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No. 129. Read the following letter from the Acting Inspector-General, Indian Medical Department, to the Secretary to Government, Public Works Department, dated Fort St George, 29th August 1871, No. 285 —

In paragraphs 4 and 5 of my letter No 242, of 24th ultimo, I had the honour to report that I had referred, for Assistant Surgeon Nicholson's decision, certain points connected with the filtered waters of the Ulsoor Tank.

2. When his letter* of 29th July came to hand, I found in it expressions which prevented me ascertaining the Analyst's opinions, and as chemical science admits of definite statements, I asked for such, and for a mature and final communication.

3 This I now beg to enclose. It is contained in letter* No. 25, of 15th instant, along with which I have the honour to append, for submission to the Right Honorable the Governor in Council, letter No 19,* of 23rd ultimo, containing, in the prescribed form, his analysis of the Ulsoor Tank water, as also an analysis† which he made in 1863 of the water of that tank, and it would seen advisable that all these should be furnished to the Chemical Examiner, who has been ordered to proceed to Bangalore and there conduct an analysis in person.

* To be returned.

† Letter No 21, 4th August 1871, to be returned

4. In letter No 19, of the 23rd July, Assistant Surgeon Nicholson explains that he had conducted the analysis of the waters in the manner prescribed, but had omitted to report that fact to me, and he then sent to me a transcript of his notes showing the results of his analysis of the Ulsoor and Dhobies' Well water. And as these analyses, so far as this system admits, show the two waters to be fit for cooking and drinking, I place in two parallel columns the results which he obtained, namely,—

5. The appended letter No 25, of 15th August, contains Assistant Surgeon Nicholson's mature and final report on the Ulsoor Tank water, and in this it is mentioned that the water of the Ulsoor Tank contains suspended matters, which, though not deleterious in any way, are disagreeable in appearance and require to be separated before the water becomes fit for any domestic purpose; these suspended matters are clay and sand in such a fine state of division as to cause complete opacity of the water, conferval vegetation which when ripe agglomerates into a green scum (duckweed), and which when blown into corners of the tank is liable to ferment, evolving the disagreeable smell peculiar to both sea and fresh-water algæ. There are also some water-fleas and infusorial animalcules, and he reports that he has failed to find any sewage matter The separation of these suspended matters is effected by filtration, through sand and through charcoal packed in the outlet pipe of the filter, but he remarks that *this additional filtering material acts mechanically only and deprives the water of none of its dissolved matters, mineral or organic*, and even the sweet earthy taste remains. The water, as it runs from the filtering bed, has still an opalescent appearance, caused by an imponderable amount of fine clay, and a water-flea occasionally, though rarely, escapes through the filter The small quantity of suspended matters, he observes, aggregate on their way to barracks, so that the water as it issues from the stand pipes has no longer any

opaline appearance, and the sediment is readily separable by domestic filtration. Assistant Surgeon Nicholson then exhibits in four parallel columns the component parts of, 1st, pure, wholesome drinking water; 2nd, usable drinking water; 3rd, Ulsoor Tank water as filtered at the works, and, 4th, Dhobies' Well water, and he mentions that the filtered Ulsoor Tank water supplied to barracks is equal to the second standard in every respect, and to the highest standard in all but three points, and, when subjected to domestic filtration, the Dhobies' Well water comes up to the highest standard, and the Ulsoor Tank water only fails in one point, the large amount of oxygen containing organic matters, a defect common to all tank waters; both these exceed the highest standard on several important points.

6 As these points are now all to be investigated by the Chemical Examiner, until that Officer's report be received, as grave questions are involved, I abstain from further commenting on the information now furnished, and the further matter, as to the arrangements for serving the water, can also be taken up when the quality of the water is ascertained.

7 I have the honour to mention that Surgeon King, MD, Chemical Examiner, is at present on privilege leave till the 24th September 1871, and is understood to be at Hassan in Mysore; and as the Medical College Sessions commence on the 1st October, in order that he may complete the Ulsoor water analysis prior to the College opening, it would seem advisable that he cancel the remainder of his leave

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From Assistant Surgeon E NICHOLSON, Analyst of Waters of Mysore, Northern and Ceded Districts, to the Secretary to the Inspector-General, Indian Medical Department, dated Bangalore, 23rd July 1871, No 19

I HAVE the honour to forward copies of the analyses of the Dhobies' Wells water and the Ulsoor Tank filtered water, which I am about to forward with the rest to the Chemical Examiner I hope the Inspector-General will excuse my reticence in not giving to understand that the analyses in my special report to Dr Ranking were independent of those made according to the form laid down for report to the Chemical Examiner I much regret having laid myself open to merited blame for allowing it to be supposed that I had neglected the orders laid down for my guidance At the time of the report I had not yet received the forms to be filled up, and I gave only the substances actually contained in the water, in future I will on all occasions confine myself strictly to the form

CHEMICAL ANALYSIS.

I —QUALITATIVE.

A —Physical Examination

	Of filtered water from the Ulsoor Tank Water Works, 23rd April 1871.	Of water from Dhobies' Wells, 30th April 1871
Filtered water †		
Colour	Opalescent	Opalescent
Taste	Good	Good
Smell	None	None
Transparency	Imperfect.	Filtration not necessary.
Development of organized forms	None except a few water-flies	
Unfiltered water		
Colour		None
Taste		Good
Smell		None
Transparency		Perfect
Development of organized forms	Keeps good for a month without developing conferva, etc	None.

† Filtering only necessary when the water is turbid after rest for twelve hours

CHEMICAL ANALYSIS —(Concluded)

I —QUALITATIVE —(Concluded)

B.—Chemical Examination

	Of filtered water from the Ulsoor Tank Water Works, 23rd April 1871	Of water from Dhobies' Wells, 30th April 1871
Re-action to test-paper	Alkaline	Alkaline
Carbonic acid	Present	Present
Solid matter in one litre	0370	·0186
Volatile	1914	·1928
Mineral		
Total	2284	·2114
Oxygen required for organic matter	None	None
Putrid	0007	0002
Decaying readily	0003	None
Decaying in twenty-four hours		
Ammonia and organic matter	None	None.
Free ammonia	None.	None
Albuminord do		
Hardness—		
Removable	3° 9	3° 6
Permanent	2° 4	2° 0
Total	6° 3	5° 6
Chlorine in one litre	0355	0350
Nitric acid	None.	None.
Mineral matter		
Soluble in water	0771	0793
Insoluble in do	·1143	1135
Insoluble—		
Silica—	0231	·0365
Calcium carbonate	0780	0571
Magnesium do *	0098	0181
Oxide of iron †	Small	Small
Soluble—		
Calcium sulphate	None	None.
Magnesium do †	None	None
Sodium (as sulphate)	1171	1215
Nitrous acid †	None	None
Sulphuretted hydrogen †	None	None
Phosphoric acid †	0002	Minute traces.

* Qualitatively, unless present in excess

† Qualitatively

CHEMICAL ANALYSIS OF FILTERED WATER FROM THE ULSOOR TANK WATER WORKS, 23RD APRIL 1871

QUALITATIVE.

A —Physical Examination

Filtered water †	Opalescent
Colour	Good
Taste	None
Smell	Imperfect
Transparency	None except a few water-fleas, keeps good for a month without developing conferva, etc
Development of organized forms	

† Filtering only necessary when the water is turbid after rest for twelve hours

B—Chemical Examination

Re-action to test-paper	Alkaline.
Carbonic acid	Present
Solid matter in one litre	
Volatile	0370
Mineral	1914
	Total .. 2284
Oxygen required for organic matter	
Putrid	None
Decaying readily	0007
Decaying in twenty-four hours	0003
Ammonia and organic matter	
Free ammonia	None
Albuminord do.	None
Hardness—	
Removable	3° 9
Permanent	2° 4
	Total .. 6° 3
Chlorine in one litre	0355
Nitric acid	None.
Mineral matter	
Soluble in water	·0771
Insoluble in do.	1143
Insoluble—	
Silica—	0231
Calcium carbonate	0780
Magnesium do *	·0098
Oxide of iron†	Small.
Soluble—	
Calcium sulphate	None.
Magnesium do †	None
Sodium (as sulphate)	1171
Nitrous acid†	None
Sulphuretted hydrogen†	None
Phosphoric acid†	0002

REMARKS

This water deposits on standing the small quantity of very fine clay and sand which renders it opalescent The small amount of chlorine, the total absence of nitric and nitrous acids and of ammonia, show that the water is free from the mineral remains which evidence any former sewage contamination, and the amount of organic matter present is very small compared to that of other tanks of Bangalore which are free from suspicion

(Signed) E NICHOLSON, *Assistant Surgeon,*
Analyst of Waters, Mysore and Ceded Districts

* Qualitatively, unless present in excess
† Qualitatively

CHEMICAL ANALYSIS OF WATER FROM DHOBIES' WELLS, 30TH APRIL 1871.

I —QUALITATIVE

A.—Physical Examination.

Filtered water†	
Colour	Filtration not necessary.
Taste	
Smell	
Transparency	

† Filtering only necessary when the water is turbid after rest for twelve hours

Development of organized forms	None
Unfiltered water	
Colour	Good
Taste	None
Smell	Perfect
Transparency	None
Development of organized forms	

B—Chemical Examination

Re-action to test-paper	Alkaline
Carbonic acid	Present
Solid matter in one litre	
Volatile	0196
Mineral	1928
Total	2114
Oxygen required for organic matter	None
Putrid	0002
Decaying readily	None.
Decaying in twenty-four hours	
Ammonia and organic matter	
Free ammonia	None
Albuminord do	None
Hardness—	
Removable	3° 6
Permanent	2° 0
Total .	5° 6
Chlorine in one litre	0350
Nitric acid	None
Mineral matter	
Soluble in water	0793
Insoluble in do	1135
Insoluble—	
Silica—	0365
Calcium carbonate	0571
Magnesium do *	0181
Oxide of iron†	small.
Soluble—	
Calcium sulphate	None
Magnesium do †	None.
Sodium (as sulphate)	1215
Nitrous acid†	None.
Sulphuretted hydrogen †	None
Phosphoric acid †	Minute traces

REMARKS

This water appears to be served from the Ulsoor Tank by filtration through a bed of lateritic gravel which passes beneath the S E end of the bund, it differs from the tank water only by having a little less calcium, carbonate and organic matter, and a little more silica and magnesia The mineral differences are very small

(Signed) E NICHOLSON, *Assistant Surgeon,*
Analyst of Waters, Mysore and Ceded Districts.

* Qualitatively, unless present in excess,
† Qualitatively

Endorsement of the Acting Inspector-General, Indian Medical Department, to the Analyst, Potable Waters, Bangalore, dated Madras, 2nd August 1871, No 4,010.

THERE are expressions in this very important document which impart doubts to the reader as to the views of the Analyst

2 A few questions are asked in the body of the letter Favour is solicited of answers to the questions at each place, not in a letter or by endorsement here, but on the margin at the places where the questions are put

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From Assistant Surgeon E NICHOLSON, Analyst of Waters, Mysore, Northern and Ceded Districts, to the Secretary to the Inspector-General, Indian Medical Department, dated Bangalore, 29th July 1871, No 22.

I HAVE the honour to submit some additional observations on the Ulsoor Tank water, which may perhaps be of use in forming a conclusion on the subject of the Bangalore water-supply —

Question —1 Name these harmless suspended matters in the tank ?

(Signed) E BALFOUR.

Answer —1 Finely divided clay Conferval vegetation * Water fleas †

(Signed) E NICHOLSON

(* Algæ and confervoid growths are often seen in tolerably pure water —*Parkes*, page 51)
(† See paragraph 3, III.)

1st —It is necessary to consider the water only as it is when supplied to barracks after filtration at the water-works, setting aside any disagreeable impressions which may be produced by the harmless suspended matters in the tank If the water itself is good and free from unwholesome matters, conservancy is alone required to keep it good

2nd —Even under the present disadvantageous circumstances the water supplied to barracks will, I believe, compare favourably with that of most Indian barracks Since I have remedied the defective filtration by subjecting the water to an extra filtration through 8 feet of animal charcoal, the water has improved in appearance, it is now of a clear blue in the cisterns, and has the slightest possible opalescence The charcoal has had no appreciable effect on dissolved organic matters, but any other than a mechanically purifying effect has always been held dubious, and I do not expect that any filtration on a large scale will remove the small quantity of organic matter present I have not had leisure to experiment on domestic filtration, but I have little doubt that filters could be made at the Ulsoor Works quite equal to any of the block carbon filters sold in England

Q —2 Is the Ulsoor Tank water now fit for cooking and drinking purposes after it has been filtered, through the former filtering material and the recently added animal charcoal ?

Q —3 Can this filtered Ulsoor Tank water be supplied in all the quantities needed by the troops for all their cooking and drinking purposes ?

(Signed) E BALFOUR

A —2 Yes. Further filtration is only necessary to improve the *appearance* of the water used for drinking

A —3 Yes The quantity at present taken from the Dhobies' Wells for drinking and cooking is but $\frac{1}{10}$th of that sent up from the Water Works The 30,000 gallons can be made 60,000

(Signed) E NICHOLSON

Q.—4 What are the contents of the water as it issues from the pipes, and is the water that issues from the pipes the ordinary filtered water, or the animal charcoal filtered water ?

(Signed) E BALFOUR

A —It contains the substances marginally noted more or less Sometimes no water fleas are visible, at other times one or two per quart may be seen This is the water filtered through animal charcoal, it is always so filtered at present

(Signed) E NICHOLSON.

3rd —The water as it issues from the pipes at the Race-course contains, or may contain in suspension—

I —Some very fine clay in imponderable quantity ;

II —Some traces of conferval spores, but insufficient to set up vegetation in less than a month's time,

III —Some water-fleas, about one per quart

(Of these, *Daphnia pulax*, Dr Parkes says, "they are found in some good waters, such as that of Manchester, which in summer is quite full of the *Daphnia* ")

Q —5 Are such good domestic filters in use, or are they available ?

(Signed) E BALFOUR

A —The three chatty filter is the only one available at present, but the Works could make up any kind of filter which may be deemed best—any of those mentioned in Parkes' Hygiene

(Signed) E NICHOLSON

All these substances are separated by any good domestic filter

4th —The water thus finally purified is unobjectionable in appearance, it has a fresh sweet taste, by no means disagreeable, (caused, I believe, by its extreme softness,) and analysis fails to reveal the traces of anything unwholesome It is impossible, I submit, that a water containing only 058 grm per litre (4 grs per gallon) of chlorides, no nitric or nitrous acids and no ammonia, could have any perceptible trace of sewage about it It must be remembered that although the organic part of sewage disappears rapidly by the action of air and vegetation, the inorganic part of it accumulates But the Ulsoor Tank water is freer from chlorides, nitrates, etc, than the purest well waters of Bangalore, in fact, the Dhobies' Well water is the only one equal to it (because it is the same water, perfectly filtered)

5th —In the following table I have compared these waters with the standard given by Dr Parkes for pure drinking water and usable drinking water, as distinguished from suspicious and impure drinking water —(*Manual of Hygiene*, pages 26—41)

1 —6 What does analysis reveal, and of what water is mention here made ?

(Signed) E BALFOUR

A —(?) Water filtered through paper for instance,

Q Nothing but 13½ grs of per gallon { Chloride of Sodium 4 ; Sulphate of Soda ½ ; Compound Silicate 4 ; Carbonate of Lime .. 5 ; Organic matter ½ }

(Signed) E NICHOLSON

Q —7 Is there any perceptible trace of sewage about the unfiltered tank water
or the filtered do do
do animal charcoal do do do ?

(Signed) E BALFOUR

A —None, kept for three months in a loosely stoppered bottle neither the unfiltered tank water nor the filtered water affords the slightest trace of smell nor any development of organized forms beyond the conforval vegetation common to all tank and river waters This conferval vegetation indeed rarely occurs with the specimens of tank water (filtered or unfiltered) which I keep by me for examination, as it does with the pellucid water of Miller's tank In only one out of five specimens on my shelf is there any, that bottle was exposed to the sun and now has some fine conferva in it on *the side of the bottle which is exposed to the light* It was taken from the filtered water basin at the Works on 7th May, and this conferva did not start until June There is not the slightest smell in this specimen, which I keep for microscopical observation The animal charcoal has to filter such a quantity of water, 30,000 gallons per diem, that none but a mechanical effect is obtained It does not produce at present any chemical effect on the water

No sewage at present goes into the tank, and the surface drainage of a remarkably well kept bazaar does not carry with it sufficient animal matters to communicate any traces of them to such an expanse (about 100 acres) of water Some recent embankment works laid bare the south west corner of the tank, there was no trace of sewage deposit visible on the bottom A butyric acid smell sometimes arises at corners where a mass of conferva has been blown by the wind and is fermenting, but this has nothing to do with sewage

(Signed) E NICHOLSON

	1st Standard, Pure and wholesome drinking water	2nd Standard, Usable drinking water	Ulsoor Tank filtered water	Dhobies' Wells water
Transparency and Suspended matters	Transparent None ...	Transparent None or small amount capable of separation by coarse filtration	Opalescent An imponderable amount separable by filtration	Transparent at the wells, but opalescent when it arrives at barracks None
Smell and taste	None	None	No smell, taste fresh, rather sweet	Good
Aeration	Good	Good ...	Good	9 grains per gallon exclusive of chalk
Total solids not to exceed	7 grs per gallon exclusive of chalk	30 grs per gallon	8 grains per gallon exclusive of chalk	None
Calcium sulphate	Traces only ..	Little only ...	None	None
Magnesia sulphate	None	Little only ...	None	None.
Nitrates .. } Ammonia . }	Only slight traces	Inconsiderable	None .	None
Nitrites	None	Inconsiderable ..	None ...	0 1 to 0 2 grains
Organic matter not to exceed	1 grain scarcely blackening	3 grains ..	0 4 to 0 6 grains, no trace of other than vegetable origin	
To use of standard solution of permanganate	2 to 3 c c ...	6 to 10 c c	7 to 10 c c.	2 c c

From this it will be seen that the Ulsoor Tank water is equal to the 2nd standard in every respect and only falls short of the highest standard in two points 1st, the slight opalescence from harmless suspended matters, and, 2nd, the larger amount of oxygen consuming organic matters, a defect common to all tank and river waters, but compensated by the guarantee their vegetation gives against accidental animal matter Animal contamination is persistent in a well, but rapidly disappears in a river or tank I may mention that the amount of organic matter in the Ulsoor Tank water is less than a quarter of that in the second reservoir of Miller's tank, a piece of water gathering from rocky ground, free from any suspicion of sewage contamination, and of remarkably limpid appearance

Q —Is the allusion here to Ulsoor tank water unfiltered or to do do do filtered do do do do do do with animal charcoal ?

E BALFOUR.

A —To the water filtered with or without animal charcoal Filtration is required to render the water fit *in appearance* for drinking purposes

(Signed) F NICHOLSON

6 I have already forwarded analysis of the Ulsoor Tank water and the Dhobies' Well water, stated both in the form laid down and in that sanctioned by chemical usage In explanation of any discrepancies between the latter analysis and any others made either by myself or other Analysts according to the form laid down, I may state that many of the methods required by that form are useless or deceptive, and the form of statement is inapplicable to the great majority of waters For instance, Messrs Wanklyn and Chapman's method of estimating organic matter is as total a failure out here as it has been proved to be at home their nitric acid estimation is open to great objection, and is in fact highly deceptive unless soda of perfect purity is provided (that now supplied contains enough nitrate in itself to show nitrates in pure distilled water), and the form of statement does not admit of the real constitution of the water being given My search for nitric acid in the Ulsoor Tank water was made repeatedly and with great care, according to the process I gave in the *Madras Monthly Journal of Medicine* for May last, it shows that the amount present is less than 00001 grm per litre—one part in 100 millions, less than 0001 may fairly be called *none*

Q —Of what water is mention here made? ordinary filtered or animal charcoal do ?

(Signed) E BALFOUR

A —That filtered through animal charcoal, though before this filtration was added, the water was also of superior appearance

(Signed) E NICHOLSON

7 I would finally draw attention to the fact that the Ulsoor Tank water as it flows from the pipes at barracks is decidedly superior in appearance to the Dhobies' Well water as it flows from the puckal in which it is brought, and that for the latter water to maintain its trifling hygienic superiority it should be conveyed to barracks by some other means less objectionable Whichever of the economical projects I have drawn attention to should be adopted is an open question, but there can be at present no hygienic objection to connect the Ulsoor Works engine with the Dhobies' Wells, as the line of pipes would be equally useful whether these wells be the sole source of supply for drinking water,* or only an adjunct and reserve to the filtered water †

Q —What are these projects ?

(Signed) E BALFOUR

1st —To use the tap water for all purposes, good mechanical filters being applied to the drinking taps

2nd —* To pump up Dhobies' Well water as far as it is available, supplementing it with the tank water which then could be filtered more leisurely and effectually; no distinctions being made in distribution

3rd —† To pump up the Dhobies' Well water into the second cisterns for supply to the drinking taps, and the filtered tank water into the first cisterns for bathing purposes, the same line of pipe being used in the pumping ‡ (Suggested, I believe, by Dr Ranking)

(Signed) E NICHOLSON

‡ But distinct pipes for distribution

From Assistant Surgeon E NICHOLSON, Analyst of Waters, Mysore, Northern and Ceded Districts, to the Secretary to the Inspector General, Indian Medical Department, dated Bangalore, 4th August 1871, No 24

I HAVE the honour, in re-transmitting my letter, No 22, with the notes requested, to submit to notice the following analysis of 'Ulsoor Tank water filtered,' made by me in September 1863, on a specimen sent to me at Calicut by Dr Inglis, P M O, British Troops I was at the time

perfectly unacquainted with the Ulsoor Tank I entered the analysis in my Note book, from which I now extract it —

—	Grm per litre		Present composition
Chloride of sodium	0945		0585
Carbonate of lime with a little sulphate*	0520	* More probably sulphate of soda	0780
Carbonate of magnesia	0185	Compound silicate	0059
Silica	0323	0708	0568
Alumina (with a little iron)	0200		
Total	2173		1992
Organic matter ...	0202		.. .
	Equal to 0025 of oxygen required		0007 to 0010

From this it will be seen that the water has decidedly improved as regards freedom from chlorides and organic matter, probably owing to all suspicious drainage being diverted into a sewer The mineral characteristics of the water seem very constant I did not observe any nitrates at the time, and I expressed an opinion that the water was good and wholesome

From Assistant Surgeon E NICHOLSON, Analyst of Waters, Mysore, Northern and Ceded Districts, to the Secretary to the Inspector-General, Indian Medical Department, dated Bangalore, 15th August 1871, No 25

I HAVE the honour to submit some additional observations on the Ulsoor Tank as a source of water-supply to the troops at Bangalore —

1st —The water of the Ulsoor Tank contains suspended matters which, though not deleterious in any way, are disagreeable in appearance and require to be separated before the water becomes fit for any domestic purpose. These suspended matters consist of —

a Mineral substances, amounting to 226 grm per litre (15 8 grs per gallon) clay and sand in such a fine state of division as to cause complete opacity of the water

b Organic substances, amounting to 025 grm per litre (1 8 grs per gallon), conferval vegetation which when ripe agglomerates into a green scum (duckweed), this when blown into corners of the tank is liable to ferment, evolving the disagreeable smell peculiar to both sea and fresh water algæ. The suspension of the clay and the presence of the conferva are caused by the absence of water plants which usually keep tanks clear. There are also some water-fleas and infusorial animalcules I fail to find any sewage matters

2nd —The separation of these suspended matters is effected at the water works by filtration through 5 feet of sand, this has been rendered more effectual by the addition of 8 feet of animal charcoal packed in the outlet pipe of the filter. *This additional filtering material acts mechanically only, and deprives the water of none of its dissolved matters, mineral or organic,* even the sweet earthy taste remains The water as it runs from the filtering bed has still an opalescent appearance caused by an imponderable amount of fine clay, a water-flea occasionally escapes through the filter, but more and more rarely as the filtration is perfected by experience.

3rd —The small quantity of suspended matters which have escaped the filter, with the dust, etc, falling into the uncovered cisterns, and the rust of the iron pipes, aggregate on their way to barracks, so that the water as it issues from the stand pipes has no longer any opaline appearance, these matters form at once a sediment readily separable by domestic filtration The least clear

specimens I have been able to find either in the cisterns, or at barracks, become perfectly clear after passing through one of the small pocket-filters procurable at most shops (a small block of carbonized material with a tube fastened into it)

4th —The dissolved matters contained in the water filtered either through sand alone (after 12 months of work) or through sand and animal charcoal are the same as those in the unfiltered tank water In either form it contains 191 grm per litre (13 4 grs per gallon) of mineral substances all of the most unobjectionable character Sodium chloride (with a little sulphate) 058, calcium carbonate 078, and silicate of magnesia 056

The organic matters are less than 010 per litre, which is small for a tank water , they are entirely of vegetable character, and the small amount of chlorides, the total absence of nitrites, ammonia, and sulphuretted hydrogen, the infinitesimal traces of nitric acid, preclude any trace of animal contamination being present I may here state that all suspicious surface drainage of the Cantonment bazaar is diverted into a sewer, the usual contents of which I have examined The sewage liquid is highly saline (1 643 grm per litre of chloride of sodium) and offensive, but devoid of fæcal character , it is derived principally from the bathing and cooking-rooms of Native houses

5th —The Ulsoor Tank water (filtered or unfiltered) is freer from chlorides, nitrates, and other suspicious salts than any well water in Bangalore except the Dhobies' Well water, to which it is in this respect equal As regards organic matter it is freer from it than any tank water I have examined, having only one-fourth of that contained in the fine clear water of Miller's tank

6th —In the following table I have compared the Ulsoor Tank filtered water (through sand or through sand and charcoal) and the Dhobies' Well water with the standards laid down by Dr Parkes for, 1st, pure and wholesome , 2nd, usable drinking water, as distinguished from , 3rd, suspicious , 4th, impure drinking water. The standards are rather high for India

—	1st, Pure and wholesome drinking water	2nd, Usable drinking water	Ulsoor Tank water as filtered at the works	Dhobies' Well water
Transparency	Transparent	Transparent	Slightly opalescent at the works Transparent at barracks	Transparent at the unused wells Opaline at those in use Turbid on arrival at barracks
Suspended matters	None	None or only a small amount separable by coarse filtration	Only a small amount, separable by domestic filtration	A small amount, separable by domestic filtration
Smell and taste (disagreeable)	None	None	Slight sweet or earthy taste, disappearing on domestic filtration	None.
Aeration	Good	Good	Good	Good
Total solids not to exceed (per gallon)	7 grains exclusive of calcium carbonate	30 grains	8 grains exclusive of calcium carbonate	9½ grains exclusive of calcium carbonate
Calcium sulphate	Traces only	Little only	None	None
Magnesium do	None	Little only	None	None.
Nitrates	Only slight traces	Inconsiderable	None (less than 1 in 100 millions)	None
Ammonia ..	Do	Do	None	None
Nitrites	None	Do	None	None
Organic matter not to exceed	1 grain scarcely blackening	3 grains ..	Less than 1 grain	About ¼ grain
Using of oxygen grm per litre	0002 to 0003	0006 to 0010 ..	0007 to 0010	0002

From this it will be seen that the filtered Ulsoor Tank water supplied to barracks is equal to the second standard in every respect, and to the highest standard in all but three points , when subjected

to domestic filtration, the Dhobies' Well water comes up to the highest standard, and the Ulsoor Tank water only fails in one point, the larger amount of oxygen consuming organic matters, a defect common to all tank waters Both these waters exceed the highest standard on several important points

7th —I have the honour, in conclusion, to draw attention to the expense of the present arrangements for supplying barracks with a water of very trifling hygienic superiority to that actually laid on to the Race-course barracks and hospitals These employ 20 puckallies, at a monthly cost exceeding Rupees 240, to bring 2,400 gallons of water per diem from the Dhobies' Wells The 21st Barracks and Hospital, with pipes laid to their gates, employ 9 puckallies to bring drinking water from the Dhobies' Wells, besides the puckallies and carts that bring water for cooking and bathing from wells nearer to barracks I would, therefore, submit for consideration three schemes, either of which would supply good and wholesome water for all purposes at a considerable economy on the present outlay, and would suggest a trial of them for a few months

(a) To use the present water-supply from the Ulsoor works for all purposes, the water used for drinking and cooking being freed from any suspended matters by efficient domestic filtration The quantity of water pumped up to barracks (30,000 gallons per diem) is sufficient to cover expenditure for all purposes , 20,000 gallons would be sufficient at the reasonable allowance of 10 gallons per diem for each person or horse, but a good deal is wasted on gardens, etc

The method of filtration at barracks is a matter of detail, but I would suggest that the uncertain chatty-filter should be superseded by block or moulded carbon filters , either 25 small ones, each filtering five gallons per hour, or a smaller number of large filters (say two, each filtering fifty gallons per hour) The cost of the blocks for these would be in London about £ 25, but they could be made as cheaply at the Ulsoor Water Works I would undertake to set up the manufacture there and to turn out filters for all the European troops in Bangalore at a cost not exceeding Rupees 500 (for 5,000 gallons of water daily) If the result were approved, the works could supply filters for the whole Presidency I could do this in three months' time, without prejudice to my other duties, and the manufacture could then be continued under the Superintendent of the Works

(b) The quantity of filtered water available, 30,000 gallons daily with one filtering bed, 60,000 gallons of the second filtering bed were put in repair, (a measure which is most urgent in every respect,) could be increased 10,000 to 15,000 gallons by connecting the Ulsoor pumps with the Dhobies' Wells About 700 out of the 1,150 feet of pipes required are available on the spot, and they could be laid in about two months I have every reason to believe that the Ulsoor engine could pump up the water without any aid from the small engine at the Dhobies' Wells

(c) In the preceding scheme the Dhobies' Wells are utilized as a reserve to the filters, but the laying of pipes to these wells would admit of the water being pumped up to barracks through the same pipes as are now used, but on different days The water would be stored in the duplicate cisterns. I fear, however, that the practical advantage of this scheme would be small, as the Dhobies' Well water after sojourning in cisterns and pipes (whether the present line or a new set) would require domestic filtration just as much as the present water-supply , and it is very doubtful whether two waters of such nearly identical composition would show much difference physically or chemically by the time they were distributed for use through one to three miles of pipe

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ORDER THEREON, 8th September 1871, No 2,292.

No 130

MILITARY WORKS, No 4.

THE Government resolve to await the report which the Chemical Examiner has been requested in G. O , No 2,178, dated 24th August 1871, to submit on his analysis of the water of the Ulsoor Tank, and the reports of Assistant Surgeon Nicholson above recorded will be communicated to Dr King for consideration in connection with his analysis and

Proceedings of the Madras Government, Public Works Department,
8th September 1871.

who the Government hope will be able to complete so much of his analysis as must be performed at Bangalore before the 1st proximo.

(True Extract)

Captain, R E,
Under Secretary to Government.

To the Superintending Engineer, 5th Division.
,, Military Department
,, Chemical Examiner
,, Inspector-General, Indian Medical Department
,, Public Department
,, Sanitary Commissioner.

Exd S. T. Augustin

No 19 Bangalore 23rd July 1871

From Ass Surgeon E. Nicholson
Analyst of Water Mysore N & Ceded Districts

To The Secretary to the Inspector General
Indian Medical Department.

Sir,

I have the honour to forward copies of the analyses of the Dhobee wells water and the Ulsoor Tank filtered water which I am about to forward with the rest to the Chemical Examiner. I hope the Inspector General will excuse my inattention in not giving to understand that the analyses in my Decr report to Ranking were independent of those made according to the form laid down for report to the Chemical Examiner. I much regret having laid myself open to merited blame for allowing it to be supposed that I had neglected the orders laid down for my guidance. At the time of the Dec report I had not yet received the forms to be filled up and I generally the substances actually contained in the water, in future I will in all occasions confine myself strictly to the forms.

I have the honour to be
Sir
Your most obedient Servant
Edward Nicholson
Ass Surgeon Ret
Analyst Water Mysore &c

No 3544/71

From the Engineer, Public Works Department

To H. F. St. P. Deane, Esq., C.S.I.

Bangalore, 25th July 1871

Sir,

I have the honor to forward herewith the Analysis of the Water from the Hebbal Tank, and from the Wells at the Hebbal Farm, as requested in your letter No. 3544/71, dated 24th instant.

I have the honor to be,
Sir,
Your most obedient servant,
[illegible]
Engineer and Surveyor

CHEMICAL ANALYSIS.

I.—QUALITATIVE

	Hebbal Tank Water taken from Outlet Sluice 23rd April 1871.	Hebbal Farm Wells 30th April 1871
A—Physical Examination.		
Filtered water †	Opalescent	Filtration not necessary
Colour	good	
Taste	none	
Smell	imperfect	
Transparency	none except a few specks	
Development of organized forms	flies	none
Unfiltered water	good	good
Colour	none	none
Taste	perfect	perfect
Smell	none	none
Transparency	Perhaps good for combustion but not developing Confervæ	
Development of organized forms		
B—Chemical Examination.		
Re-action to test-paper	Alkaline	Alkaline
Carbonic acid	present	present
Solid matter in one litre	·0870	·0186
Volatile	·1414	·1928
Mineral	Total ·2284	·2114
Oxygen required for organic matter	none	none
Put in	·0007	·0002
Decaying readily	·0003	none
Decay set in twenty-four hours	none	none
Ammonia and organic matter	none	none
Free ammonia	3·9	3·6
Albuminord do.	2·4	2·0
Hardness—	Total 6·3	5·6
Removable	·0355	·0350
Permanent	none	none
Chlorine in one litre	·0771	·0793
Nitric acid	·1143	·1135
Mineral matter	·0231	·0365
Soluble in water	·0780	·0571
Insoluble in do.	·0098	·0181
Insoluble—	small	small
Silica—	none	none
Calcium carbonate	none	none
Magnesium do *	·1171	·1215
Oxide of iron †	none	none
Soluble—	none	none
Calcium sulphate	·0002	minute traces
Magnesium do †		
Sodium (as sulphate)		
Nitrous acid †		
Sulphuretted hydrogen †		
Phosphoric acid †		

† Filtering only necessary when the water is turbid after rest for twelve hours

REMARKS

* Qualitatively, unless present in excess
† Qualitatively

No 285

Office of Inspector General, Indian Medical Department,

Fort Saint George, 29th August 1871.

From

The Acting Inspector General, Indian Medical Department,

Fort Saint George,

To

The Secretary to Government
Public Works Department.

Sir,

In paras 4 and 5 of my letter No. 242 of 24th ultimo, I had the honor to report that I had referred for Assistant Surgeon Nicholson's decision certain points connected with the filtered waters of the Ulsoor tank.

2 When his letter of 29th July came to hand, I found in it no prefix which prevented me ascertaining the Analyst's opinions; and as chemical science admits of definite statements, I asked for such, and for a mature and final communication.

3 This I now beg to enclose. It is contained in letter No 25 of 15th instant, along with which I have the honor to append, for submission to the Right Honorable the Governor in Council, Assistant Surgeon Nicholson's returns letter No 9 of 23rd ultimo, Containing in the

the prescribed form, his analysis of the Ulsoor tank water, as also an analysis which he made in 1863 of the water of that tank; and it would seem advisable that all these should be furnished to the Chemical Examiner, who has been ordered to proceed to Bangalore and there conduct an analysis in person.

Letter No 25-4th Augt 71 To be returned

4 In letter No. 19 of the 23rd July, Assistant Surgeon Nicholson explains, that he had conducted the Analysis of the Waters in the manner prescribed but had omitted to report that fact to me, and he then sent to me a transcript of his notes shewing the results of his analysis of the Ulsoor and Dhoby Well Water. And, as these Analyses, so far as this system admits, show the two waters to be fit for Cooking and drinking, I place in two parallel Columns the results which he obtained, viz:-

5 The appended letter No 25 of 15th August contains Assistant Surgeon Nicholson's mature and final report on the Ulsoor tank water; and in this it is mentioned that the water of the Ulsoor tank contains suspended matters, which, though not deleterious in any way, are disagreeable in appearance and require to be separated before the water becomes fit for any domestic purpose; these suspended matters are clay and sand in such a fine state of division as to cause complete opacity of the water. Conferval vegitation which when pipe agglomerates into a green scum/duckweed/ and which when blown into corners of the tank is liable to ferment, evolving the disagreeable smell peculiar to both sea and fresh water algæ. There are, also, some water fleas and infusorial Animalcules, and he reports that he has failed to find any sewage matter. The separation of these suspended matters is effected by filtration through sand and through charcoal packed on the outlet pipe of the filter, but he remarks that this

additional

additional filtering material acts mechanically only, and deprives the water of none of its dissolved matters, mineral or organic; and even the sweet earthy taste remains. The water, as it runs from the filtering bed, has still an opalescent appearance caused by an imponderable amount of fine clay, & a water-flea occasionally, though rarely, escapes through the filter. The small quantity of suspended matters, he observes, aggregate on their way to barracks, so that the water as it issues from the stand pipes, has no longer any opaline appearance, and the sediment is readily separable by domestic filtration. Assistant Surgeon Nicholson then exhibits in four parallel columns, the component parts of (1) pure wholesome drinking water; (2) usable drinking water; (3) Ulsoor Tank water as filtered at the works; and (4) Dhobies well water, and he mentions that the filtered Ulsoor tank water supplied to barracks is equal to the 2d standard in every respect, and to the highest standard in all but three points; and, when subjected to domestic filtration, the Dhobies well water comes up to the highest standard and the Ulsoor Tank water only fails, in one point, the large amount of oxygen containing organic matters, a defect common to all tank waters, both these exceed the highest standard on several important points.

6 As these points are now all to be investigated by the Chemical Examiner, until that Officer's report be received, as grave questions are involved, I abstain from further commenting on the information now furnished; and the further matter, as to the arrangements for serving the water, can also be taken up when the quality of the water is ascertained.

7 I have the honor to mention that Surgeon King M.D., Chemical Examiner, is at present on privilege leave, till the 24th September 1871, and is understood to be at Kaisan in Mysore; and as the Medical College Sessions commence on the 1st October, in order that he may complete the Ulsoor water analysis prior to the College opening, it would seem advisable that he cancel the remainder of his leave.

I have the honor to be
Sir
Your most Obedient Servant

Edward Balfour M.D. Surt
Acting Inspector General
Indian Medical Depart.

No. 2292

Proceedings

Office Assistant Surgeon
in charge the St. Thomas's Mount Dispensary
Read the following

Sir,

The Inspector General
Indian Medical Department

(No. E. Lr. 2285 dated 29th August 1871)

The Government
have to await the Re-
port which the Chemical
Examiner has been Re-
quested in G.O. No. 2178
dated 24th August 1871
to submit on his analysis
of the water of the Ulsoor
Tank, and the report
of Assistant Surgeon
of Nicholson about recorded
in the communication
with the Ruing for con
sideration

Mr. 24th August/71 Rs. 325-327

Pd. Mr. 1871 Dept
Passport for Septr
187

No. 4103.

From

Inspector General,
Indian Medical Department,
Fort Saint George,

To

Dated 29th August/71
Recd 31st

No. 2285

Encl: 6-1

Forwards report of
Asst Surgn Nicholson
on the Ulsoor tank
water & 10 holes well
water, with observa-
tions

No. 2292-8 Septr/71

No. 129

6 Octr/71 Selby/Octr 8 Dept

in connection with the
analysis and who
the Post Horse will be
able to complete so much
of his analysis as
must be performed at
Bangalore before the 1st
proximo –

Ref: 6th

Ref: 8th Sept 71

Sept 5th 71

Lr. S. dept. Ball 8/9/71.
S.C. 25/9/71

Lr. Engr. 5th Nov.

Asst. Dept.
Chemical Examiner
Genl & Medical Dept.
Public Dept.
Sanitary Commissioner

4103.

Govt of Madras.

PUBLIC WORKS.

To The Superintending Engr
5th Division

Dated

Rcd. 6

G O, 8 Sept 71 No 2292.

Nos. 129 & 130

Ulsoor Tank & Dhobies wells

Passing orders on
letter from the Surgeon Genl of
Madras Medical Depmt
transmitting report of Assist
Surgeon Nicholson on the
water in the Ulsoor Tank
& Dhobies wells in Bangalore,

Ret 8th Sept 71