burnt. Similarly if there be no disinfectants for covering the faeces and vomit when passed, these should be mixed with saw-dust or paddy husk and, if available, with a little kerosine-oil, and the whole be burnt outside the house.

(3) Any clothing that has been in the slightest degree touched with the faeces or vomit of the patient, should be destroyed by fire as well as any ropes of cots, mats, bedding or other destructible articles.

(4) When the soiled clothing is valuable, it may be placed in a chatty and be thoroughly boiled for use in a place distant from the village. In conducting this work, the water requisite for the purpose should be drawn from the water-supply source by a person who has not been in contact with the clothing, or in any sort of personal attendance upon the patient. The chatty after use should be broken.

(5) You should *directly*, if a person has been attacked with cholera, arrange that all persons living in the same house should not draw water from any source. It should be supplied to them by others pouring water into their chatties from a safe source.

(6) During the illness of a person, arrangements should be made for receiving all faecal matter and vomit in a "chippa" containing disinfectants to be disposed of as stated in paragraph (2). This should be continued for a period of at least ten days after the person's complete recovery.

(7) All persons attending upon the patient during his illness should be warned of the danger of eating or drinking anything from the same vessels or handling the patient and then eating anything, or placing their hands near their mouths, until purification has been carefully conducted by washing the hands and feet and preferably the whole body with water as hot as the body will bear. If obtainable, soap should also be used. If the Sanitary Inspector be communicated with, he will furnish disinfectants for purifying the hands, and will give instructions as to their method of use.

(8) When the illness is over, the earthen chatties should be broken and be buried in the pit described in paragraph (2). All chatties, metal or earthen, in the house should be placed over fire and heated till the hand cannot bear contact. Wooden articles of furniture that are not valuable should be burnt. If valuable and it is desired to retain them, boiling water may be poured over them, and they should be dried in the direct rays of the sun for two days before return to the house. Any stains of vomit or faeces on the floor or in the latrines or elsewhere should be treated as stated in paragraph (2). The drains or any places wet with the sillage from the house should be covered with disinfectants or lime. The rooms should be white-washed with freshly-slaked lime, and doors and windows should be kept open till thoroughly dry.

(9) So as to make sure that persons from infected houses do not bring their infected chatties, ropes, &c., for use in the village water-supply, you should place a constant watch on the sources of water-supply, for drinking and domestic purposes.

Note.—The reason for all the above precautions is that the poison of cholera is in the vomit and faeces of patients, and the smallest particles conveyed to the mouth from the hands or from chatties would cause infection. If the smallest particle reaches water, it will multiply in the water just as from a single seed of paddy much grain is obtained. If the poison gets into the water, all partaking of it may be infected. Hence the greatest care is necessary to preserve all water-supplies both for drinking and domestic purposes from being contaminated. Should the infective matter reach the water, it can be destroyed by boiling the water and thus it becomes harmless to man. Hence it is essential that the following command of the Hindu Shastras be carefully obeyed:—"In every case when disease is suspected, it is best to use boiled water, boiled down to tenths, six-tenths, or hundredths, and cooled down as such will cure the disturbed humors of the body, and correct digestion."

But for this advice of the Shastras to be of benefit, it is necessary that boiled water be used not only for drinking but for washing all vessels employed for cooking, eating, or storing fluid or solid articles of food.

7. The following instructions should also be proclaimed by tom-tom in the village daily during the continuance of cholera:—

The Person.

(1) The body and clothing should be kept scrupulously clean. Persons should use warm, not cold, baths.

(2) The food should be plain, nourishing and of good quality.

(3) All vegetables, or leaves, or fruits, likely to cause diarrhoea, should be abandoned

(4) All forms of drinking to excess, debauchery, late hours and exposure to wet and cold should be avoided.

(5) Cold cooked food should never be used. Care should be taken not to allow flies to settle upon food. Vegetables and leaves should never be eaten otherwise than after cooking. Before being cooked, they should be well washed in water that has been purified by boiling. Salt should be freely used with the diet—but, on the other hand, it must not be used in such unusual amounts as to excite uneasiness or looseness of the bowels.

(6) An inferior quality of water should not be kept in the house; only the cleanest available should be employed.

(7) Water for drinking purposes and for washing the mouth or eating and drinking vessels, and milk, should be boiled before use.

(8) No purgatives should be taken.

(9) Any tendency to diarrhoea should at once be checked by the taking of appropriate medicines; any person having more than two motions in twenty-four hours should take this precaution.

(10) No fear should be felt, nor should the subject of cholera be constantly thought or spoken of.

Arrangements on the Works.

8. A place should be appointed as near the centre of the works as feasible, which should be known as the "ambulance station." If it can be so arranged this should be the head-quarters of the medical subordinate, and all the sanitary staff. Here should be the store for disinfectants and stretchers, or other arrangements for transport of sick or injured persons. This place should be marked by a red cross flag, or other suitable device of the character used as a badge by the sanitary staff.

9. Suitable stretchers can be made from "chensu cots" provided with bamboo poles at the sides. Cadjan leaves or gunny bags could be arranged as an awning.

10. If there is a medical subordinate attached, it would be suitable that he should visit this site at hours that should be made known by tom-tom, when persons requiring medical aid might find him.

11. At a spot so situated that persons can readily be brought from any part of the works, a cholera shed should be erected. The question of suitable plan for this building, staff and appliances for nursing are matters that would be dealt with by the District Sanitary officer, or other officer deputed by him.

12. Diagram affords an idea of the arrangement of sheds that is considered advisable. The nursing and cooking staff should be in numbers and quality sufficient to make sufferers completely confident as to care being exercised. Of course, compulsion cannot be employed, but it would be most desirable that a person attacked on the works should not return to his village. The best way to get this result is to gain the confidence of the sufferers by seeing that their comforts are really looked after.

Duties of the Sanitary Inspector.

13. The Sanitary Inspector should be subordinate to the Tahsildar, and will look to him for executive orders. That officer will be responsible that the time of the Sanitary Inspector is efficiently employed. In professional matters, the Sanitary Inspector should be subordinate to the District Sanitary officer, or any medical officer of not lower rank than of Assistant Surgeon in charge of the area to which he is appointed.

14. The Sanitary Inspector should understand that he is responsible for the sanitary condition of the villages within five miles radius of the work, but that his special duty is not so much bringing the villages up to a standard of permanent sanitary perfection as getting them rapidly, especially with reference to conservancy and water-supply, into a condition better fitting them to resist invasion by cholera. Measures for improvement that he advises must therefore be of an inexpensive nature, and no recommendations should be made unless it be felt that direct benefit in the prevention of cholera will be obtained. The Sanitary Inspector is also responsible for advising the officer in charge of the works as to all sanitary questions in reference to conservancy, water-supply and the checking of contagious diseases. It must be distinctly understood by the Sanitary Inspector that his duties do not end with advising, but that as far as time is at his disposal he should supervise the effecting of urgent sanitary improvements, and that he is responsible for the correct effecting under his personal supervision of measures for prevention of spread of infectious diseases, both in the village and on works.

15. If the Tahsildar be within the five miles radius, of which the Sanitary Inspector has charge, he will make his recommendations as to villages in a report book. One-half page of this will be arranged for the Sanitary Inspector's recommendations, and on the other half the Tahsildar will state what action has been taken by him. If the Tahsildar is not within the five miles radius, the recommendation should be carried out in the usual manner by letter.

16. In communicating with the officer in charge of the works the separate report book arranged as above stated should be used.

17. On a visit of inspection by any superior officer of the works, the Sanitary Inspector should lay the book before him and explain what sanitary precautions have been taken.

18. The Sanitary Inspector should maintain a diary, in which he should state distinctly the nature of duties performed by him daily and the number of attacks and deaths from cholera in the area and on the works in his sanitary charge. A copy of this diary should be sent to the District Sanitary officer daily during prevalence of any epidemic disease and weekly otherwise. This book should also be placed before any superior officer during his inspection of the works.

19. Before making any recommendation involving heavy expenditure, the Sanitary Inspector should communicate with the District Sanitary officer. If the question be of importance, it will rest with the District Sanitary officer to take such action thereon as he may think fit.

Duties of Sanitary Peons.

20. One peon will act as mounted orderly to the Sanitary Inspector, and will obey all reasonable orders in aiding and effecting all sanitary duties under the orders of the Sanitary Inspector.

21. One peon will, during work hours, be at the ambulance station and will be available for general duties such as the bringing in of the sick, the despatching and carrying of disinfectants, and the superintending of the temporary disinfection of any spot in the absence of the Certificated Sanitary Inspector.

22. The remaining peon will undertake the usual routine of attending to latrines, and seeing that the menial staff of toties and sweepers are present at the required hours and effect their work correctly. In the absence of the Sanitary Inspector he will, in reference to conveyance of sick and disposal of infective matters, together with the staff of sweepers and toties under him, obey the orders of the "ambulance station peon."

23. Each peon shall in turn take care of property at the ambulance station during the night, and be liable to proceed with the Sanitary Inspector to villages, if required on urgent cholera duty.

Duty of Head Coolies in charge of Gangs.

24. The head cooly should carefully watch all workers under his charge as to going for purposes of nature. He should instruct the toty or sweeper on duty at the latrine to at once inform him, if a person goes to stool more than twice during the day or has suspicious stools. Such persons if not in a weakly state should be sent to the "ambulance station" in charge of a trustworthy person. If in a weakly state, the head cooly should send for a stretcher from the "ambulance station," and cause the person to be carried there with the aid of the sanitary peon.

25. The head cooly should carefully observe where motions have been passed, and should cover them with disinfectants obtainable at the "ambulance station" or from the head maistry, till the arrival of the sanitary peon or Sanitary Inspector, under whose orders they will be disposed of finally.

26. Head coolies should be informed of the site chosen for the ambulance station, and it shall be required that failing his finding a sanitary peon on the work, he should personally report attacks there.

Note.—After receiving temporary medical treatment and the case being considered one of cholera, the patient should be removed to the cholera hospital. If the distance be too great for hand transport, the cart employed must be thoroughly disinfected with perchloride solution 1—1,000 by the medical subordinate receiving the patient before dismissing the cart.

Disinfectants.

27. Each peon should be provided with a tin canister of the pattern as per diagram, which should be slung on the shoulders and be worn at all times when on duty. A similar tin canister should be provided for each head maistry who should be required to keep it at a place made known by him to all head coolies, and who should have access to it with reference to the duties required in paragraph 25?

28. This canister should be filled with 5 lb. of carbolic saw-dust, carbolic lime, or MacDougall's powder.

29. The Sanitary Inspector will personally superintend the distribution of the carbolic saw-dust or carbolic lime from stores supplied to him on indent through the District Medical and Sanitary officer, or, failing these being so obtained in due time, the Tahsildar should make arrangements for supply from such sources as he may find available.

30. The following disinfectants should be at all times available:—

In charge of the Reddi in each village, within five miles radius of the works, or supplying relief workers.	Carbolic saw-dust lb. 10
To be retained at the ambulance station for every thousand relief workers.	Crude Carbolic acid 2
As a general reserve, for every five thousand inhabitants of neighbouring villages.	Do. 1
For each Sanitary Inspector's charge.	Bazaar perchloride of mercury oz. 8 Fuschine (red-ink powder). grs. 80 Commercial hydrochloric acid. oz. 8 Permanganate of potash ... lb. 2

The Use of Disinfectants.

31. The crude carbolic acid should be used in the proportion of 1 part to 10 of saw-dust or, failing it being possible to obtain saw-dust, old stale lime may be employed.

32. Perchloride of mercury should be employed by Certificated Sanitary Inspectors and medical subordinates only. It should be prepared as follows:—

Perchloride of mercury, oz. $\frac{1}{2}$; Hydrochloric acid, oz. 1; Fuschine, grs. 5; Water 3 gallons.

Note.—The fuschine is added simply to colour the solution which might otherwise be taken for water—the perchloride being very poisonous.

33. Under their superintendence the solution should be employed for the disinfection of walls, flooring, "wooden furniture," and soakage of infected clothing—previous to boiling.

34. When freshly-slaked lime can be obtained it may be economically employed for disinfection of faeces and vomit-stained ground, and for the disinfection of water casks by using it in proportion of 1 part of lime to 4 of water.

Disinfection of Wells and Tanks.

35. As a matter of precaution when cholera is prevailing in the neighbourhood of the works, the water-source supplying the works, if a well, should be disinfected at intervals at the discretion of the Certificated Sanitary Inspector.

36. If it be known that a well or tank has actually been infected with cholera, it would be advisable to bale out the whole water where feasible having regard to size, and where not feasible, simple disinfection must suffice.

37. All unguarded or suspicious water-supply sources should be closed by mechanical means so as to render withdrawal of water impossible.

Disinfection by the Alum Process.

38. If the water-source is too large to be disinfected within reasonable cost by the permanganate of potash, the alum process may be employed in lieu.

39. Alum (Hind. Phitkari, Tam. and Tel. Pati-karam) is obtainable in ordinary bazaars at cheap rates. If the water is soft, the use of alum should be preceded by the use of stale lime or chalk in the proportion of one grain to the gallon. The amount of alum required is from 4 to 6 grains according to the amount of organic matter, *alias* "dirt," with which the well seems charged. A ready-reckoner for four grains per gallon is subjoined:—

TABLE I.—Quantity of water contained in Wells and Circular Tanks per foot in depth with the quantity of Alum required.

Diameter.	Contents.	Quantity of Alum required per foot.			Diameter.	Contents.	Quantity of Alum required per foot.		
INCHES.	GALS. PER FOOT.	LB.	OZ.	GRAINS.	FEET.	GALS. PER FOOT.	LB.	OZ.	GRAINS.
1	0.034	0	0	0.136	14	0.962	..	8	8
1 1/2	0.076	0	0	0.304	15	1.104	..	9	98
2	0.135	0	0	0.540	16	1.256	..	10	224
2 1/2	0.212	0	0	0.848	17	1.418	..	11	392
3	0.305	0	0	1.22	18	1.590	1	1	120
4	0.54	0	0	2.16	19	1.772	1	2	368
5	0.85	0	0	3.4	20	1.963	1	4	172
6	1.22	0	0	4.88	25	3.068	2	1	272
7	1.66	0	0	6.64	30	4.418	3	..	392
8	2.17	0	0	8.68	35	6.013	4	2	52
9	2.75	0	0	11.0	40	7.864	5	5	216
10	3.39	0	0	13.56	45	9.940	6	10	400
11	4.12	0	0	16.48	50	12.272	8	6	120
12	4.91	0	0	19.64	55	14.850	10	3	360
13	5.75	0	0	23.00	60	17.671	12	3	124
14	6.67	0	0	26.68	65	20.740	14	5	20
15	7.67	0	0	30.68	70	24.053	16	8	212
16	8.72	0	0	34.88	75	27.611	19	2	44
18	11.04	0	0	44.16	..	..	..	..	..
FT. IN.									
1 9	15.0	0	0	60.0	80	31.416	21	9	384
2 0	19.8	0	0	78.4	90	39,768	27	7	152
2 3	24.8	0	0	99.2	100	49,088	34	1	32
2 6	30.7	0	0	122.8	110	59,396	41	2	464
2 9	37.1	0	0	148.4	120	70,685	49	1	20
3 0	44.2	0	0	176.8	130	82,956	57	7	144
3 3	51.1	0	0	204.4	140	96,211	66	9	364
3 6	60.2	0	0	240.8	150	110,447	76	8	188
3 9	69.0	0	0	276.0	160	125,664	87	3	96
4 0	78.5	0	0	314.0	170	141,862	98	6	88
4 6	99.4	0	0	397.6	180	159,044	110	5	176
5 0	122.7	0	1	10.8	190	177,006	123	..	344
5 6	148.5	0	1	114.0	200	196,350	136	4	120
6 0	176.7	0	1	226.8	250	306,796	213	..	304
6 6	207.4	0	1	349.6	300	441,788	308	9	272
7 0	240.5	0	2	2.0	350	601,322	417	7	8
7 6	276.1	0	2	144.4	400	785,400	545	5	..
8 0	314.2	0	2	296.8	500	1,227,190	832	2	280
8 6	354.7	0	2	458.8	600	1,767,150	1,227	2	120
9 0	397.6	0	3	150.4	700	2,405,290	1,670	4	40
9 6	443.0	0	3	332.0	800	3,141,600	2,190	..	..
10 0	490.9	0	4	43.6	900	3,975,750	2,760	11	120
11 0	594.0	0	4	456.0	1,000	4,908,750	3,408	..	120
12 0	707.0	0	5	128.0	..	..	..	..	..
13 0	809.0	0	6	356.0	..	..	..	..	..

TABLE II.—Quantity of water contained in square cisterns or tanks per foot in depth with the quantity of Alum required.

Length of side.	Contents.	Quantity of Alum required per foot.			Length of side.	Contents.	Quantity of Alum required per foot.		
FT. IN.	GALS. PER FOOT.	LB.	OZ.	GRAINS.	FT. IN.	GALS. PER FOOT.	LB.	OZ.	GRAINS.
1 0	6.25	0	0	25	30 0	5,825	3	10	420
1 6	14.06	0	0	56.24	35 0	7,656	5	3	384
2 0	25.00	0	0	100	40 0	10,000	6	11	160
2 6	39.06	0	0	156.24	45 0	12,656	8	9	224
3 0	56.25	0	0	225	50 0	15,625	10	10	100
3 6	77.56	0	0	310.24	60 0	20,600	14	2	400
4 0	100.00	0	0	400	70 0	30,825	21	3	100
4 6	128.56	0	1	28.24	80 0	40,000	27	9	160
5 0	156.25	0	1	145	90 0	50,625	36	1	420
6 0	225	0	1	420	100 0	62,500	43	4	400
7 0	306	0	2	264	125 0	97,656	67	9	384
8 0	400	0	3	160	150 0	140,625	97	7	420
9 0	506	0	4	104	200 0	250,000	173	7	160
10 0	625	0	5	100	300 0	562,500	390	7	240
11 0	756	0	6	144	400 0	1,000,000	694	6	160
12 0	900	0	7	240	500 0	1,562,500	1,085	..	400
15 0	1,406	0	11	344	1,000 0	6,250,000	4,340	3	160
20 0	2,500	1	8	400	..	..	..	..	..
25 0	3,906	2	8	264	..	..	..	..	..

40. In dealing, with very large tanks where even the cost of alum disinfection would prove excessive, much good may be obtained by calculating for disinfection the mass of water included within twenty-five feet all round the tank,* or, if even this be expensive, *one side*—the side where water is drawn by the people.

* One cubic foot of water = 6.24 gallons.

41. The correct distribution of lime and alum in tanks can be arranged by suspending two new cooly baskets between two poles as floats, and by dragging them backwards and forwards by means of ropes till the contents of the baskets are dissolved.

Disinfection by the Permanganate of Potash Process.

42. The subjoined table gives the proportion in which permanganate of potash should ordinarily be used for wells and tanks:—

TABLE I.—Quantity of water contained in wells and circular tanks per foot in depth (Hennell) with the quantity of Permanganate of Potash required.

Diameter.	Contents.	Quantity of Permanganate of Potash required per foot.			Diameter.	Contents.	Quantity of Permanganate of Potash required per foot.		
INCHES.	GALS. PER FOOT.	LB.	OZ.	GRAINS.	FEET.	GALS. PER FOOT.	LB.	OZ.	GRAINS.
1	0.034	0	0	0.0950	14	0.962	0	3	371.00000
1 1/2	0.076	0	0	0.1300	15	1.104	0	4	184.00000
2	0.135	0	0	0.23625	16	1.256	0	5	10.50000
2 1/2	0.212	0	0	0.37100	17	1.418	0	6	294.00000
3	0.305	0	0	0.53375	18	1.590	0	7	157.50000
4	0.54	0	0	0.94500	19	1.772	0	7	372.75000
5	0.85	0	0	1.48750	20	1.963	0	12	119.00000
6	1.22	0	0	2.13500	25	3.068	1	1	293.50000
7	1.66	0	0	2.90500	30	4.418	1	8	22.75000
8	2.17	0	0	3.79750	35	6.013	1	15	182.00000
9	2.75	0	0	4.81250	40	7.864	2	7	832.50000
10	3.39	0	0	5.93250	45	9.940	3	1	38.50000
11	4.12	0	0	7.21000	50	12.272	4	11	175.00000
12	4.91	0	0	8.69250	55	14.850	5	6	299.25000
13	5.75	0	0	10.06250	60	17.671	6	2	419.50000
14	6.67	0	0	11.67250	65	20.740	6	0	92.75000
15	7.67	0	0	13.42250	70	24.053	6	0	174.25000
16	8.72	0	0	15.26000	75	27.611	7	14	290.50000
18	11.04	0	0	19.32000	80	31.416	7	13	..
FT. IN.									
1 9	15.0	0	0	26.25000	90	39,768	9	15	14.00000
2 0	19.8	0	0	34.30000	100	49,088	12	4	156.00000
2 3	24.8	0	0	43.40000	110	59,396	14	13	255.50000
2 6	30.7	0	0	53.72500	120	70,685	17	10	323.75000
2 9	37.1	0	0	64.92500	130	82,956	20	11	380.50000
3 0	44.2	0	0	77.35000	140	96,211	24	0	369.25000
3 3	51.1	0	0	89.42500	150	110,447	27	9	344.75000
3 6	60.2	0	0	104.35000	160	125,664	31	6	287.00000
3 9	69.0	0	0	120.75000	170	141,862	35	7	196.50000
4 0	78.5	0	0	137.37500	180	159,044	39	12	77.00000
4 6	99.4	0	0	173.95000	190	177,006	44	4	362.50000
5 0	122.7	0	0	214.72500	200	196,350	49	1	174.50000
5 6	148.5	0	0	259.87500	250	306,796	76	11	80.52000
6 0	176.7	0	0	309.22500	300	441,788	110	7	67.00000
6 6	207.4	0	0	362.95000	350	601,322	150	5	126.00000
7 0	240.5	0	0	420.87500	400	785,400	196	5	262.50000
7 6	276.1	0	1	45.67500	500	1,227,190	306	12	332.50000
8 0	314.2	0	1	112.35000	600	1,767,150	441	12	262.50000
8 6	354.7	0	1	183.22500	700	2,405,290	601	5	70.00000
9 0	397.6	0	1	258.80000	800	3,141,600	785	6	175.00000
9 6	443.0	0	1	337.75000	900	3,975,750	993	15	..
10 0	490.9	0	2	421.67500	1,000	4,908,750	1,227	13	..
11 0	594.0	0	2	164.50000	..	..	..	..	..
12 0	707.0	0	2	362.25000	..	..	..	..	..
13 0	809.0	0	3	103.25000	..	..	..	..	..

TABLE II.—Quantity of water contained in square cisterns or tanks per foot in depth with the quantity of Permanganate of Potash required.

Length of side.		Contents.		Quantity of Permanganate of Potash required per foot.		Length of side.		Contents.		Quantity of Permanganate of Potash required per foot.	
FT.	IN.	GALS PER FOOT.	LB.	OZ.	GRAINS.	FEET.		GALS PER FOOT.	LB.	OZ.	GRAINS.
1	0	6.25	0	0	10.93750	30		5.625	1	6	218.75000
1	6	14.05	0	0	24.60500	35		7.656	1	14	273.00000
2	0	25.00	0	0	43.75000	40		10.000	2	8	..
2	6	39.06	0	0	68.35500	45		12.656	3	2	273.00000
3	0	56.25	0	0	98.48750	50		15.625	3	14	218.75000
3	6	77.56	0	0	135.73000	60		20.500	5	2	..
4	0	100.00	0	0	175.00000	70		30.625	7	10	218.75000
4	6	126.56	0	0	221.48000	80		40.000	10	0	..
5	0	156.25	0	0	273.43750	90		50.625	12	10	218.75000
5	6	225.00	0	0	393.75000	100		62.500	15	10	..
6	0	306.	0	1	98.00000	125		97.656	24	6	273.00000
7	0	400	0	1	262.50000	150		140.625	35	2	218.75000
8	0	506	0	2	10.50000	200		250.000	62	8	..
9	0	625	0	2	218.75000	300		562.500	140	10	..
10	0	756	0	3	10.50000	400		1,000.000	250	0	..
11	0	900	0	3	262.50000	500		1,562.500	390	10	..
12	0	1406	0	5	273.00000	1,000		6,250.000	1,562	8	..
15	0	2500	0	10	..	..		..	..	..	..
20	0	3906	0	15	273.00000	..		..	..	..	..
25	0										

43. Although this table fixes the proportion of permanganate of potash (1 to 40,000) as sufficing in dealing with water of ordinary degrees of purity, it very often happens that the water dealt with may require more than that stated, on account of its being contaminated with an excess of organic matter. In this case, after the amount fixed has been used, it should be observed whether the water has an unchanging pink colour for half an hour; if not, additions must be made cautiously till this results. The addition of permanganate should be made by mixing it with water withdrawn from the source to be disinfected in any convenient vessel, and in convenient proportions. As soon as dissolved, the contents of the vessel (*e.g.*, a kerosine tin or chatty) should be poured into the well, and by sinking the vessel into and withdrawing it rapidly the whole should be put into a state of commotion so as to promote general mixing.

44. It is very rarely when the reason for using the "medicine" has been explained to natives that they object to its use. The precaution of explaining should always however be taken, as any discovery of alteration of colour is liable to be followed by panic. The colour usually fades within twelve hours completely, so that it is best to disinfect in the evening, and next morning all is found as usual. If it is necessary to get rid of the colour quickly, alum may be used after the permanganate as above described.

Personal Hygiene of Relief Workers.

45. The rules quoted in paragraph 7 should be proclaimed by tom-tom daily during the prevalence of cholera. All subordinates in charge should be repeatedly warned that it is their duty to impress on the people the desirability of using only water supplied to them, and that both this and the supplies used by them in their villages should be boiled and cooled before use for drinking or any domestic purpose.

Action required of the officer in charge of the work.

46. When no Sanitary Inspector or medical subordinate is attached, the officer in charge of the work, on a case of cholera coming to his notice either in villages from which famine-relief workers come or on his works, with the least practicable delay, and by the quickest feasible method, should communicate the fact to the Tahsildar, and to the nearest medical subordinate in charge of an out-patient dispensary, or of an in-patient hospital if one be situated within five miles of the works. Until the arrival of a medical subordinate or Certificated Sanitary Inspector, the officer in charge of the work should do all in his power to fulfil the duties laid down in this memorandum generally, and more especially should take measures in the spirit of the instructions conveyed in paragraphs 6 to 12, 24 to 26 and 35 to 44.

47. The medical subordinate on receipt of such information, unless he be able to prove subsequently to the satisfaction of the District Medical and Sanitary officer that by so doing he would endanger the life of any person actually at that time under treatment should proceed with the least possible delay to the locality indicated, and advise the officer in charge of the works and neighbouring village officials as to the effecting of urgent sanitary measures.

48. In the case of a medical subordinate holding charge of an in-patient hospital, he shall proceed to his head-quarters after having fulfilled his inspection, and having given full instructions to the officer in charge of the works and to the Reddis of the villages concerned, but shall return to perform this duty daily until the arrival of a medical subordinate from an out-patient dispensary under paragraph 49, or Certificated Sanitary Inspector, or he be otherwise relieved by the District Sanitary officer.

49. When a medical subordinate in charge of an in-patient hospital receives notice of the appearance of cholera with reference to paragraph 46 he shall, on proceeding to cholera duty under paragraph 47, despatch a message by the quickest possible method to the medical subordinate in charge of the out-patient dispensary nearest to the works, and require him to proceed without delay to his relief.

50. When a medical subordinate is required to perform urgent cholera duty under paragraph 47, he shall inform the District Medical and Sanitary officer of the circumstances under which he is leaving his head-quarters, and as soon as feasible after making his inspection shall write to that officer a full professional report of the sanitary and medical requirements of the locality.

51. When a medical subordinate in charge of an out-patient dispensary undertakes under paragraphs 46, 47 or 48 urgent sanitary duties, he shall not return to his head-quarters until he has been relieved under the order of the District Sanitary officer, or has received orders from that officer directing him to proceed elsewhere.

ORDER—No. 540, Revenue, dated 7th July 1897.

Miscellaneous.

Forwarded to the Famine Commissioner for remarks.

2. There is much that is of great value in Dr. King's Memoranda, *e.g.*, the directions as to latrine accommodation on works, which are thoroughly practical; but the instructions given for the protection of water-supply and for the treatment of cholera on works are too expensive and elaborate. The Government is also inclined to think that the people will resist and nullify elaborate arrangements, such as those proposed, for the protection of water-supplies. Much greater success will doubtless be obtained if the energies of the local authorities be directed to inducing the people to use only water known to be safe and to the disposal and destruction of cholera faecal matter; experience shows that the native population falls in readily with measures for these purposes.

3. The Famine Commissioner may sanction, in anticipation of approval, the sanitary staff which, in his opinion, is absolutely necessary.

(True Extract.)

(Signed) G. STOKES,
Ag. Secretary to Government.

To the Famine Commissioner.
" the Sanitary Commissioner.
" the Financial Department.
" the Accountant-General.
" the Local and Municipal Department.

Encl. W. D'Moss.

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