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Proceedings of the Madras Government, Public Works Department, 24th August 1871.

Read the following papers —

No. 325. From the Acting Inspector-General, Indian Medical Department, to the Secretary to Government, Public Works Department, dated Fort St George, 24th July 1871, No. 242.

I HAVE the honour to forward the marginal documents* called for in No. 131 of 17th instant, being reports by Assistant Surgeon Nicholson, by Deputy Inspector-General Ranking, and by Surgeon King, Chemical Examiner, on the waters of the Ulsoor tank and of the Dhobies' wells.

* 1871, 5th May —Report on the relation between the Ulsoor tank and the Dhobies' wells of Bangalore
1871, 6th May —Deputy Inspector-General Ranking reports on Assistant Surgeon Nicholson's Report
1871, 11th May —Chemical Examiner reports do do. do.
1871, 20th June, do do do
1871, 1st July —Assistant Surgeon Nicholson reports on letter of Chemical Examiner

2. These reports discuss two subjects, namely, the possibility of supplying the European Soldiers at Bangalore with pure water from the Ulsoor tank, or from the Dhobies' wells, and discuss also the means of conveying the required quantities of water. But the question of the possibility of so purifying the Ulsoor tank-water as to render it potable is still being inquired into by Assistant Surgeon Nicholson, and before submitting the matter to Government, I would have preferred awaiting a further communication from that officer, in order that my report on the questions involved might be complete. It will, however, be not without advantage to place before Government now a summary of all that has been hitherto done, with my opinions on the questions so far as they have been investigated.

3. Assistant Surgeon Nicholson reports that the filtered Ulsoor tank-water and the water from the Dhobies' wells are nearly identical, and he proposes to use only one set of water-pipes: on the one day sending along them the filtered water for the baths and horses; and on the following day, after flushing the pipes, sending on the Dhobies' well-water for drinking and cooking. He points out that the area of the tank has been greatly encroached on; that its waters do contain sewage, mineral, animal, and vegetable impurities, all of which, however, can, in his opinion, be separated by filtration, and he thinks it would be economical, and that money could even be made by supplying the municipality with the filtered water.

He also discusses the several available means of further purifying the filtered Ulsoor water—by electric action, by iron ore, by lime, by alum, by the water-nut, and by animal charcoal; and he is now engaged in inquiring into the manufacture and application of the last-named material.

Deputy Inspector-General Ranking, in forwarding the above, points out that Assistant Surgeon Nicholson's method of analysis differs so materially from that adopted on former occasions, and the analytical results are so different from those previously recorded that he suggests the advisability of obtaining the Chemical Examiner's opinion on the report. I accordingly referred it to the Chemical Examiner, who likewise points out that Assistant Surgeon Nicholson had, in his analysis, followed a different method from that formerly adopted; that the Chemical Examiner had formerly found nitrates, whereas Assistant Surgeon Nicholson finds none; and he declines to form an opinion on results obtained by Assistant

Surgeon Nicholson, on the ground that the latter had adopted a method different from that which the Chemical Examiner had suggested.

In a subsequent report Surgeon King observed, that as the Ulsoor tank unfiltered water had been repeatedly condemned, and was once reported to contain fœcal impurity; if the water is to be supplied for the use of troops, no pains or expense should be considered excessive which may ensure success in the process of filtration.

I then forwarded the Chemical Examiner's letter of 20th June for the observations of Assistant Surgeon Nicholson, who, in his reply, assumed that Surgeon King had, in the 20th June letter, indicated the wholesomeness of the filtered water; he mentions that, since three or four years, sewage has not found its way into the tank; that there is now no trace of sewage; and that conservancy measures will produce as great freedom from it as is possible in India He also puts the question, whether the filtered water, as now pumped up, could, after cistern filtration through 6 or 10 feet of animal charcoal, be used for drinking; and, in order to decide this point, he is experimenting as to the manufacture and application of that filtering material. He mentions that the Dhobies' wells would always be a stand-bye in the event of the filters failing, and that the two schemes combined could supply 60,000 gallons of pure water daily, sufficient for the wants of all the European and Native troops in Bangalore.

4. I have in the last paragraph summarised the information given in the Reports alike of Assistant Surgeon Nicholson and of Deputy Inspector-General Ranking and Surgeon King It will be observed that the train of thought guiding Assistant Surgeon Nicholson in his investigations is to the effect, that "as the "Dhobies' wells are filled by percolation from the tank, and their waters, by "natural filtration, have been rendered comparatively pure, so, with certain pre-"cautions, artificial filtration ought to effect a similar purification in the waters of "the Ulsoor tank," and he considers that the requisite potable purity can be secured by a further filtration through six or ten feet of animal charcoal, in experiments on the manufacture, and application of which he is now therefore engaged. The question he propounds is capable of being replied to by his chemical analysis, and it seems advisable that this should be waited for, because the Dhobies' well nearest the tank is fifty yards distant from the water, and it requires to be proved that six to ten feet of an animal charcoal filter will be equal to fifty yards of ferruginous and clayey soil.

5. It is, however, to be regretted that Assistant Surgeon Nicholson's analysis has been conducted after method so different from that suggested by the Chemical Examiner; that the latter officer has felt compelled to decline offering any opinion on that which Assistant Surgeon Nicholson has followed I have therefore requested him again to analyse the filtered water, but on this occasion in the manner which the Chemical Examiner had suggested.

6 In mentioning this, it is necessary to explain that there are at present two systems in operation for the analysis of the organic matter in water, and it was remarked in a recent number of the *Lancet*, "that when these two processes "were applied to the same sample of water, they furnished opposite results, and "when the authors of the processes investigated the question of water-supply,

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24th August 1871.

"they arrived at opposite conclusions," and with such widely different results obtained by the most distinguished Chemists in England, and the Chemical Examiner so cautious that he even declines to give an opinion as to the method which Assistant Surgeon Nicholson has pursued in examining the inorganic constituents, I think it necessary, before allowing the soldiers to use the Ulsoor water, either for drinking or cooking, and before any further step be taken, to await the report on the experiments Assistant Surgeon Nicholson is making with animal charcoal, and also to have his next analysis of the water made in the method suggested by the Chemical Examiner, and likewise to have the tank-water analysed at different seasons of the year.

7. I know Bangalore, the Ulsoor tank, and all relating to the drainage of the neighbourhood. In 1865 I carefully bottled some gallons of the tank-water, which I took up at the rock, and there and then sealed the bottles and despatched them to Madras for analysis. The Ulsoor tank has been formed by damming up the lower part of a valley, the higher part of which is occupied by the densely peopled native town, and by lines and barracks of several regiments. The physical configuration of that valley and its occupation are such as to urge the exercise of great caution in proceeding to the conclusion that the waters of the Ulsoor tank can be so filtered as to be rendered fit for drinking and cooking.

8. To Assistant Surgeon Nicholson's proposal, to have only a single main, using it for bath and horse water one day, and on the following day flushing the pipes and sending on the Dhobies' well-water for drinking, if due precautions could be taken, there seem to me no objections; nevertheless Government in Proceedings No. 1,413 of 18th May 1870 rejected that proposition when made by Deputy Inspector-General Ranking when Sanitary Commissioner, and as I fully recognize that accidents and neglects might occur and cause great injury, I am of opinion that Government, in rejecting this proposal to use one main, decided correctly

9. While awaiting further analysis and further reports effect may be given to some of the recommendations made by Assistant Surgeon Nicholson, with the object of improving the basin of the tank Its area has been diminished by encroachments; its depth has been shallowed by annual accumulations of silt, and the water-plants, so valuable aids in keeping tank-water clean, have been eradicated, and as he suggests the removal of the silt, fencing the tank, the prohibiting cattle grazing on the collecting ground, and the restoration of the fresh-water-plants, these recommendations might receive a favourable consideration.

Report on the relation between the Ulsoor Tank and the Dhobies' wells, Bangalore

Extent of Tank—I estimate the area of the Ulsoor tank to be not far short of 100 acres, exclusive of the marsh on the north-east, which, for several months in the year, forms part of the tank.

2 *Contents of Tank*—On April 15th, the water being three feet four and-a-half inches below the level when full, I found an average of about five feet of water, there being nine and-a-half feet in the deepest parts, one and-a-half feet in the shallowest, and at least six feet over by far the greater portion I estimate the contents on that date at about 570,000 tons, and the tank when full, including the reserve in the marsh at the north-east, must contain not less than a million tons of water. The present consumption by the troops (between 700,000 and 800,000 gallons monthly)

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amounts to about 40,000 tons *per annum*, so that this draught of water, about four inches, may be said to be practically without visible effect on the tank

3. *Wells round Tank* —Round the tank are numerous wells, deriving their supply principally from percolation through the bed of the tank. Those on the north and west are rather precarious, excepting the large well on the edge of the marsh, used by the Sappers and the inhabitants of St John's Hill, this well is apparently kept supplied by the under-ground reserves of the marsh. On the east the ground rises, but the wells in it give water at about a foot from the level of the water in the tank.

4 *The Dhobies' Wells* —On the south or rather the south-east percolation takes place more or less along the whole line of the bund, sparingly towards the south-western half or three quarters, where the soil is clay and disaggregated gneiss, but abundantly at the north-eastern end of the bund, where a triangular bed of ferruginous gravel, about 200 yards in side, allows the water to filter very freely The line of demarcation of this gravel bed is well defined, it extends into the new Dhobies' ground, where, in a series of seven wells, the water stand at five or at ten feet from the surface, according to the soil they are sunk in being within or without the gravel bed All over this gravelly patch of ground the water stays at a level of about six feet from the level of the water in the tank, falling regularly with it The following table, furnished me by Mr Smith, the Mechanical Engineer in charge of the Water-works, gives the comparative fall for the last four months —

Fall of water in the Tank and in the Wells

1871.	Level of Tank below sill of weir		Fall of Tank.	Fall of Dhobies' Wells
	Ft.	In.	In.	
January, 1st ...	1	0		
,, 7th ..	1	1½	1½	1½
,, 14th .	1	3	1½	1½
,, 21st ...	1	5½	2	2
,, 28th ...	1	7½	2½	2
February, 4th ...	1	9½	2	2½
,, 11th ..	1	11½	2	4
,, 18th ..	2	1½	2	3
,, 25th .	2	3½	2	3½
March, 4th	2	5½	2	3
,, 11th	2	5	½	3
,, 18th	2	8	3	3
,, 25th	2	10½	2½	3
April, 1st	3	0½	2	3
,, 8th	3	2½	2	3
,, 15th	3	4½	2	3
,, 22nd ...	3	6½	2	3
,, 29th	3	8½	2	1½
			32½	45½

The present draught of water, four to five thousand gallons of water daily, affects the wells but temporarily, the level reduced one and-a-half inches in the evening being nearly restored by the morning The steady pressure of the water causes a spring to ooze from the east side of the gravel bed into a nullah excavated by the rains

5. *Source of the Wells* —I have heard it stated that these wells are fed from springs at some miles distance up the Bederhully valley, but I cannot see any grounds for this theory, excepting inasmuch as the wells and tank have a common gathering ground there. Considering that the nearest well is not thirty yards from the foot of the tank-bund, not fifty yards from the tank-

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water, I cannot accept a theory which would make the well-water come from miles distant, passing under the marsh at the north-east of the tank, and under a piece of ground at the east of the tank, which, for ten months of the year, forms part of the tank, and is only separated in the dry weather by the foundations of a bridge.

The simple view that the water in the Dhobies' wells is simply filtered from the tank above them is supported by the relative composition of the waters They are nearer in composition than any two waters in the neighbourhood amongst those I have examined, and the filtration appears to be of the most direct character. I have made several analyses of these waters. I take the two last, the changes from earlier analyses are so trifling that their quotation would be useless; indeed, the tank-water does not differ materially from what it was in 1863 when I analysed a sample sent me by Dr. Ingles, P M O, British Troops

Analyses of Waters

[Note —The following analyses are stated on a different system from that which I should have to follow in my ordinary reports I am compelled to state them in this manner, as the form laid down for my ordinary reports would not give the information required]

Constituents	Ulsoor Tank taken from the filter, April 23rd	Dhobies' Wells, April 30th	Remarks.
	Grammes per litre		
Sodium	0379	·0393	Some potassium present.
Magnesium	0028	0052	As silicate
Calcium	0312	0228	As carbonate
Alumina and Ferric oxide .. .	0106	0034	As silicate
Chlorine	0355	0350	As sodium chloride
Sulphuric acid, SO_4	0040	0067	As sodium sulphate
Nitric acid	None.	None.	
Nitrous acid . . .	Minute traces	None.	
Phosphoric acid	Traces.	Minute traces	
Silica, SO_2 . ..	0231	·0365	As silicate of sodium, magnesium, and aluminum
Carbonic acid, CO_2	0468	·0342	As calcium carbonate
Oxygen for alkaline Silicates .	0073	0080	
	·1992	·1911	
Oxygen required to oxidize organic matter in 1 litre . ..	0007	0002	
	Empirical formula.		
Chloride of Sodium	0585	0578	
Sulphate of Sodium . .	·0059	0099	
Silicates of {Sodium, Magnesium, Aluminum. .}	0568	0664	
Carbonate of calcium	0780	0571	
	1992	1912	

6 *Difference between the Waters* —The difference presented by the water of the Dhobies' wells compared with that taken from the filtered water-basin at the water-works may be summed up thus ·—

Chloride of sodium and carbonate of calcium are the same. The silicates have slightly increased by addition of some silicate of magnesia and loss of some alumina and iron. The sulphate

was the measure of the possibility of [illegible]

of soda has slightly increased. The organic matter has decreased considerably Phosphoric acid has nearly disappeared having accompanied alumina and iron

These differences point to a good and rapid filtration, stopping organic matter with some alumina and iron, not stopping chloride of sodium and carbonate of calcium, the water gains some silica and magnesia (probably from the micaceous character of the filtering material), and also a trifling amount of sulphuric acid (perhaps from pyrites)

These differences are very trifling, and the total amount of mineral impurities is small compared with that usual in the water-supply of cantonments, these waters are surpassed perhaps only by the laterite waters of the western coast, or by good river-waters

7 *The Tank-water before filtration* —I have here been comparing the Dhobies' well-water with the tank-water after filtration, as before that operation the waters would bear little resemblance to one another

The tank-water contains a large quantity of fine sand and clay suspended, it would seem, by the mucilaginous properties of the conferval vegetation which abounds in it. This mixture of mineral and organic matters settles difficultly and clogs small filters. Tank-water in a glass vessel clears very slowly by rest; after five or six days the suspended matters begin to subside, the mineral matters go more or less completely to the bottom, whilst the mucilaginous matters subside much more slowly, leaving above them a gradually increasing layer of opaline water, it takes ten days for these matters to be entirely deposited There is no perceptible smell about the water, either fresh or after ten days in a bottle The vegetation is composed of masses of conferval filaments each terminated by an olivary body, probably a spore-case; these are readily detached (especially after a thunder-storm), and appear to swell up and burst, spreading a semi-soluble mucilage about the water The animal life visible is confined to an entomostracum, the water-flea, and a simple infusorial animalcule

Means of Purification —All this can be separated by proper filtration or clarification. The means available are—

1st —Filtration on a large scale, through several feet of sand, charcoal, etc.

2nd —Clearing by mechanical means.

3rd —Clearing by means involving an addition of some foreign matter.

The filtered water —The first process is that actually carried out at the works, and it is perfectly effective when properly done I must say that two months ago the filtration was very imperfect; but I put myself in communication with the Mechanical Engineer in charge of the Water-works, and thanks to the improvements he has effected—the filtration has become very good. It is not yet perfect; it cannot be as long as one of the two filters is thrown out of work for want of the trifling repairs necessary to stop a leak in it, and while all the work is done month after month by a single filter, but it is only a matter of detail to send the water to barracks in a perfectly clear condition. At present the water comes from the filter slightly opaline but sufficiently free from organic matter to be quite wholesome in that respect, and undergoing no conferval development by keeping. The quantity of organic matter indicated in it is not large except by comparison with the Dhoby well-water—a high standard of comparison It might, I consider, contain nearly twice as much before ceasing to be a good water, three times as much before being called a bad water

[NOTE —The Dhobies' well-water requires ·0002 grm. of oxygen per litre, the tank-water (filtered), 0007.

I reckon that water requiring less than 0004 is a very good water; more than 0004 and less than ·0011 a good water, more than 0011 and less than 0025 an indifferent water, more than 0025 and less than 0050 a bad water; more than 0050 is not often met with, it should be foul]

Absence of animal matters.—The total absence of nitric acid (if present, it is in less quantity than 1 part in 100 millions; 1 grain in 6 tons), the very minute quantity of phosphoric acid

present, both point to freedom from animal matters, the tank is doubtless contaminated by sewage, as every river is, but it is of little effect on such a mass of water and speedily disappears by oxidation, leaving little or no trace behind I cannot consider the conferval vegetation as at all harmful, and it can be totally separated by filtration, some mucilage arises from it causing the soluble portion of the organic matter found in the filtered water, but there is no reason to believe it harmful

Neglected state of the Tank — The great fault of the tank is the neglect into which it has fallen It has been encroached on in every direction, valuable land has been taken from it, reducing its area considerably; but I can see no traces of any care in compensating for this superficial curtailment by any attempt at deepening it, or even at preventing it from filling up Every rainy season brings down a quantity of silt and mud accumulating on the bottom, I should say, at the rate of three or four inches annually The weeds, which I believe formerly kept it clear, have been eradicated, and their place has been taken by low conferval vegetation I believe that if the entrances of the feeders were guarded by bulrushes (to act as silt-traps) wholesome water-plants introduced, water-fowl encouraged (as on the Miller's tanks in town), and the silt kept down by annual removal, the water would become clear again Other means of conservancy naturally suggest themselves, fencing and cleansing of the embankments and immediate gathering grounds, prevention of cattle being watered in the tank itself instead of at troughs, dredging up the mud, deepening by digging the parts exposed in the dry season

12 *Means of Clarification* —The water appears to be in great favour with natives from its softness They clear it with clearing nut I believe before using it for drinking.

The water is cleared very speedily by this means, but personally I do not like the taste of the water so cleared, a roughness is imparted which I do not like I prefer the water cleared by filtration or clarified either by electricity or by alum. I have already described the effect of filtration, the clarification is effected thus —

13 *Clearing by electrical action* —Iron by itself rusts easily in water directly a little rust has started electrical action, but the oxidation is much more rapid when the electrical action is excited by contact with an electro-negative metal zinc, copper, platinum Placed in contact with either of these, in a vessel of tank-water, the iron oxidizes rapidly and the bulky hydrated oxide carries down the suspended matters in a very effectual manner A convenient method of applying this principle is by simply letting the tank-water stand for 24 to 36 hours in a common zinc (galvanized-iron) pail, the iron is sufficiently exposed to oxidize rapidly in consequence of the zinc forming with it an electrical element The water purified thus is unexceptionable in appearance and taste, it contains but 1754 gramome of solid matters per litre, a portion of the calcium, aluminum, and silica having been carried down by the sediment

14 *Clearing by alum and lime* —Aluminum oxidizes in a similar way to iron when placed in a vessel of tank-water in contact with an electro-negative metal, a bulky precipitate of hydrated alumina is formed, which carries down the suspended matters This process is of course not adapted for practical use, but the same effect is produced by the action of alum (aluminum potassium sulphate), which, added to the water in a quantity of one part in 10,000, clarifies the water very effectually This process would be rather expensive on a large scale as one pound of alum would be required for a thousand gallons of water. Lime in the same proportion acts very effectually, and I regret that I have been prevented from trying its effect on a large scale owing to the useless state of one of the filtering basins.

15 *General observations* —It being a fact that the Dhobies' well-water, wherever derived from, is nearly identical with the Ulsoor tank-water as it runs from the filter, a question of economic importance arises, and I hope that I am not exceeding the limit of my duty in submitting a few observations thereon

The system of pipes now laid down to the four sets of barracks is very extensive, and it is worthy of consideration whether it is necessary, in order to supply drinking water to the troops, to incur the immense expense of a double system of pipes. If the tank-water were foul or unwholesome the case would be different, but the water is at present incapable of contaminating the pipes, and may by a little care be made as good as the water used for drinking Proper filtration

removes all objection to the pipes being used for the two kinds of water Setting apart this costly scheme, the following plans are available —

1*st* —To use nothing but the water from the Dhobies' wells for all purposes, sending it by the present system of pipes

The objection to this is that the wells now supplying four to five thousand gallons daily would be called on to supply upwards of thirty thousand gallons, or, when the water is laid on to the 21st barracks and the bakery, not less than fifty thousand gallons daily However well this might be done in the months when there is a good head of water in the tank above, I doubt very much if it could be kept up in the dry weather, and this limit, which there must be to the capabilities of the wells, would prevent further utilization of the system of pipes Moreover, I am assured that the small engine at the Dhobies' wells would be quite unequal to the task and the powerful engine at the water-works would have to be the greater part of the work, by means of a suction pipe laid on to it from the Dhobies' wells This plan involves a limitation of the water-supply, which, I think, would be a mistake

2*nd* —To pump up the filtered tank-water for the horse-lines, baths, etc , and Dhobies' well-water for drinking, cooking, etc.

This could be done on different days, and each barrack having two cisterns, no outlay is necessary. Before pumping up the Dhobies' well-water (which would be first pumped up to the rock by the small engine at the wells the pipes could be thoroughly flushed , though I have no doubt that the two waters will be practically undistinguishable in quality, and many a Cantonment in India would be glad to get for drinking a supply of such good water as is now pumped up to the baths in barracks I am credibly informed that the troops make practically no distinction, between the waters, little or no difference being perceptible either to the sight or the taste.

If this scheme were carried out, not only would no extra expense be entailed, but an actual economy be effected over the present expenditure Putting aside the economy from the abolition of the present system of puckallies, water-carts, etc , the water-works might be profitably employed in supplying water to the Municipality The proposed reservoir at the bakery might be made sufficiently large to supply the Municipality with water at a certain rate per thousand gallons, to be taken by their own pipes from the reservoir, and this sale of water would cover a considerable part of the present working expenses The advantage to the Municipality and the Cantonment generally is obvious

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

BANGALORE,
5th May 1871.

From the Deputy Inspector-General, Indian Medical Department, Mysore Division and Ceded Districts, to the Secretary to the Inspector-General, Indian Medical Department, dated Bangalore, 8th May 1871, No 151.

I HAVE the honour, with reference to your letter No 1,886 of 24th ultimo, to submit a report (in original) by Dr Nicholson upon the waters of the Ulsoor tank and Dhobies' wells.

2 By Dr Nicholson's analysis it is manifest that the filtered water of the tank must have much improved since it was last reported upon by the Chemical Examiner The method of analysis followed by Dr Nicholson differs materially from that adopted on former occasions, and I do not feel myself competent to offer any remarks upon it I would suggest that it be submitted to the Chemical Examiner for his opinion and report

3. Dr Nicholson States that the water of the tank is almost identical in composition with that of the Dhobies' wells, and from this fact and other circumstances noted in his report, concludes that the wells are supplied from the tank and not from a separate water bearing stratum, the difference in the waters being due to natural filtration through a ferruginous gravel

He further considers that the water of the tank is capable of being still further clarified by the "alum" or "lime" processes and that if thus cleared and filtered it will be as clear a water as hat furnished by the Dhobies' wells

But even in its present condition it is not considered to contain any injurious amount of organic matter of animal origin, and traces only of nitric acid as the result of oxidation of such matter

4. On these facts he bases certain economic recommendations, and especially that one and the same set of pipes be used for the distribution of both waters, thus saving the cost of laying down separate pipes for the Dhobies' wells scheme.

The Inspector-General may remember that in my report to Government in my late capacity as Sanitary Commissioner, upon the prevalence of typhoid fever at this state, I suggested the utilization of the same "main" for both schemes, but that the Government, in their Proceedings in the Military Department, of the 18th May 1870, No. 1,413, negatived my proposal The question on Dr Nicholson's analysis is perhaps deserving of reconsideration on economic grounds

5 Dr. Nicholson's report is a very important one, and if subsequent analyses support the conclusions he now draws, has a very important bearing upon the question of completion of the Dhobies' wells scheme

6 The Sanitary Commissioner having recently visited the station on purpose to look into the water-supply question, I submit, for the consideration of the Inspector-General, that it is very desirable that he and the Chemical Examiner at Madras should offer their views upon Dr Nicholson's report

The analytical results are so different from those previously recorded that the Chemical Examiner should, I think, test them on the spot by going through the entire analysis with Dr Nicholson, and thus settle a question upon which such different opinions have been expressed.

From the Chemical Examiner, to the Acting Inspector-General, Indian Medical Department, dated Medical College, 11th May 1871, No 111.

WITH reference to your Office Memorandum No. 2,221 of 10th instant, I have the honour to return, after careful perusal, the letter from Deputy Inspector-General, Indian Medical Department, Mysore and Ceded Districts, (No 151 of 8th May,) and Mr. Nicholson's report to which it refers

2. In paragraph 2 of Mr Ranking's letter he remarks that "the filtered water of the tank must have much improved since it was last reported on by the Chemical Examiner" No analysis of the filtered water of the Ulsoor tank (with a partial exception to be noticed presently) has been made in this Office within the last six years and-a-half The *Proceedings of Government, Public Department, 1st December* 1870, contain an abstract report of all water-analyses made by the Chemical Examiners from 1st October 1864 to 31st January 1870, including several examinations of Ulsoor water *taken from the tank* but none of filtered water.

3 About the end of 1869 the Ulsoor water as delivered at the barracks and therefore after filtration, was examined in this Office "with special reference to contamination with organic matter," with this result —

Oxygen for	Putrid matter . . .	0 00000
	Readily putrifying matter ..	0 04900
	Putrifying in 24 hours	0 23695
Chlorides		3 3 grains per gallon
Nitrates		Traces

As "the method of analysis followed by Dr Nicholson differs materially from that adopted on former occasions," comparison of the results given above with those stated on paragraph 5 of his report is unsatisfactory. He found *no* nitrates, whereas *traces* were found here He estimates chloride of sodium at 4 095 grains per gallon , the Chemical Examiner at 3 3 These differences do not seem very important For the reason just offered I am unable to compare his "oxygen" figures with those obtained here.

But the question of the possibility of so possessing the

4. Having already suggested the method of water-analysis which appeared to me best suited to the circumstances, I must decline to offer an opinion on that adopted on this occasion by Mr. Nicholson.

5 Analysis of water from some "Dhobies' wells" will be found in the report before referred to, but owing to the imperfect topographical information supplied to this Office, identification is very difficult, if not impossible

I shall only remark therefore that I learn with great surprise that the fact that a well, situated close to the edge of a large tank, derives its supply from that tank by percolation, and consequent filtration is looked upon as a new discovery of great importance.

6 I scarcely like to offer an opinion on the suggestion contained in the second clause of paragraph 6 of Mr. Ranking's letter, especially as the ground upon which it is based—the difference between Mr. Nicholson's analytical results and the Chemical Examiner's—has nearly disappeared. I may point out that generalized it amounts to a rule that whenever a Water Analyst obtains (or appears to obtain) results different from those found any time previously by any Chemical Examiner, the Chemical Examiner for the time being should leave his primary duties at the Presidency to proceed to the Mofussil and meet the Analyst in consultation To state such a proposition is enough

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From the Chemical Examiner, to the Acting Inspector-General, Indian Medical Department, dated Medical College, 20th June 1871, No 140.

In continuation of my letter No 126 of 1st instant, I have the honour to state that I have had no practical experience, beyond that of any Medical Officer, of the filtration of water for the use of troops, and that having never even seen the Ulsoor filtering works, I am quite unable to offer an opinion of any value upon steps to be taken for their improvement. It is obvious that if water which in its unfiltered condition has been repeatedly condemned, and one sample of which was reported to contain a considerable proportion of fœcal impurity, is to be supplied, after filtration, for the use of troops, no pains or expense can be considered excessive which may ensure efficiency in the process

2. The filtered water seems to me to be wholesome at present, as I have already stated It appears to me that if the filtration is rendered as efficient as possible the previous addition of lime to the water would be neither necessary nor desirable It would probably clear the water in some degree, and so relieve the filters, but the water being soft the hardness would probably be increased by the lime, and one of the few good qualities attributed to the water by previous analysts destroyed Examination of the Ulsoor water before and after the addition of lime would be desirable before deciding upon Mr Nicholson's proposals.

No 3,242

MEMORANDUM

To Assistant Surgeon NICHOLSON, M D, Analyst of Waters, Bangalore, for information and return

(By Order)

(Signed) G. BIDIE, M B,
Secretary, Inspector-General, Indian Medical Department.

Fort St George,
23*rd June* 1871.

From Assistant Surgeon E. NICHOLSON, R A, Analyst of Waters, Mysore and Ceded Districts, to the Secretary to the Inspector-General, Indian Medical Department, dated Bangalore, 1st July 1871.

I have the honour to return the enclosed letter* from the Chemical Examiner, and to express my gratification at his opinion as to the wholesomeness of the filtered water supplied to the Race Course Barracks from the Ulsoor tank I may state that the extra filter is about to be put into repair, so that there is every chance of the good quality of the water being not only kept up,

* No 140, 20th June 1871

but still further improved My suggestion as to liming the water was with a view of improvement, should the filtration not be considered satisfactory, but it would appear to be unnecessary With respect to the impurity of the unfiltered water, I think that the muddiness of the water has always produced a natural prejudice against it, and that the sample said to contain fœcal matter could not have been a fair specimen It is now three or four years since sewage has found its way into the tank, there is no trace now of its former presence, and the pursuance of conservancy measures will produce as great freedom from it as is possible in India The muddiness is common to all those tanks about Bangalore in which there are no water-plants I find several tanks out of Bangalore, and without suspicion of sewage contamination, of which the water is quite as opake as that of the Ulsoor tank, whilst these thick waters when filtered are much freer from organic matters than the clear waters of the tanks in which water-plants grow Thus the filtered water of Ulsoor tank requires but 0007 grm. of oxygen per litre for perfect oxidation, while the clear water of Miller's tank requires above 0040 grm

2 If the absence of anything unwholesome about the Ulsoor tank filtered water be accepted, two important economical plans present themselves with reference to the supply of drinking water for troops, which at present costs upwards of Rupees 400 per mensem for puckally hire

1*st* —The filtered water, as now pumped up, could be used for drinking after cistern filtration through animal charcoal. I think, however, that it would be just as easy to subject the whole of the water to a second filtration through animal charcoal before being pumped up I would submit, for consideration, whether this second filtration through 6 or 10 feet of animal charcoal would not remove any suspicion of impurity from the water, and render it perfectly fit for all purposes I am now engaged, in conjunction with the Mechanical Engineer in charge of the water works, in experimenting on the manufacture and application of the animal charcoal, and I anticipate that it can be made and applied at the works at a cost of not more than Rupees 20 or 30 per mensem Should it be deemed necessary small filters of a similar material could also be affixed to the pipes from which drinking water is drawn at barracks.

2*nd* —The Dhobies' wells would form a valuable reservoir of naturally filtered water in case of accident to the filters, as they could furnish from 10,000 to 20,000 gallons per diem for two or three weeks at a time This could readily be made available at a very small expense by laying a line of pipes from the Ulsoor engine to the nearest well (about 300 yards), the engine is only 14 to 18 feet, according to season, above the level of the water in these wells, and I am informed that there is no practical difficulty in the pumping.

The combination of these two schemes effected without expense, inasmuch as the puckallies now employed will be unnecessary, would enable the works to furnish upwards of 60,000 gallons of pure water per diem, double the present consumption, and sufficient for the wants of all the troops, European and native, in the Cantonment

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No. 326. From the Officiating Quartermaster-General, to the Officiating Secretary to Government, Military Department, dated Fort St. George, 20th July 1871, No. 4,852.

With reference to Order of Government, No 1,333, of 15th May last, directing that experiments should be tried to ascertain whether the Dhobies' wells at Bangalore could provide water sufficient for all ordinary purposes for the use of the European Troops at that station in connection with the Ulsoor water project now under the consideration of Government, I have the honour, by desire of His Excellency the Commander-in-Chief, to forward, for submission to Government, an original letter from Major-General Borton, C. B, Commanding the Mysore Division, enclosing a highly interesting report* from Assistant Surgeon Nicholson, R. A, Analyst of potable waters in Mysore and the Ceded Districts, on the water-supply for the

* With four bottles of water.

European Troops at Bangalore, and especially with reference to the water of the Ulsoor tank.

2. Sir Frederick Haines considers this is a very admirable report. It throws a flood of light on a very obscure subject, and seems to suggest a practical and economical method of arriving at a solution of the much-vexed question of the water-supply of Bangalore. This subject has been under His Excellency's consideration for the past six years, and he hails this report as the first rendered during that period which does not contain terms utterly condemnatory of the water of the Ulsoor tank as a source of supply for all purposes.

3. Lieutenant-General Haines would now suggest that the Medical authorities and the Sanitary Commissioner should be called on for their observations on Dr. Nicholson's report, and with the information which will then be available, it appears to His Excellency that Government will be in a position to decide definitively what system shall be adopted for completing the Bangalore water scheme.

From the Officer Commanding Mysore Division, to the Quartermaster-General, dated Bangalore, 18th July 1871, No 157.

With reference to the G Os marginally noted and a verbal report made by Assistant Surgeon Nicholson, R A, Government Analyst at the recent inspection of the Dhobies' wells by His Excellency the Commander-in-Chief, I have the honour to forward two reports, Nos 14 and 16, dated the 11th and 15th July 1871, respectively, from Assistant Surgeon Nicholson regarding the water in the Ulsoor tank

No	75,	dated	7th January 1870
„	30,	„	14th March „
„	1278,	„	18th May „
„	3,005,	„	12th Dec „
„	919,	„	28th March 1871
„	1,333,	„	15th May „

2 The four bottles of water alluded to in the report, dated 16th July, will be despatched to your address by this evening's train.

3 The report now made by Dr. Nicholson of the water of the Ulsoor tank differs so completely from all previous opinions expressed on this subject, that I cannot but think it very desirable the matter should be again submitted for the re-consideration of Government, as in the event of his views, in regard to the purity of the water, being accepted, a vast saving of expenditure in completing the water service from this source may doubtless be effected

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From Assistant Surgeon E NICHOLSON, R A, Analyst of Waters, Mysore and Ceded Districts, to the Assistant Quartermaster-General, Mysore Division, dated Bangalore, 11th July 1871, No 74.

I have the honour, in accordance with the request of the Major-General Commanding the Division, to forward the following account of the water supplied to the troops at this station

The Race-course and Royal Horse Artillery Barracks draw water for bathing, etc, as pumped up from the Ulsoor tank works for drinking, brought by puckallies from the Dhobies' wells

The European Infantry are supplied with water for bathing, etc., by puckallies from five wells north of the barracks near the Ulsoor tank; for drinking, by puckallies from the Dhobies' wells.

I have examined these sources with the following results —

1*st* *The Ulsoor Tank* —The Ulsoor tank contains an amount of water so great that the amount drawn at the water works does not affect it more than one-fourth of an inch per month.

The water is fawn coloured and quite opaque from a fine clay suspended in it, (as is the case with the water of all tanks in the neighbourhood of Bangalore that have no water-plants growing in them,) and it contains a considerable amount of conferval vegetation, which rises to the surface as a green scum.

Proceedings of the Madras Government, Public Works Department,
24th August 1871.

To separate these suspended matters several means may be employed · filtration through several feet of sand, etc, clearing by standing for some days (8, 10); clearing by standing in contact with two metals producing electrical action (two days), clearing by the addition of lime in suitable proportion, clearing by the addition of alum in suitable proportion, clearing by the effect of the clearing nut; The first of these is that now used, and though the water is not rendered so clear as by some of the other methods, the process of filtration is cheap and rapid. The filtered water has a more or less opaline appearance, caused by some clay so fine as to have escaped the action of the filter, some water-fleas -a harmless animalcule often found in good English water- also find their way through; but so free is the water from organic matter either suspended or dissolved that it keeps better than waters of far superior appearance Kept in a loosely stoppered bottle, the water never putrifies, it becomes perfectly clear, and no sign of vegetation takes place for more than a month.

As regards the matters in solution they are small in quantity and include nothing unwholesome Some chloride of sodium (4 grains), carbonate of lime (5½ grains), and silicate of magnesia and alumina (4 grains), form a total of 13½ grains per gallon of mineral solids, the organic matter is moderate, being about half, grain per gallon The organic matter appears to be of a purely vegetable origin; there are no nitrites, nitrates or ammonia, the usual evidence of sewage contamination

I am of opinion that the water, as supplied to barracks, is of great softness and quite free from anything unwholesome Good cistern or domestic filtration will remove the opaline appearance, which is the only drawback of the water.

2*nd* *The Dhobies' Wells* —The Dhobies' wells are supplied nearly entirely by percolation from the Ulsoor tank. A certain supply may possibly be derived from the high ground to the east of the tank, but the facilities for percolation afforded by the lateritic gravel which forms the bed of the tank at the south-east corner, and the nearly complete identity of the waters on analysis leave little doubt that the water of the Dhobies' wells is little also, but the Ulsoor tank-water filtered naturally through the laterite.

This water contains 13½ grains of mineral solids per gallon, the same as and nearly identical in proportion with those of the Ulsoor tank-water, the organic matter is much less, about one-tenth grain per gallon It is an excellent water, but not materially superior to that of the Ulsoor tank, as the organic matter of the latter, though larger, is well within the limits of good quality.

On the occasion of pumping the wells dry at the end of May, the water of these wells became turpid, owing, I believe, to the disturbance of a layer of sand by the weight of the engine-house built upon the ground. The water has not yet recovered its clearness

Bathing water of European Infantry —As the pipes from the water works now stop at the gate of the European Infantry barracks, water is procured from the wells at the north of the barracks near the Ulsoor tank. Four of these wells (the two moat-wells and the two smaller wells near them) have been all but dry during the last three months. The quality of the water in them is not very good at present, but this would probably be remedied by their being cleaned out before the wet season The bathing water puckallies resort principally to a fifth well close by (Municipal No 15), this well, though close to and of the same depth as the four others, always contains 10 feet of excellent water. (This well with that in Thopa Moodelly's compound and the old Native Cavalry moat well now used by the Sappers, afford water in abundance of quality little inferior to that of the Dhobies' wells) The water of this well might perfectly well be used for drinking purposes

Conclusion —That the troops have good water laid on to their barracks already, water which only requires efficient domestic filtration to be equal to that of the Dhobies' wells now carried to them at great expense

Recommendation —I have the honour to recommend the following measures, with the view of enabling the filtration at the water works to be kept up to a good standard, to rendering it by

domestic filtration equal in appearance to that of the Dhobies' wells, and to utilizing these latter as a secondary source of water and a reservoir in case of need.

1*st* *Filters and cisterns to be repaired* —The leaky filter at the works and the leaky cistern at the race-course should be put into repair. Both the clear-water cistern at the works and the cisterns at barracks require a light roof to keep off dust, etc , and prevent birds letting bones fall in (as they do at barracks).

2*nd* *Dhobies' wells to be connected with water works by a suction pipe* —The Dhobies wells should be connected with the engine at the water works by a line of pipes. (The difference of level is 14-18 feet according to season) The engine could thus draw water from these wells at the rate of 10,000 to 20,000 gallons per diem ; (this could, if necessary, be sent to a separate cistern from the tank-water). If a large elliptical well were made at the west corner of the Dhobies' well ground, the line of pipes would be shortened, and the daily supply would be increased.

3*rd*. *Extra filtration at Barracks* —But if the filtered tank-water be accepted as wholesome, it could be used simultaneously with the Dhobies' well-water for all purposes. It can receive an extra filtration through animal or artificial charcoal at the works, and be again subjected to domestic filtration at barracks by means of a filter attached to each stand pipe for drinking or cooking water The expense would not be much greater than the usual chatty filter. The first cost of cast-iron filters would be small, and the filtering material would be supplied from the works The filtering material I propose is either animal, (bone,) charcoal, or preferably a carbon brick which I make by calcining clay mixed with coal-tar ; the result is a friable brick so impregnated with finely divided carbon that it acts both as a mechanical and chemical filter. The water filtered through this is not distinguishable from the Dhobies' well water The cost of setting up this would be very small, about Rupees 50 would set up the carbon brick oven at the works, and Rupees 20 per mensem would suffice to keep the barrack filters in order.

4*th* *Water-plants to be introduced into Ulsoor Tank* —The muddiness of the Ulsoor tank being caused by the absence of water-plants, I would recommend that those plants which keep Miller's tank so perfectly clear should be introduced. I believe that the introduction of water-plants and water-fowl would soon clear away the present conferval vegetation. A bed of bulrushes across the shallow part of the tank about 100 yards from the entrance of the bazaar channel would also act as a silt-trap.

5*th*. *Conservancy of Ulsoor Tank*.—Stringent conservancy measures should be applied to the tank in order to remove possible objections to the water The compounds of officers require supervision much more than the gardens of natives A week or ten days ago the road between the Ulsoor end of the bund and the water works was nearly impassable owing to the disgusting stench arising from the compound of an officer on the west of the tank. This compound had been manured with what, from the stench, appeared to be putrid night-soil, creating a disgusting nuisance, and risking the contamination of the tank. Of course the nuisance was ascribed to the tank itself ; it is not the first time I have heard the tank accused of evolving smells which were entirely caused by the people living round it

I would recommend that no land within 100 yards of the tank on the north-east or west sides should be allowed to be manured ; but I think that market gardeners might not be interfered with, provided they undertook not to use night-soil or other offensive manure ; the manuring of grass land should be forbidden

Special notice should be taken of the outfall of the bazaar channel, which is liable to pollution (though, according to my observation, remarkably free from it). Several surface drains near the north-west head of the tank require diversion into the sewer.

The foreshores of the tank should be preserved as grass land, and no cultivation or excavation as are practised on the east side should be permitted. The conservancy of the compounds bordering the tank on the north (Sapper lines) should be inspected occasionally A water-trough might be provided at the foot of Saint John's Hill to avoid water-carts and cattle going into the tank

From Assistant Surgeon E. NICHOLSON, R A , Analyst of Waters, Mysore and Ceded Districts, to the Assistant Quartermaster-General, Mysore Division, dated Bangalore, 15th July 1871, No. 16.

In continuation of my letter No. 14, I have the honour to forward four samples of water taken by me this morning, illustrating the condition of the Ulsoor tank-water and the Dhobies' well-water respectively before and after their arrival at the Race-course barracks.

It appears from these samples that whilst the Ulsoor tank-water is always of good quality when supplied to barracks, (as the cisterns act as regulators checking any turpidity that may occasionally pass through the filters in their present incompleteness,) the Dhobies' well-water hardly superior even in appearance to the water filtered at the water works, is apt to become decidedly inferior in appearance after it arrives at barracks Notwithstanding all the supervision and expense entailed by the employment of puckallies to bring drinking water, this water is uncertain in quality, and on the average in no way superior to that laid on to barracks

I may observe that the water of the Ulsoor tank after filtration on the filter beds, now gets an extra filtration through 8 feet of animal charcoal before it is pumped up, and I have every reason to expect that the present high standard of purity will be kept up

I have not the slightest hesitation in saying that the water laid on to barracks might be used for all purposes, being perfectly free from anything unwholesome, and not liable to the objections on the score of uncertainty now attaching to the drinking water supplied by puckallies

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No. 327. ORDER THEREON, 24th August 1871, No. 2,178.

MILITARY WORKS, No. 6.

THE Government resolve to await Assistant Surgeon Nicholson's report on his analysis of the water of the Ulsoor Tank on the system suggested by the Chemical Examiner.

2. The Chemical Examiner will be requested to proceed to Bangalore with a view to analysing the water on the spot according to his own method both before and after filtration.

3. Until a definite conclusion can be arrived as to the quality of the filtered water, His Excellency the Governor in Council considers it advisable to defer passing any orders either as regards the Dhobies' Wells or the conservancy of the basin of the Ulsoor Tank.

(True Extract.)

(Signed) A. deC. SCOTT, Captain, R.E ,

Under Secretary to Government.

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

Public Dept.

Exd S T Augustin.

No 242

Office of Inspector General Hospitals

Fort Saint George 24th July 1871

From

The Acting Inspector General

Indian Medical Department

Fort Saint George

To

The Secretary to Government

Public Works Department

Fort Saint George.

Sir,

I have the honour to forward the marginal documents as noted for in No 131 of 17th Instant, being reports by Assistant Surgeon Nicholson, by Deputy Inspector General Ranking and by Surgeon Ranking, Chemical Examiner on the waters of the Ulsoor Tank and of the Dhobies' Wells.

2. These reports discuss two subjects, viz. the possibility of supplying the European Soldiers at Bangalore with pure water from the Ulsoor tank, or from the Dhobies' wells, and discuss also the means of conveying the required quantities of water. But the question of the possibility of so procuring the

* 1871, 5th May. Report on the relations between the Ulsoor Tank, and the Dhobies Wells of Bangalore.
" 8th May. Deputy Inspector General Ranking reports on Assistant Surgeon Nicholsons Report.
" 11th May. Chemical Examiner reports do do do
" 20th June. Chemical Examiner reports do do do
" 1st July. Assistant Surgeon Nicholson reports on letter of Chemical Examiner

Ulsoor tank water as to render it potable is still being inquired into by Assistant Surgeon Nicholson, and, before submitting the matter to Government, I would have preferred awaiting a further communication from that Officer, in order that my report on the questions involved might be complete. It will, however, be not without advantage to place before Government, now, a summary of all that has been hitherto done, with my opinion on the questions so far as they have been investigated.

3. Assistant Surgeon Nicholson reports, that the filtered Ulsoor tank Water, and the water from the Dhobies' wells are nearly identical, and he proposes to use, by one set of Water pipes — on the one day, sending along them the filtered water for the baths and horses, and on the following day, after flushing the pipes, sending on the Dhobies' well water for drinking and Cooking. He points out that the Area of the tank has been greatly encroached on, that its waters do contain sewage, mineral, Animal and Vegetable impurities, all of which, however can, in his opinion, be separated by filtration, and he thinks it would be Economical and that money could be made by supplying the Municipality with the filtered Water.

He also discusses the several available means of further purifying the filtered Ulsoor Water — by Electric Action, — by iron ore, — by lime — by alum — by the Water nut and by Animal Char-coal, and he is now Engaged in inquiring into the manufacture and application of the last named material.

Deputy Inspector General Rankin in forwarding the above, points out that Assistant Surgeon Nicholson's method of Analysis differs so materially from that adopted on former occasions, and the Analytical results are so different from those previously recorded, that he suggests the advisability of Obtaining the Chemical Examiner's opinion on the report. I accordingly referred it to the Chemical Examiner, who likewise points out, that Assistant Surgeon Nicholson had, in his Analysis, followed a different method from that formerly adopted; that the Chemical Examiner had formerly found nitrates, whereas Assistant Surgeon Nicholson finds none, and he declines to form an opinion on results obtained by Assistant Surgeon Nicholson, on the ground, that the latter had adopted a method different from that which the Chemical Examiner

had suggested.

In a subsequent report Surgeon Kirkpatrick observed, that as the Ulsoor tank unfiltered water had been repeatedly condemned and was once reported to contain foecal impurity, if the Water is to be supplied for the use of troops, no harm or expense should be considered excessive, which may ensure success in the process of filtration.

I then forwarded the Chemical Examiner's letter of 20th June for the observations of Assistant Surgeon Nicholson, when in his reply he assumed that Surgeon Kirkpatrick had in the 20th June letter indicated the wholesomeness of the filtered water, he mentions that, since three or four years, Sewage has made its way into the tank, that there is now no trace of Sewage, and that conservancy measures will produce as great freedom from it as is possible in India he also puts the question, whether the filtered water as now pumped up, cooled, after cistern filtration through 6 or 10 feet of Animal Charcoal, be used for drinking, and, in order to decide this point, he is experimenting as to the manufacture and application of that filtering material he mentions that the Dhobies wells, would always be a stand bye in the event of the filters failing, and that the two Schemes combined could supply 60000 gallons of pure water daily, sufficient for the wants of all the European and Native troops in Bangalore.

4. I have in the last paragraph, summarized the information given in the reports alike of Assistant Surgeon Nicholson, and of Deputy Inspector General Kirkpatrick and Surgeon Kirkpatrick. It will be observed, that the train of thought guiding Assistant Surgeon Nicholson in his investigations is to the effect, that as the "Dhobies wells are filled by percolation from the "tank, and their Waters, by natural filtration, "have been rendered comparatively pure, so, "with certain precautions, artificial filtration "ought to Effect a similar purification on the "waters of the Ulsoor tank;" and he considers that the requisite potable purity can be secured by a further filtration through Six or ten feet of Animal Charcoal, in Experiments on the manufacture and application of which he is now therefore Engaged. The question he propounds

is capable of being applied to by Chemical analysis, and it seems advisable that this should be waited for, because the Wilson's well nearest the tank is fifty yards distant from the water, and it requires to be proved that Six to ten feet of an Animal Charcoal filter will be equal to fifty yards of a ferruginous and clayey soil.

5. It is however to be regretted that Assistant Surgeon Nicholson's analysis has been conducted after a method so different from that Suggested by the Chemical Examiner, that the latter Officer has felt compelled to decline offering any opinion on that which Assistant Surgeon Nicholson has followed. I have therefore requested him again to analyse the filtered water, but on this occasion in the manner which the Chemical Examiner had suggested.

6. In mentioning this it is necessary to explain that there are at present two systems in operation for the Analysis of the organic matter in water, and it was remarked in a recent number of the Lancet, "that when "these two processes were applied to the same "Sample of water, they furnished opposite "results, and as both the authors of the processes "investigated the question of Water Supply, "they arrived at opposite conclusions", and, with Such widely different results obtained by the most distinguished Chemists in England and the Chemical Examiner so cautious that he even declines to give an opinion as to the method which Assistant Surgeon Nicholson has pursued in Examining the inorganic constituents, I think it necessary before allowing the soldiers to use the Ulsoor Water, either for drinking or Cooking and before any further Step be taken, to await the report on the Experiments Assistant Surgeon Nicholson is making with Animal Charcoal, and also to have his next analysis of the water made on the method Suggested by the Chemical Examiner, and likewise to have the tank water analysed at different Seasons of the year.

7. I know Bangalore, the Ulsoor tank and all relating to the drainage of the neighbourhood. In 1865 I carefully bottled some gallons of the tank water, which I

took up at the pools, and there and then sealed the bottles, and despatched them to Madras for analysis. The Ulsoor tank has been formed by damming up the lower part of a Valley, the higher part of which is occupied by the densely peopled native town, and by lines and barracks of several regiments. The physical configuration of that Valley and its occupation are such as to urge the exercise of great caution in proceeding to the conclusion that the Waters of the Ulsoor tank can be so filtered as to be rendered fit for drinking and Cooking.

8. As Assistant Surgeon Nicholson's proposal to have only a Single main, using it for bath and horse water one day, and on the following day flushing the pipes and sending on the Dhobies well water for drinking, if due precautions could be taken, there seem to me no objections, nevertheless Government in Proceedings No 1413 of 18th May 1870 rejected that proposition when made by

Deputy Inspector General Cunning when Sanitary Commissioner, and, as I fully recognize that accidents and neglects might occur and cause great injury, I am of opinion that Government, in rejecting this proposal to use one main, decided correctly

9. While awaiting further Analysis and further reports, Effect may be given to some of the recommendations made by Assistant Surgeon Nicholson, with the object of improving the basin of the tank. Its area has been diminished by Encroachments; its depth has been shallowed by Annual accumulations of Silt, and the water plants, so valuable aids in keeping tank Water clean, have been eradicated, and, as he Suggests, the removal of the Silt, fencing the tank, the prohibiting cattle grazing on the collecting ground and the restoration of the fresh Water plants, these recommendations might receive a favourable consideration

I have the honor to be
Sir
Your most Obedient Servant
Edward Balfour M.D.
Acting Inspector General
Indian Medical Department

P. R. 1871 No. 3523.

From.

The Officiating Chief Engineer Fort Division Bn. No. [illegible]

Dated 24th July 1871.
Rec'd 24th July 1871.
No. 242.
Enclosures. 5. (V)

To —

Forwarded Report on the relation between Ulsoor Tank & the Bhobies' Wells Bangalore.

25 —

Report on the relation between the Ulsoor Tank and the Bhobies' Wells, Bangalore

Extent of tank. I estimate the area of the Ulsoor Tank to be not less short of 100 acres, exclusive of the marsh on the N E, which for several months in the year forms part of the tank.

Contents of tank. On April 15th, the water being 3 ft. 4½ in. below the level when full, I found an average of about 5 feet of water: there being 9½ feet in the deepest parts, 1½ feet in the shallowest, and at least 6 feet over by far the greater portion. I estimate the contents on that date at about 57,000,000 tons, and the tank when full, including the reserve in the marsh at the N E, must contain not less than a million tons of water. The present consumption by the troops (~~about~~ between 700,000 and 800,000 gallons monthly) ~~0000~~ amount to about 40,000 tons per annum so that this draught of water, about 4 inches, may be said to be practically without visible effect on the tank.

Wells round tank. Round the tank are numerous wells, deriving their supply principally from percolation through the bed of the tank. Those on the North and West are rather precarious, excepting the large well on the edge of the marsh, used by the Sappers and the inhabitants of St. John's Hill; this well is

apparently kept supplied by the underground reserves of the marsh. On the East the ground rises, but the wells in it give water at about a foot from the level of the water in the tank. On the South or rather the S.E., percolation takes place more or less along the whole line of the bund sparingly towards the South western half or three quarters, where the soil is clay and disaggregated gneiss, but abundantly at the North eastern end of the bund, where a triangular bed of ferruginous gravel about 200 yards in side, allows the water to filter very freely. The line of demarcation of this gravel bed is well defined, it extends into the new Hobies Ground, where in a series of seven wells, the water stand at 5 or at 10 feet from the surface according to the soil they are sunk in being within or without the gravel bed. All over this gravelly patch of ground the water stays at a level of about 6 ft. from the level of the water in the tank, falling regularly with it. The following table, furnished me by Mr. Smith, the Mechanical Engineer in charge of the Water works, gives the comparative fall for the last four months.

The Hobies' Wells

Fall of water in the Tank & in the Wells.

1871	Level of tank before well of rock ft. in.	Fall of Tank inche.	Fall of Stotts wells
Jan. 1st	1. 0		
7	1. 1½	1½	1¼
14	1. 3	1½	1¾
21	1. 5½	2	2
28	1. 7½	2½	2
Feb. 4	1 9½	2	2½
11	1 11½	2	4
18	2. 1½	2	3
25	2. 3½	2	3½
March 4	2 5½	2	3
11	2. 5	+ ½	3
18	2. 8	3	3
25	2 10½	2½	3
April 1	3 0½	2	3
8	3. 2½	2	3
15	3. 4½	2	3
22	3. 6½	2	3
29	3 8½	2	1½
		32½	45½

The present drought of water, four to five thousand gallons of water daily, affects Wells but temporarily, the level, reduced 1½ inches in the evening, being nearly restored by the morning. The steady pressure of the water causes a spring to ooze ~~from the gravel~~ on the E side of the gravel bed into a Gulch excavated by the rains.

Source of the wells.

I have heard it stated that these wells are fed from springs at some miles distance, up the Beterhully valley, but I cannot see any grounds for this theory excepting inasmuch as the wells and tank have a common gathering ground there. Considering that the nearest well is not 30 yards from the foot of the tank bund, not 50 yards from the tank water, I cannot accept a theory which would make the well-waters come from miles distant, passing under the marsh at the NE of the tank, and under a piece of ground at the E of the tank, which, for ten months of the year, forms part of the tank and is only separated in the dry weather by the foundations of a bridge.

The simple view that the water in the 8 shallow wells is simply filtered from the tank above them is supported by the relative composition of the waters. They are nearer in composition than any two waters in the neighbourhood amongst those I have examined, and the filtration appears to be of the most direct character. I have made several analyses of these waters; I take the two best; the changes from earlier analyses are so trifling that fuller quotation would be useless; indeed the tank water does not differ materially from what it was in 1863 when I analyzed a sample sent me by Dr Inglis P.M.O. British Troops.

Analysis of Waters.

[Note The following analyses are stated on a different system from that which I should have to follow in my ordinary reports. I am compelled to state them in this manner, as the form laid down for my ordinary reports would not give the information required.]

Constituents	Allegan Gaol Water from the filter tap Mh 23rd	Shotter's Well Mh 30th	Remarks
	grammes per litre		
Sodium (& Potassium quantity not stated)	·0379	·0393	Some potassium present.
Magnesium	·0028	·0052	as silicate
Calcium	·0312	·0228	as carbonate
Aluminum & Ferric oxide	·0106	·0034	as silicate
Chlorine	·0355	·0350	as sodium chloride
Sulphuric acid SO_4	·0040	·0087	as sodium sulphate
Nitric acid	none	none	
Nitrous acid	minute traces	none	
Phosphoric acid	traces	minute traces	
Silica $Si O_2$	·0231	·0365	as silicate of sodium magnesium & aluminium
Carbonic acid CO_3	·0468	·0342	as calcium carbonate
Oxygen for alkaline Silicates	·0073	·0080	
	·1992	·1911	
Oxygen required to oxidize organic matter in 1 litre	·0007	·0002	
Empirical formula			
Chloride of sodium	·0585	·0578	
Sulphate of sodium	·0059	·0099	
Silicates of {Sodium magnesium aluminium}	·0568	·0664	
Carbonate of Calcium	·0780	·0571	
	·1992	·1912	

Difference between the waters.

The difference presented by the waters of the Blobie's Wells compared with that taken from the filtered-water basin ~~[illegible]~~ at the water-works may be summed up thus:—

Chloride of sodium and carbonate of calcium are the same.

The silicates have slightly increased by addition of some silicate of magnesia and loss of some alumina and iron. The sulphate of soda has slightly increased.

The organic matter has decreased considerably.

Phosphoric acid has nearly disappeared, having been accompanied alumina and iron.

These differences point to a good and rapid filtration stopping organic matter with some alumina and iron, not stopping chloride of sodium and carbonate of calcium; the water gains some silica and magnesia (probably from the micaceous character of the filtering material) and also a trifling amount of sulphuric acid (perhaps from pyrites).

These differences are very trifling, and the total amount of mineral impurities is small compared with that usual in the water-supply of cantonments.

These waters are ~~[illegible]~~ surpassed perhaps only by the Laterite waters of the Western Coast, or by good river waters.

The Tank-Water before filtration

I have here been comparing the Blobie's Well water with the tank waters after filtration;

as before that operation the waters would bear little resemblance to one another.

The tank water contains a large quantity of fine sand and clay, suspended, it would seem, by the mucilaginous properties of the conferval vegetation which abounds in it. This mixture of mineral and organic matters settles difficultly and clogs small filters. Tank water in a glass vessel clears very slowly by rest; after 5 or 6 days the suspended matters begin to subside, the mineral matters go more or less completely to the bottom, while the mucilaginous matters subside much more slowly, leaving above them a gradually increasing layer of opaline water; it takes 10 days for the ~~sediment~~ true matters to be entirely deposited. There is no perceptible smell about the water either fresh or after ten days in a bottle. The vegetation is composed of confervoid filaments each terminated by an ovary, or body probably of spore-cases, these are readily detached (especially after a thunder-storm) and appear to swell up & burst, spreading a semi-soluble mucilage about the water. The animal life visible is confined to an entomostracum, the water-flea, and a simple infusorial animalcule.

Means of Purification.

All this can be ~~cleared away~~ separated by proper filtration or clarification. The means available are:—

1° Filtration on a large scale, through several feet of sand, charcoal &c,

2° Clearing by mechanical means

3° Clearing by means involving an addition of some foreign matter.

The filtered water.

The first process is that actually carried out at the works, and it is perfectly effective when properly done. I must say that two months ago the filtration was very imperfect; but I put myself in communication with the Mechanical Engineer in charge of the water works and thanks to the improvements he has effected, the filtration has become very good. It is not yet perfect; it cannot be as long as one of the two filters is thrown out of work for want of the trifling repairs necessary to stop a leak in it, and while all the work is done by a single filter; but it is only a matter of detail to send the water to barrack in a perfectly clear condition. At present the water comes from the filter slightly opaline, but sufficiently free from organic matter and undergoing no confervoid development by keeping. The quantity of organic matter indicated in it is not large except by comparison with the Aldershot well water, a high standard of comparison. It might, I consider, contain nearly twice as much before ceasing to be a

good water, three times as much before being called a bad water.

[Note. The Okobji Well water requires ·0002 grm. of oxygen per litre, the tank water (filtered) ·0007 ... — — —
I reckon that waters requiring less than ·0004 is a very good water
more than ·0004 and less than ·0011 a good water
more than ·0011 and less than ·0025 an indifferent water
more than ·0025 and less than ·0030 a bad water
more than ·0030 must often meet with, it should be fond.]

Absence of animal matter.

The total absence of nitric acid (~~Nitrous~~ if present, it is in less quantity than 1 part in 100 millions, 1 grain in 6 tons) the very minute quantity of phosphoric acid present, tend to point to freedom from animal matters; ~~sewage contamination~~ the tank is doubtless contaminated by sewage, as every river is, but it is of little effect in such a mass of water and speedily disappears by oxidation leaving little or no trace behind ~~Report~~ I cannot consider the conferval vegetation as at all harmful, and it can be totally seperated by filtration; some mucilage arises from it, causing the soluble portion of the organic matter found in the filtered water, but there is no reason to believe it harmful.

Neglected state of the tank.

The great fault of the ~~tank~~ is the ~~the~~ neglect into which it has fallen. ~~It has been~~ It has been encroached on in every direction, valuable land has been taken from it reducing its area considerably

but I can see no traces of any care at compensating for this superficial entailment by any attempt at deepening it, or even at preventing it from filling up. Every rainy season brings down a quantity of silt and mud ~~accumulating~~ accumulating on the bottom I should say at the rate of three or four inches annually. The weeds which I believe formerly kept it clear have been eradicated, and their place has been taken by low conferval vegetation. I believe that if the entrances of the feeders were guarded by bulrushes (to act as silt-traps), wholesome water-plants introduced, and water-fowl encouraged (as on the Millers' tanks in town), and the silt kept down by annual removal, the water would become clear again. Other means of conservancy naturally suggest themselves; fencing and ~~cleansing~~ cleansing of the embankments and immediate gathering grounds, prevention of cattle being watered in the tank itself instead of at troughs, dredging up the mud, deepening by digging ~~digging out~~ the parts exposed in the dry season.

Means of Clarification.

The water appears blue in great favour with natives from its softness. They clear it — with clearing nuts I believe, before using it for drinking.

The water is cleared very speedily by this means, b
personally I do not like the taste of the water so clear
~~imparts~~ gives a roughness is imparted which I do not li
I prefer the water cleared by filtration or ~~by clari~~ clarifie
either by electricity or by alum. I have already
described the effect of filtration, the clarification
is effected thus:—

Clearing by electrical action.

Iron by itself rusts easily in water directly a lit
rust has started electrical action, but the oxidation
is much more rapid when the electrical action is
~~started~~ excited by contact with an electro-negative metal
zinc, copper, platinum. Placed in contact with ir
of these, in a vessel of tank water, the iron oxidiz
rapidly and the bulky ~~oxide~~ hydrated oxide carri
down the suspended matter in a very effective manne
A convenient method of applying this principle
is by simply letting the tank water stand for 24 to 3
hours in a common zinc (galvanized-iron) ~~pail~~
The iron is sufficiently exposed to oxidize rapidly
in consequence of the zinc forming with it an
electrical element. The water purified thus is
unexceptionable in appearance and taste; it contain
but ·1754 ~~grains~~ grammes of solid matter per litre, a
portion of the calcium, aluminium and silicia having
been carried down by the sediment.

Aluminium vitises in a similar way to iron when placed in a vessel of Clark's water in contact with an electro-negative metal; a bulky precipitate of hydrated alumina is formed, which carries down the suspended matter. This process is of course not adapted for practical use, but the same effect is produced by the action of alum, ~~basic sulphate of alum~~ (aluminium-potassium sulphate) which added to the water in a quantity of 1 part in 10,000, ~~forms a precipitate of alumina~~ clarifies the water very effectually. This process would ~~also~~ be rather expensive on a large scale as one pound of alum would be required for a thousand gallons of water. Lime, in the same proportion acts very effectually; and I regret that I have been prevented from trying its effect on a large scale owing to the useless state of one of the filtering basins.

Clearing by alum & lime

General Observations.

It being a fact that the Dublin Well water, as it comes from, is nearly identical with the Ulsan Canal water as it runs from the filter, a question of economic importance arises, and I hope that I am not exceeding the limit of my duty in submitting a few observations thereon.

The system of pipes now laid down to the four sets of barracks is very extensive, and it is worthy of consideration whether it is necessary, in order to supply drinking water to the troops, to incur the immense expense of a double system of pipes. If the tank-water were fetid or unwholesome the case would be different, but the water is at present incapable of contaminating the pipes and may by a little care be made as good as the water used for drinking. Proper filtration removes all objection to the pipes being used for the two kinds of water. Setting apart this costly scheme, the following plans are available: —

1° To use nothing but the waters from the Shorbie Wells for all purposes, sending it by the ~~present~~ present system of pipes.

The objection to this is that the wells now supplying four to five thousand gallons daily would be called on to supply upwards of thirty thousand gallons — or, when the new water is laid on to the 21st Barrack and the Bakery, not less than fifty thousand gallons daily. However well this might be done in the months when there is a good head of water in the tank above. I doubt very much if it could be kept up in the dry weather, and this limit, which there must be, to the capabilities of the wells, would prevent ~~limit~~ further utilization of the system of pipes

Moreover, I am assured that the small engine at the Shobra wells would be quite unequal to the task and the powerful engine at the Waterworks would have to do the greater part of the work, by means of a suction pipe laid on to it from the Shobra wells. This plan involves a limitation of the ~~capabilities~~ water-supply, which I think would be a mistake.

2° To pump up the filtered Nile waters for the horse-lines, baths &c, and the Shobra well waters for ~~purposes~~ drinking, cooking &c. This could be done on different days, and each barrack having two cisterns, no ~~extra~~ outlay is necessary. Before pumping up the Shobra well waters (which would be first pumped up to the Rock by the small engine at the wells) the pipes could be thoroughly flushed; though I ~~suspect~~ have no doubt that the two waters will be practically undistinguishable in quality; and many a cantonment in India would be glad to get for drinking a supply of such good water as is now pumped up to the baths in barracks. I am credibly informed that the troops make practically no distinction between the waters,

little or no difference being perceptible either to the sight or the taste.

If this scheme were carried out, not only would no extra expense be entailed, but an actual economy be effected over the present expenditure. Putting aside the economy from the abolition of the present ~~rate~~ system of pucka[illegible], water carts &c, the ~~engine~~ waterworks might be profitably employed in supplying water to the Municipality. The proposed reservoir at the Bakery might be made sufficiently large to supply the municipality with water at a certain rate per thousand gallons to be taken by their own pipes from the reservoir, and this sale of water would cover a considerable part of the present working expenses. The advantage to the municipality and the cantonment generally is obvious.

Bangalore.
5th May 1871

Edward Nicholson
Asst Surgeon Retd
Draftsman Public Works Dept &
Assistant Engineer

1871
5 May
Report on the relative
values of the Ulsoor Tank
& the Dhobie's Wells
Bangalore.

No. 151.

Office of the Insp.r Genl. of Hosp.s
Mysore Dist.n & Ceded Dists.
Bangalore 8th May 1871.

To,

The Secretary to the Inspector General
of Hosp.s Med.l Departt.
Madras.

Sir,

I have the honor with reference to your letter
No. 1866 of 24th Ultimo to submit, a Report* by Dr.
Nicholson upon the waters of the Ulsoor tank and
Dhobie's wells.

* in original.

2/ By Dr. Nicholson's analyses it is manifest that
the filtered water of the tank must have much im-
proved since it was last reported upon by the Che-
mical Examiner. The method of analysis followed
by Dr. Nicholson differs materially from that adopted
on former occasions and I do not feel myself compe-
tent to offer any remarks upon it. I would sug-
gest that it be submitted to the Chemical Examiner
for his opinion and report.

3/ Dr. Nicholson states that the water of the Tank
is almost identical in composition with that of the Dhobie's
Wells and from this fact and other circumstances noted in
his report, concludes that the wells are supplied from
the tank and not from a separate water bearing stratum
the difference in the waters being due to natural filtra-
tion thro' a ferruginous gravel.

He further considers that the water of the tank is
capable of being still further clarified by the "alum" or
"lime" processes and that if thus cleared and filtered
it will be as clear a water, as that furnished by the
Dhobie's Wells.

But even in its present condition it is not con-

=sidered

sidered to contain any injurious amount of organic matter of animal origine, and traces only of Nitric acid, as the result of oxydation of such matter.

/4./ On these facts he bases certain economic recommendations, and especially that one and the same set of pipes be used for the distribution of both waters, thus saving the cost of laying down separate pipes for the Pholoes Wells scheme.

The Inspector General may remember that in my report to Govt. in my late capacity as Sanitary Commissioner, upon the prevalence of Typhoid fever at this station, I suggested the utilization of the same "mains" for both schemes, but that the Govt. in their Proceedings in the Military Depart. of the 18th May 1870 — No. 1413 negatived my proposal. The question, on Dr. Nicholson's analyses is perhaps deserving of reconsideration on economic grounds.

/5./ Dr. Nicholson's report is a very important one, and if subsequent analyses support the conclusions he now draws, has a very important bearing upon the question of completion of the Pholoes wells scheme.

/6./ The Sanitary Commissioner having recently visited the station on purpose to look into the water supply question, I submit for the consideration of the Inspector General that it is very desirable that he and the Chemical Examiner at Madras should offer their views upon Dr. Nicholson's report.

The analytical results are so different from those previously recorded that the Chemical Examiner should submit test them on the spot by going thro' the entire analysis with Dr. Nicholson, and thus settle a question upon which such different opinions have been expressed.

J

I have the honor to be
Sir,
Your most Obedient Servant

J. Macnamara
Dy. Insp. Genl. of Hosps.
Mysore Dn. Head Qrs.

No 2221.

Memo

Referred to the Chemical Examiner for his observations & early return.

By order

Jul Selwyn
10 May
1871

Sec Insp Genl
Med

No 2150/1871

From The Dep. Insp. Genl. Med. Dept. Head Qrs.

To The Secretary to the Insp. Genl. Med. Dept.

Dated 8th
Despd 9th } May 1871

No 751. - Encls. 1

Subject.

Submits a report by Dr Muir, on upon the waters of the Mhow Tank and Pubnal Falls with observations.

P. R. 3523/71

Rec'd 10th May/71.

rence to contamination with or-
ganic matter", with this result —;

Oxygen for { Putrid matter 0.00000
Readily putrifying 0.04900
Putrifying in 24 hours 0.23695

Chlorides. 3.3 grs per gal.
Nitrates. Traces.

As the method of analysis follow-
ed by Dr Nicholson appears gener-
ally from that adopted on former
occasions", comparison of the re-
sults given above with those stated
on p. 5 of his Report is unsatisfac-
tory: He found no nitrates where-
as traces were found here. He es-
timates chlorides of sodium at
4.095 grs per gal. the Chemical Ex-
aminer at 3.3. These differences
do not seem very important.
For the reason just offered I am
unable to compare his oxygen fig-
ures with those obtained here.
4. Having already suggested the
method of water analysis which
appeared to me best suited to the
circumstances, I must decline
to offer an opinion on that adopt-
ed on the occasion by Mr Nich-
olson.
5. Analyses of waters from some
Dobbies Wells will be found in
the Report before referred to; but,
owing to the imperfect topogra-
phical information supplied
to this Office, identification of
the wells is impossible.

I shall only remark, therefore
that I learn with great surprise
that the fact that a well, situa-
ted close to the edge of a large
tank, derives its supply from
that tank by percolation and
consequent filtration, is looked
upon as a new discovery of great
importance.
6. I scarcely like to offer an o-
pinion on the suggestion con-
tained in the second clause of
para. 6 of Mr Rankine's letter, es-
pecially as the ground upon which
it is based — the difference between
Mr Nicholson's analytical results
and the Chemical Examiner's —
has in any case appeared. I may
point out that, generalized, it a-
mounts to a rule that whenever
a Water Analyst obtains, (or ap-
pears to obtain), results different
from those found anytime pre-
viously by any Chemical Exam-
iner, the Chemical Examiner
for the time being should leave
his primary duties at the Presidency
to proceed to the mofussil and
meet the Analyst in consultation.
To state such a proposition is enough.
I have the honor to be
Sir
Your most Obt. Servant
Henry Letheby AB, MB.
Medical College Chem. Exam.
May 1. 1871

No. 140

To The
Actg Surgl Genl & Sec'y
Fort St George

Sir,

In continuation of my Letter No. 126 of 1st inst. I have the honor to state that I have had occasional experience beyond that of any Medical officer here, of the filtration of water for the use of troops; and that I have given much attention to the Filtering Works. I am quite ready to offer any suggestion in my power that may appear likely to be taken for their improvement: the principal defect in which is, that if exposed to the sun, the filtered water becomes speedily contaminated, and one sample of which was reported to contain a considerable proportion of Local impurity, is to be supplied, after filtration, for the use of troops, & if any addition or expense can be considered excessive which may ensure efficiency in the process.

2. The filtered water seems to me to be wholesome at present,

No. 2201
1841

From
The Chemical Examiner
Madras.

To The Superintending Surgeon
Indian Medical Establishment
Neilgherry Hills

Dated 11th May 1841
Received 3rd May 1841
Answered 3rd June 1841
Ans. No.

Returns of Well Water
Report and Letter from
Dr Rainking on the
analysis of Water
in the Wallaw Tank
and Observations
with Remarks.

as I have already stated. It appears to me that if the filtration is rendered as efficient as possible the previous addition of lime to the water would be neither necessary nor desirable. It would probably clear the water more speedily, and so relieve the pipes; but the water being left, the hardness would probably be diminished by the lime, and one of the few good qualities attributed to the water by previous analysts destroyed. Examination of the Ilkley water before and after the addition of lime would be desirable before deciding upon the Corporation proposal.

I have the honor to be

Sir

Your most obed.

Henry Letheby

Chem. Exam.

Med. Coll.

June 20. 1871.

No. 3004 Enq.

1871

From

The Chemical Examiner
Madras.

To

The Ag Inspector General
I. Med. Department
Fort St George

Dated 20th } June.
Received 21st }

Enclosures. Two.

No 140

Remarks on the question of filtration of water of the Ulsoor lake.

P. W. 3523/71

No 3242

Memo

To Mr Surgn Nicholson MD
Analyst of Waters
Bangalore

For information & Return.

by order
Edwd Balfour Surgeon
Inspector General I.M.D
Fort St George
23 June 71

No

Bangalore 1st July 1871

From

Assistant Surgeon Nicholson, Analyst of Waters
Mysore & Coorg Districts

To

The Secretary to the Inspector General
Madras Medical Department

Sir,

No 140, 20th June 1871

I have the honour to return the enclosed letter from the Chemical Examiner, and to express my satisfaction at his opinion as to the wholesomeness of the filtered water supplied to the Race course and cantonments from the Ulsoor Tank. I may state that the extra filter is about to be put into repair, so that there is every chance of the good quality of the water being not only kept up, but even further improved. My suggestion as to lining the water race with a view of improvement should the filtration not be considered satisfactory, must I trust appear unnecessary. With respect to the impurity of the unfiltered water, I think that the muddiness of the water has always produced a natural prejudice against it, and that the sample sent Graham's fecal matter could not have been a fair sample. Three or four years since sewage has found its way into the tank; there is no trace now of its former presence, and the pursuance of conservancy measures will produce as great freedom from it as is possible in India. The muddiness is common to all those tanks about Bangalore in which

there are no water-plants I find several tanks out of Bangalore, used without suspicion of sewage contamination, of which the water is quite as opake, as that of the Ulsoor tank, while these thick waters when filtered are much freer from organic matter than the clear waters of the tanks in which water-plants grow. Thus the filtered water of Ulsoor tank requires but .0007 grm. of oxygen per litre for perfect oxidation while the clear water of Miller's tank requires above .0040 grm.

If the absence of anything unwholesome about the Ulsoor tank filtered water be accepted, these important economical plans present themselves with reference to the supply of drinking water for troops, which at present costs upwards of Rs 400 per mensem for puckally hire.

1° The filtered water as now pumped up could be used for drinking after cistern filtration through animal charcoal I think however that it would be just as easy to subject the whole of the ~~[illegible]~~ animal charcoal before being pumped up. I would submit for consideration whether this second filtration through 6 or 10 feet of animal charcoal would not remove any suspicion of impurity from the water, and render it perfectly fit for all purposes. I am now engaged, in conjunction with the Mechanical Engineer in charge of the Water-works, in experimenting on the manufacture and application of the animal charcoal, and I anticipate that it can be made and applied at the works at a cost of not more than Rs 20 or 30 per mensem. Should it be deemed necessary a small filter of a similar material could also be affixed to the pipes from which drinking water is drawn at barracks.

2° The Hobies wells would form a reliable reservoir of naturally filtered water in case of accident to the filters, as they could furnish from 10,000 to 20,000 gallons per diem for two or three weeks at a time. This could readily be made available at a very small expense by laying a line of pipe from the Ulsoor Engine to the nearest well (about 300 yards); the Engine is only 14 to 18 feet, according to season, above the level of the water in these wells, and I am informed that there is no practical difficulty in the

of all the troops European and native in the cantonment.

I have the honour to be
Sir,
Your most obedient Servant
Edward Nicholson
Ass Surgeon R.A.
Analyst Bombay Presidency Poona N.C.D.

Quarter Master General's Office
Fort St. George 20th July 1871

No. 4852

From
Colonel Arthur Hewlett
Offg Quarter Master General.

To
Colonel A.C. Silvas
Offg Secretary to Government
Military Department.

Sir,

With reference to Order of Government No. 1933 of 15th May last, directing that experiments should be tried to ascertain whether the Dhobie Wells at Bangalore could provide water sufficient for all ordinary purposes for the use of the European Troops at that Station in connection with the Ulsoor water project now under the Consideration of Government, I have the honor, by desire of His Excellency the Commander in Chief, to forward for submission to Government an Original Letter from Major General Burton C.B. Commanding the Mysore Division, enclosing a highly interesting report from Assistant Surgeon Nicholson R.A. Analyst

x with 4 bottles of water

No. 3200 Sanitary

From Surgeon Bell, Bangalore C.C.S.
To Lt. Col. Brooke, Sanitary Commr
Bangalore 1st July 1871

D.O. 35 of 71

Enclosures one

Report on samples of potable waters
By Mr. Assistant Surgeon Nicholson R.A.
Analyst Bombay Presidency

Analyses of Potable Waters in Mysore and of the Coded Districts on the water supply for the European Troops at Bangalore and especially with reference to the water of the Ulsoor Tank.

3. Sir Frederick Haines Considers this is a very admirable report. It throws a flood of light on a very obscure subject and seems to suggest a practical and economical method of arriving at a solution of the much vexed Question of the Water supply of Bangalore. This subject has been under His Excellency's Consideration for the past 6 years and he hails this report as the first rendered during that period which does not contain terms utterly Condemnatory of the water of the Ulsoor Tank as a source of supply for all purposes.

4. Lieutenant General Haines would now suggest that the Medical Authorities and the Sanitary Commissioner should be called on for their observations on Dr Nicholson's report and with the information which will then be available it appears to His Excellency that Government will be in a position to decide definitively what system shall be adopted for completing the Bangalore Water Scheme.—

I have the honor to be,
Sir,
Your Obedient Servant,

Colonel
Offg Quarter Master General

Head Quarters Mysore Division
Bangalore 18th July 1871.
No. 157.

From

The Officer Commanding
Mysore Division

To

The Quarter Master General
Head Quarters
Fort Saint George

Sir,

With reference to the G. O's mar-
ginally noted and a verbal
report made by Asst. Surgeon
Nicholson Re-Ag. Government
Analyst at the recent ins-
-pection of the Dholay Wells
by His Excellency the Com-
-mander-in-Chief, I have
the honor to forward two re-
-ports Nos. 14 and 16- dated the 11th and 15th July
1871 respectively from Asst. Surgeon Nicholson
regarding the water in the Nilson Tank-

2. The 4 bottles of water alluded to in
the report dated 16th of July will be des-
-patched to your address by this evening's
train-

3- The report now made by Dr.
Nicholson of the water of the Nilson Tank
differs so completely from all previous
opinions expressed on this subject that
I cannot but think it very desirable the
matter should be again submitted for
the re-consideration of Government, as in

No. 75 dated 7th January 1870
" 30 dated 14th March 1870
" 1278 dated 18th May 1870
" 3005 dated 12th Decr. 1870
" 919 dated 28th March 1871
" 1333 dated 15th May 1871.

Military Department.
Letter 18th July
24 - Govt. Nos 2354
& 2358
No. 3514.
From
The Quarter Master Genl
&c &c &c
To
The Chief Secretary to Government
Mily Department

Dated 28th July
Rec'd 29th July
Nos 22 & 23

Public Works Dept.
No. 1045.
Submits for Orders
Letter from Offg Consl
Engr Mysore dated 19th
July 1871 with 2 Encls.

Letter from Offg Consl
Engr Mysore dated 19th
July 1871 with 2 Encls.
No. 326.
Requests supply for the
Engineer Establishment
employed on Irrigation works.
Letter from Secretary
to Government
Public Works Department
No. 1045 dated 15th July 1871
with 2 Encls.

the event of his views, in regard to the purity of the water, being accepted, a vast saving of expenditure in completing the water service from this source may doubtless be effected.

I have the honor to be
Sir
Your most Obedient Servant
P. Porter
Brigr Genl
Commanding Brigade Division

No 74 — Bangalore 11th July 1871

From

Asst Surgeon C. Nicholson M.S.

Analyst to Waters Mysore & Coorg Districts

To

The Asst Dr Genl Mysore Division

Sir,

I have the honor in accordance with the requisition of the Major General Commanding that Division to forward the following account of the water supplied to the troops at this station.

The Race Course and B.H. at barracks draw water for bathing &c — as proposed up from the Ulsoor Tank and for drinking — brought by pack alleys from the Dhobie's wells.

The European Infantry are supplied with water for bathing &c — by pack alleys, from 5 wells at the barracks, near the Ulsoor Tank — for drinking — by pack alleys from the Dhobie's well.

I have examined these sources with the following results:—

The Ulsoor Tank — 1st The Ulsoor Tank contains an amount of water so great that the amount drawn at the water works does not appear it more than 1/4 inch per month.

The water is green coloured and quite opaque from a fine clay suspended in it (as is the case with the water of all tanks in the neighbourhood of Bangalore that have no water plants growing in them) and it contains a considerable amount of confervoid vegetation, which rises to the surface as a green scum.

To separate these suspended matters several means may be employed:—

Filtration through several feet of sand &c

Clearing by standing for some days (8–10)

Clearing by standing in contact with 2 metals producing electrical action (2 days)

1871 —

From the Officer in charge Analyses &c

To The Asst Dr Genl Mysore Division

Bangalore 3 July

Dated 18th July

Received 19th July

No 157.

Forwarding Cypher of Reports from Dr Nicholson Analyst on the waters supply & drains at this station together with 4 bottles & 1 tube of water from the wells and tanks mentioned therein & requesting that you will obtain renewed the weekly supply of water for the Hospitals from the contractor &c

Sd/ [illegible]

Lt & Adjt 22nd Regt

D.A.A.G.

Dated 25th July 1871

No 8888

1723
53

1. Cleaning by the addition of lime in suitable proportion.
2. Cleaning by the addition of alum do do
3. Cleaning by the effect of the cleaning mist.

The first of these is that now used and though the water is not rendered so clean as by some of the other methods the process of filtration is cheap and rapid. The filtered water has a more or less opaline appearance caused by some clay so fine as to have escaped the action of the filter, some matter gleaned (a harmless animalcule often found in good English water) also find their way through; but so fine is the water from organic matter either suspended or dissolved that it keeps better than waters of fair superficial appearance kept in a loosely stoppered bottle, the water never putrifies, it becomes perfectly clear and no sign of vegetation takes place for more than a month.

As regard the matters in solution they are small in quantity and include nothing unwholesome. Some chlorides of sodium (4 grs) carbonate of lime (5½ grs) and silicate of magnesia and alumina (4 grs) form a total of 13½ grains per gallon of mineral solids; the organic matter is moderate being about ½ grain per gallon. The organic matter appears to be of purely vegetable origin; there are no nitrates, nitrites or ammonia, the usual evidence of sewage contamination.

I am of opinion that the water as supplied to barracks is of great softness and quite free from anything unwholesome. Good cisterns or domestic filtration will remove the opaline appearance which is the only drawback of the water.

2. The Shalais wells are supplied nearly entirely by percolation from the Gleason Tank. It contains supply may possibly be derived from the high ground to E of the tank, but the facilities for percolation afforded by the lateritic gravel which forms the bed of the tank at the S.E. corner, and the nearly complete identity of the waters on analysis leave little doubt that the water of the Shalais wells is little else but the Gleason tank water filtered naturally through the laterite.

This water contains 13½ grains of mineral solids per gallon, the same as and nearly identical in proportion with those of the Gleason tank water; the organic matter is much less, about ½ grain per gallon. It is an excellent water, but not materially superior to that of the Gleason Tank, as the organic matter of the latter, though larger, is well within the limits of good quality.

On the occasion of pumping the wells dry at the end of May, the water of these wells became turbid, owing I believe, to the disturbance of a layer of sand by the weight of the Engine house built upon the ground. The water has not yet recovered its clearness.

Bathing water of Europ. Infantry.

As the pipes from the water works cease to stop at the Gate of the European Infantry barracks, water is procured from the wells at the N. of the barracks near the Gleason Tank. Four of these wells (the 2 most N. wells and the 2 small ones near them) have been all but dry during the last three months. The quality of the water in them is not very good at present, but this would probably be remedied by their being cleaned out before the wet season. The bathing water pickallies resort principally to a fifth well close by (municipal No. 15), this well though close to and of the same depth as the four others, always contains 10 feet of excellent water

water - (This well with that in Thopa Mudalai's compound and the old ornamental Cavalry moat well now used by the Sappers, afford water in abundance of good if little inferior to that of the Dhobies wells) The water of this well might perfectly well be used for drinking purposes -

Conclusion

That the troops have good water laid on to their barracks already; water which only requires efficient domestic filtration to be equal to that of the Dhobies wells, now carried to them at great expense -

Recommendation

I have the honor to recommend the following measures with the view of enabling the filtration at the water works to be kept up to a good standard, to rendering it by domestic filtration equal in appearance to that of the Dhobies wells, and to utilizing these latter as a secondary source of water and a reservoir in case of need -

1st The leaking filters at the works and the leaky cisterns at the Race course should be put into repair. Both the clear water cisterns at the works and the cisterns at barracks require a light roof to keep off dust &c and prevent birds letting bones fall in (as they do at barracks) -

Filters & Cisterns to be repaired

2d The Dhobies wells should be connected with the Filtering at the water works by a line of pipes (The difference of level is 14-18 feet according to season) The engines could thus draw water from these wells at the rate of 10,000 to 20,000 gallons per diem (this could if necessary be sent to a separate cistern from the tank water) If a large elliptical well were made at the N. E. corner of the Dhobies Well proved, the line of pipes would be shortened and the daily supply would be increased -

Dhobies wells to be connected with water works by a suction pipe

Extra filtration at barracks.

3d But if the filtered tank water be accepted as wholesome, it could be used simultaneously with the Dhobies well water for all purposes. It can receive an extra filtration through animal or artificial charcoal at the works and be again subjected to domestic filtration at barracks by means of a filter attached to each stand-pipe for drinking or cooking water. The expense would not be much greater than the usual chatty filter. The first cost of Castiron filters would be small, and the filtering material would be supplied from the works. The filtering material I propose is either animal (bone) charcoal or preferably a carbon brick which I make by calcining clay mixed with coal-tar; the result is a friable brick so impregnated with finely divided carbon that it acts both as a mechanical and chemical filter. The water filtered through this is not distinguishable from the Dhobies well water. The cost of setting up this would be very small, about Rs 50 would set up the Carbon bricks ovens at the works, and Rs 20 per mensem would suffice to keep the barrack filters in order -

Water plants to be introduced into Ulsoor Tank.

4th The muddiness of the Ulsoor Tank being caused by the absence of water plants I would recommend that those plants which keep Miller's Tanks so perfectly clear should be introduced. I believe that the introduction of water plants and water fowl would soon clear away the present confervoid vegetation. A bed of bulrushes across the shallow point of the tank about 100 yards from the entrance of the bazar channel, would also act as a silt-trap.

Inconvenancy of Ulsoor Tank.

5th Stringent conservancy regulations should be applied to the tank in order to remove possible objections to the

water

water. The compounds of officers require supervision much more than the gardens of natives. A week or ten days ago the road between the Ulsoor end of the bund and the waterworks was nearly impassable owing to the disgusting stench arising from the compound of an Officer on the W. of the tank. This compound had been manured with what, from the stench, appeared to be putrid night-soil, creating a disgusting nuisance and risking the contamination of the tank. Of course the nuisance was ascribed to the tank itself; it is not the first time I have heard the tank accused of evolving smells which were entirely caused by the people living round it.

I would recommend that no land within 100 yards of the tank on the N.-E. or W. sides should be allowed to be manured; but I think that market gardeners might not be interfered with provided they understood not to use night-soil or other offensive manure; the irrigating of grass land should be forbidden.

Special notice should be taken of the outfall of the Bazar Channel which is liable to pollution (though according to my observation remarkably free from it). Several surface drains near the N.W. head of the tank require diversion into the sewers.

The foreshores of the tank should be preserved as grass land, and no cultivation or excavation, as now practised on the E. side, should be permitted.

The conservancy of the compounds bordering the tank on the N. (Sappenlines) should be inspected occasionally.

A water trough might be provided at the foot of St. John's Hill to avoid water-carts and cattle going

going into the tank.

I have &c.

(Signed) Edward Nicholson Asst. Surgeon
Analyst of waters Mysore &c. &c.

Bangalore 15th July 1871

Asst. Surgeon E. Nicholson
Analyst of waters Mysore & Coded Districts

To

The Asst. Quarter Master General
Mysore Division

Sir,

In continuation of my letter of 14 I have the honor to forward 4 samples of water, taken by me this morning, illustrating the condition of the Ulsoor Tank water and the Dhobie's well water respectively before and after their arrival at the Race-Course barracks.

It appears from these samples that, whilst the Ulsoor Tank water is always of good quality when supplied to barracks, (as the cisterns act as regulators checking any turpidity that may occasionally pass through the filters in their present incomplete-ness), the Dhobies wells water, barely superior even in appearance to the water filtered at the water works, is apt to become decidedly inferior in appearance after it arrives at barracks. Notwithstanding all the supervision and expense entailed by the employment of pucka-allies to bring drinking water, this water is uncertain in quality and on the average in no ways superior to that laid on to barracks.

I have

I may observe that the water of the Filtration tank after filtration on the filter beds, now gets an extra filtration through 8 feet of animal Charcoal before it is pumped up, and I have every reason to expect that the present high standard of purity will be kept up.

I have not the slightest hesitation in saying that the water laid on to barracks might be used for all purposes, being perfectly free from any thing unwholesome and not liable to the objections on the score of uncertainty now attaching to the drinking water supplies by pack Mules.

I have &c

(Sd) Sidney Edward Nicholson

Asst Surgeon Royal Artillery

Analyst to Waters Bengal Presidency

True Copies

J. M. Beaumont Major

Assistant Adjutant General Bengal Army

P.W. 3514/71.
Bom. 24th Augt 1871 Ln. L 326 –

M.D.

Ld No 2287 of 1871

Bangalore
Water Supply.

91

It is right that upon
Surgeon Nicholsons Report
on and analysis of the
Waters of the Ulsoor Tank
should be received with
Caution and be subjected
to many possible test – but
a perusal of the Enclosed
Journals letter and of
the Chemical Examiners
Remarks fails to indicate
the to Abstract ought
from the value I am
myself disposed to
accord to Asst Surgeon
Nicholsons opinion
and operations.

As

Ltr to Govt
No 6888

As regards Para 5 of the Chemical Examiners Report to the A.P. Inspr. General of Hospitals 11th May/71 Surgn Wm. A Jephson C.B. Sanitary Commr will doubtless duly supply the most perfect topographical information regarding the sources from which all specimens of water submitted for analysis from that station have been drawn — rendering identification quite certain

Dy Asstt Commissy Genl
8th August 1871

I would await the result of Mr Nicholson's analysis of the water in the cystern presented by the Chemical Examiner which I understand has been already carried out & forwarded to Dr Balfour.

I would however also direct the Chemical Examiner to proceed to Bangalore and make his own analysis according to his own method on the spot of the water of the

9 Dec

Letters from the Acting Inspector Genl Indian Medical Department and Officiating Quarter Master Genl dated 24th and 20th July 1871 Nos 242 and 4852

In pursuance of the wish of His Excellency the Commander in Chief as conveyed in the Minute which will be found with the papers herewith circulated, the report of Assistant Surgeon Nicholson Analyst regarding the water of the Ulsoor Tank and

and the Dhobie wells were called for and these are now laid before Govt in the letter recorded above.

It will be observed that as Assistant Surgeon Nicholson's analysis has been conducted after a method different from that suggested by the Chemical Examiner the latter declines to offer an opinion, and that

about 7 ank both before & after filtration in search for careful is a matter which involves the expenditure of a large sum of money & the safety of the many lives. Until we can form a definite conclusion as to the quality of filtered water from the Tank I would give no orders either respecting the Dhobie wells or the cutting of the Bank

N.

A.

I.G.S

in consequence the Ag. Inspector General Medical Department, has requested Assistant Surgeon Nicholson to have his next analysis made in accordance with the suggestion of the Chemical Examiner, and he considers it advisable to await a further report on the subject. Meanwhile the Inspector General recommends that the proposals of Asst Surgeon Nicholson for

for improving the
basin of the tank
should be carried
out.

I have called on the
Superintending Engineer to
report what the whole
expense would be of
distributing basins
throughout the
Cantonment of Bangalore for the supply of the
Barracks during June
& July. I also called on
the Executive Engineer
to report what the whole
expense would be of
distributing basins
throughout the
Cantonment of Bangalore for the supply of the
Barracks during June
& July.

Para 9 of Inspector
Genl's letter.

Ellerton
Lt Col

Mr. Ellerton

No. 2178.

97

The Government
resolve to await Assistant
Surgeon Nicholson's report
on his analysis of the water
of the Ulsoor Tank on the
system suggested by the
Chemical Examiner.

The Chemical Ex-
aminer will be requested
to proceed to Bangalore
with a view to analysing
the water on the spot
according to his own
method both before
and after filtration.

Until a definite conclusion can be arrived as to the quality of the filtered water His Excellency the Governor in Council considers it advisable to defer passing any orders either as regards the Dhobies Wells or the conservancy of the Basin of the Ulcer Tank.

Aug 18/1

5 D

To the Insp Genl, 5" D/- ✓
1" ~~Acting~~ Public Dept. ✓
3" Chemical Examiner ✓
3" Principal Inspector General
Indian Med Dept. ✓
" Public Deptt ✓
" Asstt Genl Dept. 25 Aug 6/1
" 30 "
" 4/10/71

Govt of Madras. 1871

PUBLIC WORKS.

To The Superintending Engr. 5th Division

Dated

Recd

G 24 Augt No 2178

Nos. 325 & 327

...or Tank. Apl. Surgeon ...

...Coles's report on his analysis ...water of the Ulsoor tank, ...ted; the Chemical Ex- ...iner deputed to Bangalore ...e purpose of analysing ...water according to his own ...hod; Orders as regards ...Cholera Wells or the ...ruin[illegible] of the brain ...the Ulsoor tank, defere...