GOVERNMENT OF MADRAS.

MILITARY DEPARTMENT.

9th August 1886, No. 4761.

Sanitary—Reports and Returns.

Read the following :—

No. 95. *Military Despatch from the Right Honorable the Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George; dated India Office, London, 15th July* 1886, *No.* 9.

Para. 1. I forward, for your information, seventy * copies of a memorandum by the Army Sanitary Commission on the Health Returns of British Troops in the Madras Command for 1884.

* Twelve by mail ; fifty-eight by parcels post.

2. The unhealthy conditions prevailing at Secunderabad and Bangalore, as evidenced by the returns of sickness at those stations, call for earnest consideration at the hands of the proper authorities.

Memorandum of the Army Sanitary Commission on the following papers :—

1. Sanitary Report of Madras Army, 1884, by Surgeon-General J. Irvine, M.D.
2. Remarks on the above by the Commander-in-Chief, Madras.
3. Report on Enteric Fever in the Madras European Army, 1884, by Surgeon-General J. Irvine, M.D.

These papers are separate references, but we shall include our remarks on them in one memorandum. There is a separate paper by Surgeon-General Irvine, "Sanitary Report of British Troops in the Madras Command for 1884," which we shall also include, because all of them refer to the same subject.

1. The average strength of non-commissioned officers and men in the Madras European Army in 1884 was 10,812, as given by the Surgeon-General. But the average strength given by Dr. Stephen in his statistical tables differs slightly from the Surgeon-General's estimate; it is 10,785. The difference is so slight that we shall adopt that given in the Madras report. The year's facts will, therefore, stand as follows :—

		Ratio per 1,000.
Average strength	10,812	...
Admissions to hospital	11,960	1,106·18
Total deaths	93	8·60
Invalids sent home	350	32·37
Average daily sick	639·49	57·5

Dr. Stephen's returns differ from the Surgeon-General's in giving ninety-two deaths instead of ninety-three, and he states the average daily sick at 620. The two returns, therefore, differ from each other somewhat, but not to any material extent.

2. The really important points are given in this abstract, which shows satisfactory progress in army health.

—	1874—83.	1884.
Admissions per 1,000	1,173·87	1,106·18
Deaths ditto	13·98	8·60
Invalids ditto	40·10	32·37

As we shall presently see, there are disease and death causes still in existence which ought to be abolished, but the results of the 1884 statistics show a very substantial gain to army efficiency in all its elements.

3. As usually happens the admission rates vary considerably at different stations and in different years, but some of the stations have persistently high admission-rates.

Kamptee, for example, showed a ten years' average admission-rate of 1,460·27 per 1,000, and in 1884 the rate was 1,377·92 per 1,000. There must, of course, be some cause for this, and that it has something to do with locality appears to be shown by the fact of the high rate of 1884; there was due to fevers 587·2 per 1,000, to dysentery and diarrhœa 55·3 per 1,000. Bangalore had a ten years' admission-rate of 1,145·81 per 1,000, and in 1884 of 1,006·48 per 1,000. In the same way Secunderabad, with a ten years' admission-rate of 1,145·81 per 1,000, yielded a rate in 1884 of 1,077·53. These cases have an important bearing on the question of army efficiency, because of the number of troops stationed in the localities, although the admission-rates are not all due to local diseases.

4. The admission-rate for the whole Madras Army in 1884 was, as has been already stated 1,106·18 per 1,000; of this ratio 242·70 was due to venereal diseases, leaving for all other admissions a rate of 863·48 per 1,000. In the same way, of the Kamptee rate of 1,377·92, the venereal rate was 242 per 1,000; of the Bangalore rate 343·2 and of the Secunderabad rate 284·5 were due to syphilitic diseases.

5. Of mitigable or preventable fatal diseases, the most important were enteric fever, which yielded 129 admissions and eighteen deaths, and cholera, for which twelve were admitted, and ten of them died. The most fatal disease of the year was, however, hepatitis, to which twenty-two deaths were referred, and there were nine deaths from apoplexy. There were twelve deaths out of hospital, to be deducted from the ninety-three, which leaves eighty-one deaths, fifty-nine of which were due to these four diseases.

6. The death-causes of the year were as follow, including the above :—

Diseases.	Deaths.	Diseases.	Deaths.
Cholera	10	Hepatitis	22
Small-pox	1	Respiratory diseases ...	1
Enteric fever	18	Heart disease	1
Apoplexy	9	Phthisis pulmonalis ...	3
Delirium tremens ...	1	Wounds, &c.	1
Dysentery	4	All other causes ...	7
Diarrhœa	2	Deaths out of hospital ...	12

Taking the more important death-causes in order, we find that of the ten cholera deaths three took place at Madras, one at St. Thomas' Mount, one at Poonamallee Depôt, three at Bangalore, one at Secunderabad, and one at Kamptee. Out of twelve cases of cholera in the Madras Army ten died.

7. In connection with these cholera deaths, it should be remembered that there were 75,476 deaths from the disease among the civil population at the same time. There was a severe epidemic in the Presidency, during which the Native Army had a cholera death-rate of 1·46 per 1,000, while the rate in the European Army was 0·92 per 1,000, both of which may be favorably contrasted with the rate of 2·7 per 1,000 which ruled among the civil population.

8. *Enteric Fever.*—As already has been stated there were eighteen deaths entered under this head in 1884, which was the mortality in 129 cases of enteric fever, and we shall first show the relation which this fever has borne in time past to the general fever history of the Madras

Army. Assuming the strength, in round numbers, at 10,800, the admissions and deaths for eleven years have been as follow from all fevers :—

Fever Types.	1884.		Total in ten years 1874 to 1883.	
	Admitted.	Died.	Admitted.	Died.
Enteric fever	129	18	367	145
Simple continued fever ...	284	1	6,996	30
Febricula	626	...	4,607	...
Remittent fever	104	...	907	28
Ague	762	...	14,594	1
Total ...	1,905	19	27,471	204

The average admission rate from all fevers was for the ten years 253·33, and for 1884 it was 176·39 per 1,000. The corresponding death-rates were for ten years 1·88, and for 1884 1·76 per 1,000.

9. Of late years the nomenclature of this fever has been unsettled, on account of discussions on the subject of diagnosis of fever cases. This is well shown in the preceding table and in the following abstract prepared by the Surgeon-General :—

Years.	Ratios per 1,000.		
	Admissions.	Deaths.	Deaths to treated.
1880	2·43	1·07	440.
1881	·86	·48	416·66
1882	4·34	2·12	479·17
1883	8·86	2·73	298·97
1884	11·94	1·67	134·33

This table shows that the diagnosis was unsettled, and it seems doubtful if all the cases entered under the head in 1884 were due to developed enteric fever. But it is also known that the mortality due to this fever does vary in particular years, and the Surgeon-General accepts the diagnosis. Hence, if we agree with his view on this point, we must adopt the consequence which follows from it, that of late years enteric fever has become a more prevalent disease in the Madras European Army.

10. We shall next show where the disease occurred, and we shall place together in the same table the admissions and deaths from cholera :—

Stations.	Enteric Fever.		Cholera.	
	Admissions.	Deaths.	Admissions.	Deaths.
St. Thomas' Mount ...	1	1	1	1
Cannanore	4	1	...	...
Malapuram	1	1	...	...
Bangalore	60	1	4	3
Bellary	3	1	...	...
Wellington	1	...	...	...
Secunderabad	39	10	2	1
Kamptee	15	3	1	1
Thayetmyo	1	...	...	...
Port Blair	3	...	...	...
Madras	...	...	3	3
Poonamallee	...	...	1	1

There was a case of enteric fever among troops on march, which recovered. On looking at the data in this table, it seems very doubtful if the sixty enteric fever cases at Bangalore, of

which fifty-nine recovered, were really due to this fever. One thing, however, must be admitted and this is that there were sixty fever cases of so severe a character as to take rank with the most fatal of Indian fevers in the estimation of medical officers who treated them. But as the question is a very grave one, it may be suggested whether medical officers in their reports might not, with advantage, define what they mean by enteric fever, so as to avoid the confusion so far as it may be possible to do so. If we accept the data thus far as they stand, we shall have the conclusion forced upon us that, out of 168 station fever cases, of which eighteen died, 114 cases and fourteen deaths took place at three stations, Bangalore, Secunderabad, and Kamptee, while at the same three stations there occurred seven cases and five deaths from cholera out of a total of twelve cases and ten deaths in the Madras Army.

11. It is hence clear that in the present much improved sanitary state of the Madras Army there are nevertheless certain stations where there is preventable disease, and these are the stations where, in conformity with the sanitary economics, a further reduction in the sick and death-rates ought first to be sought.

12. The chief sanitary defects at these stations have been so long known that it seems almost unnecessary repetition to refer to them, but as they form part of the Surgeon-General's Report we may restate them. He says, "Enteric fever has increased steadily during the last four years, the increase being most marked in Bangalore, where the water-supply is always bad, and where it was scanty as well as bad in 1884. It seems probable, therefore, that the quality of the water has something to do with the spread of this disease. At Bangalore the barracks are all in good sanitary condition, but some of them are, as stated in last year's report, too close to densely-populated quarters which are under municipal authorities, and about the sanitation of which frequent complaints are made."

The remark made by the Adjutant-General on the water question is very much the same as has presented itself year after year, viz., that "the question of improving the water-supply for the troops at Bangalore, by abandoning the Ulsoor tank as a source of supply, is under consideration of Government."

This tank was condemned a quarter of a century ago, and even then it had been shown for years to have been a probable disease cause.

13. In last year's Report on the Madras Army one Medical Officer referred to the probable influence of malaria proceeding from the drying up of the edges of the tank in summer on the amount of fever among the troops, and in the present report the Surgeon-General tells us that the water-supply was "scanty as well as bad," and this fact implies concentration of all the water impurities under evaporation and absence of rain. We have thus to deal with a quite unsafe water-source which, as has been long known, receives its supply from a foul gathering surface, is liable to pollution from influx of foul drainage at Bangalore, its soluble impurities being liable to concentration by drying up, and the margins in all probability yielding unwholesome emanations at the same time. But, besides the dangers resulting from drying up of the tank, a fall of rain may increase the amount of filth in the water, for Surgeon-General Madden states that twenty-two cases of enteric fever, out of thirty, admitted to the north station hospital occurred in July and August, when much impurity was washed by the monsoon rains into the Ulsoor tank, while organic decomposition was rapid and offensive in all low-lying localities.

14. We are glad to learn that the whole subject of the water-supply of troops has been under consideration, and that several projects have been brought forward, but we should be glad to learn within what time the Ulsoor tank and its surroundings are to be finally abolished.

15. But the Surgeon-General's brief remarks raise other very important questions. The civil population of Bangalore is that of a large city, and we are told in the present year's report that "frequent complaints" have been made about the manner in which the municipal authorities perform their sanitary duties in parts near the barracks.

16. In the present report it is also remarked that "the discharge of the filth from the main drain of Richmond Town and Shoolay, within 200 yards of the old Lancers' Riding School, had probably something to do with the prevalence of the disease amongst the men of the "12th Lancers." As there are executive authorities on the spot, it would, of course, be advisable that they should do their work. But what if they neglect to do it? Are the troops to suffer on this account? And would it not be better to make such changes in the law or practice as would ensure that the part of this town near the barracks should be kept clean and otherwise in good sanitary condition?

17. The following statement by the Surgeon-General regarding Secunderabad throws some light at least on febrile disease causes there. He says, "The main defects at Secunderabad are the want of trees to check the force of the monsoon winds, and of surface drains to carry off the rain-water. At present this water percolates into the soil and foundation of the buildings."

Where foundations are raised above the ground level with free perflation of air between the ground surface and the barrack floor, this defect of the subsoil is of less importance, but where the floors are laid without air spaces in malarial climates fever is a necessary result.

But wet cultivation, with night-soil as a manure, is still carried on at no great distance from the barracks. As regards surface drainage, the Adjutant-General states that the cost of a complete system is prohibitive. But, in the meantime, it may be suggested whether raising the floors of the barracks in the way suggested would not remove much of the evil.

18. We are glad to learn from the Adjutant-General's letter that a scheme for the drainage of Secunderabad town is now under consideration. No complaint appears to have been made about the water-supply of troops at this station, so that the local causes of fever appear to be those connected with damp malaria producing subsoil under and around barracks, and probably emanations from wet sewage culture.

19. In this and indeed in all cases probably the effect of foul unhealthy bazaars and houses visited by the troops must not be overlooked. The subject is dwelt on by Medical Officers at stations, and the remedy is a long known one, viz., keeping the outskirts of stations free from disease causes.

20. The fifteen cases and three deaths from enteric fever at Kamptee have led to the following expression of opinion as to the cause by the Surgeon-Major:—"In my opinion the *probable* cause of the disease is the *latrines*. The men will not carry out the dry-earth system properly. I have constantly noticed a fæcal smell in the neighbourhood of these buildings. All the cases of enteric fever were admitted to hospital during the rainy season, when there is a very damp and close condition of the atmosphere which produces rapid putrefaction and fermentation. The latrines are cleared out morning and evening, and I think it very probable that a man visiting the latrines early in the morning before the pans are cleared out would run the risk of contracting enteric fever." The large amount of enteric fever at Lucknow had previously been attributed to this state of the latrines as a probable cause by the Deputy Surgeon-General.

21. It is an old sanitary proverb that "all smell indicates disease and loss of money." Where badly managed latrines and filth are the causes of smell, the first part of the proverb will always hold good, and the second also if the profitable application of manure be neglected. We have here instances of two stations having latrines on what is called the dry-earth system, while it is not so. Sewage emanations are the result, and we may rest assured that these are active as disease causes beyond the limits of perceptible odour, and then we have enteric fever among the troops; and as to the remedy, the Adjutant-General states that additional sweepers are required to go round and put dry earth in the pans after use by the men. We have had the subject so often before us that it seems scarcely necessary to restate the principles involved in the dry-earth system, but the practical remedy suggested by the Adjutant-General is the only one unless a suitable mechanism be provided in each seat. We may, however, report what has been said year after year since the report of the Royal Commission, that in such climates as exist in India there is no safety where there is sewage odour. This, and not the occurrence of enteric fever cases, is the real mark of danger, and whoever is charged with sanitary inspecting work should report on it again and again until the evil is dealt with.

22. The only other disease requiring notice is hepatitis, the mortality from which is differently stated in the reports and in Dr. Stephen's statistics. We have adopted the number of twenty-two deaths given in the statistics as the finally corrected one. Of these twenty-two deaths it is important to remark that nine took place at Secunderabad; but we have no recent account of the causes.

23. The account given of the general sanitary condition of stations does not call for remark, as there seems every disposition to render the barracks and stations healthy, and indeed the low death and in efficiency rates of 1884 show how much good work has been done. There are, nevertheless, exceptional cases where sanitary improvement is needed, and we shall confine our recommendations to these.

1*st*. The proposed new water-supply for Bangalore should be pressed forwards as quickly as possible, and authority should be brought to bear on the municipality to make them keep all that part of the town nearest the barracks in the best practicable sanitary condition.

2*nd*. It cannot be said that Secunderabad is as healthy as it ought to be. What appears to be required is the town drainage, regulation of wet culture, and in some way protecting ground floors from subsoil damp. Probably partial subsoil drainage around the barracks would be of use, or raising the floors. We would further suggest that some account of the reasons why so many men die there of liver disease should be forthcoming. Tree planting, if carried out so as not to interfere with ventilation, would, no doubt, be an advantage.

3*rd*. As regards the latrine details at Kamptee, the remedy is obvious, but we must state that neither at Kamptee nor anywhere else ought such a state of latrine accommodation to be permitted.

8*th June* 1886.

No. 96. ORDER THEREON, 9th August 1886, No. 4761.

Communicated to His Excellency the Commander-in-Chief and the Surgeon-General, Her Majesty's Forces.

2. The Government invite the attention of His Excellency the Commander-in-Chief to para. 2 of the above despatch.

(True Extract.)

(Signed) A. KENNEY-HERBERT, Lt.-Col.,
Secretary to Government.

To the Adjutant-General, with 8 copies of the memorandum.
" Quarter Master General, with 12 copies of the memorandum.
" Surgeon-General, Her Majesty's Forces, Madras, with 15 copies of the memorandum.
" Surgeon-General with the Government of Madras, with 20 copies of the memorandum.
" Sanitary Commissioner, with 2 copies of the memorandum.
" Public Department, with 10 copies of the memorandum.
" Public Works Department.

Exd. E. C. Shunker.

No 2139 W d/26-8-86

Communicated to the Suptg. Engrs III, IV & V circles, for information.

2. The question of improving the water supply of the troops at Bangalore is at present under reference to H.E. the Commander-in-chief.

(Sd) J. S. S.

To

S.E. III Circle
" IV ——
" V ——
Mily. Dept.

Govt. of {1886} Madras.

MILITARY.

To

THE ADJUTANT-GENERAL,
&c., &c., &c.

Dated August, 9th.

Issued

Recd. *Encl.*

G.O., 9th August 1886, No. 4761.

AUGUST.
Nos. 95-96.

Sanitary—Reports and Returns.

Memorandum by the Army Sanitary Commission on the Health Returns of British Troops in the Madras Command for 1884, communicated to His Excellency the Commander-in-Chief and the Surgeon-General, Her Majesty's Forces.

With order

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

READ again— Buildings and Roads. ~~Civil Works.~~

G.O., dated 5th October 1883, Nos. 2794-95 W.
" " 13th June 1884, Nos. 1473-74 W.
" " 25th July 1884, No. 1814 W.

READ—also the following papers :—

G.O., dated 23rd February 1885, No. 427 W., Public Works.

Read—the following letter from Colonel H. L. PRENDERGAST, R.E., Superintending Engineer, V Circle, to the Chief Engineer, Public Works Department, dated Madras, 19th January 1885, No. 3900 :—

I have the honor to forward Captain Romilly's report on the supply of water for the European troops at Bangalore, as called for in G.O., No. 1473 W., dated the 13th June 1884.

Captain Romilly has taken up thoroughly the investigation of the different schemes, and gives the cost of them in an abstract statement in appendix Y. There are added, at foot of the table, the annual maintenance charges for the three projects A, B and C.

2. The object in view is to have really good water supplied to the barracks ; and, in my opinion, this object can only be attained by distillation. By this process the water obtained from any source available is supposed to become perfectly pure ; and it will be most convenient to make use of the Halsur tank water, with condensers at the rock, new cisterns at the rock for drinking water, to be conveyed by new mains to the barracks, and with arrangements for pumping water direct from the Dhobies' Wells to the service cisterns at the barracks, to be used for other purposes than drinking.

This scheme is described in paragraphs 23 to 35 of Captain Romilly's report.

The first cost of providing distilled water, Rs. 1,67,000, is a good deal less than that of pumping filtered water from Agaram tank, Rs. 2,90,000 ; but there will be a much higher annual expenditure, which, with interest and depreciation of stock, is estimated at Rs. 84,600.

3. The objections urged in the Military Department are entered in appendix R, and consist in condemning the use of the water in the Halsur tank, in deprecating the conveyance of ablution water through the same pipes as the drinking water, and in showing the danger of depending on a single condensing apparatus, with no source to fall back upon in case of accident.

These objections appear to me to be fully met by the proposals to have a separate main-pipe for the pure drinking water, to use the water of the Halsur tank only after condensation, and to have a double condensing apparatus, so that there will be no failure in the delivery of pure water, even if the machinery in use were to be disabled temporarily.

4. The engine now at work at the Dhobies' Wells is an expensive one in fuel. It is in good order, and is saleable. The rock engine is old and liable to break down.

Hence it is desirable to get rid of the two old engines, and to provide a pair of new engines, each of 12-horse power, to be placed at the Dhobies' Wells, and to pump the water to the cisterns at the barracks.

To obviate the risk of a failure of water in the wells, it is proposed that there should be filter beds of sufficient capacity to allow of the tank water being filtered and pumped up to the service cisterns at the barracks.

The present small pure water cistern is not large enough to allow of sufficient water being pumped up; and it is proposed to utilize this cistern as an additional filter to let out water by gravitation to a new pure water cistern at the wells.

5. The condensing station is intended to be upon the Halsur rock; and it is expected that the Engine house on the rock will, with slight alterations, hold the condensing machinery; a plan of the building has in the mean time been sent to London, and the Normandy Company have been asked if there is sufficient accommodation.

A condenser producing nominally 9,000 gallons, but working up to 12,000 gallons, will in six days provide water sufficient for eight days' consumption; and it is proposed that there should be two complete condensers so as to provide against an accident happening to one.

Captain Romilly shows in paragraph 31 that it will be advantageous not to pump the condensed water over a stand-pipe at the rock but to place cisterns on the rock for the condensed water to gravitate to stand-cocks at the barracks. A lower pair of cisterns will each hold a day's supply for the Royal Horse Artillery, the Royal Artillery and the Cavalry, while an upper pair of cisterns will have command sufficient to give each a day's supply to the Infantry barracks.

The main pipes from the cisterns at different levels will be kept distinct for the delivery of water to the stand-cocks at the Agaram and at the Parade barracks. As a further precaution for maintaining the purity of the water, the estimate provides for iron water-carts, to take the place of the leathern buckets that are now in ordinary use for carrying water about the barracks.

6. The scheme would be more complete if the improvements to the Halsur tank were combined with it in part of the project C. The condition of the tank would be much improved by completely diverting the town drainage, filtering the northern drainage, and bringing in a fresh supply of water from a better gathering ground.

The additional cost through would be as given in paragraph 53:—

	RS.
New channel masonry works, compensation	26,130
Improvements to tank	33,730
Add for contingencies	2,990
Total ...	62,850

and as the condensing system is not affected by the natural quality of the water, the improvement of the Halsur tank will not be for the benefit of the British troops.

The advantages of a better supply of water would be felt chiefly by the civil population of Bangalore; but I fear the municipality would not consent to pay even a half share of the expenditure.

Order—dated 23rd February 1885, No. 427 W., Public Works.

The above papers will, in the first instance, be referred to the Sanitary Commissioner, Madras, for an expression of his opinions, and will then be forwarded for the remarks of His Excellency the Commander-in-Chief, who will be requested to return them to the Secretary to Government, Public Works Department, with a view to examination in detail and final orders by Government.

(True Extract.)

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Government, P.W.D.

From the Resident in Mysore, dated 14th March 1885, No. 2456/1280.

From Deputy Surgeon-General G. BIDIE, M.B., C.I.E., Sanitary Commissioner for Madras, to the Secretary to Government, Public Works Department, dated Madras, 15th April 1885, No. 414.

In returning the correspondence* regarding the Bangalore water-supply, referred under G.O., No. 427, of 23rd February 1885, I have the honor to submit the following remarks to the Right Honorable the Governor in Council.

* 1. Report by Captain F. J. Romilly, R.E.
2. Letter from the Superintending Engineer, V Circle, No. 3900, dated 19th January 1885.
3. Note by Under Secretary to Government, Public Works Department, dated 19th February 1885.

2. In dealing with this question it appears to me that, in restricting inquiries to the requirements of the troops, a somewhat narrow view has been taken of the necessities of the station. A large civil population has been allowed to settle down in the centre of the cantonment, and to outgrow the available water-supply and pollute its sources. These conditions are no doubt greatly to be regretted, but from a sanitary point of view they cannot be ignored. If the bazaar population be constantly exposed to epidemic and other disease from insanitary conditions, all our precautions to protect the health of the troops will be rendered more or less nugatory. I would therefore suggest that steps be taken to move the municipality of Bangalore to adopt some contemporaneous measure to secure for the inhabitants generally, independent of the troops, a sufficient supply of fairly good water. It appears to me that this might be obtained by adopting Colonel Mullins' scheme, with the additions proposed by Captain Romilly † for excluding the whole of the foul sewage of the town from the Halsur tank, and for bringing into it the drainage of a tract of open cultivated ground to the eastward of Bangalore. The supply thus obtained would not perhaps be unimpeachable, but it would be greatly superior to the existing one. The cost of these improvements is estimated at close on Rs. 30,000, which would not certainly be a heavy tax on a population of 81,810; and I have hopes that if the matter were placed fairly before the townspeople, they would not grudge so moderate an outlay for such an important purpose.

† See paragraph 37 of his report, and clause 2, paragraph 51, of Colonel Mullins' report.

3. Of the schemes suggested by Colonel Mullins and worked out by Captain Romilly for securing an improved water-supply for the troops, it appears to me that the proposal to use condensed water is, all things considered, the best.

4. The Agaram tank, which is mentioned as a possible source, receives the drainage of four villages, and although the sewage of two of these could be diverted, that of the remaining two could not be excluded. The proximity of native villages to the reservoir would also be objectionable, as it is almost impossible, under such circumstances, to prevent bathing, washing of clothing and cattle, and other objectionable practices. Captain Romilly puts the whole case very clearly when he says "there can be no doubt that the Agaram tank water is liable to dangerous contamination, and if adopted as the future reservoir for the troops, it is urged that the source of supply must not be accepted as, or expected to be, pure." Looking also at the chemical analyses of the water, they are not, so far as such results give warning of danger, of a satisfactory nature.

5. As regards the scheme for improving the Halsur tank and utilising the existing system with certain additions and modifications, there can be no doubt that, although calculated to effect a great improvement in the quality of the water, it is not such as can be recommended where the health of a large body of European troops is concerned, as they are much more sensitive to the effects of water of inferior quality than natives appear to be.

6. As stated by Colonel Mullins, "it is nearly certain that water of perfectly satisfactory quality could be obtained at Bangalore only by distillations." It is proposed, therefore, to use Normandy's condensing apparatus, and to have, in case of a break-down, two sets, each capable of producing 9,000 gallons in 24 hours. The water for distillation is, according to Captain Romilly's modification of the scheme, to

be drawn from the Halsur tank, and supplied to the troops for drinking and cooking purposes through a distinct series of cisterns, pipes and stand-cocks, at the rate of 3 gallons per head daily. Water for other purposes is to be drawn from the Dhobies' Wells, which yield a tolerably pure supply, and distributed through a separate system of pipes. These arrangements seem to meet the wants of the case. As pointed out by His Excellency the Commander-in-Chief, it is no doubt undesirable to have two qualities of water, the one potable and the other doubtful, supplied to barracks; but it is to be hoped that, by a careful arrangement of stand-cocks and other precautions, the anticipated risks may be nullified. I have therefore no hesitation in recommending the adoption of the scheme for the supply of water by Normandy's apparatus.

From Brigadier-General R. C. STEWART, Quartermaster-General, to the Secretary to Government, Public Works Department, dated Ootacamund, 2nd May 1885, No. 970 B.

In returning the documents received with your No. 10 E., of 17th April 1885, on the subject of the water-supply for Bangalore, which were forwarded for the remarks of the Commander-in-Chief, I am desired to say that, after full consideration of the three schemes which are adverted to in the above papers, Sir Frederick Roberts prefers project B, or that for retaining the present system, and providing for a separate service of water for drinking and culinary purposes by condensation.

2. The difficulty of inducing people to make invariable use of pure water when another and less wholesome supply is equally at hand, renders objectionable any system which comprises two sources, but the difficulty of securing water of sufficient quantity and of adequate purity at Bangalore is so great that His Excellency thinks it best to accept project B, provided that at the same time the conservation of the Halsur tank will be taken in hand by Government and the catchment area increased.

3. The cost of these improvements, as stated by Dr. Bidie, would be about Rs. 30,000, and taking into consideration the benefit that would accrue therefrom to the civil population of Bangalore, it would, in the Commander-in-Chief's opinion, be reasonable to expect the municipality to bear the cost of them, or at all events of a portion of them. Should the municipality not be prepared to accept the obligation, then it is hoped that Government will bear the whole expense, for unless these improvements be carried out, the water of the Halsur tank can never be satisfactory.

From A. H. T. MARTINDALE, Esq., Assistant to the Resident in Mysore, to the Secretary to the Government of Madras, Public Works Department, dated Bangalore, 23rd May 1885, No. 477/236.

In continuation of this office letter, No. 2456/1280, dated 14th March 1885, I am directed to forward copy of letter, number and date as per margin, from the President, Municipal Commission, Civil and Military Station of Bangalore, asking to be furnished with the plans of the recently selected gathering grounds in connection with the late Captain Romilly's scheme for the improvement of the Halsur tank.

No. 286, dated 13th May 1885.

2. I am to request that the plans in question may be forwarded to this office if they are available.

From Colonel J. SHAW-STEWART, R.E., Secretary to the Government of Madras, Public Works Department, to the Resident in Mysore, dated 2nd June 1885, No. 173 E.

With reference to your letter, No. 477/236, of 23rd ultimo, I have the honor to forward, for communication to the President of the Bangalore Municipality, the plans prepared by Captain Romilly for adding to the gathering grounds of the Halsur tank and improving the quality of its supply.

2. At the same time I am directed to forward copies of letters from the Quartermaster-General and the Sanitary Commissioner for Madras, in which are recorded the opinions of His Excellency the Commander-in-Chief and of the Sanitary Commissioner on the alternative schemes for improving the water-supply to the British troops at Bangalore.

3. You will observe therefrom that, whilst supporting the project for the distillation of the drinking water to be drawn, as at present, from the Halsur tank for the use of the garrison, both the Military and Sanitary authorities strongly advocate the contemporaneous adoption of the measures proposed in Captain Romilly's project C for adding to the supply available for the civil population of the cantonment, excluding foul sewage from the tank, and improving its conservancy.

4. The estimates for these improvements amount to Rs. 59,860 (not to Rs. 30,000 only as stated by Dr. Bidie), and I am to inquire whether, in view of the decided benefits that will be conferred thereby on the general public of Bangalore, the municipality are prepared to contribute towards the cost of same, and if so, to what extent.

From Major J. H. NEWILL, Assistant to the Resident in Mysore, to the Secretary to the Government of Madras, Public Works Department, dated Bangalore, 6th November 1885, No. 2172/70.

With reference to correspondence ending with your No. 173 E., dated June 2nd, 1885, I have the honor, under instructions from the Officiating Resident, to forward a copy of further papers, as noted on the margin, relative to adding to the gathering grounds of the Halsur tanks and to improving the quality of the water-supply.

1. Note, dated 6th July 1885, on the Halsur tanks, by Captain C. H. M. Kensington, R.E.
2. Letter, No. 943/44, dated 15th July 1885, to the President, Municipal Commission, Civil and Military Station.
3. Letter, No. 838, dated 27th July 1885, from the President, Municipal Commission, Civil and Military Station.
4. Letter, No. 1193/53, dated 3rd August 1885, to the President, Municipal Commission, Civil and Military Station.
5. Demi-official letter, dated 27th August 1885, from Mr. McLaughlin.
6. Letter, No. 1468/70, dated 3rd September 1885, to the President, Municipal Commission.
7. Notification by the President, No. 12, dated 11th September 1885
8. Letter, No. 1173, dated 25th September 1885, from the President, Municipal Commission, with enclosures.

2. The municipal commissioners having agreed to deepening the Lower tank, and raising the waste weir at a cost of Rs. 10,000 and to the purchase of the Jevanhully tank, the work of excavation was begun early in August and was actively carried on till the heavy fall of rain in the latter part of September stopped it. In all some 34,000 cubic yards of earth have, at a cost of Rs. 5,546-11-4, been removed from the bed of the Lower tank to form an island and an embankment on the eastern side, which are now being laid out as ornamental grounds; 1,450 lineal yards of hedge have been planted; 8,000 square yards of embankment have been sectioned and turfed; two culverts have been lengthened, and some minor works have been completed. The constant rain of the last six weeks has so raised the level of the water in the Lower tank that it is impossible at present to undertake work on the weir. The necessary notification has been given for acquiring the Jevanhully tank. This, when it comes into the possession of the municipality, will constitute a valuable reservoir. The result of what has been done is to lessen, in the Lower tank, the area exposed to evaporation, and to increase the capacity. As the level in the Lower tank sinks, the Upper tank will be drawn upon to supply what is wanting, and so long as the water in the Jevanhully tank admits of so doing, the Upper tank will be similarly replenished from it.

3. With his letter, No. 3150, dated September 22nd, which forms an enclosure to No. 1173, dated September 25th, 1885, from the President of the Civil and Military Station to my address, Colonel Burton, the Executive Engineer of the Presidency

Division, who is also a municipal commissioner for Bangalore, and who has taken a great interest in the work of improving the Halsur tank, has forwarded estimates involving a total expenditure of Rs. 21,500. Of this sum, Rs. 5,546-11-4 had, as shown above, been spent up to the date of his letter from Municipal funds. In his letter, No. 838, dated July 27th, 1885, to my address, the President of the Civil and Military Station has communicated the expectation of the municipal commissioners that the Madras Government will bear its share in the undertaking. As the commissioners have contributed so generously, I trust that their action may now be liberally supported by His Excellency the Governor in Council, and I would express the hope that a similar sum of Rs. 10,000 may be put at our disposal to help in the completion of the work. Independently of that amount already subscribed by the commissioners, there will devolve on them the further cost of compensation for the Jevanhully tank and for raising the waste weir of the Lower Halsur tank. Hence the necessity for a large measure of assistance from outside.

4. The most important feature of Captain Romilly's scheme for improving the quality of the water in the Halsur tanks was to abandon the present catchment area on the west, which is mainly covered by the cantonment bazaar, and to substitute, as the gathering ground, a tract of high and sloping land to the east which belongs almost, if not entirely, to the Mysore Government. Mr. Girdlestone visited this locality some weeks ago, in company with Colonel LeMessurier, R.E., Colonel Burton, R.E., Major Bowen, R.E., Mr. McLaughlin, C.E., and Major Maltby. The last-named officer is the President of the Municipal Commission, Civil and Military Station of Bangalore. The general opinion was that the proposed area for catchment is larger, and that its soil is more holding in its nature than are the area and the soil of the reservoir constructed by Colonel Sankey on the Tumkur road for the use of Bangalore; that for the contour channels sharper gradients than those recommended by Captain Romilly are desirable so as to ensure the prompt and efficient passage into the Halsur tanks of even slight rainfall; that if the land were taken up its cleanliness would have to be secured, as in the case of the English War Officers' Fortification Act, by reserving to the municipal commissioners the right of clearing trees, of preventing the erection of new buildings or a change in existing levels, and of forbidding the construction of unauthorized water channels. Conservancy powers would also have to be obtained over villages now in the area. At present there is sewage forming on fields within the area. Were this practice deemed prejudicial (there was a difference of opinion on this subject amongst those who accompanied Mr. Girdlestone to the spot), the municipality's sale of sewage to this tract would need to be discontinued and disallowed.

5. There does not seem to the Officiating Resident any likelihood that the municipal commissioners would contribute towards the cost of the proposed new catchment area; and in the event of opposition, Mr. Girdlestone would not, under existing circumstances, feel justified in using his influence to overcome their objections. As at present advised, he himself is not prepared to acquiesce in the belief that the proposed scheme would result in water for the garrison much more pure than that now supplied. The municipal commissioners entertain grave doubts as to the value of contour channels for supplying reservoirs; and at any rate they have for the moment before their eyes the failure of Colonel Sankey's scheme on the Tumkur road, which depended to a large extent on this source of supply. They also urge that the water-supply, as it now exists, is acceptable to the townspeople and not unhealthy in its effects; and consequently that as their first care should be for the townspeople, they would not be justified in sharing an expenditure the necessity of which has not been proved to their satisfaction. From this it follows that if the Madras Government still regards this part of Captain Romilly's proposals as imperative, it will rest with itself to provide the funds required for its accomplishment. It seems desirable that if the scheme is undertaken, the supply from the western side should not be cut off till the success of the new undertaking has been fully established.

6. I am to take this opportunity of intimating that much attention has been paid of late to the question of purifying and maintaining pure in its passage to the Halsur tanks the water which runs thither from the western side. Within the gathering ground on the west there is much cultivated land. This it is practically impossible,

owing to the prohibitive cost of compensation, to throw out of cultivation. But scavenging is systematically carried out, and patrolling frequent in all places of public resort. It having been found that on the occasion of heavy rain in the cantonment bazaar the main drain overflowed into the main sewer, the dividing wall between them has been raised so as to prevent this evil. The nuisance caused by the pollution of ground in and about the tanneries and potteries has been stopped. New sites, beyond the limits of the catchment area, for small-pox and cholera camps, are being sought. The question of allowing the Hindu burial-ground to be still used has been referred for the opinions of the Officer Commanding the Division and of the chief Medical authorities in Bangalore. If their opinions are unfavorable, the Officiating Resident will use his influence to put an end to such use. For the protection of the Halsur tanks eight watchmen have been appointed at a cost to the municipality of Rs. 56 a month. Should there be any other practical safeguards which the Madras Government may wish to suggest in the interests of the troops, Mr. Girdlestone will gladly, on receiving details from you, give consideration to them.

From the Resident in Mysore, dated 17th November 1885, No. 2293/70.

From Colonel J. SHAW-STEWART, R.E., Secretary to the Government of Madras, Public Works Department, to the Resident in Mysore, dated 8th January 1886, No. 68 W.

In reply to your Assistant's letter, No. 2172-70, dated 6th November 1885, I am directed to state that, after full and careful consideration, and taking into account the recommendations made by Sir Frederick Roberts and the Sanitary Commissioner, the Government of Madras feel convinced that the most appropriate method of securing a pure water-supply for the troops and civil population of Bangalore is to adopt the proposals made by the late Captain Romilly as set forth in his project B, with the addition of the first seven of the estimates which compose project C.

2. The cost of project B is estimated at Rs. 1,67,000; and that portion of project C that it is proposed to carry out, at Rs. 59,860; or a total expenditure of Rs. 2,26,860. In this connection I am to say that the Government of Madras note that the municipal commissioners of Bangalore are unwilling to contribute any sum towards the cost of taking up a new catchment area to the east of the Halsur tank. But it is hoped that they will raise no objection to this much-needed improvement being carried out by Government. The two items to which the consent of the municipal commission is requisite are—

(1) Diversion of the town drainage, and
(7) New supply-channel and compensation,

and I am to solicit that the matter may be laid before the municipal commissioners as early as practicable, and that you will move the commissioners to accord their consent to the scheme.

3. In view of the heavy expenditure that will be incurred should it be finally decided to carry out the works above mentioned, the Government of Madras regret that they are unable to contribute towards the estimate of Rs. 21,500 for work in connection with the tank which the municipal commissioners have taken in hand; but the Government will be prepared to pay a moiety of the sum expended by the commission on works which will render any of the items from 1 to 7 of project C unnecessary.

4. Adverting to the concluding portion of paragraph 5 of your letter under reply, I am authorized to give the assurance that the Halsur tank supply from the western side shall not be cut off until the success of the new gathering ground to the east shall have been fully established.

5. The enclosures received with your letter are herewith returned, and in conclusion I am directed to solicit that the early consent of the Government of Mysore and of the municipal commissioners to the scheme for taking up a new catchment area to the east of the Halsur tank may be obtained and communicated, in view to the proposal being submitted for the final sanction of the Government of India.

G.O., dated 1st June 1886, No. 1386 W., Public Works.

Read—the following letter from Major E. A. FRASER, Assistant to the Resident in Mysore, to the Secretary to the Government of Madras, Public Works Department, dated Bangalore, 15th April 1886, No. 1022/705 :—

With reference to letter, No. 829 C., dated 1st March 1886, from your office, requesting an early reply to letter, No. 68 W., of the 8th January 1886, regarding the proposed improvements to the Bangalore water-supply, I am directed to forward, for information, a copy of the correspondence noted on the margin which has passed on the subject.

Letter, No. 2194, dated 9th March 1886, from the President, Municipal Commission, Civil and Military Station of Bangalore.
Letter, No. 902/705, dated 7th April 1886, to the Chief Secretary to the Dewan of Mysore.

ENCLOSURES.

From Major E. P. MALTBY, President, Municipal Commission, Civil and Military Station, Bangalore, to the Assistant to the Resident in Mysore, dated Bangalore, 9th March 1886, No. 2194.

I have the honor to acknowledge the receipt of your letter, No. 396/70, dated 23rd ultimo, forwarding copies of letter, No. 2172/70, dated 6th November 1885, from the Assistant to the Resident, to the Secretary to the Government of Madras, Public Works Department, and letter, No. 68 W., dated 8th January 1886, to the Resident in Mysore.

2. In reply, I have to state that as the Government of Madras is willing to bear all the expense of bringing water into the Halsur tank by a new channel on the east, and as that Government gives an assurance that the bazaar drainage which now enters the tank from the west "shall not be cut off until the success of the new gathering ground to the east shall have been fully established," the municipal commissioners now raise no objection to the proposed improvement to the Halsur tank.

3. The commissioners were afraid that the present supply (which, indifferent as it is, is still better than none) would be cut off *before* it was *proved* that water could be brought in in sufficient quantity from the east.

4. Having now the assurance of the Madras Government that such shall not be done, they will be very glad to see the work put in hand.

From J. H. NEWILL, Esq., Assistant to the Resident in Mysore, to the Chief Secretary to the Dewan of Mysore, dated Bangalore, 7th April 1886, No. 902/705.

I am directed to forward a copy of the correspondence noted on the margin regarding improvements to the Halsur tank, and to express the hope of the Officiating Resident that the Government of His Highness the Maharaja will give the subject its most careful consideration and favor him with an early reply.

No. 2172/70, dated 6th November 1885, to the Secretary to the Government of Madras, Public Works Department, with enclosures (to be returned).
No. 68 W., dated 8th January 1886, from the Secretary to the Government of Madras, Public Works Department.
No. 2194, dated 9th March 1886, from the President, Municipal Commission, Civil and Military Station of Bangalore.

Read—the following letter from Major E. A. FRASER, Assistant to the Resident in Mysore, to the Secretary to the Government of Madras, Public Works Department, dated Bangalore, 22nd May 1886, No. 1430/705 :—

In continuation of letter, No. 1022/705, dated 15th April 1886, from this office, regarding the proposed improvements to the Halsur tank, I am directed to forward a copy of letter, No. 1159/60, dated 28th idem, from the Chief Secretary to the Dewan of Mysore stating that every facility will be afforded by His Highness' Government in the matter of acquiring land for a new catchment area to the east of the tank.

2. I am to request that you will favor the Officiating Resident with an expression of your opinion on the considerations urged by the Durbar in paragraph 3 of its letter above quoted, with regard to certain rights proposed to be reserved to the municipal commissioners of the civil and military station for the purpose of securing the cleanliness of the Halsur tank.

ENCLOSURE.

From M.R.Ry. R. VIJAYENDRA RAO, Chief Secretary to the Dewan of Mysore, to the Assistant to the Resident in Mysore, dated Ootacamund, 28th April 1886, No. 1159/60.

I am directed to acknowledge the receipt of your letter, No. 902/705, of the 7th instant, on the subject of the Halsur tank improvements, and inviting the consideration of His Highness the Maharaja's Government thereto.

2. It would appear from the correspondence that the Government of Mysore has no direct concern with the project under reference, beyond that connected with the acquisition by the British Government of the land to be taken up for the proposed channel to the east of the Halsur tank, which channel will, for the greater part of its course, run through the territory of His Highness, and in regard to this I am desired by the Dewan to say that every facility will be afforded by His Highness' Government for the transfer of the land on reasonable terms.

3. I am to invite attention, however, to paragraph 4 of your letter, No. 2172/70, of 6th November 1885, to the Secretary to the Government of Madras, Public Works Department, where it is proposed to reserve to the cantonment municipal commissioners the rights of clearing trees over the catchment area drained by the channel, of preventing the erection of new buildings or "a change of existing levels," and of forbidding the construction of unauthorized water-channels. Further, conservancy powers over the villages in this area are to be vested in the commissioners and apparently the manuring of fields is to be prohibited. This proposal involving, as it does, the abrogation of immemorial occupancy rights may, the Dewan apprehends, complicate the question considerably; and I am to request the favor of a reconsideration of the necessity for conferring on the cantonment municipality powers to this extent over lands outside their jurisdiction. His Highness' Government fully recognizes the desirability of improving the water-supply of the Bangalore cantonment, and will gladly facilitate the furtherance of any scheme to that effect, but they desire to point out that interference with the rights of land-holders outside the municipal limits should, if possible, be avoided. Extensive powers, such as those indicated above, would probably necessitate the throwing out of cultivation of a large area of land, and the payment of compensation far in excess of what was contemplated by the projectors of this contour channel.

Read—the following letter from Major E. A. FRASER, Assistant to the Resident in Mysore, to the Secretary to the Government of Madras, Public Works Department, dated Bangalore, 21st May 1886, No. 1418/3495 :—

I am directed to forward, for your information, a copy of the Officiating Resident's Minute on the water-supply of Bangalore.

ENCLOSURE.

Minute by the Officiating Resident on the Water-supply of Bangalore.

The object of various measures to which the attention of this Residency has been given during the past fourteen months has been to increase the water-supply of Bangalore and to improve the quality of the water.

2. To this end the bed of the Shoolay tank was deepened and the weir and the embankment which surrounds it were raised in the spring of 1885, the result being that an additional depth of two and a half feet was secured over the whole reservoir. The cost of the work was Rs. 7,200. There still remains the work of enlarging the catchment area of this tank and that at Hakitimanhalli, where more water is much required. The outlay on this account is estimated at Rs. 4,000, of which Rs. 1,000 have been entered in the present year's budget, and will be sanctioned, for a feeder on the side of Trinity Church.

3. During August and September 1885 about 35,000 cubic yards of earth were dug out from the bed of the Lower Halsur tank, on the northern and eastern sides, at a cost of about Rs. 5,600, and were formed into an island and an embankment on the eastern side, which are being laid out as ornamental grounds. In the conduct of all this work the help received from Colonel Burton, R.E.,

was very valuable. The total sum voted by the municipality of the civil and military station for the improvement of this tank is Rs 10,000. Since the end of last September the progress of excavation, and the raising of the waste weir, which was a part of the general scheme, have been stopped, owing to the high level of water in the reservoir caused by the autumnal rain. It is very desirable that both works should be taken in hand again whenever circumstances admit. Here, as elsewhere, it is of great importance to increase the capacity of the reservoir. For want of a higher waste weir much water ran off and was lost last October.

4. In connection with this particular supply, the municipal commissioners have exercised a wise forethought in acquiring the Jevanhully tank. The cost of this has amounted to Rs. 6,675. The tank will serve as a valuable feeder to the Upper Halsur tank.

5. The result of what has been done at Halsur is to lessen in the Lower tank the area exposed to evaporation, and to increase the capacity. As the level in the Lower tank sinks, the Upper tank is drawn upon at once to supply the deficiency, and so long as there is water in the Jevanhully tank, the Upper tank will similarly be replenished from it. The chief loss of water, in an extensive but comparatively shallow reservoir, such as the Lower Halsur tank, is due to evaporation, not to consumption. The device of preventing evaporation by means of aquatic foliage has not proved satisfactory in India. Hence the necessity for meeting the difficulty by restriction of area and corresponding excavation.

6. The Madras Government has a separate project under consideration, whereby, at a cost of about 2¼ lakhs of rupees, it would fill the Lower Halsur tank entirely from a new catchment area on the east side of the tank. The undertaking is prompted by the wish to afford the European soldiers, who are entirely dependent on the Halsur reservoir, purer water than it is believed can, with the best conditions, be secured under the present system. As the Madras Government is ready to bear all the expense, and as it has given an assurance that the rain drainage from the cantonment bazaar, &c., which now enters the tank from the west, shall not be cut off till the success of the new gathering ground to the east shall have been fully established, the municipal commissioners of the civil and military station have raised no objection to the proposal. They are averse to sharing the cost, not only because it would be difficult to find the necessary funds, but also because they do not feel justified in making such a marked change, so long as the water-supply, as at present it exists, is acceptable to the townspeople and not unhealthy in its effects. The scheme is now before the Mysore Government, whose consent has been sought to the alienation of the land involved by it.

7. Much has been done of late to purify, and to maintain pure in its passage to the Halsur tanks, the water which runs thither from the western side. Within the gathering ground there is much cultivated land. This it is practically impossible, owing to the prohibitive cost of compensation, to throw out of cultivation. But scavengering is systematically carried out, and patrolling frequent in all places of public resort. For the protection of the tanks eight watchmen have been appointed at a cost to the municipality of Rs. 56 a month. It having been found that on the occasion of heavy rain in the cantonment bazaar the main drain overflowed into the main sewer, the dividing wall between them has been raised, so as to prevent this evil, and has satisfactorily withstood the test of the late sharp storms. The nuisance caused by the pollution of ground in and about the tanneries and potteries has been much diminished. New sites, beyond the limits of the catchment area, have been chosen for small-pox and cholera camps, with special regard to the accommodation of the homeless poor in time of scarcity or famine; for experience has proved that the inhabitants of the town are best treated for infectious and contagious diseases in their own houses. A new site has also been chosen for the Hindu burial-ground, which it is hoped that the Durbar will concede. In such case the present one will be closed with as little delay as possible.

8. The supply of water to Miller's tanks, which is the third of the three great systems on which the civil and military station depends, has been facilitated by the construction of a diversion sluice in Cunningham road to serve tank No. 3. The channel with which such diversion is connected is one of the principal feeders of the Sampangi tank, which lies for the most part outside the limits of assigned tract. Consequently, as the Durbar has direct interest in the matter, it has been suggested that it should be left to the Public Works Department Secretary of the Mysore Government and to the President of the Civil and Military Station to agree when the diversion sluice should be used, and that in case of difference, the Resident should settle the question. This arrangement I hope that the Durbar will acquiesce in.

9. Advantage would be gained, I believe, by deepening all three Miller's tanks, provided that the lower soil is tenacious enough to hold water, and provided that there is no risk of setting free malarious influences if the present bottom be disturbed. Such has not been the result of the excavations at Shoolay and Halsur. I also think favorably of a scheme advocated by Mr. J. W. Hayes, municipal commissioner, for the construction of another reservoir below, but in close vicinity to the Shoolay tank. The configuration of the ground is such that the undertaking is not likely to be very expensive. Mr. Hayes puts the cost at Rs. 15,000, irrespective of compensation for house-property. Population in this neighbourhood is numerous and apparently on the increase. Hence the desirability of intercepting and holding water which, as actually happened

last year, may otherwise run to waste. In the present year I am afraid there is no prospect of funds being available for this work. I am also strongly impressed with the necessity of taking water nearer to the houses of the inhabitants as soon as money can be spared. At present the distance to which poor persons have to go for water, specially those who live in the cantonment bazaar, is considerable. This improvement may perhaps be best effected by pumping from existing reservoirs through pipes into cisterns or open basins at convenient centres. In connection with it the establishment of drinking fountains and drinking troughs at places of general resort seems desirable.

10. Not long ago it was represented to me that the water level in the wells of the civil and military station has been steadily getting lower for some years past. The fall has been variously attributed to the increased growth of casuarinas, which have a great tendency to absorb moisture, to a diminution in the rainfall, and to other climatic influences. The subject is, I think, worthy of investigation. At present the information at disposal is too limited to warrant the assumption that the water level in general has sunk. Till this fact has been established it is premature to speculate on the causes which may be at work.

11. The construction of the low level sluice from Sankey's reservoir for the benefit of the city of Bangalore does not in my opinion imperil the interests of the civil and military station. Colonel Sankey's main object of continuously supplying the High Ground and neighbourhood with water having failed, and there being no present means or likelihood of achieving that object, it would be an act of selfishness to oppose the utilization of such water as can serve the city under circumstances when the high-level sluice cannot be worked. Apart from this consideration the city has a claim by reason of the catchment area of the Dharmabudi tank having been circumscribed by the formation of Sankey's reservoir. The distribution of the water can always be determined by the Resident and the Dewan in consultation. It was by mutual agreement that Miller's tanks were thus replenished last autumn in a season of exceptional drought. As no difficulty was then experienced, there is reason for anticipating as satisfactory results in cases of future necessity. There seems no likelihood of raising the level in Sankey's reservoir, except at inordinate expense, and with risk of taking from the supply of other tanks in the neighbourhood.

12. The importance of not allowing present sources of water-supply beyond the limits of the Assigned Tract to be interfered with for purposes of irrigation or otherwise has been recognised, and assurances have been given on the part of the Durbar that it will not allow such interference, and that practically now it stops such interference in all cases which are brought to its notice.

13. There has not been leisure, on the part either of myself or of the engineer officers who have favored me with their help and advice in the above-mentioned matters of more immediate importance, to go deeply into the larger consideration of making Bangalore independent of its present system of tanks and wells. Even the preliminary inquiries involved in such schemes as that of leading water from Nundidroog and of pumping from the Cauvery would necessitate the employment of specially qualified professional men at no slight expense. That the cost of either scheme would be very great is beyond doubt. Such cost could only be met by a water-rate on the population which would be unobjectionable, if it did not exceed the present cost of fetching water, but which otherwise might press on a community that believes municipal taxation to be already quite high enough. Geologists have hitherto declared against the practicability of Artesian boring. It may be that this process, when more perfected, may solve the difficulty. Such a measure would be less likely to be hampered by questions of compensation; it would be without the risk of intermediate interruption which is attendant on the other two schemes, and it might be comparatively inexpensive. The deep borings which are now being made at various points on the Kolar gold fields may show what volume of water is to be hoped for at specified levels under known conditions of intervening rock or other material, and may yield information on other important points. Meanwhile, I think that the municipalities of Bangalore will be wise in restricting themselves, as regards improvement, to the lines which they have been pursuing of late.

12th May 1886. (Signed) C. E. R. GIRDLESTONE.

Note by the Secretary to Government, Public Works Department.

In February 1885 the three projects prepared by the late Captain Romilly, R.E., for improving the water-supply of Bangalore were referred to the Sanitary Commissioner for an expression of his opinion, and, in his No. 414, dated 15th April 1885, Dr. Bidie approved project B, which provided for drawing the supply from Halsur tank and distilling the water by means of condensing engines. His Excellency the Commander-in-Chief also expressed his preference for project B, "provided that, at

the same time, the conservation of the Halsur tank will be taken in hand by Government and the catchment area increased."

In order to carry out the foregoing proviso it was found necessary to adopt the first seven items of project C, in addition to project B; and the Resident in Mysore was informed, in January 1886, that the Government of Madras were convinced that that was the most appropriate method of securing a pure water-supply for Bangalore.

Of the first seven items of project C, two required the previous assent of the Government of Mysore, which was accordingly solicited.

The items were—

(1) Diversion of the town drainage.
(2) New supply channel and compensation.

With regard to (1) it was proposed to divert the town drainage from the west of the Halsur tank, and to draw the supply in future from a new catchment area to the east of the tank.

The area of the proposed new catchment basin was 2·4 square miles, or 1536 acres; and the compensation provided for in the estimate was Rs. 2,680 for the contour channel, and Rs. 2,635 for 52·7 acres of land thrown out of cultivation under the Kadarampolem tank.

Further information regarding the items referred to will be found in paragraphs 41—43 of Captain Romilly's report, copy of which is attached.

In requesting the approval of the Bangalore Municipal Commissioners and the Government of Mysore to the two items above referred to, the Government of Madras gave the assurance that the supply from the catchment on the west should not be cut off until the success of the new gathering ground to the east had been fully established; and, on this assurance and on the understanding that the British Government paid all expenses, the Municipal Commissioners, in March last, stated that they had no objection to the proposed improvements.

In a communication, dated 28th April 1886, to the Resident in Mysore, the Government of Mysore state that every facility will be afforded for the transfer, on reasonable terms, of the land required for the new catchment area; but invite attention to a letter from the Resident, dated 6th November last, in which it was stated that, in the event of the new catchment area being taken up, its cleanliness would have to be secured, as in the case of the English War Officer's Fortification Act, by reserving to the Municipal Commissioners the right of clearing trees, of preventing the erection of new buildings or a change in existing levels, and of forbidding the construction of unauthorised water channels. The Resident further expressed his opinion that conservancy powers would have to be obtained over villages situated within the catchment area, and that, if it were deemed prejudicial, sewage forming on fields within the area should be stopped.

The Mysore Government now represent that the prohibition of manuring of fields would involve the abrogation of immemorial occupancy rights, and might, it is feared, complicate the whole question considerably; they request that the necessity for conferring on the cantonment municipality powers to the extent indicated above over lands outside their jurisdiction may be reconsidered; and add that, while the Mysore Government will gladly facilitate any scheme for improving the water-supply of Bangalore, interference with the rights of land-holders outside the municipal limits should, if possible, be avoided. Extensive powers, such as those indicated above, would probably necessitate the throwing out of cultivation of a large area of land, and the payment of compensation far in excess of what was originally contemplated.

The question now to be decided is whether the proposed new gathering ground, lying to the east of the Halsur tank, may be added to the drainage area of the tank without taking any special precautions for securing its thorough conservancy. The only alternative appears to be to acquire possession of the land which forms the proposed new gathering ground, and to throw it permanently out of cultivation; but it is to be observed that this alternative course would involve very heavy additional expenditure.

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

31st May 1886.

Order—dated 1st June 1886, No. 1386 W., Public Works.

These papers, with the note thereon which has been drawn up in this department, will, in the first instance, be referred to Surgeon-General Bidie, who, with advertence to his letter, dated 15th April 1885, No. 414 (written as Sanitary Commissioner), will be requested to favor the Government with his opinion on the point which has lately been raised.

2. The papers will then be forwarded to the Quartermaster-General,* who will be requested to obtain the opinion of His Excellency the Commander-in-Chief, and to return the papers to the Secretary to Government in the Public Works Department.

* *Vide* his No. 970 B., dated 2nd May 1885.

(True Extract.)

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

From G. BIDIE, Esq., M.B., C.I.E., Acting Surgeon-General with the Government of Madras, to the Chief Secretary to Government, dated Ootacamund, 23rd June 1886, No. O/191.

In returning the papers referred to me under G.O., No. 924 C, of 8th June 1886, I have the honor to submit the following remarks on certain points connected with the proposals for the improvement of the water-supply of Bangalore.

2. The chief point on which my opinion is invited is, "whether the proposed new gathering ground, lying to the east of the Halsur tank, may be added to the drainage area of the tank without taking any special precautions for securing its thorough conservancy."

3. From a sanitary point of view it is no doubt desirable that the gathering ground should be thoroughly conserved, but as that end could only be attained by throwing the whole of the land out of cultivation, I am not prepared to advocate such a measure, inasmuch as the water prior to delivery to the troops is to be purified by storage in a reservoir and distillation.

4. I have not inspected the proposed new gathering ground, which is said to embrace an area of 2·4 square miles; but from Colonel Mullins' report (paragraph 34) learn that the soil is of a "light sandy character," for the most part under dry cultivation, and extensively manured with more or less filthy material collected from the barracks, the station, and the bazaars. Such land will undoubtedly contaminate the surface wash more or less, the amount of impurity depending to a considerable extent on the weight of the showers and the season at which they fall. A heavy shower, occurring shortly after tillage and the application of manure, would carry off a considerable amount of organic matter; but on the crops attaining some size, the surface water would be comparatively clean, as growing vegetation rapidly disposes of nitrogenous matter in the soil, and any of it on the surface not got rid of in this way would speedily be converted into nitrates (inorganic matter).

5. As a precautionary measure, however, I would suggest that arrangements be made for the exclusion from the tank of foul water resulting from heavy showers falling immediately after the manuring of the gathering grounds.

6. If this be done, the only other precautions that seem necessary are—

(*a*) The prohibition of any extension of the present cultivated land within the gathering grounds.
(*b*) The institution of some arrangement with the Mysore Government for the surface conservancy of the villages that exist on the protected area, and for the prevention of the erection of any more buildings except in substitution of those already existing.
(*c*) That offensive trades—such as tanning—be forbidden on the gathering ground.

7. As already stated, I make these suggestions clearly on the understanding that the water is to be purified prior to use by a Normandy's condensing apparatus; and have only to add, that the supply obtained from the proposed new gathering ground ought to be much purer than that now deposited in the Halsur tank from the densely populated and filthy town of Bangalore.

No. 318 D.

Forwarded, with advertence to G.O., No. 1386 W., dated 1st June 1886, to the Quartermaster-General, for favor of His Excellency the Commander-in-Chief's opinion.

2. Copy of a minute, dated 12th May 1886, on the water-supply of Bangalore, by Mr. Girdlestone, is enclosed for information.

OOTACAMUND, 30th June 1886. (Signed) J. SHAW-STEWART, Colonel, R.E., Secretary to Govt., P.W.D.

From Colonel E. FAUNCE, Officiating Quartermaster-General, to the Secretary to Government, Public Works Department, dated Ootacamund, 24th August 1886, No. 2797 B.

In returning the papers received with G.O., No. 318 D., dated 30th June 1886, relative to the improvement of the water-supply at Bangalore, I have the honor, by order, to state that, although the Commander-in-Chief would prefer the alternative measure of thoroughly conserving the new gathering ground to the east of the Halsur tank, by throwing the whole of the land permanently out of cultivation (similar arrangements being made as regards the old gathering ground of the north feeder) yet, as the cost of these measures would apparently be prohibitive, and great difficulty would arise in acquiring the necessary land, His Excellency accepts the scheme as proposed, viz., that the town drainage having been diverted, a new gathering ground lying to the east of the tank be added to the drainage area of the Halsur tank, the precautionary measures in connection with the entire gathering grounds suggested by Dr. Bidie (in paragraphs 5 and 6 of his letter, No. O/191, dated 23rd June 1886) being fully adopted.

2. I am to request that, if convenient, a printed copy of the correspondence now returned may be forwarded for record in this office.

ORDER—dated 10th September 1886, No. 2292 W., Public Works.

Frequent outbreaks of enteric fever among the troops at Bangalore having led to strong representations respecting the quality of the water and the sufficiency of the water-supply available for the use of the troops and of the cantonment bazaar at that station, this Government, after careful consideration of the subject, arrived, in October 1883, * at the conclusion that the best means of providing the troops and town with wholesome water would be to extend and complete the scheme known as the Ooparhalli project, which had been originated, in 1868, by Major-General Sankey, R.E., C.B., when Chief Engineer of Mysore.

* G.O., No. 2794 W., dated 5th October 1883.

2. With that object, Colonel J. Mullins, R.E., was placed on special duty to investigate the subject; and, on the 31st March 1884, that officer submitted a report in which the whole subject of the water-supply of Bangalore was exhaustively treated. The results of Colonel Mullins' inquiries were summed up by the Chief Engineer in his note printed with proceedings, No. 1473 W., dated 13th June 1884, as follows:—

(1) The Ooparhalli project is incapable of supplying the station or troops.

(2) The Halsur tanks are not capable of being made a satisfactory source of supply for the troops.

(3) Wells may be sunk which would yield a sufficient supply for the troops for drinking and cooking purposes, but the quality of the water must remain doubtful.

(4) The Agaram tank offers a new source of supply of suitable water, having an ample and sufficiently clear catchment basin.

(5) Water of unexceptional quality is probably obtainable at Bangalore only by distillation.

3. In their order, No. 1473 W., dated 13th June 1884, the Government recorded their opinion that the Agaram tank scheme offered the most promising solution of the question of the water-supply to the Bangalore garrison, and directed the late Captain Romilly, R.E., to elaborate the scheme, and to prepare the requisite plans and estimates. In the following month,* orders were issued to Captain Romilly to include in his investigations the alternative scheme suggested by Colonel Mullins for condensing a supply of water from the dhobies' wells, sufficient to meet the requirements of the troops for drinking and cooking purposes, leaving the water required for other purposes to be pumped from the Halsur tank. Captain Romilly was further ordered to investigate the question of taking in an area of additional gathering ground to the eastward of the Halsur tank, and to include in his estimate for the Agaram tank scheme all compensation for land rendered necessary thereby.

* G.O., No. 1814 W., dated 25th July 1884.

4. With his letter, No. 3900, dated 19th January 1885, the Superintending Engineer, V Circle, submitted Captain Romilly's report, accompanied by three alternative estimates. The first, A, provided for the supply of water to the barracks from the Agaram tank, and amounted to Rs. 2,90,000; the annual cost of maintenance being Rs. 44,385. The second, B, provided for drawing the supply from the Halsur tank and distilling the water by means of condensing engines, and amounted to Rs. 1,67,000; the annual cost of maintenance being Rs. 84,600. The third, C, provided for certain improvements to the existing source of supply, and the augmentation of the supply by taking up a new gathering ground. The cost was Rs. 1,33,000, and the annual maintenance charges, Rs. 27,000

5. This report having been referred to the Sanitary Commissioner, and to His Excellency the Commander-in-Chief, for opinion, the former officer condemned project A, and concurred in Captain Romilly's views that the Agaram tank-water was liable to dangerous contamination; and, if adopted as the future reservoir for the troops, the source of supply could not be accepted as pure. Dr. Bidie approved project B as the only means of insuring a supply of pure water for the use of the troops. His Excellency the Commander-in-Chief also expressed his preference for project B, "provided that, at the same time, the conservation of the Halsur tank will be taken in hand by Government, and the catchment area increased." His Excellency was of opinion that, as the civil population of Mysore would benefit by the improvements, the municipality should bear a portion of the cost; but he expressed a hope that, if the municipality were not prepared to do so, the Government would carry out the improvements and bear the whole expense.

6. In June 1885, the Resident in Mysore was addressed on the subject. The plans and estimates prepared by Captain Romilly were forwarded with the remark that, whilst supporting the project for the distillation of the drinking-water drawn from the tank for the use of the garrison, both the military and sanitary authorities strongly advocated the contemporaneous adoption of Captain Romilly's proposals for adding to the supply available for the civil population; for excluding foul sewage from the tank; and for improving its conservancy. These improvements comprised the first seven items of Captain Romilly's project C, estimated to cost Rs. 59,860; and the Resident was asked whether the Bangalore municipality were prepared to contribute towards the cost, and, if so, to what extent.

7. In his reply, dated 15th November 1885, the Resident intimated that the municipality had already incurred considerable expense on works undertaken by themselves in improving the Halsur tank; and, with respect to Captain Romilly's proposal to

substitute a tract of high and sloping ground to the east of the tank for the existing catchment area on the west, Mr. Girdlestone did not think the Commissioners would bear any portion of the outlay involved, inasmuch as the necessity for the change had not been demonstrated to their satisfaction. The Resident intimated clearly that, if the Madras Government still considered the change imperative, it would rest with this Government to provide funds to the full amount required for its accomplishment. On an assurance from this Government that the supply from the catchment on the west shall not be cut off, until the success of the new gathering ground to the east has been fully established, the municipality have given their assent to the proposal to divert the town drainage from the tank. The Government of His Highness the Maharaja also have intimated their willingness to afford every facility for the transfer, on reasonable terms, of the land required for the new catchment area. While doing this, the Mysore Government pointed out that complications would arise, and the cost of compensation would be greatly enhanced, if attempts were made to thoroughly conserve the new gathering ground, and throw it permanently out of cultivation. With reference to this point, the Government have received the opinion of Surgeon-General Bidie (who, as Sanitary Commissioner, previously reported on the water-supply question) that, if certain precautionary measures be taken, the prohibition of cultivation in the new catchment area need not be insisted upon; and His Excellency the Commander-in-Chief, in view of the great outlay which would be involved if this Government determined to acquire the whole of the gathering ground, has accepted the position.

8. His Excellency the Governor in Council considers that the question has now arrived at a stage when the Government of India may be addressed. That Government will accordingly be asked to sanction Captain Romilly's project B, with the addition of the first seven items of project C, involving a total estimated outlay from Imperial funds of Rs. 2,26,860.

9. The measures suggested by the Surgeon-General, in paragraphs 5 and 6 of his letter of 23rd June 1886, will receive consideration hereafter, should the Government of India sanction the proposals now to be submitted.

10. The following letter will be addressed to the Government of India:—

(Here enter No. 2293 W., dated 10th September 1886.

(True Extract.)

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Military Department.
" Superintending Engineer, V Circle.
" Examiner, Public Works Accounts.
" Public Department.

Letter—to the Secretary to the Government of India, ~~Public Works~~ Department, dated Fort St. George, 10th September 1886, No. 2293 W.

I am directed to forward, for the consideration of the Government of India, copies of the proceedings of this Government marginally noted, relative to the proposals for improving the water-supply of the troops at Bangalore.

No. 2794 W.,	dated	5th October	1883.
" 2795 W.,	"	5th "	"
" 1473 W.,	"	13th June	1884.
" 1474 W.,	"	13th "	"
" 1814 W.,	"	25th July	"
" 2292 W.,	"	10th Sept.	1886.

with Captain Romilly's report annexed.

2. The history of the question and its present position are stated in the last quoted proceedings of this date; and it will be seen that the sanction of the Government of India is required to a total estimated outlay, from Imperial Military Funds, of Rs. 2,26,860.

3. It will further be seen from the correspondence, that the question of improving the water-supply of Bangalore has been the subject of exhaustive inquiry by this Government, who are convinced that the only feasible means of giving the garrison a pure water-supply, at a reasonable cost, is by adopting Captain Romilly's project B, estimated to cost Rs. 1,67,000, with the addition of the first seven items of project C, estimated to cost Rs. 59,860. The annual cost of maintenance of project B is estimated at Rs. 84,600.

4. The Army Sanitary Commission in England have frequently noticed the high rate of mortality from enteric fever among the troops at Bangalore, and have urged a consideration of the question of improving the water-supply; and I am to forward, for the information of the Government of India, copies of the two last reports of that body, printed with the proceedings of this Government, in the Military Department, marginally noted.

No. 4290,	dated	5th August	1885.
" 4761	"	9th "	"

4. I am therefore to express the hope of His Excellency the Governor in Council that the Government of India will take this subject into early consideration, and sanction the proposed expenditure of Rs. 2,26,860. Also, that the Government of India will be pleased to make a substantial grant for inclusion in the budget for 1887-88, in view to the early commencement of the work.

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. E. Fernandez.
Spare Copies

BUILDINGS AND ROADS.
July ~~CIVIL~~ WORKS.

Govt. of {1886} Madras.

PUBLIC WORKS.

Dated September, 10th.

Recd. *Encl.*

G.O., 10th Sept. 1886, Nos. 2292, 2293 W.

SEPTEMBER.

Bangalore Water-Supply

Proposals for improving the — for troops, submitted for the sanction of the Government of India.

PRELIMINARY ISSUE.

IMPERIAL.
MILITARY WORKS.

MADRAS.

PUBLIC WORKS DEPARTMENT.

IMPERIAL BUDGET-ESTIMATE

OF

MILITARY WORKS

OF THE

GOVERNMENT OF MADRAS

FOR THE YEAR

1887-88.

CHEPÂK,
17th December 1886.

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

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Ditto ditto of Expenditure	2 & 3
Details of the Budget-Estimate of Expenditure—	
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Ditto ditto Class B	6 & 7
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REVENUE.

ABSTRACT OF THE **BUDGET-ESTIMATE** OF **REVENUE** OF THE **PUBLIC WORKS DEPARTMENT** FROM **MILITARY WORKS** IN **MADRAS** FROM **1st APRIL 1887** TO **31st MARCH 1888.**

—	Budget-Estimate, 1887-88.	Revised Estimate, 1886-87.	Budget-Estimate, 1886-87.	Actuals, 1885-86.
	Rs.	Rs.	Rs.	Rs.
In Public Works Department	25,000	16,000	30,000	25,881
In Civil and Military Departments	...	...	...	...
Total ...	25,000	16,000	30,000	25,881

CHARGES.

ABSTRACT OF THE **BUDGET-ESTIMATE** OF **EXPENDITURE** OF THE **PUBLIC WORKS DEPARTMENT** OF **MILITARY WORKS** IN **MADRAS** FOR THE **YEAR** FROM **1st APRIL 1887** TO **31st MARCH 1888.**

—	Reference to Detailed Estimate.	Budget-Estimate, 1887-88.	Revised Estimate, 1886-87.	Budget-Estimate, 1886-87.	Actuals, 1885-86.
		Rs.	Rs.	Rs.	Rs.
Original Works. In progress ...	...	50,900	1,85,035	2,08,035	1,85,232
Original Works. Not commenced.	...	91,650			
Repairs ... Ordinary ...	...	3,00,000	3,10,465	3,10,465	1,73,187
Repairs ... Special ...	...	...			
Establishment	...	1,03,030	1,15,396	1,20,700	83,263
Tools and Plant	...	4,420	4,969	5,200	3,563
Suspense Account	...	...	...	...	...
Total ...	...	5,50,000	6,15,865	6,44,400	4,45,245

ABSTRACT OF THE **CHARGES** TO BE **INCURRED** BY THE **PUBLIC WORKS DEPARTMENT** FROM **IMPERIAL FUNDS** AND **CONTRIBUTIONS** IN BOTH **INDIA** AND **ENGLAND.**

—	Budget-Estimate, 1887-88. Original Works. In progress.	Not commenced.	Total.	Repairs.	Establishment.	Tools and Plant.	Suspense Account.	Barrack Department.	Total.	Revised Estimate, 1886-87.	Budget-Estimate, 1886-87.	Actuals, 1885-86.
Provision from Imperial Funds.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
In India ...	50,900	91,650	1,42,550	3,00,000	1,03,030	4,420	...	...	5,50,000	6,15,865	6,44,400	4,45,245
In England.	...	...	...	...	...	...	...	...	...	—3,504	...	— 236
Total ...	50,900	91,650	1,42,550	3,00,000	1,03,030	4,420	...	...	5,50,000	6,12,36	6,44,400	4,45,009
Provision from Contributions. In India ...	...	...	...	...	...	...	...	...	...	...	...	72
Grand Total.	50,900	91,650	1,42,550	3,00,000	1,03,030	4,420	...	...	5,50,000	6,12,361	6,44,400	4,45,081

STATEMENT SHOWING THE **WORKS** ON WHICH THE **OUTLAY** IN **ENGLAND** ABOVE PROVIDED FOR IS TO BE INCURRED.

—	Budget-Estimate, 1887-88. Original Works. In progress.	Not commenced.	Total.	Tools and Plant.	Suspense Account.	Total.	Revised Estimate, 1886-87.	Budget-Estimate, 1886-87.	Actuals, 1885-86.
							Rs.		Rs.
	...	...	...	...	...	...	3,504	...	236
Total ...	...	...	...	...	...	...	3,504	...	236

PART I.

DETAIL of the BUDGET-ESTIMATE for ORIGINAL WORKS for the YEAR 1887-88.

CLASS A WORKS.

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.	Outlay. Actual to end of 1885-86.	Outlay. Probable during 1886-87.	Grant, 1887-88. Works in progress.	Grant, 1887-88. Works not commenced.	Grant, 1887-88. Total.	Item No.	Remarks and References.
					Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		
				IMPERIAL ORDINARY.								
				Military.								
				Original Works.								
(1) *Accommodation for troops*— Buildings for European troops in the plains. Permanent.	West Coast.	Malapuram ...	1	Constructing a barracks for accommodating 50 additional men and a canteen.	1,35,697	1,14,981	10,115	20,000	...	20,000	1	G.O., No. 2305 W., dated 13th September 1886. Item No. 1, class A works, budget of 1886-87. Supplemental estimate is awaited.
Accommodation for Native troops.	Presidency.	Bangalore ...	2	Public buildings for a regiment of Native infantry.	21,636	...	10,000	11,636	...		2	G.O., No. 2952 W., dated 29th November 1884. Item No. 11, class B works, budget of 1886-87.
	Trichinopoly.	Trichinopoly.	3	Construction of stone drains required for new lines.	...	...	4,907	5,140	...	16,776	3	Estimate is awaited. Item No. 13, class B works, budget of 1886-87.
				Total ...	...	...	...	36,776	...	36,776		

PART I—*cont.*

DETAIL OF THE BUDGET-ESTIMATE FOR ORIGINAL WORKS FOR THE YEAR 1887-88.

CLASS B WORKS.

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.	Outlay. Actual to end of 1885-86.	Outlay. Probable during 1886-87.	Grant, 1887-88. Works in progress.	Grant, 1887-88. Works not commenced.	Grant, 1887-88. Total.	Item No.	Remarks and References.
				IMPERIAL ORDINARY.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		
				MILITARY.								
				Original Works.								
(1) *Accommodation for troops*— Buildings for European troops in the plains. Permanent.	Bellary ...	Bellary ...	1	Collar maker and wheeler's shop, Royal Artillery.	5,663	...	...	...	5,663		1	G.O., No. 914 W., dated 3rd April 1884. Item No. 3, class C works, budget of 1886-87.
	Nilgiri ...	Wellington ...	2	Quarters for three Apothecaries ...	...	...	...	...	16,000		2	Estimate is awaited.
	Presidency.	Fort St. George.	3	Converting a racquet court into a covered gymnasium.	11,890	2,040	280	9,570	...		3	G.O., No. 1552 W., dated 20th June 1884. Item No. 17, class C works, budget of 1886-87.
	Do. ...	Bangalore ...	4	Alterations and additions to washhouses, parade barracks.	12,500	7,946	...	4,554	...	35,787	4	G.O., No. 1102 W., dated 7th May 1880. Item No. 23, class C works, budget of 1886-87.
Accommodation for Native troops.	Presidency.	Bangalore ...	5	Public buildings for a regiment of Native cavalry.	30,990	...	...	...	10,000		5	G.O., No. 1302 W., dated 25th May 1886. Item No. 36, class C works, budget of 1886-87.
	Do. ...	Do. ...	6	Store rooms and workshops for the Pioneer regiment.	...	...	...	...	3,000	13,000	6	Estimate is awaited. Item No. 35, class C works, budget of 1886-87.
(2) *Ordnance Works* ...	Bellary ...	Bellary ...	7	Twelve Staff Sergeants' quarters, Ordnance Department.	...	...	...	...	10,000		7	Estimate is awaited.
	Presidency.	Fort St. George.	8	Adopting the existing magazine for storage of powder for Fort armament.	...	...	...	...	17,000		8	Do. do.
	Do. ...	Madras ...	9	Coal store, Ordnance Department.	...	...	...	...	9,000	36,000	9	Do. do.
				Minor works	...	...	...	...	20,987	20,987		
				Total ...	...	...	...	14,124	91,650	1,05,774		
				Grand Total ...	...	...	...	...	...	1,42,550		

APPENDIX

LIST OF WORKS (OR CLASS C WORKS) OMITTED FROM THE BUDGET-ESTIMATE OF 1887-88, BUT ON CLASS B WORKS, FOR WHICH EXPENDITURE MAY BE INCURRED DURING THE YEAR BY RE-APPROPRIATION FROM

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.	Outlay. Actual to end of 1885-86.	Outlay. Probable during 1886-87.	Amount applied for 1887-88. Works in progress.	Amount applied for 1887-88. Works not commenced.	Amount applied for 1887-88. Total.	Item No.	Remarks and References.
					Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		
				IMPERIAL ORDINARY.								
				MILITARY.								
				Original Works.								
(1) *Accommodation for troops*— Buildings for European troops in the plains. Permanent.	Bellary ...	Bellary ...	1	Armourer's shop, 2nd Light Cavalry.	2,695	...	...	...	2,695		1	G.O., No. 2266 W., dated 14th September 1881. Item No. 6, class C works, budget of 1886-87.
	Do. ...	Do. ...	2	A new gun-shed, Royal Artillery.	...	...	...	...	3,979		2	Estimate is awaited.
	Do. ...	Do. ...	3	Swimming-bath, British infantry.	7,644	...	...	...	7,644		3	G.O., No. 2434 W., dated 19th October 1885. Item No. 4, class C works, budget of 1886-87.
	Do. ...	Do. ...	4	Infectious disease ward and cook-house, Station hospital.	6,140	...	...	...	6,140		4	G.O., No. 320 W., dated 7th February 1884. Item No. 5, class C works, budget of 1886-87.
	Do. ...	Do. ...	5	Alterations and additions to Military prison and adjoining buildings.	...	...	...	...	11,260		5	Estimate is awaited. Item No. 2, class C works, budget of 1886-87.
	Do. ...	Do. ...	6	Armourer's shop for the Arsenal ...	...	...	...	...	4,650		6	Estimate is awaited.
	Nilgiri ...	Wellington ...	7	Quarters for a Barrack Sergeant ...	7,348	...	...	...	7,348		7	G.O., No. 1941 W., dated 21st August 1885. Item No. 10, class C works, budget of 1886-87.
	Do. ...	Do. ...	8	Gymnasium	...	...	...	...	10,000		8	Estimate is awaited. Item No. 7, class C works, budget of 1886-87.
	Do. ...	Do. ...	9	Constructing a new Lock hospital.	...	...	...	...	4,180		9	Estimate is awaited. Item No. 9, class C works, budget of 1886-87.
	Do. ...	Do. ...	10	Accommodation for a mountain battery.	...	...	...	...	10,000		10	Estimate is awaited.
	West Coast.	Calicut ...	11	Providing barrack accommodation for 100 men.	...	...	...	...	...		11	Estimate is awaited. Amount not shown by the Military Department.
	Do. ...	Cannanore ...	12	Plunge-bath for European Infantry barracks.	4,640	...	...	...	4,640		12	G.O., No. 418, dated 16th February 1876. Item No. 11, class C works, budget of 1886-87.
	Do. ...	Do. ...	13	Improving latrines for European Infantry barracks.	2,780	...	...	...	2,780		13	G.O., No. 1056 W., dated 4th April 1879. Item No. 12, class C works, budget of 1886-87.
	Do. ...	Do. ...	14	Improving the roof of regimental guard room, European Infantry barracks.	...	...	...	...	5,060		14	Estimate is awaited.
	Presidency.	Fort St. George.	15	Remodelling drainage	...	...	...	...	10,000		15	Estimate is awaited. Item No. 13, class C works, budget of 1886-87.
	Do. ...	Madras ...	16	Constructing coach-houses and stables on the esplanade in front of the Body Guard lines for use of officers in Fort St. George.	...	...	...	...	15,770		16	Estimate is awaited.
	Do. ...	Bangalore ...	17	Constructing V drains around the single men's blocks.	...	...	...	...	7,830		17	Do. do.
	Do. ...	Do. ...	18	Quarters for schoolmaster and schoolmistress.	10,240	...	...	...	10,240		18	G.O., No. 2384 W., dated 20th September 1886. Item No. 19, class C works, budget of 1886-87.
				Carried over ...	...	...	...	...	...	...		

APPENDIX

LIST OF WORKS (OR CLASS C WORKS) OMITTED FROM THE BUDGET-ESTIMATE OF 1887-88, BUT ON CLASS B

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.
					Rs.
				Brought forward ...	
				IMPERIAL ORDINARY—*cont.*	
				Military—*cont.*	
				Original Works—cont.	
(1) *Accommodation for troops*— Buildings for European troops in the plains. Permanent.	Presidency.	Bangalore ...	19	New orderly room for 12th Lancers, or conversion of Quartermaster's stores into orderly room and stores.	...
	Do. ...	Do. ...	20	Quarters for Senior Apothecary, North Station hospital.	5,300
	Do. ...	Do. ...	21	Quarters for the Assistant Apothecary, North Station hospital.	4,773
	Chingleput.	St. Thomas' Mount.	22	A wheeler and collar maker's shop, West barracks.	5,660
	Do. ...	Do. ...	23	Sergeants' Mess for East barracks.	...
	Do. ...	Do. ...	24	General improvements to the drains of the cantonment.	...
	Do. ...	Do. ...	25	Quarters for three Medical Subordinates, Station hospital.	...
	Do. ...	Do. ...	26	Quarters for head-quarter's staff, Royal Artillery.	...
	Do. ...	Do. ...	27	Battery office for P/1st Royal Artillery.	...
	Do. ...	Do. ...	28	Raising the roof of harness rooms, troop lines.	4,200
	Do. ...	Do. ...	29	Wooden shed at the proof range ...	2,820
	Do. ...	Do. ...	30	Converting the disused gun shed between the North barracks and the main guard into a coffee shop, recreation room, and library.	2,520
	Do. ...	Pallávaram ...	31	One mortuary room for each of the three hospitals, Nos. 1 to 3.	...
	Do. ...	Poonamallee.	32	Improvements to the old barracks with possibility of obviating construction of the new.	...
	Do. ...	Do. ...	33	Warrant officers' quarters ...	...
	Do. ...	Do. ...	34	Two Staff Sergeants' quarters, first class.	...
	Do. ...	Do. ...	35	Coffee shop	...
				Carried over ...	...

B—*cont.*

WHICH EXPENDITURE MAY BE INCURRED DURING THE YEAR BY RE-APPROPRIATION FROM WORKS—*cont.*

Outlay.		Amount applied for 1887-88.			Item No.	Remarks and References.
Actual to end of 1885-86.	Probable during 1886-87.	Works in progress.	Works not commenced.	Total.		
Rs.	Rs.	Rs.	Rs.	Rs.		
...	...	...	6,500		19	Estimate is awaited.
...	...	...	5,300		20	G.O., No. 3385 W., dated 27th November 1883. Item No. 20, class C works, budget of 1886-87.
...	...	...	4,773		21	G.O., No. 938 W., dated 5th April 1884. Item No. 21, class C works, budget of 1886-87.
...	...	...	5,660		22	G.O., No. 2717 W., dated 3rd November 1884. Item No. 24, class C works, budget of 1886-87.
...	...	...	6,000		23	Estimate is awaited.
...	...	...	10,000		24	Do. do.
...	...	...	8,000		25	Do. do.
...	...	...	12,000		26	Do. do.
...	...	...	5,000		27	Do. do.
...	...	...	4,200		28	G.O., No. 3137 W., dated 17th December 1881. Item No. 25, class C works, budget of 1886-87.
...	...	...	2,820		29	G.O., No. 3077 W., dated 13th December 1884. Item No. 26, class C works, budget of 1886-87.
...	...	...	2,520		30	G.O., No. 1234 W., dated 28th May 1885. Item No. 27, class C works, budget of 1886-87.
...	...	...	3,000		31	Estimate is awaited. Item No. 28, class C works, budget of 1886-87.
...	...	...	5,000		32	Estimate is awaited.
...	...	...	3,500		33	Do. do.
...	...	...	6,000		34	Do. do.
...	...	...	9,000		35	Do. do.
...	...	...	...	...		

APPENDIX

LIST OF WORKS (OR CLASS C WORKS) OMITTED FROM THE BUDGET-ESTIMATE OF 1887-88, BUT ON CLASS B

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.
					Rs.
				Brought forward ...	...
				IMPERIAL ORDINARY—*cont.*	
				MILITARY—*cont.*	
				Original Works—cont.	
(1) *Accommodation for troops*— Buildings for Native troops.	Vizagapatam.	Vizianagrum.	36	Regimental store room for Native infantry, including storage for camp equipage.	3,480
	Bellary ...	Bellary ...	37	School-house for the Native Infantry regiment.	3,030
	West Coast.	Quilon ...	38	Sepoy lines	...
	Do. ...	Mangalore ...	39	Providing drains for the lines of the Native infantry.	...
	Presidency.	Madras ...	40	Constructing two male and two female latrines for Native Infantry lines at Perambúr.	...
	Do. ...	Do. ...	41	Flushing drains for Native Infantry lines at Ráyapuram.	4,300
	Chingleput.	Pallávaram ...	42	Magazine for a Madras Infantry regiment.	4,900
	Do. ...	Do. ...	43	Armourer's shop for a Madras Infantry regiment.	2,880
	Trichinopoly.	Trichinopoly.	44	Workshops for a Pioneer regiment.	...
(2) *Ordnance Works.*	Presidency.	Madras ...	45	Compound wall round the Gunpowder Factory.	...
	Do. ...	Do. ...	46	Extra accommodation as store-rooms in the Gunpowder Factory.	...
(3) *Commissariat Buildings.*	West Coast.	Calicut ...	47	Mules and cattle shed	...
	Presidency.	Bangalore ...	48	Quarters for a Conductor, Transport Department.	5,800
	Do. ...	Do. ...	49	Quarters for Ambulance Sergeant, near Cattle lines, Transport Department.	...
	Do. ...	Madras ...	50	Lines for transport attendants ...	...
	Do. ...	Do. ...	51	Workshops and sheds for carts, doolies, &c., Transport Department.	...
	Do. ...	Do. ...	52	Construction of a shed at the Camp Equipage Depôt.	...
				Carried over ...	...

B—*cont.*

WHICH EXPENDITURE MAY BE INCURRED DURING THE YEAR BY RE-APPROPRIATION FROM WORKS—*cont.*

Outlay.		Amount applied for 1887-88.			Item No.	Remarks and References.
Actual to end of 1885-86.	Probable during 1886-87.	Works in progress.	Works not commenced.	Total.		
Rs.	Rs.	Rs.	Rs.	Rs.		
...	...	...	3,480		36	G.O., No. 2628 W., dated 27th October 1884. Item No. 32, class C works, budget of 1886-87.
...	...	...	3,030		37	G.O., No. 149 W., dated 17th January 1884. Item No. 33, class C works, budget of 1886-87.
...	...	...	20,000		38	Estimate is awaited.
...	...	...	6,030		39	Do. do.
...	...	...	3,000		40	Do. do.
...	...	...	4,300		41	G.O., No. 1397 W., dated 4th June 1884. Item No. 34, class C works, budget of 1886-87.
...	...	...	4,500		42	G.O., No. 334 W., dated 8th February 1886. Item No. 38, class C works, budget of 1886-87.
...	...	...	2,880		43	G.O., No. 3149 W., dated 22nd December 1884. Item No. 29, class C works, budget of 1886-87.
...	...	...	8,000		44	Estimate is awaited.
...	...	...	20,200		45	Estimate is awaited. Item No. 39, class C works, budget of 1886-87.
...	...	...	6,000		46	Estimate is awaited. Item No. 40, class C works, budget of 1886-87.
...	...	...	4,000		47	Estimate is awaited.
...	...	...	5,800		48	G.O., No. 992 W., dated 16th April 1886. Item No. 51, class C works, budget of 1886-87.
...	...	...	3,000		49	Estimate is awaited.
...	...	...	48,000		50	Estimate is awaited. Item No. 49, class C works, budget of 1886-87.
...	...	...	5,500		51	Estimate is awaited. Item No. 50, class C works, budget of 1886-87.
...	...	...	5,300		52	Estimate is awaited. Item No. 48, class C works, budget of 1886-87.
...	...	...	...	...		

APPENDIX

LIST OF WORKS (OR CLASS C WORKS) OMITTED FROM THE BUDGET-ESTIMATE OF 1887-88, BUT ON CLASS B

Head of Classification.	Executive Division.	Locality.	Item No.	Projects and Works.	Amount of Estimate.
					Rs.
				Brought forward ...	...
				IMPERIAL ORDINARY—*cont.*	
				Military—*cont.*	
				Original Works—cont.	
(3) *Commissariat Buildings.*	Presidency.	Teynampet ...	53	Construction of a wheat godown ...	...
	Chingleput.	Guindy ...	54	Quarters for station butchers attached to slaughter-house.	...
(4) *Staff and Miscellaneous.*	Nilgiri ...	Ootacamund.	55	Water-supply, Lawrence Asylum.	...
(8) *Fortifications* ...	West Coast.	Malapuram ...	56	Constructing fortifications ...	...
	Presidency.	Fort St. George	57	Facing the *en ceinte* of Fort St. George with Portland cement.	...
	Do. ...	Do. ...	58	Demolition of Wallajah ravelin and two lunettes.	...
	Do. ...	Do. ...	59	Constructing a draw-bridge to North Gate.	...
	North Arcot.	Vellore ...	60	Draw-bridge and gate for the Fort.	6,450
				Total ...	...

B—*concld.*

WHICH EXPENDITURE MAY BE INCURRED DURING THE YEAR BY RE-APPROPRIATION FROM WORKS—*concld.*

Outlay.		Amount applied for 1887-88.			Item No.	Remarks and References.
Actual to end of 1885-86.	Probable during 1886-87.	Works in progress.	Works not commenced.	Total.		
Rs.	Rs.	Rs.	Rs.	Rs.		
...	...	...	5,950	...	53	Estimate is awaited. Item No. 46, class C works, budget of 1886-87.
...	...	...	4,730	...	54	Estimate is awaited. Item No. 52, class C works, budget of 1886-87.
...	...	...	7,000	...	55	Estimate is awaited. Item No. 55, class C works, budget of 1886-87.
...	...	...	8,000	...	56	Estimate is awaited.
...	...	...	5,000	...	57	Do. do.
...	...	...	7,426	...	58	Estimate is awaited. Item No. 53, class C works, budget of 1886-87.
...	...	...	2,680	...	59	Estimate is awaited.
...	...	...	6,450	...	60	G.O., No. 528 W., dated 7th March 1884. Item No. 54, class C works, budget of 1886-87.
...	...	...	...	...		

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

General.
Account.

READ—the following papers :—

From the Superintending Engineer,	I	Circle,	dated	1st	November	1886.	
„ „ „	II	„	„	22nd	October	„	
„ „ „	III	„	„	20th	September	„	
„ „ „	IV	„	„	9th	October	„	No. 378 E.W.
„ „ „	V	„	„	17th	„	„	„ 3587.
„ „ „	V	„	„	17th	„	„	„ 3588.
„ „ „	VI	„	„	30th	„	„	„ 1094 T.J.

Extract from the Proceedings of the Government of India in the Military Department, under date Simla, the 1st November 1886, No. 1672-M-W. (Accounts).

Resolution—

The following provisional distribution of the Imperial grant for Military works for 1887-88 is hereby notified :—

	Rs.
Central India	1,50,000
Hyderabad	1,75,000
Rajputana	1,50,000
Military Works Department	58,00,000
Central Provinces	1,25,000
Lower Burma	2,50,000
Assam	1,75,000
Bengal	40,000
North-Western Provinces and Oudh	1,10,000
Punjab	2,50,000
Madras	5,50,000
Bombay	11,00,000
Total ...	88,75,000
Leaving for reserve with the Government of India and for the requirements in Upper Burma	11,25,000
Total ...	1,00,00,000

2. The above allotments include provision for any expenditure that may be incurred in England on stores for works classified as Military.

3. The preliminary budget estimates should be prepared for the amounts now provisionally sanctioned, and should be submitted so as to reach the Government of India punctually by the 15th January 1887.

4. Orders as regards the grants required for special defence works will issue hereafter.

Order—

Ordered, that a copy of the foregoing Resolution be forwarded to the Local Governments, &c., noted in the margin, for information and guidance.

The Governments of Madras, Bombay, Bengal, North-Western Provinces and Oudh, and the Punjab, in the Public Works Department.
The Chief Commissioners, Central Provinces, British Burma and Assam.
The Resident at Hyderabad.
The Agents to the Governor-General for Central India and Rajputana.
The Inspector-General of Military Works.

Ordered also, that a copy be forwarded to the Quartermaster-General in India, Accountant-General, Public Works Department, and the Accountant-General, Military Department, for information.

(Signed) O. R. NEWMARCH, Major-General,
Secretary to the Govt. of India.

To the Secretary to the Government of Madras,
Public Works Department.

From Brigadier-General E. FAUNCE, Officiating Quartermaster-General, to the Secretary to Government, Public Works Department (through the Secretary to Government, Military Department), dated Bangalore, 1st December 1886, No. 51 T.

I have the honor, by order, to acknowledge the receipt of your letter, No. 4067 C., dated 18th instant, forwarding a copy of the Resolution of the Government of India, which distributes the Imperial grant for Military works in 1887-88, and submitting, for the consideration of the Commander-in-Chief, a statement showing the proposed detail allotments for major works of the grant to this presidency.

2. The Provincial Commander-in-Chief observes with regret that the grant made to Madras for the coming year falls short by no less a sum than one lakh of the amount sanctioned for the current year; he was in hopes that with the support of the Madras Government the repeated representations made of late years, showing, as they did, that for years past funds given have not admitted of either the execution of a proper proportion of new works, or the maintenance of existing works in proper repair, would have secured to the presidency more liberal treatment in the future.

3. It is therefore a serious disappointment to him to find that, in the coming year, the unfortunate condition of military works required and in existence will be aggravated instead of relieved.

4. As regards the details of the proposed distribution of the small grant for major works, General Rowlands desires me to offer the following observations :—

i. Although the additional buildings at Malapuram for 50 more men, and for canteen accommodation have not been sanctioned, the increase of the garrison of that outpost by 50 men has been approved by Government,* and estimates for the requisite accommodation have been called for, so that the Provincial Commander-in-Chief considers it essential that the preliminary budget estimate should contain provision for this work.

* Proceedings of Government (Military Department), No. 7124, dated 15th November 1886.

ii. Similarly General Rowlands would wish that provision should be made for adopting the existing magazine in Fort St. George for storage of powder for Fort armament, a work which the Government of India required to be carried out instead of a new magazine on the berm, and which the Executive Engineer, Presidency, some years ago said would cost Rs. 17,000.

iii. The item of barrack accommodation for 100 men at Calicut, the Provincial Commander-in-Chief considers, may remain unprovided for in the coming year, as the location of the extra number of men at that station has not yet been suggested to Government.

5. Assuming that it is now too late to hope for any addition to the grant, it remains to be considered how funds are to be provided for the two works above mentioned, which the Provincial Commander-in-Chief would wish to find a place in the budget.

6. I am accordingly to suggest that the works, items 6, 10, 13, 14 of the statement (herewith returned), be omitted, and that the allotments made to the works, items 7 and 12, be reduced by Rs. 5,000 each, if necessary, so as to meet the probable demands for the two works to be inserted, item No. 10 being retained, if possible, to meet requirements without making use of the grant proposed for it.

7. I am to take this opportunity of mentioning that it is presumed the Government of India will be prepared to renew such portion of its special grant for works connected with increased accommodation for British troops, consequent on augmentation, as may remain unexpended at the end of the current year; far from delay in submission of estimates and other causes, there seems at present reason to anticipate that the works which are contemplated to be met from this source will not be fully carried out before the close of this year.

8. Before closing, I am to observe that in the statement a sum of Rs. 7,946 is entered as having been expended up to 1885-86 on the improvements to the wash-houses, parade barracks, Bangalore, item 1; but this office has no knowledge of any work in connection with these wash-houses having been executed.

No. 7523, Military.

Forwarded.

Fort St. George, 3rd December 1886.

(Signed) A. R. KENNEY-HERBERT, Lieut.-Col.,
Secretary to Government.

Order—dated 17th December 1886, No. 3326 W., Public Works.

The grant of Rs. 5,50,000 provisionally sanctioned by the Government of India in their Resolution recorded above, for expenditure on Military works in this presidency during 1887-88, will be distributed as shown below, under departmental heads :—

	Rs.
Works	4,42,550
Establishment	1,03,030
Tools and plant	4,420
Total ...	5,50,000

2. Of the sum of Rs. 4,42,550 available for works, Rs. 3,00,000 for repairs and Rs. 20,987 for minor original works have been set aside; and the balance, Rs. 1,21,563, has been distributed to major works with the approval of the Provincial Commander-in-Chief. The amounts set aside for repairs and minor original works will, as usual, be held at the disposal of the Government and will be appropriated early next year on receipt of detailed proposals from the Superintending Engineers. After providing for incomplete works of the current official year, and for such of the minor new works as are considered emergent, the balance of the minor original works grant will be placed at the disposal of the Officers Commanding Divisions and Districts.

3. The Superintending Engineers concerned will submit, without loss of time, plans and estimates for the unsanctioned works for which funds have been provided during the year.

4. In the budget for the current official year a special grant of Rs. 44,000 (including establishment and tools and plant) was provided for the marginally-noted buildings required in connection with the increased strength of British troops. For causes mentioned in paragraph 7 of the Quartermaster-General's letter recorded above, the greater portion of this grant will lapse at the close of the current official year, and the Government of India will be requested to renew next year such portion of the grant which may remain unspent.

Alterations and additions to—
(1) Blocks of married quarters and to the buildings occupied by the office of the Surgeon-General, Fort St. George, Madras.
(2) Stables for 66 extra horses, British Cavalry, Bangalore.
(3) Alterations to the British Cavalry barracks, Bangalore.
(4) Improvements to the old barracks, St. Thomas' Mount.

5. The special attention of the Government of India will be drawn to the remarks in paragraphs 2 and 3 of the Quartermaster-General's letter.

6. With reference to paragraph 8 of the Quartermaster-General's letter, the Superintending Engineer, V Circle, will furnish the details of the expenditure of Rs. 7,946 recorded in the accounts for 1883-84 as having been incurred on the alterations to the parade barracks, Bangalore—Item No. 4, Class B Works.

7. The budget grant for 1886-87 was Rs. 6,44,400. This was subsequently reduced to Rs. 6,15,865, the difference having been withdrawn by the Government of India.

8. With these remarks the preliminary issue of the Military works budget estimate for 1887-88 will be printed and circulated to the officers concerned, and four copies will be forwarded to the Government of India.

(Here enter No. 3327 W., dated 17th December 1886.)

(True Extract.)

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

To Superintending Engineers.
To the Examiner, Public Works Accounts.
" Military Department.
" Financial "

Letter—to the Secretary to the Government of India, Military Department, dated Fort St. George, 17th December 1886, No. 3327 W.

With reference to Government of India Resolution, No. 1672-M-W., dated 1st November 1886, I am directed to forward four copies of the preliminary issue of the Madras Military works budget for 1887-88, prepared for the provisional grant of Rs. 5,50,000 sanctioned by the Government of India.

2. I am at the same time to draw the earnest attention of the Government of India to the remarks in paragraphs 2 and 3 of the Quartermaster-General's letter, No. 51 T., dated 1st December 1886, printed with the proceedings* herewith forwarded. The allotments sanctioned for the ensuing year are compared below with the demands detailed in the schedule of requirements forwarded with my letter, No. 2498 W., dated 25th September 1886 :—

* No. 3326 W., dated 17th December 1886.

	Demands.	Provisional grant.
	Rs.	Rs.
Major works	4,85,730	1,21,563
Minor do.	1,20,000	20,987
Repairs	3,50,000	3,00,000
Establishment	2,19,817	1,03,030
Tools and plant	9,553	4,420
Total ...	11,85,100	5,50,000

The grant for 1887-88 is thus less than the demand by Rs. 6,35,100, and one lakh less than the provisional assignment sanctioned for 1886-87. The unfortunate condition of Military works in this presidency has repeatedly been brought under the notice of the Government of India, and in my letter, No. 2498 W., dated 25th September 1886, the Government of India was urged to make a specially liberal grant for 1887-88, but notwithstanding this appeal the grant assigned is even less than that given in previous years. This result is extremely disappointing both to this Government and to His Excellency the Commander-in-Chief, and I am to urge upon the consideration of the Government of India the question of extending more liberal treatment to Madras in the distribution of Imperial allotments, and of increasing, if possible, the provisional assignment for 1887-88.

3. The items in the budget, for which estimates have not yet been sanctioned, have been entered at the special request of the Commander-in-Chief, and as it is hoped that the estimates will shortly be ready, I am to request that the amounts provided may be allowed to stand.

4. I am to invite the attention of the Government of India to the remarks in paragraph 7 of the Quartermaster-General's letter relative to the renewal next year of the unexpended portion of the special grant made this year for works connected with increased accommodation for British troops.

5. I am further to invite the attention of the Government of India to my letter, No. 2293 W., dated 10th September 1886, and to point out that no provision whatever has been made for commencing in 1887-88 the project for improving the water-supply of the garrison of Bangalore, a work essential to the health of the troops at that station.

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. P. L. Pereira.
Spare Copies

GENERAL.
ACCOUNT.

Govt. of {1886} Madras.

PUBLIC WORKS.

Dated December, 17th.

Recd. *Encl.*

G.O., 17th Dec. 1886, Nos. 3326, 3327 W.

DECEMBER.

Budget Estimate

Imperial Military works — for 1887-88.— The preliminary issue of the —, forwarded to the Government of India with remarks.

GOVERNMENT OF MADRAS.

MILITARY DEPARTMENT.

19th February 1887, No. 1011.

Sanitary.

Read the following papers :—

No. 219. *From Colonel W. H. BURTON, R.E., Superintending Engineer, V Circle, to the Chief Engineer, Public Works Department ; dated Chepâk, Madras, 13th October* 1886, *No.* 3517.

In reference to G.O., No. 2139-W, dated 26th August 1886, giving cover to a memorandum of the Army Sanitary Commission, I have the honor to inform you that scarcely a correct description of the barracks is given in para. 12, and that in my opinion the sickness amongst the troops may, in some measure, be due to the following :—

(1) The men in all the barracks live on stone floors in several places raised less than 12 inches above the ground, and rarely more than 24 inches above the ground.
(2) That none of the barrack floors are damp-proof.
(3) That all the rain-water falling from the roofs soaks into the ground equally under the barrack floors as in the surrounding ground, owing to the absence of efficient surface gutters round each barrack by which such water might be led away.

2. This is a defect duly noted against the Secunderabad barracks in para. 17, and to it is attributed the sickness at Secunderabad ; perhaps the sickness at Bangalore is due as much to this as to the water which ought by theory to be so very bad as to be unfit to drink, but is not in my humble opinion so very bad when ample in quantity.

3. I would call attention to the growing evil at Bangalore of the number of small communities which are allowed to spring up and multiply on ground (sometimes the property of Military Department and sometimes private property) in and about the cantonment ; the municipal authorities take but scant notice of the conservancy requirements of such places ; the number of inhabitants in the so-called syce and grasscutters' lines of the Mounted Corps seldom seemed to me to be regularly checked and limited.

4. As to para. 16, the action of the Municipality and Sanitary authorities at the station in past years in regard to the drainage of Shoolay has been such as to saturate the valley between the British cavalry stables and the Arab parade ground (site of one Native Cavalry, one Native Infantry Regiment) with sewage. The British Cavalry riding schools near this have recently, I understand, had to be abandoned, and the Public Works Department were called upon to make more riding schools in consequence but a little further off.

5. The whole valley requires, in my opinion, to be agriculturally drained, enclosed, and laid down in grass, and the bund of the small Sonehalli tank to be breached.

6. I may say (para. 13) that admission of water down the western channel of the Ulsoor tank might be regulated, so that all stagnant water left in the present unhealthy-looking swamp, called the Sappers' Pontoon Ground, might be passed away, without entering Ulsoor tank, at small cost. This would greatly diminish the impurity washed into the Ulsoor tank by the monsoon rains ; this is an improvement more readily described at the tank side than in writing from here.

7. There are but few latrines and urinals in and about the closely built over outlying portions of Bangalore; if the number and sites for these places were laid down by some authority which had not to pay for them, the use of the smaller feeders of the Ulsoor tank would no longer be used as latrines and urinals; the Municipal Commission will take a very long time before it voluntarily supplies enough latrines and urinals, and it is the executive authority alluded to in para. 16.

8. I believe that, if remedies such as I have here suggested be adopted, the sanitary condition of the troops at Bangalore would be greatly benefited.

No. 3594-C.

Transferred to the Military Department, with advertence to G.O. (Military) No. 4761, dated 9th August 1886.

(Signed) J. O. HASTED, Colonel, R.E.,
15*th October* 1886. *Secretary to Government, P.W.D.*

No. 6565.

Referred to His Excellency the Commander-in-Chief.

(By Order.)

(Signed) A. KENNEY-HERBERT, Lt.-Col.,
19*th October* 1886. *Secretary to Government.*

To the Quarter Master General.

No. 220. *From Brigadier-General E. FAUNCE, Quarter Master General, Madras Army, to Lieutenant-Colonel A. KENNEY-HERBERT, Secretary to Government, Military Department; dated Ootacamund, 7th February* 1887, *No.* 262-*B.*

With reference to para. 2 of Proceedings of Government, No. 4761, dated 9th August last, bringing to notice the unhealthy conditions prevailing at Secunderabad and Bangalore referred to in the memorandum of the Army Sanitary Commission on the health returns of British troops in the Madras Command for 1884, and the recommendations made in para. 23 of that memorandum embodied in the Proceedings of Government above quoted, I am desired to submit the following report for the information of Government:—

I.—BANGALORE.

(*a*) The question of the improvement of the water-supply of Bangalore is now in the hands of Government.*

* Proceedings of Government, No. 6229, dated 6th October 1886.

(*b*) The sanitation of the town receives every attention from the Municipality, the whole place being cleaned out daily, the streets daily swept, and the drains flushed once or twice weekly during the hot weather; the flushing of the drains daily throughout the year cannot be carried out as funds are insufficient and water is not always available, and when available it has to be carried long distances by carts, which is costly.

Endeavours are also being made to remedy the evil brought to notice in para. 16 of the report of the Army Sanitary Commission, regarding the main drain of Richmond Town and Shoolay, by extending it a mile beyond the barracks and the riding school, and, it is hoped, that thus all cause for complaint will be removed.

The Municipality has also recently improved one of the chief feeders to the Ulsoor tank, with the result that so much of the sewage of the town does not flow into the tank now as formerly. The work of deepening the Ulsoor tank was also undertaken by the Municipality in 1885, but owing to the rains the work was stopped and the tank having been pretty full ever since, further work has been impossible. A small tank above the Ulsoor tank was also purchased last year by the Municipality at a cost of about Rs. 7,000, with the object of allowing the drainage from the open country on that side to flow into the Ulsoor tank and so increase and improve its waters.

II.—SECUNDERABAD.

(*a*) The matter of a pure water-supply, in combination with a drainage scheme for the town of Secunderabad, is now under the consideration of, and is being dealt with by, the Resident at Hyderabad, in communication with the Government of India. Its completion is admitted to be a necessity and is believed to be purely a financial question.

The water-supply of the troops is believed to be above suspicion, yet enteric fever prevails. If it arises from water as stated by the Deputy Surgeon-General, Bangalore, then the theory of the General Officer Commanding the Bangalore Division that one chief cause is that soldiers drink impure water, &c., when visiting native huts, &c., is strengthened.

(*b*) With reference to wet cultivation at this station, the Military authorities have repeatedly and continuously moved the Resident to have such cultivation put a stop to in the vicinity of the barracks occupied by British troops; but although frequent promises have been made, no improvement has actually taken place and can hardly be expected, unless Government are prepared to pay the owners of the paddy-fields the difference between the value of wet and dry cultivation. As regards the Native troops, it has been decided that the expense of compensating the owners of a very limited area of paddy cultivation in cantonment for the loss they would suffer would be prohibitive.

(*c*) The General Officer Commanding the Hyderabad Subsidiary Force reports that it is impracticable to raise the floors of the barracks so as to have thorough ventilation underneath and to protect ground floors from sub-soil damp. None of the plinths can be considered low, and as the water drains freely away from the barracks, the tendency for moisture to rise through the stone floor is minimised. The only remedy considered at all likely to prove successful in effectually resisting damp is to point the joints in the stone with asphalte; an estimate for this work has been called for, and it will be carried out as soon as funds are available.

(*d*) About 2,000 trees were planted in the year 1884-85 in the vicinity of the barracks and lines of British and Native troops at Secunderabad. It is believed that the remark of the Surgeon-General, regarding the want of trees as a protection against unhealthy winds, referred to the hutting lines of Native troops, and not to the substantially built barracks of the British portion of the garrison.

III.—KAMPTEE.

Steps are being taken to carry out at once some of the suggestions made by the Deputy Surgeon-General, Nagpur Force, towards improving the latrine accommodation for the British Infantry Regiment at this station, such as the removal of the front splash boards of the latrines and the raising of pans so as to touch the seats, and the General Officer Commanding is of opinion that, by devoting more attention to the use of dry-earth by carrying out these alterations and by cleansing the pans by fire before they are tarred, the offensive smell complained of may be diminished.

The Deputy Surgeon-General, Nagpur Force, has brought to notice other points, such as the provision of asphalte flooring, want of ventilation, walls coming down to the ground, level partition being too high, the existence of a double row of seats, &c., but these appear to be defects inherent to the standard plan on which the latrines were built, and therefore a matter for consideration of Government in the Public Works Department.

No. 221. *From Brigadier-General E. FAUNCE, Quarter Master General, Madras Army, to Lieutenant-Colonel A. KENNEY-HERBERT, Secretary to Government, Military Department; dated Ootacamund, 7th February* 1887, *No.* 263-*B.*

In returning Reference Order No. 6565 of 19th October last, referring letter No. 3517 of 13th idem from the Superintending Engineer, V Circle, regarding cause of sickness among the British troops at Bangalore, and in continuation of this office letter No. 262-B of this date, I have the honor, by order, to state that, in the opinion of the Medical authorities at that station, the prevalence of enteric fever is due chiefly to the impure water-supply as borne out by statistics and as mentioned in my letter of this date quoted above; the question of the improvement of this water-supply is now in the hands of Government.

2. With reference to dampness of floors of barracks being a source of sickness amongst troops, I am to say that the Deputy Surgeon-General, Bangalore Division, does not concur in the opinion expressed by the Superintending Engineer, and that no complaints have ever been made on this subject; surface drains, however, to receive and carry off rain-water from the roofs, would no doubt be an improvement, but the cost of providing such drains would be very great. Should Government desire it, estimates will be called for and submitted.

3. The measures adopted for the improvement of the drainage of Shoolay are detailed in this office letter of this date quoted above.

No. 222. ORDER THEREON, 19th February 1887, No. 1011.

Ordered that the foregoing correspondence be forwarded to Her Majesty's Government.

2. The defects in regard to the construction of the latrines at Kamptee brought to notice in the concluding portion of the Quarter Master General's letter No. 262, dated 7th February 1887, will be referred to the Government of India for the issue of such orders as may be deemed necessary.

3. It is observed that the Government of India have been addressed in the Public Works Department with reference to the provision of funds to carry out the Bangalore water-supply project.

Proceedings of Government, No. 2293-W, dated 20th September 1886.

No. 223. *To the Secretary to the Government of India, Military Department; dated 19th February* 1887, *No.* 1012.

(True Extract.)

(Signed) A. KENNEY-HERBERT, Lt.-Col.,
Secretary to Government.

To the Quarter Master General.
" Adjutant-General.
" Surgeon-General, Her Majesty's Forces, Madras.
" Sanitary Commissioner, Madras.
" Public Works Department.

Exd. E. C. Shunker.

B. No. 601 Way 28 July 87

Communicated to the Supy Engineer V Circle, with reference to his No 3517, dated 13th October 886

Sd/ Jost

W

Govt. of {1887} Madras.

MILITARY.

To

THE QUARTER MASTER GENERAL,
&c., &c., &c.

Dated February, 19th,

Issued

Recd. *Encl.*

G.O., 19th February 1887, No. 1011.

B. No. 601 Way 28 July 87

FEBRUARY.
Nos. 219—224.

Sanitary.

British troops at Bangalore and Secunderabad.—Correspondence reporting on the cause of sickness among the —, forwarded to Her Majesty's Government, and the defects in regard to the construction of the latrines at Kamptee brought to notice by the Quarter Master General, referred to the Government of India for issue of the necessary orders.

S.E.V 6

With order

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Military Works.

READ—the following letter from Colonel E. COLLEN, Officiating Secretary to the Government of India, Military Department, to the Secretary to the Government of Madras, Public Works Department, dated Simla, 14th June 1887, No. 1182 M.W.:—

I am directed to acknowledge the receipt of your letter, No. 2293 W., dated 10th September 1886, forwarding a copy of the proceedings of the Madras Government marginally noted, relating to the improvement of the water supply of Bangalore, and stating that the Government of Madras are convinced that the only feasible means of giving the garrison a pure water supply, at a reasonable cost, is to adopt Captain Romilly's project for supplying distilled water for drinking and cooking, and improving the Halsur tank supply and continuing it for all other purposes than drinking and cooking. The estimated cost of the works is Rs. 2,26,860, and the annual cost of maintenance of the distilled water system is estimated at Rs. 84,600, to which has to be added the cost of the impure supply from the Halsur tank, which will apparently be Rs. 27,000 per annum more.

No. 2794 W., dated 5th Oct. 1883.
„ 2795 W., „ 5th „ „
„ 1473 W., „ 13th June 1884.
„ 1474 W., „ 13th „ „
„ 1814 W., „ 25th July „
„ 2292 W., „ 10th Sept. 1886, with Captain Romilly's report annexed.

2. With reference to this subject, I am to say that the Government of India, in view of the serious objections to a dual system of water supply, and the great annual expenditure involved in the proposals now put forward, are very unwilling to accept these proposals as the only alternative open for providing a satisfactory water supply for Bangalore; and they hope that further investigation may show that a satisfactory supply may be possible, involving a smaller recurring expenditure. In this hope the Government of India are supported by their responsible advisers on such subjects, a copy of whose note on the subject is herewith forwarded for the information of the Governor in Council.

3. I am therefore to ask that, under the orders of His Excellency, further examination of the country round Bangalore may, if considered necessary, be made.

4. I am, however, to remark that, from the papers submitted, the Agaram scheme seems to offer a reasonable prospect of a satisfactory supply, especially if the four villages, the drainage of which the Agaram tank receives, were removed. The Government of India would be glad if the cost of this as well as of reserving the whole drainage area of the tank were ascertained, as it may be found that Captain Romilly's conviction that the difficulties and expense are prohibitive was a mistaken one. Possibly, the annual expenditure connected with this scheme might be reduced

if a pipe were taken from the higher-level tanks, and the troops supplied by gravitation so long as this supply lasted.

5. If the Agaram scheme is proved to be not practicable, it would be worth while to ascertain the cost of pumping a full supply from the Cauvery.

Enclosure.

Note on Water Supply of Bangalore.

The project on which this department is asked to advise is estimated to cost Rs. 2,26,860. This sum appears to be the cost of "works" alone, and does not include provision for establishment charges or for tools and plant. The addition of these charges would increase the figures probably by about 30 per cent. I note this fact as it has an importance of its own, but throughout the remainder of this note, I will ignore the charges in question for the sake of simplicity.

The project under consideration is one which provides a dual supply. The total quantity of water to be delivered is 60,000 gallons daily. Of this, 9,000 gallons is for drinking and cooking, the remainder is for "inferior" domestic purposes. The "inferior" water is to be supplied from the Halsur tank in much the same manner as it is at present, but the tank itself is to be improved at a cost of Rs. 59,860,* and several improvements (being part of project B) are to be made in the pumping and other arrangements. The "superior" water for drinking and cooking is to be taken from the Halsur tank; it is to be distilled by Normandy's apparatus, and then delivered to the troops through iron mains.

* Part of Project C.

	Rs.
1. Channel, masonry works, compensation ..	26,130
2. Improvements to tank	33,730
	59,860

The working expenses of the project are estimated in paragraph 35, page 19, of Captain Romilly's report. The gross total is Rs. 84,600. It is not clear whether any provision is made for repairs or not. It may be that the cost of repairs is included in the percentages. No provision is made for superior establishment, nor is the original cost of the old works (about three lakhs) taken into consideration. It is desirable to decide, as far as possible, the working expenses between the two systems of the dual supply. I can only do this approximately. But it would appear that the *yearly cost of distilling 9,000 gallons a-day will be*—

	Monthly. Rs.	Rs.
Share of establishment	150	
Fuel for engine, say	25	
Fuel for condensers	3,600	
Oil, grease and sundries	25	
Total, per mensem ...	3,800	
Per annum		45,600
15 °/₀ Interest of depreciation in condensers	12,027	
15 °/₀ Interest of depreciation on share of engine and pumps, say	2,000	
10 °/₀ Interest of depreciation on other works, say ...	2,000	
		16,027
Total annual charges		61,627

This is (as nearly as I can decide the figures given) the yearly cost of (9,000 × 365 =) 3,285,000 gallons of really good water.

The cost of 1,000 gallons of good water is, therefore, about Rs. 19.

Good drinking-water in London costs about six-pence, I believe, per 1,000 gallons. In Calcutta, I know it costs less than four annas per 1,000 gallons. In Lahore it seems to cost† about six annas per 1,000 gallons.

† Page 36 of Colonel Mullins' report.

It may be said, then, that the proposed system of supply of "superior" water is enormously expensive. It stands to reason that it must be so. The proposal is to allow the pure rainfall to flow over a more or less dirty surface; to permit it to be defiled in a tank, where sewage and other foul matter is admitted, and then to turn it into steam and condense it into good water! Why cannot the pure rainfall be caught when it is pure and needs no distillation and aëration? Why permit the water to be defiled first, and then go to enormous expense to clean it again?

Let us see what is necessary to obtain the small quantity of 9,000 gallons a-day, which is proposed to be distilled. The rainfall is given for eight years on page 29 of Colonel Mullins'

report. The following table is based on the average of those years: it assumes that a catchment surface can be prepared which will—

	Percent. of rainfall.
In January, February, March, catch	00
In April, May, June, catch	50
In July, August, September, October, catch	75
In November, catch	50
In December „	00

—	Rainfall.	Proportion flow off.	Number of gallons which would be discharged from a surface of 400,000 s. ft.	Gallons drawn off at 9,000 gallons daily.	Gallons passed into reservoir from the catchment.	Number of gallons in a reservoir holding 1½ millon gallons at the end of each month.
January	0·13		*Nil*	279,000	*Nil*	942,000
February ..	0·15	*Nil.*	*Nil*	252,000	*Nil*	690,000
March	0·53		*Nil*	279,000	*Nil*	411,000
April	0·87		83,000	270,000	83,000	224,000
May	4·52	0·5	457,000	279,000	457,000	402,000
June	2·15		228,000	270,000	228,000	360,000
July	4·11		644,000	279,000	644,000	725,000
August	6·29	0·75	977,000	279,000	977,000	1,423,000
September ..	4·64		728,000	270,000	347,000	1,500,000
October ..	6·21		977,000	279,000	279,000	1,500,000
November ..	2·89	0·5	291,000	270,000	270,000	1,500,000
December ..	0·33	*Nil*	*Nil*	279,000	*Nil*	1,221,000

This table shows that a catchment of 400,000 square feet and a reservoir of 1½ million gallons will supply 9,000 gallons a-day *if the catchment discharges as is assumed*, and if the *reservoir is water-tight*. The Ooperhalli scheme failed because the catchment did not fulfil anticipations and the reservoir was not water-tight.

A catchment can be made to discharge nearly the entire rainfall if it be a plastered concrete floor. A reservoir in masonry can be made absolutely water-tight. I take the following rates from the reports:—

Concrete Rs. 12-8 per 100 c. ft., rubble masonry Rs. 14-1 per 100 c. ft. At this rate it ought to be easy to lay a good floor all over the catchment for *Rs. 6 per 100 square feet.*

Page 61 of Captain Romilly's report.

Colonel Mullins estimates a clear-water reservoir* to hold 7½ million gallons at Rs. 2,40,000, or, say, Rs. 3 per hundred gallons. Captain Romilly estimates† about Rs. 7 per 100 gallons for a small one to hold only 105,000 gallons. A rate of *Rs. 5 per 100 gallons should be* more than ample.

* Page 15.
† Page 7.
I believe the Calcutta reservoirs cost considerably less.

Filters appear to cost from Re. 1 to Rs. 1-4 per square foot. Captain Romilly takes the extraordinary low duty of only 16 gallons per square foot in 24 hours. I will take the same duty and cost at Rs. 1-8 per square foot.

On these rates it would seem to be possible to provide 9,000 gallons of water daily by the following works, costing about Rs. 1,50,000:—

	Rs.
Compensation for land, say, 15 acres at 200	3,000
A plastered concrete catchment 400,000 square feet in area at 6 per 100 square feet	24,000
Masonry ducts leading to settling tank	4,000
Open masonry settling tank to hold 500,000 gallons, at, say, Rs. 3 per 100 gallons	15,000
Two filters, each capable of passing 9,000 gallons daily at 16 gallons per square foot, 1,125 square feet at Rs. 1-8, say	2,000
Clear-water reservoir to hold 1½ million gallons at Rs. 5 per 100 gallons	75,000
Mains and stand-posts, &c., say	20,000
Total ...	143,000

or, say, a total of Rs. 1,50,000. I believe the cost to be very highly estimated, and it is open to question whether a settling tank and filters would be necessary if the catchment were railed and well preserved.

The working expenses of this project would be very small. I assume that it would either be worked by gravitation by selecting a sufficiently high site for the reservoir some distance from Bangalore, or that the reservoir would be placed near the barracks and that the soldiers would pump the water themselves.

	RS.
Taking the working expenses at	2,400
and interest and depreciation (as in Captain Romilly's estimate) at 10 per cent. on Rs. 1,50,000	15,000
the total yearly charges would be	17,400

as compared with Rs. 61,627 of the distillation project, and the water would be quite as good. Any project which costs less than about 6 lakhs of rupees would be cheaper than the one proposed.

Again, it is stated in these papers that some of the wells in Bangalore give very good water, but that they cannot be depended upon; that the water is at times brackish, or, if the wells are largely drawn upon, the supply becomes foul, because the large draught taps impure sources. This defilement must be due to local causes. By seeking a locality, some miles perhaps from Bangalore, where these causes do not exist, pure water must be obtainable from wells in abundance. Nine thousand gallons a-day is only one cubic foot per minute. If there is no spring or no well or no group of wells within a reasonable distance, say, 10 miles of Bangalore, which can be relied upon to give one cubic foot per minute, a pipe 2½ inches in diameter with a head of 5 feet per mile would carry that quantity of water. Such a pipe might cost Rs. 4,000 per mile laid. If such a well or spring could be found, the capital cost of works necessary to deliver 9,000 gallons of water per day in Bangalore might be—

	RS.
Cost of well and land	10,000
Engines and engine house	20,000
10 Miles of 2½-inch pipe	40,000
Service reservoir in Bangalore	5,000
Distribution pipes	5,000
Total ...	80,000

	RS. A-year.
The working expenses might perhaps amount to	3,000
Interest and depreciation (as before) 15 per cent. on 20,000 = 3,000) Interest and depreciation (as before) 10 per cent. on 60,000 = 6,000)	9,000

Total charges Rs. 12,000 a-year for 9,000 gallons a-day. I believe I have here exaggerated both the capital cost and the annual charges. But it is evident that, both in this project and in that sketched by me previously, there is room for large excess over my very rough estimates before the cost of the water would amount to that which is contemplated in the scheme for distillation.

The Military Department refer this matter to this department with the question: "Does the Department of Public Works recommend the adoption of the distillation project?" I would reply—"Most certainly not. It is ruinously and unreasonably expensive."

The Military Department further ask: "What does the Department of Public Works advise?" I would reply—"Do not fear to go rather further a field for the water. It is not unreasonable to think that it would be cheaper to pump from the Cauvery river itself rather than to distil water. Find pure water somewhere, it must exist, and then see what it would cost to deliver. If you are satisfied with the supply from the Halsur tank for 'inferior' purposes, by all means accept that portion of this project which contemplates an improvement in the delivery of that water for inferior purposes, and look only for 9,000 gallons a-day for 'superior' purposes. But, if you are not satisfied with that supply, do not hesitate to go further away for your supply of 60,000 gallons a-day. If this quantity of pure water can be found any where, in tank, river, or well, within about 20 miles of Bangalore, it can probably be delivered by iron mains and pumps within the annual sum of Rs. 85,000 a-year, which it is contemplated will be the gross annual charges of the dual project which is recommended by the Government of Madras."

ORDER—dated 18th July 1887, No. 1924 W., Public Works.

Communicated to the Superintending Engineer, V Circle, who will ascertain and report the cost of removing the four villages which drain into the Agaram tank, and of reserving the whole drainage area of the tanks. Also, what reduction in the estimated

annual expenditure connected with Captain Romilly's Project A could be effected by taking a pipe from the higher-level tanks.

2. The Superintending Engineer will also, if possible, prepare a rough estimate of pumping a full supply of water from the Cauvery.

(True Extract.)

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintending Engineer, V Circle.
„ Military Department.
„ Public „

Exd. E. Fernandez.
Spare Copies

BUILDINGS AND ROADS.
MILITARY WORKS.

Govt. of {1887} Madras.

PUBLIC WORKS.

Dated July, 18*th*.

Read. *Encl.*

G.O., 18th July 1887, No. 1924 W.

JULY.

Bangalore Water Supply

Orders of the Government of India on the proposals for improving the —, communicated to the Superintending Engineer, V Circle, with istructions.

~~ENCLOSURE~~.

MEMORANDUM of the Army Sanitary Commission on Sanitary Reports of the Health of British Troops in the Madras Command during 1885.

Two Reports on this subject have been separately referred to us. The earlier one, addressed by the Surgeon-General to the Secretary to the Government, Military Department, and the other, which is in most respects similar, with observations on the Surgeon-General's recommendations by the Adjutant-General, is also addressed to Secretary to Government. It does not appear to be necessary to consider these Reports on two separate Memoranda. We shall therefore deal with them together.

1. The strength of British troops in the Madras command for the year under review averaged 10,414 non-commissioned officers and men.

2. From among this number there were 12,105 admissions to hospital, 97 deaths, and 251 men were invalided home. The ratios per 1,000 strength compared with those of the preceding ten years were as follow:—

	1875—84.	1887.
Admissions per 1,000 - - -	1,172·66	1,162·38
Deaths „ „ - - -	14·62	9·31
Invalided „ „ - - -	38·04	24·10

Considering these ratios solely from the side of total loss to the Service during these 11 years, it will be seen that, counting together the deaths and invalids for each period, the average annual disappearance of men from the ranks during the 10 years 1875—84 was in the ratio of 52·66 per 1,000, and in 1885 it had fallen to 33·41 per 1,000, a decided mark of improved health and efficiency, notwithstanding the slight increase of 0·71 per 1,000 in the death-rate of 1885 over the rate of 1884.

3. The average number of men constantly sick in the force was 686. This is the least favourable feature in the year's statistics, and now that the death-rates have been so far reduced, it may be suggested whether it would not be advantageous to direct attention to this point. Unfortunately, nearly one third of the constantly sick, or 221 per 1,000, were in hospital for venereal diseases, an inefficiency cause which the measures hitherto tried have failed to diminish.

4. Of other causes more under the influence of sanitary control, the febrile disease group kept 60 men, and the digestive disease group 118 men constantly on the sick list. To these three disease groups was due considerably more than one half of all the constantly sick in 1885. They were the means of keeping 399 men out of the ranks out of 10,414.

5. The following were the principal death causes in 1885:—

Diseases.	Deaths.	Deaths per 1,000 Strength.
Enteric fever - - -	23	2·21
Tubercular diseases - - -	9	0·86
Nervous system - - -	9	0·86
Circulatory system - - -	7	0·67
Digestive system - - -	19	1·83
Injuries - - - -	16	1·53

It will be observed that cholera is not included in this abstract. In Madras Presidency there was only one death from it at Secunderabad, yielding a death-rate of 0·095 per 1,000, a degree of immunity which may be contrasted with the 58,109 deaths among the civil population of Madras Presidency itself. Their death-rate was 2·0 per 1,000, or nearly 22 times that of the European Army. There was another death from cholera at Tonghoo, in Burma. Taking the deaths in order, the most fatal disease of the year was enteric fever, from which there were 73 admissions, 23 deaths, and one invalid. During the preceding year, 1884, there were 129 cases and 18 deaths from this disease.

6. The following were the stations where troops suffered from enteric fever :—

	Cases.	Deaths.
Secunderabad	29	10
Bangalore	18	1
Bellary	8	2
Cannanore	—	2
Wellington	—	2
St. Thomas Mt.	—	1
Belgaum	—	1
Sitabuldi	—	1
Calicut	—	1
Kamptee	3	—
Rangoon	—	1
Thyet Myo	—	1

The enteric fever admissions are not given for all the stations, but the first three stations in the list yielded 45 cases out of a total of 73 in the command, and 13 out of 23 deaths.

7. The local conditions under which enteric fever continues to show itself at Secunderabad and Bangalore have not received further elucidation in the present Report. There are, indeed, the usual differences of opinion on the subject. It is thought by one medical officer that the Ulsoor tank and its water are not to be blamed solely, because enteric fever occurs where it is not used, and also in barracks out of reach of its emanations. But if this be admitted, it would only show that enteric fever does not depend on a single cause. Again, it is stated that difference of level in the tank water shows no change in the statistics of this fever. But it may be suggested that, from the nature of the case, the observations have been too few to justify such a conclusion. In questions of etiology, it scarcely helps us to assign such a disease as enteric fever to any one cause. Several causes, including age and climate, may co-operate, and the proper function of skilled sanitary investigation is to assign due weight to each, and decide what can be done to abate or remove them. Facts already ascertained, and again referred to by the Surgeon-General, such as the defective surface drainage of the barracks at Secunderabad and the proximity of part of the barracks at Bangalore to a crowded native bazaar, may have influenced unfavourably the health of troops at these stations; and we know from other reports that there are disease causes at Secunderabad in the vicinity of the staff lines which require removal. And Bangalore has not yet obtained a wholesome water-supply.

Trees were planted as a protection at Secunderabad in the course of the year, and the barracks at Bangalore are reported in good condition. But this view can scarcely be accepted regarding any Indian barrack if we adopt the facts stated by Colonel Burton, R.E., who says:—"(1) The "men in all the barracks live on stone floors, in several places raised less "than 12 inches above the ground, and rarely more than 24 inches "above the ground; (2) that none of the barrack floors are damp proof; "(3) that all the rain-water falling from the roofs soaks into the ground

"equally under the barrack floors as in the surrounding ground, owing "to the absence of efficient surface gutters round each barrack by which "such water might be led away." (Military Department, 19th February 1887, No. 1011, Sanitary.)

We have called attention year after year to these grave defects in barrack construction, and in any discussion of the causes of enteric fever they must be taken into account.

Under these local circumstances, we must either consider that some of the 47 enteric fever cases at these two stations may not have been true enteric fever, or that there are still causes in operation which predispose to this more severe fever form. The fever admissions at both stations are high. At Bangalore they amounted in 1885 to 111·16 per 1,000, and at Secunderabad to 139·07 per 1,000. Even these ratios are not high when compared with the amount of fever in the Nagpore force, which includes troops at Kamptee. In this division 1,032 men sent 383 cases of fever to hospital, equal to a ratio of 371·13 per 1,000. Four of the Nagpore cases and one death were due to enteric fever. These statistical facts show the presence of sources of malaria at the stations, but they could scarcely account for enteric fever. At most they would act as predisposing causes.

8. Evidence in the present and past Reports appear to justify a recommendation that the general sanitary condition of Secunderabad should be examined and remedies applied, that Bangalore should have its improved water-supply provided as speedily as possible, and that the Native bazaar near the barracks should be maintained in a good sanitary condition, while the well-known subsoil malarial causes at Kamptee should be dealt with. As the case stands, this is all we should be warranted by the present Reports in advising.

Some additional light on localization of enteric fever may possibly be obtained from a fact regarding part of a regiment which was sent from Madras to Port Blair. The South Welsh Borderers were stationed at Fort St. George, and a detachment from them, together with other troops for Burma, was embarked at Madras. There was no enteric fever among troops at Fort St. George, or among the troops embarked for Burma. But in the detachment landed at Fort Blair there were four cases of this fever. There is strong evidence in this instance that local conditions had something to do with the occurrence, and this appears to be the view held by the Surgeon-General.

9. Diseases included under the head of *Digestive system* yielded a large amount of sickness. There were received into hospital under this class 567 admissions from dysentery, of which 4 died, 430 admissions from diarrhœa, none fatal, and 307 admissions and 12 deaths from hepatitis, including abscess of liver. There has been some reduction in death-rates from these diseases of late years. But there is no information in the Report as to their causes, and we must therefore repeat what has been the result of past evidence, that hepatic disease may be induced by drink, as well as by climatic causes,—the first can be controlled, and the latter may be mitigated by attention to clothing; that bad water, where it is used, predisposes to dysentery as well as to other bowel diseases; and that a known cause of dysenteric attacks is exposure to cold blasts of air in bed at nights. As related to the possible influence of intemperate habits, it may be stated that there were 29 admissions from delirium tremens, 6 from alcoholic poisoning with 1 death, and 14 admissions and 4 deaths from sunstroke.

10. The chief practical result of the present year's Report is that it shows great prevalence of local causes of malarial fevers, probably arising from general malarial conditions, partly from climatic causes and want of attention on the part of tooops to clothing, and partly from undrained subsoil of stations, with all of which the predisposition to enteric fever

may be connected. In former Reports the state of latrine accommodation was included among the probable predisposing causes of this fever, and we learn from the Reports under review that at Kamptee the dry-earth latrines are not so well managed as they might be. From the few facts presented to us, we can only give general indications as to remedial measures, and they appear to be those which are well known and acknowledged, such as general sanitary improvement of stations, particularly in such cases as Secunderabad and Bangalore, scrupulous attention to the water-supply of troops, and such works and measures as will cleanse the subsoil of stations generally and diminish malaria. These, with attention to the habits of the men, so far as we can learn from the present Report, would be the most effectual means of advancing the improved standard of health which has been attained at many Madras stations in late years. It is true, as the Adjutant-General states in his remarks, that questions of finance present grave difficulties to the progress of sanitary work, but of these we cannot take account. We concur generally in the proposals of the Surgeon-General, and, as a general rule of sanitary procedure, those stations where fatal fevers are most prevalent ought to be first improved, although the required expenditure may have to be diverted from works at the less unhealthy stations.

28th May 1887.

E.1
P.W. 6368/87

B. 2232 W 20-8-87

GOVERNMENT OF MADRAS.

MILITARY DEPARTMENT.

29 July 1887, No. 4567

Sanitary—Reports and Returns.

Read the following paper :—

No. . *Despatch from the Right Honorable the Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George; dated India Office, London, 23rd June* 1887, *No.* 3.

I forward, for your information, 70 * copies of a Memorandum by the Army Sanitary Commission on the Health Returns of British troops in the Madras Command for 1885.

* 12 by mail ; 58 by parcels post.

2. I am glad to learn from your letter dated the 19th February last, No. 13 (Military), that steps have been taken for improving the sanitary condition of the stations of Bangalore, Secunderabad, and Kamptee.

Memorandum of the Army Sanitary Commission on Sanitary Reports of the Health of British Troops in the Madras Command during 1885.

Two reports on this subject have been separately referred to us. The earlier one, addressed by the Surgeon-General to the Secretary to Government, Military Department, and the other, which is in most respects similar, with observations on the Surgeon-General's recommendations by the Adjutant-General, is also addressed to the Secretary to Government. It does not appear to be necessary to consider these reports on two separate memoranda. We shall, therefore, deal with them together.

1. The strength of British troops in the Madras Command for the year under review averaged 10,414 non-commissioned officers and men.

2. From among this number there were 12,105 admissions to hospital, 97 deaths, and 251 men were invalided home. The ratios per 1,000 strength compared with those of the preceding ten years were as follow :—

	1875—84.	1887.
Admissions per 1,000	1,172·66	1,162·38
Deaths „ „	14·62	9·31
Invalided „ „	38·04	24·10

Considering these ratios solely from the side of total loss to the service during these eleven years, it will be seen that, counting together the deaths and invalids for each period, the average annual disappearance of men from the ranks during the ten years 1875—84 was in the ratio of 52·66 per 1,000, and in 1885 it had fallen to 33·41 per 1,000, a decided mark of improved health and efficiency, notwithstanding the slight increase of 0·71 per 1,000 in the death-rate of 1885 over the rate of 1884.

3. The average number of men constantly sick in the force was 686. This is the least favorable feature in the year's statistics, and now that the death-rates have been so far reduced, it may be suggested whether it would not be advantageous to direct attention to this point. Unfortunately, nearly one-third of the constantly sick, or 221 per 1,000, were in hospital for venereal diseases, an inefficiency cause which the measures hitherto tried have failed to diminish.

4. Of other causes more under the influence of sanitary control, the febrile disease group kept 60 men, and the digestive disease group 118 men constantly on the sick list. To these three disease groups was due considerably more than one-half of all the constantly sick in 1885. They were the means of keeping 399 men out of the ranks out of 10,414.

5. The following were the principal death causes in 1885 :—

Diseases.	Deaths.	Deaths per 1,000 Strength.
Enteric fever	23	2·21
Tubercular diseases	9	0·86
Nervous system	9	0 86
Circulatory system	7	0·67
Digestive „	19	1·83
Injuries	16	1·53

It will be observed that cholera is not included in this abstract. In Madras Presidency there was only one death from it at Secunderabad, yielding a death-rate of 0·095 per 1,000, a degree of immunity which may be contrasted with the 58,109 deaths among the civil population of Madras Presidency itself. Their death-rate was 2·0 per 1,000, or nearly twenty-two times that of the European Army. There was another death from cholera at Tonghoo in Burma. Taking the deaths in order, the most fatal disease of the year was enteric fever, from which there were 73 admissions, 23 deaths, and 1 invalid. During the preceding year, 1884, there were 129 cases and 18 deaths from this disease.

6. The following were the stations where troops suffered from enteric fever :—

	Cases.	Deaths.
Secunderabad	29	10
Bangalore	18	1
Bellary	8	2
Cannanore		2
Wellington		2
St. Thomas' Mount		1
Belgaum		1
Sitabuldi		1
Calicut		1
Kamptee	3	
Rangoon		1
Thayetmyo		1

The enteric fever admissions are not given for all the stations, but the first three stations in the list yielded 45 cases out of a total of 73 in the command, and 13 out of 23 deaths.

7. The local conditions under which enteric fever continues to show itself at Secunderabad and Bangalore have not received further elucidation in the present report. There are, indeed, the usual differences of opinion on the subject. It is thought by one Medical Officer that the Ulsoor tank and its water are not to be blamed solely, because enteric fever occurs where it is not used, and also in barracks out of reach of its emanations. But if this be admitted, it would only show that enteric fever does not depend on a single cause. Again, it is stated that difference of level in the tank water shows no change in the statistics of this fever. But it may be suggested that, from the nature of the case, the observations have been too few to justify such a conclusion. In questions of etiology, it scarcely helps us to assign such a disease as enteric fever to any one cause. Several causes, including age and climate, may co-operate, and the proper function of skilled sanitary investigation is to assign due weight to each, and decide what can be done to abate or remove them. Facts already ascertained, and again referred to by the Surgeon-General, such as the defective surface drainage of the barracks at Secunderabad and the proximity of part of the barracks at Bangalore to a crowded native bazaar, may have influenced unfavorably the health of troops at these stations ; and we know from other reports that there are disease causes at Secunderabad in the vicinity of the staff lines which require removal. And Bangalore has not yet obtained a wholesome water-supply.

Trees were planted as a protection at Secunderabad in the course of the year, and the barracks at Bangalore are reported in good condition. But this view can scarcely be accepted regarding any Indian barrack if we adopt the facts stated by Colonel Burton, R.E., who says :—"(1) The men in all the barracks live on stone floors, in several places raised less than 12 inches above the ground, and rarely more than 24 inches above the ground ; (2) that none of the barrack floors are damp proof ; (3) that all the rain-water falling from the roofs soaks into the ground equally under the barrack floors as in the surrounding ground, owing to the absence of efficient surface gutters round each barrack by which such water might be led away." (Military Department, 19th February 1887, No. 1011, Sanitary.)

We have called attention year after year to these grave defects in barrack construction, and in any discussion of the causes of enteric fever they must be taken into account.

Under these local circumstances, we must either consider that some of the forty-seven enteric fever cases at these two stations may not have been true enteric fever, or that there are still causes in operation which predispose to this more severe fever form. The fever admissions at both stations are high. At Bangalore they amounted in 1885 to 111·16 per 1,000, and at Secunderabad to 139·07 per 1,000. Even these ratios are not high when compared with the amount of fever in the Nagpore force, which includes troops at Kamptee. In this division 1,032 men sent 383 cases of fever to hospital, equal to a ratio of 371·13 per 1,000. Four of the Nagpore cases and one death were due to enteric fever. These statistical facts show the presence of sources of malaria at the stations, but they could scarcely account for enteric fever. At most they would act as predisposing causes.

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28*th May* 1887.

No. . ORDER THEREON, 29 July 1887, No. 4567.

Communicated to His Excellency the Commander-in-Chief and the Surgeon-General, Her Majesty's Forces, Madras, with reference to the Proceedings of Government noted in the margin, and para. 8 of the Memorandum of the Army Sanitary Commission.

No. 7533, dated 4th December 1886.
„ 7826, „ 16th „ „
„ 1011, „ 19th February 1887.

(True Extract.)

Kenney Herbert Brigdr.-Genl.,
Secretary to Government.

To the Adjutant-General, with 8 copies of memorandum.
„ Quarter Master General, with 12 copies of memorandum.
„ Surgeon-General, Her Majesty's Forces, Madras, with 15 copies of memorandum.
„ Surgeon-General with the Government of Madras, with 20 „ „
„ Sanitary Commissioner, with 2 copies of memorandum.
„ Public Department, with 10 copies of „
„ Public Works Department.

Exd. E. C. Shunker.

15 copies sent to Mr. Ff

No 2232 W dated 20th August

Communicated to the Supply Engrs III & IV Circles for information; also to the Supply Engrs V Circle with reference to G.O. No 601 W dated 28th Feby 1887.

2. The question of improving the water supply of the garrison of Bangalore is still under consideration, vide G.O. No 1924 W dated 18th July 1887.

Govt. of {1887} Madras.

MILITARY.

To THE ADJUTANT-GENERAL,
&c., &c., &c.

Dated July,

Issued

Recd. 15-8-87 Encl. 1

G.O., 29 July 1887, No. 456

No 2232 W dated 20. August

JULY.

Nos.

Sanitary—Reports and Returns.

British Troops.—Seventy copies of a Memorandum by the Army Sanitary Commission on the Health Returns of — in the Madras Command for 1885, received from Her Majesty's Government, distributed.

G.O. 3326 W dated 17.12.86.
" 2139 W dated 26.8.86.
" 601 W dated 28.2.87
" 2292.3 W dated 10.9.86
" 1924 W dated 18.7.87

S. E. III Circle
S. E. IV Circle
S. E. V Circle

July Dept. 20/8 regrets to reply

18TH JULY 1887, No. 1924 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Military Works.

READ—the following letter from Colonel E. COLLEN, Officiating Secretary to the Government of India, Military Department, to the Secretary to the Government of Madras, Public Works Department, dated Simla, 14th June 1887, No. 1182 M.W.:—

I am directed to acknowledge the receipt of your letter, No. 2293 W., dated 10th September 1886, forwarding a copy of the proceedings of the Madras Government marginally noted, relating to the improvement of the water supply of Bangalore, and stating that the Government of Madras are convinced that the only feasible means of giving the garrison a pure water supply, at a reasonable cost, is to adopt Captain Romilly's project for supplying distilled water for drinking and cooking, and improving the Halsur tank supply and continuing it for all other purposes than drinking and cooking. The estimated cost of the works is Rs. 2,26,860, and the annual cost of maintenance of the distilled water system is estimated at Rs. 84,600, to which has to be added the cost of the impure supply from the Halsur tank, which will apparently be Rs. 27,000 per annum more.

No. 2794 W., dated 5th Oct. 1883.
" 2795 W., " 5th " "
" 1473 W., " 13th June 1884.
" 1474 W., " 13th " "
" 1814 W., " 25th July "
" 2292 W., " 10th Sept. 1886, with Captain Romilly's report annexed.

2. With reference to this subject, I am to say that the Government of India, in view of the serious objections to a dual system of water supply, and the great annual expenditure involved in the proposals now put forward, are very unwilling to accept these proposals as the only alternative open for providing a satisfactory water supply for Bangalore; and they hope that further investigation may show that a satisfactory supply may be possible, involving a smaller recurring expenditure. In this hope the Government of India are supported by their responsible advisers on such subjects, a copy of whose note on the subject is herewith forwarded for the information of the Governor in Council.

3. I am therefore to ask that, under the orders of His Excellency, further examination of the country round Bangalore may, if considered necessary, be made.

4. I am, however, to remark that, from the papers submitted, the Agaram scheme seems to offer a reasonable prospect of a satisfactory supply, especially if the four villages, the drainage of which the Agaram tank receives, were removed. The Government of India would be glad if the cost of this as well as of reserving the whole drainage area of the tank were ascertained, as it may be found that Captain Romilly's conviction that the difficulties and expense are prohibitive was a mistaken one. Possibly, the annual expenditure connected with this scheme might be reduced

if a pipe were taken from the higher-level tanks, and the troops supplied by gravitation so long as this supply lasted.

5. If the Agaram scheme is proved to be not practicable, it would be worth while to ascertain the cost of pumping a full supply from the Cauvery.

Enclosure.

Note on Water Supply of Bangalore.

The project on which this department is asked to advise is estimated to cost Rs. 2,26,860. This sum appears to be the cost of "works" alone, and does not include provision for establishment charges or for tools and plant. The addition of these charges would increase the figures probably by about 30 per cent. I note this fact as it has an importance of its own, but throughout the remainder of this note, I will ignore the charges in question for the sake of simplicity.

The project under consideration is one which provides a dual supply. The total quantity of water to be delivered is 60,000 gallons daily. Of this, 9,000 gallons is for drinking and cooking, the remainder is for "inferior" domestic purposes. The "inferior" water is to be supplied from the Halsur tank in much the same manner as it is at present, but the tank itself is to be improved at a cost of Rs. 59,860,* and several improvements (being part of project B) are to be made in the pumping and other arrangements. The "superior" water for drinking and cooking is to be taken from the Halsur tank; it is to be distilled by Normandy's apparatus, and then delivered to the troops through iron mains.

* Part of Project C.

	Rs.
1. Channel, masonry works, compensation ..	26,130
2. Improvements to tank	33,730
	59,860

The working expenses of the project are estimated in paragraph 35, page 19, of Captain Romilly's report. The gross total is Rs. 84,600. It is not clear whether any provision is made for repairs or not. It may be that the cost of repairs is included in the percentages. No provision is made for superior establishment, nor is the original cost of the old works (about three lakhs) taken into consideration. It is desirable to decide, as far as possible, the working expenses between the two systems of the dual supply. I can only do this approximately. But it would appear that the *yearly cost of distilling 9,000 gallons a-day will be*—

	Monthly. Rs.	Rs.
Share of establishment	150	
Fuel for engine, say	25	
Fuel for condensers	3,600	
Oil, grease and sundries	25	
Total, per mensem ...	3,800	
Per annum		45,600
15 °/₀ Interest of depreciation in condensers	12,027	
15 °/₀ Interest of depreciation on share of engine and pumps, say	2,000	
10 °/₀ Interest of depreciation on other works, say ...	2,000	
		16,027
Total annual charges		61,627

This is (as nearly as I can decide the figures given) the yearly cost of (9,000 × 365 =) 3,285,000 gallons of really good water.

The cost of 1,000 gallons of good water is, therefore, about Rs. 19.

Good drinking-water in London costs about six-pence, I believe, per 1,000 gallons. In Calcutta, I know it costs less than four annas per 1,000 gallons. In Lahore it seems to cost† about six annas per 1,000 gallons.

† Page 36 of Colonel Mullins' report.

It may be said, then, that the proposed system of supply of "superior" water is enormously expensive. It stands to reason that it must be so. The proposal is to allow the pure rainfall to flow over a more or less dirty surface; to permit it to be defiled in a tank, where sewage and other foul matter is admitted, and then to turn it into steam and condense it into good water! Why cannot the pure rainfall be caught when it is pure and needs no distillation and aëration? Why permit the water to be defiled first, and then go to enormous expense to clean it again?

Let us see what is necessary to obtain the small quantity of 9,000 gallons a-day, which is proposed to be distilled. The rainfall is given for eight years on page 29 of Colonel Mullins'

report. The following table is based on the average of those years: it assumes that a catchment surface can be prepared which will—

	Percent. of rainfall.
In January, February, March, catch	00
In April, May, June, catch	50
In July, August, September, October, catch	75
In November, catch...	50
In December „	00

—	Rainfall.	Proportion flow off.	Number of gallons which would be discharged from a surface of 400,000 s. ft.	Gallons drawn off at 9,000 gallons daily.	Gallons passed into reservoir from the catchment.	Number of gallons in a reservoir holding 1½ millon gallons at the end of each month.
January	0·13	Nil.	Nil	279,000	Nil	942,000
February ..	0·15		Nil	252,000	Nil	690,000
March	0·53		Nil	279,000	Nil	411,000
April	0·87	0·5	83,000	270,000	83,000	224,000
May	4·52		457,000	279,000	457,000	402,000
June	2·15		228,000	270,000	228,000	360,000
July	4·11	0·75	644,000	279,000	644,000	725,000
August	6·29		977,000	279,000	977,000	1,423,000
September ..	4·64		728,000	270,000	347,000	1,500,000
October ..	6·21		977,000	279,000	279,000	1,500,000
November ..	2·89	0·5	291,000	270,000	270,000	1,500,000
December ..	0·33	Nil	Nil	279,000	Nil	1,221,000

This table shows that a catchment of 400,000 square feet and a reservoir of 1½ million gallons will supply 9,000 gallons a-day *if the catchment discharges as is assumed*, and if the *reservoir is water-tight*. The Ooperhalli scheme failed because the catchment did not fulfil anticipations and the reservoir was not water-tight.

A catchment can be made to discharge nearly the entire rainfall if it be a plastered concrete floor. A reservoir in masonry can be made absolutely water-tight. I take the following rates from the reports:—

Concrete Rs. 12-8 per 100 c. ft., rubble masonry Rs. 14-1 per 100 c. ft. At this rate it ought to be easy to lay a good floor all over the catchment for *Rs. 6 per 100 square feet.*

Page 61 of Captain Romilly's report.

Colonel Mullins estimates a clear-water reservoir * to hold 7½ million gallons at Rs. 2,40,000, or, say, Rs. 3 per hundred gallons. Captain Romilly estimates + about Rs. 7 per 100 gallons for a small one to hold only 105,000 gallons. A rate of *Rs. 5 per 100 gallons should be* more than ample.

* Page 15.
+ Page 7.
I believe the Calcutta reservoirs cost considerably less.

Filters appear to cost from Re. 1 to Rs. 1-4 per square foot. Captain Romilly takes the extraordinary low duty of only 16 gallons per square foot in 24 hours. I will take the same duty and cost at Rs. 1-8 per square foot.

On these rates it would seem to be possible to provide 9,000 gallons of water daily by the following works, costing about Rs. 1,50,000:—

	Rs.
Compensation for land, say, 15 acres at 200	3,000
A plastered concrete catchment 400,000 square feet in area at 6 per 100 square feet	24,000
Masonry ducts leading to settling tank	4,000
Open masonry settling tank to hold 500,000 gallons, at, say, Rs. 3 per 100 gallons	15,000
Two filters, each capable of passing 9,000 gallons daily at 16 gallons per square foot, 1,125 square feet at Rs. 1-8, say	2,000
Clear-water reservoir to hold 1½ million gallons at Rs. 5 per 100 gallons	75,000
Mains and stand-posts, &c., say	20,000
Total ...	143,000

or, say, a total of Rs. 1,50,000. I believe the cost to be very highly estimated, and it is open to question whether a settling tank and filters would be necessary if the catchment were railed and well preserved.

The working expenses of this project would be very small. I assume that it would either be worked by gravitation by selecting a sufficiently high site for the reservoir some distance from Bangalore, or that the reservoir would be placed near the barracks and that the soldiers would pump the water themselves.

	RS.
Taking the working expenses at	2,400
and interest and depreciation (as in Captain Romilly's estimate) at 10 per cent. on Rs. 1,50,000	15,000
the total yearly charges would be	17,400

as compared with Rs. 61,627 of the distillation project, and the water would be quite as good. Any project which costs less than about 6 lakhs of rupees would be cheaper than the one proposed.

Again, it is stated in these papers that some of the wells in Bangalore give very good water, but that they cannot be depended upon; that the water is at times brackish, or, if the wells are largely drawn upon, the supply becomes foul, because the large draught taps impure sources. This defilement must be due to local causes. By seeking a locality, some miles perhaps from Bangalore, where these causes do not exist, pure water must be obtainable from wells in abundance. Nine thousand gallons a-day is only one cubic foot per minute. If there is no spring or no well or no group of wells within a reasonable distance, say, 10 miles of Bangalore, which can be relied upon to give one cubic foot per minute, a pipe 2½ inches in diameter with a head of 5 feet per mile would carry that quantity of water. Such a pipe might cost Rs. 4,000 per mile laid. If such a well or spring could be found, the capital cost of works necessary to deliver 9,000 gallons of water per day in Bangalore might be—

	RS.
Cost of well and land	10,000
Engines and engine house	20,000
10 Miles of 2½-inch pipe	40,000
Service reservoir in Bangalore	5,000
Distribution pipes	5,000
Total ...	80,000

	RS. A-year.
The working expenses might perhaps amount to	3,000
Interest and depreciation (as before) 15 per cent. on 20,000 = 3,000) Interest and depreciation (as before) 10 per cent. on 60,000 = 6,000)	9,000

Total charges Rs. 12,000 a-year for 9,000 gallons a-day. I believe I have here exaggerated both the capital cost and the annual charges. But it is evident that, both in this project and in that sketched by me previously, there is room for large excess over my very rough estimates before the cost of the water would amount to that which is contemplated in the scheme for distillation.

The Military Department refer this matter to this department with the question: "Does the Department of Public Works recommend the adoption of the distillation project?" I would reply—"Most certainly not. It is ruinously and unreasonably expensive."

The Military Department further ask: "What does the Department of Public Works advise?" I would reply—"Do not fear to go rather further a field for the water. It is not unreasonable to think that it would be cheaper to pump from the Cauvery river itself rather than to distil water. Find pure water somewhere, it must exist, and then see what it would cost to deliver. If you are satisfied with the supply from the Halsur tank for 'inferior' purposes, by all means accept that portion of this project which contemplates an improvement in the delivery of that water for inferior purposes, and look only for 9,000 gallons a-day for 'superior' purposes. But, if you are not satisfied with that supply, do not hesitate to go further away for your supply of 60,000 gallons a-day. If this quantity of pure water can be found any where, in tank, river, or well, within about 20 miles of Bangalore, it can probably be delivered by iron mains and pumps within the annual sum of Rs. 85,000 a-year, which it is contemplated will be the gross annual charges of the dual project which is recommended by the Government of Madras."

ORDER—dated 18th July 1887, No. 1924 W., Public Works.

Communicated to the Superintending Engineer, V Circle, who will ascertain and report the cost of removing the four villages which drain into the Agaram tank, and of reserving the whole drainage area of the tanks. Also, what reduction in the estimated

annual expenditure connected with Captain Romilly's Project A could be effected by taking a pipe from the higher-level tanks.

2. The Superintending Engineer will also, if possible, prepare a rough estimate of pumping a full supply of water from the Cauvery.

(True Extract.)

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintending Engineer, V Circle.
" Military Department.
" Public "

Exd. E. Fernandez.
Spare Copies

BUILDINGS AND ROADS.
MILITARY WORKS.

Govt. of {1887} Madras.

PUBLIC WORKS.

Dated July, 18*th*.

Recd. *Encl.*

G.O., 18th July 1887, No. 1924 W.

JULY.

Bangalore Water Supply

Orders of the Government of India on the proposals for improving the —, communicated to the Superintending Engineer, V Circle, with istructions.

GOVERNMENT OF MADRAS.

MILITARY DEPARTMENT.

29 July 1887, No. 4567

Sanitary—Reports and Returns.

Read the following paper:—

No. . *Despatch from the Right Honorable the Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George; dated India Office, London, 23rd June* 1887, *No.* 3.

I forward, for your information, 70 * copies of a Memorandum by the Army Sanitary Commission on the Health Returns of British troops in the Madras Command for 1885.

*12 by mail; 58 by parcels post.

2. I am glad to learn from your letter dated the 19th February last, No. 13 (Military), that steps have been taken for improving the sanitary condition of the stations of Bangalore, Secunderabad, and Kamptee.

Memorandum of the Army Sanitary Commission on Sanitary Reports of the Health of British Troops in the Madras Command during 1885.

Two reports on this subject have been separately referred to us. The earlier one, addressed by the Surgeon-General to the Secretary to Government, Military Department, and the other, which is in most respects similar, with observations on the Surgeon-General's recommendations by the Adjutant-General, is also addressed to the Secretary to Government. It does not appear to be necessary to consider these reports on two separate memoranda. We shall, therefore, deal with them together.

1. The strength of British troops in the Madras Command for the year under review averaged 10,414 non-commissioned officers and men.

2. From among this number there were 12,105 admissions to hospital, 97 deaths, and 251 men were invalided home. The ratios per 1,000 strength compared with those of the preceding ten years were as follow:—

	1875—84.	1887.
Admissions per 1,000	1,172·66	1,162·38
Deaths " "	14·62	9·31
Invalided " "	38·04	24·10

Considering these ratios solely from the side of total loss to the service during these eleven years, it will be seen that, counting together the deaths and invalids for each period, the average annual disappearance of men from the ranks during the ten years 1875—84 was in the ratio of 52·66 per 1,000, and in 1885 it had fallen to 33·41 per 1,000, a decided mark of improved health and efficiency, notwithstanding the slight increase of 0·71 per 1,000 in the death-rate of 1885 over the rate of 1884.

3. The average number of men constantly sick in the force was 686. This is the least favorable feature in the year's statistics, and now that the death-rates have been so far reduced, it may be suggested whether it would not be advantageous to direct attention to this point. Unfortunately, nearly one-third of the constantly sick, or 221 per 1,000, were in hospital for venereal diseases, an inefficiency cause which the measures hitherto tried have failed to diminish.

4. Of other causes more under the influence of sanitary control, the febrile disease group kept 60 men, and the digestive disease group 118 men constantly on the sick list. To these three disease groups was due considerably more than one-half of all the constantly sick in 1885. They were the means of keeping 399 men out of the ranks out of 10,414.

5. The following were the principal death causes in 1885:—

Diseases.	Deaths.	Deaths per 1,000 Strength.
Enteric fever	23	2·21
Tubercular diseases	9	0·86
Nervous system	9	0·86
Circulatory system	7	0·67
Digestive "	19	1·83
Injuries	16	1·53

It will be observed that cholera is not included in this abstract. In Madras Presidency there was only one death from it at Secunderabad, yielding a death-rate of 0·095 per 1,000, a degree of immunity which may be contrasted with the 58,109 deaths among the civil population of Madras Presidency itself. Their death-rate was 2·0 per 1,000, or nearly twenty-two times that of the European Army. There was another death from cholera at Tonghoo in Burma. Taking the deaths in order, the most fatal disease of the year was enteric fever, from which there were 73 admissions, 23 deaths, and 1 invalid. During the preceding year, 1884, there were 129 cases and 18 deaths from this disease.

6. The following were the stations where troops suffered from enteric fever :—

	Cases.	Deaths.
Secunderabad	29	10
Bangalore	18	1
Bellary	8	2
Cannanore	...	2
Wellington	...	2
St. Thomas' Mount	...	1
Belgaum	...	1
Sitabuldi	...	1
Calicut	...	1
Kamptee	3	..
Rangoon	...	1
Thayetmyo	...	1

The enteric fever admissions are not given for all the stations, but the first three stations in the list yielded 45 cases out of a total of 73 in the command, and 13 out of 23 deaths.

7. The local conditions under which enteric fever continues to show itself at Secunderabad and Bangalore have not received further elucidation in the present report. There are, indeed, the usual differences of opinion on the subject. It is thought by one Medical Officer that the Ulsoor tank and its water are not to be blamed solely, because enteric fever occurs where it is not used, and also in barracks out of reach of its emanations. But if this be admitted, it would only show that enteric fever does not depend on a single cause. Again, it is stated that difference of level in the tank water shows no change in the statistics of this fever. But it may be suggested that, from the nature of the case, the observations have been too few to justify such a conclusion. In questions of etiology, it scarcely helps us to assign such a disease as enteric fever to any one cause. Several causes, including age and climate, may co-operate, and the proper function of skilled sanitary investigation is to assign due weight to each, and decide what can be done to abate or remove them. Facts already ascertained, and again referred to by the Surgeon-General, such as the defective surface drainage of the barracks at Secunderabad and the proximity of part of the barracks at Bangalore to a crowded native bazaar, may have influenced unfavorably the health of troops at these stations; and we know from other reports that there are disease causes at Secunderabad in the vicinity of the staff lines which require removal. And Bangalore has not yet obtained a wholesome water-supply.

Trees were planted as a protection at Secunderabad in the course of the year, and the barracks at Bangalore are reported in good condition. But this view can scarcely be accepted regarding any Indian barrack if we adopt the facts stated by Colonel Burton, R.E., who says :—"(1) The men in all the barracks live on stone floors, in several places raised less than 12 inches above the ground, and rarely more than 24 inches above the ground; (2) that none of the barrack floors are damp proof; (3) that all the rain-water falling from the roofs soaks into the ground equally under the barrack floors as in the surrounding ground, owing to the absence of efficient surface gutters round each barrack by which such water might be led away." (Military Department, 19th February 1887, No. 1011, Sanitary.)

We have called attention year after year to these grave defects in barrack construction, and in any discussion of the causes of enteric fever they must be taken into account.

Under these local circumstances, we must either consider that some of the forty-seven enteric fever cases at these two stations may not have been true enteric fever, or that there are still causes in operation which predispose to this more severe fever form. The fever admissions at both stations are high. At Bangalore they amounted in 1885 to 111·16 per 1,000, and at Secunderabad to 139·07 per 1,000. Even these ratios are not high when compared with the amount of fever in the Nagpore force, which includes troops at Kamptee. In this division 1,032 men sent 383 cases of fever to hospital, equal to a ratio of 371·13 per 1,000. Four of the Nagpore cases and one death were due to enteric fever. These statistical facts show the presence of sources of malaria at the stations, but they could scarcely account for enteric fever. At most they would act as predisposing causes.

8. Evidence in the present and past reports appear to justify a recommendation that the general sanitary condition of Secunderabad should be examined and remedies applied, that Bangalore should have its improved water-supply provided as speedily as possible, and that the Native bazaar near the barracks should be maintained in a good sanitary condition, while

the well-known subsoil malarial causes at Kamptee should be dealt with. As the case stands, this is all we should be warranted by the present reports in advising.

Some additional light on localization of enteric fever may possibly be obtained from a fact regarding part of a regiment which was sent from Madras to Port Blair. The South Wales Borderers were stationed at Fort St. George, and a detachment from them, together with other troops for Burma, was embarked at Madras. There was no enteric fever among troops at Fort St. George, or among the troops embarked for Burma. But in the detachment landed at Port Blair there were four cases of this fever. There is strong evidence in this instance that local conditions had something to do with the occurrence, and this appears to be the view held by the Surgeon-General.

9. Diseases included under the head of *Digestive system* yielded a large amount of sickness. There were received into hospital under this class 567 admissions from dysentery, of which 4 died, 430 admissions from diarrhœa, none fatal, and 307 admissions and 12 deaths from hepatitis, including abscess of liver. There has been some reduction in death-rates from these diseases of late years. But there is no information in the report as to their causes, and we must therefore repeat what has been the result of past evidence, that hepatic disease may be induced by drink, as well as by climatic causes,—the first can be controlled, and the latter may be mitigated by attention to clothing; that bad water, where it is used, predisposes to dysentery as well as to other bowel diseases; and that a known cause of dysenteric attacks is exposure to cold blasts of air in bed at nights. As related to the possible influence of intemperate habits, it may be stated that there were 29 admissions from delirium tremens, 6 from alcoholic poisoning with 1 death, and 14 admissions and 4 deaths from sunstroke.

10. The chief practical result of the present year's report is that it shows great prevalence of local causes of malarial fevers, probably arising from general malarial conditions, partly from climatic causes and want of attention on the part of troops to clothing, and partly from undrained subsoil of stations, with all of which the predisposition to enteric fever may be connected. In former reports the state of latrine accommodation was included among the probable predisposing causes of this fever, and we learn from the reports under review that at Kamptee the dry-earth latrines are not so well managed as they might be. From the few facts presented to us, we can only give general indications as to remedial measures, and they appear to be those which are well known and acknowledged, such as general sanitary improvement of stations, particularly in such cases as Secunderabad and Bangalore, scrupulous attention to the water-supply of troops, and such works and measures as will cleanse the subsoil of stations generally and diminish malaria. These, with attention to the habits of the men, so far as we can learn from the present report, would be the most effectual means of advancing the improved standard of health which has been attained at many Madras stations in late years. It is true, as the Adjutant-General states in his remarks, that questions of finance present grave difficulties to the progress of sanitary work, but of these we cannot take account. We concur generally in the proposals of the Surgeon-General, and, as a general rule of sanitary procedure, those stations where fatal fevers are most prevalent ought to be first improved, although the required expenditure may have to be diverted from works at the less unhealthy stations.

28*th May* 1887.

No. . ORDER THEREON, 29 July 1887, No. 4567

Communicated to His Excellency the Commander-in-Chief and the Surgeon-General, Her Majesty's Forces, Madras, with reference to the Proceedings of Government noted in the margin, and para. 8 of the Memorandum of the Army Sanitary Commission.

No. 7533, dated 4th December 1886.
,, 7826, ,, 16th ,, ,,
,, 1011, ,, 19th February 1887.

(True Extract.)

(Signed) A. KENNEY-HERBERT, Brigdr.-Genl.,
Secretary to Government.

To the Adjutant-General, with 8 copies of memorandum.
,, Quarter Master General, with 12 copies of memorandum.
,, Surgeon-General, Her Majesty's Forces, Madras, with 15 copies of memorandum.
,, Surgeon-General with the Government of Madras, with 20 ,, ,,
,, Sanitary Commissioner, with 2 copies of memorandum.
,, Public Department, with 10 copies of ,,
,, Public Works Department.

Exd. E. C. Shunker.

No 2232 W a/20th August/87

Cont'd to the S. Es III & IV Circles for information. also to the S. E. V circle with reference to G. O. No 601 W a/ 28th Feby. 1887.

2. The question of improving the water supply of the garrisons of Bangalore is still under consideration vide G. O. No: 1924 W dated 18th July 1887.

Sd/ J. O. A.

S. E. III Circle
S. E. IV "
S. E. V "
Mily Dept.

P. W. D.

Govt. of {1887} Madras.

MILITARY.

To

THE ADJUTANT-GENERAL,
&c., &c., &c.

Dated July,

Issued

Recd. *Encl.*

G.O., 29th July 1887, No. 4667

No 2232 W a/ 20th August/87

JULY.
Nos.

Sanitary—Reports and Returns.

British Troops.—Seventy copies of a Memorandum by the Army Sanitary Commission on the Health Returns of — in the Madras Command for 1885, received from Her Majesty's Government, distributed.

By order