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MADRAS RECORD OFFICE.

Government of Madras.

Public DEPARTMENT.

G.O. No.	<i>414</i>	Press ~~Mis~~
Dated	<i>24-4</i>	19 <i>46</i> .

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Department,
24th April 1866.

No. 90. Read the following Proceedings of Government in the Public Works Department, dated 11th April 1866, No. 1102.

Passing Orders on the 1st Report by Mr. } (Vide Proceedings, Public Works Depart-
W. Fraser, C. E., on the Madras Water } ment, dated 11th April 1866, Nos. 149
Works. } —153.)

No. 91. ORDER THEREON, 24th April 1866, No. 414.

Communicated to the Municipal Commissioners for information.

(Signed) A. J. ARBUTHNOT,
Chief Secretary.

To the Municipal Commissioners.

Exd. J. Tulloch.

*Proceedings of the Madras Government, Public Works Department,
11th April 1866.*

No. 149. Read the following letter from W. FRASER, Esq., C. E., Special Executive Engineer, to the Secretary to Government, Public Works Department, dated Mount Road, 26th February 1866, No. 50:—

1. I have the honor to forward my first Report on the Madras Water Works, with one volume of detailed plans, and an abstract of the estimate. I trust that these papers will be found satisfactory.
2. A detailed specification and estimate will be furnished when required. The other volumes are being bound.
3. I send this volume in a deal case, as it is large and easily injured.

FIRST REPORT ON THE MADRAS WATER WORKS

BY WILLIAM FRASER, Esq., C. E.

1. The supplying of Madras with an abundance of pure water is a question which has occupied the attention of the Government for many years; and numerous reports and suggestions have been submitted by professional Engineers and others, either under the direct orders of Government, or from having their attention directed to the subject by the repeated complaints of the gradually increasing impurity of the water drawn from the wells, which, at present, form the only source of supply.

The gradual deterioration of the Madras wells is so notorious, that it is unnecessary to enlarge on this part of the subject, for the purpose of establishing the necessity for obtaining a supply of water from some other source. Many reasons have been assigned for this deterioration of the Black Town wells, but there is no occasion to search for obscure causes, when we are familiar with the fact that Madras is built upon a portion of the belt of silicious sand which runs along the Coromandel coast; and which, in its uncontaminated state, yields, nearly every where, a very pure fresh water. At Black Town and other parts of Madras it has been thickly covered with human habitations, the surface has rarely been in any but a filthy state, and, considering the porous nature of the soil, it is but reasonable to suppose that during every monsoon a portion of the surface impurities is washed down to the water-bearing strata; and there can be no doubt too, but that the very efforts recently made to keep the town clean by flushing the drains with water from Cochrane's Canal, has hastened the deterioration of the wells; for these drains were too uneven and broken to be successfully flushed, and the diluting of the sewage only enabled the porous sub-soil to absorb it the more readily. The result has been that many of the wells which were slowly becoming impure have, of late, rapidly become not only unfit for use but offensive.

2. The troops in Fort Saint George are supplied with water through pipes from the "Seven Wells," which are in an open piece of ground at the north side of Black Town, about two miles from the Fort.

The waters of these wells, and of several others throughout Madras, have been analyzed by Doctor Wyndowe, the Government Chemical Examiner. The following copy of his analyses has been kindly placed at my disposal by the Madras Sanitary Commission.

The work on which Dr. Wyndowe is engaged, "*The Analysis of the waters of Madras*," is not yet completed. In writing of the wells of the 1st, 2nd, 3rd, and 4th Police Divisions, he says:—"The results show that, with very few exceptions, the drinking water in Madras is as bad as it possibly can be. I am also informed that the poorest only make use of these wells for drinking purposes, others obtaining their supply from the few good wells, and paying for the same." This remark quite coincides with the result of my own observation, that those who can afford to do so send for water to where the belt of sand has been either not at all, or only

Proceedings of the Madras Government, Public

Tabular Statement of the results of Analyses of the following Drinking Waters

Number.	Locality.	SENSIBLE PROPERTIES.			Re-action to test Paper.	Solid ingredients in one Imperial Gallon.		
		Appearance.	Odour.	Taste.		Organic.	Inorganic.	Total.
	<i>1st Police Division.</i>					Grains.	Grains.	Grains.
1	Well.—In China Bazaar Street, Monument Esplanade, China Bazaar Tannah.	Not clear from particles of dust, &c., suspended, clear after filtration.	None.	Slightly brackish.	Neutral.	4	79	83
2	Well.—One of the two wells on the North Glacis of the Fort, near the Windmill.	Clear ...	do.	Not unpleasant.	do.	3	75	78
3	Well.—One of two wells in Cunnee Covil Street, near the Water Gate Tannah.	do. ...	do.	No particular taste, if any, a very faint brackish taste.	do.	4	60	64
	Well.—Inside Darmaraja Covil, Linga Chetty Street, Royapooram Gate Tannah.	do. ...	do.	Agreeable not unpleasant.	do.	5	82	87
5	Well.—Thumboo Chetty Street, Royapooram Gate Tannah.	do. ...	do.	Slightly brackish.	do.	4	75	79
	<i>2nd Division.</i>							
1	Well.—Old Jail Street, near the Mint Gate Tannah.	do. ...	do.	Agreeable not brackish.	do.	5	28	33
2	Well.—Googely Bazaar road, in Durmaraja Covil compound.	do. ...	do.	Brackish.	Alkaline.	6	150	156
3	Well.—Narainen Street...	do. ...	do.	Very brackish.	do.	9	242.1	251.1
4	Well.—Ramalingen Street, (private property.)	Before & after filtration opaque.	do.	Rather sweetish.	Neutral.	3	27.30	30.3
5	Well.—Old Jail Street, in the Cotton Godown. (Mr. Barrow's.)	Clear ...	do.	Agreeable not brackish.	do.	6.5	27.8	34.30
	Well.—Seven Well's Street, Big Parcherry Tannah.	do. ...	do.	Slightly brackish.	Faintly alkaline.	5	38.3	43.30
			do.	do.	do.	7	39.30	46.30

Works Department, 11th April 1866.

in use at the Presidency, arranged according to the Police Divisions.

in use at the Presidency, arranged according to the following

CHEMICAL PROPERTIES.												Remarks.
Hardness to soap test.			Chlorides determined as Chloride of Sodium in one Imperial Gallon.	Bases in solution by Carbonic Acid.			In solution after boiling.					
Temporary.	Permanent.	Total.		Iron.	Lime.	Magnesia.	Lime.	Magnesia.	Chlorides.	Sulphates.	Nitrates.	
2°	14°	16°	60.21380 grains.	Fair...	Fair...	Fair...	Large.	Much above average.	Very large.	Large.	None.	
3½°	14°	17½°	52.90630 do.	do.	Above average.	Much above average.	do.	Small.	do.	do.	do.	
5½°	15°	20½°	40.62970 do.	Average.	do.	Traces	do.	do.	do.	do.	do.	
2½°	16°	18½°	40.92200 do.	do.	Average.	Average.	do.	Average.	do.	do.	do.	
3°	16°	19°	52.61400 do.	do.	do.	do.	do.	do.	do.	do.	do.	
3½°	7°	10½°	13.10350 do.	A little above average.	Average.	Average.	Little above average.	Traces.	Fair.	Fair.	do.	
6°	24°	30°	102.30500 do.	Average.	Considerable.	Above average.	Large.	Much above average.	Very large.	Large.	do.	
8°	19°	27°	180.64140 do.	Under average.	do.	Large.	Considerable.	Large.	Considerable.	Very large.	do.	
2½°	8°	10½°	9.06130 do.	Above.	Small average.	Average.	Small average.	Average.	Fair.	Fair.	do.	
3°	7°	9°	7.80750 do.	Little above average.	do.	do.	do.	do.	do.	do.	do.	
5°	10°	15°	22.50710 do.	Under.	Large (not very.)	Little above average.	Large.	Little above average.	Large.	Large.	do.	
4½°	14°	18½°	21.63120 do.	do.	Fair...	Average.	do.	Average.	do.	do.	do.	

Proceedings of the Madras Government Public

Tabular Statement of the results of Analyses of the following Drinking Waters

Number.	Locality.	SENSIBLE PROPERTIES.				Solid ingredients in one Imperial Gallon.		
		Appear- ance.	Odour.	Taste.	Re-action to test Paper.	Organic.	Inorganic.	Total.
						Grains.	Grains.	Grains.
<i>2nd Division—(Concluded).</i>								
8	Well.—Googely Bazaar Esplanade, Googely Bazaar Tannah.	Clear ...	None.	Brackish ...	Alkaline.	3	122	125.0
<i>3rd Division.</i>								
1	Well.—Ice House road, West of Hindu burial ground, Ice House Tannah.	do.	do.	Slightly brackish.	Very faintly alkaline.	9	39.00	48.00
2	Well.—Ice House road, inside the Hindu burial ground.	do.	do.	do.	do.	5	31.30	36.30
3	Well.—Hall's garden, near the Market Tannah.	Before and after filtration opalescent.	do.	Rather sweetish astringent.	Neutral.	4	34.30	38.30
4	Well.—Baboo or Bo-Begum street, North gate of Patter's garden, Club-House Tannah.	Clear.	do.	Slightly brackish.	Faintly alkaline.	7	44.30	51.30
5	Well.—Scoopary Goontah street, Club-House Tannah.	do.	do.	Not unpleasant.	Neutral.	5	31.30	36.30
6	Well.—Adjoining the tank in Isan Moolk's garden, South of the Royapettah Police compound.	After filtration clear.	do.	Very faintly brackish.	Faintly alkaline.	5	34.30	39.30
7	Well.—Wood's road, Patter's garden.	Clear.	do.	Agreeable.	Neutral.	4	24.30	28.30
8	Well.—Chepauk Palace compound, used by the inhabitants south of Chepauk.	do.	do.	None.	Very faintly alkaline.	4.5	36.30	40.80
9	Well.—Chepauk Palace compound, used by the inhabitants north of Chepauk.	do.	do.	Rather brackish.	Alkaline.	5	48.30	53.30
<i>4th Division.</i>								
1	Well.—Cabalisparawan Civil Maday Street, Brodie's road, Ayatoray Pillay Tannah, (used by Hindoos only.)	Opalescent both before and after filtration.	Rather muddy	Earthy like tank water, or water kept in a new pot.	Faintly acid.	2	10	12

Works Department, 11th April 1866.

in use at the Presidency, arranged according to the Police Divisions.

CHEMICAL PROPERTIES.													
Hardness to soap test.			Chlorides determined as Chloride of Sodium in one Imperial Gallon.	Bases in solution by Carbonic Acid.			In solution after boiling.					Remarks.	
Temporary.	Permanent.	Total.		Iron.	Lime.	Magnesia.	Lime.	Magnesia.	Chlorides.	Sulphates.	Nitrates.		
13°	25°	38°	90.90530 grains.	Under.	Very large considerable.	Large.	Considerable.	Above average.	Very large.	Very large.	None.		
5°	13°	23°	21.04560 do.	Average.	Fair.	Small.	Fair.	Much above average (large).	Large.	Large.	do.		
3°	13°	16°	17.53800 do.	Under.	Average.	Average.	do.	do.	do.	Fair.	Distinct evidence obtained.		
4½°	14°	18½°	19.58450 do.	Average.	Fair.	Small.	do.	Large.	do.	Not too large.	None.		
8½°	15°	23½°	27.18390 do.	do.	Rather large.	Average.	do.	do.	do.	Rather large.	do.		
3½°	13°	16½°	14.61500 do.	do.	Fair about average.	Small.	do.	do.	Fair.	Fair.	do.		
3½°	10°	13½°	22.21480 do.	do.	do.	do.	do.	Fair.	Large.	do.	do.		
3½°	9°	12½°	9.93820 do.	do.	do.	Average.	do.	do.	Fair.	Not very large.	do.		
6°	12°	18°	19.29180 do.	Small.	Rather large.	Fair above average.	Not too large.	do. above.	Large.	do.	do.		
5½°	18°	23½°	24.55320 do.	Average.	do.	do.	Large.	Large rather.	do.	Large.	do.		
½°	8½°	6°	4.38450 do.	Above.	Under.	Under.	Under.	Little above.	Small.	Average.	do.		

Proceedings of the Madras Government, Public

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Number.	Locality.	SENSIBLE PROPERTIES.				Solid ingredients in one Imperial Gallon.		
		Appearance	Odour.	Taste.	Reaction to Test Paper.	Organic.	Inorganic.	Total.
	4th Division.—(Continued.)					Grains.	Grains.	Grains.
2	Well.—In the same locality used by all other castes except Hindoos.	Turbid, suspended matters large, Iron and alumina after filtration clear.	Earthy or muddy smell.	Earthy of the unfiltered, of the filtered brisk pleasant.	Acid.	3	12	15
3	Well.—Behind Ayatray Pilliar Covil.	Clear.	None.	None.	Very faintly alkaline.	3	23	26
4	Well.—Daberood Dowlah's ground in Coonnoor Mothia Moodelly's street, Meer Saib pettah Tannah.	do.	do.	Faint brackish.	Alkaline.	5	33	38
5	Well.—In Abdool Cawder's garden, Cossapet Tannah.	Clear.	do.	Agreeable not unpleasant.	Very faintly alkaline.	3	29	32
6	Well.—Cundusawmy Moodelly's ground, Peter's road Royapettah Tannah.	do.	do.	Tasteless.	Faint alkaline.	6	37	43
7	Well.—Camalooddeen Saib's garden Royapet Tannah.	do.	do.	Sharp, very pleasant.	Acid.	4	17	21
8	Well.—Mowbray's road, Mowbray Tannah in Rungiah Naik's garden.	Turbid, suspended matters large, clear after filtration.	do.	Earthy, after filtration agreeable.	do.	3	18	21
9	Well.—Kistnampett Venkata Rungapillay street, Aroonachella Chetty's ground.	Clear.	do.	Sharp brisk	do.	4	48	52
10	Do. do. do. in the garden of Parthasarathy's Pagoda.	Opalescent.	do.	Agreeable.	Faintly acid.	6	53	59
11	Well.—Edward Elliott's road near its junction with Meeran Saib's street.	do.	do.	None.	Very faint acid.	5	52	57
12	Well.—Beemana Moodelly Pettah, Sawmynada Moodelly's ground.	Clear.	do.	do.	do.	5	38	43
13	Well.—Vellala Tanampettah, Moottiah Moodelly's street, Calatha Moodelly's garden.	do.	do.	Agreeable.	Faintly acid.	5	25.8	30.8
14	Well.—Saint George's Cathedral road, in Mr. Sim's compound.	do.	do.	Brackish.	Neutral.	4	61.43	65.43
	5th Division.							
1	Well.—Narain Moodelly's garden near Nungumbaukum Tannah.	do.	do.	Rather brackish.	Faintly alkaline.	5	48	53
2	Well.—Nungumbakum tank road, Nungumbaukum Tannah.	do.	do.	Agreeable.	Neutral.	5.1	29.40	34.5

Works Department, 11th April 1866.

in use at the Presidency, arranged according to the Police Divisions.

CHEMICAL PROPERTIES.													Remarks.
Hardness to soap test.			Chlorides determined as Chloride of Sodium in one Imperial Gallon.	Bases in solution by Carbonic Acid.			In solution after boiling.						
Temporary.	Permanent.	Total.		Iron.	Lime.	Magnesia.	Lime.	Magnesia.	Chlorides.	Sulphates.	Nitrates.		
5°	6°	11°	4.38450 grains.	Large.	Above.	Traces.	Average.	Small.	Small.	Average.	None.		
6°	7½°	13½°	12.27660 do.	Under.	do.	Average.	Fair.	Average.	Fair.	Fair.	do.		
4°	17°	21°	17.83030 do.	Average.	Average.	do.	Large.	Little above.	Large.	Large.	do.		
7°	11°	18°	12.86120 do.	do.	Large.	do.	Not too large.	do.	Fair.	do.	do.		
6½°	11½°	18°	18.70720 do.	do.	do.	Above.	do.	Large.	Large.	do.	do.		
5°	6½°	11½°	6.13830 do.	do.	Large above.	Average.	Fair.	Average.	Average.	Fair.	do.		
3½°	5°	8½°	8.47670 do.	Above.	About average.	do.	Small average.	do.	do.	do.	do.		
2½°	14°	16½°	24.84550 do.	Large.	Small.	Fair.	Not too large.	Large.	Large.	Large.	do.		
3°	20°	23°	36.82980 do.	Above.	Above average.	Above.	Large.	do.	Very large.	do.	do.		
3°	17°	20°	34.78370 do.	Much above.	do.	Average.	do.	do.	do.	do.	do.		
5°	10°	15°	16.95340 do.	Average.	Large above.	do.	Fair.	Above average.	Not too large.	Fair.	do.		
4½°	14°	18½°	18.99950 do.	do.	do.	do.	do.	Much above average.	do.	Not very large.	do.		
5°	17°	22°	38.58360 do.	do.	Large.	Little above.	Large.	Above.	Considerable.	Large.	do.		
5°	15°	20°	27.47620 do.	Under.	do.	Average.	Fair.	Much above average.	Large.	Fair.	do.		
4½°	10°	14½°	20.46100 do.	Small.	Fair.	Small.	Not too large.	Average.	do.	Not too large.	do.		

Proceedings of the Madras Government, Public

Tabular Statement of the results of Analyses of the following Drinking Waters

Number.	Locality.	SENSIBLE PROPERTIES.			Re-action to test Paper.	Solid ingredients in one Imperial Gallon.		
		Appear-ance.	Odour.	Taste.		Organic.	Inorganic.	Total.
5th Division—(Concluded.)						Grains.	Grains.	Grains.
3	Well.—Pilliar Covil, Codumbaukum road, Codumbaukum Tannah.	Opalescent otherwise clear.	None.	Slightly brackish.	Alkaline.	6.2	34.50	40.7
4	Well.—Chetput, Vydee Moodelly's garden, Amjeekaray Tannah.	After allowing to stand for 12 hours clear.	do.	Of the clear water very agreeable.	Faintly acid.	4	11	15
5	Well.—Gengoo Reddy street Egmore, near the Darogah's Tannah.	Clear ...	do.	Not unpleasant.	Alkaline.	5	23	28
6	Tank.—In compound of Lying-in-Hospital.	Turbid, after filtration, opalescent.	Earthy.	Earthy ...	Acid ...	7	10	17
7	Tank.—Egmore High road, near Darogah's Tannah.	Opaque reddish.	do.	Sweetish earthy.	Acid (Faint.)	5	14	19
8	Well.—Egmore, Seondaramanjaloo's garden, Gengoo Reddy street.	Opalescent.	None.	Agreeable.	Neutral ...	2	13	15
9	Tank.—Arduagherry Moodelly's garden, opposite the Police Commissioner's Office.	Turbid, reddish brown.	do.	Rather earthy.	Acid ...	8	10	18
10	Well.—Nungumbaukum in Mr. Hunter's compound.	Clear ...	do.	Drinkable.	Alkaline ..	4	30	34

Works Department, 11th April 1866.

in use at the Presidency, arranged according to the Police Divisions.

CHEMICAL PROPERTIES.													Remarks.
Hardness to soap test.			Chlorides determined as Chloride of Sodium in one Imperial Gallon.	Bases in solution by Carbonic Acid.			In solution after boiling.						
Temporary.	Permanent.	Total.		Iron.	Lime.	Magnesia.	Lime.	Magnesia.	Chlorides.	Sulphates.	Nitrates.		
6°	12½°	18½°	29.23000 grains.	Average.	Large.	Average.	Fair.	Above.	Large.	Not too large.	None.		
½°	8½°	9°	3.50760 do.	do.	Small.	Traces.	Average.	Under.	Small.	Average.	do.		
5°	17°	22°	11.69200 do.	Small.	Large.	do.	Above.	Small.	Fair.	Above.	do.		
½°	7½°	8°	6.13830 do.	Above.	Small average.	do.	Fair.	Traces.	Small.	Fair.	Traces.		
3°	8°	11°	3.21530 do.	do.	Fair.	do.	do.	do.	do.	Small.	None.		
5°	12°	17°	5.26140 do.	do.	Large.	do.	do.	Average.	do.	Fair.	do.		
2°	11°	13°	2.92300 do.	do.	Average.	do.	Average.	do.	Very small.	do.	Abundant.		
4°	16°	20°	10.81510 do.	Average.	Above.	Average.	Large.	Above.	Fair.	Large.	None.		

Tabular Statement of the results of Analyses of the following

Number.	Locality.	SENSIBLE PROPERTIES.					Solid ingredients in one Imperial Gallon.		
		Appearance.	Odour.	Taste.	Re-action to Test Paper.		Organic.	Inorganic.	Total.
1	Well No. I ...	To the unassisted sight, clear transparent.	Distinct, reminding one of water which has stood some days in a goblet.	There is an absence of that grateful and pleasant briskness that good water should impart to taste.	Perfectly neutral.		7.25	28.90	36.15
2	Do. ,, II ...	Clear transparent.	Void of ...	Not so fresh as good pure water should be; but in this respect it is better than No. 1.	Decidedly acid, becoming alkaline after boiling some time.		6.90	24.70	31.60
3	Do. ,, III ...	Perfectly clear and transparent.	Free from odour.	Has a taste slightly saline.	Decidedly acid in the cold.		5.00	33.00	38.65
4	Do. ,, IV ...	Clear & transparent.	Do. ...	Slightly unpleasant.	Neutral...		5.90	45.05	50.95
5	Do. ,, V ...	Clear ...	Not free from.	Not pleasant after swallowing.	Slight acid ...		3.90	19.20	23.10
6	Do. ,, VI ...	do. ...	Do. ...	Do. ...	Do. ...		7.10	26.90	34.00
7	Do. ,, VII ...	do. ...	None ...	Faintly acid	Acid ...		7.85	21.65	29.50
8	Do. ,, VIII ...	do. ...	Do. ...	None.	Neutral ...		6.70	28.30	35.00
9	Do. ,, IX ...	Not clear from numerous minute particles.	Free from ...	Not remarkable ...	Acid ...		5.25	22.95	28.20
10	Do. ,, X ...	Clear, but impurity still present.	Do. ...	Brackish	Do. ...		5.70	64.40	70.10

Drinking Waters from the "Seven Wells" enclosure.

CHEMICAL PROPERTIES.													Remarks.
Hardness to soap test.			Chlorides determined as Chloride of Sodium in one Imperial Gallon.	Bases in solution by Carbonic Acid.			In solution boiling.						
Temporary.	Permanent.	Total.		Iron.	Lime.	Magnesia.	Lime.	Magnesia.	Chlorides.	Sulphates.	Nitrates.		
3°	11°	14°	12.86 grains.	Traces	Average quantity.	In quantity rather more than the average of waters	In rather large quantity.	In rather large quantity.	Shown above quantitatively.	Not large quantity.	None detected.	Gave clear evidence of the presence of animal life as well as vegetable growth.	
3.5°	9.5°	13°	11.1 do. ...	do.	Average in fair quantity.	Rather above the average quantity.	Rather large amount	Rather large amount	Already determined quantity.	Present but not in excess.	None	Gave evidence of the presence of animal life as well as vegetable growth.	
3°	10°	13°	14.615 do. ...	do.	Average.	Average.	Average.	Large	Not determined.	Large	Nil.	Individual forms of animal organic life, besides the other appearances as described in Nos. I and II.	
17°	11°	18°	19.461 do. ...	More than traces.	Large.	do.	do.	Very large.	do.	Very large.	do.	As described in Nos. I and II.	
2°	6°	8°	4.38150 do....	Traces.	Small (average.)	Under average.	do.	Small.	Not determined here	Little under.	do.	Much vegetable and animal life.	
2°	11½°	13½°	9.35360 do....	do.	do.	do.	Large.	do.	do.	Little above.	None	Rotaria plentiful, animal and vegetable life abundant.	
2½°	13°	15½°	8.47670= 14.5°	do.	Average.	Traces.	Average.	do.	Not determined.	Large.	do.	Animalcules present species not recognizable.	
3°	12°	15°	9.06130 grains	do.	do.	Small ...	do.	do.	do.	do.	do.	Less amount of animal life present but ascillatoria distinctly observed	
3°	11.5°	14.5°	9.03820 do.	do.	do.	About average.	Small.	do.	do.	Fair	do.	Animal and vegetable matters present, the latter in larger proportions.	
9.5°	17°	26.5°	26.95160 do.	do.	Very large.	Rather large above.	Not too large.	Above average.	do.	Much above average.	do.	Same as No. 9.	

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

3. Almost every one who has suggested a plan for supplying Madras with water, more especially the portion lying to the north of the Kuam river, has recommended the use of the Red Hill Lake, as a storage reservoir; but it was not until 1854, when the Government placed the investigation of the subject in the hands of Colonel (then Lieutenant) O'Connell of the Madras Engineers, that plans or sections were prepared. Colonel O'Connell's plans and reports were published in 1855; but no action was taken upon them, and the matter was allowed to drop, until October 1861, when the Municipal Commissioners drew attention to, and recommended a project put forward by Mr. Peter Orr of Madras. The Government in their Proceedings of the 20th December 1861, referred the subject for the consideration of the Public Works Department, and in May 1862, Mr. Roberts, Civil Engineer, was appointed to re-investigate the whole project.

As, with the exception of one trial line of levels, Mr. Roberts confined his observations to the ground previously examined by Colonel O'Connell, it will be sufficient to describe briefly the plan proposed by the latter Officer.

Colonel O'Connell's plan.

4. Colonel O'Connell proposed to put an anicut or dam across the Cortilliar river at Pushali, some distance above the crossing of the Madras railway, and three or four miles below the Kasavaram dam, which now turns the surplus water of the Cortilliar into the Kuam river. The supply channel, which was to be about 28 miles in length, was, on its course to the Red Hill Lake, to supply the following eight tanks: Senji, Pudumvalungie, Kadambatoor, Puttiloor, Taneerkolam, Pakkam, Palvadee, and Mettanamallee.

After supplying these irrigation tanks the surplus water, for the supply of Madras, was to be stored in the Red Hill Lake, which was to be raised nine feet. An open channel was to convey the water from the lake to two basins in Madras, where it was to be pumped up into settling reservoirs, filtered, and passed into the mains for distribution. No detailed plans of this scheme were prepared.

5. To Colonel O'Connell's plan there are two vital objections, namely, making the storing of water for Madras a secondary matter to that of filling the eight irrigation tanks; and taking off the supply channel from the Cortilliar so close under the Kasavaram dam, which is supposed to turn most of the flood, and all the summer water of the Cortilliar into the Kuam river for the supply of the Chembrambakkam and other tanks. I am aware that Colonel O'Connell did not intend to make the supplying of Madras the secondary question, but it would have come practically to that by the arrangement he adopted. Besides, the quantity of water obtained at that point, would have been insufficient for either purpose.

It was proposed to raise the Red Hill Lake nine feet, but as this was calculated from the crown of the calingulah (surplus weir), it would have been practically only an increase of $4\frac{1}{2}$ feet, as the Mirassidars (land owners) have a right to raise the water, and do so when there is sufficient rain, to the tops of the dam stones which stand $4\frac{1}{2}$ feet above the crown.

Plan now proposed.

6. In a matter so important as that of supplying Madras with water, the extension of irrigation should be considered as of little importance compared with securing an abundant supply for the city, and to accomplish this it is evident that the supply channel should be taken off the river at the lowest point which would give sufficient fall into the storage reservoirs. But it so happens that, in this case, the two objects of water supply and irrigation can be combined without endangering the success of the former; because, between the reservoirs now proposed and the sea there are from 20,000 to 25,000 acres of land lying waste for want of water, and there could be no more convenient places for storing it than Cholvaram and Red Hill Lakes; but by filling them first, the quantity required for Madras is made secure.

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

7. With these objects in view, I examined frequently and carefully the country between Madras and the Cortilliar, and many trial lines were surveyed and levelled. It was soon ascertained that besides the Red Hill another artificial lake, Cholvaram, could be made available for storage, as it lay in the best line for the supply channel, and was fifteen feet higher than the former.

8. The general design then, which I now submit, is simply this—See the portions marked in red on sheet No. 1:—

General design.

I. To place a dam across the Cortilliar at the point marked A, which is just high enough to give a fall of two feet per mile to Cholvaram Lake.

II. To cut a supply channel $8\frac{1}{2}$ miles in length from the dam to Cholvaram Lake.

III. To enlarge this lake by raising its level six yards above the present calingulah or surplus weir.

IV. To connect Cholvaram with the Red Hill Lake by a channel $2\frac{1}{4}$ miles in length, and with an inclination of three feet in a mile.

V. To enlarge the Red Hill Lake by raising its level to five yards above the present calingulah.

VI. To cut a delivery channel from this lake to the Spur Tank in Madras, a portion of which tank would be converted into the last settling reservoir.

Here we propose to stop for the present. The works connected with the filtering, raising, and distribution of the water will form the subject of another report. The observations for which have been partly made.

Detailed drawings furnished.

9. The volume of plans furnished with this Report contains the following detailed drawings:—

- Sheet No. 1.—Index plan, and section, is appended to this Report.
- Do. " 2.—Plan, longitudinal section, and cross sections of the Cortilliar river, for some distance above and below the site of the proposed anicut.
- Do. " 3.—Plan showing details of anicut, and head works of supply channel.
- Do. " 4.—Details of head sluice.
- Do. " 5.—Plan and longitudinal section of supply channel.
- Do. " 6.—Continuation of do.
- Do. " 7.—Do. do.
- Do. " 8.—Do. up to Cholvaram Lake.
- Do. " 9.—Plan, longitudinal section, and cross section of the Katenkal drainage channel.
- Do. " 10.—Do. do. of the Boosykal drainage channel.
- Do. " 11.—Details of the proposed aqueduct across the Boosykal.
- Do. " 12.—Map of Cholvaram Lake, with details of the proposed calingulah or surplus weir.
- Do. " 13.—Cholvaram Lake. Longitudinal and cross sections of the present and proposed bunds.
- Do. " 14.—Do. Details of head sluice, also design for cart bridges in brick and stone.
- Do. " 15.—Do. Details of proposed irrigation sluices.
- Do. " 16.—Plan and longitudinal section of the channel from Cholvaram to the Red Hill Lake.
- Do. " 17.—Map of the Red Hill Lake.

Proceedings of the Madras Government, Public Works Department,
11th April 1866.

Sheet No. 18.—*Red Hill Lake.* Longitudinal and cross sections of the bund.

- Do. „ 19.—Do. Cross sections of the bund.
Do. „ 20.—Do. Detailed plan showing the present calingulah and details of the proposed one.
Do. „ 21.—Do. Details of proposed alterations to Polai irrigation sluice.
Do. „ 22.—Do. Details of proposed alterations to the northern sluice.
Do. „ 23.—Do. Plan and details of proposed head sluice.
Do. „ 24.—*Delivery channel.* Plan and longitudinal section.
Do. „ 25.—Do. Continued.
Do. „ 26.—Do. do. up to the Spur Tank in Madras.
Do. „ 27.—Map and longitudinal section of the Otary nulla, with details of the proposed aqueduct.
Do. „ 28.—Details of the design for cattle and foot timber bridges on the supply channel.
Do. „ 29.—Do. of brick cart bridges, and timber foot and cattle bridges on the delivery channel.
Do. „ 30.—Design for irrigation and drainage under-tunnels.
Do. „ 31.—Do. for culverts for road crossings in Madras.

10. The population of Madras is supposed to be about 470,000, but for our purposes we may assume it to be half a million.
Quantity of water required for the supply of Madras.

It has been generally allowed that for such a class of people 20 gallons a head per day, on the gross population, is a very liberal allowance, this would amount to 21,692,985 cubic yards per annum; but to make allowance for waste, evaporation, special cases of consumption, &c., &c., I propose that forty millions of cubic yards be stored, per annum, for the supply of the city.

Capability of the Cortilliar.

11. Of the capability of the Cortilliar to supply this quantity during average years there can, I think, be no doubt. I have had the river gauged during two monsoons, and have obtained much information regarding its floods from personal observation, and from inquiries amongst those who live upon its banks, and the result is, that at the site of the proposed dam, the average discharge during thirty or forty days of the north-east monsoon within the last ten years, was between four and five hundred millions of cubic yards.*

The floods keep up to their maximum height for four or five days, and run about three feet deep for thirty or forty days more, when the river gradually retires to its small summer channel which runs full all the year round.

The south-west monsoon is scarcely felt in this river.

12. By placing the dam at the lowest possible point we secure the discharge due to 30 miles of the Cortilliar proper, that is, from the proposed dam to the Kasavaram dam, and also that from the Trittani and Nagiri rivers.

The area of the catchment basin of the Cortilliar would be no aid in calculating the quantity of water discharged at any point below the Kasavaram dam,

* NOTE.—The actual result of the observations is 441,847,610 cubic yards; but I consider it unnecessary to perplex the reader with elaborate calculations of this kind.

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

which turns its surplus into the Kuan; besides, the Cortilliar occasionally receives an addition from the Palar river through the Cauverypak tank. The basins of the Trittani and Nagiri rivers, however, discharge their surplus water by the site of the proposed dam, and we must depend principally on them for a constant supply as they include within their area the greater portion of the Nagiri mountains.

These basins are about 770 square miles in extent, and over this area the quantity observed to flow through the Cortilliar during the north-east monsoon, would be only 6½ inches in depth, probably not one-fifth of the whole depth which falls upon the Nagiri hills.

Katankal and Boosykal.

13. It will be observed that the supply channel crosses two drainage streams, the *Katankal*, and the *Boosykal*, which carry to the Cortilliar the surplus waters from a large number of tanks which lie on the north of the railway.

Observations on these channels show that they discharge about 20 millions of cubic yards per annum, and it is proposed to divert them into the supply channel.

Cholavaram and Red Hill Lakes.

14. Cholavaram and Red Hill Lakes were both formed centuries ago, by bunding across valleys surrounded by low hills of laterite rock and gravel.

The Red Hill Lake had formerly a supply channel (see Index Plan), but for many years both lakes have been dependent for their supply on the surface drainage during the monsoons. Each has a calingulah or surplus weir, but the dam stones (stone uprights built into the weir) enable the land owners to raise the water; in the case of Cholavaram, 3 feet; and in that of the Red Hill Lake, 4½ feet above the crown of the weir. For eight or ten years past, however, (with the exception of last year) the water has rarely risen above the level of the weirs.

15. On sheets 12 and 13 in the volume of plans, are actual surveys of these two lakes, and of the adjoining villages, carefully contoured by lines at every yard in height, up to seven or eight yards above the level of their respective calingulahs.

These contours will show the extent to which the surrounding land will be swamped, and the villages affected in each case by the proposed enlargements.

The red contours show the level of the present calingulahs, and the contours shaded red or purple, show the level of the proposed calingulahs.

The following tables show the capacities, areas, and circumferences at each contour:—

CHOLAVARAM LAKE.

Contour 1 yard.	Area at each contour in yards.	Area in acres and decimals.	Area in miles and decimals.	Circumfer- ence in miles.	Cubical con- tents between each two con- tours.	Total cubical contents up to each contour.	Remarks.
8	10,381,220	2144.088	3.35	...	9,873,208	55,207,929	Level of proposed calingulah.
7	9,368,196	1935.577	3.023	...	8,907,248	45,334,721	
6	8,449,300	1745.072	2.726	9 nearly	7,958,504	36,427,473	
5	7,467,708	1542.894	2.409	...	6,944,687	28,468,969	
4	6,421,667	1326.790	2.071	...	5,891,049	21,524,282	
3	5,360,431	1107.527	1.729	...	4,948,279	15,633,233	Level of the top of the dam stones. Level of calingulah.
2	4,536,128	987.216	1.464	...	4,103,623	10,684,954	
1	3,671,118	758.392	1.184	...	...	6,581,331	
0	2,760,738	570.400	0.890	4.644	3,215,928	3,365,403	
1	1,935,035	369.800	0.623	...	2,397,886	1,67,517	
2	Take half	199.900	0.310	...	9,67,517		

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

RED HILL LAKE.

Contour 1 yard each.	Area at each contour in yards.	Area in acres and decimals.	Area in miles and decimals.	Circumfer- ence in miles.	Cubical con- tents between each two con- tours.	Total cubical contents up to each contour.*	Remarks.
					Cubic yards.	Cubic yards.	
7	28,594,962	5908.050	9.231	...	27,298,204	154,061,302	Orakadam summit.
6	26,001,446	5372.200	8.393	...	24,781,283	126,763,098	Seitapet summit and
5	23,567,120	4869.239	7.607	17.333	21,580,199	101,981,815	level of proposed
4	19,599,278	4049.437	6.310	...	18,633,617	80,401,616	calingulah.
3	17,667,956	3650.404	5.703	...	16,449,949	61,767,999	Soorapodu summit at
2	15,231,942	3147.094	4.917	...	13,775,136	45,318,050	head sluice.
1½							
1	12,318,330	2545.109	3.967	...	11,065,880	38,430,482	Top of dam stones.
0	9,813,430	2027.818	3.167	10.767	8,587,077	31,542,914	
1	7,360,725	1520.810	2.375	...	6,601,515	20,477,034	Level of calingulah.
2	5,818,306	1212.460	1.893	...	4,310,928	11,889,957	
3	2,833,514	585.442	0.914	...	944,514	5,285,442	
4	to be taken	195.147	0.304	...		0,904,514	

Height to which the lakes should be raised. 16. It is probable that differences of opinion will exist as to the heights to which these lakes should be raised; but as the water is plentiful, and as there is an abundance of waste land which can be irrigated from these lakes, it seems to be desirable to enlarge them to the fullest extent to which they can be enlarged, without incurring any extraordinary expenditure.

17. It is proposed to raise Cholavaram 18 feet above the crown of the calingulah, because if raised higher it would involve the cost of embanking along a considerable portion of the supply channel.

The Red Hill Lake is proposed to be raised 15 feet above its calingulah, because a greater height would place Cholavaram head sluice inconveniently in back-water, and occasion the cost of constructing a large embankment across the valley at Seitapet, and at one or two other places.

18. The capacity of the two lakes up to these proposed heights is 138,409,288 cubic yards. If from this quantity we deduct the capacity at the level of the dam stones, to which the Mirassidars have a right to raise the water, the difference will be 93,397,475 cubic yards; but if we deduct only the quantity to the level of the calingulahs, beyond which they have rarely had the power to raise the water, the balance will be 114,566,851 cubic yards.

We may safely assume that, in addition to the quantity to which the Mirassidars have a right, we can store 100 millions of cubic yards, leaving 60 millions for irrigation after supplying Madras.

This quantity, it is calculated, will be thrown into the reservoirs in only thirty or forty days of the monsoon, nothing being allowed for the constant run there will be in the summer channel for the greater part of the year; but neither do I take evaporation nor absorption into account, and until we have had experience of the actual working of the reservoirs, I am disposed to let one stand against the other.

19. Most of the waste land under these lakes is of an unusually fruitful character, being, for the most part, alluvial deposit; it is also well suited for irrigation, as it descends in a slightly inclined plane towards the sea.

Area of land that may be irrigated. 20. There are various opinions as to the quantity of water required to bring to maturity an acre of rice, but most people allow that if carefully husbanded it would go much farther than it does. Colonel Sir Arthur Cotton takes 7,000

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

cubic yards as sufficient, (see "Public Works of India," page 171,) and if this be correct, 60 millions of cubic yards would be sufficient for 8,571 acres, which is not one-half of the waste land available.

The general difference between the assessment on dry and wet cultivation in the vicinity of Madras is 5 Rupees an acre, but as the land to which this water could be applied pays nothing now, we may take the increase at 7 Rupees an acre, which on 8,571 acres would amount to nearly 60,000 Rupees a year. If this calculation is even nearly correct, the return on the irrigation part of the project alone would yield a fair percentage on the entire amount proposed to be expended. I may here mention that of course the irrigation sluices, as well as those on the supply channels, would be under the control of Officers appointed for the purpose, so that the water could not be wasted as it is now.

Proposed works.

21. I now come to the description of the proposed works, and which I shall make as brief as possible.

Anicut or dam on the Cortilliar.

Where the Cortilliar flows between its ordinary banks, its width, at the flood

level, is about 500 feet. I propose to put the dam right across, and to make it 600 feet in length, and to raise it to the flood level of the last ten years.

The water may rise nine feet over this height without injury to the lands above, as the banks, either immediate or remote, are high; but the highest flood observed in 1863 and in 1864 if discharged over the dam, would have a depth of only 3½ feet. As this flood, however, was rather under the average, (yielding only 840,000 cubic feet a minute,) and as the Cortilliar is subject to sudden inundations from the breaching of the Kasavaram dam, as happened last year, I consider it best to give a safe length to the dam.*

Site of the dam.

22. The site of the dam was originally fixed lower down the river, but

on boring there we found over 40 feet of sand.

This led to an examination of the bed of the river for three or four miles, and the site now proposed was found to be the only place where, in that distance, the clay approached.

From what I have seen I believe that, at the present rate of destruction, the jungles will soon disappear altogether from the Nagiri hills, and I believe that one effect of this will be to shorten the period of floods, and to increase the time of minimum discharge, although perhaps the rain-fall may not be seriously diminished.

About seven years ago I drew the attention of the Government to this subject in my reports on the Coimbatore jungles, and I still think that the question is deserving of serious consideration.

The surface: whether this clay underlies all the sand, or is only a stratum within it, I do not know, as we had no means of boring into it, but it is compact and indurated, and is the best foundation we could get. The detailed drawings on sheet No. 3 will show that it is proposed to carry the concrete retaining walls of the dam into this clay substratum.

Cortilliar Head Sluice.

23. The general plan of the head sluice is shown on sheet No. 3, and the

details on No. 4. The sill of the sluice is to be six feet below the crown of the dam, and ten openings of five feet each in the clear are proposed.

* NOTE.—To those acquainted with the phenomena of rivers, the present condition of the Cortilliar, the height of its floods compared with its cross section, &c., &c., must seem abnormal, but this is explained by the fact that the channel is now what it was many years ago, before its waters were turned into other courses, or tanks upon its tributaries were so numerous as they now are. It is quite evident that within a recent period its floods rose 12 to 15 feet higher than they do now.

This diminution is said by the people, to be caused by the cutting of the jungles from the slopes of the Nagiri hills, and no trees being planted in their stead.

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

Red Hill Lake Irrigation Sluices.

37. There are two very good irrigation sluices in the bund of this tank. Under the altered circumstance of the lake they cannot be worked, with plugs, as they now are; they are therefore proposed to be altered as shown on sheets 21 and 22; the details of the sluice gates will be the same as those of the Cholavaram irrigation sluices.

Reservoir Bunds.

38. The mode of raising the bunds of these two lakes is shown on sheets 18, 19, and 20. The old revetment is proposed to be removed, the old work stepped out where the slope is quick, and the new earth laid in thin layers sloping inwards; a puddle wall, on the lake side, to be carried up at the same time; outside the puddle a layer of gravel and stones, 12 inches thick; and outside that, the stone pitching 18 inches in thickness.

Red Hill Lake Head Sluice.

39. This will be placed in the low bund which must be constructed along the summit at Soorapoddoo tank, at the south-east side of the lake.—See sheet 24 for the general position, and sheet 23 for the details of the sluice.

Delivery channel of Madras.

40. On sheets 24, 25, 26, are shown the plan and longitudinal section of the delivery channel to the Spur Tank in Madras. The dimensions of the channel are shown on the section. It is calculated to deliver considerably more than will be required daily for the use of Madras.

Otary Nulla.

41. Where the delivery channel crosses the Otary nulla the banks are very low. It had been proposed to shut up this nulla altogether, but as some land is irrigated from it lower down, I propose to cross it by an aqueduct. A map and longitudinal section of the nulla, and the details of the aqueduct are shown on sheet 27.

Bridges.

42. On the supply channel from the Cortilliar to the Red Hill Lake it is proposed to construct nine cart bridges and five foot and cattle bridges.

The design for the former is shown on sheet No. 14, and that for the latter on sheet 28.

On the delivery channel between the Red Hill Lake and Madras five cart bridges and two foot and cattle bridges are proposed to be erected: the details of these are shown on sheet 29.

For the details of the bridges required in Madras see sheet 31.

Tunnels.

43. On the supply channel two under-tunnels will be required both for irrigation and drainage purposes. The design for these is shown on sheet No. 30. On the delivery channel ten under-tunnels will be required. These will be similar in design, but much smaller than those on the supply channel.

Estimate.

44. The following is an abstract of the estimate for the works enumerated above:—

Proceedings of the Madras Government, Public Works Department.
11th April 1866.

Abstract Estimate for Madras Water Works.

No.	Description of works.	No.	Amount of each work.			Total.		
			RS.	A.	P.	RS.	A.	P.
1	Cortilliar anicut	1	30,709	14	0	30,709	14	0
2	Do. head sluice	1	10,928	12	3	10,928	12	3
3	Channel from Cortilliar to Cholavaram Lake	1	75,637	2	1	75,637	2	1
4	Diversion of Katenkal including dam across channel	1	657	8	0	657	8	0
5	Boosykal aqueduct	1	3,738	8	6	3,738	8	6
6	Do. diversion and dam across channel	1	3,339	15	0	3,339	15	0
7	Cart bridges for main channel crossings	6	2,029	10	6	12,177	15	0
8	Foot do. do. do. 3½ feet road-way	4	837	10	0	3,350	8	0
9	Irrigation under-sluices do. do.	11	1,111	4	9	12,224	4	3
10	Cholavaram Lake bund	1	1,24,515	4	6	1,24,515	4	6
11	Head sluice for supply channel to Red Hill Lake	1	11,121	13	4	11,121	13	4
12	Irrigation sluices to Cholavaram Lake	2	851	10	0	1,703	4	0
13	Cholavaram Lake calingulah	1	1,411	10	0	1,411	10	0
14	Channel between lakes	1	56,815	3	4	56,815	3	4
15	Cart bridges for supply channel crossings	3	2,029	10	6	6,088	15	6
16	Foot do. do. do.	1	837	10	0	837	10	0
17	Irrigation under-sluices do. do.	2	1,111	4	9	2,222	9	6
18	Red Hill Lake bund	1	96,791	1	6	96,791	1	6
19	Bunds across the valleys around the Red Hill Lake	3	13,876	8	0	17,492	13	9
			2,911	14	0			
			704	7	9			
20	Red Hill Lake irrigation sluices	2	426	1	6	1,046	9	0
			620	7	6			
21	Do. calingulah	1	2,603	2	0	2,603	2	0
22	Head sluice of delivery channel to Madras	1	2,898	2	1	2,898	2	1
23	Delivery channel to Madras	1	10,497	13	3	10,497	13	3
24	Cart bridges for delivery channel crossing	5	331	11	0	1,658	7	0
25	Foot bridges do. do.	2	251	10	2	503	4	4
26	Irrigation under-sluices for delivery channel crossings	10	832	11	0	8,326	14	0
27	Otary nullah aqueduct	1	1,392	6	6	1,392	6	6
28	Railway culvert	1	742	13	0	742	13	0
29	Poonamallee road bridge	1	421	11	0	421	11	0
30	Road bridge from Aminjicary to Chetput	1	594	11	0	594	11	0
31	Harrington's road culvert	1	421	11	0	421	11	0
32	Nabob's garden culvert	1	574	9	0	574	9	0
33	Macknical's road do.	1						
						5,03,446	13	8
	Contingence, superintendence, and sundries	...	...	...	...	50,343	2	4
	Compensation for damage to land, &c.	...	...	...	...	83,140	0	0
	Total estimate	...	...	...	...	6,36,930	0	0

Compensation for damage to land.

45. In this estimate is included a sum of 83,140 Rupees for compensation for damage to land, villages, &c. This includes compensation for the houses at the Red Hill Lake.

As regards the land to be swamped by raising the lakes, much of it would still be available for cultivation every year, as the water subsided, and the remain-

*Proceedings of the Madras Government, Public Works Department,
11th April 1866.*

der would be valuable as pasturage : this would be an important set off against the sum to be paid for damages, but I have not considered it necessary to take it into account.

The Red Hill houses were valued by the Municipal Commissioners' Assessor. The villages and lands by a Revenue Inspector. My own opinion is that if these works are ever carried out, the amount to be paid for compensation for damages will not exceed 60,000 Rupees.

Quality of the Red Hill and Cortilliar water. 46. Doctor Wyndowe has analyzed the water of the Red Hill Lake, and has made the following observations about it :—

Paragraph 3. "As regards sensible properties, the water was free from odour or taste, but cloudy (even after filtration) from suspended impurities. This no doubt will subside after some time if the water be left at rest. Chemically speaking, *this is by far the best specimen of drinking water* I have yet examined in Madras. The salts are very small in amount, viz., 6.98 grains in one gallon, and the amount of organic impurity is not great, and would be still further diminished by care and proper storage.

"The tank abounds in a species of chara; although this plant acts beneficially by precipitating the carbonate of lime, its presence is objectionable by adding to the organic impurity, and also from its tendency to generate a noxious gas, which still further deteriorates the water."

47. With regard to these remarks of Doctor Wyndowe I have to observe :—
First.—That the italics are mine.

Second.—That the Red Hill Lake is now solely supplied from the surface drainage of the land lying around it.

Third.—That being now comparatively shallow, vegetation is more vigorous than it would be if increased in depth as proposed.

Fourth.—The water which is proposed to be supplied to Madras, is the rain which falls upon the Nagiri hills, which are almost wholly composed of gneiss, and the channels through which it flows consist nearly altogether of pure silicious sand.

48. The grosser particles held in suspension by the water would be deposited in Cholavaram Lake, the finer particles in the Red Hill Lake, so that water comparatively pure would be delivered to the Spur Tank, where it would pass through properly prepared filter beds into the pure water basin, which would be covered in from light and dust. From this basin, which would hold three or four days' supply, the water would pass to the pump well, placed at some central point where it would be raised, probably into an elevated cistern, and thence distributed, through iron pipes, to the several parts of the city.

Taking into account the purity of the source from which the water would be drawn, the process sketched above would probably give to Madras a purer water than is supplied to any city in the world.

49. The works, if gone about actively, might be completed in two years.

No. 150. Minute by the Honorable the President.
(Here enter 5th March 1866.)

No. 151. Minute by the Honorable T. PYCROFT.
(Here enter 5th March 1866.)

No. 152. Minute by the Honorable H. D. PHILLIPS.
(Here enter 5th March 1866.)

*Proceedings of the Madras Government, Public Works Department.
11th April 1866.*

No. 153. ORDER THEREON, 11th April 1866, No. 1,102.

CIVIL WORKS, No. 24.

1. Attention has long been directed to the Red Hill Lake as the source from which an ample supply of whole- of the Town of Madras, and Lieutenant (now Lieutenant-Colonel) O'Connell of the Royal Engineers having been deputed to investigate the subject, submitted a report with plans and estimates in 1855, showing that the scheme was perfectly feasible of execution at a cost of Rs. 43,39,476. No action was, however, taken on those subsequently put forward by other parties, till Mr. Fraser, Civil Engineer, suggested the probability of improving upon Colonel O'Connell's designs, and was forthwith directed to undertake the re-investigation of the whole project.

2nd July 1863, No. 1,741.

	RS.	A.	P.
2. His scheme consists of :—			
I. The construction of a dam across the Cortilliar...	30,709	14	0
II. The construction of a channel with head and other sluices, bridges, and all requisite works from the anicut to the Cholavaram tank a distance of 8½ miles	1,22,054	9	1
III. The enlargement of the capacity of this tank by raising its bund six yards	1,38,751	15	10
IV. The construction of a channel with sluices, bridges, &c., from the Cholavaram to the Red Hill tank, 2¼ miles in length	65,964	6	4
V. The enlargement of the capacity of this tank by raising its bund five yards	1,17,933	10	3
VI. The construction of a channel with its sluices, accommodation bridges, &c., from the Red Hill Tank to the Spur Tank in Madras	28,032	6	2
Sundries, compensation for lands and houses, superintendence, &c....	1,33,483	2	4
	6,36,930	0	0

3. Mr. Fraser shows clearly that instead of taking off the head of supply from the Cortilliar at Pashali, a distance of 28 miles from the Red Hills, and raising the bund of the tank at that place only nine feet as proposed by Colonel O'Connell, it will be better to place the anicut across the Cortilliar much lower down at a spot about 12 miles from the Red Hills, and having an elevation just sufficient to give an average fall per mile of from two to three feet.

4. The advantages of this site for the anicut are, that the discharge due to the greatest possible length of the Cortilliar below the Kasavaram dam, which turns all the ordinary freshes of that river into the Cooum, is gained, that it is situated below the confluence of the Trittani and Nagari rivers, which are streams draining large tracts of a hilly wooded country and therefore to be relied on, and that the natural configuration of the country favors the excavation of a channel in the required direction, filling, in its course to the Red Hill tank, an intermediate reservoir at Cholavaram, the capacity of which as well as of the Red Hill Tank, could be readily enlarged to the required extent by raising the bund of the former six yards, and of the latter five yards.

5. The works, so far as they are now laid before Government, appear to be projected in a careful manner, and the Government have no doubt of their perfect practicability. The anicut across the Cortilliar, 600 feet in length, will not differ from other works of the kind which have been successfully constructed in this Presidency, and no difficulty seems likely to beset the execution of the other portions of the proposed scheme.

File 1102-11 April 1866

Proceedings of the Madras Government, Public Works Department.

11th April 1866.

6. By the enlargement of the two tanks in which Mr. Fraser proposes to store the water conveyed into them by a channel from the Cortilliar, he calculates that their joint capacity will be in round numbers 140 millions of cubic yards. Of this quantity the Meerassidars owning existing wet lands have a right to about 40 millions of cubic yards, leaving for the supply of Madras and for extension of wet cultivation, 100 millions of cubic yards. Assuming the population of Madras to be half a million, and allowing each individual twenty gallons per day, the total quantity required for the use of the population will be less than twenty-two millions of cubic yards, and, making all allowances, there seems no reason to doubt that if forty millions be reserved for Madras, an ample residue would remain for distribution for increasing the area of wet cultivation under the two tanks. Mr. Fraser states that there are from 20,000 to 25,000 acres of suitable waste land that might be irrigated between Cholaveram and Madras, and he shows that if the 60 millions of cubic yards of water, which will be available after reserving 40 millions for Madras, are used for irrigation, they will suffice for between 8,000 and 9,000 acres and yield a return of some Rupees 60,000 per annum.

7. The Government do not question the correctness of these calculations, and as, by actual close observation of the Cortilliar during the three years in which he has been engaged on his investigations, Mr. Fraser has ascertained that the quantity of water which is required will be readily obtained from that river during the 30 or 40 days that it is filled by the north-east monsoon, without taking into consideration the much longer periods that a diminished stream continues to flow, the Government are satisfied that, as far as can be judged without detailed specifications and estimates, the project will prove a remunerative one, irrespective of its value as a means of improving the comfort and sanitary condition of the inhabitants of Madras.

8. If the cost of the works be taken to be seven lacs of Rupees, instead of the Rupees 6,36,930 estimated by Mr. Fraser, interest on the outlay will be Rs. 35,000 per annum, or Rupees 25,000 less than the revenue to be derived from irrigation by the surplus water stored in the two tanks. As an irrigation project, therefore, the portion of the scheme now brought under the consideration of Government is likely to be very profitable; and the works remaining to be designed and estimated being the least expensive and at the same time the most remunerative, it is very desirable that, by carrying out what is now ready for execution, the Government should be able to secure a balance of returns with which to meet the interest of such monies as it may be necessary to raise to complete the scheme for providing a full supply of water to the inhabitants of Madras.

9. Mr. Fraser will lose no time in submitting the detailed specifications and estimates, and, on their receipt, His Excellency in Council will propose to the Government of India and the Secretary of State, that the money required for carrying out the works should be borrowed on the responsibility of Government with a view to the works being given out on contract, and completed as rapidly as possible.

10. Mr. Fraser will be requested also to expedite the preparation of the remainder of the project in communication with Captain Tulloch, and to submit as early as practicable that portion of the general scheme which provides for the supply of water to the Southern Districts of Madras from the Adyar and the Cooum, as well as for the formation of a high level canal to connect these rivers and the Northern and Southern Coast Canals.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R. E.,
Secretary to Government.

To W. Fraser, Esq., Special Executive Engineer,
Captain H. Tulloch, R. E.
To the Superintending Engineer, 4th Division.

Exd. S. T. Augustin.

9-4-07

Public 1866 Department.

No. 110

RECORDS OF GOVERNMENT.

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for information -

Municipal Commissioners.

24 April 1866

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