Local & Munl. (1897) Department.

INDEXED. CR

PRINTED

G.O., No. 2156 M.

DATED 2-10-97

DESPATCHED

[Despatch Abstract.]

Water-supply

Passing orders on the proposals of Mr Walch for the improvement of the ——— of Botanical Road.

## BACK PAPERS.

| G.O. | No. | Department. | Date. | G.O. | No. | Department. | Date. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## FURTHER PAPERS.

| G.O. | No. | Department. | Date. | G.O. | No. |
|---|---|---|---|---|---|
| | | | | | |

Fo 702 h 97-4-98 Rem 6

# Government {1897} of Madras.

## LOCAL AND MUNICIPAL.

*Recd.* — *Enclosures*

1897.

*Regd.* — *Spare copies*

**G.O., No. 2156 M., 2nd October 1897.**

## OCTOBER.

**Water-supply.**

Passing orders on the proposals of Mr. G. T. Walch for the improvement of the — of Ootacamund.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper:—

Endorsement, in the Public Works Department, No. 328 D., dated 25th May 1897.

*Read*—the following papers:—

From G. T. WALCH, Esq., to the Chief Engineer, Public Works Department, Madras, dated Ootacamund, 15th March 1897.

With reference to G.O., No. 298 W., dated 24th January 1896, and Mis. No. 689 M., dated 27th April 1896, I have the honour to forward the report, plans and estimates connected with the investigations carried out by me for the improvement of the Ootacamund water-supply.

2. In all these, correctness and clearness of record have been aimed at, so that any one who may have hereafter to deal with the scheme, or any part of it, may find what has been done ready to his hand and have no need to again go over ground which has already been covered. In connection with this I would draw attention to the "Note" at the end of the "Synopsis of Bench Marks"—Appendix F of the report.

3. I enclose the statement of remuneration claimed; it will be seen that in order to keep down the cost of the present investigations I have been careful to make use as far as possible, of all suitable work which I could find already done.

4. If the claim be approved, the total cost of the investigations will amount to Rs. 6,170 * approximately.

5. If any explanation or information in addition to what will be found in the report and plans be required, I shall be happy to give it as far as may be in my power.

6. The Chairman of the Ootacamund Municipality has from time to time furnished me with most useful information both from his own extensive personal knowledge and from the records of his office, and I would also acknowledge assistance received from the Sanitary Engineer on various points connected with the proposed new main.

7. The instruments, &c., lent for the work have been returned to the Public Works Department, and the furniture, surplus stationery and the various records (survey and level books, letter files, and so on) have been handed over to the Municipal office.

| | Rs. | |
|---|---|---|
| * Engineer's fee .. .. .. .. .. .. .. .. .. | 3,930 | |
| Establishment .. .. .. .. .. .. .. .. .. | 1,708 | |
| Sundries and contingencies .. .. .. .. .. .. .. | 532 | Approximate. Some charges not yet paid. |
| Total .. | 6,170 | |



Enclosure.

## Report on the Ootacamund Water-supply Improvement.

### I.—PRESENT SOURCES OF SUPPLY.

The piped supply of Ootacamund is now derived from the following sources:—

(1) Marlimund Reservoir.

1. This is formed by an earthen embankment thrown across a stream which flows from the Tudor Hall Estate, Gayton Park Estate, and adjacent lands, and runs down the Anikorai valley to the Moyar.

2. The natural catchment basin of the reservoir has an area of about 272·15 acres, of which 196·60 acres are private and 75·55 acres Government and Municipal property. Of the 196·60 acres of private land about 84·64 acres are cultivated, chiefly with tea, but several acres of this are so neglected as to appear as if abandoned.

3. Besides the run off from the natural catchment basin, that from nearly 200 acres on the slopes of the Snowdon range is brought to the reservoir by means of open catch channels, pipes, and a masonry conduit.

4. The water spread of the reservoir when full (18 feet above its outlet pipe) is rather over 18 acres, and its capacity is 9,870,138 cubic feet, of which, however, 1,150,130 cubic feet lie below the outlet pipe, leaving 8,720,008 cubic feet, or 54½ millions of gallons, above that pipe.

5. From this reservoir all the portion of Ootacamund north of the Lake and shown in pink * on the accompanying map (scale 6″ to 1 mile) is supplied or will be supplied when an intended extension along the Segoor road is carried out. The population of the whole of this portion of the settlement is now a little over 10,000, but it is considered that before long it will at times amount to 12,000. For this number at 20 gallons a head per diem the full reservoir holds a supply for upwards of seven months, even if during that period the evaporation and soakage be only just compensated for by the discharge of springs and rainfall run off.

6. When this reservoir was constructed its water was declared unexceptionable, but this is no longer the case owing, it is supposed, to (*a*) manure used in the cultivation which drains into the reservoir and (*b*) the presence in the bed of the reservoir of a large quantity of peat. The latter is considered to be by far the more serious evil of the two, indeed the Sanitary Commissioner Surgeon-Lieut.-Colonel W. G. King has gone so far as to say "whatever steps be taken as to the catchment area, as long as the water is received there, it must be considered unfit for human consumption" and he advises "the abandonment of this reservoir completely."

See page 226 of Minutes of Proceedings of the Sanitary Commissioner for second quarter of 1894.

7. The Sanitary Board, however, came to the conclusion that this reservoir "cannot be totally abandoned," but that "all water passing from it be filtered."

See its Proceedings No. 2286, dated 14th July 1895, which are printed in Part II of this report.

(2) The Spring above Old Ooty.

8. With reference to this, the Sanitary Commissioner remarks (see paragraph 9 of his inspection notes, page 224 of minutes of proceedings of Sanitary Commissioner, second quarter 1894), that of all the sources of the Ootacamund supply this "alone presents the character of a correctly protected supply. It is derived direct from a spring which is enclosed at its point of exit from the earth and is distributed by pipes. The collection of this spring is ingeniously effected by a miniature infiltration gallery suggested by Mr. Nery, the Municipal Engineer."

* A junction with the pipes of the system *South* of the lake was made in 1892 at the "Willow Bund."

and levels of the site have been taken. The Board believe that, if the reservoir is thus extended and another reservoir (to be hereafter referred to) constructed, it will be possible to limit the use of water from the Marlimund to a somewhat insignificant amount.

(4) Marlimund, however, cannot be totally abandoned, as some of the higher houses on Church Hill must still continue to be supplied from it, and the Board therefore recommend that all water passing from it be filtered and a compensating or service reservoir will also be necessary. On the subject of filtration advised, the Board is prosecuting enquiries as to feasible methods for dealing with the large quantity of vegetable matter in the water. As to this a separate report will in due time be submitted.

(5) The Board accompany the proposals for the extension of the Snowdon reservoir with their expression of opinion of the necessity for protecting the reservoir from approach by walling and fencing, for removing the godown of Snowdon House, and for securing by means of intercepting channels and otherwise that none of the drainage of any of the surrounding basin in which the reservoir is be admitted into the reservoir unless from a perfectly clean and unpolluted area, the reservoir not in any way being dependent on its own basin for its supply. The Board also recommend the diversion of the Marlimund road along the east side of the reservoir as extended.

(6) The Board recommend that the existing north and south supply channels be bricked or lined with concrete, that the overflows be done away with as far as possible and one overflow only provided above the inlet to the Snowdon reservoir or the pipe leading to Marlimund, and that the site of the channels be increased, if necessary, to carry the maximum flow off the catchment areas.

(7) The Board further recommend the extension of the south supply channel as proposed by Mr. Ellis, Acting Sanitary Engineer, in his memorandum in reference to G.O., Mis. No. 839 M., dated 6th July 1894, viz., recutting the old supply channel from O. to N. so as to include the area, coloured green—see plan No. 4 of the accompanying plans—whence the water would find its way down the stream H. and thence by the existing channel to Snowdon; the Government House channel to be permanently cut off (it has already been done so temporarily). The Board do not consider that any other of the works proposed by Mr. Ellis in his memorandum referred to are under the present proposals of the Board necessary and would alone recommend the examination and repair where necessary of the culvert from Snowdon House to Marlimund from which apparently a large quantity of water must be lost by leakage.

(8) The effect of the above proposals would be that a new reservoir would be obtained with a supply to it from a fairly unpolluted area and an additional amount of storage would thus be secured. It is not intended that water should be passed from Marlimund to Snowdon reservoir even after filtration, but that it be delivered into the pipe below the latter reservoir, or it may be that an additional main from the latter may be necessary if Marlimund has to be retained for the higher houses on Church Hill, &c.; this however is a detail to be hereafter considered, if the recommendations of the Board as a whole receive the approval of Government. The surplus from the reservoir at Snowdon would be passed to Marlimund and no more water passed over its escape wier than is absolutely necessary for the safety of the reservoir.

(9) The Board further recommend that a new reservoir be formed in the Kodapamund valley just below the junction of the three streams coming from the saddle and from that place of Dodabetta further west. The construction of this reservoir will involve the acquisition of a few market gardens, and about eight dhobies' huts adjacent to the site of the proposed bund (these were only lately built) must be removed.

(10) The Board believe that this and the proposed Snowdon reservoir will give all the storage capacity required to serve a much increased population through any years of severe drought such as have lately occurred.

(11) It is considered that, when these new reservoirs are made, it will be advantageous to limit the supplies from each to certain areas of the town, thus, for



instance, from Marlimund to as limited an area as possible on the higher contours, from Snowdon to the middle contours and the upper portions of the bazaars, and from Kodapamund to the houses in that valley near Charing Cross, Government House road, and along the lake on the north side generally, and in this view the distribution pipes may require slight re-arrangement, but in such manner that, from higher supplies, it may always be possible to supplement the lower or from the lower to such of the higher contours as they can command.

(12) In regard to the Dodabetta reservoir, which supplies the south side of Ootacamund, the Board do not consider that any expensive alterations are required. An examination ought to be made of the lower reservoir and remedies suggested against its silting, as it does at present; its capacity might probably be slightly increased. By properly considered planting on the slopes of Tiger stream, the silt at present brought down might be reduced or by scour valves, and the supply to the reservoir might be increased by catching more of the water which at present eventually finds its way to Burnfoot lake.

(13) The Board are averse to cutting off any of the area of the upper reservoir, but if arrangements can be made to cut off the tea area and include an equal or greater area, this should be done; this however is a question which demands detailed enquiry (Dr. King dissents—see note attached).

(14) It is evident that, if the proposals of the Board meet with the approval of Government, the work of preparing plans and estimates to carry these proposals into effect will require the services of a highly qualified officer for a considerable period; there are many points in connection with the various proposals made, which demand very careful study and investigation before satisfactory designs can be prepared and details decided on.

(15) The Board therefore recommend that the municipal council should be advised to approach Mr. Walch (late Chief Engineer for Irrigation), who is now resident in Ootacamund and who has a very full knowledge of the question to be dealt with, in view to securing his services.

(16) The Board are informed that the council have already arranged to provide a sum of Rs. 2 lakhs for carrying out the improvement of the water supply and drainage. This sum is not likely to cover all the expenditure necessary, and the Board therefore trust Government will see its way to supplement that sum by whatever amount may be necessary, so that once for all the supply to Ootacamund may be placed on a satis factory basis. Any less complete measures than those proposed, the Board consider, would be temporary and ill-advised, and therefore strongly recommend that the improvements be taken up at once and made full and complete. The Board believe that any other course will lead in the end to much greater expenditure than if their proposals are accepted and the work carried out as a whole.

21. These suggestions of the Sanitary Board may be thus summarized—

(*a*) Partial abandonment of the Marlimund Reservoir; the improvement and extension of its supply channels from the Snowdon slopes; the filtration of all the water passing out of the reservoir;—paragraphs 1 to 8.

(*b*) The formation of a supplemental reservoir at the Snowdon Ponds or just below them;—paragraphs 3 and 5.

(*c*) The formation of a new reservoir in the Kodapamund Valley just below the junction of the three streams coming from the Saddle and from that part of Dodabetta further west;—paragraphs 9, 10 and 11.

(*d*) The improvement of the purity of the supply of the Dodabetta Reservoirs and the prevention of the silting up of the lower one;—paragraphs 12 and 13.

## III.—INVESTIGATIONS NOW CARRIED OUT, PROPOSALS NOW MADE, AND ESTIMATES SUBMITTED.

22. In dealing with the investigations carried out in accordance with G.O., No. 689 M., dated 27th April 1896, it will be convenient to follow the proposals of the Sanitary Board, as far as they go, in the general order of the above summary.

## (4) Marlimund Reservoir.

23. As was expected, the investigations have failed to find any site for a reservoir for the supply of Ootacamund, comparable with that of Marlimund as regards capacity or area of catchment basin. With only 18 feet depth of water it holds, as already stated, 54½ millions of gallons, or upwards of seven months' supply for 12,000 persons at 20 gallons per diem, and it draws its supply from some 469 acres which it is proposed to increase by about 59[1] acres.

| | Acs. |
|---|---|
| Its natural catchment area .. .. .. .. | 272·00 |
| Snowdon *North* Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 .. .. | 174·24 |
| Snowdon *South* Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 .. .. | 23·00 |
| Total .. | 469·24 |

[1] Paragraph 13 of Mr. Ellis' memorandum.

24. It is also no small advantage in connection with this reservoir that it lies in a valley which slopes *away* from Ootacamund, so that in the event of its ever bursting there would be no such loss of life and valuable property as would be the case were it in the Ootacamund water-shed.

25. It is certain that the occasional insufficiency of the reservoir has been due to the imperfect arrangements for taking to it the supply from a large part of its gathering ground, that along the Snowdon slopes. This may be remedied as recommended in paragraph 6 of the Sanitary Board's report, by lining the catch channels with masonry; for doing this the plans[2] and estimates[3] now submitted provide, as also for the extension[4] recommended in paragraph 7 of the Board's report.

[2] Nos. 3 and 4.
[3] Rs. 23,900.
[4] Plan No. 5.

26. If these be carried out there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year.

27. The Sanitary Board is right in considering that the "other works[5]" proposed by Mr. Ellis in his memorandum referred to are not necessary. They were arrived at on the basis of a "run off" of ½ inch in one hour, but this was probably merely a mistake, and certainly a run off of not more than one inch in *24 hours* need be provided for, which the present pipe and conduit are sufficiently large to deal with.

| | Rs. |
|---|---|
| *(c) Laying an additional pipe from K to F .. | 4,000 |
| (*d*) Enlarging masonry conduit from E to F .. | 8,220 |
| (*e*) Laying additional pipe from F to G .. | 69,000 |
| (*f*) Enlarging masonry conduit from G to Marlimund lake .. .. .. .. | 57,060 |
| Total .. | 1,38,280 |

28. That these are now so out of order, as supposed by the Board,[6] that "a large quantity of water must be lost by leakage" between Snowdon House and the Reservoir, does not appear to be the case. The Conduit has not been uncovered, but no signs of leakage from it could be detected even when it was carrying a large quantity of water during the last north-east monsoon, and the estimates now submitted do not therefore provide anything for repair of this work.

[6] Paragraph 7 of its Proceedings.

29. As regards the Filtering of the water passed out of the reservoir, this has been already thoroughly gone into as will be seen on reference to the documents noted[7] below, and plans[8] and estimates have been prepared by the Sanitary Engineer which are incorporated with those now submitted. But in addition to the arrangements provided for by the

[8] Nos. 6, 7, 8 and 9.

See letter No. 2370, dated 13th December 1896, with Chief Engineer's endorsement No. 9-C., dated 4th January 1897, Appendix B.

[7] No. 1697, dated 17th August 1893, from the Sanitary Engineer.
Note by the Chief Engineer, Public Works Department, dated 2nd October 1893.
No. 2544, dated 24th November 1893, from the Sanitary Engineer.
Endorsement of Chief Engineer, Public Works Department, No. 862, dated 1st December 1893.



Sanitary Engineer, the Sanitary Commissioner is strongly of opinion that before passing the water into filter beds it should be subjected to the action of "Anderson's[1] revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter[2] from the Agent for the patent in this country, which will be found as Appendix A to this report.

[1] See pamphlet herewith.

[2] No. 45, dated 21st January 1897.

30. The estimated cost of all these filtering arrangements is Rs. 66,000.

31. As regards the *defilement of the water flowing into the Marlimund Reservoir from cultivation*, there can be little doubt that the only effective way of dealing with it, is to acquire all the private lands in the catchment basin, and every day that this course is deferred will add to its cost, because the value of land in and about Ootacamund is increasing, and the cultivation is being extended. It is thought inadvisable in the estimates now sent to deal with the value of the lands in question but the statement Appendix C will give the information on which any provision it may be considered advisable to make can be based.

## (5) Suggested Reservoir near Snowdon House.

32. In paragraphs 3 to 5 of its proceedings the Sanitary Board proposed an "extension of the Snowdon Reservoir" or the construction of "a new dam some 200 feet lower down the valley." The term "Reservoir" here applied to what may better be named the "*Snowdon Ponds*", is likely to be misleading to those who do not know the circumstances of the case; those ponds are not connected with the Ootacamund pipe system and therefore do not form any reservoir for it.

33. Surveys and levels have shown that the valley below the site of the ponds is too steep and narrow for a storage reservoir, but a small useful one might be made at a moderate cost by raising and extending the bund of the lower pond so as to hold up water to 15 feet above its present level and incorporating it, and the other pond also, in the reservoir so formed.

34. The Survey[3] plan and sections connected with this will be found with the other plans, but no estimate is sent, because it has been finally decided [see letter[4] No. 36, dated 20th November 1896, to the Chief Engineer, Public Works Department and his reply No. 9-C, dated 4th January 1897] that, as recommended[5] by the Sanitary Board, the water supplied from the Marlimund Reservoir must be filtered, and there is no place for the required filters and service reservoir except this Snowdon Ponds site; see the documents referred to above, in paragraph 29 dealing with "Filtering."

[3] Plan No. 2 (2 sheets).

[4] Appendix B.

[5] Paragraph 4 of its Proceedings.

## (6) Kodapamund Valley—Suggested Storage Reservoir. Proposed Pipe-Head, and supply from it.

35. Much time was spent on surveys[6] and levels in connection with the suggestion (paragraph 9 of the Board's Proceedings) for a storage reservoir in this valley as it seemed an excellent one, but after all, the idea had to be given up because the valley proved so steep and contracted that no safe earthen bund could be constructed high enough to make a storage reservoir of a capacity at all commensurate with the great cost of acquiring the whole of the highly cultivated gardens and all the houses lying *above* it, as well as in its water-spread, and their acquisition would be absolutely necessary as they are sources of great pollution. The absence of rock for foundations would prevent the construction of a masonry dam at the place.

[6] Plans Nos. 11 and 12 (2 sheets).

36. But though the formation of a storage reservoir in this valley is out of the question, the adoption is strongly recommended of a scheme for utilizing the small perennial stream of beautiful water flowing into the valley from the western slopes of Dodabetta, which was worked out by Mr. Nery, Municipal Engineer in 1893, and approved by the Sanitary Engineer (see his No. T-187, dated 29th September 1894).

37. This scheme consists in forming a Pipe-Head[1] Cistern, by means of a masonry dam 15 feet high on the stream in question, well above all sources of contamination, and from it taking the water by pipes for the use of some 600 persons in the villages of Kodapamund and Vannarpetta, and the European houses lying along both sides of the Kelso road. These though they pay water-tax have now no water laid on to anywhere within their reach, but a few of them get a supply by means of an open channel from a stream known as "Sudukadu," *i.e.*, "burning ground," because its sources flow past a Hindu cremation place.

[1] See plans Nos. 10, 13 and 14.

38. As the scheme was worked out by Mr. Nery and his estimate is now used, except as regards the masonry dam for which a fresh design[2] and estimate are now prepared, his detailed description of the scheme is attached to the estimate.

[2] Plans Nos. 13 and 14.

39. The total estimated cost is Rs. 11,800.

### (7) Existing Dodabetta Reservoirs.

40. The cutting off of the tea area referred to by the Board[3] is not feasible. That area, as will be seen from the statement which forms Appendix D, is only 12 acres (including $\frac{1}{2}$ acre of fruit trees) and no extension of cultivation is in progress. There does not appear to be any manuring carried on, and from the analysis of the water given in paragraph 18 it would seem that the cultivation is not now causing contamination; it should however most certainly be acquired especially, as will be seen further on, it will also affect the proposed new Tiger-hill stream reservoir.

[3] Paragraph 13 of Proceedings.

41. To prevent cultivation being started on the other private lands ($45\frac{3}{4}$ acres) in the catchment basin of these reservoirs, those lands should also be acquired, which probably might now be effected at a moderate sum.

42. When this has been done and the "undergrowth and humus" in the sholas have been dealt with as recommended in paragraph 2 of the Board's Proceedings, the supply to these reservoirs will be of a quite unexceptionable quality.

43. The silting up of the Lower Reservoir may certainly be somewhat retarded by the means suggested in paragraph 12 of the Board's Proceedings, but the reservoir is of little consequence for storage and its life at best can be but short. This being the case, the increase of supply to it is of no moment and, as will be seen further on, the stream from which such increased supply would have to be brought it is proposed to utilize in feeding a new reservoir; the surplus from that however will still be available for taking into the Lower Reservoir if needed.

### (8) Proposed New Reservoir.

44. The Snowdon and Kodapamund valley sites not being available, as explained above, for the required storage reservoir supplemental to that of Marlimund, it became necessary to fix on some other site, and after careful examination of all apparently possible places it was ascertained that there was none with anything like the advantages of that shown on plans 15 and 16, which may be clalled the "Tiger-hill stream site."



45. It lies in a valley *out* of the Ootacamund water-shed, it has a catchment basin of large area, including that of the existing Upper reservoir, the surplus of which it can receive, and remarkably free from cultivation or possible sources of contamination; it is at such a level as to command the highest houses in Ootacamund; and there is rock for founding a masonry dam on, admitting of a structure high enough to form a really capacious reservoir.

46. The position, catchment area, water-spread, capacity, &c., of the proposed reservoir are clearly shown on plans 15 to 21 but for convenience these particulars, with others, may be here briefly stated.

47. *Position.*—On the stream which flows at the back of "Tiger-hill" and through the Craigmore Forest Reserve, at about 1,100 feet further up that stream than where it impinges against the upper corner of the *Lower* Dodabetta reservoir; and about 750 feet due south of the *upper* reservoir.

48. *Catchment*[1] *Area.*—The natural catchment area is 100 acres, which at a small cost may be increased to $108\frac{3}{4}$ acres. Of this less than 24 acres are private property and only 1·85 acres is under tea cultivation, so that the acquisition of all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that[2] of the existing upper reservoir would by means of a channel[3] provided for in the estimates, be available whenever that reservoir is full, and for a large part of the year it surpluses nearly the whole of the run off. A run off of 1 inch in 24 hours from the whole combined catchment area of 242 acres would fill the reservoir in a little over 5 days.

[1] See Appendix E.
[2] About 134 acres.
[3] See plans 16 and 18.

49. *Capacity.*—With 40 feet depth above the outlet pipe, as designed, the available quantity of water retained in the reservoir would be approximately 30,387,500 gallons, or sufficient at 20 gallons a head per diem for upwards of 4 months supply to 12,000 persons, that being the number to be provided for (see paragraph 5) on the north side of the lake, and it is for that portion of Ootacamund, it will be understood that the reservoir is specially proposed. It will therefore be generally capable of entirely taking the place of the Marlimund reservoir for several months in the year, though its drainage area is not sufficient to permit of its being solely trusted to; the Marlimund reservoir must still, it is believed, be depended on to make Ootacamund quite free of any danger of deficient supply at any time.

50. *Character of the water.*—The water of the stream on which the reservoir will be constructed is of great purity as shown in the following analysis by the Chemical Examiner to Government of samples taken just above the site for the dam:—

Water from the Craigmore Block Stream.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total solids | .. | Grms. per litre | .. | .. | .. | .. | .. | 0·040 |
| Volatile solids | .. | do. | do. | .. | .. | .. | .. | 0·020 |
| Chlorine | .. | do. | do. | .. | .. | .. | .. | 0·001 |
| Total hardness | .. | .. | .. | Clark's scale | .. | .. | .. | Trace. |
| Permanent hardness | .. | .. | .. | do. | do. | .. | .. | Trace. |
| Free ammonia | .. | Mlgrms. per litre | | .. | .. | .. | .. | Trace. |
| Albumenoid ammonia | | do. | do. | .. | .. | .. | .. | Trace. |
| Nitric acid | | do. | do. | .. | .. | .. | .. | 0·064 |
| Apparent quality of the water as inferred from the results obtained on examination | | | | | | (as Ammonia) | | Trace. Pure and wholesome. |

Remarks.—A first-class water.

The water to be brought from the existing Dodabetta Upper Reservoir is also of excellent character (see paragraph 18) and may be still further improved by the means recommended in paragraphs 40 to 42.

51. *Swamp in the bed.*—It will be noticed in plan No. 16 showing the water-spread of the proposed reservoir that there is in it a swamp of about $1\frac{1}{2}$ acre in extent. In this pits have been sunk and have shown it to be composed of vegetable soil about 8 feet in depth, portions of it being composed of imperfectly formed peat. It is not thought that this is a serious drawback to the site, but as judging from the

opinions expressed in connection with the Marlimund Reservoir, it may be considered so, it is deemed proper to bring the matter to notice. In few parts of the world can valleys which are at all flat be found without vegetable soil in their beds, and most certainly none will be found near Ootacamund which have not also a mixture of peat more or less perfectly developed.

52. It may be possible by desiccation, or some other means, to so deal with the swamp before the reservoir is brought into action and it is covered with water, as to destroy or neutralize any deleterious elements in the soil, but if this is not practicable, then rather than it should cause the rejection of this excellent site for the reservoir, the whole of the offending soil had better be removed, though this would be an expensive operation, and the disposal of the spoil on the steep hill sides above the water-spread would be a somewhat difficult matter. It should be noted that the design provides by means of a large 'scour-pipe,' for laying the bed of the reservoir dry at will.

53. The total estimated cost of this reservoir exclusive of any compensation for private land it may be decided to acquire in its catchment basin is Rs. 47,400.

54. As regards the conveyance of the water of the new reservoir to, and its distribution over, the area, the present supply of which it is intended to supplement, there are two systems which may be adopted; one that of keeping the new supply entirely separate, the other that of joining it on to the existing main above where it branches off into its distributing pipes and so making use of *them*. In either case the new main must be taken for 10,375 feet to Charing Cross, but in the former system there would from that point be required some 39,000 feet of new distributing mains, whilst in the latter system, 3,716 more feet of the new main itself would take the water to the existing[1] main from which it would be distributed by the present pipes. The latter arrangement is so greatly the cheaper, and, it is believed, so much the better, that it is recommended for adoption and the estimate Rs. 38,600 has been framed accordingly.

Plan No. 22 (3 sheets.)

55. The lowest point—Charing Cross—to which the new main will have to descend is rather more than 600 feet below the outlet pipe of the reservoir, and as so great a head would necessitate an unusual thickness of pipes for some distance, it is proposed to put a "break-pressure" tank just below the Dodabetta Lower Reservoir reducing the head by nearly 100 feet; even with this reduction the pressure when the "reducing-valve" (to be mentioned further on) is closed, or partially so, will give an ample command of the houses[2] that now lie above the influence of the present system, and also of the houses which will doubtless before long be built along the proposed new road.

[2] Shedden House and Hall. Farley. Prospect Lodge. Wrex Hurst, &c.

56. The supply thus given to the high level houses may possibly not be free from occasional failure, but this would rarely occur with proper arrangements in bringing the Marlimund Reservoir into use for the parts of the system commanded by it, before the new reservoir was run dry.

57. The "break-pressure" tank abovementioned would be 193 feet higher than the outlet pipe of Marlimund Reservoir and 226 feet above the existing main at the proposed point[3] of junction of the new main, but of this 175 feet would be absorbed by the fall required to give the required discharge through the proposed 6 inch pipe. It is however advisable (as recommended by the Sanitary Engineer when consulted on the subject) to put a "pressure-reducing valve" on the new main near the junction.

[3] The "Sump" above St. Stephen's Church.

[1] The length of the existing main from the Marlimund reservoir to the 'Sump' where the junction will be made, is 10,445 feet.



58. As it is considered necessary that half the 240,000[3] gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332[4] gallons per minute, a 6-inch diameter pipe will have to be used. This will be laid for the first 1,100 feet along the left bank of the Tiger-hill stream and then across, or round, the Lower Dodabetta reservoir, just below which the "break-pressure" tank will be placed; thence the pipe will run along the track of the existing main of the *South system* to near Walthamstow corner on the Coonoor road, and from there it will follow that road to Charing Cross where a 'wash-out' valve with pipe to the stream will be provided. From Charing Cross it will run along Church-hill road to near St. Stephen's gate and thence along the road and path beside the eastern boundary of the church enclosure direct to the "Sump," where the junction with the existing main will be made with a "pressure-reducing valve." No private land will have to be acquired for the pipe track.

[3] 12,000 × 20.

[4] This is exclusive of the 14 cubic feet per minute required between Walthamstow corner and Charing Cross, see next paragraph.

59. As the pipe passes along the Coonoor road from Walthamstow corner to Charing Cross, water can be taken from it to the houses along that road and "Old Ooty" road for the supply of which from the *South system* (which it will be well to relieve of the duty) an estimate of Rs. 6,300 has lately been prepared by the municipality and approved by the Sanitary[5] Engineer. Of that estimate Rs. 5,200 are for the arrangements connected with the main pipe, the necessity for which the main now proposed will supersede. The quantity of water to be supplied to the houses, &c., now under consideration is 10,000 gallons per diem and this the proposed main can easily carry in addition to the 240,000 gallons which it has to take on, as above explained.

[5] See his letter 122, dated 20th January 1897.

60. It may be noted that it will be easy, and cost but a small sum to put the new main into connection with that of the *south system* either at the Lower Dodabetta reservoir or near Walthamstow corner, if this should at any future time be considered advisable.

### (9) "Old Ooty" Supply.

61. This requires improvement of the infiltration arrangements by surrounding the upper cistern with broken stone and gravel through which the water will pass to open jointed or perforated pipes. This will cost so little that it need not be entered in the estimates herewith, but may be carried out from ordinary Municipal Maintenance grants.

62. It is however also very advisable that the portion of Survey field No. D/267-A shown on plan 15 enclosed in dotted red lines and containing an area of about 9 acres should be acquired and enclosed to prevent the present considerable fouling of the sources of the springs. The greater part of the ground to be acquired is very steep and quite unfitted for building sites and is at present waste, though there are signs of portions of it having been cultivated with potatoes or vegetables. The probable cost of "compensation" is not entered in the present estimates (see paragraph 31).

### (10) General Summary of Proposals.

63. The proposals made and estimates submitted are—

| | | Rs. |
|---|---|---|
| (*a*) To line the existing Snowdon channels with masonry and bring more water to the Southern one by diversion of a stream above Government gardens (Paragraphs 25 to 28.) | | 23,900 |
| (*b*) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site (Paragraphs 29 and 30.) | | 66,000 |
| (*c*) To construct a Pipe-head reservoir on the Kodapamund Valley stream (Paragraphs 35 to 39.) | | 3,740 |

| | | Rs. |
|---|---|---|
| (*d*) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta .. .. | Paragraphs 38 and 39. | 8,060 |
| (*e*) To construct a new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger-Hill .. .. .. | Paragraphs 44 to 53. | 47,400 |
| (*f*) To carry the water from the new reservoir to the '*Sump*' on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | Paragraphs 54 to 60. | 38,600 |
| (*g*) To acquire the private lands lying in the catchment basins of the Marlimund reservoir, Dodabetta reservoirs, and proposed new reservoir, and also about 9 acres of survey field No. D/267-A in connection with the "Old Ooty" supply .. .. .. .. .. .. .. .. | Paragraphs 31, 40, 41, 48, 62. | No estimate. |
| Total .. | | 1,87,700 |

64. It is confidently believed that if these recommendations be carried out Ootacamund will have a never failing supply of excellent water.

Ootacamund,
8*th March* 1897. (Signed) G. T. WALCH, M.I.C.E.

## APPENDIX A.

From S. CRANSHAW, Esq., Municipal Engineer, Agra Municipality, to G. T. WALCH, Esq., M.I.C.E., Ootacamund Water Works, dated Agra, 21st January 1897, No. 45.

The reply to your No. 57 of the 15th instant, I have much pleasure in giving you the information asked for—

For 300,000 gallons in 24 hours a revolver with 7-inch inlet pipe costing £450 F.O.B. London would be sufficient but I would in order to be prepared for an increase of consumption recommend you to have one with 8-inch inlet pipe costing £525 F.O.B. London. This would deliver 402,370 gallons per 24 hours with 3½ minutes contact. The driving power for this sized revolver would be 9,880 foot pound per minute or, say, ⅓ H.P. no staff is required as after the revolvers are started, they work on with the exception of oiling the bearing without any attention.

The floor space required is 19′ × 8′. The charge of iron punchings required is 14 cwt. which at Rs. 4 per cwt. would be Rs. 56 and the annual quantity of punchings for renewals with a 3-lac delivery would be about 36 cwt. The price I have given does not include the water pipes to and from the revolver or belting for driving same, but includes driving gear fitted with fast and loose pulleys, cast-iron pedastal bearings for cylinder and foundation bolts. The cost of freight and landing charges you will be able to work out for yourself.

My annual maintenance charges on 3—10-inch revolvers passing an average of 1½ million gallons daily is about Rs. 500.

Trusting the above will be satisfactory.

*P.S.*—If you have not steam-power available arrangements can be made to drive it by bullock-power.

## APPENDIX B.

From G. T. WALCH, Esq., M.I.C.E., Ootacamund Water Works, to the Chief Engineer, Public Works Department, dated Ootacamund, 20th November 1896, No. 36.

As I anticipated,* I have failed to find any site for a reservoir which will render the abandonment of the Marlimund reservoir as the main storage for the supply of Ooty advisable, it would however be possible to make a useful little supplementary reservoir at the site of the Snowdon ponds.

* See paragraph 3 of my letter, dated 23rd November 1895, printed with P.M.G., No. 298-W, dated 24th January 1896.

2. That site however will be required for filter beds and service reservoir if filtration of the Marlimund reservoir water be decided on (see note of Acting Chief Engineer, Public Works Department, dated 2nd October 1893, No. 3299-C, and reply of the Sanitary Engineer to Government, dated 24th November 1893, No. 2544), and I therefore request that I may be informed of the decision in the matter.



*Dated Madras, 4th January* 1897.

Letter from the Sanitary Commissioner for Madras, No. 2370-S., dated 13th December 1896.

With reference to your endorsement No. 4683 of the 8th December 1896, I have the honour to state that having regard to the chemical composition of the Marlimund water, which is the natural sequel of its mode of collection and especially of the character of the reservoir, and to the existence within its catchment of human habitations, I am of opinion that it would be sanitarily erroneous for a town of sufficient importance to demand municipal government, and still more so for a town boasting of being the sanitarium of Southern India, to permit delivery to the consumer of such water without an effort to alter its chemical composition, and guard against its possible bacterial contamination. In other words, if the full benefit of expenditure upon collection, storage, and distribution is to be reaped by the inhabitants, it can only be secured by taking these additional precautions.

2. I know of no method that will meet these combined requirements so thoroughly as by arranging in the first place to subject the water to the action of iron in Anderson's revolvers, and subsequently deliver it upon the ordinary type of public water works sand filter beds, fitted with all modern appliances for charging the beds with filtered water before starting, for regulating the fitler speed, and allowing facilities for separate bacteriological examination and the rejection of unsatisfactory filtrates without disturbance of individual beds The motive power required for the revolvers is small. But if the provision of this small power be regarded as offering difficulties, the next best, but in my opinion inferior, method would be the use of polarite combined with sand filtration.

3. Water of this character might instead of either of the above methods be advantageously dealt with, as in the case of sewage, by subjecting it to filtration through porous gravel land and re-collecting it by means of wells and sub-drains; but I am not aware of a suitable plot of ground for this process in the vicinity of Marlimund. It would however be in the interest of economy that the Engineer designing the scheme should search for such ground between Marlimund and Snowdon reservoir. Although this method would be cheap and effective, I need not remind you that it would not be economical of water.

Endorsement No. 9-C.

Copy of the Sanitary Commissioner's letter forwarded to Mr. Walch with reference to his No. 36, dated 20th November 1896, and with the remark that it appears that filtration of the Marlimund reservoir water is necessary.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer, Public Works Department.*

## APPENDIX C.

Statement of areas in the natural catchment basin of Marlimund reservoir.

| Survey field No. | Government waste. | | Private property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C 359 .. .. | 40 | .. | .. | .. | .. | .. | |
| C 138 .. .. | .. | .. | 2 | 22 | .. | .. | Tudor Hall. |
| C 137 .. .. | .. | .. | 2 | 42 | .. | .. | |
| C 139 .. .. | .. | .. | 8 | 84 | 8 | 15 | Tudor Hall. |
| C 141 .. .. | .. | .. | 1 | 30 | .. | 18 | Do. |
| C 140 .. .. | .. | .. | 1 | .. | 1 | .. | Do. |

Statement of areas in the natural catchment basin of Marlimund reservoir—*cont.*

| Survey field No. | Government waste. | | Private property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C 142 .. .. | .. | .. | .. | 61 | 3 | 44 | Tudor Hall. |
| C 143 .. .. | .. | .. | 2 | .. | .. | 50 | |
| C 145 .. .. | .. | .. | 6 | 91 | 2 | 81 | Tudor Hall. |
| C 133 .. .. | .. | .. | 3 | 46 | 4 | 10 | Do. |
| C 135 .. .. | .. | .. | .. | 15 | .. | .. | |
| C 132 .. .. | .. | .. | .. | 13 | .. | .. | |
| C 131 .. .. | .. | .. | .. | 36 | 3 | 10 | Tudor Hall. |
| C 136 .. .. | .. | .. | .. | 24 | .. | .. | |
| C 134 .. .. | .. | .. | .. | 8 | .. | .. | |
| C 144 .. .. | .. | .. | .. | 75 | 1 | 32 | Tudor Hall. |
| C 146 .. .. | .. | .. | 3 | 66 | 6 | 4 | Do. |
| C 344 .. .. | 13 | 20 | .. | .. | .. | .. | In register this appears as "municipal property." |
| C 147 .. .. | .. | .. | 5 | 89 | 4 | .. | Tudor Hall. |
| C 150 .. .. | .. | .. | 16 | .. | 18 | 40 | Do. |
| C 148 .. .. | .. | .. | 7 | 6 | 31 | 60 | Do. |
| C 149 .. .. | .. | .. | .. | 65 | .. | .. | Gayton Park. |
| C 130 .. .. | .. | .. | 47 | 73 | .. | .. | |
| C 175 .. .. | .. | .. | .. | 50 | .. | .. | Gayton Park. |
| C 177 .. .. | .. | 83 | .. | .. | .. | .. | |
| C 178 .. .. | 5 | 30 | .. | .. | .. | .. | |
| C 360-A .. .. | 7 | 10 | .. | .. | .. | .. | |
| C 338 .. .. | 9 | 12 | .. | .. | .. | .. | |
| Total,* .. | 75 | 55 | 111 | 96 | 84 | 64 | |

* Total 272 acres 15 cents. approximate.—Note.—In Appendix A of report with P.M.G., No. 286-W., dated 1st February 1882, this is given as 268 acres.

Ootacamund,
*8th March* 1897.

(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*



## APPENDIX D.

Statement of areas of Catch[illegible]t Basin of the Dodabetta Upper Reservoir.

| Survey Field No. | Government waste and forest. | | Private property. | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Uncultivated, blue gum, and cinchona. | | Tea. | | Fruit trees. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| F 234 .. | .. | .. | 6 | .. | .. | .. | .. | .. | |
| F 232 .. | .. | .. | 8 | 64 | .. | .. | .. | .. | |
| F 230 .. | .. | .. | 6 | 51 | .. | .. | .. | .. | |
| F 228-F .. | 5 | 50 | .. | .. | .. | .. | .. | .. | |
| F 304-B .. | 5 | 25 | .. | .. | .. | .. | .. | .. | |
| F 228-G .. | 46 | 18 | .. | .. | .. | .. | .. | .. | |
| F 244 .. | .. | .. | 6 | 35 | .. | .. | .. | .. | |
| F 228-Z .. | .. | 50 | .. | .. | .. | .. | .. | .. | |
| F 243 .. | .. | .. | 3 | 22 | .. | 30 | .. | .. | |
| F 241 .. | .. | .. | .. | .. | 2 | 11 | .. | .. | |
| F 240 .. | .. | .. | 1 | 46 | 2 | 34 | .. | .. | |
| F 228-E .. | 8 | 50 | .. | .. | .. | .. | .. | .. | |
| F 231 .. | .. | .. | 2 | 68 | 2 | 41 | .. | 50 | |
| F 242 .. | .. | .. | 3 | 24 | 1 | 59 | .. | .. | |
| F 239 .. | .. | .. | 2 | 10 | 2 | 80 | .. | .. | |
| F 277 .. | .. | .. | 5 | 50 | .. | .. | .. | .. | |
| F 245 .. | 3 | .. | .. | .. | .. | .. | .. | .. | |
| F 305-A .. | 7 | .. | .. | .. | .. | .. | .. | .. | |
| F 228-X .. | .. | 19 | .. | .. | .. | .. | .. | .. | |
| Total .. | 76 | 12 | 45 | 70 | 11 | 55 | .. | 50 | Total, 133 acres 87 cents. |

Ootacamund,
*8th March* 1897.

(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*

## APPENDIX E.

STATEMENT of areas in Catchment Basin of proposed "Tiger-Hill" Stream Reservoir.

| Survey Field No. | Government forest. | | Municipal property. | | Private property. | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Uncultivated, and blue gum. | | Cinchona. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| F 237 .. | 6 | 25 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 250 .. | .. | .. | 9 | 44 | .. | .. | .. | .. | .. | .. | |
| F 296 .. | .. | .. | .. | .. | .. | 87 | .. | .. | .. | .. | |
| F 249 .. | .. | .. | .. | .. | 5 | .. | .. | .. | .. | .. | |
| F 247 .. | .. | .. | .. | .. | .. | .. | 7 | 20 | .. | .. | |
| F 228-Z .. | .. | 19 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 245 .. | .. | .. | .. | .. | .. | 48 | .. | .. | .. | .. | |
| F 244 .. | .. | .. | .. | .. | .. | 47 | .. | .. | .. | .. | |
| F 243 .. | .. | .. | .. | .. | 2 | 50 | .. | .. | .. | .. | |
| F 241 .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 25 | |
| F 240 .. | .. | .. | .. | .. | .. | 50 | .. | .. | .. | 60 | |
| F 238 .. | .. | 25 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 228-A .. | 60 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 248 .. | .. | .. | .. | .. | 5 | 4 | .. | .. | .. | .. | |
| Total .. | 66 | 69 | 9 | 44 | 14 | 86 | 7 | 20 | 1 | 85 | Total, 100 * acres 4 cents. |

* Besides this, about 8½ acres of Field No. C/237 may be brought in by catch drain.)

OOTACAMUND,
*8th March* 1897.

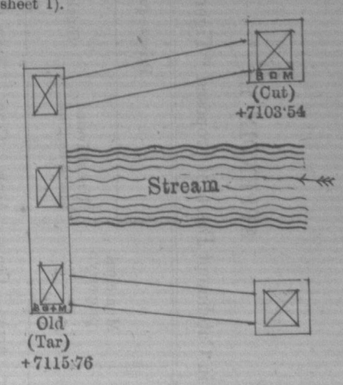
(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*



## APPENDIX F.

SYNOPSIS of Important Bench Marks in connection with the Investigations.

| Description of B.M. | Position of B.M. | Value. | Remarks. |
|---|---|---|---|
| On Rough Stone Floor .. .. | Floor of Escape of Marlimund reservoir (under bridge) .. .. .. .. .. .. [*Note.*—Zero of present gauge on water tower is 18 feet below this.] | 7444·72 | This is the initial B.M. from which all the levels of the investigations are taken; the value is that given in letter 2777 of 9th September 1896 of the Sanitary Engineer to Government. The datum is probably approximately, but only roughly approximately, mean Sea-level. |
| Tar Mark [redacted] .. .. .. | Parapet of dividing cistern south side of Kotagiri road (east of Snowdon House grounds).. | 7465·68 | See plan 2 (sheet 1). |
| .... | Floor of Escape of Lower Snowdon pond .. .. .. .. .. .. .. .. | 7423·75 | See plan 2 (sheet 1). |
| .... | Level of top of main to Ootacamund just as it leaves the tunnel near Snowdon Lower pond. | 7425·30 | |
| B. [redacted] M. Cut .. .. .. | On rock, east side of Snowdon road about 64 feet from road to "Fox How" .. .. | 7432·69 | |
| B. [redacted] M. Cut .. .. .. | On rock, east side of Snowdon road near Pear trees .. .. .. .. .. .. | 7386·99 | |
| B. [redacted] M. Cut .. .. .. | On rock, west side of Snowdon road below latrine of "Hill Side Villa" .. .. .. | 7370·95 | |
| Tar B. [redacted] M. .. .. .. | On parapet of "Sump" above St. Stephen's Church; near "Highland Villa" .. .. [*Note.*—Top of pipe inside this Sump 7392·51.] | 7397·35 | |
| Tar B. [redacted] M. .. .. .. | On west end of second step of entrance at *North* end of "Shedden House" .. .. .. | 7530·50 | See plan 1. |
| Tar B. [redacted] M. .. .. .. | On stone in north angle of brick edging of triangular plot at junction of Church Hill road, with road to Library. | 7228·10 | |
| B. [redacted] M. Cut .. .. .. | On plinth of pilaster at end of western upstream wing, Charing Cross Bridge .. .. [*Note.*—There is an old tar B.M. on the east corner of north parapet of this bridge; Value 7115.76]. See sketch in remark column. | 7103·54 | |



APPENDIX F—*cont.*

| Description of B.M. | Position of B.M. | Value. | Remarks. |
|---|---|---|---|
| B. M. Cut | On rock, east side of road to Kodapamund Dhobie village, opposite "Kelso Villa" Lawn Tennis Court. | 7179·68 | See plan 10. |
| B. M. Cut | On rock near road in Dhobie village below washerman Arumugam's house | 7246·54 | See plans 10 and 11. |
| B. M. Cut | On rock in bed of western branch ("Shudukadu") of Kodapamund valley stream, below road revetment. | 7397·89 | See plans 10 and 11. |
| B. M. in Tar | On north parapet of measuring weir across Kodapamund main stream—a short distance above Kotagiri road. | 7528·89 | This is the proposed site for "Pipe-head"—See plans 10 and 11. |
| B. M. in Tar | On rock right edge of Vannarpetta stream (Old Rifle Butts, or Manjekalmund, valley) | 7303·49 | See plans 10 and 11. |
| B. M. in Tar | On stone curb of platform round fountain at junction of "Walthamtow" road with Coonoor road. | 7302·78 | See plan 22 (sheet 1). |
| B. M. in Tar | On south parapet of cistern at Lower Dodabetta reservoir | 7631·47 | See plans 15, 16 and 22 (sheet 1). |
| | Crest of Escape of Upper Dodabetta reservoir | 7787·87 | |
| | [*Note.*—The zero of present gauge on water tower is 24·80 below this escape.] | | |
| B. M. Cut | On rock left side of "Tiger-hill stream" | 7677·44 | See plans 15, 16 and 22 (sheet 1). |
| B. M. Cut | On slab rock left side of stream a short distance above proposed site for dam of new reservoir. | 7712·09 | See plans 15 and 16. |
| B. M. Cut | On rock on left side of stream about 325 feet above the last B.M. | 7727·65 | See plans 15 and 16. |

NOTE.—There has hitherto been no datum common to all, or many, of the levels connected with the Ootacamund water-supply. As it is very advisable that this should no longer be the case much consideration was given to the question as to what datum should now be adopted. The "Survey of India Department" was addressed in the hopes that it might have established some Standard Bench Mark at Ootacamund; the reply was that "there are no G.T.S. Bench Marks in Ootacamund," but "a list of Trigonometrical Heights" was supplied, of which however no use could be made as it was not possible to fix with certainty and accuracy any of the points named. It was therefore decided to adopt the value of the *Marlimund Reservoir keeper*, as taken by the Sanitary Department in its last levelling work here, and use its datum; see remark opposite the first B.M. in the above list. It is strongly recommended that this be adhered to in future in all levels Municipal and otherwise, connected with Ootacamund water-supply and drainage; the various well defined B.M.'s here given will make this an easy matter.

(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*

OOTACAMUND,
*8th March* 1897.



## APPENDIX G.

*Plans to accompany report.*

| Distinguishing No. of plan. | Description of plan. | Number of sheets. | Paper (P.) or Tracing Linen (T.L.) | Remarks. |
|---|---|---|---|---|
| | *Book* 1. | | | |
| 1 | Parts of Revenue Survey sheets 3, 4 and 5 showing existing cultivation in catchment basin of Marlimund reservoir, &c. | 1 | P. | Lithograph. |
| 2 | Survey plan and sections, Snowdon ponds | 2 | P. | |
| 3 | Longitudinal section of Snowdon channels | 1 | T.L. | |
| 4 | Conduits and cistern for Snowdon channels | 1 | T.L. | |
| 5 | Survey plan for diversion of stream | 1 | T.L. | |
| 6 | Plan of proposed position of filter beds and service reservoir | 1 | T.L. | Prepared by Sanitary Engineer. |
| 7 | Sections for do. do. do. | 1 | T.L. | |
| 8 | Plan and sections of filter beds | 1 | T.L. | |
| 9 | Plan and sections of service reservoir | 1 | T.L. | |
| | *Book* 2. | | | |
| 10 | Parts of Revenue Survey sheets 10, 11 and 12 showing proposed Kodapamund Pipe-head. | 1 | P. | Lithograph. |
| 11 | Survey showing site which was suggested for reservoir, Kodapamund valley, &c. | 1 | T. L. | |
| 12 | Sections across Kodapamund valley | 2 | T.L. | |
| 13 | Survey for proposed Pipe-head reservoir | 1 | T.L. | |
| 14 | Drawing for Pipe-head dam | 1 | T.L. | |
| | *Book* 3. | | | |
| 15 | Parts of Revenue Survey sheets 10, 11 and 12 showing proposed new reservoir and existing Dodabetta reservoirs. | 1 | P. | Lithograph. |
| 16 | Survey plan site for proposed new reservoir, &c. | 1 | T.L. | |
| 17 | Cross sections, Tiger-hill stream | 1 | T.L. | |
| 18 | Section for channel from Dodabetta Upper reservoir to the proposed new reservoir. | 1 | T.L. | |
| 19 | Design for dam, &c. | 1 | T.L. | |
| 20 | Do. ground, plan and elevation | 1 | T.L. | |
| 21 | Survey and section for bye-wash | 1 | T.L. | |
| 22 | Sections for piping from new reservoir to Sump above St. Stephen's Church. | 3 | T.L. | |
| | *Separate.* | | | |
| | Map of Ootacamund—Scale 6″ = 1 mile showing areas supplied by pipes from various sources. | 1 | P. | Lithograph, Madras Survey. |

OOTACAMUND,
*8th March* 1897.

(Signed) G. T. WALCH,
*M. Inst. C. E.*

Note by the Chief Engineer, dated 25th May 1897, No. 327 D.

There are at present three sources of water-supply for Ootacamund—

(1) Marlimund reservoir,
(2) The spring above Old Ooty,
(3) The Dodabetta reservoirs,

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply—one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, first, in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens, second, in providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in paragraph 26 of his report that "there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year." If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

11. There are no detailed estimates for filter beds and service reservoirs.

12. I consider that if Anderson's revolvers are provided the size of the filter beds may be reduced by about one-half as the rate of filtration can be nearly doubled. The saving in this case would be about Rs. 18,000. Appendix A of Mr. Walch's report gives some information about the annual maintenance of Anderson's revolvers, but from it I cannot clearly make out what would be the cost in the case of Ootacamund.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer.*

---

*Endorsement*—No. 328 D., dated 25th May 1897.

Transferred to the Local and Municipal Department.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Secretary to Government, P.W.D.*

---

ORDER—No. 2156 M., dated 2nd October 1897.

In G.O., No. 298 W., dated 24th January 1896, recorded in G.O., No. 349 M., dated 27th February 1896, Mr. G. T. Walch was requested to draw up plans and estimates for the improvement of the water-supply of Ootacamund in accordance with the recommendations made by the Sanitary Board in its Proceedings, No. 2286, dated 14th August 1895. With the first paper read above, the Chief Engineer, Public Works Department, forwards for the orders of Government the proposals made by Mr. Walch, which, with the estimated cost, are briefly as follows :—

| | Rs. |
|---|---|
| (1) To line the existing Snowdon channels with masonry and to divert into the southern channel a stream above the Government gardens .. .. .. .. .. .. .. | 23,900 |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds .. .. .. .. .. .. .. | 66,000 |
| (3) To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| (4) To conduct the water from this new reservoir to the houses along the Kelso road and to the villages of Kodapamund and Vannarpetta .. .. .. .. .. .. | 8,060 |
| (5) To construct another new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger Hill .. .. .. .. .. .. .. .. | 47,400 |
| (6) To conduct the water from this reservoir to the "Sump" on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | 38,600 |
| Total .. | 1,87,700 |

Mr. Walch also recommends the acquisition of the private lands lying in the catchment basins of the Marlimund and Dodabetta reservoirs and the proposed new reservoir on Tiger Hill, and of about nine acres of land in connection with the "Old Ooty" supply.

2. The Chief Engineer, Public Works Department, considers that the construction of a new reservoir on Tiger Hill is unnecessary, as according to Mr. Walch himself there will be an ample supply of water in the Marlimund reservoir if the first of the improvements suggested by him is carried out. Also as to the filtering arrangements at the Snowdon ponds, the Chief Engineer considers that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the water of the Marlimund reservoir, these expensive arrangements need not be undertaken. He considers it sufficient if the first and third of Mr. Walch's proposals are adopted and if the private lands lying in the catchment areas of the Marlimund and Dodabetta reservoirs are acquired.

3. The Government agrees with the Chief Engineer with regard to the works referred to in items (1), (3) and (4) of Mr. Walch's recommendations and the works



should be carried out at once. These measures will secure a sufficient supply to meet the requirements of the town for some time to come, and nothing more is necessary, at all events for the present.

4. With regard to the quality of the Marlimund water and the necessity of filtering it, the Government has consulted some of the medical officers who have recently had extensive practice in Ootacamund, and has ascertained that they are unable to ascribe the causation of disease to the use of that water, and that in their experience they did not find any difference in health or mortality among the population residing north and south of the lake, attributable to their using respectively the Marlimund and the Dodabetta water, which latter is admittedly a most wholesome water. In these circumstances, the Government is of opinion that the scheme for the filtration of the Marlimund water is not required. If it is found to be necessary hereafter, it may then be taken up.

5. Nor does the Government consider it necessary to acquire the catchment area of the Marlimund reservoir. No doubt if this area were manured to any considerable extent, the quality of the water would be deteriorated; but under section 145 and sub-section (1) of section 228-A of the Madras District Municipalities Act IV of 1884, as amended by Act III of 1897, the municipal council has sufficient powers of control over the drainage areas of sources of water-supply to maintain them in as uncontaminated a state as can reasonably be required; and it may for this purpose, on payment, in certain circumstances, of compensation, prohibit or regulate the cultivation of any crop, the use of any manure or the irrigation of land in any specified manner, if such cultivation, manure or irrigation is, in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this and other water-supply reservoirs. The Collector is also requested to see that no Government land situated within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Government.

6. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that, as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. As it may perhaps be desirable to carry out this work at some future date, when the population of the town expands, as it may reasonably be expected to do, the Government is of opinion that the municipal council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition will probably be much less now than it will be in the future. It also seems desirable that the private lands in the catchment basin of the Dodabetta reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands and submit the same to Government at an early date. The municipal council should report whether the proposals now made by Government in regard to the improvement of the water-supply of the town meet with its approval. Its reply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in paragraph 3.

7. The thanks of Government are due to Mr. Walch for his thorough investigation and his valuable report. Separate orders have been issued directing the payment to him of the balance of his professional fee amounting to Rs. 1,830.

(True Extract.)

G. S. FORBES,
*Secretary to Government.*

To the Chairman, Municipal Council, Ootacamund.
„ the Collector of the Nilgiris.
„ the Public Works Department.
„ G. T. Walch, Esq.

Exd. A. Raitt.

Proof

# Government {1897} of Madras.

## LOCAL AND MUNICIPAL.

Proof for approval.

Pro
Stroke all round

| | | |
|---|---|---|
| *Recd.* | } 1897. | *Enclosures* |
| *Regd.* | | *Spare copies* |

**G.O., No. 2156 M., 2nd October 1897.**

**OCTOBER.**

Water-supply

Passing orders on the proposals of Mr. H. T. Walsh for the improvement of the ——— of Ootacamund.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper:—

Endorsement, in the Public Works Department, No. 328 D., dated 25th May 1897.

*Read*—the following papers:—

Letter from G. T. Walch, Esq., dated 15th March 1897.

Note by the Chief Engineer, dated 25th May 1897, No. 327 D.

There are at present three sources of water-supply for Ootacamund—

(1) Marlimund reservoir,
(2) The spring above Old Ooty,
(3) The Dodabetta reservoirs,

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply—one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, first, in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens, second, in providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in paragraph 26 of his report that "there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year." If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

3. Mr. Walch's statement is made from experience, and there can be little doubt that he is correct, but it will perhaps be as well to test what he says by figures.

4. Supposing the reservoir to be empty at the beginning of the south-west monsoon, say, 1st June, the average rainfall during that monsoon, 1st June to 1st October (4 months), is 21·78″; and supposing one-third of this, or, say, 7″, to be the run-off, the amount received into the tank would be 83·6 million gallons, the catchment area being 528 acres. The amount used at 20 gallons per head for 12,000 persons would be 29 million gallons, and the evaporation and absorption, taken at 24″ over the whole water-spread of 18 acres, would be 9·7 million gallons: therefore the balance left in the reservoir at end of the south-west monsoon, or on 1st October, would be 83·6 — (29 + 9·7) = 44·9 million, say, 45 million gallons.

5. The average rainfall during the north-east monsoon, say, 1st October to 1st January, or 3 months, is 16·19″, and supposing one-fourth of this, or, say, 4″, to be run off, the supply received would be 47$\frac{3}{4}$ million gallons. The quantity used during this period will be 22 million gallons and the evaporation and absorption at 12″, 4·8 million gallons, so that at the end of the north-east monsoon, or 1st January, there will be (45 + 47·7) — (22 + 4·8), or 65·9 million gallons, which would much more than fill the reservoir, its capacity being 54·5 million gallons. Now from 1st January to



1st June the quantity used will be 36$\frac{1}{4}$ million gallons and the evaporation and absorption taken at 36″ will be 14·5 million gallons, so that the total quantity required during the 5 months will be 50·7, so that there would still be 3·8 million gallons in the reservoir on 1st June; but it must be remembered that no credit has been given for any rain that may fall between 1st January and 1st June and the average of these 5 months is 11·30″. So I think that there can be no doubt that the Marlimund reservoir as improved by Mr. Walch's proposals will meet all requirements as regards quantity. I would further point out that I have taken the worst view of the case, for considering the nature of the catchment area, the run-off I have allowed is low, and 6′ for evaporation and absorption over the whole water-spread of 18 acres is, no doubt, much above what it will be; but in the absence of correct information I have thought it well to err on the safe side. It must further be remembered that 20 gallons per head for a population 25 per cent. greater than at present is a very liberal allowance, and I doubt (if undue wastage is prevented) that it will ever be used as the most part of the population is native. It may therefore be safely asserted that, even in the *worst* year, the supply in the Marlimund reservoir will be ample. Judging from the rain registers for the past 7 years the variations are trifling, the worst year giving a rainfall of 46·48″ and the best 64·9″, the average as taken in the foregoing calculation being 49·27.

6. As regards the quality of the water in the Marlimund reservoir, I believe it has been condemned on account of the peat soil in catchment and bed and owing to the chemical analysis being unfavourable. It has therefore been considered necessary to provide filters and a service reservoir and also Anderson's revolvers at a cost of Rs. 66,000. Though I hardly like to oppose the opinion of sanitary experts, I still think that, before such heavy expenditure is incurred, it would be well if it could be shown that the health of the people in Ootacamund has suffered by the use of the water. It is well known that chemical analysis is useless to determine whether water is wholesome or not, and, as Mr. Baldwin Latham, one of the greatest authorities on Sanitary Engineering, says, "the impure water of the chemist was not always unwholesome water, nor was the pure water of the chemist always pure," and again Professor Huxley pronounced an opinion that water might be as pure as possible from a chemist's point of view and yet be most deadly. Actual facts are therefore more to be depended on than theory. In this I am supported by the late Sanitary Commissioner for Madras, Surgeon-General M. C. Furnell, M I.F.R C.S., who in his letter, No. 96, dated 31st January 1884, to the Chief Secretary to Government, wrote as follows:—"The outcome of it all is that, if water has been drunk with impunity by people without any injury to health, it would be folly to condemn it because chemists demonstrate it contains so many hundreds or thousands of grains of organic matter per litre." Objections are also taken to the Marlimund water because the catchment and the bed are peat. With reference to the former I will quote from W. Pole, F.R.S., a great authority on such matters. He writes as follows:—"There is however one kind of effect to which water even from the highest land is liable, namely, to discolouration by peat. Most of these high lands contain in certain spots masses of decaying vegetation in the shape of morasses or peat bogs. These collect the rain water like sponges and when it flows away from them it carries with it small particles of the vegetable matter which render it brown in colour. This is no great detriment to the use of the water; the presence of these brown particles does not render it at all unwholesome: but still it is objectionable to look at." I believe it is still asserted by the Sanitary authorities that, though the catchment area being peat may not be objectionable, the bed of the reservoir being so renders the water unwholesome. This is, I fancy, theory, as I have seen no reason given for the assertion. I am therefore of opinion that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the Marlimund reservoir water, there is no necessity to go to the expense of filters and Anderson's revolvers. At the same time to be perfectly safe, I would follow Mr. Walch's suggestion and acquire the private land in the catchment basin of the reservoir. What the cost of doing so will be is not stated, but probably it will not amount to Rs. 66,300—the cost of filters and Anderson's revolvers. The private lands in the catchment area of the Dodabetta reservoir should be acquired for the same reason.

7. I am therefore of opinion that the new Tiger Hill reservoir is not required and all that is necessary to do is to improve the Marlimund reservoir as suggested by Mr. Walch. The objection to this is that some houses on high ground to the north will not be supplied; but whether it is advisable to expend Rs. 86,000 (cost of new reservoir and piping) to attain this object is a question that others must decide.

*Pipe Head Reservoir on the Kodapamund Valley.*—This is, I consider, a very necessary work and will supply some houses that pay water-tax though no water is laid on. The details have been carefully worked out and the cost will be Rs. 3,740. All that I would therefore propose to do at present as regard the water-supply of Ootacamund is :—

| | Rs. |
|---|---|
| 1*st.*—To line the existing Snowdon channels with masonry and bring more water to the southern one by diversion of a stream above Government Gardens .. .. .. .. | 23,900 |
| 2*nd.*—To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. | 3,740 |
| 3*rd.*—To acquire the private lands lying in the catchment area of the Marlimund and Dodabetta reservoirs .. .. .. | Cost unknown. |

8. In case, however, my views are not accepted and it is still considered advisable to construct the Tiger Hill reservoir, it is necessary that I should make some remarks about it. The catchment area as proposed will be 242 acres or not half that of the Marlimund reservoir. Therefore it cannot by itself be considered as a sure supply for the whole of the northern portion of Ootacamund now supplied from Marlimund. The water is said to be very pure, but the bed of the reservoir contains peat as at Marlimund, and no doubt after a time the Sanitary authorities will say that filters and Anderson's revolvers are necessary as the water will probably become discoloured.

9. The only advantage I can see in constructing this reservoir is that it will command the whole of the northern part of Ootacamund, and if it is decided to construct it I would suggest that the supply to be drawn from it be limited to that required for drinking and cooking purposes, say, 5 gallons per head per diem. The capacity would then be enough and the Marlimund water be used entirely for flushing drains, watering roads, extinguishing fires, &c. This would necessitate the new reservoir having an entirely separate pipe system of its own, but this, I believe, would cost less than the Rs. 66,000 proposed to be spent on the filters, service reservoirs and Anderson's revolvers at the Marlimund reservoir.

10. The scheme for the Ootacamund water-supply has been most carefully worked out by Mr. Walch in a very short time and it is only necessary for me to mention one or two of the details.

*Kodapamund Valley Scheme.*—The details of the piping are not complete, but these can be supplied by the Sanitary Engineer.

*Tiger Hill Dam.*—The bottom width of this should be increased to 27′.

11. There are no detailed estimates for filter beds and service reservoirs.

12. I consider that if Anderson's revolvers are provided the size of the filter beds may be reduced by about one-half as the rate of filtration can be nearly doubled. The saving in this case would be about Rs. 18,000. Appendix A of Mr. Walch's report gives some information about the annual maintenance of Anderson's revolvers, but from it I cannot clearly make out what would be the cost in the case of Ootacamund.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer.*

---

*Endorsement*—No. 328 D., dated 25th May 1897.

Transferred to the Local and Municipal Department.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Secretary to Government, P.W.D.*



Order—No. 2156 M., dated 2nd October 1897.

In G.O., No. 298 W., dated 24th January 1896, recorded in G.O., No. 349 M., dated 27th February 1896, Mr. G. T. Walch was requested to draw up plans and estimates for the improvement of the water-supply of Ootacamund in accordance with the recommendations made by the Sanitary Board in its Proceedings, No. 2286, dated 14th August 1895. With the first paper read above, the Chief Engineer, Public Works Department, forwards for the orders of Government the proposals made by Mr. Walch, which, with the estimated cost, are briefly as follows :—

| | Rs. |
|---|---|
| (1) To line the existing Snowdon channels with masonry and to divert into the southern channel a stream above the Government gardens .. .. .. .. .. .. .. | 23,900 |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds .. .. .. .. .. .. | 66,000 |
| (3) To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| (4) To conduct the water from this new reservoir to the houses along the Kelso road and to the villages of Kodapamund and Vannarpetta .. .. .. .. .. .. | 8,060 |
| (5) To construct another new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger Hill .. .. .. .. .. .. .. .. | 47,400 |
| (6) To conduct the water from this reservoir to the "Sump" on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | 38,600 |
| Total .. | 1,87,700 |

Mr. Walch also recommends the acquisition of the private lands lying in the catchment basins of the Marlimund and Dodabetta reservoirs and the proposed new reservoir on Tiger Hill, and of about nine acres of land in connection with the "Old Ooty" supply.

2. The Chief Engineer, Public Works Department, considers that the construction of a new reservoir on Tiger Hill is unnecessary, as according to Mr. Walch himself there will be an ample supply of water in the Marlimund reservoir if the first of the improvements suggested by him is carried out. Also as to the filtering arrangements at the Snowdon ponds, the Chief Engineer considers that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the water of the Marlimund reservoir, these expensive arrangements need not be undertaken. He considers it sufficient if the first and third of Mr. Walch's proposals are adopted and if the private lands lying in the catchment areas of the Marlimund and Dodabetta reservoirs are acquired.

3. The Government agrees with the Chief Engineer with regard to the works referred to in items (1), (3) and (4) of Mr. Walch's recommendations and the works should be carried out at once. These measures will secure a sufficient supply to meet the requirements of the town for some time to come, and nothing more is necessary, at all events, for the present.

4. With regard to the quality of the Marlimund water and the necessity of filtering it, the Government has consulted some of the medical officers who have recently had extensive practice in Ootacamund, and has ascertained that they are unable to ascribe the causation of disease to the use of that water, and that in their experience they did not find any difference in health or mortality among the population residing north and south of the lake, attributable to their using respectively the Marlimund and the Dodabetta water, which latter is admittedly a most wholesome water. In these circumstances, the Government is of opinion that the scheme for the filtration of the Marlimund water is not required. If it is found to be necessary hereafter, it may then be taken up.

5. Nor does the Government consider it necessary to acquire the catchment area of the Marlimund reservoir. No doubt if this area were manured to any considerable extent the quality of the water would be deteriorated; but under section 145

and sub-section (1) of section 228-A of the Madras District Municipalities Act IV of 1884, as amended by Act III of 1897, the municipal council has sufficient powers of control over the drainage areas of sources of water-supply to maintain them in as uncontaminated a state as can reasonably be required; and it may for this purpose, on payment, in certain circumstances, of compensation, prohibit or regulate the cultivation of any crop, the use of any manure or the irrigation of land in any specified manner, if such cultivation, manure or irrigation is, in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this and other water-supply reservoirs. The Collector is also requested to see that no Government land situated within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Government.

6. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that, as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. As it may perhaps be desirable to carry out this work at some future date, when the population of the town expands, as it may reasonably be expected to do, the Government is of opinion that the municipal council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition will probably be much less now than it will be in the future. It also seems desirable that the private lands in the catchment basin of the Dodabetta reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands and submit the same to Government at an early date. The municipal council should report whether the proposals now made by Government in regard to the improvement of the water-supply of the town meet with its approval. Its reply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in paragraph 3.

7. The thanks of Government are due to Mr. Walch for his thorough investigation and his valuable report. Separate orders have been issued directing the payment to him of the balance of his professional fee, amounting to Rs. 1,830.

(True Extract.)

*Secretary to Government.*

To the Chairman, Municipal Council, Ootacamund.
" the Collector of the Nilgiris.
" the Public Works Department.
" G. T. Walch, Esq.
Sanitary Board
Commissioner
Engineer

Exd. A. Baitt.

# Government {1897} of Madras.

## LOCAL AND MUNICIPAL.

V.E

Press

Please reprint the f.o with the addns indicated written and send 100 Copies, Showing proof first. Kindly make special arrangements to get this done in the very little delay.

H Revd as soon as any for first Asst 4/10/97

*Recd.* } 1897. *Enclosures*

*Regd.* } *Spare copies*

## G.O., No. 2156 M., 2nd October 1897.

## OCTOBER.

### Water-supply.

Passing orders on the proposals of Mr. G. T. Walch for the improvement of the — of Ootacamund.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper:—

Endorsement, in the Public Works Department, No. 328 D., dated 25th May 1897.

*Read*—the following papers:—

Letter from G. T. Walch, Esq., dated 15th March 1897.

Note by the Chief Engineer, dated 25th May 1897, No. 327 D.

There are at present three sources of water-supply for Ootacamund—

(1) Marlimund reservoir,
(2) The spring above Old Ooty,
(3) The Dodabetta reservoirs,

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply—one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, first, in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens, second, in providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in paragraph 26 of his report that "there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year." If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

3. Mr. Walch's statement is made from experience, and there can be little doubt that he is correct, but it will perhaps be as well to test what he says by figures.

4. Supposing the reservoir to be empty at the beginning of the south-west monsoon, say, 1st June, the average rainfall during that monsoon, 1st June to 1st October (4 months), is 21·78″; and supposing one-third of this, or, say, 7″, to be the run-off, the amount received into the tank would be 83·6 million gallons, the catchment area being 528 acres. The amount used at 20 gallons per head for 12,000 persons would be 29 million gallons, and the evaporation and absorption, taken at 24″ over the whole water-spread of 18 acres, would be 9·7 million gallons: therefore the balance left in the reservoir at end of the south-west monsoon, or on 1st October, would be 83·6 — (29 + 9·7) = 44·9 million, say, 45 million gallons.

5. The average rainfall during the north-east monsoon, say, 1st October to 1st January, or 3 months, is 16·19″, and supposing one-fourth of this, or, say, 4″, to be run off, the supply received would be 47¾ million gallons. The quantity used during this period will be 22 million gallons and the evaporation and absorption at 12″, 4·8 million gallons, so that at the end of the north-east monsoon, or 1st January, there will be (45 + 47·7) — (22 + 4·8), or 65·9 million gallons, which would much more than fill the reservoir, its capacity being 54·5 million gallons. Now from 1st January to



1st June the quantity used will be 36¼ million gallons and the evaporation and absorption taken at 36″ will be 14·5 million gallons, so that the total quantity required during the 5 months will be 50·7, so that there would still be 3·8 million gallons in the reservoir on 1st June; but it must be remembered that no credit has been given for any rain that may fall between 1st January and 1st June and the average of these 5 months is 11·30″. So I think that there can be no doubt that the Marlimund reservoir as improved by Mr. Walch's proposals will meet all requirements as regards quantity. I would further point out that I have taken the worst view of the case, for considering the nature of the catchment area, the run-off I have allowed is low, and 6′ for evaporation and absorption over the whole water-spread of 18 acres is, no doubt, much above what it will be; but in the absence of correct information I have thought it well to err on the safe side. It must further be remembered that 20 gallons per head for a population 25 per cent. greater than at present is a very liberal allowance, and I doubt (if undue wastage is prevented) that it will ever be used as the most part of the population is native. It may therefore be safely asserted that, even in the *worst* year, the supply in the Marlimund reservoir will be ample. Judging from the rain registers for the past 7 years the variations are trifling, the worst year giving a rainfall of 46·48″ and the best 64·9″, the average as taken in the foregoing calculation being 49·27.

6. As regards the quality of the water in the Marlimund reservoir, I believe it has been condemned on account of the peat soil in catchment and bed and owing to the chemical analysis being unfavourable. It has therefore been considered necessary to provide filters and a service reservoir and also Anderson's revolvers at a cost of Rs. 66,000. Though I hardly like to oppose the opinion of sanitary experts, I still think that, before such heavy expenditure is incurred, it would be well if it could be shown that the health of the people in Ootacamund has suffered by the use of the water. It is well known that chemical analysis is useless to determine whether water is wholesome or not, and, as Mr. Baldwin Latham, one of the greatest authorities on Sanitary Engineering, says, "the impure water of the chemist was not always unwholesome water, nor was the pure water of the chemist always pure," and again Professor Huxley pronounced an opinion that water might be as pure as possible from a chemist's point of view and yet be most deadly. Actual facts are therefore more to be depended on than theory. In this I am supported by the late Sanitary Commissioner for Madras, Surgeon-General M. C. Furnell, M.I.F.R C.S., who in his letter, No. 96, dated 31st January 1884, to the Chief Secretary to Government, wrote as follows:—"The outcome of it all is that, if water has been drunk with impunity by people without any injury to health, it would be folly to condemn it because chemists demonstrate it contains so many hundreds or thousands of grains of organic matter per litre." Objections are also taken to the Marlimund water because the catchment and the bed are peat. With reference to the former I will quote from W. Pole, F.R.S., a great authority on such matters. He writes as followsl:—"There is however one kind of effect to which water even from the highest land is liable, namely, to discolouration by peat. Most of these high lands contain in certain spots masses of decaying vegetation in the shape of morasses or peat bogs. These collect the rain water like sponges and when it flows away from them it carries with it small particles of the vegetable matter which render it brown in colour. This is no great detriment to the use of the water; the presence of these brown particles does not render it at all unwholesome: but still it is objectionable to look at." I believe it is still asserted by the Sanitary authorities that, though the catchment area being peat may not be objectionable, the bed of the reservoir being so renders the water unwholesome. This is, I fancy, theory, as I have seen no reason given for the assertion. I am therefore of opinion that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the Marlimund reservoir water, there is no necessity to go to the expense of filters and Anderson's revolvers. At the same time to be perfectly safe, I would follow Mr. Walch's suggestion and acquire the private land in the catchment basin of the reservoir. What the cost of doing so will be is not stated, but probably it will not amount to Rs. 66,300—the cost of filters and Anderson's revolvers. The private lands in the catchment area of the Dodabetta reservoir should be acquired for the same reason.

7. I am therefore of opinion that the new Tiger Hill reservoir is not required and all that is necessary to do is to improve the Marlimund reservoir as suggested by Mr. Walch. The objection to this is that some houses on high ground to the north will not be supplied; but whether it is advisable to expend Rs. 86,000 (cost of new reservoir and piping) to attain this object is a question that others must decide.

*Pipe Head Reservoir on the Kodapamund Valley.*—This is, I consider, a very necessary work and will supply some houses that pay water-tax though no water is laid on. The details have been carefully worked out and the cost will be Rs. 3,740. All that I would therefore propose to do at present as regard the water-supply of Ootacamund is:—

| | Rs. |
|---|---|
| 1*st.*—To line the existing Snowdon channels with masonry and bring more water to the southern one by diversion of a stream above Government Gardens .. .. .. .. | 23,900 |
| 2*nd.*—To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| 3*rd.*—To acquire the private lands lying in the catchment area of the Marlimund and Dodabetta reservoirs .. .. .. | Cost unknown. |

8. In case, however, my views are not accepted and it is still considered advisable to construct the Tiger Hill reservoir, it is necessary that I should make some remarks about it. The catchment area as proposed will be 242 acres or not half that of the Marlimund reservoir. Therefore it cannot by itself be considered as a sure supply for the whole of the northern portion of Ootacamund now supplied from Marlimund. The water is said to be very pure, but the bed of the reservoir contains peat as at Marlimund, and no doubt after a time the Sanitary authorities will say that filters and Anderson's revolvers are necessary as the water will probably become discoloured.

9. The only advantage I can see in constructing this reservoir is that it will command the whole of the northern part of Ootacamund, and if it is decided to construct it I would suggest that the supply to be drawn from it be limited to that required for drinking and cooking purposes, say, 5 gallons per head per diem. The capacity would then be enough and the Marlimund water be used entirely for flushing drains, watering roads, extinguishing fires, &c. This would necessitate the new reservoir having an entirely separate pipe system of its own, but this, I believe, would cost less than the Rs. 66,000 proposed to be spent on the filters, service reservoirs and Anderson's revolvers at the Marlimund reservoir.

10. The scheme for the Ootacamund water-supply has been most carefully worked out by Mr. Walch in a very short time and it is only necessary for me to mention one or two of the details.

*Kodapamund Valley Scheme.*—The details of the piping are not complete, but these can be supplied by the Sanitary Engineer.

*Tiger Hill Dam.*—The bottom width of this should be increased to 27'.

11. There are no detailed estimates for filter beds and service reservoirs.

12. I consider that if Anderson's revolvers are provided the size of the filter beds may be reduced by about one-half as the rate of filtration can be nearly doubled. The saving in this case would be about Rs. 18,000. Appendix A of Mr. Walch's report gives some information about the annual maintenance of Anderson's revolvers, but from it I cannot clearly make out what would be the cost in the case of Ootacamund.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer.*

---

*Endorsement*—No. 328 D., dated 25th May 1897.

Transferred to the Local and Municipal Department.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Secretary to Government, P.W.D.*



ORDER—No. 2156 M., dated 2nd October 1897.

In G.O., No. 298 W., dated 24th January 1896, recorded in G.O., No. 349 M., dated 27th February 1896, Mr. G. T. Walch was requested to draw up plans and estimates for the improvement of the water-supply of Ootacamund in accordance with the recommendations made by the Sanitary Board in its Proceedings, No. 2286, dated 14th August 1895. With the first paper read above, the Chief Engineer, Public Works Department, forwards for the orders of Government the proposals made by Mr. Walch, which, with the estimated cost, are briefly as follows:—

| | Rs. |
|---|---|
| (1) To line the existing Snowdon channels with masonry and to divert into the southern channel a stream above the Government gardens .. .. .. .. .. .. .. | 23,900 |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds .. .. .. .. .. .. | 66,000 |
| (3) To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| (4) To conduct the water from this new reservoir to the houses along the Kelso road and to the villages of Kodapamund and Vannarpetta .. .. .. .. .. .. | 8,060 |
| (5) To construct another new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger Hill .. .. .. .. .. .. .. | 47,400 |
| (6) To conduct the water from this reservoir to the "Sump" on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | 38,600 |
| Total .. | 1,87,700 |

Mr. Walch also recommends the acquisition of the private lands lying in the catchment basins of the Marlimund and Dodabetta reservoirs and the proposed new reservoir on Tiger Hill, and of about nine acres of land in connection with the "Old Ooty" supply.

2. The Chief Engineer, Public Works Department, considers that the construction of a new reservoir on Tiger Hill is unnecessary, as according to Mr. Walch himself there will be an ample supply of water in the Marlimund reservoir if the first of the improvements suggested by him is carried out. Also as to the filtering arrangements at the Snowdon ponds, the Chief Engineer considers that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the water of the Marlimund reservoir, these expensive arrangements need not be undertaken. He considers it sufficient if the first and third of Mr. Walch's proposals are adopted and if the private lands lying in the catchment areas of the Marlimund and Dodabetta reservoirs are acquired.

3. The Government agrees with the Chief Engineer with regard to the works referred to in items (1), (3) and (4) of Mr. Walch's recommendations and the works should be carried out at once. These measures will secure a sufficient supply to meet the requirements of the town for some time to come, and nothing more is necessary, at all events, for the present.

4. With regard to the quality of the Marlimund water and the necessity of filtering it, the Government has consulted some of the medical officers who have recently had extensive practice in Ootacamund, and has ascertained that they are unable to ascribe the causation of disease to the use of that water, and that in their experience they did not find any difference in health or mortality among the population residing north and south of the lake, attributable to their using respectively the Marlimund and the Dodabetta water, which latter is admittedly a most wholesome water. In these circumstances, the Government is of opinion that the scheme for the filtration of the Marlimund water is not required. If it is found to be necessary hereafter, it may then be taken up.

5. Nor does the Government consider it necessary to acquire the catchment area of the Marlimund reservoir. No doubt if this area were manured to any considerable extent the quality of the water would be deteriorated; but under section 145

and sub-section (1) of section 228-A of the Madras District Municipalities Act IV of 1884, as amended by Act III of 1897, the municipal council has sufficient powers of control over the drainage areas of sources of water-supply to maintain them in as uncontaminated a state as can reasonably be required; and it may for this purpose, on payment, in certain circumstances, of compensation, prohibit or regulate the cultivation of any crop, the use of any manure or the irrigation of land in any specified manner, if such cultivation, manure or irrigation is, in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this and other water-supply reservoirs. The Collector is also requested to see that no Government land situated within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Government.

6. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that, as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. As it may perhaps be desirable to carry out this work at some future date, when the population of the town expands, as it may reasonably be expected to do, the Government is of opinion that the municipal council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition will probably be much less now than it will be in the future. It also seems desirable that the private lands in the catchment basin of the Dodabetta reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands and submit the same to Government at an early date. The municipal council should report whether the proposals now made by Government in regard to the improvement of the water-supply of the town meet with its approval. Its reply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in paragraph 3.

7. The thanks of Government are due to Mr. Walch for his thorough investigation and his valuable report. Separate orders have been issued directing the payment to him of the balance of his professional fee, amounting to Rs. 1,830.

(True Extract.)

G. S. FORBES,
*Secretary to Government.*

To the Chairman, Municipal Council, Ootacamund.
„ the Collector of the Nilgiris.
„ the Public Works Department.
„ G. T. Walch, Esq.

Ext. A. Eallt.

# Government {1897} of Madras.

## LOCAL AND MUNICIPAL.

Proof for approval.

This is the revised copy of G.O. No. 2156 on ooty water supply embodying our views in report.

Recd. } 1897. Enclosures

Regd. } Spare copies

Send at least 15 copies in advance for consideration & disposal

**G.O., No. 2156 M., 2nd October 1897.**

## OCTOBER.

**Water-supply.**

Passing orders on the proposals of Mr. G. T. Walch for the improvement of the — of Ootacamund.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper:—

Endorsement, in the Public Works Department, No. 328 D., dated 25th May 1897.

*Read*—the following papers:—

From G. T. WALCH, Esq., to the Chief Engineer, Public Works Department, Madras, dated Ootacamund, 15th March 1897.

With reference to G.O., No. 298 W., dated 24th January 1896, and Mis. No. 689 M., dated 27th April 1896, I have the honour to forward the report, plans and estimates connected with the investigations carried out by me for the improvement of the Ootacamund water-supply.

2. In all these correctness and clearness of record have been aimed at, so that any one who may have hereafter to deal with the scheme, or any part of it, may find what has been done ready to his hand and have no need to again go over ground which has already been covered. In connection with this I would draw attention to the "Note" at the end of the "Synopsis of Bench Marks"—Appendix F of the report.

3. I enclose the statement of remuneration claimed; it will be seen that in order to keep down the cost of the present investigations I have been careful to make use as far as possible, of all suitable work which I could find already done.

4. If the claim be approved, the total cost of the investigations will amount to Rs. 6,170* approximately.

5. If any explanation or information in addition to what will be found in the report and plans be required, I shall be happy to give it as far as may be in my power.

6. The Chairman of the Ootacamund Municipality has from time to time furnished me with most useful information both from his own extensive personal knowledge and from the records of his office, and I would also acknowledge assistance received from the Sanitary Engineer on various points connected with the proposed new main.

7. The instruments, &c., lent for the work have been returned to the Public Works Department, and the furniture, surplus stationery and the various records (survey and level books, letter files, and so on) have been handed over to the Municipal office.

| | Rs. | |
|---|---|---|
| * Engineer's fee .. .. .. .. .. .. .. .. .. | 3,930 | |
| Establishment .. .. .. .. .. .. .. .. .. | 1,708 | |
| Sundries and contingencies .. .. .. .. .. .. .. | 532 | Approximate. Some charges not yet paid. |
| Total .. | 6,170 | |



Enclosure.

## Report on the Ootacamund Water-supply Improvement.

### I.—PRESENT SOURCES OF SUPPLY.

The piped supply of Ootacamund is now derived from the following sources:—

(1) Marlimund Reservoir.

1. This is formed by an earthen embankment thrown across a stream which flows from the Tudor Hall Estate, Gayton Park Estate, and adjacent lands, and runs down the Anikorai valley to the Moyar.

2. The natural catchment basin of the reservoir has an area of about 272·15 acres, of which 196·60 acres are private and 75·55 acres Government and Municipal property. Of the 196·60 acres of private land about 84·64 acres are cultivated, chiefly with tea, but several acres of this are so neglected as to appear as if abandoned.

3. Besides the run off from the natural catchment basin, that from nearly 200 acres on the slopes of the Snowdon range is brought to the reservoir by means of open catch channels, pipes, and a masonry conduit.

4. The water spread of the reservoir when full (18 feet above its outlet pipe) is rather over 18 acres, and its capacity is 9,870,138 cubic feet, of which, however, 1,150,130 cubic feet lie below the outlet pipe, leaving 8,720,008 cubic feet, or 54½ millions of gallons, above that pipe.

5. From this reservoir all the portion of Ootacamund north of the Lake and shown in pink * on the accompanying map (scale 6" to 1 mile) is supplied or will be supplied when an intended extension along the Segoor road is carried out. The population of the whole of this portion of the settlement is now a little over 10,000, but it is considered that before long it will at times amount to 12,000. For this number at 20 gallons a head per diem the full reservoir holds a supply for upwards of seven months, even if during that period the evaporation and soakage be only just compensated for by the discharge of springs and rainfall run off.

6. When this reservoir was constructed its water was declared unexceptionable, but this is no longer the case owing, it is supposed, to (*a*) manure used in the cultivation which drains into the reservoir and (*b*) the presence in the bed of the reservoir of a large quantity of peat. The latter is considered to be by far the more serious evil of the two, indeed the Sanitary Commissioner Surgeon-Lieut.-Colonel W. G. King has gone so far as to say "whatever steps be taken as to the catchment area, as long as the water is received there, it must be considered unfit for human consumption," and he advises "the abandonment of this reservoir completely."

See page 226 of Minutes of Proceedings of the Sanitary Commissioner for second quarter of 1894.

7. The Sanitary Board, however, came to the conclusion that this reservoir "cannot be totally abandoned," but that "all water passing from it be filtered."

See its Proceedings No. 2286, dated 14th July 1895, which are printed in Part II of this report.

(2) The Spring above Old Ooty.

8. With reference to this, the Sanitary Commissioner remarks (see paragraph 9 of his inspection notes, page 224 of minutes of proceedings of Sanitary Commissioner, second quarter 1894), that of all the sources of the Ootacamund supply this "alone presents the character of a correctly protected supply. It is derived direct from a spring which is enclosed at its point of exit from the earth and is distributed by pipes. The collection of this spring is ingeniously effected by a miniature infiltration gallery suggested by Mr. Nery, the Municipal Engineer."

* A junction with the pipes of the system *South* of the lake was made in 1892 at the "Willow Bund."

9. The system, however, is a very small one supplying only some 400 persons by means of pillar fountains in the village of "Old Ooty" and by service pipes to the Secretariat offices, Stonehouse Hill, and three or four other houses.

10. The area served is shown in yellow and the accompanying map of Ootacamund, scale 6″=1 mile.

### (3) The Dodabetta Reservoirs.

11. These are formed by earthern embankments across the stream which flows from the southern slopes of Dodabetta to the Burnfood and Lawrence Lakes.

12. The upper of the two reservoirs has, according to Appendix A of report printed with P.M.G., No. 286 W., dated 1st February 1882, a catchment basin of about 172·72 acres, 80·72 acres of these being private property; but from the recent investigations it would appear that the area of the catchment basin does not exceed 134 acres, and that the private property is only 57·75 acres, of which 11·50 are cultivated with tea and half an acre or so is planted with fruit trees (apparently almost entirely neglected), whilst of the remainder there are some 38¾ acres of gum plantations and 7 acres or so of cinchona, &c.

13. There are no regularly inhabited houses or huts in the catchment basin, but there are two "tea houses" which no doubt are occupied at times for short periods.

14. The capacity of this reservoir when full to 24·80 above its outlet pipe has been taken as 4,500,000 gallons, but is probably considerably more.

See P.M.G., No. 634 M., L.M., dated 28th April 1891.

15. The lower reservoir, only about 934 feet down the valley from the upper one and some 161 feet below it in level, is little more than a pond, having a capacity probably not exceeding 50,000 gallons.

16. Its chief supply is of course the surplus from the upper reservoir, but this is also at times supplemented from the stream which flows through the Craigmore forest reserves at the back of Tiger Hill.

17. From these reservoirs is supplied that portion of Ootacamund, south of the lake, shown colored in blue on the map, scale 6″=1 mile, with a population of 2,500. The capacity of the reservoirs as given above would therefore be sufficient for only three months' supply at 20 gallons a head per diem, supposing the evaporation and soakage to be only just compensated for by fresh supplies received during that period; the stream and springs which feed these reservoirs never, it is believed, run quite dry, and as a matter of fact the storage has since the supply from it was piped, proved sufficient, if extravagant consumption and waste be checked.

18. In paragraph 12 of his inspection notes, dated 5th—22nd September 1893, the Sanitary Commissioner gives analysis of the water of these reservoirs, and speaks of it as "of much better quality than the Marlimund supply though largely defiled by vegetable impurities" and an analysis lately made by the Chemical Examiner, of water taken from a house tap on the distribution system from these Dodabetta reservoirs, gives the following results:—

Page 227 of Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.

| | | B. From House service tap of Eckford Dodabetta reservoir system. |
|---|---|---|
| Total solids .. .. .. .. | Grms. per litre | 0·040 |
| Volatile solids .. .. .. .. | Do. | 0·015 |
| Chlorine .. .. .. .. | Do. | Trace. |
| Total hardness .. .. .. | Clerk's scale | Trace. |
| Permanent hardness .. .. .. | Do. | Trace. |
| Free ammonia .. .. .. | Mlgrms. per litre | Trace. |
| Albumenoid ammonia .. .. | Do. | 0·040 |
| Nitric acid .. .. (as ammonia) | Do. | Trace. |

Remarks.—Sample B is a usable and good water.



## II.—OPINIONS AND SUGGESTIONS OF THE SANITARY BOARD.

19. The occasional insufficiency of the supply from Marlimund reservoir and the unsatisfactory character of its water, and imperfections in the other sources of the water-supply of Ootacamund have from time to time during the last few years received much attention from the Sanitary Commissioner and the Sanitary Engineer, the results of which are given in the various documents noted below.[1]

20. These were referred by Government to the Sanitary Board which after full consideration came to the conclusion embodied in its Proceedings No. 2286, dated 14th August 1895, which for convenience of reference are given *in extenso* below, from Proceedings of Madras Government, No. 298-W., dated 24th January 1896.

*Proceedings of the Sanitary Board, No. 2286, dated 14th August 1895, at meetings of the Sanitary Board held at Ootacamund on the 13th, 18th, 25th and 27th June 1895.*

* * * * *

The Board, having, as requested by G.O., No. 859 M., dated 6th July 1894, fully discussed the whole of the questions relating to the water-supply of Ootacamund, having had before them report (herewith sent) of the Municipal Committee on the same matter, and having met the committee and considered the matter with them, and having inspected the various reservoirs existing and proposed and their catchment areas, resolves to report to Government as follows:—

(1) The Board finds that, in regard to the Marlimund supply, it is impure and insufficient, that the cause of the impurity of the water is due (1) to the supply received from the Tudor Hall Estate passing over cultivated lands, to the tank itself in portion being a peat bog and that in its bed are masses of vegetable matter in a state of transition towards "peat" and therefore liable to decay, and to the water derived from the Snowdon catchment having to pass to the connecting channels through sholas with thick undergrowth and over ground covered with decaying vegetable matter, (2) that its insufficiency in years of short rainfall is due to the small size of the catchment area, to the state of collecting channels themselves and to the absorption caused by undergrowth and *humus* in the sholas.

(2) To improve the purity of the water, the Board consider that the Marlimund tank as far as possible should be abandoned as a storage reservoir, and that Government should be requested to clear the sholas above the collecting channels of all wattle, undergrowth and humus and to require that such areas shall at no future time be permitted to get into the state they are at present, viz.. so thick that sun-light can hardly penetrate and reach the ground. The Board considered the question of forming new channels above the sholas and of carrying the water from the streams and springs themselves in closed piping, but looking to the insufficiency of the supply and the limited catchment areas, they do not feel justified in recommending this course, and if Government clears the sholas and maintains them in the state already advised, there is less reason for such recommendation.

(3) In order that the Marlimund tank may be, as far as possible, abandoned as a storage reservoir, the Board propose to increase the capacity of the Snowdon reservoir and consider that the bund may be raised almost to the level of the road above the reservoir and that the capacity may be further considerably extended by excavating and clearing the basin in which the existing (but not now used) reservoir is, or alternatively it may be considered whether it may not be advisable to construct a new dam at a spur some 200 feet down the valley below the bund if a further large additional amount of storage would thereby be secured; which of the two courses should be adopted is an engineering question which can only be decided after proper surveys

[1] Sanitary Engineer's No. 1697, dated 17th August 1893.
Note on same by Acting Chief Engineer, Public Works Department, dated 2nd October 1893.
Sanitary Engineer's No. 2514, dated 24th November 1893.
G.O., No. 273 M., dated 8th March 1894.
G.O., No. 859 M., Mis., dated 6th July 1894.
(All ordered to be treated as "Confidential.")
Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.
Report of Sanitary Engineer for 1895.

and levels of the site have been taken. The Board believe that, if the reservoir is thus extended and another reservoir (to be hereafter referred to) constructed, it will be possible to limit the use of water from the Marlimund to a somewhat insignificant amount.

(4) Marlimund, however, cannot be totally abandoned, as some of the higher houses on Church Hill must still continue to be supplied from it, and the Board therefore recommend that all water passing from it be filtered and a compensating or service reservoir will also be necessary. On the subject of filtration advised, the Board is prosecuting enquiries as to feasible methods for dealing with the large quantity of vegetable matter in the water. As to this a separate report will in due time be submitted.

(5) The Board accompany the proposals for the extension of the Snowdon reservoir with their expression of opinion of the necessity for protecting the reservoir from approach by walling and fencing, for removing the godown of Snowdon House, and for securing by means of intercepting channels and otherwise that none of the drainage of any of the surrounding basin in which the reservoir is be admitted into the reservoir unless from a perfectly clean and unpolluted area, the reservoir not in any way being dependent on its own basin for its supply. The Board also recommend the diversion of the Marlimund road along the east side of the reservoir as extended.

(6) The Board recommend that the existing north and south supply channels be bricked or lined with concrete, that the overflows be done away with as far as possible and one overflow only provided above the inlet to the Snowdon reservoir or the pipe leading to Marlimund, and that the site of the channels be increased, if necessary, to carry the maximum flow off the catchment areas.

(7) The Board further recommend the extension of the south supply channel as proposed by Mr. Ellis, Acting Sanitary Engineer, in his memorandum in reference to G.O., Mis. No. 839 M., dated 6th July 1894, viz., recutting the old supply channel from O. to N. so as to include the area, coloured green—see plan No. 4 of the accompanying plans—whence the water would find its way down the stream H. and thence by the existing channel to Snowdon; the Government House channel to be permanently cut off (it has already been done so temporarily). The Board do not consider that any other of the works proposed by Mr. Ellis in his memorandum referred to are under the present proposals of the Board necessary and would alone recommend the examination and repair where necessary of the culvert from Snowdon House to Marlimund from which apparently a large quantity of water must be lost by leakage.

(8) The effect of the above proposals would be that a new reservoir would be obtained with a supply to it from a fairly unpolluted area and an additional amount of storage would thus be secured. It is not intended that water should be passed from Marlimund to Snowdon reservoir even after filtration, but that it be delivered into the pipe below the latter reservoir, or it may be that an additional main from the latter may be necessary if Marlimund has to be retained for the higher houses on Church Hill, &c.; this however is a detail to be hereafter considered, if the recommendations of the Board as a whole receive the approval of Government. The surplus from the reservoir at Snowdon would be passed to Marlimund and no more water passed over its escape wier than is absolutely necessary for the safety of the reservoir.

(9) The Board further recommend that a new reservoir be formed in the Kodapamund valley just below the junction of the three streams coming from the saddle and from that place of Dodabetta further west. The construction of this reservoir will involve the acquisition of a few market gardens, and about eight dhobies' huts adjacent to the site of the proposed bund (these were only lately built) must be removed.

(10) The Board believe that this and the proposed Snowdon reservoir will give all the storage capacity required to serve a much increased population through any years of severe drought such as have lately occurred.

(11) It is considered that, when these new reservoirs are made, it will be advantageous to limit the supplies from each to certain areas of the town, thus, for



instance, from Marlimund to as limited an area as possible on the higher contours, from Snowdon to the middle contours and the upper portions of the bazaars, and from Kodapamund to the houses in that valley near Charing Cross, Government House road, and along the lake on the north side generally, and in this view the distribution pipes may require slight re-arrangement, but in such manner that, from higher supplies, it may always be possible to supplement the lower or from the lower to such of the higher contours as they can command.

(12) In regard to the Dodabetta reservoir, which supplies the south side of Ootacamund, the Board do not consider that any expensive alterations are required. An examination ought to be made of the lower reservoir and remedies suggested against its silting, as it does at present; its capacity might probably be slightly increased. By properly considered planting on the slopes of Tiger stream, the silt at present brought down might be reduced or by scour valves, and the supply to the reservoir might be increased by catching more of the water which at present eventually finds its way to Burnfoot lake.

(13) The Board are averse to cutting off any of the area of the upper reservoir, but if arrangements can be made to cut off the tea area and include an equal or greater area, this should be done; this however is a question which demands detailed enquiry (Dr. King dissents—see note attached).

(14) It is evident that, if the proposals of the Board meet with the approval of Government, the work of preparing plans and estimates to carry these proposals into effect will require the services of a highly qualified officer for a considerable period; there are many points in connection with the various proposals made, which demand very careful study and investigation before satisfactory designs can be prepared and details decided on.

(15) The Board therefore recommend that the municipal council should be advised to approach Mr. Walch (late Chief Engineer for Irrigation), who is now resident in Ootacamund and who has a very full knowledge of the question to be dealt with, in view to securing his services.

(16) The Board are informed that the council have already arranged to provide a sum of Rs. 2 lakhs for the carrying out the improvement of the water supply and drainage. This sum is not likely to cover all the expenditure necessary, and the Board therefore trust Government will see its way to supplement that sum by whatever amount may be necessary, so that once for all the supply to Ootacamund may be placed on a satisfactory basis. Any less complete measures than those proposed, the Board consider, would be temporary and ill-advised, and therefore strongly recommend that the improvements be taken up at once and made full and complete. The Board believe that any other course will lead in the end to much greater expenditure than if their proposals are accepted and the work carried out as a whole.

21. These suggestions of the Sanitary Board may be thus summarized—

(*a*) Partial abandonment of the Marlimund Reservoir; the improvement and extension of its supply channels from the Snowdon slopes; the filtration of all the water passing out of the reservoir;—paragraphs 1 to 8.

(*b*) The formation of a supplemental reservoir at the Snowdon Ponds or just below them;—paragraphs 3 and 5.

(*c*) The formation of a new reservoir in the Kodapamund Valley just below the junction of the three streams coming from the Saddle and from that part of Dodabetta further west;—paragraphs 9, 10 and 11.

(*d*) The improvement of the purity of the supply of the Dodabetta Reservoirs and the prevention of the silting up of the lower one;—paragraphs 12 and 13.

## III.—INVESTIGATIONS NOW CARRIED OUT, PROPOSALS NOW MADE, AND ESTIMATES SUBMITTED.

22. In dealing with the investigations carried out in accordance with G.O., No. 689 M., dated 27th April 1896, it will be convenient to follow the proposals of the Sanitary Board, as far as they go, in the general order of the above summary.

### (4) Marlimund Reservoir.

23. As was expected, the investigations have failed to find any site for a reservoir for the supply of Ootacamund, comparable with that of Marlimund as regards capacity or area of catchment basin. With only 18 feet depth of water it holds, as already stated, 54½ millions of gallons, or upwards of seven months' supply for 12,000 persons at 20 gallons per diem, and it draws its supply from some 469 acres which it is proposed to increase by about 59[1] acres.

| | Acs. |
|---|---|
| Its natural catchment area .. .. .. .. | 272·00 |
| Snowdon *North* Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 .. .. | 174·24 |
| Snowdon *South* Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 .. .. | 23·00 |
| Total .. | 469·24 |

[1] Paragraph 13 of Mr. Ellis' memorandum.

24. It is also no small advantage in connection with this reservoir that it lies in a valley which slopes *away* from Ootacamund, so that in the event of its ever bursting there would be no such loss of life and valuable property as would be the case were it in the Ootacamund water-shed.

25. It is certain that the occasional insufficiency of the reservoir has been due to the imperfect arrangements for taking to it the supply from a large part of its gathering ground, that along the Snowdon slopes. This may be remedied as recommended in paragraph 6 of the Sanitary Board's report, by lining the catch channels with masonry; for doing this the plans[2] and estimates[3] now submitted provide, as also for the extension[4] recommended in paragraph 7 of the Board's report.

[2] Nos. 3 and 4.
[3] Rs. 23,900.
[4] Plan No. 5.

26. If these be carried out there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year.

27. The Sanitary Board is right in considering that the "other works[5]" proposed by Mr. Ellis in his memorandum referred to are not necessary. They were arrived at on the basis of a "run off" of ½ inch in one hour, but this was probably merely a mistake, and certainly a run off of not more than one inch in *24 hours* need be provided for, which the present pipe and conduit are sufficiently large to deal with.

| | Rs. |
|---|---|
| (c) Laying an additional pipe from K to F .. | 4,000 |
| (d) Enlarging masonry conduit from E to F .. | 8,220 |
| (e) Laying additional pipe from F to G .. | 69,000 |
| (f) Enlarging masonry conduit from G to Marlimund lake .. .. .. .. | 57,060 |
| Total .. | 1,38,280 |

28. That these are now so out of order, as supposed by the Board,[6] that "a large quantity of water must be lost by leakage" between Snowdon House and the Reservoir, does not appear to be the case. The Conduit has not been uncovered, but no signs of leakage from it could be detected even when it was carrying a large quantity of water during the last north-east monsoon, and the estimates now submitted do not therefore provide anything for repair of this work.

[6] Paragraph 7 of its Proceedings.

29. As regards the Filtering of the water passed out of the reservoir, this has been already thoroughly gone into as will be seen on reference to the documents noted[7] below, and plans[8] and estimates have been prepared by the Sanitary Engineer which are incorporated with those now submitted. But in addition to the arrangements provided for by the

[8] Nos. 6, 7, 8 and 9.

See letter No. 2370, dated 13th December 1896, with Chief Engineer's endorsement No. 9-C., dated 4th January 1897, Appendix B.

[5] No. 1697, dated 17th August 1893, from the Sanitary Engineer.
Note by the Chief Engineer, Public Works Department, dated 2nd October 1893.
No. 2544, dated 24th November 1893, from the Sanitary Engineer.
Endorsement of Chief Engineer, Public Works Department, No. 862, dated 1st December 1893.



Sanitary Engineer, the Sanitary Commissioner is strongly of opinion that before passing the water into filter beds it should be subjected to the action of "Anderson's[1] revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter[2] from the Agent for the patent in this country, which will be found as Appendix A to this report.

[1] See pamphlet herewith.

[2] No. 45, dated 21st January 1897.

30. The estimated cost of all these filtering arrangements is Rs. 66,000.

31. As regards the *defilement of the water flowing into the Marlimund Reservoir from cultivation*, there can be little doubt that the only effective way of dealing with it, is to acquire all the private lands in the catchment basin, and every day that this course is deferred will add to its cost, because the value of land in and about Ootacamund is increasing, and the cultivation is being extended. It is thought inadvisable in the estimates now sent to deal with the value of the lands in question but the statement Appendix C will give the information on which any provision it may be considered advisable to make can be based.

### (5) Suggested Reservoir near Snowdon House.

32. In paragraphs 3 to 5 of its proceedings the Sanitary Board proposed an "extension of the Snowdon Reservoir" or the construction of "a new dam some 200 feet lower down the valley." The term "reservoir" here applied to what may better be named the "*Snowdon Ponds*", is likely to be misleading to those who do not know the circumstances of the case; those ponds are not connected with the Ootacamund pipe system and therefore do not form any reservoir for it.

33. Surveys and levels have shown that the valley below the site of the ponds is too steep and narrow for a storage reservoir, but a small useful one might be made at a moderate cost by raising and extending the bund of the lower pond so as to hold up water to 15 feet above its present level and incorporating it, and the other pond also, in the reservoir so formed.

34. The Survey[3] plan and sections connected with this will be found with the other plans, but no estimate is sent, because it has been finally decided [see letter[4] No. 36, dated 20th November 1896, to the Chief Engineer, Public Works Department and his reply No. 9-C, dated 4th January 1897] that, as recommended[5] by the Sanitary Board, the water supplied from the Marlimund Reservoir must be filtered, and there is no place for the required filters and service reservoir except this Snowdon Ponds site; see the documents referred to above, in paragraph 29 dealing with "Filtering."

[3] Plan No. 2 (2 sheets).

[4] Appendix B.

[5] Paragraph 4 of its Proceedings.

### (6) Kodapamund Valley—Suggested Storage Reservoir. Proposed Pipe-Head, and supply from it.

35. Much time was spent on surveys[6] and levels in connection with the suggestion (paragraph 9 of the Board's Proceedings) for a storage reservoir in this valley as it seemed an excellent one, but after all, the idea had to be given up because the valley proved so steep and contracted that no safe earthen bund could be constructed high enough to make a storage reservoir of a capacity at all commensurate with the great cost of acquiring the whole of the highly cultivated gardens and all the houses lying *above* it, as well as in its water-spread, and their acquisition would be absolutely necessary as they are sources of great pollution. The absence of rock for foundations would prevent the construction of a masonry dam at the place.

[6] Plans Nos. 11 and 12 (2 sheets).

36. But though the formation of a storage reservoir in this valley is out of the question, the adoption is strongly recommended of a scheme for utilizing the small perennial stream of beautiful water flowing into the valley from the western slopes of Dodabetta, which was worked out by Mr. Nery, Municipal Engineer in 1893, and approved by the Sanitary Engineer (see his No. T-187, dated 29th September 1894).

37. This scheme consists in forming a Pipe-Head[1] Cistern, by means of a masonry dam 15 feet high on the stream in question, well above all sources of contamination, and from it taking the water by pipes for the use of some 600 persons in the villages of Kodapamund and Vannarpetta, and the European houses lying along both sides of the Kelso road. These though they pay water-tax have now no water laid on to anywhere within their reach, but a few of them get a supply by means of an open channel from a stream known as "Sudukadu," *i.e.*, "burning ground," because its sources flow past a Hindu cremation place.

[1] See plans Nos. 10, 13 and 14.

38. As the scheme was worked out by Mr. Nery and his estimate is now used, except as regards the masonry dam for which a fresh design[2] and estimate are now prepared, his detailed description of the scheme is attached to the estimate.

[2] Plans Nos. 13 and 14.

39. The total estimated cost is Rs. 11,800.

### (7) Existing Dodabetta Reservoirs.

40. The cutting off of the tea area referred to by the Board[3] is not feasible. That area, as will be seen from the statement which forms Appendix D, is only 12 acres (including $\frac{1}{2}$ acre of fruit trees) and no extension of cultivation is in progress. There does not appear to be any manuring carried on, and from the analysis of the water given in paragraph 18 it would seem that the cultivation is not now causing contamination; it should however most certainly be acquired especially, as will be seen further on, it will also affect the proposed new Tiger-hill stream reservoir.

[3] Paragraph 13 of Proceedings

41. To prevent cultivation being started on the other private lands ($45\frac{3}{4}$ acres) in the catchment basin of these reservoirs, those lands should also be acquired, which probably might now be effected at a moderate sum.

42. When this has been done and the "undergrowth and humus" in the sholas have been dealt with as recommended in paragraph 2 of the Board's Proceedings, the supply to these reservoirs will be of a quite unexceptionable quality.

43. The silting up of the Lower Reservoir may certainly be somewhat retarded by the means suggested in paragraph 12 of the Board's Proceedings, but the reservoir is of little consequence for storage and its life at best can be but short. This being the case, the increase of supply to it is of no moment and, as will be seen further on, the stream from which such increased supply would have to be brought it is proposed to utilize in feeding a new reservoir; the surplus from that however will still be available for taking into the Lower Reservoir if needed.

### (8) Proposed New Reservoir.

44. The Snowdon and Kodapamund valley sites not being available, as explained above, for the required storage reservoir supplemental to that of Marlimund, it became necessary to fix on some other site, and after careful examination of all apparently possible places it was ascertained that there was none with anything like the advantages of that shown on plans 15 and 16, which may be clalled the "Tiger-hill stream site."



45. It lies in a valley *out* of the Ootacamund water-shed, it has a catchment basin of large area, including that of the existing Upper reservoir, the surplus of which it can receive, and remarkably free from cultivation or possible sources of contamination; it is at such a level as to command the highest houses in Ootacamund; and there is rock for founding a masonry dam on, admitting of a structure high enough to form a really capacious reservoir.

46. The position, catchment area, water-spread, capacity, &c., of the proposed reservoir are clearly shown on plans 15 to 21 but for convenience these particulars, with others, may be here briefly stated.

47. *Position.*—On the stream which flows at the back of "Tiger-hill" and through the Craigmore Forest Reserve, at about 1,100 feet further up that stream than where it impinges against the upper corner of the *Lower* Dodabettar eservoir; and about 750 feet due south of the *upper* reservoir.

48. *Catchment*[1] *Area.*—The natural catchment area is 100 acres, which at a small cost may be increased to $108\frac{3}{4}$ acres. Of this less than 24 acres are private property and only 1·85 acres is under tea cultivation, so that the acquisition of all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that[2] of the existing upper reservoir would by means of a channel[3] provided for in the estimates, be available whenever that reservoir is full, and for a large part of the year it surpluses nearly the whole of the run off. A run off of 1 inch in 24 hours from the whole combined catchment area of 242 acres would fill the reservoir in a little over 5 days.

[1] See Appendix E.
[2] About 134 acres.
[3] See plans 16 and 18.

49. *Capacity.*—With 40 feet depth above the outlet pipe, as designed, the available quantity of water retained in the reservoir would be approximately 30,387,500 gallons, or sufficient at 20 gallons a head per diem for upwards of 4 months supply to 12,000 persons, that being the number to be provided for (see paragraph 5) on the north side of the lake, and it is for that portion of Ootacamund, it will be understood that the reservoir is specially proposed. It will therefore be generally capable of entirely taking the place of the Marlimund reservoir for several months in the year, though its drainage area is not sufficient to permit of its being solely trusted to; the Marlimund reservoir must still, it is believed, be depended on to make Ootacamund quite free of any danger of deficient supply at any time.

50. *Character of the water.*—The water of the stream on which the reservoir will be constructed is of great purity as shown in the following analysis by the Chemical Examiner to Government of samples taken just above the site for the dam:—

Water from the Craigmore Block Stream.

| | | | | |
|---|---|---|---|---|
| Total solids | Grms. per litre | | | 0·040 |
| Volatile solids | do. | do. | | 0·020 |
| Chlorine | do. | do. | | 0·001 |
| Total hardness | | | Clark's scale | Trace. |
| Permanent hardness | | | do. do. | Trace. |
| Free ammonia | Mlgrms per litre | | | Trace. |
| Albumenoid ammonia | do. | do. | | 0·064 |
| Nitric acid | do. | do. | (as Ammonia) | Trace. |
| Apparent quality of the water as inferred from the results obtained on examination | | | | Pure and wholesome. |

Remarks.—A first-class water.

The water to be brought from the existing Dodabetta Upper Reservoir is also of excellent character (see paragraph 18) and may be still further improved by the means recommended in paragraphs 40 to 42.

51. *Swamp in the bed.*—It will be noticed in plan No. 16 showing the water-spread of the proposed reservoir that there is in it a swamp of about $1\frac{1}{2}$ acre in extent. In this pits have been sunk and have shown it to be composed of vegetable soil about 8 feet in depth, portions of it being composed of imperfectly formed peat. It is not thought that this is a serious drawback to the site, but as judging from the

opinions expressed in connection with the Marlimund Reservoir, it may be considered so, it is deemed proper to bring the matter to notice. In few parts of the world can valleys which are at all flat be found without vegetable soil in their beds, and most certainly none will be found near Ootacamund which have not also a mixture of peat more or less perfectly developed.

52. It may be possible by desiccation, or some other means, to so deal with the swamp before the reservoir is brought into action and it is covered with water, as to destroy or neutralize any deleterious elements in the soil, but if this is not practicable, then rather than it should cause the rejection of this excellent site for the reservoir, the whole of the offending soil had better be removed, though this would be an expensive operation, and the disposal of the spoil on the steep hill sides above the water-spread would be a somewhat difficult matter. It should be noted that the design provides by means of a large 'scour-pipe,' for laying the bed of the reservoir dry at will.

53. The total estimated cost of this reservoir exclusive of any compensation for private land it may be decided to acquire in its catchment basin is Rs. 47,400.

54. As regards the conveyance of the water of the new reservoir to, and its distribution over, the area, the present supply of which it is intended to supplement, there are two systems which may be adopted; one that of keeping the new supply entirely separate, the other that of joining it on to the existing main above where it branches off into its distributing pipes and so making use of *them*. In either case the new main must be taken for 10,375 feet to Charing Cross, but in the former system there would from that point be required some 39,000 feet of new distributing mains, whilst in the latter system, 3,716 more feet of the new main itself would take the water to the existing[1] main from which it would be distributed by the present pipes. The latter arrangement is so greatly the cheaper, and, it is believed, so much the better, that it is recommended for adoption and the estimate Rs. 38,600 has been framed accordingly.

Plan No. 22 (3 sheets.)

55. The lowest point—Charing Cross—to which the new main will have to descend is rather more than 600 feet below the outlet pipe of the reservoir, and as so great a head would necessitate an unusual thickness of pipes for some distance, it is proposed to put a "break-pressure" tank just below the Dodabetta Lower Reservoir reducing the head by nearly 100 feet; even with this reduction the pressure when the "reducing-valve" (to be mentioned further on) is closed, or partially so, will give an ample command of the houses[1] that now lie above the influence of the present system, and also of the houses which will doubtless before long be built along the proposed new road.

[1] Shedden House and Hall. Farley. Prospect Lodge. Wrex Hurst, &c.

56. The supply thus given to the high level houses may possibly not be free from occasional failure, but this would rarely occur with proper arrangements in bringing the Marlimund Reservoir into use for the parts of the system commanded by it, before the new reservoir was run dry.

57. The "break-pressure" tank abovementioned would be 193 feet higher than the outlet pipe of Marlimund Reservoir and 226 feet above the existing main at the proposed point[2] of junction of the new main, but of this 175 feet would be absorbed by the fall required to give the required discharge through the proposed 6 inch pipe. It is however advisable (as recommended by the Sanitary Engineer when consulted on the subject) to put a "pressure-reducing valve" on the new main near the junction.

[2] The "Sump" above St. Stephen's Church.

[1] The length of the existing main from the Marlimund reservoir to the 'Sump' where the junction will be made, is 10,445 feet.



58. As it is considered necessary that half the 240,000[3] gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332[4] gallons per minute, a 6-inch diameter pipe will have to be used. This will be laid for the first 1,100 feet along the left bank of the Tiger-hill stream and then across, or round, the Lower Dodabetta reservoir, just below which the "break-pressure" tank will be placed; thence the pipe will run along the track of the existing main of the *South system* to near Walthamstow corner on the Coonoor road, and from there it will follow that road to Charing Cross where a 'wash-out' valve with pipe to the stream will be provided. From Charing Cross it will run along Church-hill road to near St. Stephen's gate and thence along the road and path beside the eastern boundary of the church enclosure direct to the "Sump," where the junction with the existing main will be made with a "pressure-reducing valve." No private land will have to be acquired for the pipe track.

[3] 12,000 × 20.

[4] This is exclusive of the 14 cubic feet per minute required between Walthamstow corner and Charing Cross, see next paragraph.

59. As the pipe passes along the Coonoor road from Walthamstow corner to Charing Cross, water can be taken from it to the houses along that road and "Old Ooty" road for the supply of which from the *South system* (which it will be well to relieve of the duty) an estimate of Rs. 6,300 has lately been prepared by the municipality and approved by the Sanitary[5] Engineer. Of that estimate Rs. 5,200 are for the arrangements connected with the main pipe, the necessity for which the main now proposed will supersede. The quantity of water to be supplied to the house, &c., now under consideration is 10,000 gallons per diem and this the proposed main can easily carry in addition to the 240,000 gallons which it has to take on, as above explained.

[5] See his letter 122, dated 20th January 1897.

60. It may be noted that it will be easy, and cost but a small sum to put the new main into connection with that of the *south system* either at the Lower Dodabetta reservoir or near Walthamstow corner, if this should at any future time be considered advisable.

### (9) "Old Ooty" Supply.

61. This requires improvement of the infiltration arrangements by surrounding the upper cistern with broken stone and gravel through which the water will pass to open jointed or perforated pipes. This will cost so little that it need not be entered in the estimates herewith, but may be carried out from ordinary Municipal Maintenance grants.

62. It is however also very advisable that the portion of Survey field No. D/267-A shown on plan 15 enclosed in dotted red lines and containing an area of about 9 acres should be acquired and enclosed to prevent the present considerable fouling of the sources of the springs. The greater part of the ground to be acquired is very steep and quite unfitted for building sites and is at present waste, though there are signs of portions of it having been cultivated with potatoes or vegetables. The probable cost of "compensation" is not entered in the present estimates (see paragraph 31).

### (10) General Summary of Proposals.

63. The proposals made and estimates submitted are—

| | | |
|---|---|---|
| (*a*) To line the existing Snowdon channels with masonry and bring more water to the Southern one by diversion of a stream above Government gardens | Paragraphs 25 to 28. | 23,900 |
| (*b*) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site .. .. .. | Paragraphs 29 and 30. | 66,000 |
| (*c*) To construct a Pipe-head reservoir on the Kodapamund Valley stream. | Paragraphs 35 to 39. | 3,740 |

| | | Rs. |
|---|---|---|
| (*d*) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta .. .. | Paragraphs 38 and 39. | 8,060 |
| (*e*) To construct a new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger-Hill .. .. .. | Paragraphs 44 to 53. | 47,400 |
| (*f*) To carry the water from the new reservoir to the '*Sump*' on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | Paragraphs 54 to 60. | 38,600 |
| (*g*) To acquire the private lands lying in the catchment basins of the Marlimund reservoir, Dodabetta reservoirs, and proposed new reservoir, and also about 9 acres of survey field No. D/267-A in connection with the "Old Ooty" supply .. .. .. .. .. .. .. .. | Paragraphs 31, 40, 41, 48, 62. | No estimate. |
| Total .. | | 1,87,700 |

64. It is confidently believed that if these recommendations be carried out Ootacamund will have a never failing supply of excellent water.

Ootacamund,
8*th March* 1897. (Signed) G. T. WALCH, M.I.C.E.

## APPENDIX A.

From S. CRANSHAW, Esq., Municipal Engineer, Agra Municipality, to G. T. WALCH, Esq., M.I.C.E., Ootacamund Water Works, dated Agra, 21st January 1897, No. 45.

The reply to your No. 57 of the 15th instant, I have much pleasure in giving you the information asked for—

For 300,000 gallons in 24 hours a revolver with 7-inch inlet pipe costing £450 F.O.B. London would be sufficient but I would in order to be prepared for an increase of consumption recommend you to have one with 8-inch inlet pipe costing £525 F.O.B. London. This would deliver 402,370 gallons per 24 hours with 3½ minutes contact. The driving power for this sized revolver would be 9,880 foot pound per minute or, say, ½ H.P. no staff is required as after the revolvers are started, they work on with the exception of oiling the bearing without any attention.

The floor space required is 19′ × 8′. The charge of iron punchings required is 14 cwt. which at Rs. 4 per cwt. would be Rs. 56 and the annual quantity of punchings for renewals with a 3-lac delivery would be about 36 cwt. The price I have given does not include the water pipes to and from the revolver or belting for driving same, but includes driving gear fitted with fast and loose pulleys, cast-iron pedastal bearings for cylinder and foundation bolts. The cost of freight and landing charges you will be able to work out for yourself.

My annual maintenance charges on 3—10-inch revolvers passing an average of 1½ million gallons daily is about Rs. 500.

Trusting the above will be satisfactory.

*P.S.*—If you have not steam-power available arrangements can be made to drive it by bullock-power.

## APPENDIX B.

From G. T. WALCH, Esq., M.I.C.E., Ootacamund Water Works, to the Chief Engineer, Public Works Department, dated Ootacamund, 20th November 1896, No. 36.

As I anticipated,* I have failed to find any site for a reservoir which will render the abandonment of the Marlimund reservoir as the main storage for the supply of Ooty advisable, it would however be possible to make a useful little supplementary reservoir at the site of the Snowdon ponds.

* See paragraph 3 of my letter, dated 23rd November 1895, printed with P.M.G., No. 298-W, dated 24th January 1896.

2. That site however will be required for filter beds and service reservoir if filtration of the Marlimund reservoir water be decided on (see note of Acting Chief Engineer, Public Works Department, dated 2nd October 1893, No. 3299-C, and reply of the Sanitary Engineer to Government, dated 24th November 1893, No. 2544), and I therefore request that I may be informed of the decision in the matter.



*Dated Madras, 4th January* 1897.

Letter from the Sanitary Commissioner for Madras, No. 2370-S., dated 13th December 1896.

With reference to your endorsement No. 4683 of the 8th December 1896, I have the honour to state that having regard to the chemical composition of the Marlimund water, which is the natural sequel of its mode of collection and especially of the character of the reservoir, and to the existence within its catchment of human habitations, I am of opinion that it would be sanitarily erroneous for a town of sufficient importance to demand municipal government, and still more so for a town boasting of being the sanitarium of Southern India, to permit delivery to the consumer of such water without an effort to alter its chemical composition, and guard against its possible bacterial contamination. In other words, if the full benefit of expenditure upon collection, storage, and distribution is to be reaped by the inhabitants, it can only be secured by taking these additional precautions.

2. I know of no method that will meet these combined requirements so thoroughly as by arranging in the first place to subject the water to the action of iron in Anderson's revolvers, and subsequently deliver it upon the ordinary type of public water works sand filter beds, fitted with all modern appliances for charging the beds with filtered water before starting, for regulating the filter speed, and allowing facilities for separate bacteriological examination and the rejection of unsatisfactory filtrates without disturbance of individual beds The motive power required for the revolvers is small. But if the provision of this small power be regarded as offering difficulties, the next best, but in my opinion inferior, method would be the use of polarite combined with sand filtration.

3. Water of this character might instead of either of the above methods be advantageously dealt with, as in the case of sewage, by subjecting it to filtration through porous gravel land and re-collecting it by means of wells and sub-drains; but I am not aware of a suitable plot of ground for this process in the vicinity of Marlimund. It would however be in the interest of economy that the Engineer designing the scheme should search for such ground between Marlimund and Snowdon reservoir. Although this method would be cheap and effective, I need not remind you that it would not be economical of water.

Endorsement No. 9-C.

Copy of the Sanitary Commissioner's letter forwarded to Mr. Walch with reference to his No. 36, dated 20th November 1896, and with the remark that it appears that filtration of the Marlimund reservoir water is necessary.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer, Public Works Department.*

## APPENDIX C.

Statement of areas in the natural catchment basin of Marlimund reservoir.

| Survey field No. | Government waste. | | Private property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C/359 .. .. | 40 | .. | .. | .. | .. | .. | |
| C/138 .. .. | .. | .. | 2 | 22 | .. | .. | Tudor Hall. |
| C/137 .. .. | .. | .. | 2 | 42 | .. | .. | |
| C/139 .. .. | .. | .. | 8 | 84 | 8 | 15 | Tudor Hall. |
| C/141 .. .. | .. | .. | 1 | 30 | .. | 18 | Do. |
| C/140 .. .. | .. | .. | 1 | .. | 1 | .. | Do. |

Statement of areas in the natural catchment basin of Marlimund reservoir—*cont.*

| Survey field No. | Government waste. | | Private property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C/142 | .. | .. | .. | 61 | 3 | 44 | Tudor Hall. |
| C/143 | .. | .. | 2 | .. | .. | 50 | |
| C/145 | .. | .. | 6 | 91 | 2 | 81 | Tudor Hall. |
| C/133 | .. | .. | 3 | 46 | 4 | 10 | Do. |
| C/135 | .. | .. | .. | 15 | .. | .. | |
| C/132 | .. | .. | .. | 13 | .. | .. | |
| C/131 | .. | .. | .. | 36 | 3 | 10 | Tudor Hall. |
| C/136 | .. | .. | .. | 24 | .. | .. | |
| C/134 | .. | .. | .. | 8 | .. | .. | |
| C/144 | .. | .. | .. | 75 | 1 | 32 | Tudor Hall. |
| C/146 | .. | .. | 3 | 66 | 6 | 4 | Do. |
| C/344 | .. | .. | 13 | 20 | .. | .. | In register this appears as "municipal property." |
| C/147 | .. | .. | .. | 5 | 89 | 4 | .. Tudor Hall. |
| C/150 | .. | .. | .. | 16 | .. | 18 | 40 Do. |
| C/148 | .. | .. | .. | 7 | 6 | 31 | 60 Do. |
| C/149 | .. | .. | .. | .. | 65 | .. | .. Gayton Park. |
| C/130 | .. | .. | .. | 47 | 73 | .. | .. |
| C/175 | .. | .. | .. | .. | 50 | .. | .. Gayton Park. |
| C/177 | .. | .. | .. | 83 | .. | .. | .. .. |
| C/178 | .. | .. | 5 | 30 | .. | .. | .. .. |
| C/360-A | .. | .. | 7 | 10 | .. | .. | .. .. |
| C/338 | .. | .. | 9 | 12 | .. | .. | .. .. |
| Total,* | .. | | 75 | 55 | 111 | 96 | 84 64 |

* Total 272 acres 15 cents. approximate.—Note.—In Appendix A of report with P.M.G., No. 286-W., dated 1st February 1882, this is given as 268 acres.

Ootacamund
8th March 1897

(signed) George T. Walch
M. Inst. C.E.



## APPENDIX D.

Statement of areas of Catchment Basin of the Dodabetta Upper Reservoir.

| Survey Field No. | Government waste and forest. | | Private property. | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Uncultivated, blue gum, and cinchona. | | Tea. | | Fruit trees. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| F/234 | .. | .. | 6 | .. | .. | .. | .. | .. | |
| F/232 | .. | .. | 8 | 64 | .. | .. | .. | .. | |
| F/230 | .. | .. | 6 | 51 | .. | .. | .. | .. | |
| F/228-F | 5 | 50 | .. | .. | .. | .. | .. | .. | |
| F/304-B | 5 | 25 | .. | .. | .. | .. | .. | .. | |
| F/228-G | 46 | 18 | .. | .. | .. | .. | .. | .. | |
| F/244 | .. | .. | 6 | 35 | .. | .. | .. | .. | |
| F/228-Z | .. | 50 | .. | .. | .. | .. | .. | .. | |
| F/243 | .. | .. | 3 | 22 | .. | 30 | .. | .. | |
| F/241 | .. | .. | .. | .. | 2 | 11 | .. | .. | |
| F/240 | .. | .. | 1 | 46 | 2 | 34 | .. | .. | |
| F/228-E | 8 | 50 | .. | .. | .. | .. | .. | .. | |
| F/231 | .. | .. | 2 | 68 | 2 | 41 | .. | 50 | |
| F/242 | .. | .. | 3 | 24 | 1 | 59 | .. | .. | |
| F/239 | .. | .. | 2 | 10 | 2 | 80 | .. | .. | |
| F/277 | .. | .. | 5 | 50 | .. | .. | .. | .. | |
| F/245 | 3 | .. | .. | .. | .. | .. | .. | .. | |
| F/305-A | 7 | .. | .. | .. | .. | .. | .. | .. | |
| F/228-X | .. | 19 | .. | .. | .. | .. | .. | .. | |
| Total .. | 76 | 12 | 45 | 70 | 11 | 55 | .. | 50 | Total, 133 acres 87 cents. |

Ootacamund,
8th March 1897.

(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*

## APPENDIX E.

STATEMENT of areas in Catchment Basin of proposed "Tiger-Hill" Stream Reservoir.

| Survey Field No. | Government forest. | | Municipal property. | | Private property. | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Uncultivated, and blue gum. | | Cinchona. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| F 237 | 6 | 25 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 250 | .. | .. | 9 | 44 | .. | .. | .. | .. | .. | .. | |
| F 296 | .. | .. | .. | .. | .. | 87 | .. | .. | .. | .. | |
| F 249 | .. | .. | .. | .. | 5 | .. | .. | .. | .. | .. | |
| F 247 | .. | .. | .. | .. | .. | .. | 7 | 20 | .. | .. | |
| F 228-Z | .. | 19 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 245 | .. | .. | .. | .. | .. | 48 | .. | .. | .. | .. | |
| F 244 | .. | .. | .. | .. | 2 | 47 | .. | .. | .. | .. | |
| F 243 | .. | .. | .. | .. | .. | 50 | .. | .. | .. | .. | |
| F 241 | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 25 | |
| F 240 | .. | .. | .. | .. | .. | 50 | .. | .. | .. | 60 | |
| F 238 | .. | 25 | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 228-A | 60 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| F 248 | .. | .. | .. | .. | 5 | 4 | .. | .. | .. | .. | |
| Total .. | 66 | 69 | 9 | 44 | 14 | 86 | 7 | 20 | 1 | 85 | Total, 100 * acres 4 cents. |

* Besides this, about 8½ acres of Field No. C/237 may be brought in by catch drain.

OOTACAMUND,
*8th March* 1897.

(Signed) GEORGE T. WALCH,
*M. Inst. C E.*



## APPENDIX F.

SYNOPSIS of Important Bench Marks in connection with the Investigations.

| Description of B.M. | Position of B.M. | Value. | Remarks. |
|---|---|---|---|
| On Rough Stone Floor .. .. | Floor of Escape of Marlimund reservoir (under bridge) .. .. .. .. .. .. [*Note.*—Zero of present gauge on water tower is 18 feet below this.] | 7444·72 | This is the initial B.M. from which all the levels of the investigations are taken; the value is that given in letter 2777 of 9th September 1896 of the Sanitary Engineer to Government. The datum is probably approximately, but only roughly approximately, mean Sea-level. |
| Tar Mark [redacted] .. .. .. | Parapet of dividing cistern south side of Kotagiri road (east of Snowdon House grounds).. | 7465·68 | See plan 2 (sheet 1). |
| .... | Floor of Escape of Lower Snowdon pond .. .. .. .. .. .. .. .. | 7423·75 | See plan 2 (sheet 1). |
| .... | Level of top of main to Ootacamund just as it leaves the tunnel near Snowdon Lower pond. | 7425·30 | |
| B. [redacted] M. Cut .. .. .. | On rock, east side of Snowdon road about 64 feet from road to "Fox How" .. .. | 7432·69 | |
| B. [redacted] M. Cut .. .. .. | On rock, east side of Snowdon road near Pear trees .. .. .. .. .. .. | 7386·99 | |
| B. [redacted] M. Cut .. .. .. | On rock, west side of Snowdon road below latrine of "Hill Side Villa" .. .. .. | 7370·95 | |
| Tar B. [redacted] M. .. .. .. | On parapet of "Sump" above St. Stephen's Church; near "Highland Villa" .. .. [*Note.*—Top of pipe inside this Sump 7392·51.] | 7397·35 | |
| Tar B. [redacted] M. .. .. .. | On west end of second step of entrance at *North* end of "Shedden House" .. .. .. | 7530·50 | See plan 1. |
| Tar B. [redacted] M. .. .. .. | On stone in north angle of brick edging of triangular plot at junction of Church Hill road, with road to Library. | 7228·10 | |
| B. [redacted] M. Cut .. .. .. | On plinth of pilaster at end of western upstream wing, Charing Cross Bridge .. .. [*Note.*—There is an old tar B.M. on the east corner of north parapet of this bridge; Value 7115.76]. See sketch in remark column. | 7103·54 | |

APPENDIX F—*cont.*

| Description of B.M. | Position of B.M. | Value. | Remarks. |
|---|---|---|---|
| B. ■ M. Cut .. .. .. | On rock, east side of road to Kodapamund Dhobie village, opposite "Kelso Villa" Lawn Tennis Court. | 7179·68 | See plan 10. |
| B. ■ M. Cut .. .. .. | On rock near road in Dhobie village below washerman Arumugam's house .. .. .. | 7246·54 | See plans 10 and 11. |
| B. ■ M. Cut .. .. .. | On rock in bed of western branch ("Shadukadu") of Kodapamund valley stream, below road revetment. | 7397·89 | See plans 10 and 11. |
| B. ■ M. in Tar .. .. .. | On north parapet of measuring weir across Kodapamund main stream—a short distance above Kotagiri road. | 7528·89 | This is the proposed site for "Pipe-head"—See plans 10 and 11. |
| B. ■ M. in Tar .. .. .. | On rock right edge of Vannarpetta stream (Old Rifle Butts, or Manjekalmund, valley) .. | 7303·49 | See plans 10 and 11. |
| B. ■ M. in Tar .. .. .. | On stone curb of platform round fountain at junction of "Walthamstow" road with Coonoor road. | 7302·78 | See plan 22 (sheet 1). |
| B. ■ M. in Tar .. .. .. | On south parapet of cistern at Lower Dodabetta reservoir .. .. .. | 7631·47 | See plans 15, 16 and 22 (sheet 1). |
| .... | Crest of Escape of Upper Dodabetta reservoir .. .. .. | 7787·37 | |
| | [*Note.*—The zero of present gauge on water tower is 24·80 below this escape.] | | |
| B. ■ M. Cut .. .. .. | On rock left side of "Tiger-hill stream" .. .. .. | 7677·44 | See plans 15, 16 and 22 (sheet 1). |
| B. ■ M. Cut .. .. .. | On slab rock left side of stream a short distance above proposed site for dam of new reservoir. | 7712·99 | See plans 15 and 16. |
| B. ■ M. Cut .. .. .. | On rock on left side of stream about 325 feet above the last B.M. .. .. .. | 7727·65 | See plans 15 and 16. |

NOTE.—There has hitherto been no datum common to all, or many, of the levels connected with the Ootacamund water-supply. As it is very advisable that this should no longer be the case much consideration was given to the question as to what datum should now be adopted. The "Survey of India Department" was addressed in the hopes that it might have established some Standard Bench Mark at Ootacamund; the reply was that "there are no G.T.S. Bench Marks in Ootacamund" but "a list of Trigonometrical Heights" was supplied, of which however no use could be made as it was not possible to fix with certainty and accuracy any of the points named. It was therefore decided to adopt the value of the *Marlimund Reservoir Kerbe*, as taken by the Sanitary Department in its last levelling here, and use its datum; see remark opposite the first B.M. in the above list. It is strongly recommended that this be adhered to in future in all levels Municipal and otherwise, connected with Ootacamund water-supply and drainage; the various well defined B.M.'s here given will make this an easy matter.

(Signed) GEORGE T. WALCH,
*M. Inst. C.E.*

OOTACAMUND,
*8th March* 1897.



## APPENDIX G.

*Plans to accompany report.*

| Distinguishing No. of plan. | Description of plan. | Number of sheets. | Paper (P.) or Tracing Linen (T.L.) | Remarks. |
|---|---|---|---|---|
| | *Book* 1. | | | |
| 1 | Parts of Revenue Survey sheets 3, 4 and 5 showing existing cultivation in catchment basin of Marlimund reservoir, &c. | 1 | P. | Lithograph. |
| 2 | Survey plan and sections, Snowdon ponds .. .. .. .. | 2 | P. | |
| 3 | Longitudinal section of Snowdon channels .. .. .. .. | 1 | T.L. | |
| 4 | Conduits and cistern for Snowdon channels .. .. .. .. | 1 | T.L. | |
| 5 | Survey plan for diversion of stream .. .. .. .. .. | 1 | T.L. | Prepared by Sanitary Engineer. |
| 6 | Plan of proposed position of filter beds and service reservoir .. | 1 | T.L. | |
| 7 | Sections for do. do. do. .. | 1 | T.L. | |
| 8 | Plan and sections of filter beds .. .. .. .. .. | 1 | T.L. | |
| 9 | Plan and sections of service reservoir .. .. .. .. .. | | | |
| | *Book* 2. | | | |
| 10 | Parts of Revenue Survey sheets 10, 11 and 12 showing proposed Kodapamund Pipe-head. | 1 | P. | Lithograph. |
| 11 | Survey showing site which was suggested for reservoir, Kodapamund valley, &c. | 1 | T. L. | |
| 12 | Sections across Kodapamund valley .. .. .. .. .. | 2 | T.L. | |
| 13 | Survey for proposed Pipe-head reservoir .. .. .. .. | 1 | T.L. | |
| 14 | Drawing for Pipe-head dam .. .. .. .. .. | 1 | T.L. | |
| | *Book* 3. | | | |
| 15 | Parts of Revenue Survey sheets 10, 11 and 12 showing proposed new reservoir and existing Dodabetta reservoirs. | 1 | P. | Lithograph. |
| 16 | Survey plan site for proposed new reservoir, &c. .. .. .. | 1 | T.L. | |
| 17 | Cross sections, Tiger-hill stream .. .. .. .. .. .. | 1 | T.L. | |
| 18 | Section for channel from Dodabetta Upper reservoir to the proposed new reservoir. | 1 | T.L. | |
| 19 | Design for dam, &c. .. .. .. .. .. .. .. | 1 | T.L. | |
| 20 | Do. ground, plan and elevation .. .. .. .. .. | 1 | T.L. | |
| 21 | Survey and section for bye-wash .. .. .. .. .. | 3 | T.L. | |
| 22 | Sections for piping from new reservoir to Sump above St. Stephen's Church. | | | |
| | *Separate.* | | | |
| | Map of Ootacamund—Scale 6" = 1 mile showing areas supplied by pipes from various sources. | 1 | P. | Lithograph, Madras Survey. |

OOTACAMUND,
*8th March* 1897.

(Signed) G. T. WALCH,
*M. Inst. C. E.*

Note by the Chief Engineer, dated 25th May 1897, No. 327 D.

There are at present three sources of water-supply for Ootacamund—

(1) Marlimund reservoir,
(2) The spring above Old Ooty,
(3) The Dodabetta reservoirs,

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply—one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, first, in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens, second, in providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in paragraph 26 of his report that "there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year." If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

3. Mr. Walch's statement is made from experience, and there can be little doubt that he is correct, but it will perhaps be as well to test what he says by figures.

4. Supposing the reservoir to be empty at the beginning of the south-west monsoon, say, 1st June, the average rainfall during that monsoon, 1st June to 1st October (4 months), is 21·78″; and supposing one-third of this, or, say, 7″, to be the run-off, the amount received into the tank would be 83·6 million gallons, the catchment area being 528 acres. The amount used at 20 gallons per head for 12,000 persons would be 29 million gallons, and the evaporation and absorption, taken at 24″ over the whole water-spread of 18 acres, would be 9·7 million gallons: therefore the balance left in the reservoir at end of the south-west monsoon, or on 1st October, would be 83·6 — (29 + 9·7) = 44·9 million, say, 45 million gallons.

5. The average rainfall during the north-east monsoon, say, 1st October to 1st January, or 3 months, is 16·19″, and supposing one-fourth of this, or, say, 4″, to be run off, the supply received would be 47¾ million gallons. The quantity used during this period will be 22 million gallons and the evaporation and absorption at 12″, 4·8 million gallons, so that at the end of the north-east monsoon, or 1st January, there will be (45 + 47·7) — (22 + 4·8), or 65·9 million gallons, which would much more than fill the reservoir, its capacity being 54·5 million gallons. Now from 1st January to 1st June the quantity used will be 36¼ million gallons and the evaporation and absorption taken at 36″ will be 14·5 million gallons, so that the total quantity required during the 5 months will be 50·7, so that there would still be 3·8 million gallons in the reservoir on 1st June; but it must be remembered that no credit has been given for any rain that may fall between 1st January and 1st June and the average of these 5 months is 11·30″. So I think that there can be no doubt that the Marlimund reservoir as improved by Mr. Walch's proposals will meet all requirements as regards quantity. I would further point out that I have taken the worst view of the case, for considering the nature of the catchment area, the run-off I have allowed is low, and 6′ for evaporation and absorption over the whole water-spread of 18 acres is, no doubt, much above what it will be; but in the absence of correct information I have thought it well to err on the safe side. It must further be remembered that 20 gallons per head for a population 25 per cent. greater than at present is a very liberal allowance, and I doubt (if undue wastage is prevented) that it will ever be used as the most part of the population is native. It may therefore be safely asserted that, even in the *worst* year, the supply in the Marlimund reservoir will be ample. Judging from the rain registers for the past 7 years the variations are trifling, the worst year giving a rainfall of 46·48″ and the best 64·9″, the average as taken in the foregoing calculation being 49·27.

6. As regards the quality of the water in the Marlimund reservoir, I believe it has been condemned on account of the peat soil in catchment and bed and owing to the chemical analysis being unfavourable. It has therefore been considered necessary to provide filters and a service reservoir and also Anderson's revolvers at a cost of Rs. 66,000. Though I hardly like to oppose the opinion of sanitary experts, I still think that, before such heavy expenditure is incurred, it would be well if it could be shown that the health of the people in Ootacamund has suffered by the use of the water. It is well known that chemical analysis is useless to determine whether water is wholesome or not, and, as Mr. Baldwin Latham, one of the greatest authorities on Sanitary Engineering, says, "the impure water of the chemist was not always unwholesome water, nor was the pure water of the chemist always pure," and again Professor Huxley pronounced an opinion that water might be as pure as possible from a chemist's point of view and yet be most deadly. Actual facts are therefore more to be depended on than theory. In this I am supported by the late Sanitary Commissioner for Madras, Surgeon-General M. C. Furnell, M.D., F.R.C.S., who in his letter, No. 96, dated 31st January 1884, to the Chief Secretary to Government, wrote as follows:—"The outcome of it all is that, if water has been drunk with impunity by people without any injury to health, it would be folly to condemn it because chemists demonstrate it contains so many hundreds or thousands of grains of organic matter per litre." Objections are also taken to the Marlimund water because the catchment and the bed are peat. With reference to the former I will quote from W. Pole, F.R.S., a great authority on such matters. He writes as follows:—"There is however one kind of



effect to which water even from the highest land is liable, namely, to discolouration by peat. Most of these high lands contain in certain spots masses of decaying vegetation in the shape of morasses or peat bogs. These collect the rain water like sponges and when it flows away from them it carries with it small particles of the vegetable matter which render it brown in colour. This is no great detriment to the use of the water; the presence of these brown particles does not render it at all unwholesome: but still it is objectionable to look at." I believe it is still asserted by the Sanitary authorities that, though the catchment area being peat may not be objectionable, the bed of the reservoir being so renders the water unwholesome. This is, I fancy, theory, as I have seen no reason given for the assertion. I am therefore of opinion that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the Marlimund reservoir water, there is no necessity to go to the expense of filters and Anderson's revolvers. At the same time to be perfectly safe, I would follow Mr. Walch's suggestion and acquire the private land in the catchment basin of the reservoir. What the cost of doing so will be is not stated, but probably it will not amount to Rs. 66,300—the cost of filters and Anderson's revolvers. The private lands in the catchment area of the Dodabetta reservoir should be acquired for the same reason.

7. I am therefore of opinion that the new Tiger Hill reservoir is not required and all that is necessary to do is to improve the Marlimund reservoir as suggested by Mr. Walch. The objection to this is that some houses on high ground to the north will not be supplied; but whether it is advisable to expend Rs. 86,000 (cost of new reservoir and piping) to attain this object is a question that others must decide.

*Pipe Head Reservoir on the Kodapamund Valley.*—This is, I consider, a very necessary work and will supply some houses that pay water-tax though no water is laid on. The details have been carefully worked out and the cost will be Rs. 3,740. All that I would therefore propose to do at present as regard the water-supply of Ootacamund is:—

| | Rs. |
|---|---|
| 1*st.*—To line the existing Snowdon channels with masonry and bring more water to the southern one by diversion of a stream above Government Gardens .. .. .. .. | 23,900 |
| 2*nd.*—To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| 3*rd.*—To acquire the private lands lying in the catchment area of the Marlimund and Dodabetta reservoirs .. .. .. | Cost unknown. |

8. In case, however, my views are not accepted and it is still considered advisable to construct the Tiger Hill reservoir, it is necessary that I should make some remarks about it. The catchment area as proposed will be 242 acres or not half that of the Marlimund reservoir. Therefore it cannot by itself be considered as a sure supply for the whole of the northern portion of Ootacamund now supplied from Marlimund. The water is said to be very pure, but the bed of the reservoir contains peat as at Marlimund, and no doubt after a time the Sanitary authorities will say that filters and Anderson's revolvers are necessary as the water will probably become discoloured.

9. The only advantage I can see in constructing this reservoir is that it will command the whole of the northern part of Ootacamund, and if it is decided to construct it I would suggest that the supply to be drawn from it be limited to that required for drinking and cooking purposes, say, 5 gallons per head per diem. The capacity would then be enough and the Marlimund water be used entirely for flushing drains, watering roads, extinguishing fires, &c. This would necessitate the new reservoir having an entirely separate pipe system of its own, but this, I believe, would cost less than the Rs. 66,000 proposed to be spent on the filters, service reservoirs and Anderson's revolvers at the Marlimund reservoir.

10. The scheme for the Ootacamund water-supply has been most carefully worked out by Mr. Walch in a very short time and it is only necessary for me to mention one or two of the details.

*Kodapamund Valley Scheme.*—The details of the piping are not complete, but these can be supplied by the Sanitary Engineer.

*Tiger Hill Dam.*—The bottom width of this should be increased to 27′.

11. There are no detailed estimates for filter beds and service reservoirs.

12. I consider that if Anderson's revolvers are provided the size of the filter beds may be reduced by about one-half as the rate of filtration can be nearly doubled. The saving in this case would be about Rs. 18,000. Appendix A of Mr. Walch's report gives some information about the annual maintenance of Anderson's revolvers, but from it I cannot clearly make out what would be the cost in the case of Ootacamund.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Chief Engineer.*

---

*Endorsement*—No. 328 D., dated 25th May 1897.

Transferred to the Local and Municipal Department.

(Signed) D. McNEIL CAMPBELL, Colonel, R.E.,
*Secretary to Government, P.W.D.*

---

Order—No. 2156 M., dated 2nd October 1897.

In G.O., No. 298 W., dated 24th January 1896, recorded in G.O., No. 349 M., dated 27th February 1896, Mr. G. T. Walch was requested to draw up plans and estimates for the improvement of the water-supply of Ootacamund in accordance with the recommendations made by the Sanitary Board in its Proceedings, No. 2286, dated 14th August 1895. With the first paper read above, the Chief Engineer, Public Works Department, forwards for the orders of Government the proposals made by Mr. Walch, which, with the estimated cost, are briefly as follows :—

| | Rs. |
|---|---|
| (1) To line the existing Snowdon channels with masonry and to divert into the southern channel a stream above the Government gardens .. .. .. .. .. .. .. | 23,900 |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds .. .. .. .. .. .. .. | 66,000 |
| (3) To construct a pipe head reservoir on the Kodapamund valley stream .. .. .. .. .. .. .. .. | 3,740 |
| (4) To conduct the water from this new reservoir to the houses along the Kelso road and to the villages of Kodapamund and Vannarpetta .. .. .. .. .. .. | 8,060 |
| (5) To construct another new reservoir on the stream flowing through the Craigmore forest reserves at the back of Tiger Hill .. .. .. .. .. .. .. .. | 47,400 |
| (6) To conduct the water from this reservoir to the "Sump" on the existing main above St. Stephen's Church and there connect with the present distributary system .. .. | 38,600 |
| Total .. | 1,87,700 |

Mr. Walch also recommends the acquisition of the private lands lying in the catchment basins of the Marlimund and Dodabetta reservoirs and the proposed new reservoir on Tiger Hill, and of about nine acres of land in connection with the "Old Ooty" supply.

2. The Chief Engineer, Public Works Department, considers that the construction of a new reservoir on Tiger Hill is unnecessary, as according to Mr. Walch himself there will be an ample supply of water in the Marlimund reservoir if the first of the improvements suggested by him is carried out. Also as to the filtering arrangements at the Snowdon ponds, the Chief Engineer considers that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the water of the Marlimund reservoir, these expensive arrangements need not be undertaken. He considers it sufficient if the first and third of Mr. Walch's proposals are adopted and if the private lands lying in the catchment areas of the Marlimund and Dodabetta reservoirs are acquired.

3. The Government agrees with the Chief Engineer with regard to the works referred to in items (1), (3) and (4) of Mr. Walch's recommendations and the works



should be carried out at once. These measures will secure a sufficient supply to meet the requirements of the town for some time to come, and nothing more is necessary, at all events, for the present.

4. With regard to the quality of the Marlimund water and the necessity of filtering it, the Government has consulted some of the medical officers who have recently had extensive practice in Ootacamund, and has ascertained that they are unable to ascribe the causation of disease to the use of that water, and that in their experience they did not find any difference in health or mortality among the population residing north and south of the lake, attributable to their using respectively the Marlimund and the Dodabetta water, which latter is admittedly a most wholesome water. In these circumstances, the Government is of opinion that the scheme for the filtration of the Marlimund water is not required. If it is found to be necessary hereafter, it may then be taken up.

5. Nor does the Government consider it necessary to acquire the catchment area of the Marlimund reservoir. No doubt if this area were manured to any considerable extent, the quality of the water would be deteriorated; but under section 145 and sub-section (1) of section 228-A of the Madras District Municipalities Act IV of 1884, as amended by Act III of 1897, the municipal council has sufficient powers of control over the drainage areas of sources of water-supply to maintain them in as uncontaminated a state as can reasonably be required; and it may for this purpose, on payment, in certain circumstances, of compensation, prohibit or regulate the cultivation of any crop, the use of any manure or the irrigation of land in any specified manner, if such cultivation, manure or irrigation is, in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this and other water-supply reservoirs. The Collector is also requested to see that no Government land situated within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Government.

6. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that, as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. As it may perhaps be desirable to carry out this work at some future date, when the population of the town expands, as it may reasonably be expected to do, the Government is of opinion that the municipal council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition will probably be much less now than it will be in the future. It also seems desirable that the private lands in the catchment basin of the Dodabetta reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands and submit the same to Government at an early date. The municipal council should report whether the proposals now made by Government in regard to the improvement of the water-supply of the town meet with its approval. Its reply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in paragraph 3.

7. The thanks of Government are due to Mr. Walch for his thorough investigation and his valuable report. Separate orders have been issued directing the payment to him of the balance of his professional fee, amounting to Rs. 1,830.

(True Extract.)

*Secretary to Government.*

To the Chairman, Municipal Council, Ootacamund.
„ the Collector of the Nilgiris.
„ the Public Works Department.
„ G. T. Walch, Esq.

Exd. A. Raitt.

Ans.

# & Munl. (189 7) Department.

CURRENT No. 2065/M

RECEIVED BY MUNICIPAL DEPARTMENT 27 MAY 1897

**From** The C. W. Department

**Order**

C's note is tacked to the notes in Let't

No. 3280

**Dated** 25th May 1897

**Received** 27-5-1897

**Registered** 27-5-1897

**Enclosures** 12 Nos (3 books of plans & plans)

**Spare copies**

Please put subject to Sand proof slip

Please return to Chairman with memo

## SUBJECT.

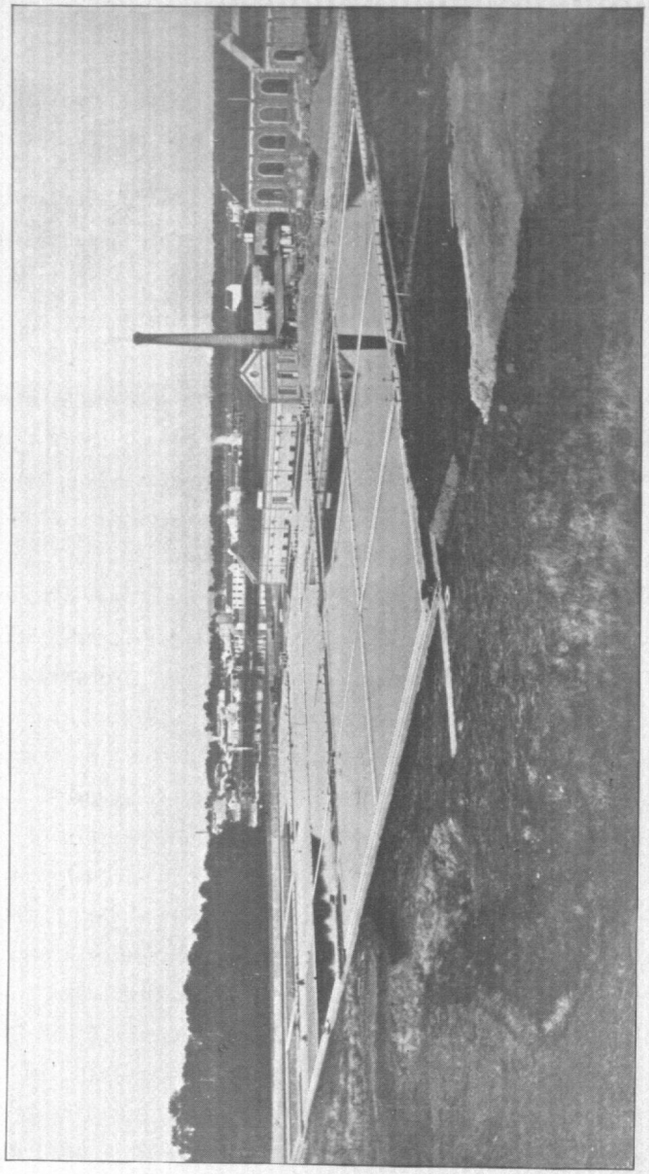
Ostacamund Water Supply Scheme

Transferring the papers connected with the —— prepared by Mr. Walch with the Chief Engineer's note thereon.

Ans 16/6/97

R.O. 19/6/97

6/21 216



General View of Water Works at Choisy-le-Roi.

# WATER FILTRATION.

## Advantages of River Water for Town Supplies.

The provision of an abundant and wholesome supply of drinking water for large towns is a problem the importance of which cannot be exaggerated. It is, however, only of late years that the subject has had the attention which it deserves, but during this period most valuable results and information have been gained.

Not the least of these has been the discovery of means by which the water of rivers, which is always available in ample quantities and at comparatively low cost, may be freed from the impurities which it commonly possesses and made suitable for public consumption.

Few rivers in their natural state are fit for use, being nearly always more or less turbid and frequently discolored from impurities which may, or may not, have any sanitary significance, but are at all events unsightly. It is this very uncertainty that constitutes the great danger in employing raw river water. It may be possible to use such water for years without ill effects, but sooner or later, in proportion to the growth of towns and cities on the banks of the river from which the water is being drawn, the river will become contaminated with some dangerous impurity, such as sewage matter containing the specific microbe of typhoid or cholera, resulting in a disastrous outbreak of disease such as occurred in Hamburg in 1892.

If, however, river water can by some suitable process of purification before delivery be rendered pure, and consequently innocuous, its advantages over any other source of supply for large towns are numerous and obvious.

In the first place, the river is generally at hand or at no great distance, thus avoiding what usually constitutes a heavy outlay in the construction of water works.

Secondly, a constant and regular supply is assured at all seasons of the year.

Thirdly, the cost of the necessary pumping is but small.

Fourthly, the supply is inexhaustible.

The advantage claimed for a spring-water supply over that of a river-derived supply is the superiority of the quality of water, although it is much harder than most river water.

If, then, an ordinary river can be made by any process of purification to yield a good and wholesome supply of water, equal in every respect to ordinary spring water, there can be no question which is the better source.

## Means of Purification—Sand Filtration.

That this can and is being done is being practically demonstrated in many of the most important cities of the world. The process which has been the most widely employed for the purification of river water is that of sand filtration. Perhaps London, England, is the best example that can be given of a large city with a river-derived supply purified in this way. There are eight companies engaged in the task of supplying London with about 200,000,000 gallons of water daily, and of these seven derive their supply from the rivers Thames and Lea, and filter through sand.

On this subject Dr. Frankland, the well-known expert, says:

"*The effect of sand filtration, as carried out by the various water companies supplying London, upon the living matter contained in the raw river water is simply*



*astounding. A single drop of Thames water passing on to the filters would be found to contain occasionally 3,000 separate living organisms, but it came out from these filters so cleansed from living matter that a single drop would be found to contain not more than two or three organisms, and sometimes the filtered water was absolutely sterile.*"

And again he says:

"*Although deep well water had from a bacteriological point of view a decided advantage, the filtered waters were not very far behind.*"

In a pamphlet* published in 1887 by M. Piefke, the well-known scientific superintendent of the Berlin Water Works, the following table is given of the microbe-removing powers of the sand filters at the Stralau Water Works at Berlin:

| Dates. | Filtered Water. | Spree Water. |
|---|---|---|
| October 6, . . . . | 1,488 | —— |
| " 7, . . . . | 864 | 8,000 |
| " 8, . . . . | 336 | 5,040 |
| " 9, . . . . | 330 | 21,600 |
| " 10, . . . . | 260 | 24,480 |
| " 11, . . . . | 630 | 31,185 |
| " 12, . . . . | 310 | 26,752 |
| " 13, . . . . | 528 | 26,432 |
| " 14, . . . . | 248 | 14,600 |
| " 15, . . . . | 140 | 4,307 |
| " 17, . . . . | 88 | —— |
| " 18, . . . . | 99 | —— |
| " 19, . . . . | 73 | 2,592 |
| " 21, . . . . | 46 | 5,328 |

To demonstrate more clearly the value of the foregoing table and the efficiency of sand filtration as a life-

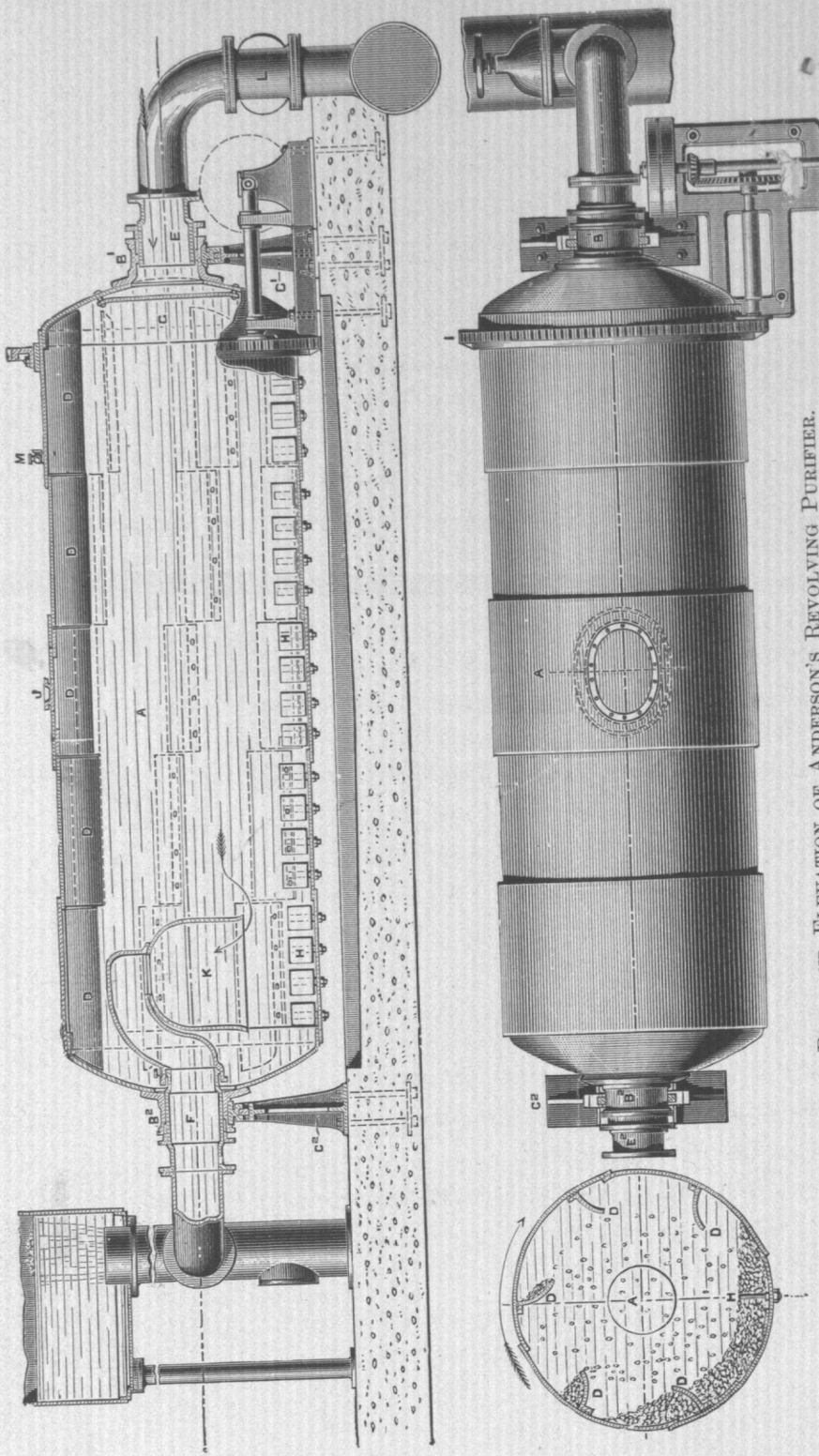
* "Die Principien der Reinwasser—Gewinnung vermittelst Filtration."

saving system it is interesting to compare the death rate from typhoid fever of five American cities where the water is taken direct from the rivers without any attempt at filtration and a similar number of European cities where sand filtration has been adopted :

| | Per 100,000 Living. | | |
|---|---|---|---|
| Allegheny, | 217 | London, | 17 |
| Camden, | 132 | Rotterdam, | 5 |
| Pittsburg, | 127 | Berlin, | 9 |
| Washington, | 87 | Hamburg, | 18 |
| Philadelphia, | 74 | Breslau, | 11 |

Nearly all the cities in the United States are supplied with unfiltered surface waters, and a large majority of the waters is taken from rivers and lakes at points where they are polluted by sewage. The death rates from typhoid fever in these cities, whether compared with better supplied cities in this country or with filtered supplied European cities, are enormously high. These rates were common in European cities before sand filtration became generally adopted, but have now been reduced to the figures given above, and it is safe to predict that a few years will see the system as generally adopted in this country as it has been in Europe.

In order to obtain the best and most uniform results great care has to be exercised in the speed of filtration. A maximum speed of 4 inches per hour, or 50 gallons per square foot of filtering area per twenty-four hours, equal to about 2,000,000 gallons per acre, is what is generally admitted to be the limit at which ordinary sand filters can be worked with safety.



PLAN AND ELEVATION OF ANDERSON'S REVOLVING PURIFIER.

A, Cylinder. $B^1$ $B^2$, Hollow Trunnions. $C^1$ $C^2$, Pedestals. D D D, Curved Shells for carrying up iron. H H, Adjustable Plates for retaining iron in Sections of Cylinder. E F, Inlet and Outlet Pipes. G, Distributing Plate. K, Hood for preventing iron from being carried into Outlet Pipe. I, Spur Wheel for Driving Cylinder. J, Manhole to Cylinder. L, Sluice Cock. M, Air Cock.

## The Anderson Iron Process.

The speed of filtration can, however, be increased to as much as 110 gallons per square foot of filtering surface per day, or 4,500,000 gallons per acre, by the employment of the Anderson Iron Process (also known as the Revolving Purifier Process). In addition to the increase of speed of filtration the microbes and general impurities are removed to a much greater degree than by sand alone.

This process, which has lately become so well known in Europe, consists in passing the water while on its way to the settling beds through a wrought iron cylinder, supported horizontally on hollow trunnions forming the inlet and outlet to the cylinder. This is kept in continual slow rotation, and contains a charge of metallic iron in small pieces. The iron is continually lifted and showered down through the water by means of scoops fixed within the cylinder. The speed of rotation of the machine is about 6 feet per minute at the periphery. The water is passed through at the rate of from a third to a fifth of the capacity of the cylinders per minute, thus keeping the water in contact with the iron for from three to five minutes, according to the quality of the water. The cylinders are made in various sizes; for example, a machine 18 feet long and 5 feet in diameter is capable of treating nearly a million gallons a day, and is charged with about 2 tons of any sort of scrap iron; one of the most convenient forms being punchings from boiler plates.

This churning with scrap iron causes the water to take up a small quantity of iron, from a tenth to a fifth of a grain per gallon, which, in precipitation, effects the purification of the water.

On leaving the cylinder these particles of iron are in the form of ferrous hydrate, but as the water is immedi-

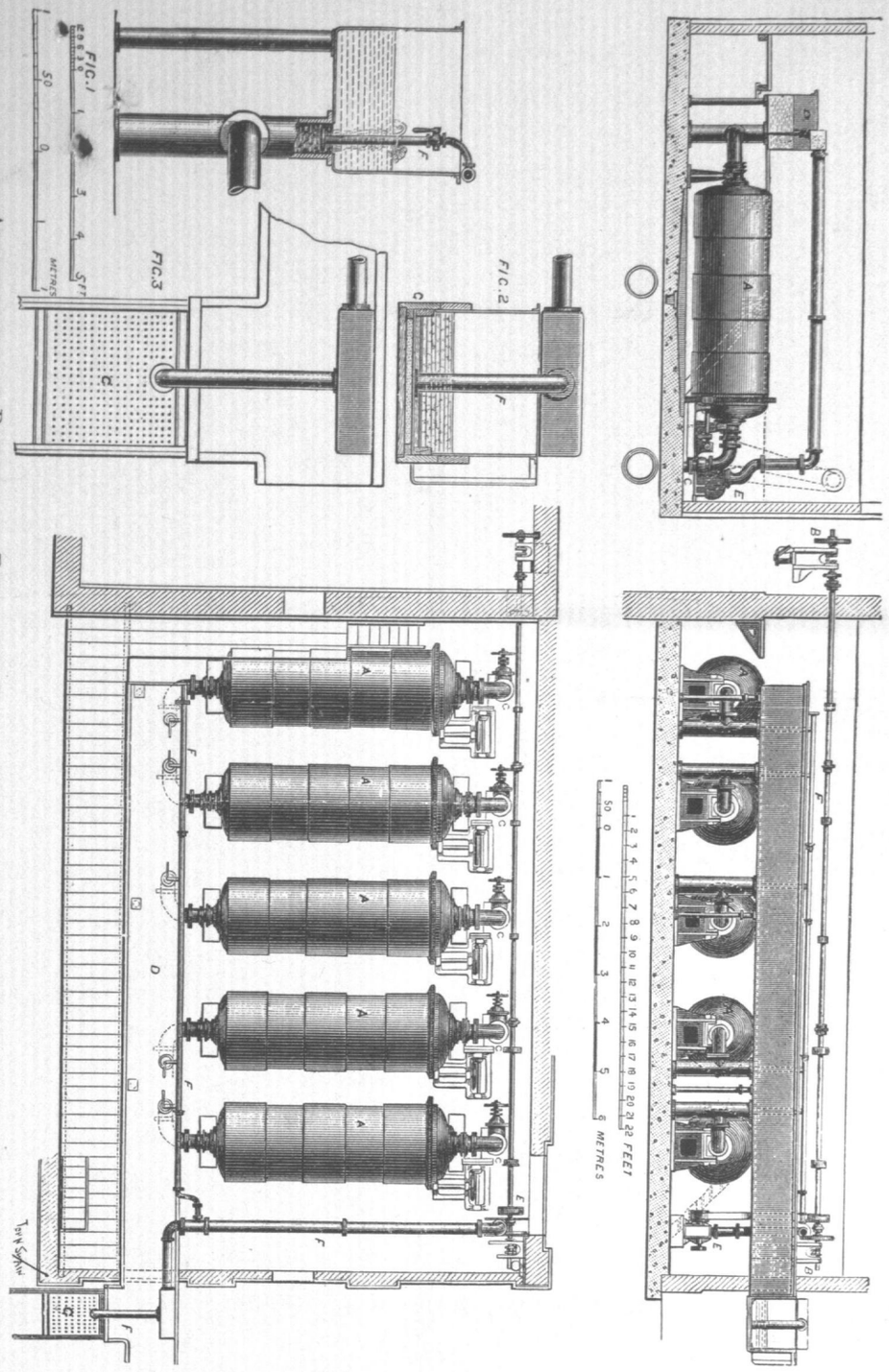
ately exposed to the influence of the air this becomes quickly changed to ferric hydrate, which is precipitated in particles more or less coarse, according to the nature of the water under treatment. On leaving the cylinder the water is passed into a settling bed or simple troughs, in which the iron is completely oxidized by exposure to the air, and in which the precipitate immediately settles.

The action of the ferric hydrate on all impurities in the water is one of coagulation, the formation of a precipitate in the water tending to throw out of solution the dissolved organic substances. This explanation of the action of the iron process upon the organic impurities of a water applies equally well to its action upon microbes. Experience shows that the microbes become entangled in the precipitate, and either subside with it to the bottom of the settling tank or remain upon the surface of the filter.

## Efficiency of the Iron Process.

The effect of the iron process of purification on highly discolored water is remarkable to a degree, and many examples could be given of cities whose water supply, being drawn from a highly discolored river, has been rendered as clear and bright as the purest spring water. It will suffice, however, to refer to the present water supply of the town of Antwerp, which is drawn from the river Nethe, a tributary of the Scheldt. The water of this river is subject to various deleterious influences. It is colored with a yellow color, exceedingly difficult to remove, by the peaty nature of the country through which the river flows. It carries down at times large quantities of silt and finely divided clay. Being subject to the influence of the tide, it is affected by sewage pollution, both above and below the point of intake.






ARRANGEMENT OF BATTERY OF REVOLVING PURIFIERS AT THE ANTWERP WATER WORKS.

In 1889 a commission was appointed to take weekly analyses of the water throughout the entire year, and was composed of the following gentlemen : Prof. C. Blas, of Louvain University ; Jorissen, of Liege University ; Swarts and Van Ermengem, of Ghent University. The final report of the commission, which gives a résumé of the weekly analyses of the whole of the year 1889, is as follows :

The analyses were made every week, thus constituting a sort of permanent inquiry into the chemical and hygienic quality of the water.

The concordant results of these numerous analyses have once more confirmed the opinion of all those who have studied the Anderson process of purification. This process, as applied at Waelhem, is of remarkable efficiency, the coefficient of purification is very high, and the water pumped into the Antwerp mains is irreproachable in every respect. The Nethe water, even after being deprived by twenty-four hours' settlement of the matter it holds in suspension, is yellow and thick, and opaque when examined through a depth of 2 feet. It has a flat taste. After a few days a deposit of brownish flakes forms in it. It shows an average of 80 milligrams of oxidizable organic matter to the litre, of 0.3 milligram of free ammonia, the same of albuminoid ammonia, and marked traces of nitrites.

After purification the water becomes limpid and brilliant in appearance. Its taste is fresh and agreeable ; when seen through a depth of 2 feet it is transparent and of a pale green tint. After being kept for several months exposed to the light in bottles stoppered with cotton wool it remains perfectly limpid. This water contains, on an average, 40 milligrams to the litre of oxidizable organic matter.

The water never contains more than one one-hundredth of a milligram of free ammonia or one-tenth of a milligram of albuminoid ammonia in a litre. It is absolutely free from nitrous acid. The results of the bacteriological examination corroborate those of the chemical analysis. The purifying action of the Anderson process is here most manifest, as is shown by the almost total elimination of

all micro-organisms. The water of the Nethe contains a great number of microbes. It may be estimated at an average of 50,000 colonies per cubic centimetre.

After purification, water taken from taps in the city, and which has circulated through a great length of mains, is found to contain an average of seventy-five colonies only. This number of germs is, indeed, small when compared with the number of micro-organisms which pass through filters reputed as the most perfect. But still fewer germs are discovered when the water is taken immediately on leaving the sand filters at the pumping station. Under the strictest conditions of experiment we find that this water may be considered practically sterile. The number of colonies which it supplies varies from two to twenty per cubic centimetre. In no case has the Antwerp water supply disclosed the presence of bacteria of a suspicious or pathogenic kind, such as those of typhoid fever, for which search has been made with special care. It is, therefore, beyond all doubt that the process employed at the Waelhem Pumping Station offers the most complete guarantee that can be desired, in the present state of science, from the point of view of public health.

## Rapidity of the Iron Process.

A very important feature of the iron process consists in the rapidity with which perfect results are secured. A sand filter of ordinary construction will remove a large proportion of microbes in a water when its surface has become sufficiently blocked by the layer of matter separated from the water being filtered. To obtain this result it is necessary to work the filter for several days, delivering all the while imperfectly filtered water, until this layer has had time to form.

The rapidity with which a high degree of microbe-removing efficiency is reached after the water has been purified by means of the Anderson process is shown by the following table of analyses taken hourly from a sand filter outlet at Antwerp by Dr. Van Ermengem, the eminent bacteriologist of the University of Ghent, on September 9, 1893 :



| Hours After Starting Filter. | No. of Microbes per C. C. | Hours After Starting Filter. | No. of Microbes per C. C. |
|---|---|---|---|
| 4 | 30 | 11 | 30 |
| 5 | 30 | 12 | 20 |
| 6 | 27 | 15 | 50 |
| 7 | 320 | 18 | 52 |
| 8 | 25 | 24 | 25 |
| 9 | 30 | 30 | 25 |
| 10 | 39 | — | — |

NOTE.—The high figure occurring on the seventh hour was doubtless due to an accident to the sample.

## The Paris Plants.

At the end of this pamphlet will be found a table of the principal towns which have up to the present adopted the iron process. Special attention should be given to the remarkable success achieved in Paris. The first plant erected there had a capacity of only about 100,000 gallons a day, but its success in dealing with the water of the Seine was so marked that the process was applied at the waterworks of Boulogne-sur-Seine to treat over a million gallons a day of Seine water taken below Paris. The working of this plant was followed and investigated with the greatest care.

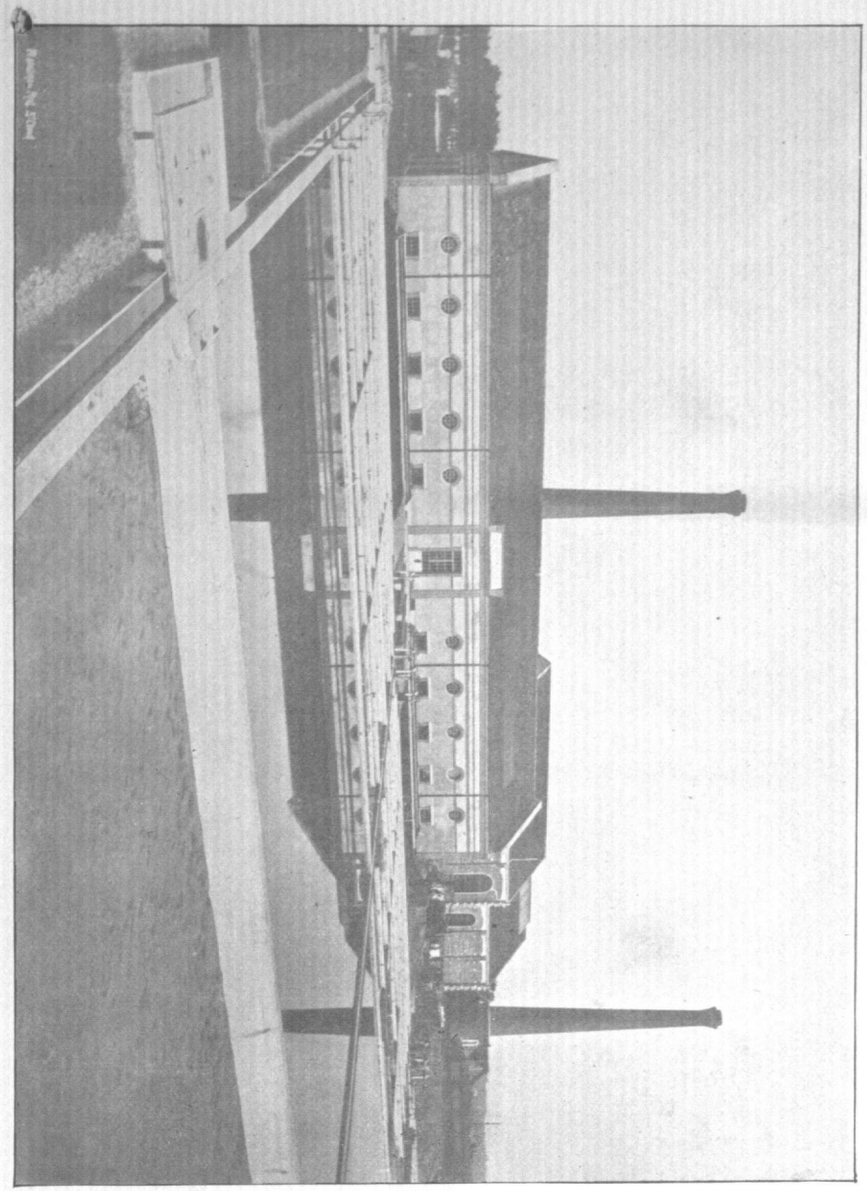
Following is the report of Dr. P. Miquel, the eminent head of the bacteriological department of the Observatoire de Montsouris, which shows the results obtained by the process upon the Seine water, and also a comparison between the purified Seine water and the spring water of the Vanne. This latter water, which is supplied to a large portion of the city of Paris, is considered to be a model of what a drinking water should be.

## BACTERIA PER CUBIC CENTIMETRE.

| Dates. | SEINE WATER. | | Coefficient of Purification. | Vanne. |
|---|---|---|---|---|
| | Unfiltered. | Filtered. | | |
| December 2, 1892, . . | 130,000 | 400 | 99,693 | 400 |
| February 23, 1893, . . | 550,000 | 2,000 | 99,637 | 1,800 |
| March 2, 1893, . . . | 60,000 | 50 | 99,917 | 4,700 |
| March 9, " . . . | 40,000 | 500 | 98,750 | 1,200 |
| March 18, " . . . | 50,000 | 700 | 98,600 | 600 |
| March 21, " . . . | 90,000 | 200 | 99,778 | 600 |
| April 1, " . . . | 280,000 | 300 | 99,893 | 800 |
| April 10, " . . . | 240,000 | 800 | 99,667 | 1,600 |
| April 6, " . . . | 130,000 | 1,700 | 98,692 | 1,600 |
| April 17, " . . . | 90,000 | 2,400 | 97,334 | 400 |
| April 27, " . . . | 600,000 | 300 | 99,950 | 600 |
| May 4, " . . . | 480,000 | 400 | 99,917 | 200 |
| May 9, " . . . | 550,000 | 8,100 | 98,528 | 600 |
| May 15, " . . . | 100,000 | 600 | 99,400 | 600 |
| May 27, " . . . | 140,000 | 700 | 99,500 | 1,200 |
| May 30, " . . . | 350,000 | 200 | 99,943 | 800 |
| June 22, " . . . | 650,000 | 5,000 | 99,231 | 200 |
| June 28, " . . . | 410,000 | 1,100 | 99,732 | 800 |
| July 8, " . . . | 170,000 | 800 | 99,530 | 600 |
| July 12, " . . . | 690,000 | 4,000 | 99,421 | 600 |
| July 22, " . . . | 1,010,000 | 1,300 | 99,872 | 1,200 |
| July 26, " . . . | 710,000 | 700 | 99,902 | 1,200 |
| MONTHLY AVERAGES. | | | | |
| February, . . . . | 550,000 | 2,000 | 99,637 | 1,800 |
| March, . . . . . | 60,000 | 362 | 99,397 | 1,775 |
| April, . . . . . | 268,000 | 1,100 | 99,590 | 1,000 |
| May, . . . . . | 324,000 | 2,000 | 99,383 | 680 |
| June, . . . . . | 530,000 | 3,050 | 99,425 | 500 |
| July, . . . . . | 645,000 | 1,700 | 99,739 | 900 |
| Means, . . . . . | 396,000 | 1,702 | 99,571 | 1,110 |

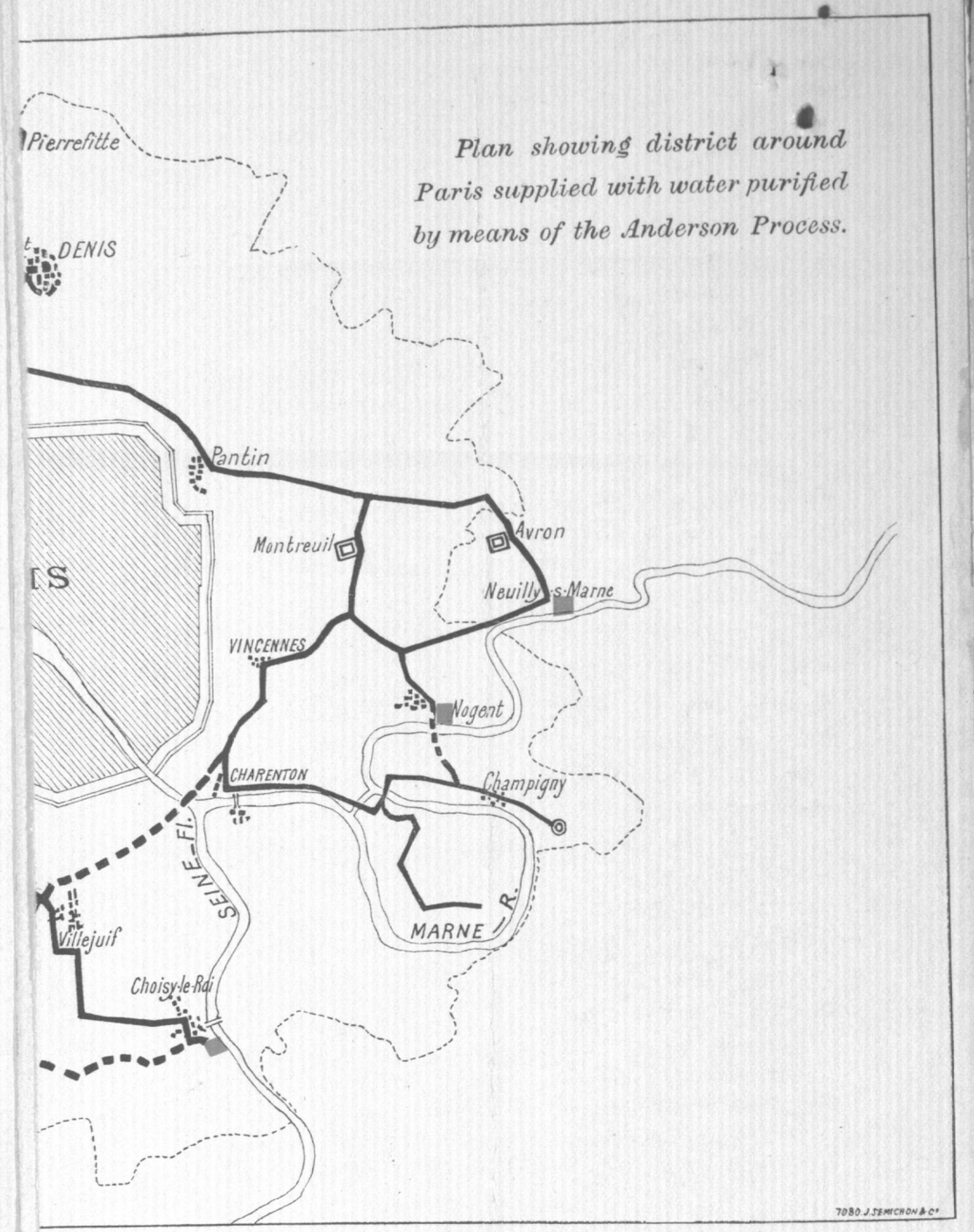
The above figures show that the Anderson process as modified and worked at the Boulogne station keeps back a mean of 99.500 per





CHOISY-LE-ROI.

Showing exterior of Purifier House and arrangement of Settling Channels.




*Plan showing district around Paris supplied with water purified by means of the Anderson Process.*

cent. of the bacteria of the water which is supplied to it; these results are certainly very encouraging, for it is evident that, dealing with a very impure water, as the Seine is at the Pont de Sèvres, it is possible to free it on a practical scale from the greater part of its bacteria, and to give it a composition very nearly equal to spring water.

It is hardly necessary to add that this purified water is clear, brilliant and colorless at all times, in spite of the fact that the Seine water at Boulogne is exceedingly impure, being *below* the city, a large proportion of the drainage of which it receives.

The speed of filtration usually employed there ranges from 105 to 115 gallons per square foot per day, and in the filter the thickness of sand, which is usually about a foot and a half in depth, has been reduced by successive filter cleaning, without replacing the sand removed, to 6 inches without impairing in any way the quality of the water.

Owing to the great success of the first plant erected on the Seine, and referred to above, a plan to supply the suburbs of Paris with spring water was abandoned, and contracts were entered into for the supplying of purified water from the Seine and Marne to fifty-eight of the communes of the Department of the Seine, representing a population of 600,000.

These works were completed on January 1, 1896, and are located as shown in the accompanying map.

The following excerpt is translated from a report printed by the Compagnie des Eaux, of Paris, in which is given the history of the adoption of the Anderson Iron Process by that company :

RESULTS OBTAINED.—The delivery of the filters is set at about 4 cubic metres per square metre per twenty-four hours (not quite 100 gallons per square foot per twenty-four hours).

The quantity of iron consumed varies from 2 to 4 grammes per cubic metre of water treated (265 United States gallons).

The cleaning of the filters takes place, according to a fixed routine, about once a month.

The organic matter in solution is reduced on the average in the proportion of from 40 to 60 per cent.; and the bacterial colonies, cultivated on gelatine, are reduced in the proportion of 996 per 1,000.

The plants at Choisy-le-Roi and at Neuilly-sur-Marne have each a capacity for treating 8,000,000 gallons per day, with a filtering area of 100,000 square feet, and that of Nogent-sur-Marne a capacity of 2,500,000 gallons, with a filtering area of 33,000 square feet, a total of 18,500,000 gallons per day, and which will during the course of the present year be increased to about 30,000,000 gallons.

It will be seen from these figures that the minimum speed of filtration is equal to about 3,500,000 gallons per acre, or about 1,500,000 gallons per acre more than can be obtained from sand filtration alone. In some instances the speed can be increased to as much as 4,500,000 gallons per day, the speed of filtration being naturally somewhat dependent on the nature of the water.

This increase in the speed of filtration has the effect of reducing the area of the filter beds, thereby greatly reducing the cost of this part of the water works.

## Cost of Plant–Working.

Special care has been taken to learn the exact working cost of a filter plant fitted with the Anderson system of purification, and the following figures have been obtained from the plants now running at Boulogne-sur-Seine and at Dordrecht:

TOTAL WORKING EXPENSES FOR THE YEAR 1893.

BOULOGNE-SUR-SEINE.

| | |
|---|---|
| Iron at 7 frs. per 100 kilogrammes, | Frs. 350.00 |
| Cleaning decanting reservoir, | 180.00 |
| Cleaning filters (5 frs. per day per man), | 780.00 |
| New sand, | 300.00 |
| Coal, oil and waste, | 1,400.00 |
| Total, | 3,010.00 |

INTERIOR OF PURIFIER HOUSE AT CHOISY-LE-ROI.

Six Purifiers. Capacity, 7,500,000 gallons per 24 hours.

This gives an average cost of 0.0016 francs per cubic metre, or about one-fourteenth of a penny per 1,000 gallons (6 shillings per million). For such a small plant this is an extraordinarily low figure.

DORDRECHT.

| | |
|---|---|
| Iron consumed per million gallons treated, | 13½ lbs. |
| Speed of filtration per square foot per 24 hours, | 100 gals. |
| Total quantity of water treated during year, | 194,000,000 gals. |
| Total cost for the year, including iron, filter cleaning, maintenance and repairs, | £53 12s. |
| Average cost per million gallons purified, | 5s. 6d. |

The iron used is in the form of punchings, three-eighths of an inch to three-quarters of an inch diameter, costing 46s. per ton.

These figures are applicable to the European scale of charges and will necessarily change in different countries, but it may be safely assumed that the cost of working in the United States will not exceed $2 per million gallons.

A particular feature in the economy effected is the saving in the cost of new sand, one of the heaviest items of expense with ordinary filter beds. In some instances where the Anderson process has been adopted it has been found unnecessary to change the sand for three years and upward. When it becomes necessary to clean the filters the water is simply drawn off to just below the level of the sand, when the film of oxide, which forms with time on the surface of the sand, is easily removed without disturbing the sand itself.

The revolving purifiers are made in different sizes, distinguished according to the diameter of the pipes conveying the water into and out of the cylinder. When the quantity of water exceeds the capacity of a single machine a battery of several is erected, such as shown in the illustration of the plant at Choisy-le-Roi.

The entire cost of a revolving purifier plant, including all connections to the main intake pipe, and to the settling

or filter beds, &c., is $5,000 per million gallons required per day.

For the following reasons it will thus be seen that the revolving purifier process is a great improvement and effects a great economy on ordinary sand filtration :

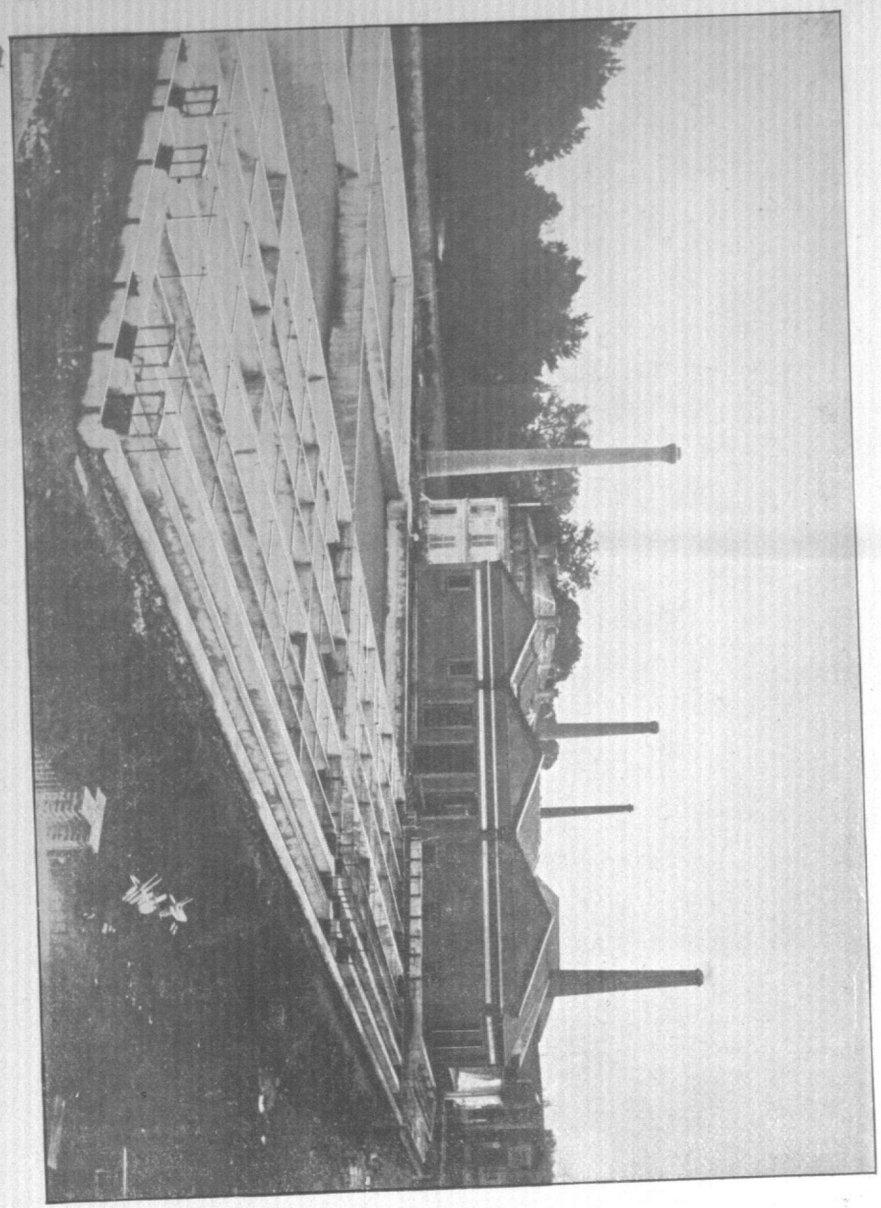
1. Filtration, after the water has been purified by means of the revolving purifier process, is carried on at about twice the customary speed, thus effecting a saving of about half the area of filter surface required.

2. The saving thus effected much more than counterbalances the cost of the revolving cylinders.

3. The purification is much more thorough and much less liable to accidental disturbance, and removes a greater percentage of microbes.

4. The working cost is low, as the iron employed is very cheap, and with efficient settlement the cost of filter cleaning is very small.





NOGENT-SUR-MARNE.

Showing Purifier House on the right and arrangement of Settling Channels.
Capacity, 3,500,000 gallons per 24 hours.

SOME OF THE TOWNS AND CITIES WHICH HAVE ADOPTED THE PROCESS OF THE

# REVOLVING PURIFIER COMPANY.

| Name of Town. | Source of Supply. | Number and Size of Purifiers. | Daily Capacity in Gallons. | |
|---|---|---|---|---|
| Agra, | River Jumna. | Three 10 inch. | | 2,000,000 |
| Antwerp, | River Nethe. | Five 10 inch. | | 3,500,000 |
| Baroda, | Lake. | Three 12 inch. | | 2,860,000 |
| Constantinople, | Lake. | Three 10 inch. | | 2,000,000 |
| Dordrecht, | River Merwede. | One 14 inch. | | 1,250,000 |
| Gouda, | River Ysel. | One 9 inch. | | 530,000 |
| Libourne, | River. | Three 6 inch. | | 700,000 |
| Montevideo, | River Sta. Lucia. | Three 14 inch. | | 3,500,000 |
| Nice, | Canal. | Three 10 inch. | | 2,000,000 |
| Paris — Boulogne, | River Seine. | Two 10 inch. | 1,300,000 | |
| Paris — Neuilly-sur-Marne, | ..... | Six 14 inch. | 7,500,000 | |
| Paris — Nogent-sur-Marne, | ..... | Three 14 inch. | 3,500,000 | 19,800,000 |
| Paris — Choisy-le-Roi, | River Seine. | Six 14 inch. | 7,500,000 | |

# OOTACAMUND WATER-SUPPLY IMPROVEMENT.

# REPORT.

4P

# OOTACAMUND WATER-SUPPLY IMPROVEMENT.

## REPORT.

### I.—PRESENT SOURCES OF SUPPLY.

The piped supply of Ootacamund is now derived from the following sources :—

**(1).**—Marlimund Reservoir.

1. This is formed by an earthen embankment thrown across a stream which flows from the Tudor Hall Estate, Gayton Park Estate, and adjacent lands, and runs down the Anikorai valley to the Moyar.

2. The natural catchment basin of the reservoir has an area of about **272·15** acres of which **196·60** acres are private, and **75·55** acres Government and Municipal property. Of the **196·60** acres of private land about **84·64** acres are cultivated, chiefly with tea, but several acres of this are so neglected as to appear as if abandoned.

3. Besides the run off from the natural catchment basin, that from nearly **200** acres on the slopes of the Snowdon range is brought to the reservoir by means of open catch channels, pipes, and a masonry conduit.

4. The water spread of the Reservoir when full (**18** feet above its outlet pipe) is rather over **18** acres, and its capacity is **9,870,138** cubic feet, of which however **1,150,130** cubic feet lie below the outlet pipe, leaving **8,720,008** cubic feet, or **54½** millions of gallons, above that pipe.

5. From this Reservoir all the portion of Ootacamund north of the Lake and shown in pink[1] on the accompanying map (scale 6″ to 1 mile) is supplied, or will be supplied when an intended extension along the Segoor Road is carried out. The population of the whole of this portion of the settlement is now a little over **10,000** but it is considered that before long it will at times amount to **12,000**. For this number at **20** gallons a head per diem the full reservoir holds a supply for upwards of 7 months, even if during that period the evaporation and soakage be only just compensated for by the discharge of springs and rainfall run off.

6. When this reservoir was constructed its water was declared unexceptionable, but this is no longer the case owing it is supposed to, (*a*) manure used in the cultivation which drains into the reservoir and (*b*) the presence in the bed of the reservoir of a large quantity of peat. The latter is considered to be by far the more serious evil of the two, indeed the Sanitary Commissioner Surgeon-Lt.-Col. W. G. King has gone so far as to say "whatever steps be taken as to the "catchment area, as long as the water is received there, it must be considered "unfit for human consumption," and he advises "the abandonment of this "reservoir completely."

7. The Sanitary Board, however, came to the conclusion that this reservoir "cannot be totally abandoned," but that "all water passing from it be filtered."

See page 226 of minutes of Proceedings of the Sanitary Commissioner for second quarter of 1894.

See its Proceedings No. 2286, dated 14th July 1895, which are printed in Part II of this report.

[1] A junction with the pipes of the system *South* of the lake was made in 1892, at the "Willow Band."

### (2).—The Spring above Old Ooty.

8. With reference to this, the Sanitary Commissioner remarks (see para. 9 of his Inspection notes, page 224 of minutes of Proceedings of Sanitary Commissioner, 2nd Quarter 1894), that of all the sources of the Ootacamund supply this, "alone presents the character of a correctly protected supply. It is derived "direct from a spring which is enclosed at its point of exit from the earth and "is distributed by pipes. The collection of this spring is ingeniously effected "by a miniature infiltration gallery suggested by Mr. Nery, the Municipal Engineer."

9. The system however is a very small one supplying only some 400 persons by means of pillar fountains in the village of "Old Ooty" and by service pipes to the Secretariat Offices Stone House Hill, and three or four other houses.

10. The area served is shown in yellow on the accompanying map of Ootacamund, scale 6″=1 mile.

### (3).—The Dodabetta Reservoirs.

11. These are formed by earthen embankments across the stream which flows from the southern slopes of Dodabetta to the Burnfoot and Lawrence Lakes.

12. The Upper of the two Reservoirs has according to Appendix A of report printed with P. M. G. No. 286-W., dated 1st February 1882, a catchment basin of about 172·72 acres, 30·72 acres of these being private property; but from the recent investigations it would appear that the area of the catchment basin does not exceed 134 acres, and that the private property is only 57·75 acres, of which 11·50 are cultivated with tea and half an acre or so is planted with fruit trees, (apparently almost entirely neglected) whilst of the remainder there are some 38¾ acres of gum plantations, and 7 acres or so of Cinchona, &c.

13. There are no regularly inhabited houses or huts in the catchment basin but there are two "tea houses" which no doubt are occupied at times for short periods.

14. The capacity of this Reservoir when full to 24·80 above its outlet pipe has been taken as 4,500,000 gallons but is probably considerably more.

See P. M. G. No. 634, M. L. M., dated 28th April 1891.

15. The Lower Reservoir, only about 934 feet down the valley from the upper one and some 161 feet below it in level, is little more than a pond, having a capacity probably not exceeding 50,000 gallons.

16. Its chief supply is of course the surplus from the upper reservor but this is also at times supplemented from the stream which flows through the Craigmore forest reserves at the back of Tiger Hill.

17. From these reservoirs is supplied that portion of Ootacamund, South of the Lake, shown colored in blue on the map, scale 6″=1 mile, with a population of 2,500. The capacity of the reservoirs as given above would therefore be sufficient for only 3 months supply at 20 gallons a head per diem, supposing the evaporation and soakage to be only just compensated for by fresh supplies received during that period; the stream and springs which feed these reservoirs never, it is believed, run quite dry, and as a matter of fact the storage has since the supply from it was piped, proved sufficient, if extravagant consumption and waste be checked.

18. In para. 12 of his Inspection notes, dated 15th—22nd September 1893 the Sanitary Commissioner gives analysis of the water of these reservoirs, and speaks of it as "of much better quality than the Marlimund supply though largely

Page 227 of minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.



58

defiled by vegetable impurities" and an analysis lately made by the Chemical Examiner, of water taken from a house tap on the distribution system from these Dodabetta Reservoirs, gives the following results:—

| | | | | | | B. From House service tap of Eckford Dodabetta Reservoir system. |
|---|---|---|---|---|---|---|
| Total solids ... | Grms. per litre | ... | ... | ... | ... | 0·040 |
| Volatile solids ... | do. do. | ... | ... | ... | ... | 0·015 |
| Chlorine ... | do. do. | ... | ... | ... | ... | Trace. |
| Total hardness ... | ... | ... | Clark's scale | ... | ... | Trace. |
| Permanent hradness | ... | ... | do. do. | ... | ... | Trace. |
| Free ammonia ... | Mlgrms. per litre... | | | ... | ... | Trace. |
| Albumenoid ammonia | do. do. | ... | ... | ... | ... | 0·040 |
| Nitric acid | do. do. | ... | ... | (as Ammonia) | | Trace. |

Remarks.—Sample B is a usable and good water.

## II.—OPINIONS AND SUGGESTIONS OF THE SANITARY BOARD.

19. The occasional insufficiency of the supply from Marlimund Reservoir and the unsatisfactory character of its water, and imperfections in the other sources of the water supply of Ootacamund have from time to time during the last few years received much attention from the Sanitary Commissioner and the Sanitary Engineer, the results of which are given in the various documents noted below.[1]

20. These were referred by Government to the Sanitary Board which after full consideration came to the conclusion embodied in its Proceedings No. 2286, dated 14th August 1895, which for convenience of reference are given in extenso below, from P.M.G. 298-W., dated 24th January 1896.

*Proceedings of the Sanitary Board, No. 2286, dated 14th August 1895, at meetings of the Sanitary Board held at Ootacamund on the 13th, 18th, 25th and 27th June 1895.*

* * * * *

The Board, having, as requested by G. O., No. 859 M., dated 6th July 1894, fully discussed the whole of the questions relating to the water-supply of Ootacamund, having had before them report (herewith sent) of the Municipal Committee on the same matter, and having met the committee and considered the matter with them, and having inspected the various reservoirs existing and proposed and their catchment areas, resolves to report to Government as follows:—

(1) The Board finds that, in regard to the Marlimund supply, it is impure and insufficient, that the cause of the impurity of the water is due (1) to the supply received from the Tudor Hall Estate passing over cultivated lands, to the tank itself in portion being a peat bog and that in its bed are masses of vegetable matter in a state of transition towards "peat" and therefore liable to decay, and to the water derived from the Snowdon catchment having to pass to the connecting channels through sholas with thick undergrowth and over ground covered with decaying vege-

[1] Sanitary Engineer's No. 1697, dated 17th August 1893.
Note on same by Acting Chief Engineer, Public Works Department, dated 2nd October 1893.
Sanitary Engineer's No. 2544, dated 24th November 1893.
G. O. No. 273-M., dated 8th March 1894.
G. O. No. 859-M., Mis., dated 6th July 1894.
(All ordered to be treated as "Confidential.")
Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.
Report of Sanitary Engineer for 1895.

table matter, (2) that its insufficiency in years of short rainfall is due to the small size of the catchment area, to the state of collecting channels themselves and to the absorption caused by undergrowth and *humus* in the sholas.

(2) To improve the purity of the water, the Board consider that the Marlimund tank as far as possible should be abandoned as a storage reservoir, and that Government should be requested to clear the sholas above the collecting channels of all wattle, undergrowth and humus and to require that such areas shall at no future time be permitted to get into the state they are at present, viz., so thick that sun-light can hardly penetrate and reach the ground. The Board considered the question of forming new channels above the sholas and of carrying the water from the streams and springs themselves in closed piping, but looking to the insufficiency of the supply and the limited catchment areas, they do not feel justified in recommending this course, and if Government clears the sholas and maintains them in the state already advised, there is less reason for such recommendation.

(3) In order that the Marlimund tank may be, as far as possible, abandoned as a storage reservoir, the Board propose to increase the capacity of the Snowdon reservoir and consider that the bund may be raised almost to the level of the road above the reservoir and that the capacity may be further considerably extended by excavating and clearing the basin in which the existing (but not now used) reservoir is, or alternatively it may be considered whether it may not be advisable to construct a new dam at a spur some 200 feet down the valley below the bund if a further large additional amount of storage would thereby be secured; which of the two courses should be adopted is an engineering question which can only be decided after proper surveys and levels of the site have been taken. The Board believe that, if the reservoir is thus extended and another reservoir (to be hereafter referred to) constructed, it will be possible to limit the use of water from the Marlimund to a somewhat insignificant amount.

(4) Marlimund, however, cannot be totally abandoned, as some of the higher houses on Church Hill must still continue to be supplied from it, and the Board therefore recommend that all water passing from it be filtered and a compensating or service reservoir will also be necessary. On the subject of filtration advised, the Board is prosecuting enquiries as to feasible methods for dealing with the large quantity of vegetable matter in the water. As to this a separate report will in due time be submitted.

(5) The Board accompany the proposals for the extension of the Snowdon reservoir with their expression of opinion of the necessity for protecting the reservoir from approach by walling and fencing, for removing the godown of Snowdon House, and for securing by means of intercepting channels and otherwise that none of the drainage of any of the surrounding basin in which the reservoir is be admitted into the reservoir unless from a perfectly clean and unpolluted area, the reservoir not in any way being dependent on its own basin for its supply. The Board also recommend the diversion of the Marlimund road along the east side of the reservoir as extended.

(6) The Board recommend that the existing north and south supply channels be bricked or lined with concrete, that the overflows be done away with as far as possible and one overflow only provided above the inlet to the Snowdon reservoir or the pipe leading to Marlimund, and that the site of the channels be increased, if necessary, to carry the maximum flow off the catchment areas.

(7) The Board further recommend the extension of the south supply channel as proposed by Mr. Ellis, Acting Sanitary Engineer, in his memorandum in reference to G. O., Mis. No. 839 M., dated 6th July 1894, viz., recutting the old supply channel from O. to N. so as to include the area, coloured green—see plan No. 4 of the accompanying plans—whence the water would find its way down the stream H. and thence by the existing channel to Snowdon; the Government House channel to be permanently cut off (it has already been done so temporarily). The Board do not consider that any other of the works proposed by Mr. Ellis in his memorandum referred to are under the present proposals of the Board necessary and would alone recommend the examination and repair where necessary of the culvert from Snowdon House to Marlimund from which apparently a large quantity of water must be lost by leakage.



68

(8) The effect of the above proposals would be that a new reservoir would be obtained with a supply to it from a fairly unpolluted area and an additional amount of storage would thus be secured. It is not intended that water should be passed from Marlimund to Snowdon reservoir even after filtration, but that it be delivered into the pipe below the latter reservoir, or it may be that an additional main from the latter may be necessary if Marlimund has to be retained for the higher houses on Church Hill, &c.; this however is a detail to be hereafter considered, if the recommendations of the Board as a whole receive the approval of Government. The surplus from the reservoir at Snowdon would be passed to Marlimund and no more water passed over its escape weir than is absolutely necessary for the safety of the reservoir.

(9) The Board further recommend that a new reservoir be formed in the Kodapamund valley just below the junction of the three streams coming from the saddle and from that place of Dodabetta further west. The construction of this reservoir will involve the acquisition of a few market gardens, and about eight dhobies' huts adjacent to the site of the proposed bund (these were only lately built) must be removed.

(10) The Board believe that this and the proposed Snowdon reservoir will give all the storage capacity required to serve a much increased population through any years of severe drought such as have lately occurred.

(11) It is considered that, when these new reservoirs are made, it will be advantageous to limit the supplies from each to certain areas of the town, thus, for instance, from Marlimund to as limited an area as possible on the higher contours, from Snowdon to the middle contours and the upper portions of the bazaars, and from Kodapamund to the houses in that valley near Charing Cross, Government House road, and along the lake on the north side generally, and in this view the distirbution pipes may require slight re-arrangement, but in such manner that, from higher supplies it may always be possible to supplement the lower or from the lower to such of the higher contours as they can command.

(12) In regard to the Dodabetta reservoir, which supplies the south side of Ootacamund, the Board do not consider that any expensive alterations are required. An examination ought to be made of the lower reservoir and remedies suggested against its silting, as it does at present; its capacity might probably be slightly increased. By properly considered planting on the slopes of Tiger stream, the silt at present brought down might be reduced or by scour valves, and the supply to the reservoir might be increased by catching more of the water which at present eventually finds its way to Burnfoot lake.

(13) The Board are averse to cutting off any of the area of the upper reservoir, but if arrangements can be made to cut off the tea area and include an equal or greater area, this should be done; this however is a question which demands detailed enquiry (Dr. King dissents —see note attached).

(14) It is evident that, if the proposals of the Board meet with the approval of Government, the work of preparing plans and estimates to carry these proposals into effect will require the services of a highly qualified officer for a considerable period; there are many points in connection with the various proposals made, which demand very careful study and investigation before satisfactory designs can be prepared and details decided on.

(15) The Board therefore recommend that the Municipal Council should be advised to approach Mr. Walch (late Chief Engineer for Irrigation), who is now resident in Ootacamund and who has a very full knowledge of the question to be dealt with, in view to securing his services.

(16) The Board are informed that the council have already arranged to provide a sum of Rs. 2 lakhs for the carrying out the improvement of the water-supply and drainage. This sum is not likely to cover all the expenditure necessary, and the Board therefore trust Government will see its way to supplement that sum by whatever amount may be necessary, so that once for all the supply to Ootacamund may be placed on a satisfactory basis. Any less complete measures than those proposed, the Board consider, would be temporary and ill-advised, and therefore strongly recommend that the improvements be taken up at once and made full and complete. The Board believe that any other course will lead in the end to much greater expenditure than if their proposals are accepted and the work carried out as a whole.

21. These suggestions of the Sanitary Board may be thus summarized.

(*a*) Partial abandonment of the MARLIMUND RESERVOIR; the improvement and extension of its supply channels from the Snowdon slopes; the filtration of all the water passing out of the Reservoir;—paras. 1 to 8.

(*b*) The formation of a supplemental reservoir at the SNOWDON PONDS or just below them;—paras. 3 & 5.

(*c*) The formation of a new reservoir in the KODAPAMUND VALLEY just below the junction of the three streams coming from the Saddle and from that part of Dodabetta further west;—paras. 9, 10 and 11.

(*d*) The improvement of the purity of the supply of the DODABETTA RESERVOIRS and the prevention of the silting up of the Lower one;—paras. 12 and 13.

## III.—INVESTIGATIONS NOW CARRIED OUT, PROPOSALS NOW MADE, AND ESTIMATES SUBMITTED.

22. In dealing with the investigations carried out in accordance with G. O. 689-M., dated 27th April 1896, it will be convenient to follow the proposals of the Sanitary Board, as far as they go, in the general order of the above summary.

### (4).—MARLIMUND RESERVOIR.

23. As was expected, the investigations have failed to find any site for a reservoir for the supply of Ootacamund, comparable with that of Marlimund as regards capacity or area of catchment basin. With only 18 feet depth of water it holds, as already stated, 54½ millions of gallons, or upwards of seven months' supply for 12,000 persons at 20 gallons per diem, and it draws its supply from some 469 acres which it is proposed to increase by about 59[1] acres.

| | | |
|---|---|---|
| Its natural catchment area ... | ... | 272·00 acres |
| Snowdon *North* Channel, see para. 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 | ... | 174·24 ,, |
| Snowdon *South* Channel, see para. 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 | ... | 23·00 ,, |
| | Total acres | 469·24 |

[1] Para. 13 of Mr. Ellis' Memorandum.

24. It is also no small advantage in connection with this Reservoir that it lies in a valley which slopes *away* from Ootacamund, so that in the event of its ever bursting there would be no such loss of life and valuable property as would be the case were it in the Ootacamund water-shed.

25. It is certain that the occasional insufficiency of the Reservoir has been due to the imperfect arrangements for taking to it the supply from a large part of its gathering ground, that along the Snowdon slopes. This may be remedied as recommended in para. 6 of the Sanitary Board's report, by lining the catch channels with masonry; for doing this the plans[2] and estimates[3] now submitted provide, as also for the extension[4] recommended in para. 7 of the Board's report.

[2] Nos. 3 and 4.
[3] Rs. 23,900.
[4] Plan No. 5.

26. If these be carried out there need be no doubt that the N.-E. Monsoon rains will always leave the Reservoir full, and experience has shown that when this is the case it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year.

27. The Sanitary Board is right in considering that the "other works[5]" proposed by Mr. Ellis in his Memorandum referred to are not necessary. They were arrived at on the basis of a "run off" of ½ inch in one hour, but this was probably merely a mistake, and certainly a run off of not more than 1 inch in *24 hours* need be provided for, which the present pipe and conduit are sufficiently large to deal with.

| | | |
|---|---|---|
| [5] (*c*) Laying an additional pipe from K to F ... | ... | Rs. 4,000 |
| (*d*) Enlarging Masonry Conduit from E to F ... | ... | ,, 8,220 |
| (*e*) Laying additional pipe ,, F to G ... | ... | ,, 69,000 |
| (*f*) Enlarging Masonry Condnit from G to Marlimund Lake | | ,, 57,060 |
| | | Rs. 1,38,280 |



[1] Para. 7 of its Proceedings.

[3] Nos. 6, 7, 8 and 9.

See letter No. 2370, dated 13th December 1896 with Chief Engineer's Endorsement No. 9-C, dated 4th January 1897, Appendix B.
[4] See pamphlet herewith.

[5] No 45, dated 21st January 1897.

28. That these are now so out of order, as supposed by the Board,[1] that "a large quantity of water must be lost by leakage" between Snowdon House and the Reservoir, does not appear to be the case. The CONDUIT has not been uncovered, but no signs of leakage from it could be detected even when it was carrying a large quantity of water during the last N.-E. Monsoon, and the Estimates now submitted do not therefore provide anything for repair of this work.

29. As regards the FILTERING of the water passed out of the reservoir; this has been already thoroughly gone into as will be seen on reference to the documents noted[2] below, and plans[3] and estimates have been prepared by the Sanitary Engineer which are incorporated with those now submitted. But in addition to the arrangements provided for by the Sanitary Engineer, the Sanitary Commissioner is strongly of opinion that before passing the water into filter beds it should be subjected to the action of "Anderson's[4] revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter[5] from the Agent for the patent in this country, which will be found as Appendix **A** to this report.

30. The estimated cost of all these Filtering arrangements is Rs. 66,000.

31. As regards the *defilement of the water flowing into the Marlimund Reservoir from cultivation*, there can be little doubt that the only effective way of dealing with it, is to acquire all the private lands in the catchment basin, and every day that this course is deferred will add to its cost, because the value of land in and about Ootacamund is increasing, and the cultivation is being extended. It is thought inadvisable in the estimates now sent to deal with the value of the lands in question but the statement Appendix **C** will give the information on which any provision it may be considered advisable to make can be based.

### (5).—SUGGESTED RESERVOIR NEAR SNOWDON HOUSE.

32. In paras. 3 to 5 of its Proceedings the Sanitary Board proposed an "extension of the Snowdon Reservoir" or the construction of "a new dam some 200 feet lower down the valley." The term "RESERVOIR" here applied to what may better be named the 'SNOWDON PONDS,' is likely to be misleading to those who do not know the circumstances of the case; those ponds are not connected with the Ootacamund pipe system and therefore do not form any reservoir for it.

33. Surveys and levels have shown that the valley below the site of the ponds is too steep and narrow for a storage reservoir, but a small useful one might be made at a moderate cost by raising and extending the bund of the lower pond so as to hold up water to 15 feet above its present level and incorporating it, and the other pond also, in the reservoir so formed.

34. The Survey[6] plan and sections connected with this will be found with the other plans, but no estimate is sent, because it has been finally decided [see letter[7] 36, dated 20th November 1896 to the Chief Engineer, P. W. D. and his reply No. 9-C, dated 4th January 1897] that, as recommended[8] by the Sanitary Board, the water supplied from the Marlimund Reservoir must be filtered, and there is no place for the required filters and service reservoir except this Snowdon Ponds site; see the documents referred to above, in para. 29 dealing with "Filtering."

[6] Plan No. 2 (2 sheets).
[7] Appendix B.

[8] Para. 4 of its Proceedings.

[2] No. 1697, dated 17th August 1893 from the Sanitary Engineer.
Note by the Chief Engineer, P. W. D., dated 2nd October 1893.
No. 2544, dated 24th November 1893 from the Sanitary Engineer.
Endorsement of Chief Engineer, P.W.D., No. 862, dated 1st December 1893.

### (6).—Kodapamund Valley—Suggested Storage Reservoir. Proposed Pipe-Head, and supply from it.

35. Much time was spent on Surveys[1] and Levels in connection with the suggestion (para. 9 of the Board's Proceedings) for a storage reservoir in this valley as it seemed an excellent one, but after all, the idea had to be given up because the valley proved so steep and contracted that no safe earthen bund could be constructed high enough to make a storage reservoir of a capacity at all commensurate with the great cost of acquiring the whole of the highly cultivated gardens and all the houses lying *above* it, as well as in its water spread, and their acquisition would be absolutely necessary as they are sources of great pollution. The absence of rock for foundations would prevent the construction of a masonry dam at the place.

[1] Plans Nos. 11 and 12 (2 sheets).

36. But though the formation of a storage reservoir in this valley is out of the question, the adoption is strongly recommended of a scheme for utilizing the small perennial stream of beautiful water flowing into the valley from the western slopes of Dodabetta, which was worked out by Mr. Nery, Municipal Engineer in 1893, and approved by the Sanitary Engineer (see his No. T-187, dated 29th September 1894).

37. This scheme consists in forming a Pipe-head[2] Cistern, by means of a masonry dam 15 feet high on the stream in question, well above all sources of contamination, and from it taking the water by pipes for the use of some 600 persons in the villages of Kodapamund and Vannarpetta, and the European houses lying along both sides of the Kelso road. These though they pay water-tax have now no water laid on to anywhere within their reach, but a few of them get a supply by means of an open channel from a stream known as "Sudukadu" *i.e.*, "burning ground," because its sources flow past a Hindu cremation place.

[2] See plans Nos. 10, 13 and 14.

38. As the scheme was worked out by Mr. Nery and his estimate is now used, except as regards the masonry dam for which a fresh design[3] and estimate are now prepared, his detailed description of the scheme is attached to the estimate.

[3] Plans Nos. 13 and 14.

39. The total estimated cost is Rs. 11,800.

### (7).—Existing Dodabetta Reservoirs.

40. The cutting off of the tea area referred to by the Board[4] is not feasible. That area, as will be seen from the statement which forms Appendix D, is only 12 acres (including ½ acre of fruit trees) and no extension of cultivation is in progress. There does not appear to be any manuring carried on, and from the analysis of the water given in para. 18 it would seem that the cultivation is not now causing contamination; it should however most certainly be acquired especially, as will be seen further on, it will also affect the proposed new Tiger-hill stream Reservoir.

[4] Para. 13 of Proceedings.

41. To prevent cultivation being started on the other private lands (45¾ acres) in the catchment basin of these reservoirs, those lands should also be acquired, which probably might now be effected at a moderate sum.

42. When this has been done and the "undergrowth and humus" in the sholas have been dealt with as recommended in para. 2 of the Board's Proceedings, the supply to these Reservoirs will be of a quite unexceptionable quality.

43. The silting up of the Lower Reservoir may certainly be somewhat retarded by the means suggested in para. 12 of the Board's Proceedings, but the reservoir is of little consequence for storage and its life at best can be but short.



This being the case, the increase of supply to it is of no moment and, as will be seen further on, the stream from which such increased supply would have to be brought it is proposed to utilize in feeding a new Reservoir; the surplus from that however will still be available for taking into the Lower Reservoir if needed.

### (8).—Proposed New Reservoir.

44. The Snowdon and Kodapamund valley sites not being available, as explained above, for the required storage reservoir supplemental to that of Marlimund, it became necessary to fix on some other site, and after careful examination of all apparently possible places it was ascertained that there was none with anything like the advantages of that shown on plans 15 and 16, which may be called the "Tiger-hill stream site."

45. It lies in a valley *out* of the Ootacamund water-shed, it has a catchment basin of large area, including that of the existing Upper Reservoir the surplus of which it can receive, and remarkably free from cultivation or possible sources of contamination; it is at such a level as to command the highest houses in Ootacamund; and there is rock for founding a masonry dam on, admitting of a structure high enough to form a really capacious reservoir.

46. The Position, Catchment area, Water-spread, Capacity, &c., &c. of the proposed reservoir are clearly shown on plans 15 to 21 but for convenience these particulars, with others, may be here briefly stated.

47. Position.—On the stream which flows at the back of "Tiger-hill" and through the Craigmore Forest Reserve, at about **1,100** feet further up that stream than where it impinges against the upper corner of the *Lower* Dodabetta Reservoir; and about **750** feet due south of the *Upper* Reservoir.

[1] See Appendix E.

48. Catchment[1] Area.—The natural catchment area is **100** acres, which at a small cost may be increased to **108¾** acres. Of this less than **24** acres are private property and only **1·85** acre is under tea cultivation, so that the acquisition of all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that[2] of the existing Upper Reservoir would by means of a channel[3] provided for in the estimates, be available whenever that reservoir is full, and for a large part of the year it surpluses nearly the whole of the run off. A run off of 1 inch in 24 hours from the whole combined catchment area of **242** acres would fill the reservoir in a little over 5 days.

[2] About 134 acres.

[3] See plans 16 and 18.

49. Capacity.—With **40** feet depth above the outlet pipe, as designed, the available quantity of water retained in the reservoir would be approximately **30,387,500** gallons, or sufficient at **20** gallons a head per diem for upwards of 4 months supply to **12,000** persons, that being the number to be provided for (see para. 5) on the North side of the Lake, and it is for that portion of Ootacamund, it will be understood, that the Reservoir is specially proposed. It will therefore be generally capable of entirely taking the place of the Marlimund Reservoir for several months in the year, though its drainage area is not sufficient to permit of its being solely trusted to; the Marlimund reservoir must still, it is believed, be depended on to make Ootacamund quite free of any danger of deficient supply at any time.

50. Character of the Water.—The water of the stream on which the reservoir will be constructed is of great purity as shown in the following analysis by

the Chemical Examiner to Government of samples taken just above the site for the dam :—

| Water from the Craigmore Block Stream. | | | | |
|---|---|---|---|---|
| Total solids | ... | Grms. per litre | ... | 0·040 |
| Volatile solids | ... | do. do. | ... | 0·020 |
| Chlorine | ... | do. do. | ... | 0·001 |
| Total hardness | ... | ... | Clark's scale | Trace. |
| Permanent hardness | | ... | do. do. | Trace. |
| Free ammonia | ... | Mlgrms. per litre | ... | Trace. |
| Albumenoid ammonia | | do. do. | ... | 0·064 |
| Nitric acid | ... | do. do. | (as Ammonia) | Trace. |
| Apparent quality of the water as inferred from the results obtained on examination. | | | | Pure and wholesome. |

Remarks.—A first class water.

The water to be brought from the existing Dodabetta Upper Reservoir is also of excellent character, (see para. 18), and may be still further improved by the means recommended in paras. 40 to 42.

51. Swamp in the bed.—It will be noticed in plan No. 16 showing the water-spread of the proposed reservoir that there is in it a swamp of about 1½ acre in extent. In this pits have been sunk and have shown it to be composed of vegetable soil about 8 feet in depth, portions of it being composed of imperfectly formed peat. It is not thought that this is a serious drawback to the site, but as judging from the opinions expressed in connection with the Marlimund Reservoir, it may be considered so, it is deemed proper to bring the matter to notice. In few parts of the world can valleys which are at all flat be found without vegetable soil in their beds, and most certainly none will be found near Ootacamund which have not also a mixture of peat more or less perfectly developed.

52. It may be possible by desiccation, or some other means, to so deal with the swamp before the reservoir is brought into action and it is covered with water, as to destroy or neutralize any deleterious elements in the soil, but if this is not practicable, then rather than it should cause the rejection of this excellent site for the reservoir, the whole of the offending soil had better be removed, though this would be an expensive operation, and the disposal of the spoil on the steep hill sides above the water-spread would be a somewhat difficult matter. It should be noted that the design provides by means of a large 'scour-pipe,' for laying the bed of the reservoir dry at will.

53. The total estimated cost of this Reservoir exclusive of any compensation for private land it may be decided to acquire in its catchment basin is Rs. 47,400

54. As regards the conveyance of the water of the New Reservoir to, and its distribution over, the area the present supply of which it is intended to supplement, there are two systems which may be adopted; one that of keeping the new supply entirely separate, the other that of joining it on to the existing main above where it branches off into its distributing pipes and so making use of *them*. In either case the new main must be taken for **10,375** feet to Charing Cross, but in the former system there would from that point be required some **39,000** feet of new distributing mains, whilst in the latter system, **3,716** more feet of the new main itself would take the water to the existing[1] main from which it would be

[1] The length of the existing main from the Marlimund Reservoir to the 'Sump' where the junction will be made, is 10,445 feet.



Plan No. 22 (3 sheets.)

distributed by the present pipes. The latter arrangement is so greatly the cheaper, and, it is believed, so much the better, that it is recommended for adoption and the estimate Rs. 38,600 has been framed accordingly.

55. The lowest point—Charing Cross—to which the new main will have to descend is rather more than **600** feet below the outlet pipe of the reservoir, and as so great a head would necessitate an unusual thickness of pipes for some distance, it is proposed to put a "break-pressure" tank just below the Dodabetta Lower Reservoir reducing the head by nearly **100** feet; even with this reduction the pressure when the "reducing-valve" (to be mentioned further on) is closed, or partially so, will give an ample command of the houses[1] that now lie above the influence of the present system, and also of the houses which will doubtless before long be built along the proposed new road.

[1] Shedden House, and Hall. Farley. Prospect Lodge. Wrex Hurst, &c.

56. The supply thus given to the high level houses may possibly not be free from occasional failure, but this would rarely occur with proper arrangements in bringing the Marlimund Reservoir into use for the parts of the system commanded by it, before the new reservoir was run dry.

57. The "break-pressure" tank abovementioned would be **193** feet higher than the outlet pipe of Marlimund Reservoir and **226** feet above the existing main at the proposed point[2] of junction of the new main, but of this **175** feet would be absorbed by the fall required to give the required discharge through the proposed 6-in. pipe. It is however advisable (as recommended by the Sanitary Engineer when consulted on the subject) to put a "pressure-reducing valve" on the new main near the junction.

[2] The "Sump" above St. Stephen's Church.

58. As it is considered necessary that half the **240,000**[3] gallons to be provided per diem should be deliverable in six hours, that is at the rate of **332**[4] gallons per minute, a 6 inch diameter pipe will have to be used. This will be laid for the first **1,100** feet along the left bank of the Tiger-hill stream and then across, or round, the Lower Dodabetta Reservoir, just below which the "break-pressure" tank will be placed; thence the pipe will run along the track of the existing main of the *South System* to near Walthamstow corner on the Coonoor Road, and from there it will follow that Road to Charing Cross where a 'wash-out' valve with pipe to the stream will be provided. From Charing Cross it will run along Church-hill Road to near St. Stephen's gate and thence along the road and path beside the Eastern boundary of the church enclosure direct to the "Sump," where the junction with the existing main will be made with a "pressure-reducing valve." No private land will have to be acquired for the pipe track.

[3] 12,000 × 20.

[4] This is exclusive of the 14 cubic feet per minute required between Walthamstow corner and Charing Cross, see next para.

59. As the pipe passes along the Coonoor Road from Walthamstow corner to Charing Cross, water can be taken from it to the houses along that Road and "Old Ooty" Road for the supply of which from the *South* system (which it will be well to relieve of the duty) an estimate of Rs. 6,300 has lately been prepared by the Municipality and approved by the Sanitary[5] Engineer. Of that estimate Rs. 5,200 are for the arrangements connected with the main pipe the necessity for which the main now proposed will supersede. The quantity of water to be supplied to the houses, &c., now under consideration, is **10,000** gallons per diem and this the proposed main can easily carry in addition to the **240,000** gallons which it has to take on, as above explained.

[5] See his letter 122, dated 20th January 1897.

60. It may be noted that it will be easy, and cost but a small sum to put the new main into connection with that of the *South* system either at the Lower

# APPENDIX B.

No. 36. OOTACAMUND, *20th November* 1896.

To

THE CHIEF ENGINEER,
*P. W. D., Madras.*

SIR,

As I anticipated,[1] I have failed to find any site for a reservoir which will render the abandonment of the Marlimund Reservoir as the main storage for the supply of Ooty advisable, it would however be possible to make a useful little supplementary reservoir at the site of the Snowdon Ponds.

[1] See para. 3 of my letter, dated 23rd November 1895, printed with P. M. G., No. 298-W, dated 24th January 1896.

2. That site however will be required for filter beds and service reservoir if filtration of the Marlimund Reservoir water be decided on, (see note of Acting Chief Engineer, P. W. D., dated 2nd October 1893, No. 3299-C, and reply of the Sanitary Engineer to Government, dated 24th November 1893, No. 2544) and I therefore request that I may be informed of the decision in the matter.

(Sd.) G. T. WALCH.

*Dated Madras, 4th January* 1897.

Letter for the Sanitary Commissioner for Madras, No. 2370-S, dated 13th December 1896.

With reference to your endorsement No. 4683 of the 8th December 1896, I have the honour to state that having regard to the chemical composition of the Marlimund water, which is the natural sequel of its mode of collection and especially of the character of the reservoir, and to the existence within its catchment of human habitations, I am of opinion that it would be sanitarily erroneous for a town of sufficient importance to demand municipal Government, and still more so for a town boasting of being the sanitarium of Southern India, to permit delivery to the consumer of such water without an effort to alter its chemical composition, and guard against its possible bacterial contamination. In other words, if the full benefit of expenditure upon collection, storage, and distribution is to be reaped by the inhabitants, it can only be secured by taking these additional precautions.

2. I know of no method that will meet these combined requirements so thoroughly as by arranging in the first place to subject the water to the action of iron in Anderson's revolvers, and subsequently deliver it upon the ordinary type of public water works sand filter beds, fitted with all modern appliances for charging the beds with filtered water before starting, for regulating the filter speed, and allowing facilities for separate bacteriological examination and the rejection of unsatisfactory filtrates without disturbance of individual beds. The motive power required for the revolvers is small. But if the provision of this small power be regarded as offering difficulties, the next best, but in my opinion inferior, method would be the use of polarite combined with sand filtration.

3. Water of this character might instead of either of the above methods be advantageously dealt with, as in the case of sewage, by subjecting it to filtration through porous gravel land and re-collecting it by means of wells a sub-drains ; but I am not aware of a suitable plot of ground for this process in the vicinity of Marlimund. It would however be in the interest of economy that the Engineer designing the scheme should search for such ground between Marlimund and Snowdon reservoir. Although this method would be cheap and effective, I need not remind you that it would not be economical of water.

ENDORSEMENT No. 9-C.

Copy of the Sanitary Commissioner's letter forwarded to Mr. Walch with reference to his No. 36, dated 20th November 1896, and with the remark that it appears that filtration of the Marlimund Reservoir water is necessary.

D. McNEIL CAMPBELL, COLONEL, R. E.,
*Chief Engineer, Public Works Department.*



# APPENDIX C.

## Statement of areas in the natural Catchment Basin of Marlimund Reservoir.

| Survey Field No. | Government Waste. | | Private Property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue Gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C/359 ... | 40 | ... | ... | ... | ... | ... | |
| C/138 ... | ... | ... | 2 | 22 | ... | ... | Tudor Hall. |
| C/137 ... | ... | ... | 2 | 42 | ... | ... | |
| C/139 ... | ... | ... | 8 | 84 | 8 | 15 | Tudor Hall. |
| C/141 ... | ... | ... | 1 | 30 | ... | 18 | Tudor Hall. |
| C/140 ... | ... | ... | 1 | ... | 1 | ... | Tudor Hall. |
| C/142 ... | ... | ... | ... | 61 | 3 | 44 | Tudor Hall. |
| C/143 ... | ... | ... | 2 | ... | ... | 50 | |
| C/145 ... | ... | ... | 6 | 91 | 2 | 81 | Tudor Hall. |
| C/133 ... | ... | ... | 3 | 46 | 4 | 10 | Tudor Hall. |
| C/135 ... | ... | ... | ... | 15 | ... | ... | |
| C/132 ... | ... | ... | ... | 13 | ... | ... | |
| C/131 ... | ... | ... | ... | 36 | 3 | 10 | Tudor Hall. |
| C/136 ... | ... | ... | ... | 24 | ... | ... | |
| C/134 ... | ... | ... | ... | 8 | ... | ... | |
| C/144 ... | ... | ... | ... | 75 | 1 | 32 | Tudor Hall. |
| C/146 ... | ... | ... | 3 | 66 | 6 | 4 | Tudor Hall. |
| C/344 ... | 13 | 20 | ... | ... | ... | ... | In Register this appears as "Municipal property." |

APPENDIX C.—(*Continued*).

| Survey Field No. | Government Waste. | | Private Property. | | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | Not cultivated and Blue Gums. | | Tea. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| C/147 ... | ... | ... | 5 | 89 | 4 | ... | Tudor Hall. |
| C/150 ... | ... | ... | 16 | ... | 18 | 40 | Tudor Hall. |
| C/148 ... | ... | ... | 7 | 6 | 31 | 60 | Tudor Hall. |
| C/149 ... | ... | ... | ... | 65 | ... | ... | Gayton Park. |
| C/130 ... | ... | ... | 47 | 73 | ... | ... | |
| C/175 ... | ... | ... | ... | 50 | ... | ... | Gayton Park. |
| C/177 ... | ... | 83 | ... | ... | ... | ... | |
| C/178 ... | 5 | 30 | ... | ... | ... | ... | |
| C/360-A ... | 7 | 10 | ... | ... | ... | ... | |
| C/338 ... | 9 | 12 | ... | ... | ... | ... | |
| Total*... | 75 | 55 | 111 | 96 | 84 | 64 | |

* Total 272 acres 15 cents. approximate:—Note. In Appendix A of Report with P.M.G. No. 286-W, dated 1st February 1882, this is given as 268 acres.

Ootacamund,
*8th March* 1897.

GEORGE T. WALCH,
*M. Inst. C. E.*



# OOTACAMUND WATER-SUPPLY IMPROVEMENT REPORT.

## APPENDIX D.

### Statement of areas of Catchment Basin of the Dodabetta Upper Reservoir.

| Survey Field No. | Government Waste and Forest. | | Private Property. | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Uncultivated, Blue Gum, and Cinchona. | | Tea. | | Fruit Trees. | | |
| | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | |
| F/234 ... | ... | ... | 6 | ... | ... | ... | ... | ... | |
| F/232 ... | ... | ... | 8 | 64 | ... | ... | ... | ... | |
| F/230 ... | ... | ... | 6 | 51 | ... | ... | ... | ... | |
| F/228-F ... | 5 | 50 | ... | ... | ... | ... | ... | ... | |
| F/304-B ... | 5 | 25 | ... | ... | ... | ... | ... | ... | |
| F/228-G ... | 46 | 18 | ... | ... | ... | ... | ... | ... | |
| F/244 ... | ... | ... | 6 | 35 | ... | ... | ... | ... | |
| F/228-Z ... | ... | 50 | ... | ... | ... | ... | ... | ... | |
| F/243 ... | ... | ... | 3 | 22 | ... | 30 | ... | ... | |
| F/241 ... | ... | ... | ... | ... | 2 | 11 | ... | ... | |
| F/240 ... | ... | ... | 1 | 46 | 2 | 34 | ... | ... | |
| F/228-E ... | 8 | 50 | ... | ... | ... | ... | ... | ... | |
| F/231 ... | ... | ... | 2 | 68 | 2 | 41 | ... | 50 | |
| F/242 ... | ... | ... | 3 | 24 | 1 | 59 | ... | ... | |
| F/239 ... | ... | ... | 2 | 10 | 2 | 80 | ... | ... | |
| F/277 ... | ... | ... | 5 | 50 | ... | ... | ... | ... | |
| F/245 ... | 3 | ... | ... | ... | ... | ... | ... | ... | |
| F/305-A ... | 7 | ... | ... | ... | ... | ... | ... | ... | |
| F/228 X ... | ... | 19 | ... | ... | ... | ... | ... | ... | |
| Total... | 76 | 12 | 45 | 70 | 11 | 55 | ... | 50 | Total 133 acres 87 cents. |

Ootacamund,
*8th March* 1897.

GEORGE T. WALCH,
*M. Inst. C. E.*

## APPENDIX E.

### Statement of areas in Catchment Basin of proposed "Tiger-Hill" Stream Reservoir.

| Survey Field No. | Government Forest. | | Private Property. | | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Municipal Property. | | Uncultivated, and Blue Gum. | | Cinchona. | | Tea. | | | | |
| | Acres. | Cents. | Acres | Cents. | Acres. | Cents. | Acres. | Cents. | Acres. | Cents. | | | |
| F 237 | ... | 6 | 25 | ... | ... | ... | ... | ... | ... | ... | | | |
| F 250 | ... | ... | ... | 9 | 44 | ... | ... | ... | ... | ... | | | |
| F 296 | ... | ... | ... | ... | ... | 87 | ... | ... | ... | ... | | | |
| F 249 | ... | ... | ... | ... | 5 | ... | ... | ... | ... | ... | | | |
| F 247 | ... | ... | ... | ... | ... | ... | 7 | 20 | ... | ... | | | |
| F 228-Z | ... | 19 | ... | ... | ... | ... | ... | ... | ... | ... | | | |
| F 245 | ... | ... | ... | ... | ... | 48 | ... | ... | ... | ... | | | |
| F 244 | ... | ... | ... | ... | ... | 47 | ... | ... | ... | ... | | | |
| F 243 | ... | ... | ... | ... | 2 | 50 | ... | ... | ... | ... | | | |
| F 241 | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 25 | | | |
| F 240 | ... | ... | ... | ... | ... | 50 | ... | ... | ... | 60 | | | |
| F 238 | ... | 25 | ... | ... | ... | ... | ... | ... | ... | ... | | | |
| F 228-A | 60 | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | |
| F 248 | ... | ... | ... | ... | 5 | 4 | ... | ... | ... | ... | | | |
| Total ... | 66 | 69 | 9 | 44 | 14 | 86 | 7 | 20 | 1 | 85 | Total 100* acres 4 cents. | | |

* Besides this, about $8\frac{3}{4}$ acres of Field No. C/237 may be brought in by catch drain.

OOTACAMUND,
*8th March* 1897.

GEORGE T. WALCH,
*M. Inst. C. E.*

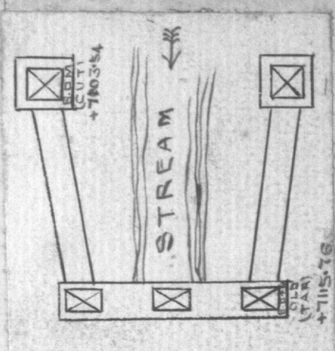


## APPENDIX F.

### Synopsis of Important Bench Marks in connection with the Investigations.

| Description of B. M. | Position of B. M. | Value. | Remarks. |
|---|---|---|---|
| On Rough Stone Floor | Floor of Escape of Marlimund Reservoir (under Bridge) ... ... ... [*Note.*—Zero of Present Gauge on Water Tower is 18 feet below this.] | **7444·72** | This is the initial B. M. from which all the levels of the investigations are taken; the value is that given in Letter 2777 of 9th September 1896 of the Sanitary Engineer to Government. The datum is probably approximately, but only roughly approximately, mean Sea-level. |
| Tar Mark [redacted] ... | Parapet of Dividing Cistern South Side of Kotagiri Road (East of Snowdon House grounds). | **7465·68** | See Plan 2 (Sheet 1). |
| | Floor of Escape of Lower Snowdon Pond ... ... ... ... | **7423·75** | See Plan 2 (Sheet 1). |
| | Level of Top of Main to Ootacamund just as it leaves the Tunnel near Snowdon Lower Pond. | **7425·30** | |
| B. [redacted] M. Cut ... | On Rock, East Side of Snowdon Road about 64 feet from Road to "Fox How" ... | **7432·69** | |
| B. [redacted] M. Cut ... | On Rock, East Side of Snowdon Road near Pear Trees ... ... ... | **7386·99** | |
| B. [redacted] M. Cut ... | On Rock, West Side of Snowdon Road below Latrine of "Hill Side Villa" ... | **7370·95** | |
| Tar B. [redacted] M. ... | On Parapet of "Sump" above St. Stephen's Church, near "Highland Villa." ... [*Note.*—Top of Pipe inside this Sump **7392·51**.] | **7397·35** | |
| Tar B. [redacted] M. ... | On West End of Second Step of entrance at *North* End of "Shedden House" ... | **7530·50** | See Plan 1. |
| Tar. B [redacted] M. ... | On Stone in North Angle of Brick edging of Triangular Plot at Junction of Church Hill Road, with Road to Library. | **7228·10** | |

APPENDIX F.—(*Continued*).

| Description of B. M. | Position of B. M. | Value. | Remarks. |
|---|---|---|---|
| B. M. Cut ... | On Plinth of Pilaster at end of Western Upstream Wing, Charing Cross Bridge...<br>[*Note.*—There is an old bar B. M. on the East Corner of North Parapet of this Bridge; Value **7115·76**]. See sketch in Remark Column. | **7103·54** |  |
| B. M. Cut ... | On Rock, East Side of Road to Kodapamund Dhobie Village, opposite "Kelso Villa," Lawn Tennis Court. | **7179·68** | See Plan 10. |
| B. M. Cut ... | On Rock near Road in Dhobie Village below Washerman Arumugam's House ... | **7246·54** | See Plans 10 and 11. |
| B. M. Cut ... | On Rock in bed of Western Branch ("Shudukadu") of Kodapamund Valley Stream, below Road Revetment. | **7397·89** | See Plans 10 and 11. |
| B. M. in Tar ... | On North Parapet of Measuring Weir across Kodapamund Main Stream—a short distance above Kotagiri Road. | **7528·89** | This is the Proposed Site for "Pipe Head" see Plans 10 and 11. |
| B. M. in Tar ... | On Rock right edge of Vaumarpetta Stream (Old Rifle Butts, or Manjekalmund, Valley). | **7303·49** | See Plans 10 and 11. |
| B. M. in Tar ... | On Stone Curb of Platform round fountain at Junction of "Walthamstow" Road with Coonoor Road. | **7302·78** | See Plan 22 (Sheet 1). |
| B. M. in Tar ... | On South Parapet of Cistern at Lower Dodabetta Reservoir.<br>Crest of Escape of Upper Dodabetta Reservoir.<br>[*Note.*—The Zero of Present Gauge on Water Tower is 24·80 below this Escape.] | **7631·47**<br>**7787·87** | See Plans 15, 16 and 22 (Sheet 1). |
| B. M. Cut ... | On Rock left side of "Tiger-Hill Stream." | **7677·44** | See Plans 15, 16 and 22 (Sheet 1). |
| B. M. Cut ... | On Slab Rock left side of stream a short distance above proposed site for Dam of New Reservoir. | **7712·99** | See Plans 15 and 16. |
| B. M. Cut ... | On Rock on left side of stream about 325 feet above the last B. M. | **7727·65** | See Plans 15 and 16. |

NOTE.—There has hitherto been no datum common to all, or many, of the levels connected with the Ootacamund Water-Supply. As it is very advisable that this should no longer be the case much consideration was given to the question as to what datum should now be adopted. The "Survey of India Department" was addressed in the hopes that it might have established some Standard Bench Mark at Ootacamund; the reply was that "a list of Trignometrical Heights" was supplied, of which however no use could be made as it was not possible to fix with certainty and accuracy any of the points named. It was therefore decided to adopt the value of the *Marlimund Reservoir Escape*, as taken by the Sanitary Department in its last levelling work here, and use its datum; see remark opposite the first B. M. in the above list. It is strongly recommended that this be adhered to in future in all levels Municipal and otherwise, connected with Ootacamund Water-Supply and drainage; the various well defined B. M.'s here given will make this an easy matter.

GEORGE T. WALCH,
*M. Inst. C. E.*

OOTACAMUND,
*8th March* 1897.



# OOTACAMUND WATER-SUPPLY IMPROVEMENT REPORT.

## APPENDIX G.

### Plans to accompany Report.

| Distinguishing No. of Plan. | Description of Plan. | Number of Sheets. | Paper (P.) or Tracing Linen (T. L.) | Remarks. |
|---|---|---|---|---|
| | Book 1. | | | |
| 1 | Parts of Revenue Survey Sheets 3, 4 and 5 showing existing cultivation in catchment basin of Marlimund Reservoir, &c. | 1 | P. | Lithograph. |
| 2 | Survey Plan and Sections, Snowdon Ponds. ... ... | 2 | P. | |
| 3 | Longitudinal Section of Snowdon Channels. ... ... | 1 | T. L. | |
| 4 | Conduits and Cistern for Snowdon Channels. ... ... | 1 | T. L. | |
| 5 | Survey Plan for Diversion of Stream. ... ... | 1 | T. L. | |
| 6 | Plan of proposed Position of Filter beds and Service Reservoir. | 1 | T. L. | Prepared by Sanitary Engineer. |
| 7 | Sections for do. do. do. ... | 1 | T. L. | |
| 8 | Plan and Sections of Filter Beds. ... ... ... | 1 | T. L. | |
| 9 | Plan and Sections of Service Reservoir. ... ... | 1 | T. L. | |
| | Book 2. | | | |
| 10 | Parts of Revenue Survey Sheets 10, 11 and 12, showing proposed Kodapamund Pipe-Head. | 1 | P. | Lithograph. |
| 11 | Survey showing site which was suggested for Reservoir, Kodapamund valley, &c. | 1 | T. L. | |
| 12 | Sections across Kodapamund valley. ... ... | 2 | T. L. | |
| 13 | Survey for Proposed Pipe-Head Reservoir ... ... | 1 | T. L. | |
| 14 | Drawing for Pipe-Head Dam. ... ... ... | 1 | T. L. | |
| | Book 3. | | | |
| 15 | Parts of Revenue Survey Sheets 10, 11 and 12 showing Proposed New Reservoir and existing Dodabetta Reservoirs. | 1 | P. | Lithograph. |
| 16 | Survey Plan site for Proposed New Reservoir, &c. ... | 1 | T. L. | |
| 17 | Cross Sections Tiger-hill stream. ... ... ... | 1 | T. L. | |
| 18 | Section for Channel from Dodabetta Upper Reservoir to the proposed New Reservoir. | 1 | T. L. | |
| 19 | Design for Dam, &c. ... ... ... ... | 1 | T. L. | |
| 20 | Do. Ground, Plan and Elevation. ... ... | 1 | T. L. | |
| 21 | Survey and Section for Bye-wash. ... ... ... | 1 | T. L. | |
| 22 | Sections for piping from New Reservoir to Sump above St. Stephen's Church. | 3 | T. L. | |
| | Separate. | | | |
| | Map of Ootacamund—Scale 6″=1 mile showing areas supplied by pipes from various sources. | 1 | P. | Lithograph Madras Survey. |

OOTACAMUND,
*8th March* 1897.

GEORGE T. WALCH,
*M. Inst. C. E.*

Co[illegible] Kalyanamund Water Supply Improvement.

Statement for calculation of Professional remuneration - see P.M.S. Nos 689-27/4/96 —

| | Rs. | Rs |
|---|---|---|
| Total amount of Estimate. | | 1,87,700 |
| Deduct | | |
| Filtering arrangements (the State part of this Estimate prepared by the Sanitary Department) — | 66,000 | |
| Piping from Kalyanamund Pipe-Head - Mr Harp's Estimate. | 8060 | |
| Estimated cost of Pipes and fittings for the Mains from new Reservoir. | 35,000 | 109,060 |
| Balance on which fee to be calculated | | 78,640 |
| Five per cent on Rs. 78,640 | | 3930 |
| Already drawn (7 months. @ Rs 300) | | 2100 |
| Balance due | Rs | 1830 |

Co[illegible] Kalyanamund
15th March 1897

C. Lewis

Rec'd. 2
25/4/97

1
2065 May 1897

OWS.1
1240/57

#A 28

Coimbatore
15th March 1897

To
The Chief Engineer. P.W.D.
Madras

Sir.

× B.P. 1499 W 8/3.5.96

With reference to P.O. 298 W 24/1/96 and 689 W. dtd 27/4/96, × I have the honor to forward the Report. Plans × Estimates connected with the investigations carried out by me for the improvement of the Coimbatore Water-supply —

× In box

* For list see Appx G of Report

(2) In all these, correctness and clearness of record has been aimed at, so that any one who may hereafter have to deal with the scheme, or any part of it, may find what has been done made to his hand and have no need to search for ground which has already been covered. In connection with this I would draw attention to the "Note" at the end of the "Synopsis of Bench Marks" Appendix F of the Report —

(3) I enclose the Statement of remuneration claimed. It will be seen that in order to keep down the cost of the present

investigations I have been careful to make use as far as possible, of all suitable work which I could find already done.

(4) If the Claims be approved the total Cost of the investigations will amount to £ 6170 - approximately.

£ 3930 Engineering &c
1708 Establishment
532 Sundries
£ 6170 Contingencies

(5) If any explanation or information in addition to that will be found in the Report and Plans be required I shall be ready to furnish as far as may be in my power.

(6) The Chairman of the Estacaument Municipality be from time to time furnished me with most useful information both from his own extensive personal knowledge, and from the records of his office, and I would also acknowledge assistance received from the Sanitary Engineer on various points connected with the proposed new Main.

(7) The instruments &c lent for the work have been returned to the Public Works Department, and the furniture, Templer Stationery and the various records (Survey & Level books, Letter files & &c &c) have been handed over to the Municipal Office

I have the honour to be
Sir
Your most-obedient-Servant
Chas. Tidswell

Contents of Box 20ut.
3 Books of Plans.
1 Separate Map of Estacaument. Scale 6"=1 Mile
1 Pamphlet, "Rate Filtration"
4 Packets of Tracings
120 Copies of printed Report.
(One signed Copy sent by Book post)

Read - the following papers:-
GON 3280 & 25/5/97 P.W.D.

No. 3280

LOCAL & MUNICIPAL DEPT.
CURRENT No. 2065-M

Government of Madras.

P U B L I C  W O R K S  D E P A R T M E N T.

---

Endorsement.

Dated, Ootacamund, 25th May 1897.

Letter from G.T. Walch Esquire, dated 15th March 1897.

Note by the Chief Engineer, dated 25th May 1897. No 3278

There are at present three sources of water supply for Ootacamund.

1. Marlimund Reservoir.
2. The spring above old Ooty.
3. The Dodabetta Reservoirs.

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply, one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, 1st. in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens. 2nd. In providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in para 26 of his report that "there need be no doubt that the N.E. monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year" If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

3. Mr. Walch's statement is made from experience, and there can be little doubt that he is correct, but it will perhaps be

be as well to test what he says by figures.

4. Supposing the reservoir to be empty at the beginning of the S.W. monsoon, say 1st June, the average rainfall during that monsoon, 1st June to 1st October, (4 months), is 21.78"; and supposing 1/3rd of this, or say, 7" to be the run off, the amount received into the tank would be 83.6 million gallons, the catchment area being 528 acres. The amount used at 20 gallons per head for 12,000 persons would be 29 million gallons, and the evaporation and absorption taken at 24" over the whole water spread of 18 acres would be 9.7 million gallons: therefore the balance left in the reservoir at end of the S.W. monsoon, or on 1st October, would be 83.6-(29+9.7) = 44.9 million, say 45 million gallons.

5. The average rainfall during the N.E. monsoon, say 1st October to 1st January, or 3 months, is 16.19" and supposing 1/4th of this, or say 4" to be run off, the supply received would be 47¾ million gallons. The quantity used during this period will be 22 million gallons and the evaporation and absorption at 12", 4.8 million gallons, so that at the end of the N.E. monsoon, or 1st January, there will be (45+47.7)-(22+4.8), or 65.9 million gallons which would much more than fill the reservoir, its capacity being 54.5 million gallons. Now from 1st January to 1st June the quantity used will be 36¼ million gallons and the evaporation and absorption taken at 36" will be 14.5 million gallons, so that the total quantity required during the 5 months will be 50.7, so that there would still be 3.8 million gallons in the reservoir on 1st June; but it must be remembered that no credit has been given for any rain that may fall between 1st January and 1st June and the average of these 5 months is 11.30". So I think that there can be no doubt that the Marlimund reservoir as improved by Mr. Walch's proposals will meet all requirements as regards quantity. I would further point out that I have taken the worst view of the case, for considering the nature of the catchment area, the run off I have allowed is low, and 6' for evaporation and absorption over the whole water spread

of



of 18 acres is no doubt much above what it will be; but in the absence of correct information I have thought it well to err on the safe side. It must further be remembered that 20 gallons per head for a population 25 per cent greater than at present is a very liberal allowance and I doubt (if undue wastage is prevented) that it will ever be used as the most part of the population is native. It may therefore be safely asserted that even in the worst year the supply in the Marlimund reservoir will be ample. Judging from the rain registers for the past 7 years the variations are trifling, the worst year giving a rainfall of 46.48" and the best 64.9", the average as taken in the foregoing calculation being 49.27.

6. As regards the quality of the water in the Marlimund reservoir, I believe it has been condemned on account of the peat soil in catchment and bed and owing to the chemical analysis being unfavourable. It has therefore been considered necessary to provide filters and a service reservoir and also Anderson's revolvers at a cost of Rs. 66,000. Though I hardly like to oppose the opinion of Sanitary experts, I still think that, before such heavy expenditure is incurred, it would be well if it could be shown that the health of the people in Ootacamund has suffered by the use of the water. It is well known that chemical analysis is useless to determine whether water is wholesome or not, and as Mr. Baldwin Latham one of the greatest authorities on Sanitary Engineering says "the impure water of the chemist was not always unwholesome water, nor was the pure water of the chemist always pure", and again Professor Huxley pronounced an opinion that water might be as pure as possible from a chemist's point of view and yet be most deadly. Actual facts are therefore more to be depended on than theory. In this I am supported by the late Sanitary Commissioner for Madras, Surgeon General M.C. Furnell, M.I.F.R.C.S.,

who

who in his letter No.96 dated 31st January 1884 to the Chief Secretary to Government wrote as follows:- "The outcome of it all is that, if water has been drunk with impunity by people without any injury to health, it would be folly to condemn it because chemists demonstrate it contains so many hundreds or thousands of grains of organic matter per litre". Objections are also taken to the Marlimund water because the catchment and the bed are peat. With reference to the former I will quote from W. Pole, F.R.S., a great authority on such matters. He writes as follows:- There is however one kind of effect to which water even from the highest land is liable, namely, to discolouration by peat. Most of these high lands contain in certain spots masses of decaying vegetation in the shape of morasses or peat bogs. These collect the rain water like sponges and when it flows away from them it carries with it small particles of the vegetable matter which render it brown in colour. This is no great detriment to the use of the water; the presence of these brown particles does not render it at all unwholesome: but still it is objectionable to look at". I believe it is still asserted by the Sanitary authorities that, though the catchment area being peat, may not be objectionable, the bed of the reservoir being so, render the water unwholesome. This is I fancy theory, as I have seen no reason given for the assertion. I am therefore of opinion that unless it can be shown that the health of the inhabitants of Ootacamund has suffered by the use of the Marlimund reservoir water, there is no necessity to go the expense of filters and Andersons revolvers. At the same time to be perfectly safe, I would follow Mr. Walch's suggestion and acquire the private land in the catchment basin of the reservoir. What the cost of doing so will be is not stated, but probably it will not amount to Rs. 66,000, the cost of filters and Anderson's revolvers. The private lands in the catchment area of the Dodabetta reservoir should be acquired for the same reason.

7. I am therefore of opinion that the new Tiger Hill reservoir is not required and all that is necessary to do is to improve the



the Marlimund reservoir as suggested by Mr. Walch. The objection to this is that some houses on high ground to the north will not be supplied; but whether it is advisable to expend Rs. 86,000 (cost of new reservoir and piping) to attain this object is a question that others must decide.

Pipe-Head Reservoir on the Kodapamund valley. This is I consider a very necessary work and will supply some houses that pay water tax though no water is laid on. The details have been carefully worked out and the cost will be Rs. 3,740. All that I would therefore propose to do at present as regard the water supply of Ootacamund is —

1st. To line the existing Snowdon channels with masonry and bring more water to the southern one by diversion of a stream above Government Gardens --- --- Rs. 23,900.

2nd. To construct a pipe head reservoir on the Kodapamund valley stream. --- 3,740.

3rd. To acquire the private lands lying the in the catchment area of the Marlimund and Dodabetta reservoirs. Cost --- --- unknown.

8. In case however my views are not accepted and it is stil considered advisable to construct the Tiger Hill reservoir, it is necessary that I should make some remarks about it. The catchment area as proposed will be 242 acres or not half that of the Marlimund reservoir. Therefore it cannot by itself be considered as a sure supply for the whole of the northern portion of Ootacamund now supplied from Marlimund. The water is said to be very pure but the bed of the reservoir contains peat as at Marlimund, and no doubt after a time the Sanitary authorities will say that filters and Anderson's revolvers are necessary as the water will probably become discoloured.

9. The only advantage I can see in constructing this reservoir is that it will command the whole of the northern part

of

of Ootacamund and if it is decided to construct it I would suggest that the supply to be drawn from it be limited to that required for drinking and cooking purposes, say 5 gallons per head per diem. The capacity would then be enough, and that the Marlimund water be used entirely for flushing drains watering roads, fires, &c. This would necessitate the new reservoir having an entirely septrate pipe system of its own, but this I believe would cost less than the Rs. 66,000 proposed to be spent on the filters, service reservoirs and Anderson's revolvers at the Marlimund reservoir.

10. The scheme for the Ootacamund water supply has been most carefully worked out by Mr. Walch in a very short time and it is only necessary for me to mention one or two of the details.

Kodapamund valley scheme.-the details of the piping are not complete, but these can be supplied by the Sanitary Engineer.

Tiger Hill dam.-the bottom width of this should be increased to 27'.

11. There are no detailed estimates for filter beds and service reservoirs.

12. I consider that if Anderson's revolvers are provided the size of the filter beds may be reduced by about one half as the rate of filtration can be nearly doubled. The saving in this case would be about Rs. 18,000. Appendix A of Mr. Walch's report gives some information about the annual maintenance of Anderson's revolvers, but from it I cannot clearly make out what would be the cost in the case of Ootacamund.

(Signed) D. McNeil Campbell, Colonel, R.E.
Chief Engineer.

---

Transferred to the Local and Municipal Department.

D. McN. Campbell Colonel, R.E.,
Secretary to Government.

To The Local & Municipal Department.

L. & M.
1,000—11-11-96.

# Local & Munl. (1897) Department.

D.O.
~~CURRENT~~ No. 76

*From* Surg.-Maj. W. B. Browning

*No.*

*Dated* 1. 8. 97
*Received* 1. 8. 97
*Registered* 3. 8. 97.
*Enclosures*
*Spare copies*

SUBJECT.

Reporting on the quality of the water of the Marlimund reservoir

# Water ... Filtration

*To accompany*
*Report on*
*Ootacamund Water-Supply Improvement.*

C. Stewart

The Anderson Process of Purification Compared with Ordinary Sand Filtration.

Ow 5.3
2060 (57)

5-
2088 Nov 1847

L & M. D.O. No. 76

1.8.97

GOVERNMENT HOUSE,
OOTACAMUND.

My dear Mr. Forbes:

This matter of the Marlimund water was re-opened, indirectly, by myself - Lord Wenlock having noticed that the pipe water was discoloured drew my attention to it & I sent samples to the Chemical Examiner - his report was then sent to the Chairman of M & C & on this the correspondence started. I further went all over

servants here at G. House drink nothing but Marlimund water ~~Two are~~ Bowel complaints are, practically, unknown. In outside practice, diarrhoea & Sporadic forms of dysentery occur in the earlier months of the season April & May. This period doubtless corresponds with the minimum height of the Marlimund: but the diseases above referred to are attributable, not to this fact but to others much more rational. The period

GOVERNMENT HOUSE,
OOTACAMUND.

corresponds with the arrival of visitors, often in poor health, from the plains & it is among this class, & chiefly in children, that the above occur. At this period the upper lake is most pestilential & to this & climatic change I have always ascribed such bowel troubles as do arise in the period referred to.

With the monsoon bowel troubles disappear as a rule

the catchment area with the late Governor in connection with this subject & the idea of cutting off the catchment area round the lake & utilising only the Snowdon area -

From the above you will understand that my attention has been particularly directed to the question of possible causation of bowel complaints in connection with this water supply - I have never seen a case of disease that I could in any way attribute to the water supply fr. Marlborough or Dodaletta

I have had ample opportunities in seven years practice both amongst residents visitors & our very large body of servants to form a definite opinion - perhaps as I do not quote statistics I should say "impression" not opinion - Our natural

if such affections were attributable to peat we would expect to find an increase when the water was as it were 'stirred up' & fresh supplies of the seepage came washed into the reservoir.

When the landslip occurred at Marlinmoss & peat bog slipped into the lake - no increase among bowel affections was noted -

The only difference I have noted between the N. & S. sides so far as health is concerned is a greater prevalence, comparatively speaking, of sore throats among residents on the south side. This is attributable to the cause enumerated & entered into here -

Regarding the general question perhaps I may not be overstepping the subject of your letter if I observe that peat water or rather water from a peaty source is considered 'good' - that the water supply of many English towns considered to be good is so. This source and that the most accurate Sanitarian we have ever had, 'Parkes' quotes only one example of bowel trouble arising so. Peaty water and

GOVERNMENT HOUSE,
OOTACAMUND.

this one case, he quotes on the authority of others, I forget the precise quotation but I was struck by the cautious way in which it was put It may be found in any edition of his book - I regret I have not got a copy with me.

Upon the above rather lengthy remarks you will observe that I do not

consider

the great a matter requiring much attention.

whether with the increase in the size of this town the possible extension of building within the watershed of the reservoir. Steps should not be taken to conserve the area to a greater extent is beyond the limits of the queries you have put to

me

Yours truly

W. Bottomley

[L. & M. 1,000—11-11-96.]

# Local & Munl. (1897) Department.

D.O

~~CURRENT~~ No. 77

*From*
Surg.-Major. C.M. Thompson
Civil Surgeon
Ootacamund

*No.*

*Dated* 2.8.97
*Received* do
*Registered* 3.8.97
*Enclosures*
*Spare copies*

SUBJECT.

Reporting on the qualities of the water of the Marlimund reservoir

L. & M.
1,000—11-11-96.

# Local & Munl. (1897) Department.

D.O.

CURRENT No. ~~78~~

*From* J. H. A. Tremenheere Esq
Collector of the Nilgiris

*No.*

*Dated* 2. 9. 97
*Received* 4. 9. 97
*Registered* do.
*Enclosures*
*Spare copies*

SUBJECT.

Stating that there is in the drying
area of Marlimund reservoir, no
tea or
other cultivation than blue

L+M. D.O. No. 77

Civil Surgeon's Office,
Ootacamund, Aug 27 1897

Dear Sir Forbes
Mr Tremenheere
Collector of Nilgiris
a Confidential inspection of
the Samlimund reservoir
& found that at the
Southern end there is
some Cultivation of
the waste from the Dam
by Sitarial Race; it
would be best if the
Chavinga from this bog

Supply through Thuricam
he not shoulder the Kettle
& the Pumda Nurse
to Kotagiri water of
the Tank.

Yours truly
C Mullaney

L. & M.
1,000—11-11-96.

# Local & Munl. (1897) Department.

D.O

CURRENT No. 79

*From*
Surg.-Lt.-Col. G.L. Walker
Pres.cy Surgeon
1st District

*No.* —

*Dated* 4.8.97
*Received* 6.8.97
*Registered*
*Enclosures*
*Spare copies*

SUBJECT.

Reporting on the quali
of the water in the
Marlimund reserv

...ey. your favouring me
with any information
on the Subject- yours
may possess.

Yours Sincerely
(Signed) E.S. Forbes.

Desp. 30.7.97
Encl

No. 51

Local & Municipal

GOVERNMENT OF MADRAS

OOTACAMUND,
30.7.1897

My dear Dr. Thompson
Dr. Walker
Dr. Browning.

Representations have been made that the quality of the Marlimund reservoir water is contaminated by the peat-bog in & surrounding the reservoir. There appear to be differences of opinion as to whether the water is thus rendered

Confidential.

D.O.No. 52.

Local & Municipal Departme...

GOVERNMENT OF MADRAS

OOTACAMUND,
30th July 1897.

My dear Tremenheere,

In connection with the Ootacamund Water Supply Scheme, the Government desires to receive a report as to the area of cultivable land in the drainage area of the Marlimund Reservoir which can be irrigated without detriment to the supply of water for domestic purposes. The area which has been cultivated and the

year. Taking the estate as a whole he doubts whether more than an average of one ton an acre all round has been put out annually during the last five years.

In the absence of any knowledge of the yield of tea from the estate, & of the condition of the bushes before manure was applied, he considers it impossible to say with any degree of accuracy how much manure has

Confidential.

Nilgiri Collector's Office,

Ootacamund, 2. Sept. 1897.

My dear Forbes,

In your notes of 30 July & 12. August you enquired the nature & extent of manure applied during the last five years to the cultivation in the drainage area of the Marlimund Reservoir.

I have already informed you that Tea is the only crop manured. Of this there



Nilgiri Collector's Office,

Ootacamund, 189

actually been used. If definite information is required, it will be necessary to refer to the Proprietor. Periodical analyses of the water would of course show whether pollution had occurred to any dangerous extent.

The terms of your note have precluded me from applying to the Proprietor.

Yours Sincerely

H. Tremenheere

...ally deleterious; and although perhaps it may be that theoretically the peat bog ought to render the drinking water injurious to the public health, yet the question is whether in fact it does so. I am to enquire whether in the course of your medical practice in Ootacamund you have seen reason to trace illness among your patients to the Cause, and whether you have observed any difference of health or mortality, north & South of the lake, ascribable to the difference of their respectively using the Marlimund and the Doddabetta water. The Government will be much obliged if you will to what extent & which the ground has been what way manured during the last five years: and I will you therefore, take you to send me a confidentially the information required in detail on the subject. You should associate Mr Standen with yourself in the enquiry as he is an expert in such matters as whatever manured manuring &c.

Yours Sincerely

Desp.

---

[L. & M. 1,000—11-11-96.]

# Local & Munl. (1897) Department.

D.O

CURRENT No. 79

*From*
Surg.-Lt.-Col. G.L. Walker
Pres.cy Surgeon
1st District

No.

*Dated* 4.8.97
*Received* 6.8.97
*Registered*
*Enclosures*
*Spare copies*

SUBJECT.

Reporting on the quali
of the water in the
Marlimund reser

B

LOCAL AND MUNICIPAL DEPARTMENT.

Again G.O., dated 189 , No.

Current No. 2065. M. of 1897, dated 25th May 1897 from the P.W. Department.

Current No. 2260. M. of 1897, dated 8th June 1897 from ~~the~~ Mr G.J. Walch.

SUBJECT.

Ootacamund water supply scheme.

FOR ORDERS.

× Please see pp 29 & 30 of 24-1-96 records in this file. N

In G.O. No. 349, M, dated 27th February 1896 Mr. G.J. Walch, retired chief Engineer, Public Works Department, was requested to draw up plans and estimates for the improvement of the water supply of Ootacamund in accordance with the proposals of the Sanitary Board. With his letter, read above, Mr Walch submits revised proposals and estimates for the following works:—

| | Estimated cost Rs. |
|---|---|
| (1) To line the existing Snowdon channels with masonry and bring more water to the Southern one by diversion of a stream above the Government Gardens - - - | 23,900 |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds site - - - - - - - - | 66,000 |
| (3) To construct a pipehead reservoir on the Kodapamund valley stream - - - - - | 3,500 |
| (4) To lay a 9" main from the Snowdon ponds to the Kodapamund pipehead reservoir - - - - - | 15,000 |
| (5) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund village - - - - - | 5,000 |
| (6) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Tank - - - - - | 3,000 |
| (7) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (8) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (9) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (10) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (11) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (12) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (13) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (14) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (15) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (16) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (17) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (18) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (19) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (20) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (21) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (22) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (23) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (24) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (25) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (26) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (27) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (28) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (29) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (30) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (31) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (32) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (33) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (34) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (35) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (36) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (37) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (38) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (39) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (40) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (41) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (42) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (43) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (44) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (45) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (46) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (47) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (48) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (49) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (50) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (51) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (52) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (53) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (54) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (55) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (56) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (57) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (58) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (59) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (60) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (61) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (62) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (63) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (64) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (65) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (66) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (67) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (68) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (69) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (70) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (71) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (72) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (73) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (74) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (75) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (76) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (77) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (78) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (79) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (80) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (81) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (82) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (83) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (84) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (85) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (86) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (87) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (88) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (89) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (90) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (91) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (92) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (93) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (94) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (95) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (96) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (97) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (98) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (99) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |
| (100) To lay a 6" main from the Kodapamund pipehead reservoir to the Kodapamund Valley - - - - - | 3,000 |

(Vide page 12 of the report submitted by him.) L.

× Both supply channel Rs 15,170
Scotts " 5810
Procession de 2920
23,900

(4) To take the water from that pipe-head to the houses along the Kelso road and to the villages of Kodapamund and Kannaipetta - - - - - - 8,060

(5) To construct a new reservoir on the stream flowing through the Craigmore Forest Reserve at the back of the Tiger Hill - - - - 47,400

(6) To carry the water from the new Reservoir to the "Sump" on the existing main above St. Stephen's Church and there connect with the present distributory system - - - - - 38,600

Total. 187,700

The total cost of carrying out these proposals is estimated at Rs 187,700. It is also proposed to acquire the private lands lying in the catchment basins of the Marlimund Reservoir, Dodabetta Reservoirs and the proposed new Reservoir (apparently the one at the Tiger Hill) and also about 9 acres of survey field No. 3/267A in connection with the "old Ootg" supply, but the cost of acquisition of these lands is not known.

2. The Chief Engineer, Public Works Department, through whom these proposals have been forwarded points out, that as Mr Walch states in paragraph 26 of his report that if the first of the improvements above referred to is carried out "there need be "no doubt that the North East "monsoon rains will always "leave the (Marlimund) reservoir "full and experience has shown "that when this is the case it "never fails, even with its supply "channels in their present "imperfect state, to meet all "the demands during the follow-"ing year", the construction of a new reservoir at "Tiger Hill" is unnecessary. He is also of opinion that "unless it can "be shown that the health of "the inhabitants of Ootacamund "has suffered by the use of the "Marlimund reservoir water, "there is no necessity to go to the "expense of filters and Anderson's "revolvers." He however supports

* Item No 2 of Mr Walch's proposals.

This has been inserted by the office.

The catchment area of the Reservoir is now proposed to be increased by 59 acres as per Mr Walch's report. The cost per acre of the land for the same purpose was estimated by the Collector of the Nilgiris in 1894 at Rs 200 per acre. 295 acres at Rs 200 per acre Rs 59,000.

* The increased catchment area of 59 acres belongs to the "stream above the pot forests" as proposed to divert to Whyte G.A.

* Vide notes in different place G.A.

Mr. Walch's recommendations to acquire the lands in the catchment basins of the Marlimund and Dodabetta Reservoirs, and to construct a pipe-head reservoir on the Kodapamund valley stream. All that the Chief Engineer would therefore propose to do at present, as regards the water supply of Ootacamund, is:

Item No. 3 of Mr. Walch's proposals.

(1) To line the existing Government channels into masonry and bring more water to the Southern one by diversion of a stream above — Government Gardens -- 23,900 Rs

(2) To construct a pipe head reservoir* on the Kodapamund valley stream and - - - - - 3,740

(3) To acquire the private lands lying in the Catchment area of the Marlimund and Dodabetta reservoirs, the Cost of which is however not known.

*Laying on the water from this will cost R8060

In case, however, it is decided to construct the proposed reservoir at the Tiger Hill, the Chief Engineer suggests that the supply to be drawn from it may be limited to that required for drinking and cooking purposes only, as it cannot by itself be considered as a sure supply for the whole of the northern portion of Ootacamund now supplied from the Marlimund reservoir, its catchment area not being half that of the Marlimund Reservoir. He also considers that the bottom width of the Tiger Hill dam should be increased to 27'. He further points out that in Mr. Walch's report and in the accompanying estimates, the details of the piping of the Kodapamund valley scheme are not complete, that there are no detailed estimates for filterbeds and service reservoirs and that the annual maintenance co

...derson's revolvers in the case
...Cotacammund has not been
...ven. It, however, Mr Walch
...ates in his letter to the Chief
Engineer dated 15th March 1897,
paragraph(5), that he will be
prepared to give any explanation
additional information that
may be required in connection
with his scheme, he may be
asked to supply these omissions.

2 It is for consideration
whether the proposed scheme
should be referred to the Sanitary
Board, as it has been drawn upon
the lines laid down by the Sanitary
Board, and the Chief Engineer
has already offered his remarks
on it. If this is decided to be
necessary, it is submitted
that the papers may be forwarded
to the Municipal Council of
Cotacammund for report as to

(1)

I think we had better get all these schemes completed, while we are about it. We don't, the whole of the work will have to be done over again when the day comes, as no doubt it will, when it will be decided to carry them out - that is, supposing we decide not to carry them out now.
A.94

Note
Please see Rule 16 of the Sanitary Board Rules in P 16982 15-9-96

It does not seem necessary to refer again to San. Board.

which of the proposals now made, Mr Walch's or the Chief Engineer's, it is willing to adopt and how it proposes to finance the scheme, on the understanding that no more grants than those already given will be made from Provincial funds. A Provincial grant of Rs 189,000 was drawn by the Municipal Council on account of the water supply scheme, but of this, a sum of Rs 25,450 has been utilized for the improvement of drainage.

4. The cost of the investigations is fixed by Mr Walch at Rs 6,170, as follows:—

| | Rs |
|---|---|
| Engineer's fee | 3,930 |
| Establishment | 1,708 |
| Sundries and Contingencies | 532 |
| | 6,170 |

The terms on which Mr Walch undertook the investigation of the water supply scheme

K
Vide P 107 hi 27-1-97

O
Vide para 4 of his letter, dated 15th March 1897.

will be found in G.O. No. 849. M. dated 27th February 1896, and 689. M. dated 27th April 1896. According to these orders, Mr. Walch is to receive Rs 300 per mensem during the course of the investigation, on completion of which the total remuneration calculated at 5 per cent on the estimates excluding all amounts for compensation of land and for cost of pipes, is to be paid to him, after deducting the total amount of monthly payments received by him. It is not known how much has been drawn by Mr. Walch in the shape of monthly payments. The chairman may be asked to report this.

5. In the second letter read above, Mr. Walch requests that the professional fee for the preparation of the scheme may be paid to his account in the Bank of Madras.

V.B. 10/11/97

Hm.

In any case the first thing to do is to pay Mr Walch his account; the balance of professional fee due to him is Rs 1830 — see Mess: pp. following the printed report.

2. Col. Campbell's note on the report gives a very clear summary of it and contains his recommendations as to what is to be done. These are set out in the office note & may I think be accepted as sufficient at any rate for the present.

3. Leaving with reference to the existing Saidapet channels & diverting the small stream abo

I have tacked this to Mess notes GK

I would at once carry out the following works:—

| | |
|---|---|
| Improvement of the Madimund Reservoir supply channels — | Rs 23,900 |
| Kodapakkam and pipe head distribution premises | 3740 |
| | 8060 |
| | 35700 |

Nothing more seems to me necessary, at all events for the present.

I would not carry out the expensive filtering arrangements because I know of no facts which make me believe that these arrangements are necessary for the health of the population. If the soil in the bed & drainage area of the Madimund Reservoir does affect the public health, it must do so by causing bowel diseases. But I have never heard of bowel diseases being more prevalent among that part of the population of Ooty which uses the Madimund water than among the population of the country generally — say in Madras, where the water is good. Enquiries might be made of the medical men in practice, a

Mess.
In the Statt. of 15th March appended to the Report the amt. already drawn is given as Rs 2100 = Rs 300 a mn. for 7 months

S.R.

2

Sept. 30 1897.

Gov. Gardens are estimated to cost only R23,900. This will secure the required quantity of water. The proposals relative to the quality of the water are however the more costly. If the peat bog in & surrounding the reservoirs is really contaminating the water then an expensive arrangement of filters will be requisite, costing R66,000. But Col. Campbell doubts whether Dr. King's data on this point are borne out by experience. In his letter of 19th Apl: 94 para: 8, the Asst. San: Engineer also did not consider it proved that the peat bog had rendered the water impure. It may be that theoretically the peat bog ought to render the water impure but the question is whether in fact it is thus rendered deleterious to the public health. This is

recently in practice, in Ooty; and, at same time, the Sec. might do this by L.O. before the issue of orders. But, in appraising the significance of such opinion as they may make, allowance must be made for the fact that the natives dwelling in the lower bagas have probably frequently made use of the water of the Upper Lake (Horsley, Thorpe, & Watermead into dry land) although they have had access to the pipe water.

Personally I do not like the proposal of acquiring the drainage area of the Marlimund Reservoir or of the proposed new Reservoir on Tiger Hill &. I admit the theoretical desirability of deriving water supply from lands which are kept free from all possibility of contamination. But, supposing a large expense to be incurred & all the lands suggested to be taken up & acquired, should we secure an absolute certainty that there would be no contamination? I much doubt it. The lands would still be grazed over & would be fouled by cattle droppings and by the cattle tenders. I consider therefore that the proper (certainly much the cheaper) plan will be to rely on S. 228A(1) of the Municipal Act as lately amended. Under that section the M.C. has, it seems to me, quite sufficient powers of control over the drainage areas of the water supply sources,

*Page 27 of the San. Engr's Admn Report for 1895

& maintain them in as uncontaminated a state as in this imperfect world can reasonably be required. It can stop any cultivation & any use of manure it pleases; & whatever can be needed, if all these Parsley Vieu drainage areas may be outside the Municipal boundary. If so, S. 145 (6)(i) and (ii) comes in. Under S. 228A(2) compensation has to be paid if any kind of cultivation or use of manure which has been carried on within the last 5 years is prohibited. But the compensation payable under this clause must be much less than the cost of taking up the land. I think :. that what should be done

is that the M.C. should at once prohibit within the private lands comprised in the drainage areas in question the cultivation of potatoes & all other crops which are usually manured, & the use as manure of night soil, cattle dung, stable refuse & other kinds of manure which are likely to foul the water; and that the Govt. lands within such areas should be reserved & not granted to any one. Meanwhile Govt. might be called on to advise as to the kinds of cultivation and of manures to be prohibited. This should be done before the papers are sent to the M.C., so that the case may be presented to it complete. As regards the Govt. lands I do not know that it is necessary that it should be reserved for all time, nor do I think that any harm would be done by granting some, if not all, of it for use for the erection of labourers' houses. But further I would think the order should be that none of it shall be granted to any individual without the special sanction of Govt.

While this report & the San: Commr's is being made, the Collr: should be instructed confidentially to ascertain to what extent these drainage areas have been cultivated (otherwise than with tea about which we know) and have been manured and in what way manured, during the last 5 years. In conducting this enquiry he should associate Mr. Standen with himself. Mr. Standen is an expert in such matters as manuring.

It will be noticed that S. 145 is an amendment, and S. 228A an addition to, the old Act. They were designed specially to meet such cases as these.

the records of the hospital & the opinion of a point on which the physicians practising in Ootacamund should be able to enlighten us.

4. Assuming however that filtering need not be undertaken - at any rate for the present - there is nevertheless a permanent liability to contamination in the catchment area; & accordingly both Mr Walch & the Chief Engr recommend that the private lands in that area should be acquired. Of the desirability of doing this at any rate to some extent there cannot be any question. In plan no. 1 Mr Walch shows by a blue dotted line the "boundary of the catchment basin": & the detail of the areas within that boundary are set out in Appx C (page 15) of the Report. This total area is 196½ acres the balance of 75½ ac: out of the area within the boundary being already Govt. land.

Of the 196 1/2 ac., 112 are shown as "not cultivated" or under "Blue gums", while 84 1/2 ac. are under tea.

5. In the confidential annexure is some correspondence of 1894 with Mr Rees as to the probable price of land in the catchment area. Without more particular information than is available, however, it is impossible to arrive at any really trustworthy estimate of what it would cost to buy the whole area of 196 1/2 acres, for that I take to be Mr Walch's recommendation vide para. 31 of the report: "as regards the deficiency of the water supply the only effective way of dealing with it, is to acquire all the private lands in the catchment basin". It will be remembered that Mr Ellis proposed to acquire only 68 acres (vide plans No B attached to Mr Rees letter of 24th Nov. 94 in the confidential cover), & that the acquisition of this area Mr Rees estimated to cost £17 300. If however the whole catchment basin is to be acquired, I doubt if it

Such being my views, I consider (vide the linked plan) there is no reason why Rs 40 shouldn't be diverted, from the grants of Rs 1 85 000 already made to the Mun. for water works, for the completion of the works, for filling in the lake; and that, after all these works have been carried out & paid for, there will remain a substantial sum which, as it will not be required for water works, the Mun. may be called upon to repay to Govt.

BRS
17/7/97

Circ:

I agree with the Hon: Sir H Ellis that it will be sufficient for the present to impound the Maninnund reservoir & its supply channels, & to utilize the streams of the Kodapamund valley, as proposed by Mr Walch. I presume we may conclude from Mr Ellis saying nothing about it that the bund of the Maninnund Reservoir is safe, as I know this has been questioned.

If Ootacamund extends, as I believe it will, it will be necessary after a few years to undertake the Tejpur-Hill storage project. I cannot ascertain from the papers whether any part of the site of the proposed reservoir is private property; but some of the catchment area is, & it could be acquired

for a small sum now, though its value will increase rapidly hereafter. As the Hon: Sir H Ellis points out the Govt. should prevent formation by private owners to any greater extent, but it could be prevented much more completely if private owners were excluded. I think therefore that the cost of these lands should be estimated, & that if we can afford it they should be acquired. To also ascertain what Dodabetta acquiring We certainly cannot afford to acquire the private land on the Maninnund catchment area at present, so we must be content there with what the Govt can do for us, but the Govt land in it should not be given to cultivators on any tenure. The land can be got this way, however, be granted on annual leases.

I think it will be better before referring to the Sanitary Commr as to what kinds of cultn & in the Maninnund catchment area manure should be prohibited, to instruct the Collr (confidentially) to ascertain about the cultn & manuring during the last 5 years. The old associate Mr Shawdon with himself in this inquiry.

The Doctors who have had charge of Ootacamund lately should be asked, (1) whether there is any difference of health &

it should be done much under a lakh, for we did remit the Indor Hall estate as an estate (including of the house &c. is within the boundary and the whole estate) was purchased for Rs 150,000. Of the 234 acres of the estate the catchment boundary includes 142 acres - vide figs. in Appx C to the Report.

6. As before it is not necessary to acquire the whole 196 1/2 acres or whether only 68 acres, or a greater or less portion, are really essential for the conservation of the reservoir water, we did I think have the definite opinion of the San. Comrs. If only the 68 acres did be conserved the cost of acquiring the 57 odd acres of that area which is private & not good land will probably not exceed Mr Rees estimate of Rs 17,300. It seems however to me that a much larger area did be secured.

7. The diversion of the stream above the good for den

will add an additional catchment area of 59 acres. It is not stated whether it is private or govt. land; but from its situation I presume it is govt. At any rate no proposal to acquire that area also is put forward.

8. With regard to the proposed new reservoir on Tiger Hill, the cost is ₹80000, exclusive of the cost of acquiring the private lands in the catchment, but as less than 24 acres are private of wh. only 1·85 ac. is under tea (₹7·20 under chinchona) this expense wd be small.
It wd supply a first class water but wd be only an adjunct to the Marlimund scheme.
As recommended by the Chief Engr the proposal may be postponed. No sufficient case for its immediate adoption is made out: but it shd be kept in view for future demands; & it wd be well to acquire at once the ten[x] acres of private land included in its catchment area.

marking North & South of the Lake, as in table which differentiates between the Marlimund & Dodabetta water. I believe the Dodabetta water was any lands on in Dr Walker's time.

When we have got more reports we can add from the Mun[t].

As regards the filtration of Marlimund water, this scheme can be taken up here after if it is found to be necessary.

JG
21/7/97

[x] are the Lr ow-ers of Reservoirs to pay a share of the Municipality? I have been told that they belong to the Same Asn. there were given written pro-mises during pro-posals. (The papers on this point are being looked up. E.H.)

para 5 of the para. 48 of Report

1. I concur with Hon. Member as to the action which should be taken.

2. I cannot find that Mr. Walker has dealt with a difficulty that must arise, if his full scheme is to be carried out, and that is the disposal of the claims of private proprietors to concessions in the water which he proposes to divert to the water-supply purposes. Mr. Moor and others are pretty sure to make claims. He should be asked about this.

H.S.H 28.7.97

[x] Details of the area are in Appx E.

paras 35–39 of Report

Q. The next point is the construction of the pipehead reservoir in the Kodapamund valley stream. The estimate for this is ₹3740 This is strongly recommended by the C.E, & may be accepted. It will supply the houses not at present supplied along the Kotagiroad & in the villages of Kodapamund & Karapetta. The cost of laying on the water to these is estimated at ₹8060.

para 40 of Report

[x] for details see Appx D

10. Finally with regard to the Dodabetta reservoirs it is recommended that the private lands in the catchment basins be acquired. The area in question is 12 acres under tea[x] and 45¾ ac. of other private land. This area shd certainly be acquired, & the Collr may be asked to make an estimate of the cost.

11. The proposals of Govt will be referred to the Dy Secy for their views

H.S.H 14/7/97

[L. & M.] 150—30-6-97.

Ootacamund water supply improvements

LOCAL AND MUNICIPAL DEPARTMENT.

Papers to be read in proceedings:—

Again G.O., No. dated 189 .

~~Cancel~~ Again ~~G.O.~~, No. ~~2798m~~ ~~dated~~ (Conspo 189 .

Current No. 2065 M of 1897, dated 25-5-1897, from Public Works Deptt.

" " ~~2260m~~ " 1897, " 8-6-1897, " Mr. G. T. Walch.

" " " 189 , " , "

D.o. ~~76 to 77 & 79~~

ORDER.

(1) Hon Sir H Blair
(2) Hon Mr Love
(3) H.E. the Governor

AM
25/8/97
JG
26/8/97

In G.O. No. 298 W, dated 24th January 1896, recorded in G.O. No. 349 M. dated 27th February 1896, Mr. G.T. Walch was requested to draw up plans and estimates for the improvement of the water supply of Ootacamund in accordance with the recommendations made by the sanitary Board in its Proceedings No. 2286 dated 14th August 1895. With the first paper read alone, the Chief Engineer, Public Works Deptt, forwards for the orders of Govt. the proposals made by Mr. Walch, which, with the estimated cost are briefly as follows.

(1) To line the existing Snowden Channels with masonry by diverted into and bring the

printed on page 2 of G.O. 298 W 24-1-96.

I concur with the modifications suggested by the Members, in their Notes on this Office Note.

I would only suggest a word of thanks to Mr. Walch for his most thorough investigations and his valuable report.

J.S.H. 31.8.97

Thos

| | Rs. |
|---|---|
| Southern ~~catchment of~~ channel of a stream alone the fruit gardens. | 23,900. |
| (2) To provide filtering arrangements and a service reservoir at the Snowdon ponds ~~&c~~. | 66,000 |
| (3) To construct a pipe-head reservoir on the Kodapamund valley stream. | 3,740. |
| (4) To conduct the water from this new reservoir ~~that pipe head~~ to the houses along the Kelso road and to the villages of Kodapamund and Vannarpetta. | 8,060. |
| (5) To construct a new reservoir on the stream flowing through the Craigmore forest reserves at the back of the Tiger Hill. | 47,400 |
| (6) To conduct the water from this reservoir to the "Sump" on the existing main above St. Stephens' Church and there connect with the present distributory system. | 38,600. |
| | Rs 87,700. |

Mr. Walch also recommends the acquisition of the private lands lying in the catchment basins of the Marlimund and Dodabetta reservoirs and the proposed new reservoir on the Tiger Hill and also



also of about nine acres of land ~~held at present~~ in connection with the "old Ooty" supply.

2. The chief Engineer, Public Works deptt. considers that the construction of a new reservoir on the Tiger Hill is unnecessary, as according to Mr. Walch himself there will be an ample supply of water in the Marlimund Reservoir if the first of the improvements suggested by him is carried out. Also a ~~the~~ filtering arrangements at the Snowden ponds, the Chief Engr. considers that unless it can be shown that the health of the inhabitants of Kotacamund has suffered by the use of the water from the Marlimund reservoir the expensive arrangements ~~suggested~~ need not be undertaken. He considers it sufficient

~~adoption~~ if the first and third of Mr Walch's proposals ~~under System No 1~~ are adopted and ~~the execution~~ if the private lands lying in the catchment areas of the Marlimund and Dodabetta reservoirs are acquired. The Govt. ~~is~~ agree with the Chief Engineer with regard to ~~execution~~ the works referred to in items (2), (3), and (4) of Mr. Walch's recommendations and ~~direct that the~~ works should be carried out at once, for these measures will secure a sufficient supply ~~to meet the requirements~~ of the town for some time to come & nothing more is necessary at all events for the present. ~~With regard to the quality of the water~~ if the Marlimund water is found necessary of filtering it the Govt. has consulted some of the medical officers who have recently had extensive practice in Ootacamund and they are unable to ascribe the ~~origination~~ of disease to the use of ~~Marlimund~~ water, nor in their

K. P. 4

In these circs the Govt. is of opinion that the scheme for the filtration of the Marlimund water is not required. If it is found necessary hereafter it may then be taken up.

No doubt if this area were ~~not~~ secured to any considerable extent the quality of the water would be deteriorated; but



experience they find any difference in health or mortality among the population residing North and South of the lake, attributable to their using respectively the Marlimund water as compared with the Dodabetta water, which is admittedly a most wholesome water of the purest kind. Nor does the Govt. consider it necessary to acquire the catchment area of the Marlimund Reservoir under section 145 and 228 sub-section (1) of section 4 of the Madras District Municipalities Act IV of 1884, as amended by Act III of 1897, the Municipal Council has sufficient powers of control over the drainage areas of sources of water supply to maintain them in as uncontaminated a state as can reasonably be required; and it may for this purpose in certain circumstances prohibit the cultivation of any crop, the

of any manure or the irrigation of land in any specified manner, if such cultivation, manure or irrigation is in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this & other water-supply reservoirs.

The Collector is also requested to see that no Govt. land situated within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Govt.

2. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that

Note
The Hon'ble Secretary Mr. Reid requested that the Sanry Commissioner might be called and advise as to the kind Cultivation and manures to be prohibited before the papers go to the Legal Council. As this will involve delay, the reference to The Sanitary Comm'r is included in the draft. H.H.G. W.R.

H.H. Note
Mr. Fremenheere has been requested by G. to make an inquiry as to the extent of the manuring: but it does not seem necessary to await his report; or does H.E. think it Mr. should be awaited
Better send him a reminder that he should complete his inquiry before the G.O. issues — The G.O. can be kept back for a few days until this is done — But as printing must take some time sometimes, may not be necessary WS
H.H.



that as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. If it should perhaps be necessary to carry out this work at some future date, when the population of the town expands as may reasonably be expected to do, the Govt is of opinion that the Municipal Council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition will probably be much less than it will be in the future.

Although it may not increase rapidly here after, the Govt. is of opinion that it would be well for the Municipal Council to acquire these lands at

~~if I can afford to do so~~.

It is also ~~desirable~~ seems desirable that the private lands in the catchment basin of the Dodabetta Reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands ~~if I can afford to do so~~ and submit the same to Govt. at an early date. The Municipal Council should also report whether the proposals now made by Govt. in regard to the improvement of the water supply of the town meet with its approval. Supply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in para. 3.

5. In the report submitted by Mr. Walch and in the accompanying estimates, the details of the piping of the Kodapamund valley scheme

as this portion of the scheme is dropped, these remarks may be omitted

See Mr's note.
Is Mr. Walch not now functus officio? and is it desirable to refer questions as to easement to him now. The better way would be, perhaps, to ask the Coll^r to make confidential inquiries

Yes, I think so - The draft may be altered - or, rather, omit ~~may be altered~~ - & send a separate & altogether fresh one to the Coll^r - There is no need to prompt the public, as it were, to such enquiries

H.H.
Does this better form a separate communication

23181

scheme are not complete, no detailed estimates for filter-beds and service reservoirs have been furnished, nor has the annual maintenance cost of Anderson's revolvers in the case of Ootacamund been given. It is also observed that Mr. Walch has not dealt with a difficulty which must arise if his full scheme is carried out, viz, the disposal of the claims of private parties to easements in the water which he proposes to divert to water supply purposes. He is requested to be good enough to supply these omissions at an early date.

6. The Public Works Dept. is requested to examine

10

report whether the bund
of the Mahimmud reservoir
is safe.

7. Separate orders have
been issued directing the
payment to Mr. Walch of
the balance of his profession-
al fee amounting to Rs 1830, on account
of the investigation of
the water supply scheme.

(From orders)

V.R
6/8/97

Do

The chairman, M.C., Osha
a Collector of the Talgir
a Public Works Dept
G.T. Walch Esqr

The thanks of Govt are due to Mr Walch for his thorough investigation & valuable report.

[L&M. 500—3-12-96.]

Yes. Let these orders issue

Approved

We shall see what the Law Comr. says, but I should think that the best thing for the M.C. to do wd be at once to prohibit the use of manure in the drainage area of the Mahimmud Reservoir. His evidence proves that Messrs T. & S. reports that manuring cannot have been

NOTE FOR THE SECRETARY.

Three proof Copies of the draft G.O. on the Osbaramund water supply scheme, are herewith submitted, as desired. Para. 7 of the draft has been slightly altered with reference to His Excellency the Governor's remark on the first page of the rough draft.

2. Separate orders have to be issued on the notes on page 9 of the rough draft.

V.R
7/9/97

R 20.9.97

H.H.

Proof below for final approval.

As to the investigation by Mr Tamenbeere & Mr Standen please see the former's D.O. of 2nd Sept. They are unable to give any definite opinion as to the extent of the manuring in the Mahimmud catchment area. If we start with the hypothesis that the water has not been shown to be deteriorated by any manuring that has taken place on the

just, it wd. seem to follow that provided manuring is not used to a greater extent than it has been, no injury will be done — assuming that the cultivation absorbs the whole of the manure salts. I do not know how far they accumulate in the soil so as to pollute the surface drainage in course of years.

The Rety. might I think, in the interests of safety issue an injunction prohibiting manuring to a greater degree than has been practised in the past 5 years.

S.R. 29/9/17

Heavy systematic & consequent compensation, & thereon will be high.

BB
1/10/17

er read above, the Chief Engineer, Public
rs of Government the proposals made by Mr.
e briefly as follows :—

| | Rs. |
|---|---|
| hannels with masonry and to el a stream above the Govern- .. .. .. .. .. | 23,900 |
| and a service reservoir at the .. .. .. .. .. | 66,000 |
| on the Kodapamund valley .. .. .. .. | 3,740 |
| new reservoir to the houses the villages of Kodapamund .. .. .. .. | 8,060 |
| rvoir on the stream flowing reserves at the back of Tiger .. .. .. .. | 47,400 |
| reservoir to the "Sump" on Stephen's Church and there butory system .. .. | 38,600 |
| Total .. | 1,87,700 |

quisition of the private lands lying in the Dodabetta reservoirs and the proposed new acres of land in connection with the "Old

s Department, considers that the construc- unnecessary, as according to Mr. Walch ater in the Marlimund reservoir if the first is carried out. Also as to the filtering ief Engineer considers that unless it can be f Ootacamund has suffered by the use of the ensive arrangements need not be undertaken. hird of Mr. Walch's proposals are adopted ment areas of the Marlimund and Dodabetta

Chief Engineer with regard to the works Walch's recommendations and the works res will secure a sufficient supply to meet to come, and nothing more is necessary, at

arlimund water and the necessity of filter- of the medical officers who have recently finds that they are unable to ascribe the and that in their experience they did not among the population residing north and respectively the Marlimund and the Doda- holesome water. In these circumstances heme for the filtration of the Marlimund necessary hereafter, it may then be taken

necessary to acquire the catchment area his area were manured to any consider- be deteriorated; but under section 145 Madras District Municipalities Act IV of municipal council has sufficient powers of water-supply to maintain them in as required; and it may for this purpose on nsation, prohibit the cultivation of any of land in any specified manner, if such

new Tiger Hill reservoir is not required
the Marlimund reservoir as suggested by
ome houses on high ground to the north
isable to expend Rs. 86,000 (cost of new
a question that others must decide.

*Valley*.—This is, I consider, a very neces-
pay water-tax though no water is laid on.
and the cost will be Rs. 3,740. All that
s regard the water-supply of Ootacamund

| | Rs. |
|---|---|
| hannels with masonry and<br>ern one by diversion of a<br>ens .. .. .. .. | 23,900 |
| on the Kodapamund valley<br>.. .. .. .. | 3,740 |
| ng in the catchment area of<br>eservoirs .. .. .. | Cost unknown. |

accepted and it is still considered advisable
ecessary that I should make some remarks
will be 242 acres or not half that of the
by itself be considered as a sure supply for
nund now supplied from Marlimund. The
f the reservoir contains peat as at Marli-
itary authorities will say that filters and
ater will probably become discoloured.

structing this reservoir is that it will com-
tacamund, and if it is decided to construct
awn from it be limited to that required for
s per head per diem. The capacity would
used entirely for flushing drains, watering
necessitate the new reservoir having an
t this, I believe, would cost less than the
filters, service reservoirs and Anderson's

ater-supply has been most carefully worked
it is only necessary for me to mention one

ails of the piping are not complete, but
neer.

f this should be increased to 27′.

filter beds and service reservoirs.

vers are provided the size of the filter beds
rate of filtration can be nearly doubled.
Rs. 18,000. Appendix A of Mr. Walch's
nual maintenance of Anderson's revolvers,
what would be the cost in the case of

McNEIL CMPABELL, Colonel, R.E.
*Chief Engineer.*

1897.

d Municipal Department.

cNEIL CAMPBELL, Colonel, R.E.,
*Secretary to Government, P.W.D.*

1897.

nuary 1896, recorded in G.O., No. 349 M.,
alch was requested to draw up plans and
supply of Ootacamund in accordance with
Board in its Proceedings, No. 2286, dated

GOVERNMENT OF MADRAS.

## LOCAL AND MUNICIPAL DEPARTMENT.

Read—the following paper:—

Endorsement, in the Public Works Department, No. 328 D., dated 25th May 1897.

*Read*—the following papers:—

Letter from G. T. Walch, Esq., dated 15th March 1897.

Note by the Chief Engineer, dated 25th May 1897, No. 327 D.

There are at present three sources of water-supply for Ootacamund—

(1) Marlimund reservoir,
(2) The spring above Old Ooty,
(3) The Dodabetta reservoirs,

and Mr. Walch proposes to improve the supply from Marlimund both in quantity and quality and to add two new sources of supply—one a pipe head reservoir on the Kodapamund valley and the other a new reservoir at the back of Tiger Hill.

2. The improvements to the Marlimund supply consist, first, in lining the existing Snowdon channels with masonry and bringing more water to the southern one by diversion of a stream above Government Gardens, second, in providing filtering arrangements and a service reservoir at the Snowdon pond site. If the first of these improvements is carried out, Mr. Walch states in paragraph 26 of his report that "there need be no doubt that the north-east monsoon rains will always leave the reservoir full, and experience has shown that when this is the case, it never fails, even with its supply channels in their present imperfect state, to meet all the demands during the following year." If this is accepted, there seems to me to be no reason for the construction of the new reservoir at Tiger Hill.

3. Mr. Walch's statement is made from experience, and there can be little doubt that he is correct, but it will perhaps be as well to test what he says by figures.

4. Supposing the reservoir to be empty at the beginning of the south-west monsoon, say, 1st June, the average rainfall during that monsoon, 1st June to 1st October (4 months), is 21·78″; and supposing one-third of this, or, say, 7″, to be the run-off, the amount received into the tank would be 83·6 million gallons, the catchment area being 528 acres. The amount used at 20 gallons per head for 12,000 persons would be 29 million gallons, and the evaporation and absorption, taken at 24″ over the whole water-spread of 18 acres, would be 9·7 million gallons: therefore the balance left in the reservoir at end of the south-west monsoon, or on 1st October, would be 83·6 — (29 + 9·7) = 44·9 million, say, 45 million gallons.

5. The average rainfall during the north-east monsoon, say, 1st October to 1st January, or 3 months, is 16·19″, and supposing one-fourth of this, or, say, 4″, to be run off, the supply received would be 47¾ million gallons. The quantity used during this period will be 22 million gallons and the evaporation and absorption at 12″, 4·8 million gallons, so that at the end of the north-east monsoon, or 1st January, there will be (45 + 47·7) — (22 + 4·8), or 65·9 million gallons, which would much more than fill the reservoir, its capacity being 54·5 million gallons. Now from 1st January to

nillion gallons and the evaporation and
gallons, so that the total quantity required
ere would still be 3·8 million gallons in
membered that no credit has been given
ry and 1st June and the average of these
can be no doubt that the Marlimund
sals will meet all requirements as regards
ave taken the worst view of the case, for
a, the run-off I have allowed is low, and
whole water-spread of 18 acres is, no
he absence of correct information I have
It must further be remembered that 20
cent. greater than at present is a very
age is prevented) that it will ever be used
e. It may therefore be safely asserted
the Marlimund reservoir will be ample.
t 7 years the variations are trifling, the
ne best 64·9″, the average as taken in the

in the Marlimund reservoir, I believe it
soil in catchment and bed and owing to
It has therefore been considered necessary
l also Anderson's revolvers at a cost of
he opinion of sanitary experts, I still think
red, it would be well if it could be shown
has suffered by the use of the water. It
ss to determine whether water is whole-
ne of the greatest authorities on Sanitary
e chemist was not always unwholesome
mist always pure," and again Professor
might be as pure as possible from a
ly. Actual facts are therefore more to be
poned by the late Sanitary Commissioner
I.F.B C.S., who in his letter, No. 96, dated
Government, wrote as follows:—"The
nk with impunity by people without any
emn it because chemists demonstrate it
f grains of organic matter per litre."
vater because the catchment and the bed
vill quote from W. Pole, F.R.S., a great
llows:—"There is however one kind of
nd is liable, namely, to discolouration by
tain spots masses of decaying vegetation
e collect the rain water like sponges and
ith it small particles of the vegetable
s is no great detriment to the use of the
does not render it at all unwholesome:
lieve it is still asserted by the Sanitary
eing peat may not be objectionable, the
unwholesome. This is, I fancy, theory,
rtion. I am therefore of opinion that
inhabitants of Ootacamund has suffered
here is no necessity to go to the expense
same time to be perfectly safe, I would
e private land in the catchment basin of
ll be is not stated, but probably it will
and Anderson's revolvers. The private
eservoir should be acquired for the same

7. I am t[h]erefore o[p]inion that the
and all that is n[e]cessar[y] to is to improve
Mr. Walch. The obj[e]ction to this is that
will not be supplied; but whether it is ad[v]
reservoir and piping) to attain this object is

*Pipe Head Reservoir on the Kodapamund*
sary work and will supply some houses that
The details have been carefully worked out
I would therefore propose to do at present
is:—

1*st.*—To line the existing Snowdon c
bring more water to the south
stream above Government Gard
2*nd.*—To construct a pipe head reservoi
stream .. .. .. ..
3*rd.*—To acquire the private lands lyi
the Marlimund and Dodabetta

8. In case, however, my views are not
to construct the Tiger Hill reservoir, it is n
about it. The catchment area as proposed
Marlimund reservoir. Therefore it cannot
the whole of the northern portion of Ootaca
water is said to be very pure, but the bed
mund, and no doubt after a time the San
Anderson's revolvers are necessary as the w

9. The only advantage I can see in co
mand the whole of the northern part of Oo
it I would suggest that the supply to be dr
drinking and cooking purposes, say, 5 gallon
then be enough and the Marlimund water be
roads, extinguishing fires, &c. This would
entirely separate pipe system of its own, b
Rs. 60,000 proposed to be spent on the
revolvers at the Marlimund reservoir.

10. The scheme for the Ootacamund w
out by Mr. Walch in a very short time and
or two of the details.

*Kodapamund Valley Scheme.*—The de
these can be supplied by the Sanitary Engi

*Tiger Hill Dam.*—The bottom width

11. There are no detailed estimates fo

12. I consider that if Anderson's revol
may be reduced by about one-half as the
The saving in this case would be about
report gives some information about the an
but from it I cannot clearly make out
Ootacamund.

(Signed) D.

---

*Endorsement*—No. 328 D., dated 25th Ma
Transferred to the Local a

(Signed) D.

---

ORDER—No. 2156 M., dated 2 Septe

In G.O., No. 298 W., dated 24th J
dated 27th February 1896, Mr. G. T.
estimates for the improvement of the wa
the recommendations made by the Sanita

14th August 1895. With the first pa
Works Department, forwards for the ord
Walch, which, with the estimated cost, a

(1) To line the existing Snowdon
divert into the southern chan
ment gardens .. .. .
(2) To provide filtering arrangement
Snowdon ponds .. .
(3) To construct a pipe head reservo
stream .. .. .. .
(4) To conduct the water from this
along the Kelso road and to
and Vannarpetta .. .
(5) To construct another new res
through the Craigmore forest
Hill .. .. .. .
(6) To conduct the water from this
the existing main above St.
connect with the present distri

Mr. Walch also recommends the a
catchment basins of the Marlimund and
reservoir on Tiger Hill and of about nin
Ooty" supply.

2. The Chief Engineer, Public Wor
tion of a new reservoir on Tiger Hill i
himself there will be an ample supply of
of the improvements suggested by him
arrangements at the Snowdon ponds, the C
shown that the health of the inhabitants
water of the Marlimund reservoir, these ex
He considers it sufficient if the first and
and if the private lands lying in the catch
reservoirs are acquired.

3. The Government agrees with th
referred to in items (1), (3) and (4) of
should be carried out at once. These m
the requirements of the town for some ti
all events, for the present.

4. With regard to the quality of the
ing it, the Government has consulted so
had extensive practice in Ootacamund,
causation of disease to the use of that wa
find any difference in health or mortalit
south of the lake, attributable to their usi
betta water, which is admittedly a most
the Government is of opinion that the
water is not required. If it is found to
up.

5. Nor does the Government consid
of the Marlimund reservoir. No doubt
able extent the quality of the water wo
and sub-section (1) of section 228-A of t
1884, as amended by Act III of 189
of control over the drainage areas of
uncontaminated a state as can reasona
payment, in certain circumstances, of
crop, the use of any manure or the irr

cultivation, manure or irrigation is, in the opinion of the Sanitary Commissioner, injurious to the public health. The Sanitary Commissioner is accordingly requested to report as to the kinds of cultivation, if any, and of manure, which he considers should be prohibited within the catchment basin of this and other reservoirs. The Collector is also requested to see that no Government water-supply within any such area, including that mentioned in the following paragraph, is granted to any person without the previous sanction of Government.

6. With regard to the construction of a new reservoir on Tiger Hill, His Excellency the Governor in Council considers that, as no immediate necessity for an additional supply from this quarter has been shown, the proposal may, as recommended by the Chief Engineer, be postponed. As it may perhaps be ~~necessary~~ desirable to carry out this work at some future date, when the population of the town expands, as it may reasonably be expected to do, the Government is of opinion that the municipal council would be well advised to acquire at once that portion of the catchment area which is private property since the cost of acquisition is probably much less now than it will be in the future. It also seems desirable that the private lands in the catchment basin of the Dodabetta reservoir should be acquired now. The Collector is accordingly requested to make an estimate of the cost of the acquisition of these lands and submit the same to Government at an early date. The municipal council should report whether the proposals now made by Government in regard to the improvement of the water-supply of the town meet with its approval. Its reply should be expedited so that no time may be lost in beginning such works as it may be determined to carry out, especially those mentioned in paragraph 3.

7. The thanks of Government are due to Mr. Walch for his thorough investigation and his valuable report. Separate orders have been issued directing the payment to him of the balance of his professional fee, amounting to Rs. 1,830.

(True Extract.)

*Secretary to Government.*

To the Chairman, Municipal Council, Ootacamund.
„ the Collector of the Nilgiris.
„ the Public Works Department.
„ G. T. Walch, Esq.

sent to Press. 12-10-97

r signature. 14-10-97

print. 15-10-97

Remd ndr

11-11-97 — 11-11-97 | Order complete. 60

12-11-97 — [illegible] COPIES EXACTLIED. | Letter only.

14/11/97 | Order complete with Letter.

— 15-11-97.

22-11-97

DATED.

GOVERNMENT

GOVERNMENT.

DITTO.

NOT FILED UP BEING MEANT FOR DESPATCH
AS ORIGINAL.

A = Print in full.
B = Not to be printed.
P = Print abstract only.
Q = Print heading only.