M.R. O. 1—32,000—15-10-29.

MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No.	2792	Press MRS.
95-96. Dated	6-11-	№ C868

Not to be folded or roughly handled

9/6

Proceedings of the Madras Government, Revenue Department,
6th November 1868.

No. 95. Read the following Proceedings of the Madras Government in the Public Works Department:—

Passing orders on the estimates amounting to Rupees 8,31,600 for extending irrigation from the Tambrapoorney river in the Tinnevelly District. } (Here enter 26th October 1868, No. 3,365.)

No. 96. ORDER THEREON, 6th November 1868, No. 2,792.

Irrigation, No. 1.

Communicated to the Revenue Board.

(True Extract.)

(Signed) H. SEWELL,
Acting Under Secretary to Government.

To the Board of Revenue, with Proceedings Public Works Department, No. 3,365.

Exd. F. R. Bantleman.

Note by the Hon'ble Mr. Arbuthnot

These proceedings will of course be communicated in the Revenue Department to the Board of Revenue.

[Signed] A. J. A.

Cont. of 1868 Mudras

REVENUE.

To

THE BOARD OF REVENUE.

Dated

Recd.

Encl.

G. O. No. dated September 1868, No. 2,792.

NOVEMBER.

Nos. 95-98.

Extension of irrigation from Tambraparny River at Tinnevelly District.—Order requiring to submit the project for the sanction of Government of India, communicated to Revenue Board.

the greatest portion of the year they are merely a
Tambraparny, even in the driest months,

MEMORANDUM ON THE TAMBRAPOORNEY RIVER AND THE IRRIGATION WORKS CONNECTED WITH IT.

1. The Tambrapoorney river rises in the Western Ghauts, and has a drainage area at the first anicut, which is at the foot of the hills, of about 200 square-miles, though it cannot be asserted with any accuracy, as the greater portion is impenetrable jungle, and unsurveyed.

2. We, however, do know that there is a constant supply of water—more than sufficient for the seven anicuts across the river, and four supply channels, leaving a large surplus flowing into the sea even at the hottest season of the year.

3. It is to utilize this surplus that it is now proposed to build the Streevygoontum anicut and its subsidiary works.

4. This river is the only river south of Madras, except the Cauvery, that rises in the Western Ghauts that gets any benefit, beyond an occasional fresh from the south-west monsoon. The rain-fall at Uthemallay, where the principal feeder rises, is about 300 inches yearly, while the fall at Palamcottah only averages 22½ inches. From Uthemallay, for about eleven miles, the river flows with a rapid current, till it precipitates itself over a ledge of rock about 100 feet in height, and thence, by a succession of minor falls, amounting in the aggregate to 200 feet in four and a half miles, it comes to Vanatheertum fall, about 150 feet in height, at the foot of which it is joined by the Pombaur, which rises to the south of Mount Augustier, where there is also a fall of 300 inches of rain. Between Mount Augustier and this junction is the very fine cataract called the Pombaur falls. From the junction to Soorimoothen Covil, a distance of about three and three-quarters miles, the fall of the river is about twenty feet a mile, but the slope varies, and near the Covil it is like a rapid. From this it traverses a table land for about five miles, receiving a large tributary on its right bank, where it reaches the Paupanassum barrier of rocks, and falls into a basin at a depth of about 250 feet. About one and a half miles below is the first rough anicut on the river.

5. The several rivers in Madura and north Tinnevelly, whose sources are in the Western Ghauts, are not affected by the south-west monsoon, but only get freshes in north-east monsoon, and for the greatest portion of the year they are merely a waste of sand, like the Palar, while the Tambrapoorney, even in the driest months, is (nineteen miles from the sea) a running river with high banks.

6. It may be here noticed that the mouth of the river is never closed, and while I am now writing this at Streevygoontum, in the end of April, there is a stream of 100 feet broad and half a yard deep with an average fall of three feet per mile, or sufficient for 26,544 acres; so that unless the south-west monsoon fails, there is a perfect certainty of there being quite sufficient water for the Streevygoontum project.

7. Colonel Horsley, in his report on the Streevygoontum project, shows the capabilities of the river to be very great, for an ordinary high fresh was ascertained to discharge 47,520 cubic feet a second at Palamcottah, and including the water brought down by the Chittaur, there would at the same time be 56,970 cubic feet a second immediately above the Murdoor anicut. I have carefully gone down the river from Paupanassum to the mouth, and consider that he rather understates the quantity.

8. Any further additions that would be made to the present works would only be in order to collect the flood-water, and would have nothing to do with present surplus usual stream, which will all be kept for the Streevygoontum project.

9. None of the feeders of the Tambrapoorney are completely under the influence of the south-west monsoon. The Mannemootooaur, however, which falls into the river just above the Cannadien anicut, has a hill drainage area of about fifty square-miles, but is only partially under the influence of the south-west monsoon. But still it is a stream that is never dry, and has two large anicuts on it, which are of the same date, I should think, as Cannadien. The upper one made by nature of a bridge of rocks, the gaps in which are closed with rough stones yearly.

10. The other large feeder is the river Chittaur, which falls into the Tambrapoorney, ten miles below Palamcottah, and two above the Murdoor anicut. The drainage area is about 1,000 square-miles, and although it rises in the Western Ghauts, it is only in a small degree affected by the south-west monsoon. The principal stream falls into the low country, at the well known falls of Courtallum.

11. There are four anicuts on the Chittaur but, except the Marantha, are not of much importance. It is, however, proposed to repair an old ruined anicut, and thus fill a very large reservoir near the town of Sivilperri. This is now under consideration, and will be reported on directly an Officer can be spared to investigate it.

12. The Government are aware that there has been a project for making a large reservoir in the hills above the Paupanassum falls, but I do not see that it is required unless all the channels in the district be made for navigation, an expense not likely to be made with doubtful results, and without the problem being solved of the possibility in India at a moderate expense of making reservoirs that shall keep up the supply of water in rivers.

13. The following are the names of the anicuts and channels on the Tambrapoorney. They are old works, built before the British were in possession of the country, and I have entirely failed in getting information as by whom they were founded, though each one has its tradition :—

1. Codymalaligien anicut-and channels (2).
2. Nethyooney anicut and channel, north side.
3. Cannadien do. do. south do.
4. Kodagun do. do. north do.
5. Pallyoor do. do. south do.
6. Sutamullay do. do. north do.
7. Murdoor anicut with channel, on both sides of the river.

There are also four channels without anicuts for supplying tanks in high freshes, all below Murdoor—

Keelpadagay channel } on north side.
Coorkay do. }
Tendripairy do. } on south do.
Authoor do. }

14. Codymalaligien or Thalay anicut.—This anicut, situated close to Paupanassum, can hardly take the name of more than a "Vaganai," as it is re-built every year with strong jungle-wood stakes and brush-wood fixed in large holes cut for the purpose in the rock. It has, however, two good channels, one on the north ten miles long, and the other to the south, six miles, ending in tanks. As a great deal of the land under them is Inam, I have not obtained the necessary information as to amount of cultivation or revenue under them.

15. Nethyooney anicut.—This anicut, about six miles below the Paupanassum falls, is constructed across the stream at a very oblique angle, as most ancient works of the kind are, and has only one channel. The anicut consists of a row of large blocks of stone, many of them ten feet by four feet by three feet, and is evidently a very old work. It puts me much in mind of the several anicuts built, chiefly by Deewan Purneah, in the Mysore country, across the Hennavutty, Lutchmatert, and Lockanny, all branch rivers to the Cauvery. The length of the anicut proper is 468 feet, though it is difficult to distinguish where the anicut ends.

The channel is about twelve miles long, and revenue derived from it about Rupees 12,968 from 1,119 acres of land.

16. Cannadien anicut.—A mile and a half below comes the Cannadien anicut, a carefully built cut-stone work nine feet high with a top width of six feet, and with a large rough stone apron which varies in width from thirty-five feet to 160 feet. A small portion has a cut-stone curved section, as if repaired at a breach, but I can find no record of the same. It is divided into two portions by a rocky island, and just above the anicut the Mannemootooaur falls into the river. The channel is a noble stream, and can, I hope, be still improved. Its length is twenty-two miles, and the land so good under it that at Shermadavi, the residence of the Sub-Collector, the land sells at Rupees 2,500 to Rupees 3,000 an acre.

Revenue on 9,574 acres is Rupees 1,79,812, or Rupees 18$\frac{3}{4}$ per acre.

17. Kodagun anicut.—Six miles below is Kodagun anicut, and is of cut-stone, but very roughly put together. It is oblique to the river, and has one channel on the north bank. Length of anicut 2,289 feet. The channel is about ten miles long, and the revenue is, on 1,131 acres, Rupees 18,043, or Rupees 16 (nearly) per acre, in the Sub-Collectorate, and 4,302 acres under the Collector, of which I have not the assessment, but say Rupees 10 per acre, which would be 43,020 Rupees, or a total of 61,063.

18. Palyoor anicut.—Seven miles below. This anicut is formed with several different sections of cut-stone, the original section having a perpendicular drop on the apron. I found an inscription cut on a stone, showing that very extensive repairs had been carried out by a Collector named Hudleston in the year 1829. The length of the anicut is 2,532 feet. It has a very fine large channel twenty-six miles long, and supplies water to fifty-four tanks, terminating below Palamcottah.

The cultivation consists of 2,865 acres, Revenue Rupees 54,688.

19. Sutamullay anicut.—One and a half miles. This anicut is in two portions divided by a rock, and has one channel on the northern side. I am rather inclined to think that, at first, the northern portion from the rock was the original anicut, and that in some high flood the water made its way to the south of the rock. The southern portion, as may be seen from the plan, has quite a different section from the northern, which is more of the native form, with upright stones like a calingulah. A very large breach was repaired in 1855, at a cost of Rupees 2,527 in the southern portion. The channel is fourteen miles long, it then branches into two, one flowing for two miles further, the other supplying several tanks. This channel runs into the town of Tinnevelly.

The acreage under the channels is about 1,806 acres, with a revenue of Rupees 32,995.

20. MURDOOR ANICUT.—Eighteen miles below and twenty-seven from the sea, the last and much the largest anicut on the river. It is of a curious horse-shoe shape, with curve up the river, and is of several quite different sections, I suppose, owing to repairs being made at different times. There is an east as well as a west channel, and the former one has a head-sluice to it. At the head of the south channel is a very large calingulah of beautifully cut-stone work. The whole length o the anicut is 4,028 feet. There are nine sand sluices on the body of the work. The channels can hardly be counted by length, as they run in and out of several of the largest tanks in the Collectorate, both on the north and south side. The last tank on the south side being the Katumba, and on the north the Peruncollum. The total number of acres under cultivation on both sides is 14,400, giving a revenue Rupees 1,77,000.

The four channels below Murdoor anicut.

21. KEELPADAGAY CHANNEL on the north side has a head-sluice in position where the head-sluice of the Streevygoontum north channel will be, and the new channel follows the same course for about two and a half miles. It supplies the large tank of Aroomoogamungalum, and has a cultivation of about 1,347 acres, and a revenue of Rupees 16,611.

22. COOROOKAY CHANNEL.—The head-sluice of this channel is nearly opposite to Yeral. The channel supplies the tank at Coorookay. Revenue about Rs. 10,856, acres 1,064.

23. TENDRIPARI CHANNEL.—Rupees 1,860, acres 115.

24. AUTHOOR CHANNEL.—Head-sluice six miles below Streevygoontum on the southern bank, and the channel supplies the Authoor tank. Revenue 20,429, acres 1,854. When the Streevygoontum project is carried out, these channels will all be supplied from the anicut.

25. The revenue under the anicuts and channels is as follows, amounting in a total to Rupees 5,68,282. These amounts have been taken chiefly from records in my office, and only show the revenue for one year, but I am inclined to think that seven lacs is nearer the average yearly revenue, at least that is the amount Colonel Horsley calculated it at, and in the last revenue report on the district, I see that the number of acres under the Tambrapoorney river works were in Fusly 1274, 24,962 in the Sub-Collectorate, and 93,426, or a total of 1,18,388 acres, the assessment of which at 10 Rupees an acre is nearly double what I have put it at The revenue returns of each work are now under preparation in Tinnevelly, and will be shortly printed.

				Revenue.
1. Codymalaligien anicut and channels			No	record.
2. Nethyooney	do.	do.	Rs.	12,968
3. Cannadien	do.	do.	,,	1,79,812
4. Kodagun	do.	do.	,,	61,063
5. Pallyoor	do.	do.	,,	54,688
6. Sutamullay	do.	do.	,,	32,995
7. Murdoor	do.	do.	,,	1,77,000
				5,18,526

Channel.

Keelpadagay	Rs.	16,611
Coorookay	,,	10,856
Tendripari	,,	1,860
Authoor	,,	20,429
Rupees		49,756
Grand Total, Rupees		5,68,282

The average repairs for five years of the six anicuts and channels amount to only Rupees 7,264, while the revenue for one year is Rupees 5,18,526, or the repairs have only cost 1·4 per cent. on the revenue.

MADURA,
1st August 1868.

(Signed) C. V. WILKIESON, Lieut.-Colonel, R. E.,
Superintending Engineer, 8th Division.

Exd. F. R. Bantleman.

MEMORANDUM BY THE CHIEF ENGINEER FOR IRRIGATION.

1. The project now submitted by the Superintending Engineer, 8th Division, is substantially the same, as regards alignment of channels and the tract of country to be commanded by them, as the one which was drawn up in 1855 by Colonel Horsley then District Engineer of Tinnevelly. It differs from the latter, however, in other respects. Colonel Horsley proposed to adapt his main channels for navigation with the object of connecting them with the Coast Canal. In the present design irrigation only has been provided for. The surveys and levels have been carried out afresh with much care and minuteness, and with the aid of the additional information which has been thus obtained, combined with a careful inquiry into the circumstances of the country, it has been ascertained that a considerably larger area of land can be brought under irrigation than was contemplated by Colonel Horsley. In justice to that Officer, it should however be mentioned that the new levels which have been carried out by Captain Prendergast and Lieutenant Shepherd have served to confirm the accuracy of the original measurements; that the site he selected for the construction of an anicut across the Tambrapoorney has been retained; and that his various designs of masonry works, and for the general arrangement of the channels have formed the basis of the designs now submitted.

2. The project has been drawn up under the direction of the Superintending Engineer, 8th Division, Colonel Wilkieson. Lieutenant Shepherd was employed for three months in drawing up the preliminary surveys, and afterwards continued to work under Captain Prendergast. The result of their operations is, I consider, very creditable to both Officers, and particularly to Lieutenant Shepherd, whose intelligence and indefatigable industry have placed him on the footing, so far as the value of his services to Government is concerned, of Officers of much longer standing in the department.

3. The Government are aware that Colonel Horsley's project, though pronounced well devised and feasible and actually sanctioned by them, was not carried out in consequence of the mutiny. It does not appear to have again attracted much notice until the present Collector of Tinnevelly, Mr. Puckle, reported to the Board of Revenue that there had been remissions of revenue aggregating upwards of a lac of Rupees on the very land which would have been watered by the proposed channels, and that the people were so impressed with the advantage to be gained from an improved supply of water that they had subscribed and deposited in the Treasury upwards of 20,000 Rupees as their contribution to the work; and the Government, being satisfied that the scheme would prove highly beneficial, authorized the appropriation of the amount subscribed towards carting a large quantity of fine stone which was available from the dismantled fort of Palamcottah to the site of the proposed anicut. A further sum having been contributed by the cultivators, a head sluice at the south flank of the proposed anicut, and a cutting from it to the Cadamba tank were commenced under the superintendence of Lieutenant Shepherd in April, and were completed or sufficiently far advanced, to allow of the freshes of the south-west monsoon being utilized, for the cultivation of the current season.

Copy attached.

4. A Memorandum recently submitted by the Superintending Engineer contains a description of the Trambrapoorney river generally, of the anicuts already in operation, the channels leading from them, and the extent and value of the cultivation. It may, therefore, suffice here to mention that the Tambrapoorney, though an insignificant river as regards its length, or the area of its catchment basin, is, for its size, by far the most valuable river in the Presidency. It is one of the four which alone derive a supply from the south-west monsoon, which as the Government are aware, compared with the supply from the north-east monsoon, constitutes all the difference between a certain and a precarious cultivation. The other three rivers, are the Godavery, the Kistna, and the Cauvery. The two former, with their branches, drain the eastern slopes of the ghats for a distance of 550 miles, and as far south as the Kudray Mukh (horse's head), a hill 5,000 to 6,000 feet high, and about forty miles east of Mangalore. The Cauvery drains a strip of country extending from thence to the Pulney Hills, and including the Neilgherries; and the only other rivers besides the Tambrapoorney which have their sources in the Western Ghats, viz., the Vigay and Vypar—the one in Madura and the other in Tinnevelly—do not get a supply from the south-west monsoon, in consequence of their sources reaching only to the eastern edge of the ghats where the rain-fall is scanty. It is to turn the supply of the Perryaur from its natural course to the West Coast, across the water-shed which divides it from the plains of Madura, and thus to obtain for that district the inestimable benefit of an abundant supply from the south-west monsoon, that is the object of a scheme which has been brought forward by Captain Ryves and which is now under investigation.

5. I have mentioned these points, because the importance of making the most of all the available supply from the south-west monsoon cannot in this Presidency be over-rated. It is the only supply which has never been known to fail, and consequently the only real security against famines. Much has been said of late years of the necessity of maintaining, improving, and extending the means of irrigation in this country, and if a famine occurs immediate attention is drawn either to the inefficiency of the existing works, or to the want of new ones. But it is not always considered, that famines most generally occur—so far at least as this Presidency is concerned—in districts where not only tanks are dried up, but where the rivers which traverse them are dry also. There was a scarcity in the North Arcot and Madras Districts only a few months ago, and though there has since then been a considerable fall of rain, which has had the most beneficial influence, the Palar river, the largest if not the most important source of supply in the two districts, and the one which would naturally be looked to as the best subject for an artificial improvement on the supply derived from local rains, has been dry from February 1867 to the beginning of the present month, or for a period of nineteen months.

6. All the other rivers in the Presidency, with the exception of the four above mentioned, and to a certain extent the Pennair which has a very large catchment basin (20,000 square-miles), and which even in the worst seasons brings down a considerable volume of water to Nellore, are in the same category as the Palar. They are most useful adjuncts in average seasons, when tanks may not derive an adequate supply from the fall of rain within the limits of the area drained by them, but in famine years they are absolutely powerless.

7. The superabundant supply of the rivers which are fed by the south-west monsoon, if it could only be distributed over the Presidency would probably make up for the deficiency from other sources, but as this cannot be accomplished it is very desirable that every thing should be done which can be done to utilize that supply to the utmost in the localities immediately within the influence of these rivers.

8. The rate of assessment for lands under irrigation is, moreover, a very fair indication of the value of the water-supply. Along all the old native channels which derived a certain supply from the south-west monsoon, it was formerly, if it is not now, largely in excess of the average assessment of the irrigated lands throughout the Presidency. Thus, on the Calingaroyen and other channels from the Cauvery, and on the Toongaboodra channels in Bellary, the assessment of wet land was 12 Rupees and upwards. The improvement and extension of the irrigation channels in the Godavery and Kistna are of recent date, and the assessment is comparatively low, but on the old established irrigation system under the Tambrapoorney, it reaches the very high rate of 18 or 19 Rupees per acre. And the selling price of the land is also very high—1,500, 2,000, or even more per acre; whereas in Nellore, as I was lately informed, 40 Rupees per acre might be considered a fair rate of compensation for lands taken up for Government works. The above may probably be what may be called a fancy price for land, which people who have acquired wealth are ready to give, to be land-owners in a favored spot, even if the outlay does not prove remunerative to them; but at all events it shows the singular value which the natives set upon such land, or rather upon the land combined with an abundant and never failing supply of water, for we do not hear of such prices being paid for land in other parts of the district.

9. The existing channels from the Tambrapoorney water a strip of alluvial land along its banks of from two to four miles in width. This land has been formed by the river, and is extremely fertile. It is moreover tilled and manured with an unusual amount of care, and the crops yielded by it are abundant, amounting, I was informed, in some cases to 130 bushels of paddy per acre in one year. The country rises rapidly out of the valley of the river, and the soil becomes gravelly and stony. If any improvement is capable of being effected along the upper section of the river, it would be in the form of channels starting from a high level and worked up along the slope of the country bordering the valley of the river, so as to admit of the surplus flood-water being carried into tanks which are now dependent for their supply on the local rains. But this operation would of course be more expensive in the first instance, and less remunerative in the second, than the conveyance of the river water to alluvial lands which are naturally within command of it. Hence, whatever ulterior improvements may be devised in connection with the Tambrapoorney the completion of the system of irrigation within the limits of the valley of the river should engage attention first of all. This is the scope of the present project.

10. There would be no object in building a dam higher up than the proposed site at Streevigoontum, for at that site it will give the means of supplying all the land, that could be irrigated from any higher attainable level. The limits of the small delta at the mouth of the Tambrapoorney are, in fact, clearly defined by a range of sand-hills of considerable height. The channels could not be carried inland of them, and if carried to the seaward side they must be at such a distance as will render them secure from being

NOTE.—Of a reddish tinge which gives them a resemblance to heaps of powdered laterite.

filled up by the drifted sand. Captain Prendergast has, in my opinion, carried the lines of channels quite as near the sand-hills as is consistent with safety, and if this be the case, he has aligned them to command the greatest area possible of land.

11. On both the north and south sides of the river the channels after being carried in a direction nearly parallel to that of the river, and skirting as closely as possible the cultivated lands under a series of tanks which draw a supply from the higher or Maradoor Anicut, are led to two important tanks of that series which now receive but an imperfect supply. It would, of course, have been possible to have so improved the channels from the Maradoor Anicut as to enable them to irrigate the whole of the land which it is proposed to include in the new project; but such a scheme would amount to an entire remodelling of them, and would certainly be more costly than the proposed works in consequence of rock prevailing in the cuttings, while it would deprive the lands of the benefits which the latter will procure for them, by intercepting the leakage and waste from the Maradoor Anicut.

12. It will be observed that Captain Prendergast has carried his main channels round, and not through, the two principal tanks they have to supply. Although I fear this arrangement will expose the channels to some extent to invasion by the drift-sand, it gives a power of distribution which would be wanting if the tanks in question had to be filled before the other tanks lower down got any water. This advantage is not continued to all the tanks in the series, because it would add very greatly to the expense of the project, particularly on the north bank. But it will be observed that the escapes to these tanks are adapted with sluices on a low level (five feet below full tank), and as their capacity up to that level is very inconsiderable there will be no delay worth mentioning in passing on the water to the last of the chain.

13. With regard to the supply of water available for the new works, Captain Prendergast, in paragraph 3 of his report, explains that the discharge in March during the last five years has not fallen below 194 cubic feet per second, and that during the last hot weather (May) it was 324 cubic feet per second, also that for six months in the year (15th June—15th November) it is not less than 594 cubic feet per second.

14. The latter quantity, or 79,200 cubic yards per hour, he considers competent to irrigate 39,600 acres, allowing two cubic yards per hour per acre; which, if the experience gained in the Northern Deltas is to be trusted, is a sufficiently liberal allowance.

15. This has been taken as the standard or normal supply on which the capacity of the channels was to be based. The bottom width of each main channel has been fixed at thirty-six feet, and, with a depth of three feet they will each discharge a moiety of the above quantity with a velocity of about two-and-a-half feet a second. At times during high freshes when a larger volume might be required, a depth of four-and-a-half-feet, and a velocity of about three feet per second, would give nearly double the normal discharge. I need not follow Captain Prendergast in his calculation of the mode by which he proposes to use the storing powers of the tanks, which are to be fed by his channels, to make good the deficiency in the river for a second crop. It may be sufficient for me to say that he has carefully considered the subject, and that his calculations are as close an approach to accuracy as the nature of the case admits of. It would have been more satisfactory if a register of the rise and fall of the river for five years had been furnished; but from what I heard when in Tinnevelly I conclude that a complete record has not been kept up*. If, however, Captain Prendergast's account of the minimum monsoon discharge of the river at Streevigoontum is correct, it serves to show how completely the Maradoor Anicut fails to intercept the supply that reaches it, for nearly every tank comprised in the present project is connected with the channels leading from that anicut, and *might* be supplied from it. In fact, the Maradoor Anicut does intercept the monsoon supply in a great measure, but a large proportion of it must find its way back to the river; and, apart from any wastage which may be due to the imperfections of the channels, the cultivators of the upper portion of the channel, after satisfying their own wants, will turn off as much water as possible in this way rather than let it reach the tanks at the lower part of thechannel. This is the usual practice that prevails in the old native systems of irrigation, and it is one which it is impossible to subvert unless Government take active measures in support of their own rights in the matter. When the new channels from Streevigoontum come into operation, the officers in charge cannot be too careful to introduce a proper system of distribution from the first, and above all never to allow a cultivator to touch a sluice in the main or branch channels.

* Colonel Wilkieson in May last made arrangements for keeping correct registers in future at several points.

16. The following is a summary of the information furnished by the Collector regarding the extent of land to be irrigated by the new channels :—

North bank—Total area under command of channel 39,023 acres.

Present wet cultivation ...	4,091			4,091
Area under dry irrigation ...	18,585	deduct 8,585	leaving to be irrigated	10,000
Cultivable waste	8,329	,, 3,329 ,,	,,	5,000
Uncultivable waste ...	8,018	,, 88,01 ,,	,,	.....
	39,023	19,932		19,091

17. Of the first item 4,091 acres, 2,709 acres are single, and 1,382 double crop, so that there will be 15,000 acres dry and waste converted into wet (two crops), and 2,709 acres yielding a second crop.

18. On the south bank the total area under command of the channels is not given, but it does not differ greatly from that on the north.

19. The area to be irrigated is the following :—

Wet cultivation ...	8,358,	of which 1,036 acres yield one crop only.—
Dry do.	... 1,631	
Waste do.	... 3,587	
	13,576	

So that, if the whole area be taken at 80,000 acres, the proportion irrigated will be about two-fifths.

20. The assessment is calculated at the rate of 4 Rupees for the first crop, 2 Rupees for the second, in addition to 1 Rupee at which the land would be assessed for dry cultivation. Deducting present revenue, the gain would thus be found to amount to 1,42,385 Rupees per annum, exclusive of the average loss to Government of 10,000 Rupees for remissions in past years.

21. The Collector has not described in the letter accompanying the reports on the project, the principles on which the rate of assessment is based, nor is it my province to enter into the question; but, since Captain Prendergast, in paragraph 6 of his report, states that the Collector sets down the assessment at a proposed reduced rate of 7 Rupees for a double crop, but deducts the present revenue on 4,091 acres, Rupees 37,491, or at the average rate of 9 Rupees per acre, to show the net gain, I must remark that, if it is intended to lower the assessment on the 4,091 acres in question to a rate of 7 Rupees, that rate should, of course, be also taken as the basis of the calculation of gain to Government from the opening of the new works, since without those works the assessment would remain at that figure.

22. The proposed rate of assessment is much lower than that prevailing on the land watered by the Tambrapoorney channels generally. As I have already observed it is not in my province to enter into the question of revenue assessment, but it may not be foreign to the line of my duties to point out, that, as the new works will be carried out from the "Loan" grant, the Government of India are likely to demand that any additional water which is led by means of expenditure from that source, to extend the irrigation in any district, is paid for at the full value current in the locality. So that the question is not purely a land revenue one. The Government of India may set any price they please on the water thus provided, while the cultivators would equally have the liberty of using it or not, as they pleased. All I would venture to urge is the importance of not giving the water at too low a rate. The project now submitted is a very promising one, perhaps the most promising that will come before Government from any part of the Presidency. A number of other projects are under preparation, which if carried out would doubtless improve the condition of the country, but there has been a great reduction of the revenue assessment in some districts, while the prices of labor and materials have much advanced; and I fear it will be the exception, rather than the rule, for the projects now under consideration to promise a certain return of five per cent. on the outlay. Consequently, it may be anticipated that many of them will, be returned as failing to come up to the standard required by the Government of India to entitle them to a grant from the "Loan" Fund. It is easily seen that if the rate of assessment is reduced by one-half, while prices of labor and materials are doubled, a return of twenty per cent. is at once cut down to five per cent. and this is hardly an exaggeration of the changes which have occurred within the last ten or fifteen years in various parts of the Presidency. Hence, it becomes a matter of vital importance for Government to secure the highest possible return, consistent with justice to the people, from lands irrigated under favorable conditions, since it is only by setting the net returns in excess of five per cent. from such lands against the deficiency below that standard obtained from lands less favorably situated, that the aggregate returns from new irrigation works will reach the same standard, after deducting all charges of whatever kind.

23. The present project offers a very good example of the change that has occurred in the prices of labor and materials since Colonel Horsley's time, 1855. Captain Prendergast in August 1867 sent in a comparative statement showing what the works would cost, by merely altering the rates allowed by Colonel Horsley, and the estimate by the latter Officer was thus raised from Rupees 3,28,954 to 7,50,000 or more than double. The following are the former and present rates of some of the most important articles:—

	1855.	1867.
Brick-work per cubic yard	2 0 0	5 0 0
Cut-stone	7 0 0	12 0 0
Wells	2 4 0	5 8 0
Jungle-wood, per foot	1 4 0	3 8 0
Earth-work	0 0 8	0 2 0
Kunker	0 12 0	1 8 0

24. The expected returns, according to the statement obtained from the Collector, amount to Rupees 1,52,385, or deducting ten per cent. for repair and management, to Rupees 1,37,150 per annum, and the estimates to 8,31,600, that is 16·48 per cent. But some additional works will be required, and an extra establishment of probably not less than ten per cent. on the estimates will have to be included in the outlay, which in all will then probably amount to about 9,47,696 Rupees. The returns would then be 14½ per cent. And this would only be the eventual return: for some years it would be less.

25. As regards the designs for the works, I am of opinion that they have been prepared with much care and judgment. In the case of the anicut only has it appeared necessary for me to make any additions or alterations worthy of notice. I append a Memorandum descriptive of these and other purely technical details.

26. It will be observed that no provision is made in the estimates either for distribution or drainage channels, but as regards the former, the tanks along the lines of new channel are already furnished with means of distributing the water to the fields, and in any case it is the invariable custom in this Presidency for the cultivators to form the small village channels for leading the water from *tanks*. The Superintending Engineer has allowed for irrigation sluices along such portions of the new channels as are unconnected with tanks, and he apparently assumes that the village channels from them also will be carried out by the cultivators according to the custom prevailing in Tinnevelly; and as the distances to which the water has to be led to the fields is inconsiderable, it may not be unreasonable to throw this operation upon them. Still as a channel may be required to irrigate the lands of two or three villages, the arrangement for leading the water to them cannot be left entirely in the hands of the people; I have therefore added 10,000 Rupees to the estimates to allow of the Executive Officer carrying out the distribution channels, up to the point where separate channels for different interests may be required.

27. Some provision for drainage channels would seem also to be requisite. The amount of drainage which will cross the new channels is not very large, if we except that due to one large nullah on the northern side, and for that embankments are allowed for leading off the drainage water after it crosses the channel to a tidal creek near the mouth of the river. The new channels are, for the greater part of their course, masked by the line of sand-hills previously described, and any drainage water that leaves them must come in the form of infiltration. Various masonry works are allowed both for crossing the natural drainage and the surplus from the tanks above the new works, and they appear to be ample for that purpose. Moreover, the

southern channel from the Maradoor Anicut has an open head, and when this defect is remedied, as I hope will be the case before long, the surplus of the tanks in question will be reduced, in times of extraordinary flood, to the local drainage only. But still any water which would cross the new channels, (excepting what is passed off by the embanked channel above-mentioned,) must find its way into the low strip of ground which extends along the landward side of the sandy ridge bordering the coast, and as it would appear that this low ground is already in part swamp, it cannot be expected to improve when the surplus water from the fields under the new channels, which will be all extra to the present supply, shall be thrown upon it. The natural flow of the water to the tidal out-falls will therefore, I contemplate, have to be improved. A channel thirty feet wide, and averaging three feet deep, would cost 2,640 Rupees per mile, and I would propose to allow for ten miles of channel of that capacity. This, with smaller channels, would add 30,000 Rupees to the estimate.

28. It is not necessary that this amount should be sanctioned until detailed estimates are submitted ; but it should be kept in view, when the total probable cost of the project is under the consideration of Government.

29. An allowance in the estimate of 5,400 and 21,058 Rupees for office and petty establishment for three years has been struck out ; a special establishment, both executive and office, will however be required when the works are authorized for execution.

30. The estimates as revised by these, and several other alterations amount to Rupees 8,31,600, (not including probable cost of additional drainage channels, Rupees 30,000,) which I beg to recommend for early sanction.

31. The Order of Government, No. 2,680, dated 21st August, directing the adoption of certain scales in the preparation of all maps and plans, was not received in time to be acted on for the project now under consideration ; but the plans now submitted will be recopied if required, on their being returned by the Government of India.

32. In closing this report, I would beg to state that the Officers employed in investigating the project have received the most cordial assistance from the Collector, Mr. Puckle, who not only went over the whole of the ground in their company to point out to them the tract which they might count on bringing under irrigation with an improved supply of water, but also induced the cultivators to take so great an interest in the work, as to contribute both funds and labor, for carting material, building a head sluice, and opening out a channel sufficient to provide a supply for the wants of the current season.

Memorandum on Estimates.

Anicut.—A row of wells has been added at the rear of the floor to secure it against risk of subsidence. The flanks in rear have been altered from straight lines to curves, as the violent eddy from the former would produce an erosive action on the bank of the river down stream. Additional rough stone $120 \times 24 \times 3$ has been allowed for an extension of the apron in rear of each set of under-sluices, and rough stone has also been added as a protection to the base of front curved wing-wall, against a set of the river. Seven counterforts have been added to the wing-walls and returns at each flank of the anicut. The mean thickness of walls should not be much under one-third height. The batter should also rather be to the outside than inside. These additions will raise the estimate from Rupees 1,48,500 to 1,59,500.

The arrangement of under-sluices is, in my opinion, judicious. The object of under-sluices is not to prevent a *general* silting up of the bed of the river above the anicut, but to keep channels clear in front of the head-sluices. So long as this object is accomplished, I do not see that any practical injury can result from the silting of the bed in the rest of the river channel, and I consider the practice in the South of India of allowing a series of small vents, which in the larger anicuts at the Godavery and Kistna are arched over, preferable to large openings, because the resistance offered by the intervening piers prevents an undue acceleration of velocity when the river rises several feet above the anicut.

It will be observed that the retaining and wing-walls are not to be built on wells, but Colonel Wilkieson reports that the same soil for foundations will be encountered as was met in the foundation at the south head-sluice (built during past dry season) that is compact clay.

A section of the river is given on rather a small scale in the longitudinal section of the southern channel. The height of an ordinary fresh above the average deep bed of the river, or the proposed level of sluices, may be taken at ten feet.

	Sq. Feet.
Total Sectional area above level of sluices $1,400 \times 10$	= 14,000
Sectional area from same level to level of bed	4,679
Present waterway	9,321
Obstruction by anicut—area of section	7,848
Proposed waterway	= 14,000—7,848 = 6,152

or with a ten feet fresh one-third the waterway will be obstructed, or the velocity will be increased in the proportion of three to two. Average depth of water in natural condition of river is seven feet, velocity 5 to 5·6 feet per second, according as the fall is taken at two-and-a-half or three feet a mile, within which limits the actual fall of surface is likely to be, the distance to mouth of river being sixteen miles, and the total fall forty feet. The velocity of the water passing over the dam, supposing the surface to remain the same as before would, therefore, be only 8·4 to 7·5 feet per second, and the afflux corresponding to the natural mean velocity of 5·6 feet would be slightly under two feet. This is moderate. On the Kistna Anicut, which is reckoned at twenty feet above the ordinary river bed, when the river in its natural state is four feet above the crown, the afflux is from three-and-three-fourths to four feet, and the velocity twelve feet per second, and on the Godavery Anicut with a like depth on the crown the afflux is nearly three feet.

Head Sluices.—The south sluice, as before observed, was built by Lieutenant Shepherd in order to secure a supply to the Cadamba tank during the present season. It has three vents of four feet. When the water in the channel has a depth of three feet the velocity is two-and-a-half feet per second, and the discharge, in round numbers, 300 cubic feet per second. This passed through a sluice twelve feet by three waterway, gives a velocity of 8·33 feet per second, and to generate such a velocity, the head must be such that $v = 5\sqrt{h}$; hence $h = 2{\cdot}77$ feet. The

required supply would therefore be delivered before the water rose to the crest of the anicut. It is desirable that the waterway of the sluices should be kept within moderate limits to reduce the risk of accidents in sudden floods, still the northern head-sluice, which moreover has to supply a larger area than the south, has been judiciously allowed an increased waterway of four vents, or sixteen feet in all. This will reduce the velocity and afflux corresponding to a discharge of 300 cubic feet per second to six-and-a-quarter feet per second and 1·56 feet respectively.

Channels.—Several small inlets should have been provided for receiving surplus water from paddy fields for the first three miles from head-sluice southern channel. These works may be carried out from the allowance for contingencies.

On the northern channel, all surplus will find its way to the Aurmoogamungalum tank. The regulating sluice, shown in the first sheet of sections for the southern channel, is an old work, and will be rendered useless by the new channel. The Coloor calingulah will also be removed. Bridge near Alwar Tinnevelly, is to be removed. Several new bridges are allowed a roadway only six feet wide ; on these provision for cart traffic is not required.

Two Syphon Sluices.—In reply to a remark from me that the levels would appear to be suitable for aqueducts instead of syphons, the Superintending Engineer explains that, with the former, there would be no means of passage for canoes, &c., when the channel is full. This point should, however, be reconsidered before the works are built.

Bridge of three arches at Tricaloor.—The channel at the spot where this work must be built is both wide and deep.

Ahtoor Branch Channel.—Two masonry works are provided for carrying the new channel across the old Ahtoor channel and the Tenteraperry channel. Colonel Wilkieson reports that the latter cannot be closed, and that the other had better be left as it is. I do not think it necessary to detain the estimates for a further explanation, but it appears to me very desirable that these old channels should be closed, seeing that the new works will be competent to irrigate the land under them.

The dimensions of the calingulahs provided for various tanks have been considered with reference to the volume of surplus water.

Northern Channel.—Dam across sandy stream, 270 yards below head sluice. This dam is on the left bank of channel. No vents are required. The drainage will pass on to the river as at present.

Syphon Sluice near Yeral.—This work is for carrying the surplus water from fields above across the new channel.

Double dam across Stream falling into Arumoogamungalum tank.—The higher dam with vents is on the lower or right bank for the supply of the tank.

Double embankment for drainage along the Oopaur stream.—The levels are not given in detail, but can be ascertained approximately from contoured plan.

The flooring of the calingulahs or escapes to various tanks is to be of rough stone in lime. The rough stone obtainable is of a very superior quality, and as there will be either water in the lower channel, or only a small discharge into it, this may be considered sufficient provision in the way of strength, still it is desirable that there should be some further protection to the retaining wall of floor in rear, and I therefore have thought it expedient to add 5,000 Rupees to the estimates to provide for work of the kind.

FORT ST. GEORGE,
28*th September* 1868.

(Signed) J. C. ANDERSON, Colonel, R. E.,
Chief Engineer for Irrigation.

Exd. S. T. Augustin.

Proceedings of the Madras Government, Public Works Department, 26th October 1868.

Read the following papers:—

No. 549. From the Superintending Engineer, 8th Division, to the Chief Engineer for Irrigation, dated Madura, 10th August 1868, No. 1,172.

1 List containing—
13 Plans.
60 Estimates in 49 Abstracts.
1 Report.
1 Memorandum.
1 Specification.
1 Descriptive Abstract Estimate.
1 Classified do. in two parts.
1 Copy of Collector's letter.

1. I have the honor to forward, for submission to Government, the plans and estimates (as per margin) for the project of constructing, at a cost of Rs. 8,32,000, an Anicut at Streeviguntum over the Tambrapoorney river in the Tinnevelly Collectorate, with two channels, head sluices, and other subsidiary works on the north (left) and south (right) banks of river for the irrigation of about 33,000 acres of land, which will yield an increased revenue of Rupees 1,52,385 per annum.

2. It will be in the recollection of Government that the original project was prepared by Colonel (then Captain) Horsley in the year 1855, and was sanctioned by Government some years afterwards, but cancelled; no funds being available. This very promising scheme was again brought forward by Captain Prendergast while Acting Superintending Engineer of the Division in 1866-67, who forwarded it to Government in much the same state as sent up by Colonel Horsley, except with regard to the rates, which have of course increased much since that date.

3. Government in G. O., 25th September 1867, No. 2,987, called for an amended project for the anicut, &c., and in G. O., No. 563, of the 19th February 1868, on my taking charge of the division, Captain Prendergast was placed in charge of the investigation of the Streeviguntum anicut project.

4. The amended scheme now forwarded consists of an anicut 1,380 feet long, to be built across the Tambrapoorney at Streeviguntum on wells, the bed being of sand, and consists of a wall 6 feet high, 7½ feet broad, incased in cut-stone with a cut-stone apron 24 feet in width, with rough stone below it. Full description of the anicut and its subsidiary works are entered into in Captain Prendergast's report,* so I will not say more here than that on the south side the channels after supplying the large Cadamba tank, runs through several large tanks, and finishes at Tritchendoor, a town on the coast, to which place twice a year a large number of pilgrims resort, and at present there is only one well of fresh water for the supply, on these occasions, of water for several thousand pilgrims.

* Paragraph 7.

5. On the north (left) side the channel takes its course of 21 miles through several large tanks, until it comes down to the port of Tuticorin, where fresh water is very much wanted, and it may perhaps be worth the consideration of Government if a tax should not be levied on the town for the water it will receive.

6. I have been frequently over the whole ground that is to be irrigated, once in company with the Government Chief Engineer for Irrigation, and am in a position to say that I quite agree with the whole system now proposed by Captain Prendergast and to the conclusions he has arrived at.

7. I would remark, however, that the assessment proposed by the Collector appears to be very low, whether you take it with reference to that paid for the portions now under wet cultivation, or with reference to the actual value of the land, which close to Streeviguntum is valued at Rupees 2,000 an acre, while higher up the river it frequently reaches as high a price as Rupees 3,000. The present average assessment of wet crops is about Rupees 18 an acre, while the Collector proposes Rupees 4 for a single crop, or Rupees 6 when two crops are grown, and these are rates at which the profits have been calculated by Captain Prendergast. I forward a copy of the Collector's letter on the subject of the return expected, in which he still calculates the assessment on all the lands (old and new) that come under the influence of the anicut at the proposed reduced rate, Rupees 4 and Rupees 2, and deducts from it the present high rate on lands now under wet cultivation—evidently not a fair way of arriving at the profits to accrue from a new work. There is also a certain amount of acreage on the south side omitted. These will account for the difference of profit in the two statements of the Collector and Captain Prendergast.

8. In the present project I have recommended that the bridge over the anicut should be cut out of the estimate, as it is hardly fair to make an irrigation project pay for a bridge, but the foundations to the piers are included, so that at any future date one can be built. The channels have not been made for navigation, as it is considered it would add greatly to the cost, and eventually a line of rail will run almost parallel.

9. There is an item in the Budget of Rupees 58,100 for this project, and if Government considers it a sufficiently promising scheme, might I ask that the sum should at once be sanctioned for the preparation of materials in anticipation of orders of the Supreme Government.

10. In conclusion, I would beg to bring to notice of Government the very efficient way in which Captain Prendergast has got up this project. He was most ably assisted by Lieutenant Shepherd, who has gone to the extra labor of making a contour map over the whole country where the channels are to run and the land to be irrigated.

From Captain H. L. PRENDERGAST, R. E., Executive Engineer, on Special duty, to the Superintending Engineer, 8th Division, dated Madura, 8th August 1868.

60 Estimates contained in 49 Abstracts.
1 Specification.
1 Descriptive Abstract Estimate.
1 Classified Abstract in two parts.
13 Plans.
1 Memorandum.

1. I have the honor to submit plans and estimate of Rupees 8,32,000, for constructing an anicut across the Tambrapoorney at Streeviguntum, and channels for irrigation, led off both banks, each extending to a distance of about 21 miles.

The original plans and survey of Colonel Horsley have been revised, and levels have been taken all over the extent of land that it is proposed to bring newly under wet cultivation. Many years have elapsed since the sections were first taken, and not one bench mark was to be found, or any of the Surveyors' Field books: the only fixed points to which reference could be made were the floors of the head

Proceedings of the Madras Government, Public Works Department,
26th October 1868.

sluices of village channels in the river bank, and by comparing the differences of level, which were found to be perfectly accurate, the datum line from which Colonel Horsley's sections were plotted was ascertained.

2. The sketch plan of the country to the east of Streeviguntum shows the direction of the channels, and the land to be irrigated by them. The site of the anicut has been determined with reference to the existing system of irrigation on the north bank, which is also found to be the most suitable point for extending the irrigation on the south bank. The anicut is to be built immediately below the present temporary dam, which supplies the Keelpadagay channel on the left bank of the river; the course of this channel is followed for about 2½ miles, and a new channel is then traced to the south of the present cultivation, so as to avoid interfering with existing rights, past the village of Mungalacurchi, to join the Armugamungalum supply channel, where the surplus channel of the Perungoolum tank falls in. From this point there is at present a branch channel for the supply of the Coorkay tank, as also another old channel to Armugamungalum tank; and the main channel being carried northwards, above the Armugamungalum tank, to maintain the head of water, passes through the Paycolum tank, and following the line of bund of several small ruined tanks, terminates at the Korumpullum tank. The surplus of this tank will be conveyed to Tuticorin, and a sluice is provided to furnish a constant supply of water for the benefit of that town. It had been expected that irrigation might have been carried for some miles further to the north; but levels having been taken as far as 4 miles to the north of Tuticorin, it is found that beyond Korumpullum the land is altogether too high to admit of its being brought under the influence of an anicut at Streeviguntum.

On the right bank of the river a new opening is made for the main channel, which at 300 yards distance meets and absorbs the Keelavycal, a channel that carries off the drainage from the cultivation under the large Tenkarrai tank, and flows into the Cadamba tank at 5½ miles distance from the anicut head sluice. At the western extremity of the Cadamba tank, the main channel throws off a branch to the north, for the supply of the Ahtoor tank, as compensation for the loss of water in the Ahtoor river channel that will be caused by the anicut arresting the greater part of the river supply in the dry season: the Cadamba tank will receive its share of water at once from a sluice in the main channel, which turns to the south from the same point, and passes round the spread of the Cadamba tank, instead of flowing through it. By this arrangement the Government will retain the entire command of the water supplied by the anicut, to be apportioned both to the Cadamba tank and to the lands irrigated independently further on; the existing rights of the villages of Tenterapery, &c., will thus be maintained, while there will be no cause for the exhibition of that jealousy which the ryots are disposed to feel when their tanks are made to serve the purpose of benefiting their neighbours as well as themselves. At the southern extremity of the Cadamba tank bund there is a small channel which carries off water from a high level to the Ammenpuram tank, 3 miles below; this channel is to be enlarged, and the anicut water on leaving the Cadamba tank will pass down the enlarged channel to the Ammenpuram tank and the contiguous Kanum tank; from the southern end of the latter, a new channel has to be excavated for a length of 5

miles, to the Ellapanaiken tank, throwing off a branch eastwards for the supply of the Tritchendoor tank, and another small branch to Shonancatvele tank.

3. The Tambrapoorney differs materially from the Pennair and Palar rivers, which are swollen by short and uncertain freshes; for while floods of magnitude occur usually several times in the year, there is a constant moderate stream which, even so low down as Streeviguntum, never fails. The principal source of the Tambrapoorney is from the extensive valley above Papanassum, and this being within the influence of the south-west monsoon, a flood comes down as an ordinary occurrence in the early part of June. In the present season the river rose in the first week of June, and on the 7th there was a depth of 10 feet at Streeviguntum. For the next six months, or till the close of the north-east monsoon, the river is subject to floods of frequent recurrence: while the natural drainage from the hills keeps up a hot weather stream, that was calculated by experiment, opposite Streeviguntum in the present year, at 12 cubic yards per second; while also from the record of five years, it is found that during the month of March the discharge of the river is never less than 7½ cubic yards per second. But for six months of the year the volume of water in the river is not less than 79,200 cubic yards per hour, which, with the sectional area allowed, gives a discharge on each channel of 11 cubic yards a second, for a depth of 3 feet, or sufficient water for the irrigation of 39,600 acres of land at 2 cubic yards per acre per hour. The total quantity of water available for irrigation is thus arrived at:—

For six months, or for the full period of 125 days for raising the first crop, the discharge of the river at 22 cubic yards a second is 237,600,000 cubic yards, and allowing 48 cubic yards a day for each acre, or 6,000 yards for 125 days, there is water sufficient for 39,600 acres.

Next, considering fifty-seven days to elapse before the full quantity of water is needed for the second crop, the river discharges 15 cubic yards per second for a period of forty-five days, or a total of 58,320,000; and 1,350 cubic yards being required per day, at 30 cubic yards per acre per day for the second crop, 43,200 acres might be irrigated in this period. Again, for another term of forty-five days taking the minimum river discharge at 7½ cubic yards per second, there is a to volume of 28,382,400 cubic yards, which would irrigate 21,024 acres at the sa rate of 1,350 cubic yards per acre.

Now, the land to be brought newly under cultivation from the anicut is 21,2 acres, 15,000 acres being on the north side and 6,254 acres on the south side the river. Add 4,091 acres of land at present cultivated on the north bank a 7,322 acres on the south bank, and there is a total of 32,667 acres; of wh 19,091 acres are on the north and 13,576 on the south bank. For the first c

the volume of water available is	237,600,000	cubic yar
and the water required for 32,667 acres is	196,002,000	
Excess...	41,598,000	

For the first period of forty-five days for the second crop—

The water available is	58,320,000
The water required is	44,100,450
Excess...	14,219,550

For the second period of forty-five days for the second crop—

The water available is	28,320,000
The water required is	44,100,450
Deficiency...	15,718,050

Or throughout the dry season of the year the quantity of water wanting is only 1,498,500 cubic yards. For the first crop there is an excess of water to the extent of 41½ million cubic yards over the volume required for watering 32,667 acres, viz., 196 millions, or an excess of about 20 per cent.; but in this calculation no account is taken of the floods by which an immense body of water is poured into the sea. The observation of an ordinary high fresh passing Palamcottah to a depth of 12 feet in the north-east monsoon gave the discharge past Streeviguntum (allowance being made for further drainage, and the Murdoor anicut intervening) at upwards of 2,000 cubic yards per second. The storage capacity of the tanks on the line of channel on the north bank is 15 million cubic yards, and on the southern line 20 million cubic yards of water; hence 35 million cubic yards may be held in reserve in case of a failure of the ordinary river supply, which at a safe computation gives about one-fifth more water than is required.

During the first half of the period in which the second crop is growing, there is an excess of water of nearly 14¼ million cubic yards, and in the latter half of the growing season there is a deficiency of nearly 15¾ millions. But before the second crop requires water, the freshes of the north-east monsoon will have come down, and the tanks will be filled, so that there is a store of 35 million cubic yards available, in addition to the gradually accumulating excess of 14¼ millions, to make good the want of 15¾ millions towards the close of the season.

To illustrate the capacity of the channels in carrying off the water in freshes: if we suppose only a depth of 4½ feet of water in each main channel which will be given by a very moderate flood, the discharge down each channel is 21 cubic yards per second; or the supply obtained by both channels together is upwards of 3½ million cubic yards in a day. Again, at the time of cutting the first crop, when no water is required to be admitted to the fields, and with only a slight use in the river for nine days, sufficient water will be poured into the tanks to provide for the deficiency of 15¾ million cubic yards for the second crop.

4. The Tambrapoorney being a perennial stream, and the discharge of water vacying very much according to the time of year, as regulated by the West Coast monsoon, no provision is attempted for storing the flood waters, as the existing tanks will hold a moderate reserve, sufficient to provide against the very probable event of a failure of the ordinary flow after the north-east monsoon has ceased. While then every high fresh sends a large body of water to waste into the sea, it is altogether beyond the present scheme to utilize this excess of water. In the flat sandy plains near the coast there are no natural facilities for storing a large body of water, and in fact there is no inducement to consider such a proposition, for there is but a limited area of land between the existing cultivation and the seashore. If the flood-waters of the river are ever to be turned to useful account, it must be in their being stored up in reservoirs before the river leaves the hills, or in moderate-sized tanks higher up, at any rate, than Streeviguntum. What the present project aims at is to secure the cultivation of the tract of land that has hitherto been the last to receive water, by admitting the first freshes at the beginning of the cultivating season, to draw off the fields all the water (*i.e.*, taken at a minimum) that has hitherto run to waste during the dry season, thus ensuring the growth of a second crop on land that has had but a precarious supply for one crop, and to bring the remaining cultivable land that is suitably situated under irrigation from the river.

5. In the calculations of water-supply, the unfailing stream of water from the hills is depended on for the cultivable area. For as much as forty-five days of the cultivating season the average daily supply is taken at the minimum, and after March, or in the most dry time of year, hardly any water at all is required for the fields; but there is also a stand-by in the event of a season of extraordinary drought, in the water drawn off the river on both banks, from the Murdoor anicut, 12 miles above Streeviguntum. On the north bank the Peerungoolum tank, which is the last of the chain of tanks fed by the Murdoor channel, is so well supplied that it is never empty, and after a succession of floods the surplus water passes down to the Armugamungalum tank. This extra supply will now be caught by the new channel, and be available for distribution independent of the water in the river at Streeviguntum, while it may further provide a store against the diminution of water that commences in January, inasmuch as the floods of greatest magnitude come down during the north-east monsoon, which terminates in the month of December. The Paycolum tank, next beyond the Armugamungalum, may also obtain a large supply; this tank has hitherto been very badly off for water, and there has been very little cultivation from it; it will, however, be increased as to capacity, by the strengthening of the bund, and, in fact, become a considerable reservoir. On the south bank there is a similar additional supply of water. The Tenkarrai tank is filled by the channel from the Murdoor anicut, on the right bank, and the waste water from its calingulah passes down to the Cadamba tank, so as to be in future a supplemental supply for filling directly the Cadamba tank, and also for the benefit of the lands further on.

From the Collector's statement of land that can be brought under cultivation, and the additional revenue to be thereby raised, the following details are obtained:—

On the North Bank.

2,709 Acres, now one crop land for second crop at 2 Rupees	Rs. 5,418	
10,000 Acres, dry cultivation at 7 Rs. for two crops	70,000	
Deduct present assessment	4,000	
Increase	66,000	
5,000 Acres waste, at 7 Rupees for two crops ...	35,000	
		1,06,418

On the South Bank.

1,036 Acres, now one crop land for two crops at 2 Rupees	Rs. 2,072	
1,631 Acres, dry cultivation at 6 Rs. for two crops, there being 1 Rupee already paid as dry assessment	9,786	
3,587 Acres principally waste, at 7 Rupees for two crops ... ... Rs. 25,109		
But deducting for present assessment ... ... Rs. 1,003		
	24,109	
		35,967
Total...		1,42,385
Add the gain from the abolition of ordinary remissions, averaging...		10,000
Grand total Rupees		1,52,385

Allowing 10 per cent. of the gross profits for repair and management, or Rupees 15,235, there remains a net profit of Rupees 1,37,150 per annum, or 16·48 per cent. on the capital to be expended in carrying out the works.

6. The Collector in his statement of expected profits sets down the assessment at his proposed reduced rate of Rupees 7 per acre for a double crop; but he deducts the present revenue of 4,091 acres on the north, Rs. 37,491, from the aggregate future revenue of the total acreage, to show the net gain. Now, it is manifestly unfair to deduct the present average rate* per acre, of Rupees 9, from the total revenue, the greater part of which is obtained from the lower rate. To institute a proper comparison, either the future assessment of the 4,091 acres should be deducted at the 7 Rupees rate, or the whole assessment should be reckoned on the higher rate. Hence the actual profits are shown above, on the Collector's low assessment, without regard to the higher rate already paid for a small portion of the land. Again, if a moderate water-rate of Rupees 4 per acre were to be levied, as distinct from the ordinary wet assessment, the additional return on 23,963 acres would be Rupees 95,852, and the gross profits 28 per cent.

1 Rupee rate for dry land.		
4 Rupees	do.	first crop.
2 ,,	do.	second crop.
7 Rupees total.		

7. The anicut is to be 1,380 feet in length between the wing-walls, to be raised 6 feet above the average level of the deep bed of the river, and the width at the crown to be 7½ feet; there is a front slope of ½ to 1, and in rear a perpendicular fall on to a cut-stone apron 24 feet wide and 4½ feet in depth: beyond, there is a rough-stone apron of the same depth and 36 feet in width, protected by a retaining wall. The foundations of the body of the work and of the cut-stone apron in rear are to be of brick-in-chunam, laid on wells sunk 10½ feet in the sand, and raised 4½ feet above the wells, including the cut-stone covering; the retaining wall to be built of stone-in-chunam will also rest on a line of wells, to be sunk to the same depth, 10½ feet. The body of the anicut is to be of brick-in-chunam, faced throughout with cut-stone, and furnished with a set of under-sluices at each extremity of the work to let off sand and surplus water. Each set of sluices is to consist of nine vents of 4 feet width each, lined with cut-stone, it was originally intended to have three more similar sets of sluices at equal distances throughout the length of the work, but with the example of the Kistna anicut it is now considered preferable to dispense with the intermediate sets of sluices.

The original estimate also provided for a bridge of thirty-three arches of 36 feet span, and 9 feet rise, with piers 15 feet in height above the apron, to carry a roadway 15 feet in width between the parapets; but as the anicut is not situated

* Note.—This rate is the average of Rupees 37,491 for 4,091 acres, but does not at all represent the real rate paid for a double crop, for there are 2,709 acres for which the rate for—

1 crop is paid
and 1,382 acres for which the rate for—
2 crops is paid

hence a rate of	1	Rupee for dry land will give Rupees		4,091
Do.	7	Rupees for first crop... ...	,,	28,637
Do.	3½	,, for second crop ...	,,	4,837
Total	11½		Rupees	37,565

Thus the average rate of assessment is about Rupees 11½, without making any allowance for remissions, which are for this land, usual and not exceptional.

on any line of road, it is now felt that the expensive construction of a bridge is not a legitimate charge to a work of irrigation, but should be carried out, hereafter, under the head of "Communications." Still with a view to economy and a saving of time in future, it is proposed to build the foundations of the thirty-two piers, each 6 feet thick, to the same depth as those of the body of the anicut, supported by wells, as also the foundations of the wing-walls, in order that the superstructure of a bridge as described above may at any time be built.

It is found by calculations that a height of 6 feet for the anicut allows of a convenient slope of 1½ feet per mile down each of the main channels for the first few miles, the floor of the head sluice being 6 feet below the crown of the anicut. Owing to the loose sandy nature of the soil, in many places sand, the main channels must have side slopes of 2 to 1: the channels are not designed to carry off water rapidly, as in arresting freshes of sudden rise and brief duration, but width is required to enable the requisite body of water to pass down with moderate velocity.

The top of the wing-walls of the anicut are brought to a height of 3 feet above the level of a maximum rise of the river, the afflux caused by the anicut during a flood of magnitude is hardly appreciable (being calculated at less than 3 inches) from the increased velocity, and no precautionary measures are required to prevent the river topping its banks, as there is an artificial bund along each bank, for some miles, both above and below the site of the anicut.

8. The northern channel for the first 7 miles, and the southern for 5½ miles, have both a fall of 1½ feet per mile, with a bottom breadth of 36 feet; the sectional area of each will be 6½ square yards, and the hydraulic mean depth about 16 inches, when there is a depth of water of 18 inches in the channel. Hence by Neville's Hydraulic rules, the velocity is about 20 inches per second; and the discharge becomes 3⅔ cubic yards per second, as the minimum supply of water in the channel during the cultivating season. With 3 feet of water in a channel, the discharge will be 11 cubic yards a second, as the normal state of the channel for at least six months; and when 4½ feet depth of water is admitted, at the time of freshes, the delivery of the channel will be about 21 cubic yards per second. On these data the supply of water at different seasons, and the area of land thereby irrigable, have been calculated.

In reckoning on the supply of water derivable from the river, the additional supply by the rain-fall has been neglected, for the rain-fall is but insignificant; the average rain-fall in a succession of years being 21·06 inches, and that in a very bad season only 11·68 inches; a constant stream of water is also depended on for the cultivation, not storage in tanks to be maintained by the drainage of the country, in the short season of the rains.

But to provide for the disposal of the natural drainage, and also of the surplus water passing from the cultivation above the lines of new channel, a further valid reason exists for these channels having a considerable capacity in width, and for their sectional area being greater than would be necessary only for the passage of water actually requisite for irrigation. In addition to other escapes for storm-water, there is on the northern line a dam 200 yards in length, with under-sluices, across the Oopaur, Oday, or jungle stream; and on the south side there is an extensive calingulah in the Cadamba tank bund, measuring 330 yards in length.

9. The wing-walls of the anicut are carried round by a curve to join the lower wing-wall of the head-sluice on each bank; on the right bank the head-sluice contains three vents of 4 feet, on the left bank the head-sluice has four similar vents, inasmuch as the area of land to be irrigated on the north bank is greater than that on the south.

On the north bank, at a distance of 2½ miles from the head-sluice, there is to be a division sluice for the irrigation of the Keelpadagay lands, where the new channel leaves the old one at D. on the sketch plan. This sluice consists of two vents of 2 feet width by 4 feet, and is capable of discharging 24·6 cubic feet per second, with a depth of 18 inches of water in the channel.

Five miles on, a head-sluice is provided for the present branch channel to the Coorkay tank, the sluice has two vents of 2 feet width each and 4 feet height; hence it is calculated to discharge 14,514 cubic yards an hour, for storage in the tank, when the channel is running 4 feet deep. Close beyond the above there is a division sluice, serving also as a surplus calingulah for the supply of the Armugamungalum tank. The sluice contains three vents of 4 feet width each and 6 feet height, which will discharge 28,281 cubic yards per hour, with the ordinary flow of 3 feet in the main channel, and in flood times will send down 79,993 cubic yards per hour for storage in the tank. The waterway of the calingulah is 10 yards in length, and supposing the water to pass over 2 feet deep when the Perungcolum surplus channel is running, the discharge over the calingulah will be 38,486 cubic yards per hour. Over this calingulah there is a bridge of 30 feet span, and a causeway leads to another bridge of the same dimensions over the main channel; this arrangement being necessary to maintain communication along the road from Yeral through Siruthundoo to other villages to the north.

Following the main channel, at a distance of about 2½ miles, a jungle stream falls into the Armugamungalum tank; and to allow this to discharge into the tank, when in flood, there is a calingulah of 150 feet in length and 4½ feet high. In the body of the calingulah there are ten vents, each of 4 feet; and if the stream is in flood, a depth of 2 feet over the calingulah will carry off 192,434 cubic yards per hour, which is ample provision for the drainage of the lands above. After another half a mile, in consequence of the rapid rise of the ground to the west, the main channel falls into the Paycolum tank, the bund of which is to be strengthened and slightly raised where necessary.

From the floor of the calingulah of this tank there is a fall of 1 foot per mile along the line of bund of several small ruined tanks to the Korumpullum tank, these bunds will be strengthened to a proper section, and calingulahs are provided with sluice vents to pass on the ordinary flow from the main channels, which will also be closed in order to obtain storage and pass the surplus water on over the crown.

Within a mile from the Korumpullum tank to the south, the Oopaur jungle stream crosses the line of water-supply; this stream runs in several widely diverging channels, and, when swollen by heavy rain, spreads over a broad strip of land; for the disposal of floods a long dam or calingulah, 600 feet between wing-walls, is provided, and the banks on either side are further protected by a revet-

ment wall for a length of 225 feet, to be built on deep foundations. In the body of the work, which is 4½ feet high, there are twenty vents of 4 feet each; in a heavy burst of monsoon, supposing the water from the stream to rise 3 feet above the crown, the discharge per hour will be 1,414,099 cubic yards. To compare this with the volume of water liable to be brought down, a maximum fall of rain is taken at 8 inches in the twenty-four hours. Along the coast of Southern India the rain cloud is known to take its course along a narrow belt of country, and in the north-east monsoon its direction is not far different from that of the coast line; hence its path intersects, nearly at right angles, the general course of the rivers which run down from the west. In the case of the Oopaur, it is assumed, that there may be a fall of 8 inches over about one-fourth of the drainage area, or 80 miles
4 inches over another fourth or ... ... 80 ,,
and 2 inches over the remainder ... ... 182 ,,

Total ... 342 square miles.

and allowing one-fourth of the rain-fall to run off, there is a discharge of 1,186,546 cubic yards an hour. Thus the dimensions of the dam are sufficient to carry off the drainage from an excessive fall of rain.

Beyond the Korumpullum tank the channel is carried on through four vents of 4 feet width, with a fall of 1 foot a mile, to Tuticorin, while in the monsoon the surplus water brought into the tank by drainage will pass over the crown of the calingulah. The channel will cut off the drainage of the ground on the north, and prevent the accumulation of water in the low land to the south, which is thus reclaimed for irrigation. While then the duty to be ordinarily performed by this channel is merely that of supplying fresh water to Tuticorin, the channel is liable, at certain times, to have a considerable accession of flood-water, and the fall given, viz., 1 foot in a mile, is the greatest possible, as it terminates at the high tide level: hence on calculating the amount of drainage that the channel receives and intercepts, a bottom width of 24 feet must be allowed.

The present principal outlet for the discharge of waste water along the course of the main channel to the south of the Oopaur river is the calingulah of the Armugamungalum tank, the capacity of this calingulah exceeds that of the two new calingulahs provided in the channel bank, and the work, therefore, does not require alteration.

The Oopaur stream, however, must not be left in its natural condition, for the several channels in which it is divided meet again in two lines of drainage, or rather these two lines indicate the general direction to the sea, for the water spreads promiscuously over the country and lodges in extensive swamps. To remedy this the drainage to the north will be cut off, and the whole of it will be kept within bounds, to follow the line to the south and enter the sea at the natural outlet, near the main mouth of the river. The fall of the ground lies in this direction, as seen by the contour plan, and from the wing-walls of the dam across the Oopaur a bank will be thrown up on each side of the drainage channel to a height of 6½ feet. The deep bed of the channel is about 4 feet in depth and 300 feet wide, a berm of 100 feet width is given on each side, and by the

dimensions thus fixed (the excavation for the bunds being all taken from the inside) the channel will carry off a volume of 1,294,705 cubic yards of water per hour. Thus the channel will dispose of the flood-waters passed on from the dam, calculated above at 1,186,556 cubic yards per hour.

The minor works, on the north side of the river, besides those specified above, are a dam across a sandy stream falling into the main channel, within 300 yards from the head sluice;

A bridge of 36 feet span for communication with the villages north of the channel;
A syphon sluice to carry off the drainage from the fields of Perungcolum under the main channel;
A small supply sluice near Mungalacurchee near E. on the plan;
A bridge of 30 feet span on the road between Mungalacurchee and Perungcolum; A similar bridge on the Palyacoil salt road marked H;
And four calingulahs, each of 24 yards length, and furnished with four vents of four feet width at the extremities of the Paycolum, the Pottacolum, the Chinnasawmy Naick, and the Korumpullum tanks.

The estimated cost of the channels and subsidiary works on the north-side is Rupees 2,97,940.

10. On the south bank, at a distance of 5½ miles from the head sluice, the main channel arrives at the Cadamba tank. At the entrance to the Cadamba tank, where there is at present a dam that retains the water in the tank and prevents it flowing up the Keelavycal channel, dividing works are proposed for three-fold purpose, viz., for supplying direct the Cadamba tank; for a channel on the left bank to the Ahtoor tank; and for carrying on the main channel on the right bank, round the Cadamba tank.

For the Ahtoor channel there is provided a head sluice of two vents, each 2 feet wide by 4 feet. For the Cadamba tank the head sluice consists of four vents, each 4 feet wide by 6 feet high, over which there is a platform bridge to give communication along the left bank of the channel; close to this there is another head sluice of three vents, each 4 feet wide and 6 feet high, for the channel round the Cadamba tank.

The Ahtoor branch channel has a bottom width of 12 feet, side slopes two to one, and a fall of 1 foot in a mile; with this section the discharge at a depth of 3 feet is 3⅔ cubic yards a second (or double the volume needed for the 3,000 acres dependent on the channel supply), at a distance of about half a mile the branch channel crosses the Tenterapery river channel, the latter being carried under by an inverted syphon; then passing under the Tritchendoor road, at about 1½ miles further on, it crosses by an aqueduct the old Ahtoor river channel, and falls into the Shedavycal tank. The tract of land between the old Ahtoor channel and the river will thus be brought under cultivation as far as Shedavycal, and the old tank being strengthened, the stream of water will be passed on by a calingulah, of 30 feet length for the supply of the Ahtoor tank. In addition to the aqueduct and syphon sluice, there is provided a platform bridge of two vents of 4 feet each, on the Tritchendoor road; another similar bridge on the road leading to Yeral across the river, and an ordinary sluice of irrigation in the Shedavycal tank bund.

The main channel on leaving the dividing works has a bottom width of 24 feet side slopes of two to one, and a fall of 1 foot per mile, for a length of 8 miles, at the end of which the channel falls into the Ammenpuram tank. When running 4 feet deep this channel will convey 12 cubic yards per second for the supply of the Ammenpuram tank; at a distance of nearly 2 miles from the head sluice the channel is taken under the surplus stream from the Tenkarrai tank by an arched tunnel of four vents, each 4 feet wide and 5 feet high, with a water way of 90 feet length, and, at the southern extremity of the Cadamba tank bund, joins in with the present high level channel leading down to the Ammenpuram tank. The section of this latter channel is increased both by deepening and widening, width being for these 3 miles especially requisite, as the channel skirts the edge of the hills of red sand which are loose, and much affected by the strong westerly winds.

The Ammenpuram tank is separated from the Kanum tank by a calingulah, to be built 24 yards long and 5 feet high, and with four vents 4 feet wide; a similar calingulah is provided at the southern extremity of the Kanum tank, to admit of the constant stream flowing through the tanks to the channel beyond. On leaving the Kanum calingulah, the channel is continued with the same section as before, along the slope of the land that falls rapidly from the Red Hills, for a distance of 5 miles, to the Ellapanaiken old tank, which is its termination. This latter section of the channel is of greater width than would be necessary merely to convey the water for irrigation: but the channel cuts off the drainage of the land above entirely, the soil is sandy, and a greater fall than that allowed is not attainable; hence in providing for a maximum fall of rain, it is not safe to reduce the channel section. A branch channel is thrown off at $1\frac{1}{2}$ miles above the Ellapanaiken tank, with a bottom width of 12 feet, and of the same capacity as the Ahtoor channel. This branch channel will supply the town of Tritchendoor with fresh water in filling the old tank which is to be restored, for the irrigation also of the land below it. A regulating dam of 15 feet length and $4\frac{1}{2}$ height is provided where the branch channel leaves the main channel: one sluice vent of 3 feet width will pass on the supply of water for irrigation, and flood-water will flow over the dam.

Another similar regulating dam is provided a short distance below the Kanum calingulah for the branch channel, of about a mile to the Shonancatvele or Thulukencolum old tank. The bund of this tank is to be restored, two irrigating sluices are also provided, and a surplus calingulah of 30 feet length.

The other works estimated for consist in the restoration of the old Ellapanaiken tank, with a surplus calingulah of 30 feet length, for the discharge of the monsoon drainage into the swamp a mile below, which has its exit into the sea, some miles on, near Colasagarapatam. A surplus calingulah is also to be provided for the Tritchendoor tank, and an irrigating sluice.

The other minor works are ten irrigating sluices along the channel between the Kanum and Ellapanaiken tanks, and six irrigating sluices in the Ahtoor branch channel.

The cost of the channels and subsidiary works on the south side is Rs. 3,02,682.

Within the high belt of land along the seashore, between the salt pans and Trichendoor, there are low lying swamps, marked on the sketch map: and levels

have been taken over these parts to ascertain if it is possible to drain them off. They are found, however, to be so very low that such a measure is not practicable, and the idea of bringing them under cultivation has consequently been abandoned.

11. A small tiled bungalow is provided for in the estimate, consisting of two rooms, for the occupation of the resident Executive Officer, and for the safe keeping of the Office records, instruments, &c., during the progress of the works. This will be built as near as convenient to the site of the anicut, there being at present no building at all in the vicinity. Provision is further made for erecting temporary sheds, at distances of ten miles apart, for the general accommodation of the Engineering staff, Contractors, and other persons connected with the works.

Under Superintendence no entry is made in the estimate for the salary of the Executive staff, as the general establishment will furnish the Officers and Overseers; but due provision is made for the Subordinates of lower grade that come under the head of Petty Establishment, and also for the Office establishment, which is set down on the scale of a first class Range Office.

The rates are taken in general as those prevailing in the Tenkarai Talook; for some of the masonry works a higher rate must be allowed than for the head works, as both bricks and stone, as well as chunam, must be conveyed several miles. No increase in prices has been made in anticipation of Railway operations being commenced from Tuticorin, but the sooner the anicut works are put in hand, the less will the Government suffer in consequence of the demand for labor on the railway, and the rise of prices that must then inevitably take place.

MEMORANDUM.

The dimensions of the head sluices have been determined with relation to the height of the anicut. When the river water stands on a level with the crown of the anicut, the head sluice on the north bank will discharge about 21 cubic yards per second, or double the volume required for irrigating the land, viz., 19,091 acres, the flow of water in the river being constant, and there being partial storage, it is held that twice the actual quantity to be used will be sufficient, evaporation and other losses inclusive. If the crown of the anicut had been 1 foot lower, the head sluice must have been enlarged to allow of the same discharge of water; but from the tendency of a river to silt up above an anicut, necessitating an increased height being given to the work after a few years, it appears advisable to place the crown of the anicut on that level, which will allow a sluice of moderate dimensions to discharge the required quantity of water.

The width of the body of the anicut, at top $7\frac{1}{2}$ feet, is somewhat great, but in the event of the work being raised in course of time, it will be an advantage having a good top width upon which to build.

The discharge of the river has been taken from the record of the average of five years, which gives 22 cubic yards a second for six months, and never less than $7\frac{1}{3}$ cubic yards up to the end of the cultivating season. Now, considering that only the minimum discharge is reckoned on for as much as forty-five days, it is taken as a fair average calculation that, for the other forty-five days, the discharge is 15 cubic yards a second.

If, however, only the minimum discharge were assumed as available for the whole ninety days of the second crop—

There would be water available	56,764,800 cubic yards
Do. required	88,200,900
Deficit...	31,436,100

and to meet this extreme case there is storage capacity to the extent of 35 million cubic yards, to be obtained by all the floods of the north-east monsoon.

The land commanded by the channels is limi ted on the north side of the river by the sand hills to the west of the line of channel, as far as the Oopaur stream, beyond which on the north the ground is all several feet above the channel level, and no extension of the channel can be made.

On the south bank the channel likewise is taken round the edge of the hills of sand, and the cultivation is limited by the backwater running up from the sea. The minimum supply of water from the river not being quite enough for the irrigable area, recourse is had to storage for that deficiency of water by making use of the existing tanks. More water is available for several months, but is not wanted, more land might be irrigated, but is not available. It does not appear likely at present that the channels will ever be required for navigation, and therefore there have been alterations made in the course of the channels, from those originally proposed, when it was considered that the East Coast Canal might be extended to the south of the Peninsula: the development of the railway system in the last few years having altogether changed the prospects that were entertained formerly of improved means of communication. On the north bank the channel might have been taken along the upper spread of the Paycolum tank, but the expense of 4 miles of excavation is saved by letting the channel into the tank; again, the channel might be continued above the tanks beyond the Paycolum, but the bunds of these tanks, which have fallen into disuse from want of water, provide a line of embankment that only needs restoration.

On the south bank the channel might have been kept up at the edge of the Ammenpuram and Kanum tanks, but the cost of two miles of channel is avoided by making use of these tanks.

The channel leading into Tuticorin must carry off the drainage from the north, and its section is determined from the drainage area in a heavy burst of monsoon; the channel also cannot pass the drainage across by escapes through the land to be brought under cultivation, without embankments along the course the water would have to take, and thus further intercepting the field channels from the Korumpullum sluices.

Likewise, on the south, the channel from Kanum tank must conduct the drainage by the Ellapanaicken tank, to the natural outlet into the sea further south.

MADURA,
8th August 1868.

(Signed) H. L. PRENDERGAST, Captain, R. E.,
Executive Engineer.

Specification to accompany the Estimate for the Streeviguntum Anicut Project.

Estimate of Rupees 8,32,000 for constructing an Anicut across the Tambrapoorney river at Streeviguntum, in the Tenkarrai Talook of the Tinnevelly District,

Proceedings of the Madras Government, Public Works Department, 26th October 1868.

with channels for irrigation to Korumpallum on the north and Trichendoor in the south, as also branch channels for the supply of Ahtoor and other tanks, comprising the following items:—

	RS.
Anicut	1,48,500
Northern channel	1,28,370
Subsidiary works of do.	1,69,570
Southern channel	1,93,850
Subsidiary works of do.	1,08,832
Cost of land, superintendence, plant, &c.	82,878
Total...	8,32,000

1. The Anicut is to be 1,380 feet in length between the wing-walls, the foundations both of the body of the work and of the piers of the bridge to be of brick-in-chunam, laid on 924 wells, each well to be 4 feet inside diameter and 6 feet deep, the thickness of the brick-work of the wells to be 10 inches, making a total or outer diameter of 5 feet 8 inches. The wells are to be sunk 10½ feet in the sand, and the foundations to be raised 4½ feet above the wells, including the cut-stone covering. The height of the Anicut is to be 6 feet above the average level of the deep bed of the river, the width at the crown is to be 7½ feet, and with a batter in front of 3 feet, the bottom thickness is 10½ feet. The body of the anicut is to be faced throughout with cut-stone 9 inches thick, and to be furnished with two sets of under-sluices, to let off sand and surplus water, each set to contain nine vents of 4 feet width. The breadth of the cut-stone apron in rear is to be 24 feet, the stone-work being 9 inches thick above the brick foundation of 3 feet 9 inches, which makes a total depth of 4½ feet; beyond this, there is to be a rough stone apron 36 feet in breadth and 4½ feet in depth, including the retaining wall 3 feet broad and 4½ feet deep, built on a row of wells of the same dimensions as those of the body. Each of the wing-walls is to be 151 feet in length, including a curve of 47 feet length, which connects the anicut wing-wall with the wing-wall of the head-sluice. The foundations to the wing-walls to be built of brick-in-chunam, 8½ feet in breadth and 7½ feet depth; the wings above will be 20 feet high, the breadth at bottom 7 feet, and at top 3 feet, including a cut-stone facing 9 inches thick throughout. Two sets of cross-stones are provided for each vent for working the wooden shutters; the stones to be 5½ feet long, having 9 inches let into the masonry on each side. The shutters are to be of teak wood, 3 inches thick and 7½ feet long, the grooves for the shutters being of cut-stone.

Northern Channel.

The Northern Channel has a bottom breadth of 36 feet, with side slopes of 2 to 1, and a fall of 10½ feet in the first 7 miles, or 1½ feet per mile; during the next 11 miles, or as far as the Korampullum tank, the average fall is 1 foot per mile. Beyond the Korumpullam tank, the channel to Tuticorin has a bottom width of 24 feet, and fall of 1 foot per mile to the level of high water in the sea.

Head Sluice for the Northern Channel, estimate Rupees 12,520. *No.* 1.

The abutments and piers are to be built on a foundation 29½ feet in length, 26½ feet in breadth, and 7 feet deep (inclusive of the 9 inches cut-stone

covering). The sluice is to contain four vents, each 4 feet in width. The thickness of the abutments above to be 4 feet at top, and 5 feet at bottom, with steps of 2 feet 8 inches each, and offsets of 6 inches each. The piers will be 3 feet thick, and raised to a height of 8 feet.

The front and rear aprons, which are 3 feet thick, are protected by retaining walls 3 feet broad and 7 feet deep.

The foundations of the wing-walls, both in front and rear of the sluice, are to be $8\frac{1}{2}$ feet in breadth and 7 feet deep. The front wing-walls to be raised above to a height of 20 feet, the top thickness of 3 feet to be carried down uniformly for the first 4 feet; and with steps of 2 feet, and offsets of 6 inches, the thickness at bottom is 7 feet. The rear wing-wall is 20 feet high for a length of 12 feet, and from thence for a length of 18 feet it slopes down to a height of 10 feet, the front face of these wing-walls on the river side will be faced with cut-stone 9 inches thick. The head-sluice will be connected with the anicut by a curve of 30 feet radius for a length of 47 feet. A flight of twelve steps is made in the wing-wall, each step 1 foot in breadth and 3 feet in length. A stone platform is laid in front, above the piers, 4 feet in breadth and 2 feet thick; for working the shutters of the sluice twelve cross stones are provided for the three vents, 9 inches square and $5\frac{1}{2}$ feet in length. The shutters are each 4 feet in breadth, 3 inches thick, and 11 feet 6 inches in length. The wing-walls of the road-way will be built on a foundation 5 feet in breadth and 7 feet deep. The height of walls above is 6 feet, and the average breadth 3 feet.

The versed sine of the arches over the vents will be 2 feet, giving a total height of 10 feet to the soffits.

The face-walls above the arches are to be 6 feet broad at bottom, and $2\frac{1}{2}$ feet broad at top, with offsets of 6 inches, to a total height of $14\frac{1}{4}$ feet.

The blocking course is to be 1 foot 9 inches thick and $1\frac{1}{2}$ feet deep, over which the parapet walls are $1\frac{1}{2}$ feet in thickness and 3 feet in height, with pedestals $2\frac{1}{2}$ feet square at each end, and protected by ten guard stones, each 9 inches square.

The thickness of the arch will be $1\frac{1}{2}$ feet, and the breadth 18 feet. The roadway will have a clear width of 15 feet between parapets, and 24 feet between the wing-walls. With the exception of the cut-stone casing and apron the work is to be constructed of brick-in-chunam.

A Dam across a sandy stream falling into the channel, 270 yards below the Keelpadagay head-sluice. Estimate Rupees 620. No. 2.

The body is to be 30 feet in length, 3 feet broad, and $7\frac{1}{2}$ feet high, raised on a foundation 4 feet broad, and $4\frac{1}{2}$ feet deep; with wing-walls 36 feet long, $2\frac{1}{4}$ feet thick, and $10\frac{1}{2}$ feet high, built on foundations similar to those of the body. The whole to be built of brick-in-chunam, except the rough-stone apron in rear, which is $31\frac{1}{4}$ feet average length, $5\frac{1}{2}$ feet broad, and $2\frac{1}{2}$ feet deep.

Proceedings of the Madras Government, Public Works Department,
26th October 1868.

A Bridge of one elliptical arch 36 feet span across the channel, in lieu of the present imperfect stone platform bridge, to keep open the communication between the villages to the north of the channel and the river. Estimate Rupees 3,400. *No.* 3.

The foundations of the abutments are to be 6 feet deep, 9 feet broad at top, and 12 at bottom, resting on clay; with an inverted flooring under the arch 6 feet in breadth, and $1\frac{1}{2}$ feet thick, protected by front and rear retaining walls $1\frac{1}{2}$ feet thick and $5\frac{1}{4}$ feet in depth. The abutments above will be 9 feet thick, raised to a height of 5 feet; the versed sine of the arch to be 9 feet, giving a total height of 14 feet to the soffit. The foundations of the wing-walls are to be 15 feet in length, with a breadth at top of $6\frac{1}{2}$ feet, and at bottom $8\frac{1}{2}$, and sunk to a depth of 6 feet; the wing-walls above will be $15\frac{3}{4}$ feet high, and 4 feet average thickness. The face walls are to be 2 feet thick, and the blocking course $1\frac{3}{4}$ feet. The thickness of the arch will be $1\frac{3}{4}$ feet at the crown and $4\frac{1}{2}$ at the haunches. The road-way will have a clear width of 6 feet between parapets (which are to be $1\frac{1}{2}$ feet thick and 3 feet high), and 12 feet between the wing-walls. The bridge is to be constructed of brick-in-chunam throughout.

A division Sluice with two vents 2 feet × 4 feet each, for supplying the Keelpadagay lands at the point where the new channel leaves the old one, at D. in the sketch map. Estimate Rupees 1,440. No. 4.

The sluice consists of two vents, each 2 × 4. The abutments and pier will be 16 feet in length including the cut-water, 3 feet broad including a cut-stone facing of 9 inches thickness, and $5\frac{1}{2}$ feet high, built on foundations 6 feet in depth and 4 feet broad. The wing-walls are to be 22 feet in length each, of 2 feet mean thickness, and 10 feet high, resting on a foundation $3\frac{1}{2}$ feet in breadth, and 6 feet in depth. The flooring to the vents will be 12 feet in length, 4 feet broad, and $1\frac{1}{4}$ thick, with a cut-stone lining above of 9 inches thickness; the flooring is supported by a front and rear retaining wall $1\frac{1}{2}$ feet thick and $5\frac{1}{4}$ feet deep. In rear, there is a rough stone apron of 13 feet mean length, $7\frac{1}{2}$ feet breadth, and 3 feet depth; protected also by a retaining wall 18 feet in length, $1\frac{1}{2}$ feet breadth, and $4\frac{1}{2}$ feet in depth. The covering stone platform will be 14 feet in length, 7 feet broad, and 9 inches thick; four cross stones are provided, 9 inches thick, for the wooden shutters, which will be 4 feet × 7, and consist of 3 inches teak planking. The whole of the work is of brick-in-chunam, with the exception of the apron of rough stone.

A small supplying Sluice at the head of the branch channel to the Keelpadagay lands. Estimate Rupees 470. *No.* 5.

The sluice is to have a vent $1\frac{1}{2}$ feet square, the body being 30 feet long, 6 feet broad, and 6 feet deep; the wing-walls in front and rear being 18 feet in length, $13\frac{1}{2}$ feet high, and $2\frac{1}{4}$ feet thick. The sluice will be built of brick-in-chunam, excepting the cut-stone lining of the vent.

A Bridge of one elliptical arch 30 feet span, on the cross road leading from Parrongolum to Mungalacurichy. Estimate Rupees 3,260. *No.* 6.

The foundations of the abutments are to be 6 feet deep, $7\frac{1}{2}$ feet thick at top, and $10\frac{1}{2}$ feet at bottom, resting on clay. The abutments above will be $7\frac{1}{2}$ feet

broad, and 3 feet high; the wing-walls are to be 12 feet high, and of 3 feet mean thickness, resting on foundations 6 feet deep, and 4½ feet broad, with a length of 20 feet each. The versed sine of the arch is to be 7½ feet, giving a total height of 10½ feet to the soffit. The face walls are to be 2 feet thick, and the blocking course 1¾ feet, over which the parapet is 1½ feet thick, and 3 feet high. The thickness of the arch at the crown will be 1½ feet, and at the haunches 4 feet. The road-way will have a clear width of 15 feet between the parapets, and 21 feet between the wing-walls. The flooring is to be an invert 30 feet in length, 15 feet wide, and 1½ feet thick, protected by retaining walls 1½ feet thick, and to a mean depth of 5¼ feet. The bridge is to be built of brick-in-chunam throughout.

Ten irrigating Sluices for new land to be brought under cultivation, between the extremity of the Payacolum tank and the north end of the Korumpullum tank. Each to be similar to that for the Keelpadagay lands, No. 5, but with a length 60 feet. Estimate Rupees. 2,670. *No.* 15.

Two Bridges, each of one elliptical arch 30 *feet span, with a causeway* 471 *feet in length, and a Calingulah with sluice vents across the Armugamungalum channel at Yeral. Estimate Rupees* 19,060. *No.* 9.

The foundations of the abutments are to be 6 feet deep, 7½ feet thick at top, and 10½ at bottom, resting on clay; the abutment walls above are to be 7½ feet thick, raised to a height of 6¾ feet; the versed sine of the arch to be 7½ feet, giving a total height of 14¼ feet to the soffit. The abutments are strengthened by buttresses 3 feet thick, raised to the full height. The wing-walls are curved, 15¾ feet high, 1½ feet thick at top, and 6½ feet thick at bottom, resting on foundations of 6 feet depth and 8 feet in thickness. The face walls will be 2 feet thick, and the blocking course 1¾ feet; over this the parapet is 1½ feet thick and 3 feet high. The thickness of the arch at the crown will be 1½ feet, and at the haunches 3½ feet. The flooring under the arch is to be 30 feet long, 16½ feet broad, and 1½ feet thick, with a retaining wall 1½ feet thick and 5¼ feet deep. The body of the calingulah has a length of 30 feet, breadth 4 feet, and height 6 feet, which includes stone lining 9 inches thick. There are three vents each 4 feet × 6 feet and nine cross stones for the shutters, which are 4 feet × 6 and 3 inches thick. The road-way over the bridge and the approaches are horizontal, the clear width between parapets being 16½ feet. The work is to be built of brick-in-chunam.

Constructing a double Dam across a jungle stream falling into Armugamungalum tank. Estimate Rupees 5,850. *No.* 10.

The body of the dam on the right bank is 150 feet long, 3¾ feet thick, and 4½ feet high; these dimensions including a cut-stone facing of 9 inches, the foundations are 4½ feet thick, and 4½ feet deep. Ten sluice vents are provided, each 4 feet wide and 4½ feet high, lined with cut-stone. The wing-walls are curved 24 feet long, their mean thickness being 2¾ feet and height 9 feet; the foundations, being 4 feet thick and 4½ feet deep. Below the dam there is an apron 6 feet wide and 2½ feet thick, with a rear retaining wall 159 feet long, 2 feet thick, and 4½ feet deep.

The body of the dam on the left bank is 150 feet long, 3 feet thick, and 2¼ feet high, the foundations being 3¾ feet thick, and 4½ feet deep: there is one inlet vent of 1½ feet width. The wing-walls are similar to those of the dam described above. The flooring between the two dams is 44½ feet wide and 2½ feet thick, supported by side-retaining walls, each 30 feet long, and of the same section as the wing-walls. The whole work to be of brick-in-chunam, except the flooring, and apron of rough stone-in-chunam, and the lining of the vents in cut-stone.

A Bridge of one elliptical arch 30 *feet span for the Pullayacoil salt pan road. Estimate Rupees* 3,260. *No.* 11.

Similar to that on the Mungalacurchy road, No. 6.

A Dam across the Oopoday, a large jungle stream which crosses the line at I. in the sketch map. Estimate Rupees 36,640. *No.* 12.

The dam is to be 600 feet in length, 4½ feet thick, and 4½ feet high, including the cut-stone facing 9 inches thick; the foundations will be 9 feet deep and 6 feet thick. The wing-walls will be 97½ feet in length each, 2¼ feet thick, and rising in height from 6 to 10½ feet; the body is to have twenty discharge vents, each 4 feet wide and 4½ feet high. The apron is 16 feet wide, and consists of rough stone-in-chunam 2¼ feet thick, covered with cut-stone, 9 inches in thickness with a fall in rear of 3 feet; a second apron extends to a width of 22 feet, being 3 feet thick, in rough stone, each apron has a retaining wall 9 feet deep and 2 feet thick. The vents have the usual arrangement of cross stones and shutters 3 inches thick. The walls and foundations are to be of brick-in-chunam. Stream wings are also to be built, each 225 feet in length, 3 feet thick, and 9 feet high, built on foundations 4 feet thick and 9 feet deep.

Constructing a head Sluice 350 *yards below the proposed Bridge calingulah at Yeral for the supply of Coorkay tank. Estimate Rupees* 1,440. *No.* 7.

The particulars are the same as those explained for the sluice provided for the Keelpadagay lands, (No. 4.)

A Syphon Sluice of one vent near Yeral. Estimate Rupees 3,150. *No.* 8.

The body of the sluice is to be 114 feet in length, 11½ feet in breadth, and 3 feet deep; the side walls of the vent are to be 3 feet thick, including the cut-stone facing 9 inches thick, and 4 feet deep; the versed sine of the segmental arch will be 1 foot, making a total height of 5 feet to the soffit. The thickness of the arch is to be 2 feet, with backing 3 feet deep. The retaining walls are to be 10 feet long, 3 feet thick, and 3 feet deep, the top being on a level with the side walls of the cisterns. The front and rear cisterns are to be 6 feet square each, the body of the cistern and the side walls will be 2½ feet thick. The side walls of the cistern are to be 10 feet high; the thickness at bottom being 3 feet and at top 2 feet, inclusive of the cut-stone casing.

The sides and bottom of the vent and of the cisterns are to be lined with cut-stone 9 inches thick.

The sluice is to be constructed otherwise of brick-in-chunam.

A Calingulah at the northern extremity of the Payacolum tank in lieu of the present Calingulah. Estimate Rupees 2,790. *No.* 13.

The body is to be 72 feet in length and 4 feet thick, the foundations to be $5\frac{1}{2}$ feet thick and 6 feet deep, the height of the body for a length of 31 feet in the centre will be 8 feet, and the remaining portion at the sides (41 feet in length) will be 5 feet high. The wing-walls are to be $10\frac{1}{2}$ feet high and 34 feet in length each, with breadth at bottom $3\frac{1}{2}$ feet and at top $1\frac{1}{2}$, with three offsets, each 6 inches wide in rear, the front face being vertical. The foundations of the wing-walls will be 6 feet deep and 5 feet in breadth.

Four sluice vents are provided, each 4 × 8, and 7 feet apart from centre to centre, having shutters 3 inches thick, supported by sixteen cross stones; twelve upright stones of 6 feet length are sunk 3 feet into the lower part of the body, so that the top of the upright stones is on a level with the crown of the higher part of the calingulah.

The rough stone apron in rear is $74\frac{1}{2}$ feet average length, $8\frac{3}{4}$ feet in width, and 3 feet deep; supported by a retaining wall $78\frac{1}{2}$ feet in length, $2\frac{1}{2}$ feet thick, and 6 feet deep.

The body wall will be faced all round with cut-stone 9 inches thick, as also the sides and bottom of vents. The rest of the work is to be constructed of the brick-in-chunam.

Three other Calingulahs, similar to the above, for the Pottacolum, Chinnasamy Naick, and Korumpullum tanks, Rupees 8,370. *Estimate No.* 14.

Southern Channel.

The southern channel will have the same sectional area as the northern, and the same slope for the first $5\frac{3}{4}$ miles as far as the Cadamba tank. For the remaining 14 miles the bottom width is 24 feet, and the fall 1 foot a mile.

The branch to Ahtoor, 5 miles long, has a bottom width of 12 feet, and fall of 1 foot a mile for the first 2 miles, then a fall of 2 feet a mile for the remaining 3 miles.

The branch channel to Tritchendoor has a bottom width of 12 feet, and fall of 1 foot a mile throughout its length of $1\frac{1}{2}$ miles.

The subsidiary works required for this channel are as follows:—

Head Sluice at the head of the Southern channel. Estimate Rupees 11,750. *No.* 1.

The sluice is in all respects similar to that at the head of the channel on the north bank, except that there are three vents instead of four.

Two Syphon Sluices, one above and another below the small bridge to the west of Tricaloor, in lieu of the present aqueduct. Estimate Rupees 1,460 *each. No.* 2.

The body of the sluice is to be 84 feet in length, 6 feet broad, and $6\frac{1}{2}$ feet deep. The vent to be 2 feet broad and $1\frac{1}{2}$ high, the wing-walls in front and rear to be 36 feet long, $3\frac{1}{2}$ feet average thickness, and $11\frac{1}{4}$ feet height above the vent. The cisterns in front and rear will be each $4\frac{1}{2}$ feet square, the side walls being $1\frac{1}{2}$ feet thick and 11 feet high. The sluices will be built throughout of brick-in-chunam.

A Bridge of one elliptical arch 36 *feet span on the west of Tricaloor in lieu of the present stone platform bridge. Estimate Rupees* 3,400. *No.* 3.

The abutments are to be 30 feet in length, 9 feet thick, and 5 feet high, resting on foundations 6 feet deep, 9 feet broad at top, and 12 feet broad at bottom, resting on clay. The wings are to be 15 feet in length, 4 feet mean thickness, and $15\frac{3}{4}$ feet height, built on foundations $7\frac{1}{2}$ feet thick and 6 feet deep. The versed sine of the arch is to be 9 feet, giving a total height of 14 feet to the soffit. The face walls are to be 2 feet thick and the blocking course $1\frac{3}{4}$ feet, over which the parapet walls are $1\frac{1}{2}$ feet thick, and 3 feet high. The thickness of the arch at the crown will be 1 foot 9 inches, and at the haunches $4\frac{1}{2}$ feet. The roadway will have a clear width between parapets of 6 feet, and between wing-walls of 13 feet. The floor is an invert $35\frac{1}{2}$ feet in length, 6 feet broad, and $1\frac{1}{2}$ feet thick. The retaining wall in front and rear is $1\frac{1}{2}$ feet thick, and $5\frac{1}{2}$ feet average depth. The bridge is to be built of brick-in-chunam, and plastered.

A Bridge of three arches at Tricaloor. Estimate Rupees 6,156. *No.* 4.

The foundations of the abutments and piers are to be 6 feet deep, the average thickness of the former to be 6 feet, and of the latter $7\frac{1}{2}$ feet, resting on clay. The piers are to be 6 feet thick, and the abutments $4\frac{1}{2}$ feet, raised to a uniform height of 5 feet; the versed sine of the centre arch to be 9 feet, and that of the side arches $7\frac{1}{2}$ feet, giving a total height to soffit of 14 feet for the centre arch and $12\frac{1}{2}$ feet for the side arches. The wing-walls are to be 25 feet in length, 13 feet average height, 2 feet thick at top, and 5 feet at base: the foundations to be 6 feet mean thickness and 6 feet deep. The face walls are to be 2 feet thick, and the blocking course $1\frac{3}{4}$ feet. The parapet walls are $1\frac{1}{2}$ feet thick and 3 feet high. The centre arch is to be elliptical, the thickness at the crown being $1\frac{3}{4}$ feet, and at the haunches 4 feet; side arches are segmental, thickness at crown being 1 foot 6 inches. The invert under the arches is 15 feet broad, and $1\frac{1}{2}$ feet deep, with the support of a retaining wall $1\frac{1}{2}$ feet thick and $5\frac{1}{4}$ feet deep. Over the arches the clear width of roadway between parapets will be 15 feet, and between wing-walls 24 feet. The bridge is to be built of brick-in-chunam, and plastered.

Ten small Sluices for irrigation in the portion of channel between Kanum and Ellapanaiken tank. Estimate Rupees 140 *each. No.* 18.

Each to be similar to the ten irrigating sluices on the northern channel No. 15, but 30 feet only in length.

Two irrigation Sluices in Ellapanaiken Colum. Estimate Rupees 650. *No.* 25.

Each similar to that in Shadavycal tank, No. 11.

The body of the sluice is to be 72 feet in length, $3\frac{3}{4}$ feet in breadth, and $3\frac{3}{4}$ feet deep, with a water-way of $\frac{3}{4}$ foot square, the thickness of the outer wall is to be $1\frac{1}{2}$ feet, with front and rear retaining walls 12 feet in length each, $1\frac{1}{2}$ feet broad and $7\frac{1}{2}$ feet deep, provided also with a basin $4\frac{1}{2}$ feet square, and $5\frac{1}{4}$ feet high, and floored 9 inches thick; the sluice is to be constructed with brick-in-chunam.

A surplus Calingulah for Ellapanaiken Colum. Estimate Rupees 670. *No.* 26.

The body is to be 30 feet long, $3\frac{3}{4}$ feet broad, and 3 feet 9 inches height, raised on a foundation $4\frac{1}{2}$ feet thick and 6 feet deep. There are three vents, each 3

feet wide and $3\frac{3}{4}$ feet high, lined with cut-stone. The wing-walls are to be 24 feet in length, $1\frac{1}{2}$ feet thick, and 6 feet high, on a foundation 6 feet deep and $2\frac{1}{4}$ feet thick. The rear apron will be $7\frac{1}{2}$ feet wide, and 3 feet thick, with a retaining wall 6 feet deep and 1 foot 6 inches thick. The calingulah is to be built of brick-in-chunam, with the exception of the apron of rough stone-in-chunam.

A regulating Dam for the branch channel to Auvadayar ruined tank. Estimate Rupees 530. *No.* 22.

The body of the dam is to be 15 feet in length, 3 feet 9 inches thick, and $4\frac{1}{2}$ feet high, on a foundation $4\frac{1}{2}$ feet broad and 6 feet deep. There is one vent 3 feet wide and $4\frac{1}{2}$ feet high, with cross-stones and teak shutters of 3 inches thickness. The foundations of the wing-walls are to be 24 feet long, 2 feet 3 inches thick, and 6 feet deep, the wing-walls above to be 6 feet high and $1\frac{1}{2}$ feet thick. The apron is $7\frac{1}{2}$ feet wide and 3 feet thick, with a retaining wall $1\frac{1}{2}$ feet thick and 6 feet deep. The vent is to be faced with cut-stone 9 inches thick. The walls and foundations are to be of brick, and the apron of rough-stone-in-chunam.

Do. for Shonancatvele channel, Rupees 530. Estimate No. 19.

An irrigating Sluice in Auvadayar Colum tank. Estimate Rupees 325. *No.* 24.

The dimensions of the sluice to be the same as those given for the Shedavycal tank, (No. 11.)

A Calingulah of discharge in Auvadayar Colum tank. Estimate Rupees 520. *No.* 24.

The body will be 18 feet in length, $3\frac{3}{4}$ feet thick, and 3 feet 9 inches high, on a foundation $4\frac{1}{2}$ feet broad and 6 feet deep. There is one vent 3 feet wide and $3\frac{3}{4}$ feet high, with three cross-stones and shutters as usual. The foundations of the wings are to be 21 feet long, 6 feet deep, and $2\frac{1}{4}$ feet broad; the wing-walls above to be 6 feet high and $1\frac{1}{2}$ feet thick. The rear apron is 6 feet wide and 3 feet thick, with a retaining wall $1\frac{1}{2}$ feet thick, and 6 feet deep. The vent will be faced with cut-stone 9 inches thick. The walls and foundations to be built of brick-in-chunam, and the apron of rough-stone-in-chunam.

Two irrigating Sluices in Shonancatvele tank. Estimate Rupees 325 *each.* *No.* 20.
And one for Avadayar Colum tank. Estimate Rupees 325. *No.* 23.

The dimensions to be the same as those given for the sluice in Shedavycal tank, (No. 11.)

A Calingulah of discharge in Shonancatvele tank. Estimate Rupees 670. *No.* 21.

The Calingulah is to be similar to that provided for the Ellapanaiken tank, (No. 26.)

A Head Sluice for the Ahtoor branch channel, similar to that for the Keelpagay lands on the north side, No. 4, *Rupees* 1,440. *Estimate No.* 6.

Aqueduct across the old Ahtoor channel. Estimate Rupees 3,400. *No.* 8.

The abutments and piers are to be built on a foundation $26\frac{1}{2}$ feet in length, $18\frac{1}{2}$ feet in breadth, and 6 feet deep. The aqueduct consists of three arched

vents, each 4 feet in width. The thickness of the abutments to be 4 feet, and that of the piers $2\frac{1}{2}$ feet, inclusive of the cut-stone facing 9 inches thick. The height of piers and abutments to be 6 feet. The versed sine of the arches will be 1 foot, making a total height of 7 feet to the soffits; the thickness of the arch being 2 feet. The foundations of the wing-walls are to be 6 feet thick and 6 feet deep, the wing-walls above to be 21 feet long, 3 feet thick at top, and $4\frac{1}{2}$ feet at bottom; their height being 15 feet. The parapet walls of the water-way will be 6 feet high, 3 feet thick at top, and $4\frac{1}{2}$ feet at bottom. The breadth of the water-way between parapets will be 8 feet. A rough stone revetment is provided at the end of the front wing-walls, $7\frac{1}{2}$ feet in length, 2 feet thick, and 7 feet deep. The sides and flooring of the vents are to be lined with cut-stone. The aqueduct is to be otherwise constructed of brick-in-chunam.

Six small Irrigating Sluices in the Ahtoor branch channel, the dimensions as given in Estimate No. 18, *each Rupees* 140. *Estimate No.* 13.

A Tunnel across the Ahtoor channel on the road to Tritchendoor, two vents, Rupees 880. *Estimate No.* 9.

The foundations of the abutments and piers are to be $4\frac{1}{2}$ feet deep, the thickness of the former to be $4\frac{1}{2}$ feet, and that of the latter $3\frac{1}{4}$ feet, the abutments are to be 3 feet, and the pier $2\frac{1}{2}$ feet thick, raised to a height of 4 feet. The wing-walls are to be 13 feet in length, $4\frac{3}{4}$ feet high, 1 foot 9 inches thick at top, and 2 feet at base; built on a foundation $3\frac{1}{4}$ feet thick and $4\frac{1}{2}$ feet deep. The blocking course will be $1\frac{1}{4}$ feet deep, and the parapets $1\frac{1}{2}$ feet thick, and 3 feet high. The flooring to be $1\frac{1}{2}$ feet thick, supported by a retaining wall in front $1\frac{1}{2}$ feet thick, and 4 feet deep. The vents will be covered with cut-stone 9 inches thick. Over the vents the clear width of road-way between parapets will be 15 feet, and between wing-walls 24 feet. The tunnel is to be built of brick-in-chunam.

A similar Tunnel on the Yeral road. Estimate Rupees 880. *No.* 10.

A Syphon Sluice under the Ahtoor channel, where it crosses the Tenterapery channel, three vents, Rupees 6,320. *Estimate No.* 7.

The body of the sluice is to be 70 feet in length, $26\frac{1}{2}$ feet in breadth, and $4\frac{1}{2}$ feet deep. The foundations of the cisterns in front and rear to be $27\frac{1}{2}$ feet average length, $11\frac{1}{4}$ feet in breadth, and $4\frac{1}{2}$ feet deep. The wing-walls are to be 6 feet in length, $2\frac{3}{4}$ feet average thickness, and $7\frac{1}{2}$ feet deep; built on a foundation 5 feet in breadth, and $4\frac{1}{2}$ feet deep. The abutments are to be 4 feet thick, and the piers $2\frac{1}{2}$ feet, inclusive of the cut-stone casing, 9 inches thick; and to be raised to a height of 4 feet, the versed sine of the arches will be 1 foot, making a total height of 5 feet to the soffit. The sluice is to consist of three vents, 4 feet in width, the arch-work being 2 feet thick. The side walls of the cisterns are to be $2\frac{3}{8}$ feet average breadth, their mean height being $7\frac{1}{2}$ feet, and the end walls are to be $1\frac{3}{4}$ feet mean thickness, and 4 feet deep. The face walls above the arches are to be 25 feet in length, $1\frac{1}{2}$ feet thick at top, and 2 feet in bottom, and 4 feet deep. The sides and flooring of the vents and cisterns are to be lined with cut-stone 9 inches thick.

The sluice is to be otherwise constructed of brick-in-chunam.

feet wide and $3\frac{3}{4}$ feet high, lined with cut-stone. The wing-walls are to be 24 feet in length, $1\frac{1}{2}$ feet thick, and 6 feet high, on a foundation 6 feet deep and $2\frac{1}{4}$ feet thick. The rear apron will be $7\frac{1}{2}$ feet wide, and 3 feet thick, with a retaining wall 6 feet deep and 1 foot 6 inches thick. The calingulah is to be built of brick-in-chunam, with the exception of the apron of rough stone-in-chunam.

A regulating Dam for the branch channel to Auvadayar ruined tank. Estimate Rupees 530. *No.* 22.

The body of the dam is to be 15 feet in length, 3 feet 9 inches thick, and $4\frac{1}{2}$ feet high, on a foundation $4\frac{1}{2}$ feet broad and 6 feet deep. There is one vent 3 feet wide and $4\frac{1}{2}$ feet high, with cross-stones and teak shutters of 3 inches thickness. The foundations of the wing-walls are to be 24 feet long, 2 feet 3 inches thick, and 6 feet deep, the wing-walls above to be 6 feet high and $1\frac{1}{2}$ feet thick. The apron is $7\frac{1}{2}$ feet wide and 3 feet thick, with a retaining wall $1\frac{1}{2}$ feet thick and 6 feet deep. The vent is to be faced with cut-stone 9 inches thick. The walls and foundations are to be of brick, and the apron of rough-stone-in-chunam.

Do. for Shonancatvele channel, Rupees 530. Estimate No. 19.

An irrigating Sluice in Auvadayar Colum tank. Estimate Rupees 325. *No.* 24.

The dimensions of the sluice to be the same as those given for the Shedavycal tank, (No. 11.)

A Calingulah of discharge in Auvadayar Colum tank. Estimate Rupees 520. *No.* 24.

The body will be 18 feet in length, $3\frac{3}{4}$ feet thick, and 3 feet 9 inches high, on a foundation $4\frac{1}{2}$ feet broad and 6 feet deep. There is one vent 3 feet wide and $3\frac{3}{4}$ feet high, with three cross-stones and shutters as usual. The foundations of the wings are to be 21 feet long, 6 feet deep, and $2\frac{1}{4}$ feet broad; the wing-walls above to be 6 feet high and $1\frac{1}{2}$ feet thick. The rear apron is 6 feet wide and 3 feet thick, with a retaining wall $1\frac{1}{2}$ feet thick, and 6 feet deep. The vent will be faced with cut-stone 9 inches thick. The walls and foundations to be built of brick-in-chunam, and the apron of rough-stone-in-chunam.

Two irrigating Sluices in Shonancatvele tank. Estimate Rupees 325 *each.* *No.* 20.
And one for Avadayar Colum tank. Estimate Rupees 325. *No.* 23.

The dimensions to be the same as those given for the sluice in Shedavycal tank, (No. 11.)

A Calingulah of discharge in Shonancatvele tank. Estimate Rupees 670. *No.* 21.

The Calingulah is to be similar to that provided for the Ellapanaiken tank, (No. 26.)

A Head Sluice for the Ahtoor branch channel, similar to that for the Keelpagay lands on the north side, No. 4, *Rupees* 1,440. *Estimate No.* 6.

Aqueduct across the old Ahtoor channel. Estimate Rupees 3,400. *No.* 8.

The abutments and piers are to be built on a foundation $26\frac{1}{2}$ feet in length, $18\frac{1}{2}$ feet in breadth, and 6 feet deep. The aqueduct consists of three arched

Proceedings of the Madras Government, Public Works Department,
26th October 1868.

vents, each 4 feet in width. The thickness of the abutments to be 4 feet, and that of the piers $2\frac{1}{2}$ feet, inclusive of the cut-stone facing 9 inches thick. The height of piers and abutments to be 6 feet. The versed sine of the arches will be 1 foot, making a total height of 7 feet to the soffits; the thickness of the arch being 2 feet. The foundations of the wing-walls are to be 6 feet thick and 6 feet deep, the wing-walls above to be 21 feet long, 3 feet thick at top, and $4\frac{1}{2}$ feet at bottom; their height being 15 feet. The parapet walls of the water-way will be 6 feet high, 3 feet thick at top, and $4\frac{1}{2}$ feet at bottom. The breadth of the water-way between parapets will be 8 feet. A rough stone revetment is provided at the end of the front wing-walls, $7\frac{1}{2}$ feet in length, 2 feet thick, and 7 feet deep. The sides and flooring of the vents are to be lined with cut-stone. The aqueduct is to be otherwise constructed of brick-in-chunam.

Six small Irrigating Sluices in the Ahtoor branch channel, the dimensions as given in Estimate No. 18, *each Rupees* 140. *Estimate No.* 13.

A Tunnel across the Ahtoor channel on the road to Tritchendoor, two vents, Rupees 880. *Estimate No.* 9.

The foundations of the abutments and piers are to be $4\frac{1}{2}$ feet deep, the thickness of the former to be $4\frac{1}{2}$ feet, and that of the latter $3\frac{1}{4}$ feet, the abutments are to be 3 feet, and the pier $2\frac{1}{2}$ feet thick, raised to a height of 4 feet. The wing-walls are to be 13 feet in length, $4\frac{3}{4}$ feet high, 1 foot 9 inches thick at top, and 2 feet at base; built on a foundation $3\frac{1}{4}$ feet thick and $4\frac{1}{2}$ feet deep. The blocking course will be $1\frac{1}{4}$ feet deep, and the parapets $1\frac{1}{2}$ feet thick, and 3 feet high. The flooring to be $1\frac{1}{2}$ feet thick, supported by a retaining wall in front $1\frac{1}{2}$ feet thick, and 4 feet deep. The vents will be covered with cut-stone 9 inches thick. Over the vents the clear width of road-way between parapets will be 15 feet, and between wing-walls 24 feet. The tunnel is to be built of brick-in-chunam.

A similar Tunnel on the Yeral road. Estimate Rupees 880. *No.* 10.

A Syphon Sluice under the Ahtoor channel, where it crosses the Tenterapery channel, three vents, Rupees 6,320. *Estimate No.* 7.

The body of the sluice is to be 70 feet in length, $26\frac{1}{2}$ feet in breadth, and $4\frac{1}{2}$ feet deep. The foundations of the cisterns in front and rear to be $27\frac{1}{2}$ feet average length, $11\frac{1}{4}$ feet in breadth, and $4\frac{1}{2}$ feet deep. The wing-walls are to be 6 feet in length, $2\frac{3}{4}$ feet average thickness, and $7\frac{1}{2}$ feet deep; built on a foundation 5 feet in breadth, and $4\frac{1}{2}$ feet deep. The abutments are to be 4 feet thick, and the piers $2\frac{1}{2}$ feet, inclusive of the cut-stone casing, 9 inches thick; and to be raised to a height of 4 feet, the versed sine of the arches will be 1 foot, making a total height of 5 feet to the soffit. The sluice is to consist of three vents, 4 feet in width, the arch-work being 2 feet thick. The side walls of the cisterns are to be $2\frac{3}{8}$ feet average breadth, their mean height being $7\frac{1}{2}$ feet, and the end walls are to be $1\frac{3}{4}$ feet mean thickness, and 4 feet deep. The face walls above the arches are to be 25 feet in length, $1\frac{1}{2}$ feet thick at top, and 2 feet in bottom, and 4 feet deep. The sides and flooring of the vents and cisterns are to be lined with cut-stone 9 inches thick.

The sluice is to be otherwise constructed of brick-in-chunam.

A Calingulah at the southern extremity of the Ammenpuram tank, and another at the southern extremity of the Kanum tank, each similar to that for the Payacolum tank on the north side, each Rupees 2,790. *Estimates Nos.* 16 *and* 17.

Head Sluice at the west end of Cadamba tank. Rupees 3,390. *Estimate No.* 5.

The abutments and piers are to be built 6 feet high, on a foundation 33 feet in length, 24¾ feet in breadth, and 6 feet deep. The sluice is to contain four vents each 4 feet in width, the thickness of the abutments is to be 4 feet, and thas of the piers 2½ feet, inclusive of the cut-stone casing 9 inches thick. The vents will be covered with cut-stone 9 inches thick. The wing-walls are to be 19 feet in length, 1½ feet thick at top, and 3 feet at bottom, the height being 9 feet. The foundations of wing-walls will be 4½ feet thick and 6 feet deep. The length of the cut-waters is to be 1¼ feet, and the caps to be 9 inches high.

The front face walls, including the platform for working the shutters, will be 31½ feet in length, 5½ feet thick, and 2¼ feet high, the rear wall being 2 feet thick. The parapet walls of the same length to be 1½ feet thick and 3 feet high.

The rear apron, which is 31 feet average length, 15¼ feet wide, and 3 feet thick, is supported by a retaining wall 36 feet in length, 2½ feet thick, and 6 feet deep; sixteen cross stones are provided for the four vents to hold the shutters. The sides and flooring of the vents are to be faced with cut-stone 9 inches thick. The road-way over the sluice will be 15 feet in width, between parapets. A rough stone revetment is to be built 15 feet in length, 3 feet thick, and 4½ feet average height, at each end of the wing-walls.

With the exception of the apron and the revetment, the sluice is to be constructed of brick-in-chunam.

A similar Head Sluice for the channel round the Cadamba tank, but with three vents and the road-way 6 *feet wide. Estimate Rupees* 2,280. *No.* 14.

Aqueduct for passing Tenkarrai surplus channel over the new channel round the Cadamba tank, Rupees 10,126. *Estimate No.* 15.

The abutments and piers are to be built on a foundation 100½ feet in length, 33 feet in breadth, and 6 feet deep. The aqueduct is carried over four arched vents, each 4 feet in width. The thickness of the abutments to be 4 feet, and that of the piers 2½ feet, inclusive of the cut-stone casing 9 inches thick, and the height of piers and abutments to be 4 feet; the versed sine of the arches will be 1 foot, making a total height of 5 feet to the soffits, and the thickness will be 2 feet. The foundations of the wing-walls are to be 6 feet thick and 6 feet deep, the wing-walls above to be 25 feet long, 3 feet thick at top, and 4½ feet at bottom, their height being 13 feet. The parapet walls of the waterway will be 6 feet high, 3 feet thick at top, and 4½ feet at bottom. The breadth of the waterway between parapets will be 90 feet.

A rough stone revetment is provided at each end of the wing-walls, 6 feet in length, 3 feet thick, and 7 feet deep. The aqueduct is to be constructed otherwise of brick-in-chunam.

An embankment will be raised for a length of 100 yards along each bank of the surplus channel, with a top thickness of 6 feet, to prevent the water spreading on either side.

Proceedings of the Madras Government, Public Works Department,
26th October 1868.

A Calingulah and regulating Dam in the Shedavycal tank bund, similar to that provided for the Auvadayar Colum tank, No. 12, *Rupees* 520.

An irrigating Sluice in the bund of the Shedavycal tank, 72 *feet in length, on the usual sluice plan. Rupees* 325. *Estimate No.* 11.

Bungalow, Rupees 3,370.

The building is to be 63½ feet in length and 38 feet in breadth, comprising one room 24 feet long and 18 feet broad, one room 18 feet square.

Two verandah rooms, each 12 feet in length and 7 feet in breadth, and a verandah all round 7 feet in breadth, supported by 16 pillars. The basement of the walls and pillars is to be 2 feet thick and 2 feet deep, raised on a foundation 2½ feet thick and 3 feet deep. The basement or retaining walls between pillars is to be 1½ feet thick and 3½ feet deep, including the foundation.

The principal walls will be 1½ feet thick and 12 feet in height, and the verandah pillars and walls are to be 7 feet high and 1½ feet thick. Seven doors are provided, each 4×7 for the main building, and six windows, each 3½×5; the verandah rooms are to have two doors each, 3×6 and 2½×5, and one window 2½×3½ in the rear walls. The hip roof consist of couples, with two collar pieces, jack and hip rafters, reepers, pantiles, &c. The building is to be floored with square bricks The foundations, basement, pillars, retaining walls, as well as the jambs and soffits of doors, and jambs and cills of windows, are to be of brick-in-chunam: the walls being of brick-in-clay and plastered with chunam. The whole roof is to be made of Palmyrah wood, except the brestsummers and wall plates, which will be of Vengay wood.

Out-Houses.

The out-houses consist of two rooms, each 12 feet long and 8 feet broad, with open godown in rear.

The outer walls, of brick-in-clay and 1¼ feet thick, have a foundation 2 thick and 2 feet deep. The pillars are 1¼ feet square and 8 feet in height, each room will have a door 3×6, and a window 2×2. The rear godown is to be floored with gravel.

MADURA,
8*th August* 1868.

(Signed) H. L. PRENDERGAST, Captain, R. E.,
Executive Engineer.

No. 550. Memorandum by the Chief Engineer for Irrigation.

(Here enter 28th September 1868.)

Proceedings of the Madras Government, Public Works Department, 26*th October* 1868.

No. 551. ORDER THEREON, 26th October 1868, No. 3,365.

IRRIGATION, No. 25.

1. With his Memorandum above recorded the Chief Engineer for Irrigation submits a project estimated to cost Rupees 8,31,600 for extending irrigation from the Tambrapoorney river in the Tinnevelly District by the construction of an anicut across that river at Streevigoontum, and of channels to be taken off from either flank for the better supply of several tanks, and for the irrigation directly from those channels of a considerable tract of land on either side of the river.

2. As the project appears to have been carefully designed and matured, and promises not only to be remunerative, but, in other respects very beneficial, His Excellency the Governor in Council will have much pleasure in submitting it for the sanction of the Government of India. Meanwhile, considering the importance of the undertaking, and the interest with which the cultivating classes are stated to look forward to its early execution, the Government resolve, in anticipation of the sanction of the Right Honorable the Governor General in Council, and in accordance with the recommendation of the Superintending Engineer, to authorise the collection of materials to be proceeded with, and the construction of the work to be put in hand with the assignment of Rupees 58,100 which has been made for it in the Budget of the current official year.

(Here enter No. 3,366, dated 26th October 1868.)

(True Extract.)

Colonel, R. E.,
Secretary to Government.

To the Chief Engineer for Irrigation.
,, Superintending Engineer, 8th Division.
,, Controller of Public Works Accounts.
,, Accountant General.
,, Revenue Department, with Note by the Honorable A. J. Arbuthnot.
,, Collector of Tinnevelly.

Exd. S. T. Augustin.

Govt. of [1868] Madras.

PUBLIC WORKS

To

THE CHIEF ENGINEER FOR

IRRIGATION.

&c., &c., &c.

Dated October, 26th.

Recd. 30th — Encl.

G. O., 26th October 1868, *No.* 3,365.

OCTOBER.

Nos. 549-551

Irrigation.—Passing orders on the estimates amounting to Rupees 8,31,600 for extending —from the Tambrapoorney river in the Tinnevelly District.