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Government of Madras

Public Works

DEPARTMENT

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195

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
11th August 1876. No. 2,075.*

No. 249. Read the following docket from the Government of India in the Public Works Department (Military Works), dated Simla, 25th July 1876 No. 1,108 M.W. :—

Copy of the following forwarded to the Government of Madras in the Public Works Department in continuation of G.O., No. 431, 15th February 1875. Public Works Department No. 1,210 MW, dated 23rd July 1874, for necessary action with special reference to the recommendations made for the improvement of the existing sources of water-supply to the troops at Bangalore from the Dhobies wells and Ulsoor tank independently of the large project for a general water supply for the station upon which orders have been issued to the Chief Commissioner of Mysore in Public Works Department No. 230 CWM, dated 24th July 1876 (copy annexed), and with a request that the Government of Madras will favor the Government of India with a report of the action taken upon this department's No. 1,210 MW, dated 23rd July 1874.

(By Order.)

(Signed) W. A. CROMMELIN, Colonel, R.E.,
Deputy Secy. to the Govt. of India.

From the Sanitary Commissioner with the Government of India, Military Department, Fort William (Sanitary—Reports and Returns), to Secretary to the Government of India, Military Department, dated Delhi, 16th March 1876, No. 165.

In reply to Military Department No. 869 (Sanitary—Reports and Returns), dated the 17th ultimo, with annexures regarding certain matters relating to the sanitary condition of the Cantonment of Bangalore, I have the honor to submit the following observations :—

2. As regards the general health of the place to which my attention has been specially drawn, I would observe that the statistics of sickness and mortality, as a whole, are very favorable. During the ten years, 1860-69, the admissions into hospital from among the European Troops annually averaged 1,043 per 1,000, the daily sick rate 49, and the death rate 14.77. In 1870, the mortality was only 12.14; but, owing in the main to the great prevalence of fever in the 1—21st Fusiliers which arrived in January of that year “saturated with malaria contracted during a residence in Sind,”* the sickness was great, the admissions equalled 2,317, and the daily sick 76 per 1,000.

* Report of Sanitary Commissioner for Madras for 1870, page 23.

3. Since 1870, the sickness and mortality have been in the following proportions :—

Year.	Rates per 1000.		
	Admissions.	Daily Sick.	Deaths.
1871... ..	1,230	53	10.24
1872... ..	1,239	55	15.39
1873... ..	1,109	55	8.30
1874... ..	1,014	60	11.81

4. But although these results compare favorably with those of many other Indian stations, there can be no question that, in the matter of water-supply, Bangalore labors under very serious disadvantages, and there is every reason to believe that, if a proper supply of water were provided, the health of the troops would be much improved. I agree generally in the recommendations

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made by Surgeon-General C. A. Gordon for protecting and improving the water in the Ulsoor lake and Dhobies wells; but would again urge what I have said in former communications on this question, that all such measures are mere palliatives. They may diminish the evils somewhat, but they can never remove them. The water of the Ulsoor lake or Dhobies wells can never be a safe water such as is fit for the troops or any other people to drink. It is of the greatest importance that a proper scheme for supplying Bangalore with good water should be pushed on with as little delay as possible.

Proceedings of the Madras Government in the Military Department, dated 19th January 1876, No. 338.

From Brigadier-General A. HOWLETT, C.B., Quartermaster-General, to Colonel A. C. SILVER, Secretary to Government, Military Department, dated Fort St. George, 6th December 1875, No. 7,758.

I HAVE the honor, by desire of the Commander-in-Chief, to forward for submission a very interesting report on Bangalore, drawn up by Doctor C. Gordon, C.B., Surgeon-General, British Medical Forces, in this Presidency. His Excellency would suggest that six copies be forwarded to the Right Honorable the Secretary of State for India, for communication to the Army Sanitary Commission in London.

From Surgeon-General C. A. GORDON, M.D., C.B., Principal Medical Officer, British Forces, to Brigadier-General A. HOWLETT, C.B., Quartermaster-General, dated Fort St. George, 6th November 1875, No. 205.

WITH reference to my late visit to Bangalore and inquiries into certain matters of Army sanitation there, I have the honor to forward the accompanying report on the results of that visit for the information of His Excellency the Commander-in-Chief.

2. The points I have more particularly adverted to include the water-supply, the present condition of the Ulsoor tank, the evils attributed to a swamp connected with the Dumlloor tank, the state of the Badarhally valley, and of the Tanneries. I have further discussed a few matters connected with the scheme now in progress for supplying pure water to the troops; the occasional occurrence of typhoid fever among them, and the measures adopted at the time of visit to meet, if necessary, the advent of cholera.

ORDERED that copies of the report be distributed as under:—

To the Home Government	20 copies.
" Government of India	12 "
" Quartermaster-General	3 "
" Adjutant-General	3 "
" Surgeon-General, British Medical Service	5 "
" " Indian Medical Department	2 "
" Sanitary Commissioner	2 "
" Military Department	5 "

(True Extract.)

(Signed) A. C. SILVER, Colonel,
Secretary to Government.

Docket, 19th January 1876, No. 339.

Copy of the above, with twelve copies of the report, forwarded to the Secretary to the Government of India, Military Department, for submission to the Right Honorable the Governor-General in Council.

(By Order,)

(Signed) A. C. SILVER, Colonel,
Secretary to Government.

*Proceedings of the Madras Government, Public Works Department,
11th August 1876. No. 2,075.*

REMARKS on certain subjects in connection with Army Sanitation at Bangalore, by Surgeon-General C. A. GORDON, M.D., C.B., Principal Medical Officer, British Forces, Madras Presidency.

WATER-SUPPLY.

THE principal sources whence the water-supply for the British troops at Bangalore is obtained, comprise a series of reservoirs near the Railway Station, the Sampengy tank, a series of wells near what was formerly a race course, the Ulsoor tank, and Dhobies' wells. Of these, the two latter are alone made use of for the ordinary supply, the others being in reserve. Some years ago, an attempt was made to collect sufficient water on the roofs of the barracks near the race course to meet the requirements of the troops quartered therein, and to store it in underground reservoirs. This project was suggested in 1865, in accordance with the system in use successfully at Malta and some other places. It was, however, soon afterwards abandoned in favor of the Ulsoor water works.

The estimated numbers of troops for whom it is necessary to provide water include 2,400 persons and 850 horses. The former require about ten gallons per day, the latter eight,—equal to a minimum average of 30,800 gallons per day. In fact, however, the expenditure is said to equal 50,000 gallons; but besides culinary and drinking purposes, a certain quantity is diverted to bath and ablution rooms, and, if reports speak true, to the irrigation of some gardens.

The troops on duty in the old fort near the station are provided with water from a well in its near vicinity.

THE DHOBIES' WELLS.

Of these, there are thirty-one in all—seventeen comparatively new, fourteen of older date; their total yield equal to 20,000 to 50,000 gallons of potable water per day according to season. Such is the rapid rate of their supply that during the time required to pump up 47,181 gallons, the amount which enters by filtration by their sides equals an average of 16,989. With the exception of three, they are ostensibly supplied from the Ulsoor tank by means of percolation through a stratum of laterite gravel which separates them from that reservoir. The water thus obtained is said to be three times purer than that of the neighbouring tank, as indeed is naturally to be expected. The yield during the dry season, that is from January till June, decreases to 20,000 gallons daily. This quantity would be quite equal to the actual requirements of the troops, if husbanded with care; but as houses are also supplied with filtered water, as well as baths and ablution rooms, the quantity required daily for the whole is stated to be nearly 50,000 gallons. With regard to the three remaining wells, there appears to exist some doubt. According to one expert, their contents are obtained from the deep rock strata beyond the tank, and it is even said that chemical analysis indicates a difference between the water drawn from them and that from the other twenty-eight. According to fact, the supply in the whole thirty-one accords with the depth of water in the larger tank, an ancient from which, recently made for the purpose, enhances the supply from the three that are specially alluded to. Five of those originally excavated had to be closed on account of the rapidity and violence with which water poured through their sides, evidently from the Ulsoor tank, from which they are situated not more than a distance varying from 100 to 200 yards, according to their individual position. A recommendation was submitted that their number should be increased; but in practice it has been found that the actual yield has not been added to according to the increase of their numbers, and it is considered that their yield has now attained its maximum. The water is at present drawn from them by means of steam pumps. It is being conveyed to a general reservoir, where it is mixed with that from the Ulsoor tank after filtration, the mixture being thence supplied to barracks.

WELLS ON THE OLD RACE COURSE.

Some few years ago it appears that the water of these wells became suspected of being contaminated and of being influential in the causation of typhoid fever then prevalent among

the families of pensioners and colored people located in a depression or valley near them. Specimens of the water were accordingly despatched for analysis, and the report being unfavorable the wells were duly condemned: although it would appear that, during the whole time the prohibition against them continued, an old waterman, whose residence in the place extended over fifty years, clandestinely obtained from them the supply for an Officers' Mess in their neighbourhood, declaring it the while to be the very best water in Bangalore. Nor did any disease attributable to the use of water internally manifest itself.

By and bye Surgeon-Major Nicholson, of the Army Medical Department, observed, what indeed is sufficiently apparent, that in the nature of the soil and surroundings of these wells there is nothing calculated to contaminate their water. He subjected their contents to very careful scientific examination, with the result that the opinion of the old native waterman was confirmed; the quality of the supply was most excellent. The "taboo" was accordingly removed, and now the wells are freely used by native camp followers and others. They are, for the time being, not required for the soldiers, but would doubtless be valuable as a reserve in case of need, and in the mean time it is well to keep them fresh and clean by constant use.

WATER-SUPPLY FOR BANGALORE FORT.

About 150 soldiers are employed within the old fort of Bangalore, as a guard over stores and Medical Forces, in a large enclosure. They receive their supply of water from a spring situated at an inconsiderable distance from one of its principal gates. But the well is, it appears, the private property of a native land-holder, and, being so, direct jurisdiction over it becomes a matter of some difficulty. At the time of visit, a black woman was employed washing her clothes in it; the water was tinged blue with indigo, and as we stood beside it, a man laden with soiled clothes came towards it—for what purpose seemed plain enough. These matters were mentioned to the Assistant Quartermaster-General, who at once determined to take the necessary action. Were the well preserved, the quality of its water is extremely good. A simple and effectual way to attain this end would be for Government to purchase the well, and enclose it.

ULSOOR TANK.

Until very recently, the Ulsoor tank was almost the only source whence water was obtained for the use of the British troops at Bangalore. It collects the storm water of a gathering ground having a superficial area equal to 3,200 acres (5 square miles). The extent of the tank itself is said to be about 100 square acres, its average depth to vary from 8 to 13 feet according to season, the quantity of water contained in it when at its fullest to equal one million of tons. The rate of supply from it for the use of the troops is calculated as varying from 700,000 to 800,000 gallons monthly, or 40,000 tons per annum; but in addition to this expenditure, there is considerable decrease by evaporation, by percolation, and by consumption on the part of the native population, who resort to it in larger numbers apparently than is generally believed. The site of the tank is said to have been originally a receptacle for the filth and refuse of old Bangalore. It has been calculated that the quantity of debris of various kinds in course of deposition is so great, that at its present rate the obliteration of the tank would occur about the year 1908, and the ooze which now forms its bottom is said to be so extremely offensive that it could not be disturbed with safety. The native troops do not draw their supply from this source. They obtain the water made use of by them from Miller's tank, and from wells. Numbers of the native population use the water of the Ulsoor tank unfiltered and as it is taken from that tank; others of them, however, are said to boil it before making use of it for drinking purposes.

SOURCES OF SUPPLY AND OF CONTAMINATION.

Some of the sources whence the tank obtains its supply of water deserve particular notice, although they have been described in detail in the many reports that have already been submitted on the subject.

(a.)—The Ulsoor tank is supplied from the overflow of conduits from the native town of Bangalore. These conduits extend through streets and alleys, receive the surface drainage and household liquid refuse of these places; they unite in principal open channels, which in their turn meet in one still larger, and thus communicate directly with the tank or reservoir.

By a simple and ingenious arrangement, these conduits are so constructed that the first flow along them carries with it whatever impurities may at the time be lodged in them, and discharges the whole into an open sewer, the sewer being itself extended to a considerable distance from the tank and station, and there its contents are discharged. Afterwards, as the rainfall continues and the stream along the conduits has attained a certain calibre, the overflow falls into a drain specially constructed to supply the tank, and so falls into the general reservoir. It so happens, however, that, notwithstanding all the care bestowed upon the condition of these conduits—and it is unquestionably very great—animals of different kinds secrete themselves in them; at some places where they are crossed by bridges or road ways, filth accumulates, some being of the most offensive nature, so that even the overflow water becomes polluted thereby in its course. Nor is this all. Although the parapet along the side of the discharge conduits protects them to a great extent, yet, as in it apertures occur at intervals, sewage direct from native houses, and matters from public latrines placed at different points along the streets, are thus admitted. The latrines in the native town are kept as clean as they can be, considering the habits of the classes by whom they are frequented, but no amount of care can obviate a certain amount of escape from them, or do away with the general saturation of the soil, caused by the customs of the people of retaining their filth in cesspools excavated in the floors of their houses, it being next to impossible to obtain access to their dwellings. These conditions are perfectly well known to the Army Sanitary Commission. With regard to them, that body observes—"It is evident that the subsoil of Bangalore possesses a powerful nitrifying property, and it appears probable that the comparative healthiness of the station, in the absence of any domestic drainage, has been mainly due to this fact. But it would be contrary to all experience to depend on this property for the continued health of the station."

A considerable extent of the large supply channel was until lately unpaved, the soft mud which formed its bottom being a convenient resort of people and animals, and a receptacle for a great deal that was unseemly and objectionable. Much of it has now been flagged and paved, yet a portion still continues in its original condition at the point where it enters the tank, and there debris of various kinds remains, the smell emitted therefrom being extremely offensive.

(b.)—The Ulsoor tank further obtains its supply of water from sundry streams which run along valleys towards it, past villages and by fields strewn often with a kind of poudrette. These carry with them debris and filth in proportion to the fall of rain. Two of the most objectionable sources of contamination in connection with these are the following, viz.—

(c.)—*The Badarhully Valley.*—Its sides are for the most part under cultivation with crops of Indian corn, ragee, (*Eleusine coracana*), gourds and other indigenous crops, also some foreign vegetables. The fields are rendered fertile by manure from the town and from the villages of the agriculturists. The natives, after their domestic habits, make use of the running stream for the most offensive of all purposes.

(d.)—*The Tanneries.*—These places include thirty establishments of their kind, large and small, some capable of preparing 20,000 to 30,000 hides and skins of sorts per month, and employing collectively 3,000 persons. They range along both sides of the public road, and are situated upon the side of a slope which leads direct to the Badarhully valley. The extent and nature of the nuisance connected with them have only lately been discovered, although the tanneries have occupied their present site since 1861. They were such that the Municipality undertook the labor and expense of effecting a tolerably complete clearance, although a continuance of the labor and expense can hardly be looked for. At present, the existing cholera panic has stimulated exertion. Liquid from the tan-pits is collected in masonry, and other pits made for the purpose. These are from time to time emptied, their contents removed to a distance in carts and casks; yet it is stated that the pits often overflow, that in heavy rain offensive matters from them are carried into the neighbouring valley, and so to the Ulsoor tank. Public latrines are

in course of erection for the people connected with these places, but for the time being, the drain channels near them are resorted to, notwithstanding the presence of a native policeman, and at the time of visit the smell in some of the tan-houses that were entered was literally sickening in its effects. Are these statements met by a repetition of opinions expressed that emanations from tanneries, although offensive to, and insupportable by, those unaccustomed to them, are not necessarily productive of injurious effects? It is answered, that even those who thus argue stop short of the assumption that the liquid refuse from such places, when mixed with water and thus drank, can be other than pernicious to health. The point is only alluded to in this place, so that the distinction should be rendered the clearer.

(c.)—A surface drain on the east side of the Infantry Barracks leads direct into the Ulsoor tank. Compared with the sources of contamination already enumerated, its effects are small. It conveys for the most part surplus water from bath and cook rooms. It thus unquestionably adds to the mass of impurities; and as observed at the time of visit, "How can we urge upon the Municipality the necessity of further measures on their part, so long as they are able to point to this defect within cantonments?"

The subject of this drain is, however, now before the proper authorities, and the defects related will be speedily rectified.

QUALITY OF THE WATER OF THE ULSOOR TANK.

From the particulars already given, we naturally expect to find what chemical analysis indicates as among the constituents of the water of the Ulsoor tank. It yields chlorine, a trace of nitric acid, ammonia and albuminoid ammonia, the amount of oxygen required to oxidize the organic matters is greatly in excess of that required for really good water. Unfortunately, however, the results of analyses performed by two different experts differ considerably. Even after the water has undergone filtration, it is said to contain three times the amount of impurities found in that from the Dhobies' wells, yet, according to analysis, to contain nothing unwholesome.

It would seem as if in the tank, the balance of organisms necessary to maintain water in a wholesome condition is imperfectly maintained. Of the smaller existences, namely, entomostracæ, daphnæ, and infusorîæ, there appear to be abundance, although none of those enumerated are in any way pernicious. Examination of the water under the microscope is reported by Dr. D. Cunningham to reveal large numbers of filaments of *Oscillaria*, *Beggiatoa* and *Hyphothrix*; *Bacteria*, *Diatoms* of various forms; a few *desmids*, the commonest forms being two species of *Cosmarium*; *Amaba*, *Distuglia*, *Euglena*, *Placus*, *Cyclidia*, *Actinophrys*, *Clathrocystis*, *Spirostomum* and *Pandorina*.

Of plants in the body of the tank capable of evolving oxygen, there appears to be a complete absence. All such are said to have been eradicated some five or six years ago, and their reintroduction recommended by Surgeon-Major Nicholson, A.M.D., in 1871. Along the edges in several places some such do exist, although by no means abundantly, while in the more sheltered nooks and corners the surface is covered with some that are absolutely pernicious. Of these, *confervæ* in all stages of existence and of decomposition render the surface green, the water so mucilaginous that several days are required for suspended matters to subside, and its filtration becomes a matter of difficulty. But this remark is also applicable, although in a minor degree, to the water of the tank generally. An offensive effluvia pervades the air as we pass such places. The accumulation of *confervæ*, however, is unquestionably kept considerably under by a special conservancy establishment, which since 1867 has been maintained for the purpose. This establishment consists of a peon, four coolies and punt. Of the *lemnacæ*, two genera were observed. The common *Lemna* or duck weed, which formed small islets among the masses of *confervæ*, and the *Pistia stratiotes*, a plant which so far unites in itself good and bad qualities, in that it emits oxygen and thus purifies water, while it communicates to the water its own irritant properties to such an extent as, when abundant, to render the internal use of it dangerous. Fortunately, the quantity of *pistia* in the Ulsoor tank is yet a long way from giving rise to any such danger.

Besides these, there are patches of *Trapa*, the fruit of which, under the name of *Singhara nuts* is apparently sold as food, the influence of the plant itself upon the water on which it floats being in all respects beneficial. This plant seems to have been introduced recently, at the recommendation of Surgeon-Major Nicholson.

Fish, in considerable numbers, exist in this tank. They include two kinds of carps, viz., *Barbus sarana* and *Discognathus lampeta*; four Silurians, viz., *Silurus wallago*, *Bagrus albilabris*, *Saccobranchus singis* and *Clarias magur*; besides one murrel, viz., *Ophiocephalus striatus*. It is said, however, that one or two other species, if not genera, exist in the tank, confining themselves to its muddy bottom. I am indebted for these particulars to Surgeon-Major Massy, of the Army Medical Department, and to Surgeon-Major Bidie, Curator of the Madras Museum. Considerable numbers of Molluscs were observed in the water, including *Limnaea*, *Paludina* and *Planorbis*. Probably, however, others, including some bivalves, would have been found had time permitted. Only one genus of aquatic bird was seen, viz., a *Podiceps*. The surface of the tank was a lifeless expanse of brown muddy water. Like other lakes, however, it is at times visited by duck and teal.

It is well known in India that occasions occur when, without apparent cause, the water of tanks undergoes putrescence, and examples are given where disease, more especially cholera, has been directly traced to the use of water thus suddenly and unexpectedly deteriorated. The putrescence is believed to be due to the heating of superficial layers of mud, which in all tanks abound with the lower forms of animal and vegetable life, and which are suddenly destroyed by such changes. On the other hand, equally sudden development of infusorial life takes place, discoloring in parts or entirely the tanks in which the phenomenon occurs.

No doubt, to an important degree the impurities which find their way into the tank are precipitated to the bottom, and the water, percolating through the bed so formed, carries with it into the deeper soil a large amount of the products of decomposition. Were this not the case, it is obvious that the water of the tank would be utterly unfit for use. On the other hand, the capacity of water for gaseous products is extremely great. Although water is capable of oxidizing a large amount of organic impurities, it is doubtful if this can be effected in a comparatively stagnant lake, such as the Ulsoor tank undoubtedly is. Products of decomposition of substances, more or less directly traceable to persons and animals laboring under diseases and capable of propagation, are thus absorbed. They are incapable of detection by chemical agencies as at present known, their removal by any process of filtration is open to grave doubt, nor can their presence in water made use of by soldiers be looked upon otherwise than a constant source of danger to health. As observed by the principal Medical Officer, British Forces, in this district, in his report for 1874—"In the face of the Analysts' report of the wholesomeness of the water of the Ulsoor tank when filtered, it may appear hypercritical to disapprove of it; but looking at the surroundings of the Ulsoor tank, its sources of supply, and the numerous and extensive sources of pollution, I cannot rest satisfied that its purity can be sufficient for drinking;" and he adds, "moreover, year by year, these sources of impurity must increase with the increase of population." Whatever chemical examination may indicate, it is inconceivable that, considering the nature of its contaminations, the water of this tank can be pure. It seems not without good reason that the late occurrence of typhoid fever has been attributed to its use, nor can we believe that, if there be any truth in accepted principles of sanitation, it can be other than pernicious.

FILTERS AND CISTERNS.

Originally, there were two extensive filters in connection with the Ulsoor tank. For several years, viz., since 1870, there has only been one, the foundation of the second having given way and itself fallen into a state of ruin. At the time of visit, workmen were engaged upon it, however, and it is hoped that ere long a new structure having a stable basis will be produced. That which is in working order is necessarily in continuous use. It has a superficial area of 5,942 square feet, with an average constant depth of water over its filtering bed equal to 20 inches. The water is pumped into it from the tank by means of a steam engine, the same

machine also distributing the filtered supply from the adjoining reservoir to those connected immediately with barracks. The filter bed is composed of the following materials in their order from below, viz., twelve inches of flag stones, twelve of road metal, three of gravel, four of charcoal, and thirty of fine sand, making a total depth of materials of 61 inches. The whole is renewed or cleaned once in every three years, inconvenience on each occasion arising while the operation is proceeding. The materials are then washed and replaced in the filter, with the exception of the sand and charcoal, both of which are renewed.

Laterite gravel was in the first instance made use of for the middle layer. Experience speedily proved, however, that it was unsuitable for its intended purpose; that not only was it destitute of the power of removing impurities from the water, but that it retarded the process of filtration, and communicated to the water some of the extremely soft tenacious clay which enters into its own composition. Even now, with the siliceous gravel substituted for the laterite, the rate of filtration is no more than from thirty-nine to forty-nine gallons of water per square yard of filtering surfaces per day, as against 600, the ordinary rate in England. Thus, the peculiarly tenacious nature of some of the impurities contained in the Ulsoor tank becomes apparent. Besides this large filter, a series of ordinary small ones are distributed through the different barracks. Some of these are of the common old Indian pattern, some of the new kind according to the plan of Surgeon-Major Nicholson, Army Medical Department. In so far, therefore, as water can be purified by filtration, the means of effecting this end appear sufficient. But the question often asked, never yet satisfactorily answered, naturally presents itself—What are the precise contaminations that are capable of removal from water by means of filtration? What those that resist the operation? We know indeed that by means of efficient filtration, 88 per cent. of organic matter, and 28 to 30 per cent. of certain kinds of mineral matters can be separated from water. But are there not properties of a pernicious nature contained in some waters which resist the power of all known filters to remove? No doubt, many such are capable of undergoing transformation in the process. On the other hand, will filtration destroy the influences produced by the poisons of intermittent or typhoid fever, dysentery, cholera and so on? It is more than doubtful. There is also the important point to be borne in mind that, allowing to the process of filtration all the effects claimed for it, there exists a danger that water, however effectually cleared from mechanical impurities, may subsequently undergo deterioration in its conduits of supply. Unless the flow through them be regular and in proportion to the quantity admitted, water which may enter in a potable condition may become spontaneously deteriorated, so as when drawn to be unfit for use. The whole of the filtered water is stored in the first instance in a large reservoir recently erected close to the Ulsoor tank. This reservoir has a capacity equal to 155,000 gallons, and contains a quantity which varies from 10,000 to 100,000. Its contents comprise a mixture of filtered water, of the tank and that from the Dhobies' wells—the latter, as already observed, being sent direct into it by a special engine connected with those wells.

Connected with each of the several barrack ranges, there is a large reservoir out of doors, the object being thus to retain a sufficient reserve of water to provide against accident and contingencies; indeed, these reservoirs are absolutely necessary, in order that a continuous supply of water may under all circumstances be obtainable. A metal cistern of considerable size in the Artillery and Cavalry Hospitals, and two in the hospital for soldiers' wives, are in addition maintained, with a view of still further ensuring the supply to the patients. The dimensions of the two former are 22' x 14' x 2' 6", of those in the latter 10' x 10' x 2' 6". Each cistern is situated in the ablution room of the upper story, and is supported by tall and powerful iron pillars.

The cistern for the Infantry Barracks is not yet roofed in, but the estimate for the work is said to have obtained the requisite authority. The necessity for all such places being so protected is generally admitted, but in India it is particularly obvious. Impurities are carried into open reservoirs by the wind; crows and kites drop bones and other impurities into them; and boys—irrepressible here as elsewhere—make it an interesting part of their "play" to throw objectionable matters into them.

RECOMMENDATIONS.

The important question now presents itself—What is to be done with a view to improve the insanitary conditions of the present water-supply, and to provide a wholesome supply for the future? For a number of years back, the same questions have been asked by Army Medical Officers quartered at Bangalore; nor does the reply seem easier now than when the subject was first agitated. It is clear that for the present, and for some years to come, the existing sources of supply must be preserved. When, hereafter, the scheme of Colonel Sankey is proved a success, the question of how far it may be advisable and expedient to trust to it either altogether or in part may be considered. But until then it seems to me, our object should be to improve by all possible means that which already exists. To this end, accordingly, the following observations are intended to apply.

It is true that in so far as mere filtration is capable of improving otherwise bad water, the process is carried out as effectually as circumstances permit, and measures are in progress to render it by and bye still more effectual. In the course of a very large amount of reports of one kind or another that have from time to time appeared in connection with the subject, we find sundry supplemental processes recommended. Thus, it has been recommended to employ some of the known deodorizers of water in addition to filtration, including magnetic or silicated iron, lime, alum, clearing nut, (*Strychnos potatorum*), and some others. The first named of these, however, would probably be unsuited to the large quantity daily required, and the others would undoubtedly communicate more or less of a rough and unpalatable flavor to the water. Lime would moreover alter the quality of the water from soft to hard. Further, it has been recommended that the water should be allowed to remain in galvanized iron tanks from twenty to thirty-six hours, during which time, it is believed, sufficient electricity will be generated by its presence to completely purify it.

It seems to me that in the majority of recommendations in regard to means for improving the quality of water obtained from the Ulsoor tank, undue importance has been attached to such as are artificial, too little to natural. Experience has amply shown that the purity of water is most effectually assured by the establishment in it of a proper balance of its proper organisms; mollusks and fish to keep down conifers, certain oxygen-evolving plants to induce oxidization of impurities, whether of animal or vegetable origin, with which it is contaminated. That certain other plants are capable of communicating irritating and other noxious properties to water in which they grow is equally well understood. It will therefore be necessary to make a discriminate selection of those to be introduced. The presence of aquatic birds furnishes an important means of preserving the balance of life. They, besides, give beauty and animation to lakes frequented by them. Thus then it seems to me that, were the Ulsoor tank converted into an *aqua-vivarium*, as indeed has to a limited extent been done, not only would the quality of its water become enhanced thereby, but the lake itself would be transformed from its present dreary condition into an ornament to the locality.

With regard to the mollusca, it is observed that the genera most useful in maintaining the balance of lower plant life in water include *Limnea*, *Paludina*, *Planorbis*, and in India the *Ampullaria*. The *Unio* and allied genera live imbedded in mud, and are thus useful in the transformation of organisms contained therein. The *Succinea* is in a manner amphibious, living rather upon aquatic plants at and above the water level than actually in the water. Its different species live chiefly upon parasitical conifers, and are thus valuable in preventing the increase of those organisms that otherwise take place in comparatively still water.

Certain kinds of fish not only flourish in tanks and lakes, but are of the greatest value in maintaining the necessary balance between organisms to preserve their waters in a clean and wholesome condition. Of these, the chief are the true carp (*Oxyrinus*) and tench (*Tinea*), both valuable, moreover, on account of their own rapid rate of increase and excellent qualities as food—circumstances well known and taken advantage of from ancient times down to the present. Besides these, there are the ordinary lake fishes of India, several of which exist in the tank. Of aquatic birds, the various kinds of *Anatide*, as ducks and teal, might with advantage be introduced. It

would, as a matter of course, become necessary to set apart for them an island or other safe retreat, and to protect them, as well as the fish, from unauthorized depredation; were this provided, no doubt the place would speedily attract other kinds. With regard to appropriate plants, some already exist around the borders of the lake; others may, it is stated, be obtained from the Millar and Kooramughan tanks in the neighbourhood, the remaining few from the Agri-Horticultural garden. Of the plants proposed as suitable, some root in the mud, one series of these spreading their leaves and erecting their inflorescence above water; others live and propagate entirely submerged. Others float upon the surface, their rootlets extending to an inconsiderable depth below. Some live and flourish only in deep water; others have their proper locality in shallow. Some are capable of growing alike in ground that is flooded, and that left dry by the recession of the water.

Of those adapted for the deeper portions of the tank or lake I would indicate the following, viz.:—(1) *Potamogeton*, (2) *Vallisneria*, (3) *Nuphar lutea*, (4) *Nelumbium*. These, and some other genera, take root in the ooze which forms the bottom of still masses of water, and by deriving their nutrition chiefly therefrom, oxidize and transform organic matters contained in it. No doubt, the *Anacharis* is among the most remarkable of all aquatic plants in its power of eliminating oxygen. I hesitate to recommend its introduction, however, chiefly because its rate of increase is so extremely rapid that it would speedily become a nuisance.

For the less deep portion I would indicate—(1) *Typha*, (2) *Sparganium*, (3) *Utricularia*, (4) various sedges or *Cyperaceæ*, besides others known to be well adapted for the purpose. For the sides and in the shallow portions, I would indicate among others the following:—(1) *Poa fluitans*, (2) *Polygonum Amphibium*, (3) *Juncus*, (4) *Cyperus*, (5) *Equisetum*. Of floating plants the presence of which are beneficial are—(1) *Trapa*, (2) *Hydrocharidææ*, (3) *Pistia*. The known irritating properties of the latter being only perceptible in very limited bodies of water. In a large body such as the Ulsoor tank, it would be valuable as source of oxygen, and could always be kept within proper limits.

For the marshy tracts leading towards the tank, and which form the principal channels of supply, several amphibious plants might be enumerated; some of which are already present in them. For example, (1) *Rumex*, (2) *Cyperus*, (3) *Juncus*, (4) *Bidens*, (5) *Poa*, (6) *Alopecurus*, (7) *Catabrosa*, (8) *Iris*, (9) *Impatiens*, (10) *Arum*, (11) *Pulicaria*, (12) *Veronica*, (13) *Eriocaulon*, (14) *Mentha*, (15) *Typha*, &c., besides many others. The quantity of trees at present around the tank appears quite sufficient; when in large numbers or of dense foliage, they interfere with free circulation of air and the admission of prevailing winds over the surface of the water, and consequently with its perfect aeration. Leaves falling from them are, moreover, calculated to impair the quality of the water, in proportion to their quantity.

But while means are being taken to improve the quality of the water contained in the Ulsoor tank, it is apparent that the measures already taken to purify the supply ought to be persevered in, and such others taken as may, from time to time, become expedient and practicable. Much has already been done with this object, much more is in contemplation, and undoubtedly great credit is due to Military, Medical, and Municipal authorities on the spot for the energetic and efficient action they have taken in their several departments. Nor must I omit to observe that care and discretion are required in the additions herein suggested. If overdone, corresponding results will follow to those already complained of, and deterioration of water take place from superabundance of organisms. All that is intended to be pointed out is the natural means by which the purity of tank water may be best maintained.

Conservancy in streets and houses throughout the native town and neighbouring villages will doubtless be continuously observed, and improved in so far as the peculiar habits of the populace permit; drains connected with town and cantonments, not as yet connected with the common sewer, will be so connected without unnecessary delay; continued attention will be paid to the cleanliness of conduits and other channels; the entrance of refuse matters, from whatever source, tanneries, latrines and others, will, as far as possible, be put a stop to.

The precise means by which the present evils caused by the tanneries and villages in the Baderhully Valley may most effectually be met have for some time occupied, and still occupy, the attention of the local authorities. The fact is also borne in mind by them that, unless speedily remedied, evils arising from rapid increase of population and of buildings in that valley will continue progressively to increase. It has been stated that the removal of the tanneries to a site on the slope opposite to that on which they now stand would not only be a very expensive measure, but by itself insufficient so long as an effectual drainage scheme for the valley leading towards the Ulsoor tank is wanting at the same time that a complete scheme of drainage for the tanneries and villages in the valley would not only cost some £15,000, but could not be completed so as to meet immediate requirements.

It seems to me, therefore, that the palliative measures recommended by a Committee convened towards the end of September 1875 are such as for the time being are suitable, at the same time that the larger scheme which alone can be effectual is pushed on.

These measures include—

(a.)—Stringent conservancy measures throughout the valley and villages in or connected with it.

(b.)—That tanning operations be carried on under cover; fluid and other refuse discharged into masonry tanks not accessible to rains or storm water.

(c.)—That the erection of further tanneries be interdicted, and ground resumed where any now exist, whenever the owner relinquishes his claims thereto.

(d.)—That in order to prevent this extinction of the trade, however, any new tanneries that may be hereafter applied for, be erected upon the reverse slope to that on which the present stand.

COLONEL SANKEY'S SCHEME.

It is obvious that so long as the ordinary rainfall and natural springs can be kept free from contamination, they furnish the purest sources of water-supply; for although rain water when first collected is not agreeable to the palate whatever may be its absolute standard of purity, yet it becomes so after exposure to the atmosphere in motion. On the plan of collecting the rainfall, Colonel Sankey, R.E., has founded his scheme, which, although yet to be carried out, promises, so far as the works connected with it have been completed, to be ultimately a success. The object proposed is to collect the rainfall over a considerable extent of ground enclosed and reserved for the purpose, storing it in a reservoir situated about three miles north-eastward of Bangalore, and upon sufficiently high ground to admit of a supply being directly conveyed to the different barracks occupied by the British soldiers and their families. The greater part of the expenses connected with the proposed works are, it appears, to be borne by the Government of Mysore, one of the objects of the scheme being to provide the Native population with pure water supply, a rate being levied for whatever may be distributed to the troops.

The area set apart as a gathering ground has an extent of two and-a-half square miles, equal to 1,640 acres, and probably 250 or more may hereafter be added. At the time of our visit, a series of experiments were in progress with a view of indicating, by means of rain-gauges and reservoirs, the collecting power of the surface ground according as to whether it was left bare or covered with grass of different kinds. From these experiments and without taking into account the supply which doubtless will be obtained from springs laid open during necessary excavations for the reservoir, it is calculated that the quantity of water capable of being annually collected with a minimum rainfall will amount to 63½ millions of cubic feet. The tank will cover a space of 62 square acres, will have a maximum depth at the main bund of 54 feet, and an average depth of 18 to 19. It will be capable of yielding a supply equal to 47 millions of gallons per annum; in other words, a supply for 80,000 persons at the rate of 10 gallons per head per day, this amount of water being considerably beyond what past experience shows to be necessary.

Difference of opinion exists in regard to the probable success or otherwise of the scheme, and in regard to the capability of water from the reservoir being delivered at sufficient height to supply the barracks. Both these questions belong to the province of the Engineer. But with

regard to the latter point, the readiness with which in case of necessity water could be raised by means of a steam engine presents itself to the ordinary observer. It is further remarked that various circumstances combine to render it undesirable that the troops should be entirely dependent upon the intended reservoir for their water supply. Some of the reasons adduced are beyond the scope of sanitation. Others, however, come within its sphere, the principal of which being that it is undesirable to trust implicitly to a scheme the completion of which is still in the future, and which is entirely artificial in its nature, to the neglect of a source which, however capable of being improved, is nevertheless natural. Nor should the fact be lost sight of that under any circumstances some years must elapse before the scheme can be in actual operation, and that in the mean time much may be effected to improve the existing supply. The reservoir, however, promises to afford an ample supply of good and pure water free from noxious contamination.

DUMLOOR TANK.

The existence of a marshy tract between the barracks occupied by the Royal Horse Artillery and the Dumloor tank is beyond doubt a source of evil to the troops, the extent of that evil being, as a matter of course, in accordance with the extent of space occupied by the marsh, and with the season of the year during which the periodical wind blows directly across it towards the barracks. At the date of visit (September 1875), the Dumloor tank was said itself to cover upwards of 27 acres of surface. Its chief supply of water is obtained from the overflow from the Ulsoor tank, and although on account of the exceptional dryness of the past season, the extent of marsh stretching from the borders of the former was described as much less than usual, it was sufficiently large to constitute, in its then condition, an obvious source of malaria. According to statistics furnished in regard to disease among the troops directly exposed to emanations from this marsh, it appears that for the nine months from 26th September 1874 to 25th June 1875 the rate of prevalence of malarious fevers in the Royal Artillery whose barracks are nearest to the tank amounted during that period to a ratio of 184.5 per 1,000 strength per annum, a considerable number of the Artillerymen having served at no other station in India. Previous statistics published from time to time in official reports indicate that, for a number of years back, the troops occupying the same barracks have been peculiarly liable to similar affections as compared to those situated elsewhere in the station. A mixed committee of officers some time ago reported that the malarial influences from the Dumloor tank admitted of being abolished by the apparently simple process of defining the borders of the tank, without destroying it, by means of completely draining off its waters. They further recorded their views, that it is inadvisable to abolish the tank; that not only would the inhabitants having land in the immediate vicinity be put to much inconvenience were such a measure carried out, but that the whole community would, to some extent, similarly suffer.

With regard to the precise means by which the present pernicious effects of the marshy tract in question may be most effectually remedied, the question seems to me one specially connected with the province of the Engineer. It is considered, however, appropriate to observe that the removal of so large a body of water as that contained in the Dumloor tank may be expected to be followed by modifications in the hygrometric conditions and temperature of the atmosphere of the locality and its immediate neighbourhood; also that in the event of the site of the lake from any cause not being capable of thorough drainage, more harm than good might arise from a partial operation, it being an accepted fact that even a marsh, so long as it is completely submerged, is in reality less injurious than bad or insufficient drainage.

TYPHOID FEVER.

Attention has, for the past few years, been drawn to the somewhat frequent occurrence of typhoid fever among the troops at Bangalore, and various opinions expressed in regard to the probable causes of the disease.

In 1870, returns show that ten cases of the disease were recorded among the men of the Royal Artillery, none of them proving fatal; eleven among the Infantry with four deaths; while among soldiers' wives one case occurred, the event being fatal, and among their children three

with two deaths. Unfortunately, however, further information regarding statistics of the disease, during the year, are incomplete.

In 1871, the following cases are recorded, viz., in the Cavalry one, ending in recovery, the subject 36 years of age and upwards of five in India. In the Royal Artillery one case, ending in recovery, the patient 21 years of age and three in India. In the Infantry, four cases and two deaths, two of the patients aged 18 to 19, one 20, and one 21, the length of service in India under one year in one case, under two in one, between two and three in two, both the fatal cases occurring in the latter. On this occasion, the wives and children appear to have been exempt from the affection.

In 1872, there occurred in the Cavalry three cases and two deaths; of the former, one of the subjects was 18, another 19, the third 20 years of age, the two patients who died, both in their first year of Indian service. In the Royal Artillery, the disease seems to have prevailed extensively, there having occurred fourteen cases, although with but one death. Of the men admitted, one was 19 years of age, four were 20, two were 21, two were 22, two were 27, one was 28, one was 30, and one was 31. Of the duration of their Indian service, eight were in their first year, two had completed one year, one was over two, one over seven, and two over eight. The fatal case occurred in a young man 19 years of age, and in his first year in India. Among the Infantry, there were five cases and four deaths. Of the patients attacked, three were over 19 years of age, one over 20, and one over 32, two were under one year's Indian service, one over one, and two over two but under three. Of the four fatal cases, three occurred in the lads of 19 years of age, one in a patient of 20; the service in India under one year in two instances, over two but under three in the other two. Of the wives of soldiers, all seemed exempt from the disease; of children, two were attacked, one died.

In 1873, one case of the disease, but no death, occurred in the Cavalry; the patient 19 years of age and in his first year of Indian service. In the Royal Horse Artillery seven cases, and in the Royal Artillery one case, and no death in either; the ages of the patients in one instance 18, in one 19, two 20, three 21, and one 22; the period in India under one year in seven cases, between three and four in one. The Infantry on this occasion appear to have been exempt, as were also the families of all the soldiers.

In 1874, two cases of the disease are recorded in the Cavalry, both ending in recovery. One of the patients was 21 years of age, the other 22; both two years in India. In the Royal Artillery there were fourteen cases, three of the number fatal. Of the men attacked, three were aged 20, one 21, one 23, two 24, three respectively 25, 26, and 27, two were 29, one 31, and one 32. The duration of service in India was one year in eight cases, two in one, three in another, and four in four. Of the soldiers who succumbed to the disease, one was 24 years of age, one 29, and one 32; of their service in India, one had been one year, two had been four. Among the Infantry only one case occurred, the patient recovering; the subject of attack 21 years of age, and three in India; one soldier's wife was attacked by the disease and died, all children were exempt.

If we summarise the above figures, we find the following results of the four years from 1871 to 1874 inclusive, viz., 4 admissions with 1 death took place in lads of 18 years of age; 22 admissions and 5 deaths in those with less than one year's service in India; 7 admissions with 4 deaths in men of 19 years of age; 12 cases and 1 death among soldiers of one year's Indian service; 11 admissions with 3 deaths in men of 20; 8 admissions with 4 deaths among those of two years' Indian service; 4 cases without a death in men of 22, 4 cases with 2 deaths in those of four years' service in India; one admission, no death, in a man of 23; one case also without death in men of five years' Indian service; 2 cases with 1 death in men of 24 years of age, no cases recorded among men of six years' residence in India; one case without fatal result in a man of 24; one case, the patient recovering, in a soldier seven years in India; one case, terminating in recovering, in a patient 26 years old; two cases without a death in men of eight years' service in India. Of those attacked, none had longer service in India than this; but in regard to age, it is observed, that three cases occurred in men of 27, one in those of 28, two in those of 29, one in

those of 30, two in those of 31, two in those of 32, and one in those of 33, one fatal case occurring in those of 29, and one in those of 32.

It is considered that these particulars, dry and technical as they are in nature, have nevertheless a certain measure of importance in relation to the question of age and service of men most liable to attack. They may also, it is hoped, form the basis of further inquiry which it may hereafter be deemed advisable to institute in the same direction. It is further deemed of importance to observe that in 1871 the disease chiefly prevailed among the men of the Infantry; in 1872, 1873, and 1874, among those of the Artillery; the Cavalry, although occupying barracks close to those of the Artillery, being only affected in a small degree, the Infantry altogether exempt in 1873 and nearly so in 1874. During all those years also, the disease has been confined to the British troops, apparently to the complete exclusion of the Native sepoys. With regard to this alleged complete exclusion of the natives, however, there are medical officers who declare it to be more apparent than real. They further assert their belief that were *post-mortem* examinations obtainable among natives—which they are not—they have little doubt but that the appearances indicative of this affection could be discovered in them equally as in the bodies of British soldiers.

The reports by the Army Medical Officers quartered at Bangalore throw but little light upon the causes that probably gave rise to the disease. In 1869, the occurrence of the affection was attributed to the use of water drawn from wells in the ravine between the Artillery Barracks and Race-course plateau. These were accordingly abandoned, the supply drawn from the Dhobies' wells by water-carriers sent thither under escort, yet the result was not satisfactory, nor does the precaution appear to have been long observed. It was next supposed that the cause of the prevalence of the disease among the men of the Royal Horse Artillery was to be found in the proximity to them of the filthy Ulsoor Bazaar. But against this appeared the fact that two-thirds of the cases really happened among men located in the barrack buildings farthest from that bazaar. Yet it would seem that in 1870, this circumstance was so far reversed, that of seven cases among the Royal Horse Artillery, four occurred in the block nearest to the bazaar, and three in that farthest from it. In the latter year, the disease is stated to have appeared among the Infantry earlier than among the Artillery and Cavalry. On that occasion, the cause of the outbreak was considered to exist in an extremely filthy locality, close to the Infantry Barracks. Forthwith, active measures were taken effectually to remedy the objectionable condition.

In 1871, it was observed that the men of the Infantry attacked occupied different barracks, in none of which were any local conditions apparent, sufficient to account for the occurrence of the disease. In 1872, the occurrence of the disease was again attributed to the vicinity of the Ulsoor bazaar, but also in addition to the vicinity of the Horsekeepers' Lines to windward of the Royal Horse Artillery Barracks. On this occasion, the few cases of the disease that happened among the men of the Infantry and Cavalry were attributed to the fact of the water used by them being "other than that of the Dhobies' wells;" the Principal Medical Officer also, considering these conditions insufficient to account for the disease, included among them "the condition of portions of the Native town, to bad water there obtained and to more general defects in conservancy." He also hints at, rather than alludes to, the effect of heat in producing the disease among young and recent arrivals, according, as he says, to the theory which has obtained consideration both in India and in the West Indies.

In 1873, it is stated that "it would be unreasonable to persist that the disease was due to any insanitary feature of the Field Battery or Cavalry Barracks." In this year, dry-earth conservancy was introduced, and it was assumed, although without actual data, that the prevalence of the disease had, up till then, been traceable to the former plan of latrines. Alluding to the vicinity of the filthy Ulsoor bazaar, it is further stated—"But local insanitary conditions will not account for the disease in the Field Artillery and Cavalry Barracks, nor for its appearance in the hospital." The Medical Officer thus continues—"My impression, in spite of analysis, is that the water of the Ulsoor tank, though filtered, is not a good water for drinking and cooking purposes."

but he adds, "I cannot believe that those few cases occurring in young soldiers, recently arrived from England, of the Horse Artillery, were attributable to water-poisoning;" all the troops use the same water, "the Infantry had not a case in 1873, the Cavalry only one, the Field Batteries one doubtful case early in the year, whereas there were seven in the Horse Artillery. Surely, were the latter due to water-poisoning, the effect would have been more general among the troops." He expresses his belief that the disease "can and does frequently arise *de novo*," but adduces no fact in support of his opinion. He also doubts the complete immunity from the disease the Natives are said by some writers to enjoy.

In another report, the occurrence of the disease is attributed to the circumstance of soldiers visiting "the foul bazaars and houses in those bazaars, always most foul and stinking," and to the want of "a liberal water-supply laid on to their yards." It is stated, as a fact beyond doubt, that recently arrived and young troops are most liable to the disease, but that this fact is by no means absolute.

In 1874, the circumstance most noticeable in the reports is the prevalence of the disease among the men of the Artillery. It is observed that seven attacks and three deaths occurred in the C Battery, 9th Brigade, most excellently placed in good barracks with good surroundings; moreover, that the battery had been more than a year in Bangalore before a case occurred in it; also that among those who were attacked in the Artillery, four were thirty years of age or more, and of more than five years' service in India. As to the period of the year at which they occurred, some took place in February and March, when no rain had fallen for five months. It has been said that, when typhoid or enteric fever gets into a barrack, it sticks to it. Prior to 1872, the Infantry Barracks at Bangalore had suffered more or less for some years; but since that year only one case has occurred in them.

Such is a summary of what of late years appears in official records in regard to the probable origin of typhoid fever at Bangalore. The summary, it must be confessed, consists of a series of negatives; nevertheless, it is valuable if for no other reason than that it indicates how very little is really known as yet in regard to the actual influences upon which the occurrence of that disease among English troops depends.

CHOLERA.

For some months, cholera had prevailed as an epidemic throughout the peninsula of India, its progress in some instances following the line of greatest communication or that of prevailing winds, in others indicating no definite adhesion to routes followed by travellers, and certainly advancing against the prevailing breeze. In others again, following a line of communication to a particular point, there being localised, while the flood of travellers continued to places beyond to which the epidemic did not attain. With regard to subjects also, it appeared to select, almost without exception, the natives; a few persons of occidental origin were attacked by and fell victims to it, but they were the rare exceptions.

As at other places where British troops are located, so at Bangalore, much alarm had been caused by the near approach of the epidemic. Ample measures were taken by Deputy Surgeon-General Massy, c.b., in communication with the local military authorities, with a view, as far as practicable, to guard against it, and to provide for the requirements of its subjects should it attack soldiers or others belonging to regiments. So complete and appropriate are the measures in question that a record of them is given, with a view, it may be, to furnish a ready means of reference to what would similarly be suitable on a future occasion should cholera unhappily enter the place.

In conjunction with Colonel Mesham, Quartermaster-General, he visited the whole of the barracks and their vicinity, taking a portion daily.

He inspected the tanneries and other places in the neighbourhood of the station, which constitute sources of pollution of the potable water-supply, offering suggestions in regard to them.

The barracks occupied by the Royal Horse Artillery and the Infantry being in close proximity to the Native town, attention was directed to the conditions of the latter.

Arrangements were made to treat such cases of the disease as should occur as follows: Men of Cavalry and Artillery in contagious wards, detached about 100 yards from their several hospitals; women and children, similarly in the contagious ward for them. Should the troops move into camp, the course laid down as regards such, in G.O.C.C., 3rd August 1870, would be carried out. In the event of married non-commissioned officers soldiers of the Royal Engineers or members of their families being attacked by the disease, as the distance at which they reside is considerable, they will be treated in a portion of the Sapper Hospital which is near at hand.

Native camp-followers, including horsekeepers, grass-cutters, hospital servants, lascars, &c., should be treated in the hospital for Natives erected by the Municipality. Should the troops move into camp, and they be there attacked, they will be treated in a hospital to be prepared for them there.

The attention of Executive Medical Officers has been drawn to existing regulations and orders regarding cholera.

The following general arrangements, founded upon G.O.C.C., 3rd August 1870, are further proposed in the event of cholera attacking the British troops at Bangalore:—

Should the invasion of cholera be general, it may be necessary to move all, or nearly all, the white troops at the outset to the camp ground near Sibadar Chuttrum, five miles from the cantonments, and which has been selected for the purpose of encampment, in the event of cholera amongst the troops in Bangalore rendering the move advisable.

Should, however, the disease appear in the Infantry Barracks—say a case in one block—the men in that block would be moved into a separate block, recently repaired by the District Engineer. Should a second case occur in this body of men, they will be moved into tents pitched on the cholera camp ground. In the event of a case happening in a second company of the 45th Regiment, it would be encamped on ground within the barrack enclosure; but on a second case occurring in the company, it would move to the cholera camp. But should scattered cases occur through the barracks, showing a general distribution, the entire regiment would move into camp.

Should a case occur in the Horse Artillery Barracks, the building would be vacated, and the men encamped in front of the barracks; and if a second case occurred in the same body, it would be moved to the cholera camp. If a case appeared in the second building at the same time, or within a week of the disease appearing in the first portion of the battery, the whole would move to the cholera camp.

Should a case of cholera appear in a bungalow of 18th Hussars or of the Field Batteries, the occupants to vacate the building and encamp on ground south of the regimental hospitals.

If a second case occur in the body moved, the tents should be struck and pitched on new ground. Should a third case happen in the body moved, they should be marched at once to the cholera camp ground.

Should, however, the second case appear in another building of the Cavalry or Field Batteries, it will suffice to move the inhabitants into camp to the south of the regimental hospitals; but should a third case occur in other than the body first moved, the 18th Hussars or Field Batteries, as the case may be, should at once move to the cholera camping ground.

In the event of a case occurring in married soldiers' quarters, the quarters to be vacated and the family moved into another quarter if one is available, or if not, into the camp near the regimental hospitals.

Should only a few cases occur in quarters separated from each other, it will suffice to move only the families in those quarters to camp near the regimental hospital, but any evidence of spreading or of a general invasion should move the families into the cholera camping ground, as in the case of the men.

Every building vacated should be cleaned and fumigated, as laid down in G.O.C.C. of August 1870.

It is proposed to treat cases of cholera occurring in barracks of 45th Regiment in a detached building in the regimental hospital facing the gate. There are two wards for men,

and two for women and children. The distance is too great to remove women suffering from cholera to the Female Hospital, Agram.

It is proposed to treat cases of cholera occurring amongst men, women and children of 18th Hussars and Royal Artillery in the contagious wards for males and females at Agram.

It is recommended that, in the event of cholera appearing in the station, the number of bearers to each dooly be increased from four to six, inasmuch as that with only four men they will not all be always present, some will be occasionally at their meals. One dooly will always be at each barrack.

An old dooly should be provided for Agram Hospital, and another for the 45th Regiment, to carry the dead to the grave, existing orders prohibiting the employment of doolies for sick for this purpose.

It is proposed to send Native camp-followers attacked by cholera to the temporary hospital formed by the Municipality, beyond the Sappers' Lines, and that a tent or tents, as may be required, be pitched for them at that locality. And further, that a dooly with six bearers be placed near the contagious ward of the Military Hospital, Agram, to convey the Native sick to the Native hospital.

Men attacked by diarrhoea in barracks will at once receive medicine from a non-commissioned officer of their room, and will be sent to hospital—not necessarily for admission, but for detention under observation. Such men will not be placed in wards with men suffering from cholera, nor in wards with patients suffering from other diseases.

Their return to their barrack room, further temporary detention, or admission to hospital, will depend upon their progress towards recovery, or increase of disease, while under observation. They will use night-chairs, and their motions will be deodorized, as if suffering from cholera.

When a patient suffering from cholera is brought to hospital, his bedding and clothing will invariably accompany him, or be sent on, as soon as possible, after him, and a receipt be given for them by the Hospital Serjeant.

The mattress and bolsters, or pillows, brought from barracks, will be used by the patient in hospital. Should they, however, not arrive in time, or be too soiled for use, straw mattress and bolster will be supplied in hospital.

The soldier's clothing, hospital clothing and all bedding will be treated as laid down in Section X, pages 201 and 202, and in Section II, paragraph 116, Volume I, Medical Code, care being taken that the means of purification are employed at once, and that accumulation of infected articles is strictly prohibited.

Medical Officers will indent on the Commissariat, either for large chatties or other suitable means of boiling infected articles, which is always preferable, when it can be done, to steeping in boiling water.

FORT ST. GEORGE,
6th November 1875.

(Signed) C. A. GORDON, Surgeon-General,
Principal Medical Officer, British Forces.

No. 166.

Copy of the foregoing forwarded to the Public Works Department for consideration, with reference to the Memorandum thence, No. 1,211 M. W., dated 23rd July 1874, and previous correspondence.

(By Order,)

(Signed) W. M. LEES, Lieut.-Colonel,
Asst. Secy. to the Govt. of India.

From Colonel C. H. DICKENS, R.A., Secretary to the Government of India, Public Works Department, (Civil Works—Miscellaneous,) to the Chief Commissioner of Mysore, Public Works Department, dated Simla, 24th July 1876, No. 230 C.W.M.

I AM directed to acknowledge the receipt of your Officiating Secretary's letter No. 62, B.O., of the 1st May last, submitting for approval and sanction a revised project, amounting to Rupees 5,36,363 for the water-supply of Bangalore, and in reply to communicate the following remarks thereon.

*Proceedings of the Madras Government, Public Works Department,
11th August 1876. No. 2,075.*

2. It appears from the plans submitted that the side walls of the three waste weirs are only 2½ feet above the sills, so that when the tank is full, the level of the water would be only 1½ feet below the tops of the walls, and I am to say that it will be safer to raise the side walls to 4 feet in height above the sills, and to request that this may be arranged for.

3. It is observed that the two settling reservoirs, in connection with the filters provided for in the original scheme, have been abandoned in the revised project now submitted, it being considered that with the new arrangements for silt tanks in the large reservoirs, the water will issue from the tower in a sufficiently clear state, without the aid of such reservoirs. The correctness of this view can only be proved by actual experience, but it is presumed that there would be no difficulty in the construction of settling tanks should the necessity hereafter arise.

4. The substitution of concrete and stone ducts for the iron delivery pipes is an improvement, but it is observed that the head channel, 9,033 feet in length, is proposed to be left uncovered; this arrangement is not approved of, and I am to request that the head channel may be covered over, as also all other channels for delivery of filtered water, it being important to guard such water from the contamination to which it is liable in open channels.

5. The progress made in the construction of the work has not been stated as it should have been, and I am to request that the omission may be supplied at an early date.

6. It is observed that the detailed distribution arrangements to be undertaken by the Municipality have not been remarked upon in the present papers, as was done in the original project, and I am to inquire what is intended to be done.

7. With these remarks, I am to convey the sanction of the Government of India to the revised project as now submitted. The additions to the estimate necessitated by the orders passed in paragraphs 2 and 4 should be reported to the Government of India, and every endeavour should be made to hasten the completion of the work.

8. The sanction herein accorded for Rupees 5,36,363 has been registered in this office as No. 8 M. of 1876-77, in supersession of that conveyed in Public Works Department, No. 688 B. C. of the 23rd August 1870, for Rupees 5,09,257, and registered as No. 24 B.C. of 1870-71.

9. The original documents received with the letter under reply are returned herewith.

Nos. 250 & 251. ORDER THEREON, 11th August 1876, No. 2,075.

MILITARY WORKS, No. 10.

THE Government of India will be supplied with copy of Proceedings of this Government, No. 431, of 15th February 1875, with reference to their docket No. 1,210, M. W., of 23rd July 1874, therein recorded. Also with copy of G.O., No. 599, of 6th March 1876, relating to the speedy shipment of the new pumps for the Dhobies' Wells at Bangalore.

2. The District Engineer, Bangalore, will expedite submission of the revised plan and estimate for a new second filter for the Ulsoor Tank which, in G.O., No. 1,397, of 5th June 1876, he was ordered to revise in direct communication with, and to submit through, Major Scott.

(Here enter No. 2,076, dated 11th August 1876.)

(True Extract.)

Colonel,

Offg. Under Secy. to Govt., P.W.D.

To the District Engineer, Bangalore.
To Major A. de C. Scott, R.E.
To the Military Department.

Exd. B. C. Shunker.
Exd. T. O'Connor.
Spare Copies

PUBLIC WORKS DEPARTMENT,
FORT ST. GEORGE, 11th August 1876.

No. 252.

No. 2,076.

FROM

MAJOR-GENERAL G. W. WALKER, R.E.,

Secretary to the Government of Madras,

Public Works Department,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA,

Public Works Department.

MILITARY WORKS, No. 11.

SIR,—I am directed to acknowledge the receipt of your docket, No. 1,108, M. W., dated 25th July 1876, giving cover to

correspondence on the subject of the water-supply at Bangalore, and requesting to be furnished with information as to the action taken by the Government of Madras on Government of India No. 1,210, M. W., dated 23rd June 1874. In reply, I am to forward copy of the Proceedings of the Madras Government, No. 431, of 15th February 1875, which explains the action taken with special reference to the improvement of the existing sources of water-supply to the troops. The Proceedings of Government, under date the 6th March 1876, No. 599, of which a copy is also appended, will show that arrangements have been made for the speedy shipment of the new pumps which have been ordered for the Dhobies' Wells.

2. It is proposed to construct a new second filter for the Ulsoor Tank, and the District Engineer has been called upon to expedite the submission of the plan and estimate for the work.

I have the honor to be,

Sir,

Your most obedient servant,

Colonel,

Offg. Under Secy. to Govt., P.W.D.

for Secretary to Government.

Exd. T. O'Connor.

Spare Copies

observation - They will use night-chairs, and their motions will be deodorized, as if suffering from cholera.

When a patient suffering from cholera is brought to hospital, his bedding and clothing will invariably accompany him, or be sent on as soon as possible after him, and a receipt be given for them by the Hospital Sergeant.

The mattress and bolsters, or pillows, brought from barracks, will be used by the patient in hospital. Should they, however, not arrive in time, or be too soiled for use, straw mattress and bolster will be supplied in hospital.

The soldier's clothing, hospital clothing and all bedding will be treated as laid down in Section I, pages 201-202, and in Section II, paragraph 116, Vol: I, Medical Code, care being taken that the means of purification are employed at once, and that accumulation of infected articles is strictly prohibited.

Medical Officers will indent on the Commissariat, either for large chatties or other suitable means of boiling infected articles, which is always preferable, when it can be done, to steeping in boiling water.

Fort Saint George
6th November 1875.

/s/ C. A. Gordon - Surgeon-General
P. M. O. British Forces.

No 166

Copy of the foregoing forwarded to the Public Works Dept. for consideration, with reference to the Memorandum thence No 1211 M. W. dated 28th July 1874 and previous correspondence.

By order - Lt Col.
J. M. Lee - Secy to the Govt of India.

M. 5521/76.

All communications
should be addressed
to the Secretary.

No. 230 C. M. M.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

Civil Works
Miscellaneous.

To, The Chief Commissioner of Mysore
Public Works Department.

Simla 24th July 1876.

Sir,

I am directed to acknowledge the receipt of your Offt Secretary's letter No. 52 B. C. of the 1st May last, submitting for approval and sanction a revised project amounting to Rs. 536,363 for the water supply of Bangalore, and in reply to communicate the following remarks thereon -

2. It appears from the plans submitted that the side walls of the three waste weirs, are only $2\frac{1}{2}$ feet above the sills, so that when the tank is full, the level of the water would be only $1\frac{1}{2}$ feet below the tops of the walls, and I am to say that it will be safer to raise the side walls to 4 feet in height above the sills, and to request that this may be arranged for -

3. It is observed that the two settling reservoirs in connection with the filters provided for in the original scheme, have been abandoned in the revised project.

project now submitted, it being considered that with the new arrangements for silt tanks in the large reservoirs, the water will issue from the tower in a sufficiently clear state, without the aid of such reservoirs.

The correctness of this view, can only be proved by actual experience, but it is presumed that there would be no difficulty in the construction of settling tanks should the necessity hereafter arise.

4. The substitution of concrete and stone ducts for the iron delivery pipes, is an improvement, but it is observed that the head channel 7033 feet in length is proposed to be left uncovered, this arrangement is not approved of, and I am to request that the head channel may be covered over, as also all other channels for delivery of filtered water, it being important to guard such water from the contamination to which it is liable in open channels.

5. The progress made in the construction of the work has not been stated as it should have been, and I am to request that the omission may be supplied at an early date.

6. It is observed that the detailed distribution arrangements to be undertaken by the Municipality, have not been remarked upon, in the present papers, as was done in the original project, and I am to enquire what is intended to be done.

7. With these remarks, I am to convey the sanction of the Govt. of India to the revised project as now submitted.

submitted - The additions to the estimate necessitated by the orders passed in paras: 2 & 4 should be reported to the Govt. of India - and every endeavour should be made to hasten the completion of the work.

8. The sanction herein accorded for Rs. 5,36,363, has been registered in this Office as No. 8 M of 1876/77, in supersession of that conveyed in P.M.D. No. 688 B.C. of the 23rd August 1870, for Rs. 5,69,257 - and registered as No. 24 B.C. of 1870/71.

9. The original documents received with the letter under reply are returned herewith.

I have the honor to be &c.
/s/ C. H. Dickens, Col. R. A.
Secretary to the Govt. of India.

S. 210

Sanitary
Reports & Returns

M. 5521/76
4/76

Government of India.
Military Department.
Fort William, the 4th April 1876.

No 165.

From

The Sanitary Commissioner with the
Government of India.

To

The Secretary to the Government of India
Military Department.

Dated Delhi, 16th March 1876.

In reply to Military Department No 869
Sanitary Reports & Returns dated the 17th ultimo with annexures re-
garding certain matters relating to the Sanitary condi-
tion of the Cantonment of Bangalore, I have the honor
to submit the following observations.

2. As regards the general health of the place
to which my attention has been specially drawn,
I would observe that the statistics of sickness and
mortality as a whole are very favorable. During the
ten years 1860-69 the admissions into hospitals from
among the European troops annually averaged 1043
per 1000, the daily sick rate 49 and the death
rate

rate 14.77. In 1870 the mortality was only 12.14 but owing in the main to the great prevalence of fever in the 1-21st Fusiliers which arrived in January of that year "saturated with malaria contracted during a residence in Sind" the sickness was great the admissions equalled 2317 and the daily sick 76 per 1000.

* Report of San Commissioner
Munro for 1870
page 28.

3. Since 1870 the sickness and mortality have been in the following proportions.

Year	Rates per 1000		
	Admissions	Daily Sick	Deaths.
1871	1230	53	10.24
1872	1239	53	15.39
1873	1109	53	8.30
1874	1014	60	11.81

4. But although these results compare favorably with those of many other Indian Stations there can be no question that in the matter of water supply Bangalore labors under very serious disadvantages and there is every reason to believe that if a proper supply of water were provided the health of the Troops would be much improved. I agree generally in the recommendations made by Surgeon General G. A. Gordon for protecting and

and improving the water in the Ulsoor lake and Dhobies wells but would again urge what I have said in former communications on this question that all such measures are more palliatives. They may diminish the evils somewhat but they can never remove them. The water of the Ulsoor lake or Dhobies wells can never be a safe water such as is fit for the Troops or any other people to drink. It is of the greatest importance that a proper scheme for supplying Bangalore with good water should be pushed on with as little delay as possible.

*Proceedings of the Madras Government, Military Department,
19th January 1876.*

Sanitary—Reports and Returns.

Read the following papers:—

No. 340. From Brigadier-General A. HOWLETT, c.B., Quartermaster-General, to Colonel A. C. SILVER, Secretary to Government, Military Department; dated Fort St. George, 6th December 1875, No. 7753.

I have the honor, by desire of the Commander-in-Chief, to forward for submission, a very interesting report on Bangalore, drawn up by Doctor C. Gordon, c.B., Surgeon-General, British Medical Forces, in this Presidency. His Excellency would suggest that six copies be forwarded to the Right Honorable the Secretary of State for India, for communication to the Army Sanitary Commission in London.

From Surgeon-General C. A. GORDON, M.D., c.B., Principal Medical Officer, British Forces, to Brigadier-General A. HOWLETT, c.B., Quartermaster-General; dated Fort St. George, 6th November 1875, No. 205.

With reference to my late visit to Bangalore and inquiries into certain matters of Army sanitation there, I have the honor to forward the accompanying report on the results of that visit, for the information of His Excellency the Commander-in-Chief.

2. The points, I have more particularly adverted to, include the water-supply, the present condition of the Ulsoor tank, the evils attributed to a swamp connected with the Dumbur tank, the state of the Badarhully Valley and of the Tanneries. I have further discussed a few matters connected with the scheme now in progress for supplying pure water to the troops; the occasional occurrence of typhoid fever among them, and the measures adopted at the time of visit to meet, if necessary, the advent of cholera.

No. 341. ORDER THEREON, 19th January 1876, No. 338.

Ordered that copies of the report be distributed as under:—

To the Home Government	...	20 copies.
„ Government of India	...	12 „
„ Quartermaster-General	...	3 „
„ Adjutant-General	...	3 „
„ Surgeon-General, British Medical Service	...	5 „
„ Do. Indian Medical Department	...	2 „
„ Sanitary Commissioner	...	2 „
„ Military Department	...	5 „

(True Extract.)

(Signed) A. C. SILVER, Colonel,
Secretary to Government.

No. 342. DOCKET, 19th January 1876, No. 339.

Copy of the above, with twelve copies of the report, forwarded to the Secretary to the Government of India, Military Department, for submission to the Right Honorable the Governor-General in Council.

(By order,)

(Signed) A. C. SILVER, Colonel,
Secretary to Government.

Exd. A. Raiff.

$$\begin{array}{r} 4903 \\ \hline 2 \end{array}$$

Munroe's COR. E.
Industries from the Govt. of India.

10/9-11-73 No 3833 milky Dept
 - 21-5-74 - 1610 milky Dept
 - 24-7-74 - 217
 - 5-10-74 - 18
 - 18-11-74 - 3765 milky Dept
 - 15-2-75 - 431
 - 14-1-76 - 177
 - 6-3-76 - 589
 - 5-6-76 - 1397
 10-9-75 58.
 18-8-78 - 111 orig.
 Memos. 1196 + 1197.

J. W. 1876 Dep
 No. 552

From

The Govt. of Ind

Dated 25th July 1896
 Recd. 30th Aug 1896

E. 4. No. 1108 M. W

Forwarding copies of
 Correspondence on the sub-
 ject of improving the ex-
 isting sources of water to
 ply to the troops at Ban-
 galore.

No 249

C. 7-8-76 11-8-76

PROCEEDINGS of the MADRAS GOVERNMENT.

Under date the 11 Aug 76
 Read the following.

The Government of India. (No. 1108 M. W. 425 July 76)

The Government of
 India will be supplied
 with copy of Proceedings
 of this Government No. 431
 of 18th February 1875 with
 reference to their Order
 No. 1210 M. W. of 23rd July 1874
 therein recorded. Also
 with copy of G. O. No. 599
 of 6th March 1876 relating
 to the speedy shipment
 of the new pumps for
 the Phobies Wells at Ban-
 galore.

The District Engineer
 Bangalore will expedite
 submission of the proposed
 Plan and Estimate
 for

for a second filter
for the Pulveriser
which in G.O. No. 1397
of 5th June 1876 he was
ordered to revise in
direct communication
with, and to submit
through Major Scott.
H. 2007/11 Aug 76

No 244-251

J. E. Boulanger
Major A. de la Force
M. de la Force

Sept. 11-9-76

No 2076 9/11 Aug 76 P. H. Dept.

The Secretary to the
Government of India
Public Works Dept.

Sir,
I am directed to
acknowledge the receipt
of your letter No. 1108 M. S.
dated 25th July 1876 giving
order to correspondence
in the subject of the water
supply at Bangalore
and requesting to be
furnished with infor-
-mation as to the action
taken by the Government
of Madras on Government
of India No. 1210 M. S.
dated 23rd June 1874.
In reply I am to forward
copy of the Proceedings
of the Madras Government
No. 431 of 15th February 1875
which explain the action
taken

As per with special
reference to the improve-
ment of the existing
sources of water supply
to the troops. The Proceed-
ings of Government
under date the 6th March
1876 No 599 of which
a copy is also appended
will show that arrange-
ments have been made
for the speedy shipment
of the new pumps
which have been ordered
for the Dhoby Wells.

It is proposed to
construct a new second
filter for the Dhoby
Tank, and the District
Engineer has been called
upon to expedite the
submision of the plan
and Estimate for the work.

249-252

C.M.M.

Chaff. with a copy of G.O. No 131
dated 15-2-76. & a copy of
G.O. No 599 of 6-3-76. in the
H. B. file 4776

5521

Govt. of India
PUBLIC WORKS.

The B. & B. Bangalore

10

Date

Time

Place

Time

W. O. No. 2075/2071

Dec. 21, 1902

Water supply to the
Troops at Bangalore

Passing orders in accordance from the Govt. of India forwarding copies of correspondence in the subject of improvement of the existing sources of —

but in the
a. p. 41

Forwarding copies of certain Proceedings explaining the action taken with special reference to the improvement of the existing sources of water supply to the Troops at Bangalore & the arrangements which have been made for the speedy shipment of the new pumps ordered for the Shobys Wells —