

Public Works (1897) Department.

G.O., No. 2851 W

DATED 23 Oct 1897

[Despatch Abstract.]

Water supply of Botacarnum, Pros.
Lt Col Deft passing orders on the proposals
of Mr E. T. Welch for the improve-
ment of the —, Comtd to S.E. IV and

[illegible]

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

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 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 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 38.3 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.

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 Craigmere 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 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 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 Doda- betta 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. 2544, dated 24th November 1893.
G.O., No. 273 M., dated 8th March 1894.
G.O., No. 859 M., Mis., dated 6th July 1894.
Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.
Report of Sanitary Engineer for 1895.

(All ordered to be treated as "Confidential.")

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 to 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 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 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 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, $54\frac{1}{2}$ 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 59¹ acres.

Its natural catchment area	ACS.
Snowdon North Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	272-00
Snowdon South Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	174-24
	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 plans² and estimates³ now submitted provide, as also for the extension⁴ 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 $\frac{1}{2}$ 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	3,220
(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

⁶ Paragraph 7 of its Proceedings.

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.

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 noted⁷ below, and plans⁸ 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's¹ revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter² from the

¹ See pamphlet herewith.

² No. 45, dated 21st January 1897.

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 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 Survey³ 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 letter⁴ 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 recommended⁵

³ Plan No. 2 (2 sheets).

⁴ Appendix B.

⁵ Paragraph 4 of its Proceedings.

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."

(6) KODAPAMUND VALLEY—SUGGESTED STORAGE RESERVOIR. PROPOSED PIPE-HEAD, AND SUPPLY FROM IT.

35. Much time was spent on surveys⁶ 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

⁶ Plans Nos. 11 and 12 (2 sheets).

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.

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-Head¹ 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.

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 design² and estimate are now prepared, his detailed description of the scheme is attached to the estimate.

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 Board³ 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 there does not appear to be any manuring

no extension of cultivation is in progress. 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.

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 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., 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 Craigmere 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. *Catchment¹ 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

¹ See Appendix E.

² About 134 acres.

³ See plans 16 and 18.

all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that² of the existing upper reservoir would by means of a channel³ 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.

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 Craigmere 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 existing¹ 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

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

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 houses³ 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.

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 point³ 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.

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 240,000³ gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332⁴ 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.

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

See his letter 122, dated 20th January 1897.

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.

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	23,900
Paragraphs 25 to 28.	
(b) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site	66,000
Paragraphs 29 and 30.	
(c) To construct a Pipe-head reservoir on the Kodapamund Valley stream	3,740
Paragraphs 35 to 39.	4

(d) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta	Rs. 8,060
Paragraphs 38 and 39.	
(e) To construct a new reservoir on the stream flowing through the Craigmere forest reserves at the back of Tiger-Hill	47,400
Paragraphs 44 to 53.	
(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	38,600
Paragraphs 54 to 60.	
(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	No estimate.
Paragraphs 31, 40, 41, 48, 62.	
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,
8th 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 $3\frac{1}{2}$ minutes contact. The driving power for this sized revolver would be 9,880 foot pound per minute or, say, $\frac{1}{2}$ 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 $19' \times 8'$. 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 pedestal 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 $1\frac{1}{2}$ 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

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

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.

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 sanitariously 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.

STATEMENT OF LAND

Survey field No.	Government waste.		Private property.				Remarks.
	Acres.	Cents.	Not cultivated and Blue gums.		Tea.		
			Acres.	Cents.	Acres.	Cents.	
C 359	40	..	..	..	..	..	Tudor Hall.
C 138	..	..	2	22	..	..	
C 137	..	..	2	42	..	..	Tudor Hall.
C 139	..	..	8	84	8	15	
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.
	Acres.	Cents.	Not cultivated and Blue gums.		Tea.		
			Acres.	Cents.	Acres.	Cents.	
<u>C</u> 142	..	..	..	61	3	44	Tudor Hall.
<u>C</u> 143	..	..	2	..	..	50	
<u>C</u> 145	..	..	6	91	2	81	Tudor Hall.
<u>C</u> 133	..	..	3	46	4	10	Do.
<u>C</u> 135	..	..	..	15	..	..	
<u>C</u> 132	..	..	..	13	..	..	
<u>C</u> 131	..	..	..	36	3	10	Tudor Hall.
<u>C</u> 136	..	..	..	24	..	..	
<u>C</u> 134	..	..	..	8	..	..	
<u>C</u> 144	..	..	..	75	1	32	Tudor Hall.
<u>C</u> 146	..	..	3	66	6	4	Do.
<u>C</u> 344	13	20	..	..	..	..	In register th appears "municipal property."
<u>C</u> 147	..	..	5	89	4	..	Tudor Hall.
<u>C</u> 150	..	..	16	..	18	40	Do.
<u>C</u> 148	..	..	7	6	31	60	Do.
<u>C</u> 149	..	..	..	65	..	..	Gayton Park.
<u>C</u> 130	..	..	47	73	..	..	
<u>C</u> 175	..	..	..	50	..	..	Gayton Park.
<u>C</u> 177	..	83	..	..	..	..	
<u>C</u> 178	5	30	..	..	..	..	
<u>C</u> 360-A	7	10	..	..	..	..	
<u>C</u> 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 1892, 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.

STATEMENT OF AREAS OF CATCHMENT DISTRICT

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 250	..	..	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.

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.	

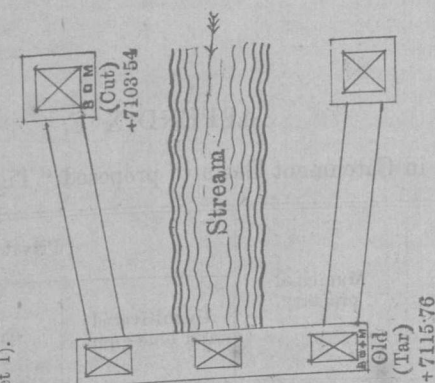
* Besides this, about 8½ acres of Field No. C/237 may be brought in by catch drain.

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 Marimund reservoir (under bridge)	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. See plan 2 (sheet 1).
Tar Mark	Parapet of dividing cistern south side of Kotagiri road (east of Snowdon House grounds). [Note.—Zero of present gauge on water tower is 18 feet below this.]	7465.68	
....	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. M. Cut	On rock, east side of Snowdon road about 64 feet from road to "Fox How"	7432.69	
B. M. Cut	On rock, east side of Snowdon road near Pear trees	7386.99	
B. M. Cut	On rock, west side of Snowdon road below latrine of "Hill Side Villa"	7370.95	
Tar B. M.	On parapet of "Sump" above St. Stephen's Church, near "Highland Villa"	7397.35	
....	[Note.—Top of pipe inside this Sump 7392.61.]		
Tar B. M.	On west end of second step of entrance at North end of "Shedden House"	7530.50	See plan 1.
Tar B. 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. M. Cut	On plinth of pilaster at end of western upstream wing, Charing Cross Bridge	7103.54	
....	[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.		



APPENDIX F—cont.

Description of B.M.	Position of B.M.	Value.	Remarks.
B. M. Out	On rock, east side of road to Kodapamund Dhoibie village, opposite "Kelso Villa" Lawn Tennis Court.	7179.68	See plan 10.
B. M. Out	On rock near road in Dhoibie village below washerman Arumugam's house	7246.54	See plans 10 and 11.
B. M. Out	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 Yamapetta stream (Old Rifle Butte, or Manjekalamund, valley)	7303.49	See plans 10 and 11.
B. M. in Tar	On stone curb of platform round fountain at junction of "Walhamstow" road with Conoor 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).
B. M. Out	Crest of Escape of Upper Dodabetta reservoir	7787.87	
B. M. Out	[Note.—The zero of present gauge on water tower is 24.80 below this escape.]		
B. M. Out	On rock left side of "Tiger-hill stream"	7677.44	See plans 15, 16 and 22 (sheet 1).
B. M. Out	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. Out	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 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.

OOTACAMUND,
8th March 1897.

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

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.	} Prepared by Sanitary Engineer.
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.	
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.

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

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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.

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(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.

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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.)

[Signature]
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.

[Signature]

P.W. Current No. 10258

16.10.97

Government {1897} of Madras.
LOCAL AND MUNICIPAL.

Recd. { 16-10- } 1897.
Regd.

Enclosures
Spare copies

one revised copy
attached

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

No 299/Wg 23 10 97

OCTOBER.

Communicated to
the Super Survey IV
Circ.
W. H. D. 21.10.97

S. S. IV Circ.
3-4-97

Water-supply.

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

Revised
copy 1/11/97
26/11/97

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 Kodamund 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 47.3 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 $(45 + 47.3) - (22 + 4.8)$, 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

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J. H. M.
Secretary to Government.

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

Remond

Leopold's
supplied accor-
dingly. If you
will kindly let us
have two copies
of the reprint,
we shall be obliged.

RS
4-hw 37

Required with thanks. What was
required, were copies of Mr. Welch's
original report on the Botanical
water supply improvements and
not copies of go. no. 245 (und) 2 October
1897 passing orders on the ^{proposed} ~~proposed~~
Mr. Welch. Ten Copies of the Reprint will
be sent as requested.

1. Raphaela Barker
First Assistant

Regd.

1897.

Enclosures

Spare copies

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

No 2891 Wg 23.647
communicated to the
Suptg. Engr IV circle.
(Ed.) W. B. de W.
W

OCTOBER.

S. & IV circle

Water-supply.

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

GOVERNMENT OF MADRAS.

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- (2) The spring above Old Ooty,
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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 Kodamund valley and the other a new reservoir at the back of Tiger Hill.

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Chief Engineer.

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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.
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" the Public Works Department.
" G. T. Walch, Esq.

Ed. A. Raitt.

Government (1897) of Madras.

LOCAL AND MUNICIPAL.

Recd.

Enclosures

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N. 225/6923. 1097
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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.

Ed. A. Baitt.

Government (1897) of Madras.

LOCAL AND MUNICIPAL.

Recd.

Enclosures

Regd.

1897.

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.

2991W dy 23/10/97
Communicated to the
S-5111 with
[20] W.B. 11

20-5-9111 with

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 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 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 38 $\frac{3}{4}$ 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.

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 Craigmöre 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 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 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 Doda- betta 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. 2544, dated 24th November 1893.
G.O., No. 273 M., dated 8th March 1894.
G.O., No. 859 M., dated 6th July 1894.
Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.
Report of Sanitary Engineer for 1895.

(All ordered to be treated as "Confidential.")

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 to 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 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 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 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 Marlimumd as regards capacity or area of catchment basin. With only 18 feet depth of water it holds, as already stated, $54\frac{1}{2}$ 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 59¹ acres.

Its natural catchment area	ACS.
Snowdon North Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	272-00
Snowdon South Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	174-24
Total	23-00
	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 plans² and estimates³ now submitted provide, as also for the extension⁴ 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 $\frac{1}{2}$ 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 Marlimumd 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.

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 noted⁷ below, and plans⁸ 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

⁵ 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's¹ revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter² from the

¹ See pamphlet herewith.

² No. 45, dated 21st January 1897.

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 Marlimumd 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 Survey³ 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 letter⁴ 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 recommended⁵

³ Plan No. 2 (2 sheets).

⁴ Appendix B.

⁵ Paragraph 4 of its Proceedings.

by the Sanitary Board, the water supplied from the Marlimumd 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."

(6) KODAPAMUND VALLEY—SUGGESTED STORAGE RESERVOIR. PROPOSED PIPE-HEAD, AND SUPPLY FROM IT.

35. Much time was spent on surveys⁶ 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

⁶ Plans Nos. 11 and 12 (2 sheets).

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.

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-Head¹ 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.

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 design² and estimate are now prepared, his detailed description of the scheme is attached to the estimate.

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 Board³ 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.

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 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., 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 Craigmores 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. *Catchment¹ 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

¹ See Appendix E.

² About 134 acres.

³ See plans 16 and 18.

all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that² of the existing upper reservoir would by means of a channel³ 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.

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 Craigmores 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.	..	..	..	..	..	Trace.
Apparent quality of the water as inferred from the results obtained on examination	(as Ammonia)						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 th

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 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

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

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 houses² 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.

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

³ The "Sump" above St. Stephen's Church. and 226 feet above the existing main at the proposed point³ 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.

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 240,000³ gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332⁴ 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

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.

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.

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 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.

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	23,900
Paragraphs 25 to 28.	
(b) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site	66,000
Paragraphs 29 and 30.	
(c) To construct a Pipe-head reservoir on the Kodapamund Valley stream	3,740
Paragraphs 35 to 39.	

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(b) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site	66,000
Paragraphs 29 and 30.	
(c) To construct a Pipe-head reservoir on the Kodapamund Valley stream	3,740
Paragraphs 35 to 39.	4

(d) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta	rs.
Paragraphs 38 and 39.	
(e) To construct a new reservoir on the stream flowing through the Craigmure forest reserves at the back of Tiger-Hill	8,060
Paragraphs 44 to 53.	
(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	47,400
Paragraphs 54 to 60.	
(g) To acquire the private lands lying in the catchment basins of the Marlimumd reservoir, Dōdabetta reservoirs, and proposed new reservoir, and also about 9 acres of survey field No. D/267-A in connection with the "Old Ooty" supply	38,600
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,
8th 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' x 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 pedestal 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, 24th November 1896, No. 36.

As I anticipated,* I have failed to find any

site for a reservoir which will render the abandonment of the Marlimumd 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.

2. That site however will be required for filter beds and service reservoir if filtration of the Marlimumd 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. 2514), 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 Marlimumd 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 sanitariously erroneous 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 Marlimumd. It would however be in the interest of economy that the Engineer designing the scheme should search for such ground between Marlimumd 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 Marlimumd 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 Marlimumd reservoir.

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

APPENDIX E.

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

of proposed "Tiger-Hill" Stream Reservoir.											
Survey Field No.	Government forest.		Municipal property.		Private property.						Remarks.
	Acres.	Cents.	Acres.	Cents.	Uncultivated, and blue gum.		Cinchona.		Tea.		
					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.

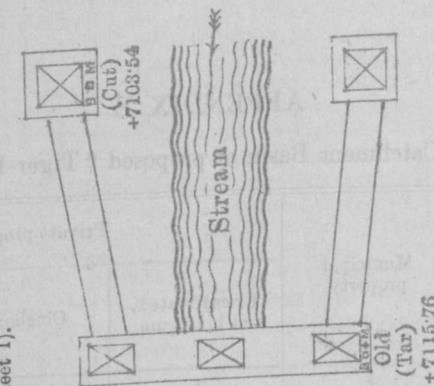
Synopsis of Important Bench Marks in connection with the Investigations.

Description of B.M.	Position of B.M.	Value.	Remarks.
On Rough Stone Floor	Floor of Escape of Marimund reservoir (under bridge)	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. See plan 2 (sheet 1).
Tar Mark	Parapet of dividing cistern south side of Kotagiri road (east of Snowdon House grounds) ..	7465.68	See plan 2 (sheet 1).
B. M. Cut	Floor of Escape of Lower Snowdon pond	7423.75	
B. M. Cut	Level of top of main to Ootacamund just as it leaves the tunnel near Snowdon Lower pond.	7425.30	
B. M. Cut	On rock, east side of Snowdon road about 64 feet from road to "Fox How" ..	7432.69	
B. M. Cut	On rock, east side of Snowdon road near Pear trees	7386.99	
B. M. Cut	On rock, west side of Snowdon road below latrine of "Hill Side Villa"	7370.85	
Tar B. M.	On parapet of "Sump" above St. Stephen's Church, near "Highland Villa"	7397.35	
Tar B. M.	On west end of second step of entrance at North end of "Shedden House"	7530.50	See plan 1.
Tar B. 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. M. Cut	On plinth of pilaster at end of western upstream wing, Charing Cross Bridge	7103.54	

[Note.—Zero of present gauge on water tower is 18 feet below this.]

[Note.—Top of pipe inside this Sump 7392.51.]

[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.



APPENDIX F—cont.

Description of B.M.	Position of B.M.	Value.	Remarks.
B. M. Cut	On rock, east side of road to Kodapamund Dhoibie village, opposite "Kelso Villa" Lawn Tennis Court.	7179-68	See plan 10.
B. M. Cut	On rock near road in Dhoibie 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 valley stream, below 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).
B. M. Cut	Crest of Escape of Upper Dodabetta reservoir ..	7787-87	See plans 15, 16 and 22 (sheet 1).
B. M. Cut	[Note.—The zero of present gauge on water tower is 24.80 below this escape.]	7677-44	See plans 15, 16 and 22 (sheet 1).
B. M. Cut	On rock left side of "Tiger-hill stream" ..	7712-99	See plans 15 and 16.
B. M. Cut	On slab rock left side of stream a short distance above proposed site for dam of new reservoir.	7727-65	See plans 15 and 16.
B. M. Cut	On rock on left side of stream about 325 feet above the last B.M. ..		

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 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.

OOTACAMUND,
8th March 1897.

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

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	Admits and cistern for Snowdon channels	1	T.L.	
5	Survey plan for diversion of stream	1	T.L.	
6	Position of filter beds and service reservoir	1	T.L.	
7	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.	} Prepared by Sanitary Engineer.
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	Drawings 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 Desigew reservoir.	1	T.L.	
19	Do. for dam, &c.	1	T.L.	
20	Survey and ground, plan and elevation	1	T.L.	
21	Sections for paction for bye-wash	1	T.L.	
22	Church.	1	T.L.	
	ing from new reservoir to Samp above St. Stephen's	3	T.L.	
	Map of Ootacamund—Scale			
	pipes from various sources. " = 1 mile showing areas supplied by	1	P.	Lithograph, Madras Survey.
Ootacamund, 8th March 1897				

OOTACAMUND,
8th March 1897.

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

Note by the Chief Engineer, dated 25.—

There are at present three sources of water. May 1897, No. 327 D.

- (1) Marlimund resupply for Ootacamund—
- (2) The spring above reservoir,
- (3) The Dodabetta re Old Ooty,

and Mr. Walch proposes to improve the supply from reservoirs, quality and to add two new sources of supply—one, Marlimund both in quantity and pamund valley and the other a new reservoir at the pipe head reservoir on the Koda-

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

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 47.3 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 $(45 + 47.3) - (22 + 4.8)$, 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 36.1 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, 7" 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 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 the 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 is so filthy to condemn it because chemists demonstrate it contains so many hundreds of 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.
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	23,900
2nd.—To construct a pipe head reservoir on the Kodapamund valley stream	3,740
3rd.—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 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.
" Sanitary Board.
" Commissioner.
Exd. A. Raith. " Engineer.

Government { 1897 } of Madras.
LOCAL AND MUNICIPAL.

Recd.

Regd.

} 1897.

Enclosures

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.

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 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 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 38 $\frac{3}{4}$ 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 Craigmere 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 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 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 Doda- betta 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. 2544, dated 24th November 1893.
G.O., No. 273 M., dated 8th March 1894.
G.O., No. 859 M., Mis., dated 6th July 1894.
Minutes of Proceedings of the Sanitary Commissioner for second quarter 1894.
Report of Sanitary Engineer for 1895.

(All ordered to be treated as "Confidential.")

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 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 wiew 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, f

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 what 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. 639 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, $54\frac{1}{2}$ 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 59¹ acres.

Its natural catchment area	ACS.
Snowdon North Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	272-00
Snowdon South Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895	174-24
Total	23-00
	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 plans² and estimates³ now submitted provide, as also for the extension⁴ 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 $\frac{1}{2}$ 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.

(c) Laying an additional pipe from K to F	RS.
(d) Enlarging masonry conduit from E to F	4,000
(e) Laying additional pipe from F to G	8,220
(f) Enlarging masonry conduit from G to Marlimund lake	69,000
Total	57,060
	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 noted⁷ below, and plans⁸ 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 1893, 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's¹ revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter² from the

¹ See pamphlet herewith.

² No. 45, dated 21st January 1897.

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 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 Survey³ 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 letter⁴ 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 recommended⁵

³ Plan No. 2 (2 sheets).

⁴ Appendix B.

⁵ Paragraph 4 of its Proceedings.

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."

(6) KODAPAMUND VALLEY—SUGGESTED STORAGE RESERVOIR. PROPOSED PIPE-HEAD, AND SUPPLY FROM IT.

35. Much time was spent on surveys⁶ 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

⁶ Plans Nos. 11 and 12 (2 sheets).

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.

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-Head¹ 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

¹ See plans Nos. 10, 13 and 14.

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.

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 design² 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 Board³ 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

³ Paragraph 13 of Proceedings.

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.

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 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., 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 Craigmere 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. *Catchment¹ 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

¹ See Appendix E.

² About 134 acres.

³ See plans 16 and 18.

all the private lands would cost a comparatively small sum. Besides this natural catchment basin, that² of the existing upper reservoir would by means of a channel³ 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.

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 Craigmere 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
(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 existing¹ 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

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

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 houses² 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.

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 point³ 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.

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 240,000³ gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332⁴ 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.

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 Sanitary⁵ 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.

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	23,900
Paragraphs 25 to 28.	
(b) To provide Filtering arrangements and a service reservoir at the Snowdon Ponds site	66,000
Paragraphs 29 and 30.	
(c) To construct a Pipe-head reservoir on the Kodapamund Valley stream	3,740
Paragraphs 35 to 39.	
	4

(d) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta	RS.
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	47,400
Paragraphs 44 to 53.	
(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	38,600
Paragraphs 54 to 60.	
(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	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,
8th 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 $3\frac{1}{2}$ minutes contact. The driving power for this sized revolver would be 9,880 foot pound per minute or, say, $\frac{1}{2}$ 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 $19' \times 8'$. 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 pedestal 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 $1\frac{1}{2}$ 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.

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 sanitariously 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.

STATEMENT

Survey field No.	Government waste.		Private property.				Remarks
	Acres.	Cents.	Not cultivated and Blue gums.		Tea.		
			Acres.	Cents.	Acres.	Cents.	
C 359	40	..	..	..	..	..	Tudor Hall.
C 138	..	..	2	22	..	..	
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 "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.	
<u>F</u> 234	..	..	6	..	..	..	..	..	
<u>F</u> 232	..	..	8	64	..	..	..	..	
<u>F</u> 230	..	..	6	51	..	..	..	..	
<u>F</u> 228-F	..	5	50	..	..	..	..	..	
<u>F</u> 304-B	..	5	25	..	..	..	..	..	
<u>F</u> 228-G	..	46	18	..	..	..	..	..	
<u>F</u> 244	..	..	6	35	..	..	..	..	
<u>F</u> 228-Z	..	..	50	..	..	..	..	..	
<u>F</u> 243	..	..	3	22	..	30	..	..	
<u>F</u> 241	..	..	..	..	2	11	..	..	
<u>F</u> 240	..	..	1	46	2	34	..	..	
<u>F</u> 228-E	..	8	50	..	..	..	..	..	
<u>F</u> 231	..	..	2	68	2	41	..	50	
<u>F</u> 242	..	..	3	24	1	59	..	..	
<u>F</u> 239	..	..	2	10	2	80	..	..	
<u>F</u> 277	..	..	5	50	..	..	..	..	
<u>F</u> 245	..	3	..	..	..	..	..	..	
<u>F</u> 305-A	..	7	..	..	..	..	..	..	
<u>F</u> 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.

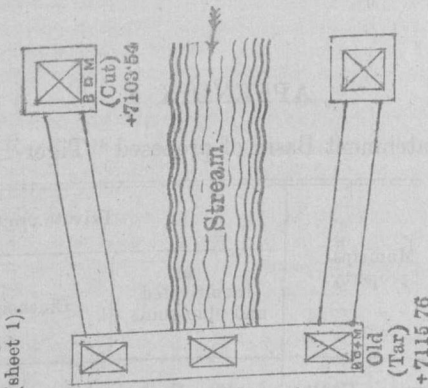
Survey Field No.	Government forest.		Municipal property.		Private property.						Remarks.
	Acres.	Cents.	Acres.	Cents.	Uncultivated, and blue gum.		Cinchona.		Tea.		
					Acres.	Cents.	Acres.	Cents.	Acres.	Cents.	
F 237	6	25	..	..	..	..	..	..	..	..	..
F 250	..	..	9	44	..	..	..	..	..	..	..
F 296	..	..	..	..	..	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.(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)	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 1886 of the Sanitary Engineer to Government. The datum is probably approximately, but only roughly approximately, mean Sea-level. See plan 2 (sheet 1).
Tar Mark	[Note.—Zero of present gauge on water tower is 18 feet below this.]		
On Rock	Parapet of dividing cistern south side of Kotagiri road (east of Snowdon House grounds) ..	7465-68	
On Rock	Floor of Escape of Lower Snowdon pond	7423-75	See plan 2 (sheet 1).
On Rock	Level of top of main to Ootacamund just as it leaves the tunnel near Snowdon Lower pond.	7425-30	
On Rock	On rock, east side of Snowdon road about 64 feet from road to "Fox How"	7432-69	
On Rock	On rock, east side of Snowdon road near Pear trees	7386-99	
On Rock	On rock, west side of Snowdon road below latrine of "Hill Side Villa"	7370-95	
On Parapet	On parapet of "Sump" above St. Stephen's Church; near "Highland Villa"	7397-85	
On West end	[Note.—Top of pipe inside this Sump 7392-51.] On west end of second step of entrance at North end of "Shedden House"	7530-50	See plan 1.
On Stone	On stone in north angle of brick edging of triangular plot at junction of Church Hill road, with road to Library.	7226-10	
On Plinth	On plinth of pilaster at end of western upstream wing, Charing Cross Bridge	7103-54	
On Corner	[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.		



APPENDIX F—cont.

Description of B.M.	Position of B.M.	Value.	Remarks.
B. M. Cut ..	On rock, east side of road to Kodapamund Dhoibie village, opposite "Kelso Villa" Lawn Tennis Court.	7179.68	See plan 10.
B. M. Cut ..	On rock near road in Dhoibie village below washerman Arumugam's house ..	7246.54	See plans 10 and 11.
B. M. Cut ..	On rock in bed of western branch ("Shudikadu") 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 Vannapetta stream (Old Rifle Butte, 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 ..	7787.87	
B. M. Cut ..	[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 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.

OOTACAMUND,
8th March 1897.

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

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.	} Prepared by Sanitary Engineer.
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.	
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.

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.L.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.
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	23,900
2nd.—To construct a pipe head reservoir on the Kodapamund valley stream	3,740
3rd.—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.
" Sanitary Board.
" Commissioner.
Exd. A. Raitt. " Engineer.

Government { 1897 } of Madras.
LOCAL AND MUNICIPAL.

Recd.

Regd.

} 1897.

Enclosures

Spare copies

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

OCTOBER.

Water-supply.

Passing orders on the proposals of Mr. G. T. Welch for the improvement of the — of
Samund.

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 investigation, 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.

* Engineer's fee	rs.
Establishment	3,930
Sundries and contingencies	1,708
	532
Total	6,170

Approximate. Some charges not yet paid.

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 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 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 38 $\frac{3}{4}$ 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.

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 Craigmere 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 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 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 Doda- betta 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. 2544, dated 24th November 1893.

G.O., No. 273 M., dated 8th March 1894.

G.O., No. 859 M., Mis., dated 6th July 1894.

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

Report of Sanitary Engineer for 1895.

(All ordered to be treated as "Confidential.")

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 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, $54\frac{1}{2}$ 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 59¹ acres.

Its natural catchment area ..	ACS.
Snowdon North Channel, see paragraph 11 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 ..	272-00
Snowdon South Channel, see paragraph 12 of Mr. Ellis' memorandum, page 28, of Sanitary Engineer's Administration Report, 1895 ..	174-24
	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 plans² and estimates³ now submitted provide, as also for the extension⁴ 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 $\frac{1}{2}$ 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.

(c) Laying an additional pipe from K to F ..	RS.
(d) Enlarging masonry conduit from E to F ..	4,000
(e) Laying additional pipe from F to G ..	8,220
(f) Enlarging masonry conduit from G to Marlimund lake ..	69,000
	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 noted⁷ below, and plans⁸ 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 1893, 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's¹ revolvers." Provision for the necessary apparatus has accordingly been made in the estimates now submitted, on the information given in the letter² from the

¹ See pamphlet herewith.

² No. 45, dated 21st January 1897.

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 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 Survey³ 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 letter⁴ 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 recommended⁵

³ Plan No. 2 (2 sheets).

⁴ Appendix B.

⁵ Paragraph 4 of its Proceedings.

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."

(6) KODAPAMUND VALLEY—SUGGESTED STORAGE RESERVOIR. PROPOSED PIPE-HEAD, AND SUPPLY FROM IT.

35. Much time was spent on surveys⁶ 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

⁶ Plans Nos. 11 and 12 (2 sheets).

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.

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-Head¹ Cistern, by means of a masonry dam 15 feet high on the stream

¹ See plans Nos. 10, 13 and 14.

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.

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 design² 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 Board³ is not feasible.

³ Paragraph 13 of Proceedings.

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.

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 Snowden 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., 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 Craigmere 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. *Catchment¹ Area.*—The natural catchment area is 100 acres, which at a small

¹ See Appendix E.

² About 134 acres.

³ See plans 16 and 18.

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, that² of the existing upper reservoir would by means of a channel³ 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.

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 Craigmere 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 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 houses² 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.

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 point³ 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.

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 240,000³ gallons to be provided per diem should be deliverable in six hours, that is at the rate of 332⁴ 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.

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 Sanitary⁵ 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.

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

(d) To take the water from that pipe-head to the houses along the Kelso Road and to the villages of Kodapamund and Vannarpetta ..	Rs.
Paragraphs 38 and 39.	8,060
(e) To construct a new reservoir on the stream flowing through the Craigmere forest reserves at the back of Tiger-Hill ..	47,400
Paragraphs 44 to 53.	
(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 ..	38,600
Paragraphs 54 to 60.	
(g) To acquire the private lands lying in the catchment basins of the Marlimumd 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 ..	No estimate.
Paragraphs 31, 40, 41, 48, 62.	
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,
8th 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' x 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 pedestal 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 Marlimumd 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.

2. That site however will be required for filter beds and service reservoir if filtration of the Marlimumd 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.

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

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 Marlimumd 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 Marlimumd. It would however be in the interest of economy that the Engineer designing the scheme should search for such ground between Marlimumd 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 Marlimumd 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 Marlimumd reservoir.

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

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.

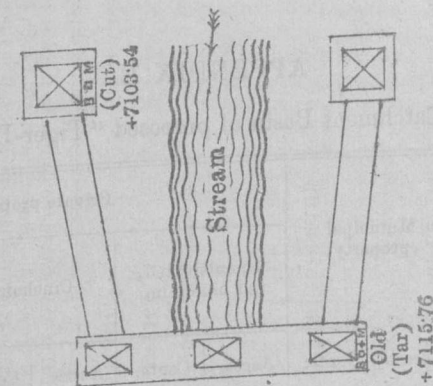
* Besides this, about 8½ acres of Field No. C/237 may be brought in by catch drain.

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 Marimund reservoir (under bridge)	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	[Note.—Zero of present gauge on water tower is 18 feet below this.]	7465.68	See plan 2 (sheet 1).
..	Parapet of dividing eastern south side of Kotagiri road (east of Snowdon House grounds) ..	7423.75	See plan 2 (sheet 1).
..	Floor of Escape of Lower Snowdon pond	7425.30	
..	Level of top of main to Ootacamund just as it leaves the tunnel near Snowdon Lower pond.	7432.69	
B. M. Out	On rock, east side of Snowdon road about 64 feet from road to "Fox How"	7386.99	
B. M. Out	On rock, east side of Snowdon road near Pear trees	7370.95	
B. M. Out	On rock, west side of Snowdon road below latrine of "Hill Side Villa"	7397.35	
Tar B. M.	On parapet of "Sump" above St. Stephen's Church; near "Highland Villa"		
..	[Note.—Top of pipe inside this Sump 7392.51.]		
Tar B. M.	On west end of second step of entrance at North end of "Shedden House"	7630.50	
Tar B. 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. M. Out	On plinth of pilaster at end of western upstream wing, Charing Cross Bridge	7103.54	
..	[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.		



APPENDIX F—cont.

Description of B.M.	Position of B.M.	Value.	Remarks.
B. ■ M. Cut ..	On rock, east side of road to Kodapamund Dhoibie village, opposite "Kelso Villa" Lawn Tennis Court.	7179.68	See plan 10.
B. ■ M. Cut ..	On rock near road in Dhoibie village below washerman Arumugam's house ..	7246.64	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 "Walhumstow" 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).
B. ■ M. in Tar ..	Crest of Escape of Upper Dodabetta reservoir ..	7787.87	
B. ■ M. Cut ..	[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 Esape*, 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.

OOTACAMUND,
8th March 1897.

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

APPENDIX G.

Plans to accompany report.

Distinguishing No. of plan.	Description of plan.	Number of sheets.	Paper (P.) or Tracing Linen (T.L.)	Remarks.
<i>Book 1.</i>				
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.	
<i>Book 2.</i>				
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.	
<i>Book 3.</i>				
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.	
<i>Separate.</i>				
	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 47.3 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 $(45 + 47.3) - (22 + 4.8)$, 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 36.1 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 whole-Engineering, says, "the impure water of the chemist was not always unwholesome 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.
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	23,900
2nd.—To construct a pipe head reservoir on the Kodapamund valley stream	3,740
3rd.—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 Craigmere 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 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.
" Sanitary Board.
" Sanitary Commissioner.
Exd. A. Raitt. " Engineer.

Government { 1897 } of Madras.
EDUCATIONAL

Recd.

Regd.

1897.

Enclosures

Spare copies

G.O., No. 541, 22nd September 1897.

SEPTEMBER.

N: 2993W 726-10-97
Communicated to
officers of the P.W. Dept.
for information

W.B. D. W.

Ch. E. for J.
C. E. for Rys.
Supg. Engrs.
Ch. to Govt.

College of Engineering.

Reviewing the report on the working of the — during 1896; and forwarding copy of the
Proceedings to the Secretary of State.

GOVERNMENT OF MADRAS.
EDUCATIONAL DEPARTMENT.

READ—the following paper:—

From the Honourable Mr. D. DUNCAN, M.A., D.Sc., LL.D., Director of Public Instruction, to the Secretary to Government, Educational Department, dated Madras, 14th May 1897, No. 5299.

I have the honour to submit, for the information of Government, a copy of my Proceedings, No. 5145, dated 11th instant, reviewing the report on the working of the College of Engineering during the past calendar year.

ENCLOSURE.

PROCEEDINGS of the Director of Public Instruction, dated 11th May 1897, No. 5145.
Read the following letter from Major H. D. LOVE, R.E., Principal, College of Engineering, to the Director of Public Instruction, No. 1613-C., dated 30th January 1897:—

I have the honour to submit the following review of the working of the College of Engineering during the year 1896.

2. *Establishment.*—The only change which occurred in the establishment was that due to the departure on furlough of Mr. Chatterton, the Professor of Engineering, on 29th August. Mr. H. T. Keeling, Executive Engineer, Public Works Department, was appointed to act, but, owing to urgent duties connected with floods in the Kistna district, he was unable to join until the 24th December. In the interim, the more pressing portions of the Professor's duties were undertaken by the Principal, while instruction in the Chemical Laboratory was given by M.R.Ry. T. K. Hanumantha Rau, B.A., the Assistant Professor of Chemistry at the Presidency College. The Instructor in Gymnastics, Ghaus Khan, was transferred to the Kumbakonam College, his place being taken on 9th November by Mira Khan from that institution. The Workshop Instructor, Mr. Perkins, was absent on sick leave during October and November, his duties being carried on as far as possible by the Assistant Instructor Govindaswami Rau. The Librarian and Storekeeper, Shiva Rau, reverted to his permanent post of first assistant clerk and was relieved on 16th November by S. Parthasarathi Aiyangar, B.A., from the School of Arts. The work of taking over stock had not been completed at the close of the year. The insufficiency of the clerical establishment has been again brought to notice, but no adequate relief has been afforded. The special constitution of the college and its relation to the Public Works and Military departments involves work which is foreign to other educational institutions, especially in regard to the admission and final examinations, the practical courses, the system of students' deposits, the college workshop and stores, the soldier students and the assistance given to students towards securing employment. Financial transactions occur with nearly all the district treasuries, and the quarterly reconciliation of the accounts with those of the Accountant-General involves considerable labour. The offices of both the Head Clerk and the Librarian and Storekeeper are overworked, and not only is difficulty experienced in keeping abreast of current work, but the Principal is compelled to devote time which he can ill-spare from important duties to work which might be done by a superior clerk.

3. *Numbers.*—The numbers on the rolls at the end of the session were—

Class.	Practical course.	In College.			Total.
		First division.	Second division.	Third division.	
Engineer class	6	6	6	7	25
Engineer Subordinate class	16	18	21	29	84
Draftsman class	..	* 25	30	..	55
Surveyor class	..	* 21	25	..	46
Artisan class	..	..	..	..	37
Total	..	..	..	..	247

* Including one each who, for examination purposes, were classed as independent candidates.

Excluding the students going through the practical course on works, the total number actually in the college on the 31st December 1896 was 225. The corresponding totals for the four preceding years were 1895, 231; 1894, 265; 1893, 252; 1892, 217. The slight fall in the total numbers since 1895 is due to the non-admission of Military probationers and to the occurrence of a few casualties in the Draftsman class—items which could not be foreseen when the forecast for the year was made.

The distribution of the students by classes of the community, by districts of the Presidency, and by wealth and occupation of parents are given in appendices A, B and C. Among the most noteworthy features of the statistics are that 64 per cent. of the students are Brahmans, while no less than 28 per cent. came from a single district, Tanjore. Madras and the Chingleput district supply only 15 per cent. The numbers offering for admission were: Engineer classes 21, of whom 14 passed the entrance examination of December 1896; Engineer Subordinate class 85, of whom 78, viz., 14 F.A.'s and 64 Matriculates, qualified in April for admissions Sub-overseer and Surveyor class 92, of whom 59 qualified in December 1895; Draftsman class 59, of whom 36 qualified; Artisan class 113, of whom 45 were selected. It appears from these figures that the strength of the Engineer class is rising, that the new Sub-overseer and Surveyor class is likely to become a popular one, and that the remaining classes will be maintained at full strength during 1897.

4. *Examinations.*—The final and term examinations were conducted as usual by the Board of Examiners with Mr. Ashpitel as President. A brief abstract of the results is given below:—

(a) *Engineer class.*—The first division contained six third-year students, all of whom passed the final examination. Two independent candidates also presented themselves, of whom one withdrew and the other failed. The second and third divisions numbering six and seven, respectively, passed the usual term examinations.

(b) *Engineer Subordinate class.*—The senior division of 18 students appeared for the final examination and 14 were successful. Five independent candidates also appeared and one passed. The second and third divisions of 21 and 29, respectively, passed the usual term examinations.

(c) *Draftsman class.*—The senior division consisted of 24 students, of whom 11 qualified, viz., two in the second class and nine in the third class. This result cannot be regarded as satisfactory. As in 1894 the majority of the failures took place in Estimating. In 1895 special attention was given to this subject, with the result that, though improvement occurred in estimating, another subject, building drawing, was unfavourably criticised. During 1896 special attention was given to building drawing, and better results were obtained in the recent examination, but the standard in Estimating has not been maintained. Next year special attention will be given to both these subjects.

Eighteen independent candidates presented themselves, of whom seven passed, viz., two in the second class and five in the third class. Of the two second-class men, one already holds a certificate in that class. Of the five who have passed in the third class, one already holds a second-class certificate and the remainder hold third-class certificates. Three of the candidates who failed hold third-class certificates. The

majority of the failures occur in estimating. The facts recorded point to unusual difficulty experienced by the candidates, including the regular students, in dealing with the paper set in estimating. The second division of the Draftsman class appeared for a term examination with only moderate results.

(d) *Surveyor class.*—The first division of 20 students appeared for the final examination and 17 passed, viz., one for first-class, two for second-class and fourteen for third-class certificates. Fifteen independent candidates presented themselves and eight were successful, one gaining a second-class and seven securing third-class certificates. The former already holds a second-class certificate, and of the latter four hold third-class certificates. The junior division of the class, which will henceforth be entitled the Sub-overseer and Surveyor class, consisting of 25 students, passed a very satisfactory term examination. This reflects credit on M.R.Ry. M. A. Anantalwar, B.A., B.C.E., who has been in sole charge of the division.

(e) *Artisan class.*—This class, which opened with 43 students, fell, through resignations and dismissals, to 37 at the close of the year. Evening instruction was imparted as usual, supplemented by morning surveying two days a week. The class, which is a popular one, is reserved, as far as possible, for maistries, artisans, and the sons of such persons.

The class percentages of the marks under the various subject heads compare as follows with the average results of the preceding four years:—

<i>Engineer class.</i>								1896.	Average of previous four years.
Mathematics	...	...	...	...	...	...	...	60	67
Science	...	...	...	...	...	...	...	46	52
Engineering	...	...	...	...	...	...	...	48	63
Drawing	...	...	...	...	...	...	...	53	67
Surveying	...	...	...	...	...	...	...	64	62
Language	...	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	...	77	71
Total	...	...	...	...	...	...	...	54	62
<i>Engineer Subordinate class.</i>									
Mathematics	...	...	...	...	...	...	...	58	50
Engineering	...	...	...	...	...	...	...	50	51
Drawing	...	...	...	...	...	...	...	48	55
Surveying	...	...	...	...	...	...	...	61	56
Language	...	...	...	...	...	...	...	45	45
Drills and Exercises	...	...	...	...	...	...	...	82	70
Total	...	...	...	...	...	...	...	54	53
<i>Draftsman class.</i>									
Practical Geometry	...	...	...	...	...	...	...	66	59
Free-hand, Perspective, and Model Drawing	...	...	...	...	...	...	...	53	55
Building Drawing	...	...	...	...	...	...	...	50	55
Machine Drawing	...	...	...	...	...	...	...	54	56
Estimating	...	...	...	...	...	...	...	35	46
Topographical Drawing	...	...	...	...	...	...	...	54	50
Drills and Exercises	...	...	...	...	...	...	...	68	66
Total	...	...	...	...	...	...	...	51	52
<i>Surveyor class.</i>									
Chain, Compass and Plane Table Surveying	...	...	...	...	...	...	...	57	55
Levelling	...	...	...	...	...	...	...	56	61
Theodolite Surveying	...	...	...	...	...	...	...	41	56
Topographical Drawing	...	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	...	78	65
Total	...	...	...	...	...	...	...	55	57

These figures show that, in regard to the students now passing out of the college, the Engineer class is, notwithstanding the uniform success of its members in passing

the examination, considerably below the average merit; that the Engineer Subordinate and Surveyor classes are of average merit; and that the Draftsman class, notwithstanding its heavy proportion of single-subject failures, is also of average merit.

5. *Practical courses.*—The reduction of the practical course from two years to one came into effect during the year. To avoid, however, the simultaneous completion of the course by two different batches of Engineers and two of Engineer Subordinates, it was decided that the batches which left the college in December 1894 and spent the year 1895 in the Public Works Workshop should complete their works course on the 30th June 1896, while the batches which left the college in December 1895 should proceed at once to works and complete the course on the 31st December 1896. The former batches consisted of two Engineers and 17 Engineer Subordinates, and the latter of six Engineers and 15 Engineer Subordinates. The whole of these with the exception of one Engineer Subordinate (who was absent through sickness upwards of two months) completed their course during the year under review. The two junior batches were transferred to Madras in two sections for their equitation course at the Body Guard school. One Engineer Subordinate student, who left the college in December 1894, was permitted to go through a special course in the college workshops. He will be transferred to works in February 1897.

The progress reports, so far as they have been received from Executive Engineers, are almost without exception favourable.

Six Engineer and 15 Engineer Subordinate students will join the works course early in 1897. The distribution to Public Works Circles was notified before the Christmas holidays, so as to avoid delay in the commencement of the practical course. One Engineer student has elected to become a Mechanical Engineer, and will go through his practical course in the Madras Railway Locomotive shops.

6. *Military students.*—The total number of soldier students on the 31st December was six, viz., two on works and four in the Engineer Subordinate class. Two others completed their works course on 30th June. Owing to the reduction of the probationary course from one year to six months, no probationers were admitted during the year; but a competitive examination was held in November and a full class of five students will join the college at the commencement of 1897. A proposal that Military Engineer Subordinates required for the Burma Public Works Department shall be obtained from this college has been approved by Government and forwarded to the Government of India.

7. *Government Technical Examinations.*—Eighteen candidates appeared voluntarily for the Government Technical examinations in various engineering subjects. Of these 12 passed in one or more subjects, and six failed. Details will be found in appendix D.

8. *Surveying.*—During February the whole of the Engineer, Engineer Subordinate and Surveyor classes, comprising 109 students, were encamped at and near Avadi for sixteen days' continuous survey work. The students worked from day-light until about 11 A.M. in the field and from 3 to 6 P.M. at plotting. In July the same classes, comprising 136 students, proceeded to Poonamallee and Avadi for a similar period. The larger camp at Avadi was in charge of the Instructor in Surveying and Drawing and the smaller at Poonamallee in that of the Instructor in Engineering. Six students of the Draftsman class were attached to the latter in order to assist in the project assigned to the Engineer students. Satisfactory work was done during both periods. My thanks are due to the Commandant, Queen's Depôt, Poonamallee, who provided a large barrack room as a drawing office, and to the Executive Engineer, Military Works department, who placed a bungalow at Avadi at my disposal for a similar purpose. Thanks are also due to the Inspector-General of Ordnance for the supply of tents to supplement those belonging to the college. The total cost of the two camps was Rs. 1,192.

9. *Inspections of works.*—In addition to the usual inspections of buildings, bridges and factories, a tour was made by 85 students of the Engineer, Engineer Subordinate and Draftsman classes to the Redhills Tank System. The tour extended over five days, and the principal masonry works in the tank, the supply channel and head works were measured up. The cost of the inspection was Rs. 175.

10. *Workshops.*—The workshops were attended by the Engineer and Engineer Subordinate students, who participated in the various work executed. An iron lathe

was completed and a 1-h.p. engine commenced; sundry tools were made; moulding and brass casting were practised; benches, almirahs, drawing-tables and drawing-boards were constructed, and various repairs undertaken. The Instructor reports that the students have displayed more interest in their work than heretofore, and that a great improvement in the style of work is noticeable. The 100-ton testing machine was erected by the Workshop Instructor Mr Perkins under the supervision of the Professor of Engineering, and a series of tests, in which the Engineer students assisted, was carried out by Mr. Chatterton on timber, cement, concrete, stone, iron and steel specimens. A number of rails were tested for the Madras and South Indian Railway Companies, and it appears that considerable use is likely to be made of the testing machine by the public. My thanks are due to the officer in charge of the Arsenal for the loan of the hoisting appliances used in the erection of the machine.

During the year, a small planing machine was added to the stock of machine tools. A plan and estimate for extending the workshop on the south side was prepared by the Consulting Architect and submitted to Government. The cost is estimated at Rs. 8,636.

A scheme for training apprentices in the workshops with the view of fitting them to become teachers in technical schools was drawn up and approved.

11. *Revision of Rules.*—The development of the Surveyor class into a class for the training of Lower Subordinates for the Public Works Department and other services, which was recommended by Mr. West's Committee in March 1895, was sanctioned, and the new scheme of instruction was brought into force during 1896 in regard to the second division of the Surveyor class. The instruction in surveying remains much as before, but building construction, drawing and estimating are added to the course. Considering that the new system was introduced only in the second half of the year, the results attained by the junior division of the class in the late term examination are very creditable. The class will be a popular one, judging from the large number of applications for the admission examination of December last.

Sanction was at the same time accorded to the revision of the syllabuses proposed by the Committee above mentioned. The general features of the revision are the reduction, with the view of affording more time for practical work, of the book-work portions of the Engineer class and Engineer Subordinate class curricula, and the addition of certain branches to the Sub-overseer and Surveyor class, and Draftsman class curricula in order to render the instruction given more complete. The new syllabuses were at once taken up by all class divisions except the senior division of each class, so that the recent final examination is the last under the old syllabuses. One important point raised was the question of retaining the marks awarded by the college as a credit in the final examination totals. It was pointed out that the system served to encourage practical work, to test points which are not of a nature to be readily gauged by ordinary examinations and to create a constant incentive to work throughout the year. It was also brought to notice that the practice prevails in the other Indian Engineering colleges, as well as at Cooper's Hill, the City and Guilds of London Technical Institute and other important colleges in England. It was ultimately decided that the system should continue in force in all classes except the Draftsman class. Every effort will be made to exact the full quota of practical work from this class, notwithstanding the lack of incentive, and the matter will be reported on specially after sufficient time has elapsed to enable judgment to be formed of the effect of the change.

Independent candidates for the college certificate examinations have hitherto been persons who have at some period gone through a full course. At the instance of Colonel Pennycuik, the experiment is now to be tried of admitting other persons to the examinations for Draftsman certificates to be held in 1897 and 1898. It is not expected that the concession will be largely made use of.

Revision of the college rules, embracing the changes in the syllabuses as well as many other points, was also undertaken, and a draft code submitted. Sanction, however, had not been accorded by the close of the year, so that we are now in the rather anomalous position involved by working on a system which is not in accord with the published rules.

12. *Physical training and recreation.*—Compulsory instruction in gymnastics and drill was given as usual to all classes except the Artisan class. An improvement in the drill was observed. The concession of allowing deficiency of marks for physical

exercises up to a maximum of 25 per cent. to be made good in the case of students who regularly attend cricket practices, was extended this year to foot-ball. The latter is the more popular game, and several matches with other colleges and clubs were played. Cricket is regularly practised and the college took part in the inter-collegiate competition, but gained little success. Tennis continues to be played by a few students. The recreation ground is in good order, and the funds of the recreation club are in a satisfactory state. The athletic sports, which were to have taken place in November, fell through on account of the abnormally protracted rainfall of that month.

A former student of the College, M.R.Ry. S. A. Jagadisa Aiyar, B.A., Assistant Engineer, Public Works Department, kindly placed a sum of Rs. 33 at the disposal of the recreation club for prizes in sports. One of the prizes, a cricket bat, falls to T. Ramachandra Rau of the Engineer class, who made the best batting average among native students in the inter-collegiate competitions.

13. *Library.*—During the year, 184 books were added to the library, which now contains 3,409 volumes. The books issued to the students numbered 2,630, and to the staff 675 against 2,396 and 463, respectively, in the previous year, while 1,156 references were made to the consulting library. The new catalogue which was under preparation in 1895 was completed and published during the year.

14. *Buildings.*—The allotment of Rs. 17,000 which was made in the Public Works budget for 1895-96 was not utilized, and no addition was made to the accommodation during the year. The pressing need of additional space has, however, been again pointed out, and a plan and estimate drawn up by the Consulting Architect have been submitted. Provision has been made for one additional class room, two lecture rooms, a library and reading-room, and for a verandah along the west front of the old portion of the building. The total cost is estimated at Rs. 41,900.

15. *Attendance and conduct.*—The percentage of numbers present to numbers on the rolls was 94.4 for the Engineer and Engineer Subordinate classes, and 92.6 for the junior classes. The attendance by class divisions is given in appendix E. The conduct of the students has been satisfactory throughout the year.

16. *University examinations.*—Six candidates appeared for the B.E. degree examination of 1896, and four were successful in the Civil Branch. All were third-year students of the Engineer class. Eight candidates presented themselves for the first examination in Engineering and six passed. Of the latter, five were second-year students of the Engineer class, while the sixth was a third-year student. Of the two who failed, one was a second-year man and the other an ex-student.

17. *Financial details.*—The approximate total expenditure for the calendar year 1896 amounted to Rs. 66,290, and the income from fees, &c., to Rs. 14,590. Detailed statements of receipts and charges are given in appendix F. It should be noted that the figures for different years cannot be compared since large items for stores debited to a particular official year may appear in either of two calendar years. Full and accurate financial details are furnished with my annual returns for the official year. The average daily attendance throughout the year was 205, so that the net cost to Government of educating each student was Rs. 252.

18. *Educational Rules.*—The provisions of the Educational Rules have been carried out so far as the special constitution of the college will admit, except in regard to accommodation, which, as elsewhere reported, is insufficient. Academic costume has been worn by graduate professors and assistants not engaged in practical work.

19. *Employment of passed students of 1895 and 1896.*—Of the three Engineer students who completed their practical course on 31st December 1895, the senior R. N. Arokyaswami Mudaliyar, B.A., B.C.E., was appointed Assistant Engineer in the Public Works Department, and the other two accepted posts as temporary Upper Subordinates.

Of the two who completed their course on 30th June 1896, the senior S. A. Jagadisa Aiyar, B.A., was appointed an Assistant Engineer in the Public Works Department, while the other accepted employment under the Travancore Government. Of the 26 Engineer Subordinates who qualified for diplomas in December 1895, seven were appointed to the permanent and twelve to the temporary Upper Subordinate

establishment of the Public Works Department; four joined the permanent Lower Subordinate establishment; two were appointed to the Travancore Public Works Department; and one entered the Salt Department.

Of the 17 Engineer Subordinates who completed their practical course on the 30th June 1896, four were appointed to the permanent and seven to the temporary Upper Subordinate establishment of the Public Works Department; five joined the Lower Subordinate establishment, and one took service under a local board.

Of the 20 Draftsmen who passed out in December 1895, all but one are known to have been in employment during 1896 in the Public Works Department, Railways or Local Fund service; but six were unemployed towards the close of the year.

Of the 16 Surveyors who qualified in December 1895, all but four are known to have obtained employment on salaries ranging from Rs. 50 to Rs. 70. The Public Works Department, the Railways and the Revenue Department absorbed the majority.

It will be seen from the above figures that, notwithstanding the supply this year of an unusual number of Engineers and Engineer Subordinates, there has been no difficulty in securing employment.

20. *Prospects of employment.*—I regard the prospects of employment in the immediate future as good. Owing to double batches of Engineers and Engineer Subordinates leaving the college during the year, difficulty has been experienced in fulfilling the expectations of the students in regard to permanent appointments. Special sanction was obtained to the appointment of the senior engineer student of the batch of June 1896 as Assistant Engineer, and the senior student of the batch of December 1896 will be appointed to the provincial service as Apprentice Engineer under the new rules introduced by the Government of India. The permanent appointments of civilian Engineer Subordinates were two and three, respectively, in the senior and junior batches; but it is understood that the remaining students who were led to expect such appointments will be provided for as vacancies occur. This course will doubtless affect, to some extent, the prospects of subsequent batches.

At this moment there is a very large demand for temporary upper subordinates for Famine Relief work, and it is not improbable that a large proportion of the Engineers, Engineer Subordinates, Draftsmen and Surveyors of December 1896 will be absorbed by the Public Works Department.

The vacancies notified during the year in the Gazette, the public press, and by letter to the Principal, were one hundred and sixteen in number, of which sixty-eight were under Government, nineteen under local boards and municipalities, nine on railways, fifteen under Native States and five under private employers. Fourteen of the vacancies were for Engineers and Assistants, four for Supervisors, twenty-eight for Overseers, eleven for Sub-Overseers, twenty-one for Draftsmen, twenty-six for Surveyors, and nine for maistries, while three were of a miscellaneous character. Seven of the appointments carried salaries of Rs. 200 and upwards, fifteen between Rs. 100 and Rs. 200, thirty-six between Rs. 50 and Rs. 100, and fifty-eight under Rs. 50. Particulars are given in Appendix G.

21. *General.*—My thanks are due to the President of the Board of Examiners, Mr. Ashpitel, for the promptness and consideration he has displayed in the supply of the examination results. I also acknowledge the co-operation of the Professor of Engineering, Mr. Chatterton, and the Acting Professor of Mathematics, M.R.Ry. B. Hanumantha Rau, in the work of the College, as well as the willing aid rendered by the majority of the members of the junior staff. Special acknowledgment of the good work done by the Instructor in Surveying and Drawing, Sergeant Goddard, and the Instructor in Engineering, Sergeant Reynolds, is also made. Sergeant Goddard is steadily improving the style and accuracy of the survey work turned out. Sergeant Reynolds has, in addition to his regular duties, which have been carried out with energy and ability, been engaged in the preparation of a new series of pattern estimates, and of drawings for estimating purposes; and he has also compiled, for the use of the college, a Manual of Irrigation Works adapted from General Mullins' "Irrigation Manual" with the kind permission of the author. General Mullins has always taken a deep interest in this institution—an interest undiminished by retirement from active service in India—and I take this opportunity of publicly thanking him for the generous assistance which he has now rendered.

APPENDIX A.

DISTRIBUTION of students by wealth and occupations of parents on the 31st December 1896.

Classes in college.	Wealth.				Occupations.								Total.
	Richer classes.	Middle classes.	Poorer classes.	Total.	Officials.	Petty officials.	Traders.	Landholders.	Artisans.	Coolies including agricultural labourers.	Mendicants.	Others.	
Engineer class—													
I	2	4	6	2	1	..	3	..	..	..	..	..	6
II	6	..	6	3	..	..	3	..	..	..	..	..	6
III	7	..	7	1	..	..	6	..	..	..	..	..	7
Engineer Subordinate class—													
I	17	..	18	3	..	1	13	..	..	..	..	1	18
II	19	2	21	5	1	..	13	..	..	..	..	2	21
III	29	..	29	9	3	..	15	..	..	..	..	2	29
Draftsman class—													
I	25	..	25	17	1	1	5	1	..	..	..	..	25
II	26	4	30	14	3	1	12	..	..	..	..	..	30
Surveyor class—													
I	19	1	21	10	..	..	11	..	..	..	..	..	21
II	24	1	25	11	..	..	14	..	..	..	..	..	25
Artisan class	32	5	37	30	3	1	2	1	..	..	..	..	37
Total	2	206	17	225	105	12	4	97	2	..	..	5	225

APPENDIX B.

DISTRIBUTION of students by districts on the 31st December 1896.

Districts.	Engineer classes.	Engineer Subordinate class.	Draftsman class.	Surveyor class.	Artisan class.	Total.
Ganjām	..	..	1	1	..	2
Vizagapatam	..	..	..	1	1	2
Godāvari	1	..	1	3	..	5
Kistna	..	..	2	..	..	2
Nellore	..	3	..	2	..	5
Bellary	..	..	..	..	3	3
Madras	..	2	9	3	14	28
Chingleput	..	..	2	1	3	6
North Arcot	..	..	4	1	2	7
South Arcot	..	2	5	2	..	9
Tanjore	5	28	11	14	6	64
Trichinopoly	2	4	10	7	1	24
Madura	2	4	..	2	..	8
Tinnevely	..	6	..	4	1	11
Coimbatore	1	3	3	2	4	13
Nilgiris	..	..	..	1	..	1
Salem	..	1	2	1	..	4
South Canara	..	2	3	..	..	5
Malabar	..	3	..	..	..	3
Mysore	7	..	1	..	1	9
Travancore	1	2	..	..	1	4
Cochin	..	..	1	..	..	1
Pondicherry	..	..	..	1	..	1
Pudukóttai	..	2	..	..	..	2
Ceylon	..	1	..	..	..	1
Military students	..	5	..	..	..	5
Total	19	68	55	46	37	225

APPENDIX C.

DISTRIBUTION of students according to classes of the community on 31st December 1896.

Classes.	Europeans and Eurasians.	Native Christians.	Muhammadans.	Hindus.				Aborigines.	Others.	Total.
				Brahmans.	Non-Brahman Caste Hindus.	Pariahs.	Other castes.			
Engineer classes	..	..	..	18	1	..	..	..	..	19
Engineer Subordinate classes ..	5	1	..	57	4	..	1	..	..	68
Draftsman classes	1	..	..	32	22	..	..	..	..	55
Surveyor class	1	..	3	35	7	..	..	..	..	46
Maistry and Artisan class	..	2	1	5	29	..	..	..	..	37
Total ..	7	3	4	147	63	..	1	..	..	225

APPENDIX D.

GOVERNMENT Technical Examinations of 1896.

Subject.	Grade.	Number examined.	Number passed.	
			First class.	Second class.
Building Materials and Construction	Elementary	8	1	1
Building Drawing and Estimating	Intermediate	2	..	2
Earthwork and Road Making	Elementary	3	..	1
Surveying and Levelling	Intermediate	3	1	1
Applied Mechanics	Elementary	7	..	6
Mensuration	Elementary	1	1	..
Machine Construction	Intermediate	1	..	1
Machine Drawing	Advanced	1	..	1
Steam and Steam Engine	Intermediate	3	..	2
Fitter's work	Elementary	7	..	..
.. ..	Do.	3	..	1
.. ..	Do.	2	..	1
.. ..	Do.	1	..	..
.. ..	Elementary	2	..	2
Total ..	..	44	3	19

APPENDIX E.

Average attendance throughout 1896.

				Average number on rolls.	Average daily attendance.
College department—					
Engineer class, first (senior) division	..	..	..	6.0	5.6
Do. second division	..	..	..	6.0	5.8
Do. third do.	..	..	..	7.0	6.5
Engineer Subordinate class, first division	..	..	..	18.7	17.6
Do. do. second do.	..	..	..	21.1	19.6
* Do. do. third do.	..	..	..	17.7	17.1
† Military probationers	..	..	..	0.8	0.8
				77.3	73.0
School department—					
Draftsman class, first (senior) division	..	..	..	25.7	23.5
Do. second division	..	..	..	31.4	28.8
Surveyor class, first division	..	..	..	21.1	19.8
Do. second do.	..	..	..	25.9	24.5
Maistry and Artisan class	..	..	..	33.6	35.6
				142.7	132.2
Total college and school departments ..				220.0	205.2
Percentage of numbers present to numbers on the rolls—					
College department	..	..	..	..	94.4
School department	..	..	..	..	92.6

* This division joined in July.

† The probationers were absorbed in July.

APPENDIX F.

Financial Details for 1896.

	RS.	A.	P.
<i>Receipts—</i>			
Tuition fees	10,398	0	0
Entrance and final examination fees	3,340	0	0
Fines and other receipts	851	13	8
Total ..	14,589	13	8
<i>Charges—</i>			
Principal	14,890	8	0
Professors, masters and teachers	27,845	2	7
Clerks, librarian and servants	3,300	14	8
Board of Examiners	4,500	0	0
Library and prize allowances	557	3	0
Books and instruments	596	14	9
Other Europe stores	2,654	11	2
Miscellaneous	4,555	15	2
Travelling allowances	412	13	6
Scholarships	2,700	12	6
Exchange compensation allowances	4,273	2	4
Total ..	66,288	1	8

	RS.
Net cost to Government	51,698
Average attendance throughout the year	205
Net cost per student	252

From F. W. ASHPITEL, Esq., President of the Board of Examiners, College of Engineering, to the Director of Public Instruction, dated 28th January 1897.

I have the honour to forward herewith the report on the Civil Engineering College Examinations for 1896, together with the reports of the individual Examiners. The mark sheets have been handed over to the Principal of the college.

2. I also enclose remuneration bills amounting to Rs. 3,956-4-0 as noted below:—

	RS.	A.	P.
F. W. Ashpitel, Esq.	1,294	0	0
C. T. R. Scovell, Esq.	1,141	4	0
A. Moffat, Esq.	918	0	0
Rao Bahadur V. Krishnama Chary	210	0	0
C. E. Phipps, Esq.	393	0	0
Total ..	3,956	4	0

Rupees three thousand nine hundred and fifty-six and annas four only.

Report on the examinations held at the College of Engineering, Madras, in December 1896.

Engineer Classes—Percentage of marks obtained.

	E I.	E II.	E III.	Average, 1890-95.
Mathematics	60	68	64	63
Science	46	43	..	50
Engineering	48	49	74	63
Drawing	53	42	45	67
Surveying	64	66	52	67
Language	53	..	..	55
Drills and Exercises	77	..	..	70
Total ..	54	54	60	62

In the first division, six college students and one independent candidate were examined. The college students all passed, but the independent candidate failed to secure the required total number of marks. The percentage of marks obtained is the same as last year but considerably below the average, the principal failures being in engineering and drawing. The class was, in fact, below the average in every subject in which they were examined by the board and three out of the six candidates only just succeeded in qualifying. In engineering only one student and in building drawing no student obtained half marks.

In the second division, six college students were examined and, with the exception of mathematics, the percentage of marks obtained was below the average. In engineering, there was a general failure in building construction, for which there is no excuse seeing that there is a text-book available if the students will only study it. In building drawing no student obtained half marks.

In the third division, seven college students presented themselves for examination, and the class is considerably better than the other divisions. In engineering and mathematics the percentage of marks obtained is above the average and the percentage on the total marks obtained is practically up to the average. The failure is in drawing in which it will be observed that all the divisions of the Engineer class are bad.

Engineer Subordinate classes.—Percentage of marks obtained.

	Es I.	Es II.	Es III.	Average, 1890—95.
Mathematics	58	61	..	49
Engineering	50	53	..	49
Drawing	48	50	..	56
Surveying	61	56	..	57
Language	45	..	..	46
Drills and Exercises	82	..	..	71
Total ..	54	56	54	54

In the first division, the class is apparently up to the average, but the average is not very high. In mathematics, engineering and surveying the percentage of marks obtained is above, but in drawing considerably below the average. In the division 18 college students and five independent candidates were examined, of whom four college students and four independent candidates failed to qualify.

In the second division, 21 college students were examined and the percentage of marks obtained is above the average in mathematics and engineering, up to the average in surveying and below the average in drawing. The general result of the examination is good and the class should do very well.

In the third division, 29 college students were examined, but the papers were few in number. The class appears to be up to the average, and several students did remarkably well.

Draftsman Class—Percentage of marks obtained.

	D I	D II	Average, 1890—95.
Practical Geometry	66	..	62
Free-hand and Model Drawing	53	..	56
Building Drawing	50	..	57
Machine	54	..	56
Estimating	35	..	48
Topographical Drawing	54	..	51
Drills and Exercises	68	..	67
Total ..	51	43	56

In the first division, 24 college students presented themselves for examination, of whom 13 failed; of 18 independent candidates, 11 failed. The principal failure is in estimating, in much due to college marks as to the Board's examination. The results being so very unsatisfactory, the President of the Board called for the mark sheets and the whole of the papers were was up to the average in other subjects and two college students and two independent candidates obtain second-class certificates. The work done by the class in estimating during the college course was also examined by the board and the failure does not appear to be attributable to any want of attention to this subject. It is suggested, however, that the Consulting Engineer for Railways, the Chief Engineer, Madras-Bezawada Railway, and the Irrigation office should be asked to supply the college with some of the more recent designs and estimates for bridges and irrigation works, as the selection available at the college, though much improved during recent years, is still somewhat deficient.

In the second division, the students were only examined in geometrical and free-hand drawing and two students did exceptionally well.

Surveyor Class—Percentage of marks obtained.

	S I, 1896.	Average, 1890—95.
Chain Compass and Plane Table	57	57
Levelling	56	62
Theodolite Survey	41	57
Topographical Drawing	53	56
Drills and Exercises	78	67
Total ..	55	59

In the first division, twenty college students and fifteen independent candidates were examined, of whom three college students and five independent candidates failed. The class is below the average in all subjects in which they were examined, though slightly better than last year.

Sub-Overseer and Surveyor class.—Though the actual percentage of marks obtained by this class is not high the result of the examination is, in the opinion of the board, most satisfactory. Several students did extremely well and only six out of 25 failed to obtain half marks, of whom only one seems to be likely to fail eventually. Taking into consideration the educational qualifications of the students the way in which they answered the papers was remarkably good and appears to reflect great credit on the instructors. The class is a new one, and it is believed had not the full time for preparation owing to the introduction of the new syllabus late in the year. The only suggestion that the board have to make is that the students should, in future, be instructed not to attempt to learn by heart the chemistry of building materials which they cannot possibly understand, but to confine their attention to the practical parts of the text-book. The text-book on building materials and construction requires, in fact, to be marked, so as to indicate to students which parts they are expected to study.

General Remarks.—With the exception of estimating in the draftsman class and drawing and engineering in the Engineer and Engineer Subordinate classes, the board are of opinion that the results of the examination may be considered to be fairly satisfactory. The reduction in the percentage of marks obtained is largely due to the strictness with which college marks are awarded as inspection of the mark sheets will show.

Read the following endorsement from the Director of Public Instruction, No. 854, dated 29th January 1897:—

Referred to the Principal, College of Engineering, Madras, for favour of remarks, if any, and scrutiny of the remuneration bills of the members of the Board of Examiners.

Read the following letter from the Principal, College of Engineering, to the Director of Public Instruction, No. 1697-C, dated 15th February 1897:—

Referring to your endorsement No. 854, dated 29th January 1897, on file from the President, Board of Examiners, herewith returned, I have the honour to offer the following remarks.

2. The mark sheets mentioned in the first paragraph of Mr. Ashpitel's covering letter were forwarded to you with my annual report No. 1613-C, dated 30th January 1897.

3. Under "Engineer classes" in the body of the report the word "failures" is misleading, seeing that all the students of the senior division passed the final examinations. The average percentage of the division was 48 in engineering and 53 in drawing.

4. The President observes that the results were not good in engineering and building drawing in the senior division of the Engineer class. It should be noted that, while Engineering is a main head, building drawing is only a sub-head of the main head Drawing, the percentage in which was 53.

5. The percentages for the second division of the Engineer class are those of the results of two term examinations, those of 1895 and 1896. A similar remark applies to the percentages given under the second division of the Engineer Subordinate class.

6. The President considers that the existence of a recognised text-book in a subject leaves no excuse for failure in that subject. I fear that something more than text-books is needed to enable students to pass examinations.

7. The want of success in estimating in the Draftsman class is commented on in my Annual report, paragraph 4 (c), and certain facts are adduced which tend to show that the paper set offered unusual difficulties to the candidates. The President admits that the failures are not attributable to want of attention to the subject in the college.

8. Throughout his report the President compares the results of 1896 with those of the preceding five years. In my Annual report, I take, as usual, the preceding four years.

Proceedings No. 5145 of 1897.

The Principal's report deals with the working of the college during the past calendar year. But for facility of preparation of the quinquennial report ordered by the Government of India, statistics for the past five years have been incorporated in this review. In his future reports the Principal should adopt the designations given to the several classes in the Madras Educational Rules.

2. *Staff.*—The only change of importance was the appointment of Mr. H. T. Keeling as Acting Professor of Engineering during the absence on furlough of Mr. A. Chatterton, the permanent incumbent. Several minor changes also took place in the subordinate staff and in the clerical establishment. The Director is not quite convinced as to the necessity for a fourth clerk for the college. Indeed in no institution is the clerical establishment so strong as in this college. It appears to the Director that the work of the clerks needs re-distribution, the head clerk being entrusted with all cash transactions and the storekeeper and librarian with the charge of books and stores and instruments. The difficulty might be got over by placing the clerical establishment under the immediate supervision of some senior instructor of the college as has been the practice in the Medical College, where, it is believed, the correspondence work is as heavy as, if not heavier than, in the College of Engineering. This arrangement would relieve the Principal from much routine work and enable him to devote more time than at present, viz., $4\frac{1}{2}$ hours a week, to instruction in connection with the Engineer classes, which did not, in certain important subjects, do as well as Examiners.

3. *Accommodation.*—The necessity for additional accommodation has been admitted by Government, which has approved the extension at present of the ground floor of the college and accordingly called for revised plans and estimates.

4. *Library and reading-room.*—A more satisfactory use was made of the library during the year. No reference has been made in the report to the working of the reading-room maintained by the college recreation club.

5. *Workshops.*—The workshop fittings have now been completed, and the usefulness of the workshops has been enhanced by the provision of the 100-ton Testing Machine. The students have of late been receiving ample practice in the workshop, and they are therefore sent to works divisions only during their practical course, excepting students who desire to become mechanical engineers. The scheme for the training in the workshops of apprentices already possessing some technical qualification has met with the general approval of Government, and the Director trusts that schools in the mofussil teaching mechanical engineering subjects will, in the course of a few years, be supplied with trained teachers from the college.

6. *Strength and attendance.*—In the following statement the strength of each class of the college for the past five years is compared:—

Class.	Strength on the 31st December					Remarks.
	1892.	1893.	1894.	1895.	1896.	
Engineer	10	14	17	19	19	This statement excludes the number of students undergoing the practical course.
Engineer Subordinate	77	81	76	63	63	
Do. Military probationers	5	2	3	2	5	
Draftsman	51	67	73	64	55	
Sub-Overseer and Surveyor	37	50	57	48	46	
Artisan class	34	38	39	35	37	
Artisan students	3	..	..	..	..	
Total ..	217	252	265	231	225	

It is observed that the strength on the 31st December 1896 was the lowest in the quinquennium, the year 1892 excepted, though it very nearly approached that of 1895. The fall is due chiefly to the causes explained by the Principal and also partly to the strictness with which the entrance tests are conducted. The gradual increase, however, in the strength of the Engineer class is encouraging, and a further increase is expected. From paragraph 6 of the Principal's report it is noted that there were four military students receiving theoretical instruction, whereas Appendix B gives the corresponding figure as five. This discrepancy needs to be explained. The average number on the rolls and the average daily attendance were fairly satisfactory, namely, 220.0 and 205.2, respectively. All the districts with the exception of Kurnool, Cuddapah and Anantapur were represented, and Tanjore and Madras changed places during the year, the former district being far ahead of the latter as regards the number of students supplied. The richer and middle classes contributed 92 per cent., and Brahmans and non-Brahman caste Hindus 65 and 28 per cent., respectively, of the total strength. What is even more noteworthy is that 18 out of 19 Engineers and 57 out of 68 Engineer Subordinates were Brahmans. Muhammadans numbered four only, and they were found in the Surveyor and Artisan classes; nor was the Native Christian element suitably represented. The concession of half fees granted in favour of Muhammadans and the reservation of a few scholarships awarded in the college for this class preferentially in the new rules now before Government will, the Director trusts, induce a larger number of Muhammadan youths to seek instruction in Engineering. Turning to the occupation of parents it is observed that the majority of the students were the sons of officials and landholders and that the artisan element was very poorly represented, the number in the whole college being two while that in the Artisan class was only one. This is very disappointing indeed.

7. *Examinations.*—(i) *University examinations.*—The last quinquennium was remarkable for the institution of separate engineering degrees in the civil and mechanical branches and for the bifurcation of the examination for the engineering degree into the first examination in Engineering and the Bachelor of Engineering degree (or the final) examination. This bifurcation was given effect to in January 1895.

The results of the University examinations for five years are recorded in the margin. Since January 1892, 20 students of the college had appeared for the degree examination in Engineering and 16 of them had met with success. These results are satisfactory. Twenty-one independent candidates also presented themselves for the above examination and seven were successful. The college acquitted itself fairly satisfactorily both in the First and in the Degree examinations of January 1896.

Year.	B.C.E. or B.E. degree.		First examination in Engineering.	
	Ex-aminated.	Passed.	Ex-aminated.	Passed.
1892	5	4	..	..
1893	4	3	..	..
1894	3	3	..	..
1895	2	2	9	7
1896	6	4	8	6
Total ..	20	16	17	13

(ii) *College Board examinations.*—The following summary furnishes the results of the final examinations conducted by the college board during the past five years :—

Class.	Number presented.					Number passed.				
	1892.	1893.	1894.	1895.	1896.	1892.	1893.	1894.	1895.	1896.
Engineer	4	2	2	7	6	4	2	2	6	6
Engineer Subordinate	18	26	31	21	18	13	24	19	15	14
Surveyor	18	18	25	22	20	16	12	20	16	17
Draftsman	24	26	34	28	24	18	21	10	20	11

The results of 1896 compared favourably with those of the year previous except in the case of the Draftsman class in which there was a large number of failures. On the manner in which each class acquitted itself at the examinations conducted by the Board in December 1896 the Director would remark :

Engineer class.—This class was much below the average, the percentages of marks obtained in several important subjects not approximating the average of the previous four years. All the three divisions exhibited weakness in drawing, and the first and second divisions in engineering and in building construction, respectively.

The Principal points out that the term “failures” used by the Board of Examiners in connection with the first division of the Engineer class is misleading as all the six students presented for the final examination were declared to have passed. Presumably the Board’s remark refers to the results of the examination conducted by the Board irrespective of the college or session marks. The President is requested to be good enough to state whether this presumption is correct.

Engineer Subordinate class.—The class was up to the average in all the subjects except drawing, which should consequently receive greater attention. The poor results in drawing obtained by the Engineer and Engineer Subordinate classes justify the inclusion in the revised rules before Government of the subject in the entrance tests for admission to the above classes.

Draftsman class.—This class fared badly at the final examination, the chief failures being in estimating. The Principal is of opinion that the unsatisfactory results were due to the unusual difficulty which the paper on estimating presented to the candidates and not to any want of attention to the subject. Building-drawing, however, does not appear to have received sufficient attention. As suggested by the Board of Examiners, the Principal is requested to arrange to procure for the college a few recent designs and estimates for bridges and irrigation works.

Sub-overseer and Surveyor class.—The Senior division of this class acquitted itself creditably at the final examination and the Junior division also did well at the term examination. The attention of the instructors should be drawn to the Board’s suggestion that the students should be taught to devote their attention to the practical parts of the text book on building materials and construction.

The remarks of the examiner in the vernaculars should be commended to the vernacular assistants. A large number of students, especially of the Engineer and Engineer Subordinate classes, are stated not to have numbered their answer papers. The omission should be guarded against.

(iii) *Government technical examinations.*—From the particulars furnished in Appendix D to the report, it is observed that 44 single subject candidates appeared voluntarily for the Government technical examinations and that 22, or 50 per cent. passed. The results in building materials and construction (Elementary), building-drawing and estimating (Elementary), mensuration (Elementary) and machine construction (Intermediate) were decidedly poor. Information should be given in future reports as to the classes to which candidates for the Government technical examinations severally belonged.

8. *Independent candidates.*—The results obtained by the independent candidates at the final examinations held in December were poor excepting as regards surveyor candidates, as may be seen from the figures in the margin. It is hoped that the draftsman candidates will fare better in future as their success is to be determined purely by the marks gained at the examination conducted by the Board.

Description.	Number examined.	Number passed.
Engineer candidates	1	..
Do. Subordinate candidates	5	1
Draftsman candidates	18	7
Surveyor do.	15	8

9. *Military students.*—Including the students in their practical course the total number of soldier students on the rolls on the 31st December last were six as against eleven in the year previous, the decrease being due to the non-admission of any probationers during the year. The success obtained by the soldier students at the examinations held by the Board of Examiners and at the Government technical examinations has again not been noted. The Government of India has decided that five military candidates may annually be admitted into the college. It has also been ruled that the probationary course for these students should be reduced from twelve to six months until 1898 and that it be entirely abolished thereafter, the same entrance examination being prescribed for civil and soldier candidates.

10. *Practical courses.*—The reduction in the length of the practical course from two years to one in the case of Engineer and Engineer Subordinates was carried out during the year under report. As the students will in future be chiefly engaged on works during their practical course the Madras University has made the necessary modification in its by-laws relating to the B.E. degree Examination. The conduct of the students during their practical course was uniformly satisfactory.

11. *Physical education.*—Judged from the results shown in drill, &c., at the college examinations, the physical training of the students seems to have received increased attention.

12. *Employment of former students.*—The Director is glad to note that as usual the students of the last set found little difficulty in securing employment. During the past five years various concessions have been granted to the students of the college, and their prospects have in consequence been improved. The disability under which the Engineer students had long suffered of being shut out from appointments on the upper subordinate ranks of the Public Works Department has been removed. From and after 1st January 1897 training in this college, or such approved service as the Governor in Council may consider equivalent thereto, has been made a qualification for Public Works appointments under district boards and municipalities carrying salaries of Rs. 100 and upwards, whilst preference should generally be given to men so trained. The Bengal Government has declared that under certain circumstances graduates in Engineering from the Madras College are eligible for appointments to the Public Works Upper Subordinate establishment in Bengal. Draftsmen holding lower class certificates have been allowed to be promoted to the higher grades for approved service and exceptional merit. It has been decided to make the award of the guaranteed apprentice Engineership at the termination of the theoretical course instead of after the completion of the practical course as originally contemplated. The selection of an apprentice Engineer in alternate years from the upper subordinates of the Public Works Department is an additional inducement to the Engineer subordinates of the college. Lastly, the Government of India has recently accepted the recommendation of the local Government that recruits of Military Upper Subordinates for the Public Works Department in Burma be made in future from the College of Engineering, Madras, instead of from the Thomason Civil Engineering College, Roorkee, vide G.O., No. 828-W., dated 22nd March 1897, communicated in G.O., No. 203-E., dated 7th April 1897.

13. *Finance.*—The financial position of the college during the past four years can be glanced at from the subjoined summary. The figures relating to 1892 are not available :—

Year.	Fees and other receipts.	Total charges of the college, including scholarships but exclusive of outlay on workshop fittings, and on buildings.	Net cost of educating each student.
1893	Rs. 15,957	Rs. 67,070	Rs. 209
1894	13,817	67,407	223
1895	14,190	72,080	273
1896	14,590	66,290	252

The net cost of educating each student during the year was smaller than in 1895. The slight fall under fees proper was more than compensated for by the increase under fines and miscellaneous receipts. The decrease in charges is due chiefly to diminished expenditure on Europe stores and under exchange compensation allowance.

14. *Revision of syllabuses and rules.*—The most important event of the year was the revision of the college syllabus by a committee of experts, which, with certain modifications, received the sanction of Government in G.O., No. 444, Educational, dated 22nd July 1896. Major Love's report touches on the salient features of the revision, and the effect of the changes will be watched with interest. The rules of the college have also been thoroughly recast, the several alterations sanctioned by Government from time to time, chiefly as regards the institution of admission tests for the Draftsman and Surveyor classes, the reduction of the practical course, the institution of the equitation course, the development of the Surveyor into the Sub-overseer and Surveyor class, the altered conditions of the guaranteed appointment and the establishment of stipendiaryships in connection with the workshop being incorporated in the rules. It is hoped that the early sanction of Government will be accorded to the revised rules as the present rules have become obsolete in several respects.

15. *General.*—The administration of the college was on the whole fairly satisfactory and its working was creditable to the Principal, the Professors and the staff.

(A true Extract.)

(Signed) D. DUNCAN,
Director of Public Instruction.

To the Principal, College of Engineering.
" the Principals of other Government Colleges.
" the Inspectors of Schools.
" the Superintendent, School of Arts.

Copy to the President, Board of Examiners, College of Engineering.
" Chief Engineer, Public Works Department, for information.
Copies to the Editors, *Indian Journal of Education*, and the *Educational Review*.
Copy to Government with covering letter.

ORDER—No. 541, Educational, dated 22nd September 1897.

The report on the working of the College of Engineering in 1896 and the review of it by the Director of Public Instruction call for the following remarks:—

(1) The fall in the strength of the students, which was considered to be merely temporary in the report of the previous year, continued during the year under review and is due chiefly to the decrease in the strength of the Draftsman class. The Principal attributes the fall to the non-admission of military probationers, but it is observed that the Director of Public Instruction in paragraph 6 of his review shows five as the number of such probationers on the 31st December 1896 as against two in the year

1895. The increase in the strength of the Engineer class from ten to nineteen during the last quinquennium is satisfactory. In the Engineer Subordinate class, there has been a gradual diminution in strength, which is to be regretted. There was no Muhammadan student in the Engineer, Engineer Subordinate and Draftsman classes, and there were only four in the other departments. In the whole college there were only two students belonging to the artisan class. The Government has recently allowed Muhammadan students in professional colleges to pay fees at half the prescribed rates and a few of the scholarships awarded in the College of Engineering have been reserved for Muhammadans. These concessions will, it is hoped, induce a larger number of Muhammadan students to take to the study of engineering.

(2) The results of the several University examinations, and of the examinations conducted by the College Board of Examiners are fairly satisfactory, except in the case of draftsman students. The Government notes with dissatisfaction that there should have been so large a number of failures in the subject of estimating among the students of the Draftsman class. The attention of the college authorities was drawn to this defect in the review of the report for 1894. It is not satisfactory to learn that the Board of Examiners found the whole Engineer class much below the average. The Principal will take steps to improve the instruction given in drawing. The teaching of the engineering subjects of the first division and of building construction should also be improved.

(3) The Government is glad to note that the double batches of Engineer and Engineer Subordinate students who completed their course during the year experienced no difficulty in finding employment. During the past five years, a considerable improvement has taken place in the prospects of the passed students of the college, which, the Government trusts, will increase the popularity of the institution greatly.

(4) Orders on the revised rules of the college will be passed in separate proceedings.

(5) In consequence of the decrease in the strength of the college, the receipts from fees declined, and notwithstanding this decline, the net cost of maintaining the college fell by Rs. 6,120. The net cost of educating each student fell from Rs. 273 in 1895 to Rs. 252 in the year under review, but it is still high. In 1893 the cost was only Rs. 209. The receipts from "fines and other receipts" rose from Rs. 242 to Rs. 852; to which particular item this large increase is due should be explained.

[Here enter letter, No. 542, Educational, dated 22nd September 1897.]

(True Extract.)

G. S. FORBES,
Secretary to Government.

To the Director of Public Instruction.
" Public Works Department.
" Local and Municipal Department.
" Deputy Adjutant-General, Madras Command.
Editors' Table.

Exd. A. F. Eccleston.

Public Works (1897) Department
Proceedings of the Madras Government
Read the following: —

Government {1897} of Madras.
EDUCATIONAL

Recd.

Regd.

} 1897.

Enclosures

Spare copies

G.O., No. 541, 22nd September 1897.

2993W
26-10-97

SEPTEMBER.

College of Engineering.

Reviewing the report on the working of the — during 1896; and forwarding copy of the
Proceedings to the Secretary of State.

GOVERNMENT OF MADRAS.
EDUCATIONAL DEPARTMENT.

READ—the following paper:—

From the Honourable Mr. D. DUNCAN, M.A., D.Sc., LL.D., Director of Public Instruction, to the Secretary to Government, Educational Department, dated Madras, 14th May 1897, No. 5299.

I have the honour to submit, for the information of Government, a copy of my Proceedings, No. 5145, dated 11th instant, reviewing the report on the working of the College of Engineering during the past calendar year.

ENCLOSURE.

PROCEEDINGS of the Director of Public Instruction, dated 11th May 1897, No. 5145.
Read the following letter from Major H. D. LOVE, R.E., Principal, College of Engineering, to the Director of Public Instruction, No. 1613-C., dated 30th January 1897:—

I have the honour to submit the following review of the working of the College of Engineering during the year 1896.

2. *Establishment.*—The only change which occurred in the establishment was that due to the departure on furlough of Mr. Chatterton, the Professor of Engineering, on 29th August. Mr. H. T. Keeling, Executive Engineer, Public Works Department, district, he was unable to join until the 24th December. In the interim, the more pressing portions of the Professor's duties were undertaken by the Principal, while instruction in the Chemical Laboratory was given by M.R.Ry. T. K. Hanumantha Rau, B.A., the Assistant Professor of Chemistry at the Presidency College. The Instructor in Gymnastics, Ghaus Khan, was transferred to the Kumbakonam College, his place being taken on 9th November by Mira Khan from that institution. The Workshop Instructor, Mr. Perkins, was absent on sick leave during October and November, his duties being carried on as far as possible by the Assistant Instructor Govindaswami Rau. The Librarian and Storekeeper, Shiva Rau, reverted to his permanent post of first assistant clerk and was relieved on 16th November by S. Parthasarathi Aiyangar, B.A., from the School of Arts. The work of taking over stock had not been completed at the close of the year. The insufficiency of the clerical establishment has been again brought to notice, but no adequate relief has been afforded. The special constitution of the college and its relation to the Public Works and Military departments involves work which is foreign to other educational institutions, especially in regard to the admission and final examinations, the practical courses, the system of students' deposits, the college workshop and stores, the soldier students and the assistance given to students towards securing employment. Financial transactions occur with nearly all the district treasuries, and the quarterly reconciliation of the accounts with those of the Accountant-General involves considerable labour. The offices of both the Head Clerk and the Librarian and Storekeeper are overworked, and not only is difficulty experienced in keeping abreast of current work, but the Principal is compelled to devote time which he can ill-spare from important duties to work which might be done by a superior clerk.

3. *Numbers.*—The numbers on the rolls at the end of the session were—

Class.	Practical course.	In College.			Total.
		First division.	Second division.	Third division.	
Engineer class	6	6	6	7	25
Engineer Subordinate class	16	18	21	29	84
Draftsman class	..	25	30	..	55
Surveyor class	..	21	25	..	46
Artisan class	..	..	..	..	37
Total	..	..	..	..	247

* Including one each who, for examination purposes, were classed as independent candidates.

Excluding the students going through the practical course on works, the total number actually in the college on the 31st December 1896 was 225. The corresponding totals for the four preceding years were 1895, 231; 1894, 265; 1893, 252; 1892, 217. The slight fall in the total numbers since 1895 is due to the non-admission of Military probationers and to the occurrence of a few casualties in the Draftsman class—items which could not be foreseen when the forecast for the year was made.

The distribution of the students by classes of the community, by districts of the Presidency, and by wealth and occupation of parents are given in appendices A, B and C. Among the most noteworthy features of the statistics are that 64 per cent. of the students are Brahmans, while no less than 28 per cent. came from a single district, Tanjore. Madras and the Chingleput district supply only 15 per cent. The numbers offering for admission were: Engineer classes 21, of whom 14 passed the entrance examination of December 1896; Engineer Subordinate class 85, of whom 78, viz., 14 F.A.'s and 64 Matriculates, qualified in April for admissions Sub-overseer and Surveyor class 92, of whom 59 qualified in December 1895; Draftsman class 59, of whom 36 qualified; Artisan class 113, of whom 45 were selected. It appears from these figures that the strength of the Engineer class is rising, that the new Sub-overseer and Surveyor class is likely to become a popular one, and that the remaining classes will be maintained at full strength during 1897.

4. *Examinations.*—The final and term examinations were conducted as usual by the Board of Examiners with Mr. Ashpitel as President. A brief abstract of the results is given below:—

(a) *Engineer class.*—The first division contained six third-year students, all of whom passed the final examination. Two independent candidates also presented themselves, of whom one withdrew and the other failed. The second and third divisions numbering six and seven, respectively, passed the usual term examinations.

(b) *Engineer Subordinate class.*—The senior division of 18 students appeared for the final examination and 14 were successful. Five independent candidates also appeared and one passed. The second and third divisions of 21 and 29, respectively, passed the usual term examinations.

(c) *Draftsman class.*—The senior division consisted of 24 students, of whom 11 qualified, viz., two in the second class and nine in the third class. This result cannot be regarded as satisfactory. As in 1894 the majority of the failures took place in Estimating. In 1895 special attention was given to this subject, with the result that, though improvement occurred in estimating, another subject, building drawing, was unfavourably criticised. During 1896 special attention was given to building drawing, and better results were obtained in the recent examination, but the standard in Estimating has not been maintained. Next year special attention will be given to both these subjects.

Eighteen independent candidates presented themselves, of whom seven passed, viz., two in the second class and five in the third class. Of the two second-class men, one already holds a certificate in that class. Of the five who have passed in the third class, one already holds a second-class certificate and the remainder hold third-class certificates. Three of the candidates who failed hold third-class certificates. The

majority of the failures occur in estimating. The facts recorded point to unusual difficulty experienced by the candidates, including the regular students, in dealing with the paper set in estimating. The second division of the Draftsman class appeared for a term examination with only moderate results.

(d) *Surveyor class.*—The first division of 20 students appeared for the final examination and 17 passed, viz., one for first-class, two for second-class and fourteen for third-class certificates. Fifteen independent candidates presented themselves and eight were successful, one gaining a second-class and seven securing third-class certificates. The former already holds a second-class certificate, and of the latter four hold third-class certificates. The junior division of the class, which will henceforth be entitled the Sub-overseer and Surveyor class, consisting of 25 students, passed a very satisfactory term examination. This reflects credit on M.R.Ry. M. A. Anantalwar, B.A., B.C.E., who has been in sole charge of the division.

(e) *Artisan class.*—This class, which opened with 43 students, fell, through resignations and dismissals, to 37 at the close of the year. Evening instruction was imparted as usual, supplemented by morning surveying two days a week. The class, which is a popular one, is reserved, as far as possible, for maistries, artisans, and the sons of such persons.

The class percentages of the marks under the various subject heads compare as follows with the average results of the preceding four years:—

<i>Engineer class.</i>							1896.	Average of previous four years.
Mathematics	...	...	...	...	...	...	60	67
Science	...	...	...	...	...	...	46	52
Engineering	...	...	...	...	...	...	48	63
Drawing	...	...	...	...	...	...	53	67
Surveying	...	...	...	...	...	...	64	62
Language	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	77	71
Total	...	...	...	...	...	...	54	62
<i>Engineer Subordinate class.</i>								
Mathematics	...	...	...	...	...	...	58	50
Engineering	...	...	...	...	...	...	50	51
Drawing	...	...	...	...	...	...	48	55
Surveying	...	...	...	...	...	...	61	56
Language	...	...	...	...	...	...	45	45
Drills and Exercises	...	...	...	...	...	...	82	70
Total	...	...	...	...	...	...	54	53
<i>Draftsman class.</i>								
Practical Geometry	...	...	...	...	...	...	66	59
Free-hand, Perspective, and Model Drawing	...	...	...	...	...	...	53	55
Building Drawing	...	...	...	...	...	...	50	55
Machine Drawing	...	...	...	...	...	...	54	56
Estimating	...	...	...	...	...	...	35	46
Topographical Drawing	...	...	...	...	...	...	54	50
Drills and Exercises	...	...	...	...	...	...	68	66
Total	...	...	...	...	...	...	51	52
<i>Surveyor class.</i>								
Chain, Compass and Plane Table Surveying...	...	...	...	...	...	...	57	55
Levelling	...	...	...	...	...	...	56	61
Theodolite Surveying	...	...	...	...	...	...	41	56
Topographical Drawing	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	78	65
Total	...	...	...	...	...	...	55	57

These figures show that, in regard to the students now passing out of the college, the Engineer class is, notwithstanding the uniform success of its members in passing

the examination, considerably below the average merit; that the Engineer Subordinate and Surveyor classes are of average merit; and that the Draftsman class, notwithstanding its heavy proportion of single-subject failures, is also of average merit.

5. *Practical courses.*—The reduction of the practical course from two years to one came into effect during the year. To avoid, however, the simultaneous completion of the course by two different batches of Engineers and two of Engineer Subordinates, it was decided that the batches which left the college in December 1894 and spent the year 1895 in the Public Works Workshop should complete their works course on the 30th June 1896, while the batches which left the college in December 1895 should proceed at once to works and complete the course on the 31st December 1896. The former batches consisted of two Engineers and 17 Engineer Subordinates, and the latter of six Engineers and 15 Engineer Subordinates. The whole of these with the exception of one Engineer Subordinate (who was absent through sickness upwards of two months) completed their course during the year under review. The two junior batches were transferred to Madras in two sections for their equitation course at the Body Guard school. One Engineer Subordinate student, who left the college in December 1894, was permitted to go through a special course in the college workshops. He will be transferred to works in February 1897.

The progress reports, so far as they have been received from Executive Engineers, are almost without exception favourable.

Six Engineer and 15 Engineer Subordinate students will join the works course early in 1897. The distribution to Public Works Circles was notified before the Christmas holidays, so as to avoid delay in the commencement of the practical course. One Engineer student has elected to become a Mechanical Engineer, and will go through his practical course in the Madras Railway Locomotive shops.

6. *Military students.*—The total number of soldier students on the 31st December was six, viz., two on works and four in the Engineer Subordinate class. Two others completed their works course on 30th June. Owing to the reduction of the probationary course from one year to six months, no probationers were admitted during the year; but a competitive examination was held in November and a full class of five students will join the college at the commencement of 1897. A proposal that Military Upper Subordinates required for the Burma Public Works Department shall be obtained from this college has been approved by Government and forwarded to the Government of India.

7. *Government Technical Examinations.*—Eighteen candidates appeared voluntarily for the Government Technical examinations in various engineering subjects. Of these 12 passed in one or more subjects, and six failed. Details will be found in appendix D.

8. *Surveying.*—During February the whole of the Engineer, Engineer Subordinate and Surveyor classes, comprising 109 students, were encamped at and near Avadi for sixteen days' continuous survey work. The students worked from day-light until about 11 A.M. in the field and from 3 to 6 P.M. at plotting. In July the same classes, comprising 136 students, proceeded to Poonamallee and Avadi for a similar period. The larger camp at Avadi was in charge of the Instructor in Surveying and Drawing and the smaller at Poonamallee in that of the Instructor in Engineering. Six students of the Draftsman class were attached to the latter in order to assist in the project assigned to the Engineer students. Satisfactory work was done during both periods. My thanks are due to the Commandant, Queen's Depot, Poonamallee, who provided a large barrack room as a drawing office, and to the Executive Engineer, Military Works department, who placed a bungalow at Avadi at my disposal for a similar purpose. Thanks are also due to the Inspector-General of Ordnance for the supply of tents to supplement those belonging to the college. The total cost of the two camps was Rs. 1,192.

9. *Inspections of works.*—In addition to the usual inspections of buildings, bridges and factories, a tour was made by 85 students of the Engineer, Engineer Subordinate and Draftsman classes to the Redhills Tank System. The tour extended over five days, and the principal masonry works in the tank, the supply channel and head works were measured up. The cost of the inspection was Rs. 175.

10. *Workshops.*—The workshops were attended by the Engineer and Engineer Subordinate students, who participated in the various work executed. An iron lathe

was completed and a 1-h.p. engine commenced; sundry tools were made; moulding and brass casting were practised; benches, almirahs, drawing-tables and drawing-boards were constructed, and various repairs undertaken. The Instructor reports that the students have displayed more interest in their work than heretofore, and that a great improvement in the style of work is noticeable. The 100-ton testing machine was erected by the Workshop Instructor Mr Perkins under the supervision of the Professor of Engineering, and a series of tests, in which the Engineer students assisted, was carried out by Mr. Chatterton on timber, cement, concrete, stone, iron and steel specimens. A number of rails were tested for the Madras and South Indian Railway Companies, and it appears that considerable use is likely to be made of the testing machine by the public. My thanks are due to the officer in charge of the Arsenal for the loan of the hoisting appliances used in the erection of the machine.

During the year, a small planing machine was added to the stock of machine tools. A plan and estimate for extending the workshop on the south side was prepared by the Consulting Architect and submitted to Government. The cost is estimated at Rs. 8,636.

A scheme for training apprentices in the workshops with the view of fitting them to become teachers in technical schools was drawn up and approved.

11. *Revision of Rules.*—The development of the Surveyor class into a class for the training of Lower Subordinates for the Public Works Department and other services, which was recommended by Mr. West's Committee in March 1895, was sanctioned, and the new scheme of instruction was brought into force during 1896 in regard to the second division of the Surveyor class. The instruction in surveying remains much as before, but building construction, drawing and estimating are added to the course. Considering that the new system was introduced only in the second half of the year, the results attained by the junior division of the class in the late term examination are very creditable. The class will be a popular one, judging from the large number of applications for the admission examination of December last.

Sanction was at the same time accorded to the revision of the syllabuses proposed by the Committee above mentioned. The general features of the revision are the reduction, with the view of affording more time for practical work, of the book-work portions of the Engineer class and Engineer Subordinate class curricula, and the addition of certain branches to the Sub-overseer and Surveyor class, and Draftsman class curricula in order to render the instruction given more complete. The new syllabuses were at once taken up by all class divisions except the senior division of each class, so that the recent final examination is the last under the old syllabuses. One important point raised was the question of retaining the marks awarded by the college as a credit in the final examination totals. It was pointed out that the system served to encourage practical work, to test points which are not of a nature to be readily gauged by ordinary examinations and to create a constant incentive to work throughout the year. It was also brought to notice that the practice prevails in the other Indian Engineering colleges, as well as at Cooper's Hill, the City and Guilds of London Technical Institute and other important colleges in England. It was ultimately decided that the system should continue in force in all classes except the Draftsman class. Every effort will be made to exact the full quota of practical work from this class, notwithstanding the lack of incentive, and the matter will be reported on specially after sufficient time has elapsed to enable judgment to be formed of the effect of the change.

Independent candidates for the college certificate examinations have hitherto been persons who have at some period gone through a full course. At the instance of Colonel Pennyuck, the experiment is now to be tried of admitting other persons to the examinations for Draftsman certificates to be held in 1897 and 1898. It is not expected that the concession will be largely made use of.

Revision of the college rules, embracing the changes in the syllabuses as well as many other points, was also undertaken, and a draft code submitted. Sanction, however, had not been accorded by the close of the year, so that we are now in the rather anomalous position involved by working on a system which is not in accord with the published rules.

12. *Physical training and recreation.*—Compulsory instruction in gymnastics and drill was given as usual to all classes except the Artisan class. An improvement in the drill was observed. The concession of allowing deficiency of marks for physical

exercises up to a maximum of 25 per cent. to be made good in the case of students who regularly attend cricket practices, was extended this year to foot-ball. The latter is the more popular game, and several matches with other colleges and clubs were played. Cricket is regularly practised and the college took part in the inter-collegiate competition, but gained little success. Tennis continues to be played by a few students. The recreation ground is in good order, and the funds of the recreation club are in a satisfactory state. The athletic sports, which were to have taken place in November, fell through on account of the abnormally protracted rainfall of that month.

A former student of the College, M.R.Ry. S. A. Jagadisa Aiyar, B.A., Assistant Engineer, Public Works Department, kindly placed a sum of Rs. 33 at the disposal of the recreation club for prizes in sports. One of the prizes, a cricket bat, falls to T. Ramachendra Rau of the Engineer class, who made the best batting average among native students in the inter-collegiate competitions.

13. *Library.*—During the year, 184 books were added to the library, which now contains 3,409 volumes. The books issued to the students numbered 2,630, and to the staff 675 against 2,396 and 463, respectively, in the previous year, while 1,156 references were made to the consulting library. The new catalogue which was under preparation in 1895 was completed and published during the year.

14. *Buildings.*—The allotment of Rs. 17,000 which was made in the Public Works budget for 1895-96 was not utilized, and no addition was made to the accommodation during the year. The pressing need of additional space has, however, been again pointed out, and a plan and estimate drawn up by the Consulting Architect have been submitted. Provision has been made for one additional class room, two lecture rooms, a library and reading-room, and for a verandah along the west front of the old portion of the building. The total cost is estimated at Rs. 41,900.

15. *Attendance and conduct.*—The percentage of numbers present to numbers on the rolls was 94.4 for the Engineer and Engineer Subordinate classes, and 92.6 for the junior classes. The attendance by class divisions is given in appendix E. The conduct of the students has been satisfactory throughout the year.

16. *University examinations.*—Six candidates appeared for the B.E. degree examination of 1896, and four were successful in the Civil Branch. All were third-year students of the Engineer class. Eight candidates presented themselves for the first examination in Engineering and six passed. Of the latter, five were second-year students of the Engineer class, while the sixth was a third-year student. Of the two who failed, one was a second-year man and the other an ex-student.

17. *Financial details.*—The approximate total expenditure for the calendar year 1896 amounted to Rs. 66,290, and the income from fees, &c., to Rs. 14,590. Detailed statements of receipts and charges are given in appendix F. It should be noted that the figures for different years cannot be compared since large items for stores debited to a particular official year may appear in either of two calendar years. Full and accurate financial details are furnished with my annual returns for the official year. The average daily attendance throughout the year was 205, so that the net cost to Government of educating each student was Rs. 252.

18. *Educational Rules.*—The provisions of the Educational Rules have been carried out so far as the special constitution of the college will admit, except in regard to accommodation, which, as elsewhere reported, is insufficient. Academic costume has been worn by graduate professors and assistants not engaged in practical work.

19. *Employment of passed students of 1895 and 1896.*—Of the three Engineer students who completed their practical course on 31st December 1895, the senior R. N. Arokyaswami Mudaliyar, B.A., B.C.E., was appointed Assistant Engineer in the Public Works Department, and the other two accepted posts as temporary Upper Subordinates.

Of the two who completed their course on 30th June 1896, the senior S. A. Jagadisa Aiyar, B.A., was appointed an Assistant Engineer in the Public Works Department, while the other accepted employment under the Travancore Government. Of the 26 Engineer Subordinates who qualified for diplomas in December 1895, seven were appointed to the permanent and twelve to the temporary Upper Subordinate

establishment of the Public Works Department; four joined the permanent Lower Subordinate establishment; two were appointed to the Travancore Public Works Department; and one entered the Salt Department.

Of the 17 Engineer Subordinates who completed their practical course on the 30th June 1896, four were appointed to the permanent and seven to the temporary Upper Subordinate establishment of the Public Works Department; five joined the Lower Subordinate establishment, and one took service under a local board.

Of the 20 Draftsmen who passed out in December 1895, all but one are known to have been in employment during 1896 in the Public Works Department, Railways or Local Fund service; but six were unemployed towards the close of the year.

Of the 16 Surveyors who qualified in December 1895, all but four are known to have obtained employment on salaries ranging from Rs. 50 to Rs. 70. The Public Works Department, the Railways and the Revenue Department absorbed the majority.

It will be seen from the above figures that, notwithstanding the supply this year of an unusual number of Engineers and Engineer Subordinates, there has been no difficulty in securing employment.

20. *Prospects of employment.*—I regard the prospects of employment in the immediate future as good. Owing to double batches of Engineers and Engineer Subordinates leaving the college during the year, difficulty has been experienced in fulfilling the expectations of the students in regard to permanent appointments. Special sanction was obtained to the appointment of the senior engineer student of the batch of June 1896 as Assistant Engineer, and the senior student of the batch of December 1896 will be appointed to the provincial service as Apprentice Engineer under the new rules introduced by the Government of India. The permanent appointments of civilian Engineer Subordinates were two and three, respectively, in the senior and junior batches; but it is understood that the remaining students who were led to expect such appointments will be provided for as vacancies occur. This course will doubtless affect, to some extent, the prospects of subsequent batches.

At this moment there is a very large demand for temporary upper subordinates for Famine Relief work, and it is not improbable that a large proportion of the Engineers, Engineer Subordinates, Draftsmen and Surveyors of December 1896 will be absorbed by the Public Works Department.

The vacancies notified during the year in the Gazette, the public press, and by letter to the Principal, were one hundred and sixteen in number, of which sixty-eight were under Government, nineteen under local boards and municipalities, nine on railways, fifteen under Native States and five under private employers. Fourteen of the vacancies were for Engineers and Assistants, four for Supervisors, twenty-eight for Overseers, eleven for Sub-Overseers, twenty-one for Draftsmen, twenty-six for Surveyors, and nine for maistries, while three were of a miscellaneous character. Seven of the appointments carried salaries of Rs. 200 and upwards, fifteen between Rs. 100 and Rs. 200, thirty-six between Rs. 50 and Rs. 100, and fifty-eight under Rs. 50. Particulars are given in Appendix G.

21. *General.*—My thanks are due to the President of the Board of Examiners, Mr. Ashpitel, for the promptness and consideration he has displayed in the supply of the examination results. I also acknowledge the co-operation of the Professor of Engineering, Mr. Chatterton, and the Acting Professor of Mathematics, M.R.Ry. B. Hanumantha Rau, in the work of the College, as well as the willing aid rendered by the majority of the members of the junior staff. Special acknowledgment of the good work done by the Instructor in Surveying and Drawing, Sergeant Goddard, and the Instructor in Engineering, Sergeant Reynolds, is also made. Sergeant Goddard is steadily improving the style and accuracy of the survey work turned out. Sergeant Reynolds has, in addition to his regular duties, which have been carried out with energy and ability, been engaged in the preparation of a new series of pattern estimates, and of drawings for estimating purposes; and he has also compiled, for the use of the college, a Manual of Irrigation Works adapted from General Mullins' "Irrigation Manual" with the kind permission of the author. General Mullins has always taken a deep interest in this institution—an interest undiminished by retirement from active service in India—and I take this opportunity of publicly thanking him for the generous assistance which he has now rendered.

APPENDIX A.

DISTRIBUTION of students by wealth and occupations of parents on the 31st December 1896.

Classes in college.	Wealth.				Occupations.								
	Richer classes.	Middle classes.	Poorer classes.	Total.	Officials.	Petty officials.	Traders.	Landholders.	Artisans.	Coolies including agricultural labourers.	Mendicants.	Others.	Total.
Engineer class—													
I		2	4	6	2	1	..	3	..	..	..	..	6
II		6	..	6	3	..	..	3	..	..	..	..	6
III		7	..	7	1	..	..	6	..	..	..	..	7
Engineer Subordinate class—													
I	1	17	..	18	3	..	1	13	..	..	..	1	18
II		19	2	21	5	1	..	13	..	..	..	2	21
III		29	..	29	9	3	..	15	..	..	..	2	29
Draftsman class—													
I		25	..	25	17	1	1	5	1	..	..	..	25
II		26	4	30	14	3	1	12	..	..	..	..	30
Surveyor class—													
I	1	19	1	21	10	..	..	11	..	..	..	..	21
II		24	1	25	11	..	..	14	..	..	..	..	25
Artisan class		32	5	37	30	3	1	2	1	..	..	..	37
Total	2	206	17	225	105	12	4	97	2	..	..	5	225

APPENDIX B.

DISTRIBUTION of students by districts on the 31st December 1896.

Districts.	Engineer classes.	Engineer Subordinate class.	Draftsman class.	Surveyor class.	Artisan class.	Total.
Ganjám	..	..	1	1	..	2
Vizagapatam	..	..	..	1	1	2
Górávari	1	..	1	3	..	5
Kistna	..	..	2	..	..	2
Nellore	..	3	..	2	..	5
Bellary	..	..	..	..	3	3
Madras	..	2	9	3	14	28
Chingleput	..	..	2	1	3	6
North Arcot	..	..	4	1	2	7
South Arcot	..	2	5	2	..	9
Tanjore	5	28	11	14	6	64
Trichinopoly	2	4	10	7	1	24
Madura	2	4	..	2	..	8
Tinnevely	..	6	..	4	1	11
Coimbatore	1	3	3	2	4	13
Nilgiris	..	..	..	1	..	1
Salem	..	1	2	1	..	4
South Canara	..	2	3	..	..	5
Malabar	..	3	..	..	..	3
Mysore	7	..	1	..	1	9
Travancore	1	2	..	..	1	4
Cochin	..	..	1	..	..	1
Pondicherry	..	..	..	1	..	1
Pudukottai	..	2	..	..	..	2
Ceylon	..	1	..	..	..	1
Military students	..	5	..	..	..	5
Total	19	68	55	46	37	225

APPENDIX C.

DISTRIBUTION of students according to classes of the community on 31st December 1896.

Classes.	Europeans and Eurasians.	Native Christians.	Muhammadans.	Hindus.				Aborigines.	Others.	Total.
				Brahmans.	Non-Brahman Caste Hindus.	Pariahs.	Other low castes.			
Engineer classes	..	..	..	18	1	..	..	..	..	19
Engineer Subordinate classes	5	1	..	57	4	..	1	..	..	68
Draftsman classes	1	..	..	32	22	..	..	..	..	55
Surveyor class	1	..	3	35	7	..	..	..	..	46
Maistry and Artisan class	..	2	1	5	29	..	..	..	..	37
Total ..	7	3	4	147	63	..	1	..	..	225

APPENDIX D.

GOVERNMENT Technical Examinations of 1896.

Subject.	Grade.	Number examined.	Number passed.	
			First class.	Second class.
Building Materials and Construction	Elementary	8	1	1
	Intermediate	2	..	2
Building Drawing and Estimating	Elementary	3	..	1
	Intermediate	3	1	1
Earthwork and Road Making	Elementary	7	..	6
	Intermediate	1	1	..
Surveying and Levelling	Advanced	1	..	1
	Intermediate	3	..	2
Applied Mechanics	Elementary	7	..	..
Mensuration	Intermediate	3	..	1
Machine Construction	Do.	2	..	1
Machine Drawing	Do.	1	..	..
Steam and Steam Engine	Elementary	2	..	2
Fitter's work		..	..	..
Total ..	..	44	3	19

APPENDIX E.

Average attendance throughout 1896.

	Average number on rolls.	Average daily attendance.
College department—		
Engineer class, first (senior) division	6.0	5.6
Do. second division	6.0	5.8
Do. third do.	7.0	6.5
Engineer Subordinate class, first division	18.7	17.6
Do. do. second do.	21.1	19.6
* Do. do. third do.	17.7	17.1
† Military probationers	0.8	0.8
	77.3	73.0
School department—		
Draftsman class, first (senior) division	25.7	23.5
Do. second division	31.4	28.8
Surveyor class, first division	21.1	19.8
Do. second do.	25.9	24.5
Maistry and Artisan class	38.6	35.6
	142.7	132.2
Total college and school departments ..	220.0	205.2
Percentage of numbers present to numbers on the rolls—		
College department	..	94.4
School department	..	92.6

* This division joined in July.

† The probationers were absorbed in July.

APPENDIX F.

Financial Details for 1896.

Receipts—		RS.	A.	P.
Tuition fees	..	10,398	0	0
Entrance and final examination fees	..	3,340	0	0
Fines and other receipts	..	851	13	8
Total ..	..	14,589	13	8

Charges—		RS.	A.	P.
Principal	..	14,890	8	0
Professors, masters and teachers	..	27,845	2	7
Clerks, librarian and servants	..	3,300	14	8
Board of Examiners	..	4,500	0	0
Library and prize allowances	..	557	3	0
Books and instruments	..	596	14	9
Other Europe stores	..	2,654	11	2
Miscellaneous	..	4,555	15	2
Travelling allowances	..	412	13	6
Scholarships	..	2,700	12	6
Exchange compensation allowances	..	4,273	2	4
Total ..	..	66,288	1	8

		RS.
Net cost to Government	..	51,698
Average attendance throughout the year	..	205
Net cost per student	..	252

From F. W. ASHPITEL, Esq., President of the Board of Examiners, College of Engineering, to the Director of Public Instruction, dated 28th January 1897.

I have the honour to forward herewith the report on the Civil Engineering College Examinations for 1896, together with the reports of the individual Examiners. The mark sheets have been handed over to the Principal of the college.

2. I also enclose remuneration bills amounting to Rs. 3,956-4-0 as noted below:—

	RS.	A.	P.
F. W. Ashpittel, Esq.	1,294	0	0
C. T. R. Scovell, Esq.	1,141	4	0
A. Moffat, Esq.	918	0	0
Rao Bahadur V. Krishnama Chary	210	0	0
C. E. Phipps, Esq.	393	0	0
Total ..	3,956	4	0

Rupees three thousand nine hundred and fifty-six and annas four only.

Report on the examinations held at the College of Engineering, Madras, in December 1896.

Engineer Classes—Percentage of marks obtained.

	E I.	E II.	E III.	Average, 1890—95.
Mathematics	60	68	64	63
Science	46	43	..	50
Engineering	48	49	74	63
Drawing	53	42	45	67
Surveying	64	66	52	67
Language	53	..	..	55
Drills and Exercises	77	..	..	70
Total ..	54	54	60	62

In the first division, six college students and one independent candidate were examined. The college students all passed, but the independent candidate failed to secure the required total number of marks. The percentage of marks obtained is the same as last year but considerably below the average, the principal failures being in engineering and drawing. The class was, in fact, below the average in every subject in which they were examined by the board and three out of the six candidates only just succeeded in qualifying. In engineering only one student and in building drawing no student obtained half marks.

In the second division, six college students were examined and, with the exception of mathematics, the percentage of marks obtained was below the average. In engineering, there was a general failure in building construction, for which there is no excuse seeing that there is a text-book available if the students will only study it. In building drawing no student obtained half marks.

In the third division, seven college students presented themselves for examination, and the class is considerably better than the other divisions. In engineering and mathematics the percentage of marks obtained is above the average and the percentage on the total marks obtained is practically up to the average. The failure is in drawing in which it will be observed that all the divisions of the Engineer class are bad.

Engineer Subordinate classes.—Percentage of marks obtained.

	Es I.	Es II.	Es III.	Average, 1890—95.
Mathematics	58	61	..	49
Engineering	50	53	..	49
Drawing	48	50	..	56
Surveying	61	56	..	57
Language	45	..	..	46
Drills and Exercises	82	..	..	71
Total	54	56	54	54

In the first division, the class is apparently up to the average, but the average is not very high. In mathematics, engineering and surveying the percentage of marks obtained is above, but in drawing considerably below the average. In the division 18 college students and five independent candidates were examined, of whom four college students and four independent candidates failed to qualify.

In the second division, 21 college students were examined and the percentage of marks obtained is above the average in mathematics and engineering, up to the average in surveying and below the average in drawing. The general result of the examination is good and the class should do very well.

In the third division, 29 college students were examined, but the papers were few in number. The class appears to be up to the average, and several students did remarkably well.

Draftsman Class.—Percentage of marks obtained.

	D I	D II	Average, 1890—95.
Practical Geometry	66	..	62
Free-hand and Model Drawing	53	..	56
Building Drawing	50	..	57
Machine	54	..	56
Estimating	35	..	48
Topographical Drawing	54	..	51
Drills and Exercises	68	..	67
Total	51	43	56

In the first division, 24 college students presented themselves for examination, of whom 13 failed; of 18 independent candidates, 11 failed. The principal failure is in estimating, in which no less than 11 students failed to qualify—a result which, it should be observed, is as much due to college marks as to the Board's examination. The results being so very unsatisfactory, the President of the Board called for the mark sheets and the whole of the papers were re-examined, but it was not found possible to materially modify the original result. The class was up to the average in other subjects and two college students and two independent candidates obtain second-class certificates. The work done by the class in estimating during the college course was also examined by the board and the failure does not appear to be attributable to any want of attention to this subject. It is suggested, however, that the Consulting Engineer for Railways, the Chief Engineer, Madras-Bezwada Railway, and the Irrigation office should be asked to supply the college with some of the more recent designs and estimates for bridges and irrigation works, as the selection available at the college, though much improved during recent years, is still somewhat deficient.

In the second division, the students were only examined in geometrical and free-hand drawing and two students did exceptionally well.

Surveyor Class.—Percentage of marks obtained.

	S I. 1896.	Average, 1890—95.
Chain Compass and Plane Table	57	57
Levelling	56	62
Theodolite Survey	41	57
Topographical Drawing	53	56
Drills and Exercises	78	67
Total	55	59

In the first division, twenty college students and fifteen independent candidates were examined, of whom three college students and five independent candidates failed. The class is below the average in all subjects in which they were examined, though slightly better than last year.

Sub-Overseer and Surveyor class.—Though the actual percentage of marks obtained by this class is not high the result of the examination is, in the opinion of the board, most satisfactory. Several students did extremely well and only six out of 25 failed to obtain half marks, of whom only one seems to be likely to fail eventually. Taking into consideration the educational qualifications of the students the way in which they answered the papers was remarkably good and appears to reflect great credit on the instructors. The class is a new one, and it is believed had not the full time for preparation owing to the introduction of the new syllabus late in the year. The only suggestion that the board have to make is that the students should, in future, be instructed not to attempt to learn by heart the chemistry of building materials which they cannot possibly understand, but to confine their attention to the practical parts of the text-book. The text-book on building materials and construction requires, in fact, to be marked, so as to indicate to students which parts they are expected to study.

General Remarks.—With the exception of estimating in the draftsman class and drawing and engineering in the Engineer and Engineer Subordinate classes, the board are of opinion that the results of the examination may be considered to be fairly satisfactory. The reduction in the percentage of marks obtained is largely due to the strictness with which college marks are awarded as inspection of the mark sheets will show.

Read the following endorsement from the Director of Public Instruction, No. 854, dated 29th January 1897:—

Referred to the Principal, College of Engineering, Madras, for favour of remarks, if any, and scrutiny of the remuneration bills of the members of the Board of Examiners.

Read the following letter from the Principal, College of Engineering, to the Director of Public Instruction, No. 1697-C, dated 15th February 1897:—

Referring to your endorsement No. 854, dated 29th January 1897, on file from the President, Board of Examiners, herewith returned, I have the honour to offer the following remarks.

2. The mark sheets mentioned in the first paragraph of Mr. Ashpitel's covering letter were forwarded to you with my annual report No. 1613-C, dated 30th January 1897.

3. Under "Engineer classes" in the body of the report the word "failures" is misleading, seeing that all the students of the senior division passed the final examinations. The average percentage of the division was 48 in engineering and 53 in drawing.

4. The President observes that the results were not good in engineering and building drawing in the senior division of the Engineer class. It should be noted that, while Engineering is a main head, building drawing is only a sub-head of the main head Drawing, the percentage in which was 53.

5. The percentages for the second division of the Engineer class are those of the results of two term examinations, those of 1895 and 1896. A similar remark applies to the percentages given under the second division of the Engineer Subordinate class.

6. The President considers that the existence of a recognised text-book in a subject leaves no excuse for failure in that subject. I fear that something more than text-books is needed to enable students to pass examinations.

7. The want of success in estimating in the Draftsman class is commented on in my Annual report, paragraph 4 (c), and certain facts are adduced which tend to show that the paper set offered unusual difficulties to the candidates. The President admits that the failures are not attributable to want of attention to the subject in the college.

8. Throughout his report the President compares the results of 1896 with those of the preceding five years. In my Annual report, I take, as usual, the preceding four years.

Proceedings No. 5145 of 1897.

The Principal's report deals with the working of the college during the past calendar year. But for facility of preparation of the quinquennial report ordered by the Government of India, statistics for the past five years have been incorporated in this review. In his future reports the Principal should adopt the designations given to the several classes in the Madras Educational Rules.

2. *Staff.*—The only change of importance was the appointment of Mr. H. T. Keeling as Acting Professor of Engineering during the absence on furlough of Mr. A. Chatterton, the permanent incumbent. Several minor changes also took place in the subordinate staff and in the clerical establishment. The Director is not quite convinced as to the necessity for a fourth clerk for the college. Indeed in no institution is the clerical establishment so strong as in this college. It appears to the Director that the work of the clerks needs re-distribution, the head clerk being entrusted with all cash transactions and the storekeeper and librarian with the charge of books and stores and instruments. The difficulty might be got over by placing the clerical establishment under the immediate supervision of some senior instructor of the college as has been the practice in the Medical College, where, it is believed, the correspondence work is as heavy as, if not heavier than, in the College of Engineering. This arrangement would relieve the Principal from much routine work and enable him to devote more time than at present, viz., $4\frac{1}{2}$ hours a week, to instruction in connection with the Engineer classes, which did not, in certain important subjects, do as well as might have been expected, at the last final examination conducted by the Board of Examiners.

3. *Accommodation.*—The necessity for additional accommodation has been admitted by Government, which has approved the extension at present of the ground floor of the college and accordingly called for revised plans and estimates.

4. *Library and reading-room.*—A more satisfactory use was made of the library during the year. No reference has been made in the report to the working of the reading-room maintained by the college recreation club.

5. *Workshops.*—The workshop fittings have now been completed, and the usefulness of the workshops has been enhanced by the provision of the 100-ton Testing Machine. The students have of late been receiving ample practice in the workshop, and they are therefore sent to works divisions only during their practical course, excepting students who desire to become mechanical engineers. The scheme for the training in the workshops of apprentices already possessing some technical qualification has met with the general approval of Government, and the Director trusts that schools in the mofussil teaching mechanical engineering subjects will, in the course of a few years, be supplied with trained teachers from the college.

6. *Strength and attendance.*—In the following statement the strength of each class of the college for the past five years is compared:—

Class.	Strength on the 31st December					Remarks.
	1892.	1893.	1894.	1895.	1896.	
Engineer	10	14	17	19	19	This statement excludes the number of students undergoing the practical course.
Engineer Subordinate	77	81	76	63	63	
Do. Military probationers	5	2	3	2	5	
Draftsman	51	67	73	64	55	
Sub-Overseer and Surveyor	37	50	57	48	46	
Artisan class	34	38	39	35	37	
Special students	3	..	..	..	..	
Total ..	217	252	265	231	225	

It is observed that the strength on the 31st December 1896 was the lowest in the quinquennium, the year 1892 excepted, though it very nearly approached that of 1895. The fall is due chiefly to the causes explained by the Principal and also partly to the strictness with which the entrance tests are conducted. The gradual increase, however, in the strength of the Engineer class is encouraging, and a further increase is expected. From paragraph 6 of the Principal's report it is noted that there were four military students receiving theoretical instruction, whereas Appendix B gives the corresponding figure as five. This discrepancy needs to be explained. The average number on the rolls and the average daily attendance were fairly satisfactory, namely, 220.0 and 205.2, respectively. All the districts with the exception of Kurnool, Cuddapah and Anantapur were represented, and Tanjore and Madras changed places during the year, the former district being far ahead of the latter as regards the number of students supplied. The richer and middle classes contributed 92 per cent., and Brahmans and non-Brahman caste Hindus 65 and 28 per cent., respectively, of the total strength. What is even more noteworthy is that 18 out of 19 Engineers and 57 out of 68 Engineer Subordinates were Brahmans. Muhammadans numbered four only, and they were found in the Surveyor and Artisan classes; nor was the Native Christian element suitably represented. The concession of half fees granted in favour of Muhammadans and the reservation of a few scholarships awarded in the college for this class preferentially in the new rules now before Government will, the Director trusts, induce a larger number of Muhammadan youths to seek instruction in Engineering. Turning to the occupation of parents it is observed that the majority of the students were the sons of officials and landholders and that the artisan element was very poorly represented, the number in the whole college being two while that in the Artisan class was only one. This is very disappointing indeed.

7. *Examinations.*—(i) *University examinations.*—The last quinquennium was remarkable for the institution of separate engineering degrees in the civil and mechanical

Year.	B.C.E. or B.E. degree.		First examination in Engineering.	
	Ex-aminated.	Passed.	Ex-aminated.	Passed.
1892	5	4	..	..
1893	4	3	..	..
1894	3	3	..	..
1895	2	2	9	7
1896	6	4	8	6
Total ..	20	16	17	13

branches and for the bifurcation of the examination for the engineering degree into the first examination in Engineering and the Bachelor of Engineering degree (or the final) examination. This bifurcation was given effect to in January 1895. The results of the University examinations for five years are recorded in the margin. Since January 1892, 20 students of the college had appeared for the degree examination in Engineering and 16 of them had met with success. These results are satisfactory. Twenty-one independent

candidates also presented themselves for the above examination and seven were successful. The college acquitted itself fairly satisfactorily both in the First and in the Degree examinations of January 1896.

(ii) *College Board examinations.*—The following summary furnishes the results of the final examinations conducted by the college board during the past five years :—

Class.	Number presented.					Number passed.				
	1892.	1893.	1894.	1895.	1896.	1892.	1893.	1894.	1895.	1896.
Engineer	4	2	2	7	6	4	2	2	6	6
Engineer Subordinate	18	26	31	21	18	13	24	19	15	14
Surveyor	18	18	25	22	20	16	12	20	16	17
Draftsman	24	26	34	28	24	18	21	10	20	11

The results of 1896 compared favourably with those of the year previous except in the case of the Draftsman class in which there was a large number of failures. On the manner in which each class acquitted itself at the examinations conducted by the Board in December 1896 the Director would remark :

Engineer class.—This class was much below the average, the percentages of marks obtained in several important subjects not approximating the average of the previous four years. All the three divisions exhibited weakness in drawing, and the first and second divisions in engineering and in building construction, respectively.

The Principal points out that the term “failures” used by the Board of Examiners in connection with the first division of the Engineer class is misleading as all the six students presented for the final examination were declared to have passed. Presumably the Board’s remark refers to the results of the examination conducted by the Board irrespective of the college or session marks. The President is requested to be good enough to state whether this presumption is correct.

Engineer Subordinate class.—The class was up to the average in all the subjects except drawing, which should consequently receive greater attention. The poor results in drawing obtained by the Engineer and Engineer Subordinate classes justify the inclusion in the revised rules before Government of the subject in the entrance tests for admission to the above classes.

Draftsman class.—This class fared badly at the final examination, the chief failures being in estimating. The Principal is of opinion that the unsatisfactory results were due to the unusual difficulty which the paper on estimating presented to the candidates and not to any want of attention to the subject. Building-drawing, however, does not appear to have received sufficient attention. As suggested by the Board of Examiners, the Principal is requested to arrange to procure for the college a few recent designs and estimates for bridges and irrigation works.

Sub-overseer and Surveyor class.—The Senior division of this class acquitted itself creditably at the final examination and the Junior division also did well at the term examination. The attention of the instructors should be drawn to the Board’s suggestion that the students should be taught to devote their attention to the practical parts of the text book on building materials and construction.

The remarks of the examiner in the vernaculars should be commended to the vernacular assistants. A large number of students, especially of the Engineer and Engineer Subordinate classes, are stated not to have numbered their answer papers. The omission should be guarded against.

(iii) *Government technical examinations.*—From the particulars furnished in Appendix D to the report, it is observed that 44 single subject candidates appeared voluntarily for the Government technical examinations and that 22, or 50 per cent. passed. The results in building materials and construction (Elementary), building-drawing and estimating (Elementary), mensuration (Elementary) and machine construction (Intermediate) were decidedly poor. Information should be given in future reports as to the classes to which candidates for the Government technical examinations severally belonged.

8. *Independent candidates.*—The results obtained by the independent candidates at the final examinations held in December were poor excepting as regards surveyor candidates, as may be seen from the figures in the margin. It is hoped that the draftsman candidates will fare better in future as their success is to be determined purely by the marks gained at the examination conducted by the Board.

Description.	Number examined.	Number passed.
Engineer candidates	1	..
Do. Subordinate candidates	5	1
Draftsman candidates	18	7
Surveyor do.	15	8

9. *Military students.*—Including the students in their practical course the total number of soldier students on the rolls on the 31st December last were six as against eleven in the year previous, the decrease being due to the non-admission of any probationers during the year. The success obtained by the soldier students at the examinations held by the Board of Examiners and at the Government technical examinations has again not been noted. The Government of India has decided that five military candidates may annually be admitted into the college. It has also been ruled that the probationary course for these students should be reduced from twelve to six months until 1898 and that it be entirely abolished thereafter, the same entrance examination being prescribed for civil and soldier candidates.

10. *Practical courses.*—The reduction in the length of the practical course from two years to one in the case of Engineer and Engineer Subordinates was carried out during the year under report. As the students will in future be chiefly engaged on works during their practical course the Madras University has made the necessary modification in its by-laws relating to the B.E. degree Examination. The conduct of the students during their practical course was uniformly satisfactory.

11. *Physical education.*—Judged from the results shown in drill, &c., at the college examinations, the physical training of the students seems to have received increased attention.

12. *Employment of former students.*—The Director is glad to note that as usual the students of the last set found little difficulty in securing employment. During the past five years various concessions have been granted to the students of the college, and their prospects have in consequence been improved. The disability under which the Engineer students had long suffered of being shut out from appointments on the upper subordinate ranks of the Public Works Department has been removed. From and after 1st January 1897 training in this college, or such approved service as the Governor in Council may consider equivalent thereto, has been made a qualification for Public Works appointments under district boards and municipalities carrying salaries of Rs. 100 and upwards, whilst preference should generally be given to men so trained. The Bengal Government has declared that under certain circumstances graduates in Engineering from the Madras College are eligible for appointments to the Public Works Upper Subordinate establishment in Bengal. Draftsmen holding lower class certificates have been allowed to be promoted to the higher grades for approved service and exceptional merit. It has been decided to make the award of the guaranteed apprentice Engineership at the termination of the theoretical course instead of after the completion of the practical course as originally contemplated. The selection of an apprentice Engineer in alternate years from the upper subordinates of the Public Works Department is an additional inducement to the Engineer subordinates of the college. Lastly, the Government of India has recently accepted the recommendation of the local Government that recruits of Military Upper Subordinates for the Public Works Department in Burma be made in future from the College of Engineering, Madras, instead of from the Thomason Civil Engineering College, Roorkee, vide G.O., No. 828-W., dated 22nd March 1897, communicated in G.O., No. 203-E., dated 7th April 1897.

13. *Finance.*—The financial position of the college during the past four years can be glanced at from the subjoined summary. The figures relating to 1892 are not available :—

Year.	Fees and other receipts.	Total charges of the college, including scholarships but exclusive of outlay on workshop fittings, and on buildings.	Net cost of educating each student.
1893	Rs. 15,957	Rs. 67,070	Rs. 209
1894	13,817	67,407	223
1895	14,190	72,087	273
1896	14,590	66,230	252

The net cost of educating each student during the year was smaller than in 1895. The slight fall under fees proper was more than compensated for by the increase under fines and miscellaneous receipts. The decrease in charges is due chiefly to diminished expenditure on Europe stores and under exchange compensation allowance.

14. *Revision of syllabuses and rules.*—The most important event of the year was the revision of the college syllabus by a committee of experts, which, with certain modifications, received the sanction of Government in G.O., No. 444, Educational, dated 22nd July 1896. Major Love's report touches on the salient features of the revision, and the effect of the changes will be watched with interest. The rules of the college have also been thoroughly recast, the several alterations sanctioned by Government from time to time, chiefly as regards the institution of admission tests for the Draftsman and Surveyor classes, the reduction of the practical course, the institution of the equitation course, the development of the Surveyor into the Sub-overseer and Surveyor class, the altered conditions of the guaranteed appointment and the establishment of stipendiaryships in connection with the workshop being incorporated in the rules. It is hoped that the early sanction of Government will be accorded to the revised rules as the present rules have become obsolete in several respects.

15. *General.*—The administration of the college was on the whole fairly satisfactory and its working was creditable to the Principal, the Professors and the staff.

(A true Extract.)

(Signed) D. DUNCAN,
Director of Public Instruction.

To the Principal, College of Engineering.
" the Principals of other Government Colleges.
" the Inspectors of Schools.
" the Superintendent, School of Arts.

Copy to the President, Board of Examiners, College of Engineering.
" " Chief Engineer, Public Works Department, for information.
Copies to the Editors, *Indian Journal of Education*, and the *Educational Review*.
Copy to Government with covering letter.

ORDER—No. 541, Educational, dated 22nd September 1897.

The report on the working of the College of Engineering in 1896 and the review of it by the Director of Public Instruction call for the following remarks:—

(1) The fall in the strength of the students, which was considered to be merely temporary in the report of the previous year, continued during the year under review and is due chiefly to the decrease in the strength of the Draftsman class. The Principal attributes the fall to the non-admission of military probationers, but it is observed that the Director of Public Instruction in paragraph 6 of his review shows five as the number of such probationers on the 31st December 1896 as against two in the year

1895. The increase in the strength of the Engineer class from ten to nineteen during the last quinquennium is satisfactory. In the Engineer Subordinate class, there has been a gradual diminution in strength, which is to be regretted. There was no Muhammadan student in the Engineer, Engineer Subordinate and Draftsman classes, and there were only four in the other departments. In the whole college there were only two students belonging to the artizan class. The Government has recently allowed Muhammadan students in professional colleges to pay fees at half the prescribed rates and a few of the scholarships awarded in the College of Engineering have been reserved for Muhammadans. These concessions will, it is hoped, induce a larger number of Muhammadan students to take to the study of engineering.

(2) The results of the several University examinations, and of the examinations conducted by the College Board of Examiners are fairly satisfactory, except in the case of draftsman students. The Government notes with dissatisfaction that there should have been so large a number of failures in the subject of estimating among the students of the Draftsman class. The attention of the college authorities was drawn to this defect in the review of the report for 1894. It is not satisfactory to learn that the Board of Examiners found the whole Engineer class much below the average. The Principal will take steps to improve the instruction given in drawing. The teaching of the engineering subjects of the first division and of building construction should also be improved.

(3) The Government is glad to note that the double batches of Engineer and Engineer Subordinate students who completed their course during the year experienced no difficulty in finding employment. During the past five years, a considerable improvement has taken place in the prospects of the passed students of the college, which, the Government trusts, will increase the popularity of the institution greatly.

(4) Orders on the revised rules of the college will be passed in separate proceedings.

(5) In consequence of the decrease in the strength of the college, the receipts from fees declined, and notwithstanding this decline, the net cost of maintaining the college fell by Rs. 6,120. The net cost of educating each student fell from Rs. 273 in 1895 to Rs. 252 in the year under review, but it is still high. In 1893 the cost was only Rs. 209. The receipts from "fines and other receipts" rose from Rs. 242 to Rs. 852; to which particular item this large increase is due should be explained.

[Here enter letter, No. 542, Educational, dated 22nd September 1897.]

(True Extract.)

G. S. FORBES,
Secretary to Government.

To the Director of Public Instruction.
" Public Works Department.
" Local and Municipal Department.
" Deputy Adjutant-General, Madras Command.
Editors' Table.

Order thereon 2993 W 26-10-97
communicated to officers of the Public Works
Department for information.
(True Extract.)

Ed. A. F. Eccleston.

To
The Superintending Engineer
on Special duty.

Under Secretary.

Government {1897} of Madras.
EDUCATIONAL

Recd.

Regd.

} 1897.

Enclosures

Spare copies

G.O., No. 541, 22nd September 1897.

SEPTEMBER.

College of Engineering.

Reviewing the report on the working of the — during 1896; and forwarding copy of the
Proceedings to the Secretary of State.

GOVERNMENT OF MADRAS.

EDUCATIONAL DEPARTMENT.

Read—the following paper:—

From the Honourable Mr. D. DUNCAN, M.A., D.Sc., LL.D., Director of Public Instruction, to the Secretary to Government, Educational Department, dated Madras, 14th May 1897, No. 5299.

I have the honour to submit, for the information of Government, a copy of my Proceedings, No. 5145, dated 11th instant, reviewing the report on the working of the College of Engineering during the past calendar year.

ENCLOSURE.

PROCEEDINGS of the Director of Public Instruction, dated 11th May 1897, No. 5145.

Read the following letter from Major H. D. LOVE, R.E., Principal, College of Engineering, to the Director of Public Instruction, No. 1613-C., dated 30th January 1897:—

I have the honour to submit the following review of the working of the College of Engineering during the year 1896.

2. *Establishment.*—The only change which occurred in the establishment was that due to the departure on furlough of Mr. Chatterton, the Professor of Engineering, on 29th August. Mr. H. T. Keeling, Executive Engineer, Public Works Department, was appointed to act, but, owing to urgent duties connected with floods in the Kistna district, he was unable to join until the 24th December. In the interim, the more pressing portions of the Professor's duties were undertaken by the Principal, while instruction in the Chemical Laboratory was given by M.R.Ry. T. K. Hanumantha Rau, B.A., the Assistant Professor of Chemistry at the Presidency College. The Instructor in Gymnastics, Ghaus Khan, was transferred to the Kumbakonam College, his place being taken on 9th November by Mira Khan from that institution. The Workshop Instructor, Mr. Perkins, was absent on sick leave during October and November, his duties being carried on as far as possible by the Assistant Instructor Govindaswami Rau. The Librarian and Storekeeper, Shiva Rau, reverted to his permanent post of first assistant clerk and was relieved on 16th November by S. Parthasarathi Aiyangar, B.A., from the School of Arts. The work of taking over stock had not been completed at the close of the year. The insufficiency of the clerical establishment has been again brought to notice, but no adequate relief has been afforded. The special constitution of the college and its relation to the Public Works and Military departments involves work which is foreign to other educational institutions, especially in regard to the admission and final examinations, the practical courses, the system of students' deposits, the college workshop and stores, the soldier students and the assistance given to students towards securing employment. Financial transactions occur with nearly all the district treasuries, and the quarterly reconciliation of the accounts with those of the Accountant-General involves considerable labour. The offices of both the Head Clerk and the Librarian and Storekeeper are overworked, and not only is difficulty experienced in keeping abreast of current work, but the Principal is compelled to devote time which he can ill-spare from important duties to work which might be done by a superior clerk.

3. *Numbers.*—The numbers on the rolls at the end of the session were—

Class.	Practical course.	In College.			Total.
		First division.	Second division.	Third division.	
Engineer class	6	6	6	7	25
Engineer Subordinate class	16	18	21	29	84
Draftsman class	..	25	30	..	55
Surveyor class	..	21	25	..	46
Artisan class	..	..	..	..	37
Total	..	..	..	..	247

* Including one each who, for examination purposes, were classed as independent candidates.

Excluding the students going through the practical course on works, the total number actually in the college on the 31st December 1896 was 225. The corresponding totals for the four preceding years were 1895, 231; 1894, 265; 1893, 252; 1892, 217. The slight fall in the total numbers since 1895 is due to the non-admission of Military probationers and to the occurrence of a few casualties in the Draftsman class—items which could not be foreseen when the forecast for the year was made.

The distribution of the students by classes of the community, by districts of the Presidency, and by wealth and occupation of parents are given in appendices A, B and C. Among the most noteworthy features of the statistics are that 64 per cent. of the students are Brahmans, while no less than 28 per cent. came from a single district, Tanjore. Madras and the Chingleput district supply only 15 per cent. The numbers offering for admission were: Engineer classes 21, of whom 14 passed the entrance examination of December 1896; Engineer Subordinate class 85, of whom 78, viz., 14 F.A.'s and 64 Matriculates, qualified in April for admissions Sub-overseer and Surveyor class 92, of whom 59 qualified in December 1895; Draftsman class 59, of whom 36 qualified; Artisan class 113, of whom 45 were selected. It appears from these figures that the strength of the Engineer class is rising, that the new Sub-overseer and Surveyor class is likely to become a popular one, and that the remaining classes will be maintained at full strength during 1897.

4. *Examinations.*—The final and term examinations were conducted as usual by the Board of Examiners with Mr. Ashpitel as President. A brief abstract of the results is given below:—

(a) *Engineer class.*—The first division contained six third-year students, all of whom passed the final examination. Two independent candidates also presented themselves, of whom one withdrew and the other failed. The second and third divisions numbering six and seven, respectively, passed the usual term examinations.

(b) *Engineer Subordinate class.*—The senior division of 18 students appeared for the final examination and 14 were successful. Five independent candidates also appeared and one passed. The second and third divisions of 21 and 29, respectively, passed the usual term examinations.

(c) *Draftsman class.*—The senior division consisted of 24 students, of whom 11 qualified, viz., two in the second class and nine in the third class. This result cannot be regarded as satisfactory. As in 1894 the majority of the failures took place in Estimating. In 1895 special attention was given to this subject, with the result that, though improvement occurred in estimating, another subject, building drawing, was unfavourably criticised. During 1896 special attention was given to building drawing, and better results were obtained in the recent examination, but the standard in Estimating has not been maintained. Next year special attention will be given to both these subjects.

Eighteen independent candidates presented themselves, of whom seven passed, viz., two in the second class and five in the third class. Of the two second-class men, one already holds a certificate in that class. Of the five who have passed in the third class, one already holds a second-class certificate and the remainder hold third-class certificates. Three of the candidates who failed hold third-class certificates. The

majority of the failures occur in estimating. The facts recorded point to unusual difficulty experienced by the candidates, including the regular students, in dealing with the paper set in estimating. The second division of the Draftsman class appeared for a term examination with only moderate results.

(d) *Surveyor class.*—The first division of 20 students appeared for the final examination and 17 passed, viz., one for first-class, two for second-class and fourteen for third-class certificates. Fifteen independent candidates presented themselves and eight were successful, one gaining a second-class and seven securing third-class certificates. The former already holds a second-class certificate; and of the latter four hold third-class certificates. The junior division of the class, which will henceforth be entitled the Sub-overseer and Surveyor class, consisting of 25 students, passed a very satisfactory term examination. This reflects credit on M.R.Ry. M. A. Anantalwar, B.A., B.C.E., who has been in sole charge of the division.

(e) *Artisan class.*—This class, which opened with 43 students, fell, through resignations and dismissals, to 37 at the close of the year. Evening instruction was imparted as usual, supplemented by morning surveying two days a week. The class, which is a popular one, is reserved, as far as possible, for maistries, artisans, and the sons of such persons.

The class percentages of the marks under the various subject heads compare as follows with the average results of the preceding four years:—

<i>Engineer class.</i>							1896.	Average of previous four years.
Mathematics	...	...	...	...	...	...	60	67
Science	...	...	...	...	...	...	46	52
Engineering	...	...	...	...	...	...	48	63
Drawing	...	...	...	...	...	...	53	67
Surveying	...	...	...	...	...	...	64	62
Language	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	77	71
Total							54	62
<i>Engineer Subordinate class.</i>								
Mathematics	...	...	...	...	...	...	58	50
Engineering	...	...	...	...	...	...	50	51
Drawing	...	...	...	...	...	...	48	55
Surveying	...	...	...	...	...	...	61	56
Language	...	...	...	...	...	...	45	45
Drills and Exercises	...	...	...	...	...	...	82	70
Total							54	53
<i>Draftsman class.</i>								
Practical Geometry	...	...	...	...	...	...	66	59
Free-hand, Perspective, and Model Drawing	...	...	...	...	...	...	53	55
Building Drawing	...	...	...	...	...	...	50	55
Machine Drawing	...	...	...	...	...	...	54	56
Estimating	...	...	...	...	...	...	35	46
Topographical Drawing	...	...	...	...	...	...	54	50
Drills and Exercises	...	...	...	...	...	...	68	66
Total							51	52
<i>Surveyor class.</i>								
Chain, Compass and Plane Table Surveying	...	...	...	...	...	...	57	55
Levelling	...	...	...	...	...	...	56	61
Theodolite Surveying	...	...	...	...	...	...	41	56
Topographical Drawing	...	...	...	...	...	...	53	55
Drills and Exercises	...	...	...	...	...	...	78	65
Total							55	57

These figures show that, in regard to the students now passing out of the college, the Engineer class is, notwithstanding the uniform success of its members in passing

the examination, considerably below the average merit; that the Engineer Subordinate and Surveyor classes are of average merit; and that the Draftsman class, notwithstanding its heavy proportion of single-subject failures, is also of average merit.

5. *Practical courses.*—The reduction of the practical course from two years to one came into effect during the year. To avoid, however, the simultaneous completion of the course by two different batches of Engineers and two of Engineer Subordinates, it was decided that the batches which left the college in December 1894 and spent the year 1895 in the Public Works Workshop should complete their works course on the 30th June 1896, while the batches which left the college in December 1895 should proceed at once to works and complete the course on the 31st December 1896. The former batches consisted of two Engineers and 17 Engineer Subordinates, and the latter of six Engineers and 15 Engineer Subordinates. The whole of these with the exception of one Engineer Subordinate (who was absent through sickness upwards of two months) completed their course during the year under review. The two junior batches were transferred to Madras in two sections for their equitation course at the Body Guard school. One Engineer Subordinate student, who left the college in December 1894, was permitted to go through a special course in the college workshops. He will be transferred to works in February 1897.

The progress reports, so far as they have been received from Executive Engineers, are almost without exception favourable.

Six Engineer and 15 Engineer Subordinate students will join the works course early in 1897. The distribution to Public Works Circles was notified before the Christmas holidays, so as to avoid delay in the commencement of the practical course. One Engineer student has elected to become a Mechanical Engineer, and will go through his practical course in the Madras Railway Locomotive shops.

6. *Military students.*—The total number of soldier students on the 31st December was six, viz., two on works and four in the Engineer Subordinate class. Two others completed their works course on 30th June. Owing to the reduction of the probationary course from one year to six months, no probationers were admitted during the year; but a competitive examination was held in November and a full class of five students will join the college at the commencement of 1897. A proposal that Military Upper Subordinates required for the Burma Public Works Department shall be obtained from this college has been approved by Government and forwarded to the Government of India.

7. *Government Technical Examinations.*—Eighteen candidates appeared voluntarily for the Government Technical examinations in various engineering subjects. Of these 12 passed in one or more subjects, and six failed. Details will be found in appendix D.

8. *Surveying.*—During February the whole of the Engineer, Engineer Subordinate and Surveyor classes, comprising 109 students, were encamped at and near Avadi for sixteen days' continuous survey work. The students worked from day-light until about 11 A.M. in the field and from 3 to 6 P.M. at plotting. In July the same classes, comprising 136 students, proceeded to Poonamallee and Avadi for a similar period. The larger camp at Avadi was in charge of the Instructor in Surveying and Drawing and the smaller at Poonamallee in that of the Instructor in Engineering. Six students of the Draftsman class were attached to the latter in order to assist in the project assigned to the Engineer students. Satisfactory work was done during both periods. My thanks are due to the Commandant, Queen's Depot, Poonamallee, who provided a large barrack room as a drawing office, and to the Executive Engineer, Military Works department, who placed a bungalow at Avadi at my disposal for a similar purpose. Thanks are also due to the Inspector-General of Ordnance for the supply of tents to supplement those belonging to the college. The total cost of the two camps was Rs. 1,192.

9. *Inspections of works.*—In addition to the usual inspections of buildings, bridges and factories, a tour was made by 85 students of the Engineer, Engineer Subordinate and Draftsman classes to the Redhills Tank System. The tour extended over five days, and the principal masonry works in the tank, the supply channel and head works were measured up. The cost of the inspection was Rs. 175.

10. *Workshops.*—The workshops were attended by the Engineer and Engineer Subordinate students, who participated in the various work executed. An iron lathe

was completed and a 1-h.p. engine commenced; sundry tools were made; moulding and brass casting were practised; benches, almirahs, drawing-tables and drawing-boards were constructed, and various repairs undertaken. The Instructor reports that the students have displayed more interest in their work than heretofore, and that a great improvement in the style of work is noticeable. The 100-ton testing machine was erected by the Workshop Instructor Mr Perkins under the supervision of the Professor of Engineering, and a series of tests, in which the Engineer students assisted, was carried out by Mr. Chatterton on timber, cement, concrete, stone, iron and steel specimens. A number of rails were tested for the Madras and South Indian Railway Companies, and it appears that considerable use is likely to be made of the testing machine by the public. My thanks are due to the officer in charge of the Arsenal for the loan of the hoisting appliances used in the erection of the machine.

During the year, a small planing machine was added to the stock of machine tools. A plan and estimate for extending the workshop on the south side was prepared by the Consulting Architect and submitted to Government. The cost is estimated at Rs. 8,636.

A scheme for training apprentices in the workshops with the view of fitting them to become teachers in technical schools was drawn up and approved.

11. *Revision of Rules.*—The development of the Surveyor class into a class for the training of Lower Subordinates for the Public Works Department and other services, which was recommended by Mr. West's Committee in March 1895, was sanctioned, and the new scheme of instruction was brought into force during 1896 in regard to the second division of the Surveyor class. The instruction in surveying remains much as before, but building construction, drawing and estimating are added to the course. Considering that the new system was introduced only in the second half of the year, the results attained by the junior division of the class in the late term examination are very creditable. The class will be a popular one, judging from the large number of applications for the admission examination of December last.

Sanction was at the same time accorded to the revision of the syllabuses proposed by the Committee above mentioned. The general features of the revision are the reduction, with the view of affording more time for practical work, of the book-work portions of the Engineer class and Engineer Subordinate class curricula, and the addition of certain branches to the Sub-overseer and Surveyor class, and Draftsman class curricula in order to render the instruction given more complete. The new syllabuses were at once taken up by all class divisions except the senior division of each class, so that the recent final examination is the last under the old syllabuses. One important point raised was the question of retaining the marks awarded by the college as a credit in the final examination totals. It was pointed out that the system served to encourage practical work, to test points which are not of a nature to be readily gauged by ordinary examinations and to create a constant incentive to work throughout the year. It was also brought to notice that the practice prevails in the other Indian Engineering colleges, as well as at Cooper's Hill, the City and Guilds of London Technical Institute and other important colleges in England. It was ultimately decided that the system should continue in force in all classes except the Draftsman class. Every effort will be made to exact the full quota of practical work from this class, notwithstanding the lack of incentive, and the matter will be reported on specially after sufficient time has elapsed to enable judgment to be formed of the effect of the change.

Independent candidates for the college certificate examinations have hitherto been persons who have at some period gone through a full course. At the instance of Colonel Pennycuik, the experiment is now to be tried of admitting other persons to the examinations for Draftsman certificates to be held in 1897 and 1898. It is not expected that the concession will be largely made use of.

Revision of the college rules, embracing the changes in the syllabuses as well as many other points, was also undertaken, and a draft code submitted. Sanction, however, had not been accorded by the close of the year, so that we are now in the rather anomalous position involved by working on a system which is not in accord with the published rules.

12. *Physical training and recreation.*—Compulsory instruction in gymnastics and drill was given as usual to all classes except the Artisan class. An improvement in the drill was observed. The concession of allowing deficiency of marks for physical

exercises up to a maximum of 25 per cent. to be made good in the case of students who regularly attend cricket practices, was extended this year to foot-ball. The latter is the more popular game, and several matches with other colleges and clubs were played. Cricket is regularly practised and the college took part in the inter-collegiate competition, but gained little success. Tennis continues to be played by a few students. The recreation ground is in good order, and the funds of the recreation club are in a satisfactory state. The athletic sports, which were to have taken place in November, fell through on account of the abnormally protracted rainfall of that month.

A former student of the College, M.R.Ry. S. A. Jagadisa Aiyar, B.A., Assistant Engineer, Public Works Department, kindly placed a sum of Rs. 33 at the disposal of the recreation club for prizes in sports. One of the prizes, a cricket bat, falls to T. Ramachandra Rau of the Engineer class, who made the best batting average among native students in the inter-collegiate competitions.

13. *Library.*—During the year, 184 books were added to the library, which now contains 3,409 volumes. The books issued to the students numbered 2,630, and to the staff 675 against 2,396 and 463, respectively, in the previous year, while 1,156 references were made to the consulting library. The new catalogue which was under preparation in 1895 was completed and published during the year.

14. *Buildings.*—The allotment of Rs. 17,000 which was made in the Public Works budget for 1895-96 was not utilized, and no addition was made to the accommodation during the year. The pressing need of additional space has, however, been again pointed out, and a plan and estimate drawn up by the Consulting Architect have been submitted. Provision has been made for one additional class room, two lecture rooms, a library and reading-room, and for a verandah along the west front of the old portion of the building. The total cost is estimated at Rs. 41,900.

15. *Attendance and conduct.*—The percentage of numbers present to numbers on the rolls was 94.4 for the Engineer and Engineer Subordinate classes, and 92.6 for the junior classes. The attendance by class divisions is given in appendix E. The conduct of the students has been satisfactory throughout the year.

16. *University examinations.*—Six candidates appeared for the B.E. degree examination of 1896, and four were successful in the Civil Branch. All were third-year students of the Engineer class. Eight candidates presented themselves for the first examination in Engineering and six passed. Of the latter, five were second-year students of the Engineer class, while the sixth was a third-year student. Of the two who failed, one was a second-year man and the other an ex-student.

17. *Financial details.*—The approximate total expenditure for the calendar year 1896 amounted to Rs. 66,290, and the income from fees, &c., to Rs. 14,590. Detailed statements of receipts and charges are given in appendix F. It should be noted that the figures for different years cannot be compared since large items for stores debited to a particular official year may appear in either of two calendar years. Full and accurate financial details are furnished with my annual returns for the official year. The average daily attendance throughout the year was 205, so that the net cost to Government of educating each student was Rs. 252.

18. *Educational Rules.*—The provisions of the Educational Rules have been carried out so far as the special constitution of the college will admit, except in regard to accommodation, which, as elsewhere reported, is insufficient. Academic costume has been worn by graduate professors and assistants not engaged in practical work.

19. *Employment of passed students of 1895 and 1896.*—Of the three Engineer students who completed their practical course on 31st December 1895, the senior R. N. Arokyaswami Mudaliyar, B.A., B.C.E., was appointed Assistant Engineer in the Public Works Department, and the other two accepted posts as temporary Upper Subordinates.

Of the two who completed their course on 30th June 1896, the senior S. A. Jagadisa Aiyar, B.A., was appointed an Assistant Engineer in the Public Works Department, while the other accepted employment under the Travancore Government. Of the 26 Engineer Subordinates who qualified for diplomas in December 1895, seven were appointed to the permanent and twelve to the temporary Upper Subordinate

establishment of the Public Works Department; four joined the permanent Lower Subordinate establishment; two were appointed to the Travancore Public Works Department; and one entered the Salt Department.

Of the 17 Engineer Subordinates who completed their practical course on the 30th June 1896, four were appointed to the permanent and seven to the temporary Upper Subordinate establishment of the Public Works Department; five joined the Lower Subordinate establishment, and one took service under a local board.

Of the 20 Draftsmen who passed out in December 1895, all but one are known to have been in employment during 1896 in the Public Works Department, Railways or Local Fund service; but six were unemployed towards the close of the year.

Of the 16 Surveyors who qualified in December 1895, all but four are known to have obtained employment on salaries ranging from Rs. 50 to Rs. 70. The Public Works Department, the Railways and the Revenue Department absorbed the majority.

It will be seen from the above figures that, notwithstanding the supply this year of an unusual number of Engineers and Engineer Subordinates, there has been no difficulty in securing employment.

20. *Prospects of employment.*—I regard the prospects of employment in the immediate future as good. Owing to double batches of Engineers and Engineer Subordinates leaving the college during the year, difficulty has been experienced in fulfilling the expectations of the students in regard to permanent appointments. Special sanction was obtained to the appointment of the senior engineer student of the batch of June 1896 as Assistant Engineer, and the senior student of the batch of December 1896 will be appointed to the provincial service as Apprentice Engineer under the new rules introduced by the Government of India. The permanent appointments of civilian Engineer Subordinates were two and three, respectively, in the senior and junior batches; but it is understood that the remaining students who were led to expect such appointments will be provided for as vacancies occur. This course will doubtless affect, to some extent, the prospects of subsequent batches.

At this moment there is a very large demand for temporary upper subordinates for Famine Relief work, and it is not improbable that a large proportion of the Engineers, Engineer Subordinates, Draftsmen and Surveyors of December 1896 will be absorbed by the Public Works Department.

The vacancies notified during the year in the Gazette, the public press, and by letter to the Principal, were one hundred and sixteen in number, of which sixty-eight were under Government, nineteen under local boards and municipalities, nine on railways, fifteen under Native States and five under private employers. Fourteen of the vacancies were for Engineers and Assistants, four for Supervisors, twenty-eight for Overseers, eleven for Sub-Overseers, twenty-one for Draftsmen, twenty-six for Surveyors, and nine for maistries, while three were of a miscellaneous character. Seven of the appointments carried salaries of Rs. 200 and upwards, fifteen between Rs. 100 and Rs. 200, thirty-six between Rs. 50 and Rs. 100, and fifty-eight under Rs. 50. Particulars are given in Appendix G.

21. *General.*—My thanks are due to the President of the Board of Examiners, Mr. Ashpitel, for the promptness and consideration he has displayed in the supply of the examination results. I also acknowledge the co-operation of the Professor of Engineering, Mr. Chatterton, and the Acting Professor of Mathematics, M.R.Ry. B. Hanumantha Rau, in the work of the College, as well as the willing aid rendered by the majority of the members of the junior staff. Special acknowledgment of the good work done by the Instructor in Surveying and Drawing, Sergeant Goddard, and the Instructor in Engineering, Sergeant Reynolds, is also made. Sergeant Goddard is steadily improving the style and accuracy of the survey work turned out. Sergeant Reynolds has, in addition to his regular duties, which have been carried out with energy and ability, been engaged in the preparation of a new series of pattern estimates, and of drawings for estimating purposes; and he has also compiled, for the use of the college, a Manual of Irrigation Works adapted from General Mullins' "Irrigation Manual" with the kind permission of the author. General Mullins has always taken a deep interest in this institution—an interest undiminished by retirement from active service in India—and I take this opportunity of publicly thanking him for the generous assistance which he has now rendered.

APPENDIX A.

DISTRIBUTION of students by wealth and occupations of parents on the 31st December 1896.

Classes in college.	Wealth.				Occupations.								
	Richer classes.	Middle classes.	Poorer classes.	Total.	Officials.	Petty officials.	Traders.	Landholders.	Artisans.	Coolies including agricultural labourers.	Mendicants.	Others.	Total.
Engineer class—													
I		2	4	6	2	1	..	3	..	..	..	..	6
II		6	..	6	3	..	..	3	..	..	..	..	6
III		7	..	7	1	..	..	6	..	..	..	..	7
Engineer Subordinate class—													
I	1	17	..	18	3	..	1	13	..	..	..	1	18
II	..	19	2	21	5	1	..	13	..	..	..	2	21
III	..	29	..	29	9	3	..	15	..	..	..	2	29
Draftsman class—													
I	..	25	..	25	17	1	1	5	1	..	..	..	25
II	..	26	4	30	14	3	1	12	..	..	..	..	30
Surveyor class—													
I	1	19	1	21	10	..	..	11	..	..	..	..	21
II	..	24	1	25	11	..	..	14	..	..	..	..	25
Artisan class	..	32	5	37	30	3	1	2	1	..	..	..	37
Total	2	206	17	225	105	12	4	97	2	..	..	5	225

APPENDIX B.

DISTRIBUTION of students by districts on the 31st December 1896.

Districts.	Engineer classes.	Engineer Subordinate class.	Draftsman class.	Surveyor class.	Artisan class.	Total.
Ganjám	..	..	1	1	..	2
Vizagapatam	..	..	1	1	1	3
Górávari	1	..	1	3	..	5
Kistna	..	..	2	..	..	2
Nellore	..	3	..	2	..	5
Bellary	..	..	..	..	3	3
Madras	2	9	3	14	..	28
Chingleput	..	2	1	3	..	6
North Arcot	..	4	1	2	..	7
South Arcot	2	5	2	..	..	9
Tanjore	5	28	11	14	6	64
Trichinopoly	2	4	10	7	1	24
Madura	2	4	..	2	..	8
Tinnevely	6	..	..	4	1	11
Coimbatore	1	3	3	2	4	13
Nilgiris	..	..	..	1	..	1
Salem	..	1	2	1	..	4
South Canara	..	2	3	..	..	5
Malabar	..	3	..	..	..	3
Mysore	7	..	1	..	1	9
Travancore	1	2	..	..	1	4
Cochin	..	..	1	..	..	1
Pondicherry	..	..	..	1	..	1
Pudukóttai	..	2	..	..	..	2
Ceylon	..	1	..	..	..	1
Military students	..	5	..	..	..	5
Total	19	68	55	46	37	225

APPENDIX C.

DISTRIBUTION of students according to classes of the community on 31st December 1896.

Classes.	Europeans and Eurasians.	Native Christians.	Muhammadans.	Hindus.				Aborigines.	Others.	Total.
				Brahmans.	Non-Brahman Caste Hindus.	Pariahs.	Other castes.			
Engineer classes	..	..	..	18	1	..	..	..	..	19
Engineer Subordinate classes	5	1	..	57	4	..	1	..	..	68
Draftsman classes	1	..	..	32	22	..	..	..	..	55
Surveyor class	1	..	3	35	7	..	..	..	..	46
Maistry and Artisan class	..	2	1	5	29	..	..	..	..	37
Total ..	7	3	4	147	63	..	1	..	..	225

APPENDIX D.

GOVERNMENT Technical Examinations of 1896.

Subject.	Grade.	Number examined.	Number passed.	
			First class.	Second class.
Building Materials and Construction	Elementary	8	1	1
Building Drawing and Estimating	Intermediate	2	..	2
Earthwork and Road Making	Elementary	3	..	1
Surveying and Levelling	Intermediate	3	1	1
Applied Mechanics	Elementary	7	..	6
Mensuration	Intermediate	1	1	..
Machine Construction	Advanced	1	..	1
Machine Drawing	Intermediate	1	..	1
Steam and Steam Engine	Elementary	3	..	2
Fitter's work	Intermediate	7	..	..
.. ..	Do.	3	..	1
.. ..	Do.	2	..	1
.. ..	Do.	1	..	..
.. ..	Elementary	2	..	2
Total ..	..	44	3	19

APPENDIX E.

Average attendance throughout 1896.

				Average number on rolls.	Average daily attendance.
College department—					
Engineer class, first (senior) division	..	..	..	6.0	5.6
Do. second division	..	..	..	6.0	5.8
Do. third do.	..	..	..	7.0	6.5
Engineer Subordinate class, first division	..	..	..	18.7	17.6
Do. do. second do.	..	..	..	21.1	19.6
* Do. do. third do.	..	..	..	17.7	17.1
† Military probationers	..	..	..	0.8	0.8
				77.3	73.0
School department—					
Draftsman class, first (senior) division	..	..	..	25.7	23.5
Do. second division	..	..	..	31.4	28.8
Surveyor class, first division	..	..	..	21.1	19.8
Do. second do.	..	..	..	25.9	24.5
Maistry and Artisan class	..	..	..	38.6	35.6
				142.7	132.2
Total college and school departments	..	..	..	220.0	205.2
Percentage of numbers present to numbers on the rolls—					
College department	..	..	..	..	94.4
School department	..	..	..	..	92.6

* This division joined in July.

† The probationers were absorbed in July.

APPENDIX F.

Financial Details for 1896.

Receipts—				RS.	A.	P.
Tuition fees	..	..	..	10,398	0	0
Entrance and final examination fees	..	..	..	3,340	0	0
Fines and other receipts	..	..	..	851	13	8
Total ..	..	..	..	14,589	13	8

Charges—

Principal	..	..	..	14,890	8	0
Professors, masters and teachers	..	..	..	27,845	2	7
Clerks, librarian and servants	..	..	..	3,300	14	8
Board of Examiners	..	..	..	4,500	0	0
Library and prize allowances	..	..	..	557	3	0
Books and instruments	..	..	..	596	14	9
Other Europe stores	..	..	..	2,654	11	2
Miscellaneous	..	..	..	4,555	15	2
Travelling allowances	..	..	..	412	13	6
Scholarships	..	..	..	2,700	12	6
Exchange compensation allowances	..	..	..	4,273	2	4
Total ..	..	..	..	66,288	1	8

Net cost to Government	..	..	..	51,698	..	..
Average attendance throughout the year	..	..	..	205	..	..
Net cost per student	..	..	..	252	..	..

From F. W. ASHPITEL, Esq., President of the Board of Examiners, College of Engineering, to the Director of Public Instruction, dated 28th January 1897.

I have the honour to forward herewith the report on the Civil Engineering College Examinations for 1896, together with the reports of the individual Examiners. The mark sheets have been handed over to the Principal of the college.

2. I also enclose remuneration bills amounting to Rs. 3,956-4-0 as noted below:—

	RS.	A.	P.
F. W. Ashpitel, Esq.	1,294	0	0
C. T. R. Scovell, Esq.	1,141	4	0
A. Moffat, Esq.	918	0	0
Rao Bahadur V. Krishnama Chary	210	0	0
C. E. Phipps, Esq.	393	0	0
Total ..	3,956	4	0

Rupees three thousand nine hundred and fifty-six and annas four only.

Report on the examinations held at the College of Engineering, Madras, in December 1896.

Engineer Classes—Percentage of marks obtained.

	E I.	E II.	E III.	Average, 1890-95.
Mathematics	60	68	64	63
Science	46	43	..	50
Engineering	48	49	74	63
Drawing	53	42	45	67
Surveying	64	66	52	67
Language	53	..	..	55
Drills and Exercises	77	..	..	70
Total ..	54	54	60	62

In the first division, six college students and one independent candidate were examined. The college students all passed, but the independent candidate failed to secure the required total number of marks. The percentage of marks obtained is the same as last year but considerably below the average, the principal failures being in engineering and drawing. The class was, in fact, below the average in every subject in which they were examined by the board and three out of the six candidates only just succeeded in qualifying. In engineering only one student and in building drawing no student obtained half marks.

In the second division, six college students were examined and, with the exception of mathematics, the percentage of marks obtained was below the average. In engineering, there was a general failure in building construction, for which there is no excuse seeing that there is a text-book available if the students will only study it. In building drawing no student obtained half marks.

In the third division, seven college students presented themselves for examination, and the class is considerably better than the other divisions. In engineering and mathematics the percentage of marks obtained is above the average and the percentage on the total marks obtained is practically up to the average. The failure is in drawing in which it will be observed that all the divisions of the Engineer class are bad.

Engineer Subordinate classes.—Percentage of marks obtained.

	Es I.	Es II.	Es III.	Average, 1890—95.
Mathematics	58	61	..	49
Engineering	50	53	..	49
Drawing	48	50	..	56
Surveying	61	56	..	57
Language	45	..	..	46
Drills and Exercises	82	..	..	71
Total ..	54	56	54	54

In the first division, the class is apparently up to the average, but the average is not very high. In mathematics, engineering and surveying the percentage of marks obtained is above, but in drawing considerably below the average. In the division 18 college students and five independent candidates were examined, of whom four college students and four independent candidates failed to qualify.

In the second division, 21 college students were examined and the percentage of marks obtained is above the average in mathematics and engineering, up to the average in surveying and below the average in drawing. The general result of the examination is good and the class should do very well.

In the third division, 29 college students were examined, but the papers were few in number. The class appears to be up to the average, and several students did remarkably well.

Draftsman Class—Percentage of marks obtained.

	D I	D II	Average, 1890—95.
Practical Geometry	66	..	62
Free-hand and Model Drawing	53	..	56
Building Drawing	50	..	57
Machine	54	..	56
Estimating	35	..	48
Topographical Drawing	54	..	51
Drills and Exercises	68	..	67
Total ..	51	43	56

In the first division, 24 college students presented themselves for examination, of whom 13 failed; of 18 independent candidates, 11 failed. The principal failure is in estimating, in which no less than 11 students failed to qualify—a result which, it should be observed, is as much due to college marks as to the Board's examination. The results being so very unsatisfactory, the President of the Board called for the mark sheets and the whole of the papers were re-examined, but it was not found possible to materially modify the original result. The class was up to the average in other subjects and two college students and two independent candidates obtain second-class certificates. The work done by the class in estimating during the college course was also examined by the board and the failure does not appear to be attributable to any want of attention to this subject. It is suggested, however, that the Consulting Engineer for Railways, the Chief Engineer, Madras-Bewdala Railway, and the Irrigation office should be asked to supply the college with some of the more recent designs and estimates for bridges and irrigation works, as the selection available at the college, though much improved during recent years, is still somewhat deficient.

In the second division, the students were only examined in geometrical and free-hand drawing and two students did exceptionally well.

Surveyor Class—Percentage of marks obtained.

	S I, 1896.	Average, 1890—95.
Chain Compass and Plane Table	57	57
Levelling	56	62
Theodolite Survey	41	57
Topographical Drawing	53	56
Drills and Exercises	78	67
Total ..	55	59

In the first division, twenty college students and fifteen independent candidates were examined, of whom three college students and five independent candidates failed. The class is below the average in all subjects in which they were examined, though slightly better than last year.

Sub-Overseer and Surveyor class.—Though the actual percentage of marks obtained by this class is not high the result of the examination is, in the opinion of the board, most satisfactory. Several students did extremely well and only six out of 25 failed to obtain half marks, of whom only one seems to be likely to fail eventually. Taking into consideration the educational qualifications of the students the way in which they answered the papers was remarkably good and appears to reflect great credit on the instructors. The class is a new one, and it is believed had not the full time for preparation owing to the introduction of the new syllabus late in the year. The only suggestion that the board have to make is that the students should, in future, be instructed not to attempt to learn by heart the chemistry of building materials which they cannot possibly understand, but to confine their attention to the practical parts of the text-book. The text-book on building materials and construction requires, in fact, to be marked, so as to indicate to students which parts they are expected to study.

General Remarks.—With the exception of estimating in the draftsman class and drawing and engineering in the Engineer and Engineer Subordinate classes, the board are of opinion that the results of the examination may be considered to be fairly satisfactory. The reduction in the percentage of marks obtained is largely due to the strictness with which college marks are awarded as inspection of the mark sheets will show.

Read the following endorsement from the Director of Public Instruction, No. 854, dated 29th January 1897:—

Referred to the Principal, College of Engineering, Madras, for favour of remarks, if any, and scrutiny of the remuneration bills of the members of the Board of Examiners.

Read the following letter from the Principal, College of Engineering, to the Director of Public Instruction, No. 1697-C, dated 15th February 1897:—

Referring to your endorsement No. 854, dated 29th January 1897, on file from the President, Board of Examiners, herewith returned, I have the honour to offer the following remarks.

2. The mark sheets mentioned in the first paragraph of Mr. Ashpitel's covering letter were forwarded to you with my annual report No. 1613-C., dated 30th January 1897.

3. Under "Engineer classes" in the body of the report the word "failures" is misleading, seeing that all the students of the senior division passed the final examinations. The average percentage of the division was 48 in engineering and 53 in drawing.

4. The President observes that the results were not good in engineering and building drawing in the senior division of the Engineer class. It should be noted that, while Engineering is a main head, building drawing is only a sub-head of the main head Drawing, the percentage in which was 53.

5. The percentages for the second division of the Engineer class are those of the results of two term examinations, those of 1895 and 1896. A similar remark applies to the percentages given under the second division of the Engineer Subordinate class.

6. The President considers that the existence of a recognised text-book in a subject leaves no excuse for failure in that subject. I fear that something more than text-books is needed to enable students to pass examinations.

7. The want of success in estimating in the Draftsman class is commented on in my Annual report, paragraph 4 (c), and certain facts are adduced which tend to show that the paper set offered unusual difficulties to the candidates. The President admits that the failures are not attributable to want of attention to the subject in the college.

8. Throughout his report the President compares the results of 1896 with those of the preceding five years. In my Annual report, I take, as usual, the preceding four years.

Proceedings No. 5145 of 1897.

The Principal's report deals with the working of the college during the past calendar year. But for facility of preparation of the quinquennial report ordered by the Government of India, statistics for the past five years have been incorporated in this review. In his future reports the Principal should adopt the designations given to the several classes in the Madras Educational Rules.

2. *Staff*.—The only change of importance was the appointment of Mr. H. T. Keeling as Acting Professor of Engineering during the absence on furlough of Mr. A. Chatterton, the permanent incumbent. Several minor changes also took place in the subordinate staff and in the clerical establishment. The Director is not quite convinced as to the necessity for a fourth clerk for the college. Indeed in no institution is the clerical establishment so strong as in this college. It appears to the Director that the work of the clerks needs re-distribution, the head clerk being entrusted with all cash transactions and the storekeeper and librarian with the charge of books and stores and instruments. The difficulty might be got over by placing the clerical establishment under the immediate supervision of some senior instructor of the college as has been the practice in the Medical College, where, it is believed, the correspondence work is as heavy as, if not heavier than, in the College of Engineering. This arrangement would relieve the Principal from much routine work and enable him to devote more time than at present, viz., $4\frac{1}{2}$ hours a week, to instruction in connection with the Engineer classes, which did not, in certain important subjects, do as well as might have been expected, at the last final examination conducted by the Board of Examiners.

3. *Accommodation*.—The necessity for additional accommodation has been admitted by Government, which has approved the extension at present of the ground floor of the college and accordingly called for revised plans and estimates.

4. *Library and reading-room*.—A more satisfactory use was made of the library during the year. No reference has been made in the report to the working of the reading-room maintained by the college recreation club.

5. *Workshops*.—The workshop fittings have now been completed, and the usefulness of the workshops has been enhanced by the provision of the 100-ton Testing Machine. The students have of late been receiving ample practice in the workshop, and they are therefore sent to works divisions only during their practical course, excepting students who desire to become mechanical engineers. The scheme for the training in the workshops of apprentices already possessing some technical qualification has met with the general approval of Government, and the Director trusts that schools in the mofussil teaching mechanical engineering subjects will, in the course of a few years, be supplied with trained teachers from the college.

6. *Strength and attendance*.—In the following statement the strength of each class of the college for the past five years is compared:—

Class.	Strength on the 31st December					Remarks.
	1892.	1893.	1894.	1895.	1896.	
Engineer	10	14	17	19	19	This statement excludes the number of students undergoing the practical course.
Engineer Subordinate	77	81	76	63	63	
Do. Military probationers	5	2	3	2	5	
Draftsman	51	67	73	64	55	
Sub-Overseer and Surveyor	37	50	57	48	46	
Artisan class	34	38	39	35	37	
Special students	3	..	..	..	..	
Total ..	217	252	265	231	225	

It is observed that the strength on the 31st December 1896 was the lowest in the quinquennium, the year 1892 excepted, though it very nearly approached that of 1895. The fall is due chiefly to the causes explained by the Principal and also partly to the strictness with which the entrance tests are conducted. The gradual increase, however, in the strength of the Engineer class is encouraging, and a further increase is expected. From paragraph 6 of the Principal's report it is noted that there were four military students receiving theoretical instruction, whereas Appendix B gives the corresponding figure as five. This discrepancy needs to be explained. The average number on the rolls and the average daily attendance were fairly satisfactory, namely, 220.0 and 205.2, respectively. All the districts with the exception of Kurnool, Cuddapah and Anantapur were represented, and Tanjore and Madras changed places during the year, the former district being far ahead of the latter as regards the number of students supplied. The richer and middle classes contributed 92 per cent., and Brahmans and non-Brahman caste Hindus 65 and 28 per cent., respectively, of the total strength. What is even more noteworthy is that 18 out of 19 Engineers and 57 out of 68 Engineer Subordinates were Brahmans. Muhammadans numbered four only, and they were found in the Surveyor and Artisan classes; nor was the Native Christian element suitably represented. The concession of half fees granted in favour of Muhammadans and the reservation of a few scholarships awarded in the college for this class preferentially in the new rules now before Government will, the Director trusts, induce a larger number of Muhammadan youths to seek instruction in Engineering. Turning to the occupation of parents it is observed that the majority of the students were the sons of officials and landholders and that the artisan element was very poorly represented, the number in the whole college being two while that in the Artisan class was only one. This is very disappointing indeed.

7. *Examinations*—(i) *University examinations*.—The last quinquennium was remarkable for the institution of separate engineering degrees in the civil and mechanical branches and for the bifurcation of the examination for the engineering degree into the first examination in Engineering and the Bachelor of Engineering degree (or the final) examination. This bifurcation was given effect to in January 1897.

Year.	B.C.E. or B.E. degree.		First examination in Engineering.	
	Ex-aminated.	Passed.	Ex-aminated.	Passed.
1892	5	4	..	..
1893	4	3	..	..
1894	3	3	..	..
1895	2	2	9	7
1896	6	4	8	6
Total ..	20	16	17	13

The results of the University examinations for five years are recorded in the margin. Since January 1892, 20 students of the college had appeared for the degree examination in Engineering and 16 of them had met with success. These results are satisfactory. Twenty-one independent candidates also presented themselves for the above examination and seven were successful. The college acquitted itself fairly satisfactorily both in the First and in the Degree examinations of January 1896.

(ii) *College Board examinations.*—The following summary furnishes the results of the final examinations conducted by the college board during the past five years :—

Class.	Number presented.					Number passed.				
	1892.	1893.	1894.	1895.	1896.	1892.	1893.	1894.	1895.	1896.
Engineer	4	2	2	7	6	4	2	2	6	6
Engineer Subordinate	18	26	31	21	18	13	24	19	15	14
Surveyor	18	18	25	22	20	16	12	20	16	17
Draftsman	24	26	34	28	24	18	21	10	20	11

The results of 1896 compared favourably with those of the year previous except in the case of the Draftsman class in which there was a large number of failures. On the manner in which each class acquitted itself at the examinations conducted by the Board in December 1896 the Director would remark :

Engineer class.—This class was much below the average, the percentages of marks obtained in several important subjects not approximating the average of the previous four years. All the three divisions exhibited weakness in drawing, and the first and second divisions in engineering and in building construction, respectively.

The Principal points out that the term “failures” used by the Board of Examiners in connection with the first division of the Engineer class is misleading as all the six students presented for the final examination were declared to have passed. Presumably the Board’s remark refers to the results of the examination conducted by the Board irrespective of the college or session marks. The President is requested to be good enough to state whether this presumption is correct.

Engineer Subordinate class.—The class was up to the average in all the subjects except drawing, which should consequently receive greater attention. The poor results in drawing obtained by the Engineer and Engineer Subordinate classes justify the inclusion in the revised rules before Government of the subject in the entrance tests for admission to the above classes.

Draftsman class.—This class fared badly at the final examination, the chief failures being in estimating. The Principal is of opinion that the unsatisfactory results were due to the unusual difficulty which the paper on estimating presented to the candidates and not to any want of attention to the subject. Building-drawing, however, does not appear to have received sufficient attention. As suggested by the Board of Examiners, the Principal is requested to arrange to procure for the college a few recent designs and estimates for bridges and irrigation works.

Sub-overseer and Surveyor class.—The Senior division of this class acquitted itself creditably at the final examination and the Junior division also did well at the term examination. The attention of the instructors should be drawn to the Board’s suggestion that the students should be taught to devote their attention to the practical parts of the text book on building materials and construction.

The remarks of the examiner in the vernaculars should be commended to the vernacular assistants. A large number of students, especially of the Engineer and Engineer Subordinate classes, are stated not to have numbered their answer papers. The omission should be guarded against.

(iii) *Government technical examinations.*—From the particulars furnished in Appendix D to the report, it is observed that 44 single subject candidates appeared voluntarily for the Government technical examinations and that 22, or 50 per cent. passed. The results in building materials and construction (Elementary), building-drawing and estimating (Elementary), mensuration (Elementary) and machine construction (Intermediate) were decidedly poor. Information should be given in future reports as to the classes to which candidates for the Government technical examinations severally belonged.

8. *Independent candidates.*—The results obtained by the independent candidates at the final examinations held in December were poor excepting as regards surveyor candidates, as may be seen from the figures in the margin. It is hoped that the draftsman candidates will fare better in future as their success is to be determined purely by the marks gained at the examination conducted by the Board.

Description.	Number examined.	Number passed.
Engineer candidates	1	..
Do. Subordinate candidates	5	1
Draftsman candidates	18	7
Surveyor do.	15	8

9. *Military students.*—Including the students in their practical course the total number of soldier students on the rolls on the 31st December last were six as against eleven in the year previous, the decrease being due to the non-admission of any probationers during the year. The success obtained by the soldier students at the examinations held by the Board of Examiners and at the Government technical examinations has again not been noted. The Government of India has decided that five military candidates may annually be admitted into the college. It has also been ruled that the probationary course for these students should be reduced from twelve to six months until 1898 and that it be entirely abolished thereafter, the same entrance examination being prescribed for civil and soldier candidates.

10. *Practical courses.*—The reduction in the length of the practical course from two years to one in the case of Engineer and Engineer Subordinates was carried out during the year under report. As the students will in future be chiefly engaged on works during their practical course the Madras University has made the necessary modification in its by-laws relating to the B.E. degree Examination. The conduct of the students during their practical course was uniformly satisfactory.

11. *Physical education.*—Judged from the results shown in drill, &c., at the college examinations, the physical training of the students seems to have received increased attention.

12. *Employment of former students.*—The Director is glad to note that as usual the students of the last set found little difficulty in securing employment. During the past five years various concessions have been granted to the students of the college, and their prospects have in consequence been improved. The disability under which the Engineer students had long suffered of being shut out from appointments on the upper subordinate ranks of the Public Works Department has been removed. From and after 1st January 1897 training in this college, or such approved service as the Governor in Council may consider equivalent thereto, has been made a qualification for Public Works appointments under district boards and municipalities carrying salaries of Rs. 100 and upwards, whilst preference should generally be given to men so trained. The Bengal Government has declared that under certain circumstances graduates in Engineering from the Madras College are eligible for appointments to the Public Works Upper Subordinate establishment in Bengal. Draftsmen holding lower class certificates have been allowed to be promoted to the higher grades for approved service and exceptional merit. It has been decided to make the award of the guaranteed apprentice Engineership at the termination of the theoretical course instead of after the completion of the practical course as originally contemplated. The selection of an apprentice Engineer in alternate years from the upper subordinates of the Public Works Department is an additional inducement to the Engineer subordinates of the college. Lastly, the Government of India has recently accepted the recommendation of the local Government that recruits of Military Upper Subordinates for the Public Works Department in Burma be made in future from the College of Engineering, Madras, instead of from the Thomason Civil Engineering College, Roorkee, vide G.O., No. 828-W., dated 22nd March 1897, communicated in G.O., No. 203-E., dated 7th April 1897.

13. *Finance.*—The financial position of the college during the past four years can be glanced at from the subjoined summary. The figures relating to 1892 are not available :—

Year.	Fees and other receipts.	Total charges of the college, including scholarships but exclusive of outlay on workshop fittings, and on buildings.	Net cost of educating each student.
1893	RS. 15,957	RS. 67,070	RS. 209
1894	13,817	67,407	223
1895	14,190	72,080	273
1896	14,590	66,290	252

The net cost of educating each student during the year was smaller than in 1895. The slight fall under fees proper was more than compensated for by the increase under fines and miscellaneous receipts. The decrease in charges is due chiefly to diminished expenditure on Europe stores and under exchange compensation allowance.

14. *Revision of syllabuses and rules.*—The most important event of the year was the revision of the college syllabus by a committee of experts, which, with certain modifications, received the sanction of Government in G.O., No. 444, Educational, dated 22nd July 1896. Major Love's report touches on the salient features of the revision, and the effect of the changes will be watched with interest. The rules of the college have also been thoroughly recast, the several alterations sanctioned by Government from time to time, chiefly as regards the institution of admission tests for the Draftsman and Surveyor classes, the reduction of the practical course, the institution of the equitation course, the development of the Surveyor into the Sub-overseer and Surveyor class, the altered conditions of the guaranteed appointment and the establishment of stipendiaryships in connection with the workshop being incorporated in the rules. It is hoped that the early sanction of Government will be accorded to the revised rules as the present rules have become obsolete in several respects.

15. *General.*—The administration of the college was on the whole fairly satisfactory and its working was creditable to the Principal, the Professors and the staff.

(A true Extract.)

(Signed) D. DUNCAN,
Director of Public Instruction.

To the Principal, College of Engineering.
" the Principals of other Government Colleges.
" the Inspectors of Schools.
" the Superintendent, School of Arts.

Copy to the President, Board of Examiners, College of Engineering.
" " Chief Engineer, Public Works Department, for information.
Copies to the Editors, *Indian Journal of Education*, and the *Educational Review*.
Copy to Government with covering letter.

ORDER—No. 541, Educational, dated 22nd September 1897.

The report on the working of the College of Engineering in 1896 and the review of it by the Director of Public Instruction call for the following remarks:—

(1) The fall in the strength of the students, which was considered to be merely temporary in the report of the previous year, continued during the year under review and is due chiefly to the decrease in the strength of the Draftsman class. The Principal attributes the fall to the non-admission of military probationers, but it is observed that the Director of Public Instruction in paragraph 6 of his review shows five as the number of such probationers on the 31st December 1896 as against two in the year

1895. The increase in the strength of the Engineer class from ten to nineteen during the last quinquennium is satisfactory. In the Engineer Subordinate class, there has been a gradual diminution in strength, which is to be regretted. There was no Muhammadan student in the Engineer, Engineer Subordinate and Draftsman classes, and there were only four in the other departments. In the whole college there were only two students belonging to the artizan class. The Government has recently allowed Muhammadan students in professional colleges to pay fees at half the pre-scribed rates and a few of the scholarships awarded in the College of Engineering have been reserved for Muhammadans. These concessions will, it is hoped, induce a larger number of Muhammadan students to take to the study of engineering.

(2) The results of the several University examinations, and of the examinations conducted by the College Board of Examiners are fairly satisfactory, except in the case of draftsman students. The Government notes with dissatisfaction that there should have been so large a number of failures in the subject of estimating among the students of the Draftsman class. The attention of the college authorities was drawn to this defect in the review of the report for 1894. It is not satisfactory to learn that the Board of Examiners found the whole Engineer class much below the average. The Principal will take steps to improve the instruction given in drawing. The teaching of the engineering subjects of the first division and of building construction should also be improved.

(3) The Government is glad to note that the double batches of Engineer and Engineer Subordinate students who completed their course during the year experienced no difficulty in finding employment. During the past five years, a considerable improvement has taken place in the prospects of the passed students of the college, which, the Government trusts, will increase the popularity of the institution greatly.

(4) Orders on the revised rules of the college will be passed in separate proceedings.

(5) In consequence of the decrease in the strength of the college, the receipts from fees declined, and notwithstanding this decline, the net cost of maintaining the college fell by Rs. 6,120. The net cost of educating each student fell from Rs. 273 in 1895 to Rs. 252 in the year under review, but it is still high. In 1893 the cost was only Rs. 209. The receipts from "fines and other receipts" rose from Rs. 242 to Rs. 852; to which particular item this large increase is due should be explained.

[Here enter letter, No. 542, Educational, dated 22nd September 1897.]

(True Extract.)

G. S. FORBES,
Secretary to Government.

To the Director of Public Instruction.
" Public Works Department.
" Local and Municipal Department.
" Deputy Adjutant-General, Madras Command.
Editors' Table.