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~~405~~

No. ~~405~~ Read the following Note by the Acting Chief Engineer for Irrigation, dated 7th February 1870, No. 27 :—

Read the following letter from Captain R. F. OAKES, R. E., Superintending Engineer, 6th Division, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, Public Works Department, dated Tanjore, 24th January 1870, No. 1,235.

G. O., No. 3,292, of 12th October 1869.
Your Memo., No. 269, of 14th Sept. ,,
My reply, No. 983, of 25th Nov. ,,
Your Memo., No. 315, of 4th Dec. ,,

Plans.

1 and 1-A.—Survey of a portion of the Vennaur and Vettaur.
2-A.—Longitudinal sections of do.
3 and 3-A.—Plan and sections of the proposed dams. Original and revised for do.
4-A.—Survey and longitudinal sections of the Vennaur, Pamaniyaur, and Coriyaur.
4-B.—Enlarged plan of Pamaniyaur showing new cut.
4-C.—Section along line of new cut.
5 and 5-A.—Plan and sections of the proposed dams. Original and revised.
6-A.—Longitudinal sections of portions of the Vennaur, Paundaviyaur, and Velliyaur.
7 and 7-A.—Plan and sections of the proposed dams for the Paundaviyaur. Original and revised.
8 and 8-A.— Do do. for the Velliyaur.
9.—Plan and sections of alterations to the dam at the Athiveraramanar head.
10.—Plan and section of a store-shed.
11.—Sketch-map showing position of works proposed.
12-A.—Estimates and specifications of the Revised Head Works.

	Original.	*Revised.*
	Rs.	Rs.
Vettaur	27,600	82,140
Pamaniyaur and Coriyaur .	22,200	62,400
Paundaviyaur	29,700	30,180
Velliyaur	13,600	24,730
Athiveraramanar	150	150
Total .	93,150	1,99,600

Estimate for raising lower step of the south branch of the upper anicut, Rupees 800.
13.—Revised statements B, C, D, and E, showing the head of water through closed vents.
Statement A and Plans 2, 4, and 6, giving plans and cross sections of the various rivers, were sent on 25th November with letter No. 983, and have not been returned.
The estimates in red were forwarded on 30th August with letter No. 617, and have not been returned.

* Rupees 7,950.

With reference to the papers noted in the margin I have the honour to submit revised estimates for the regulating works for the branches of the Vennaur, providing closed works for all the new regulators.

2. The alterations to the original work for the Paundaviyaur head is very trifling, consisting merely of the raising of the platform from which the shutters are to be worked and extending the arch over the sluice piers. It has been found unnecessary to alter the bridges for Road No. 58 connected with the head-work, as the height given to those bridges affords sufficient space to lift the shutters clear of the highest water-mark.

3. The Velliyaur head-work is precisely similar in character to that for the Paundaviyaur: the work is to be built in connexion with the bridge on Road No. 58.

4. The estimate for the Paundaviyaur head-work inclusive of bridges is Rupees 30,180. If built according to the design adopted for the Vettaur head-work the cost would be Rupees 27,410, and half* the cost of the bridges will be defrayed from Local Funds. The construction of the regulator in connexion with the bridges will effect a saving of Rupees 5,180, while the bridge in rear will prove a source of strength to the work, and will afford a safe platform from which to work the sluices.

5. For the Velliyaur head it was proposed to complete the bridge over the Velliyaur only and to lay the foundations and raise the piers for a bridge over the Vennaur, as a bridge over the latter river is not required for traffic at

1

present. In now providing a closed regulator at the Velliyaur head, the completion of the bridge will be necessary; this will add but Rupees 1,110 to the estimate for the bridges, and doubtless the Revenue Board will sanction a moiety of this sum in addition to the Rupees 5,450 already sanctioned. As in the Paundaviyaur, the saving effected on the Velliyaur regulator, if built in connexion with the bridges, will be Rupees 4,135 as per margin.

	Rs.
With bridges	24,730
Design without bridges	22,860
Difference...	1,870
Half cost of bridges only	6,005
Saving...	4,135

6. In the open work originally estimated for the Velliyaur head, the level of the dam or retaining wall was placed at 85 above datum; in providing closed works the floor or cills of the sluices are placed at 84½, so as to form as little of an obstruction as possible: and as the tendency of all works across rivers is to lower the bed of the river immediately below the works, the floor of the bridges which forms the aprons to the sluices has been placed 1′ below the floor of the sluices.

7. For the works at the heads of the Vettaur, Pamaniyaur, and Coriyaur, where bridges for traffic are not required, the plan of sluice proposed by you has been adopted. I have, however, placed the aprons one foot lower than the cills of the sluices. The estimate has been prepared so as to provide for one vent, one pier, and the apron, &c., appertaining thereto, so that there will be no difficulty in altering the estimates if the number of vents proposed is not approved. The alteration of the number of vents in the Vennaur and Vettaur from twenty-six and fourteen to thirty and seventeen respectively reduces the head of water through the sluices but little, as will be observed by comparing the column headed Shutters out in Form B. now submitted with that despatched on the 25th November.

8. From Form C. submitted on the 25th November it will be observed that a head of one foot was required to discharge the theoretical supply through the Pamaniyaur head and nearly two feet to discharge the proportion of water to be carried off by the Pamaniyaur in a twelve-feet flood, and the head in the Coriyaur for the same discharges was higher than that required for the Vennaur. To assimilate the heads as nearly as possible I have proposed to add one vent to the sluices for the Coriyaur and Pamaniyaur, and to provide the new cutting for the Pamaniyaur with a bottom width of fifty-two feet instead of forty. I have also placed the floors of the sluices at 44½ instead of at 45, and hence statement C. has been revised, and the levels of the water, as indicated in Plans 2, 4, and 6,* will have to be altered as shown on the longitudinal sections of the rivers now sent. I have recently inspected the Pamaniyaur relative to the alteration in the direction of the new head. The bed of the river has been considerably altered, since Captain Mead's survey was made, by the cutting away of an island† and the planting up of the elbow, as is clearly shown in the enlarged plan‡ of the river herewith sent. The direction marked on the plan for the new head appears to be preferable to that suggested by Captain Mead, and has been provided for accordingly in the revised estimate now submitted.

	Vents.
Vennaur	14
Coriyaur	9
Pamaniyaur.....	4

* Sent on 25th November, No. 983.

† See Plan 4 sent on 25th November.

‡ No. 4-B.

9. From statements B., C., D., and E. now sent, it will be observed that the difference of the water-level between the maximum twelve-feet flood and the maximum regulated flood is as per margin, while the head of water through the sluices is as indicated, so that it would not be well to reduce the number of vents whether the Cauvery head-sluice be built or not, and the mere reduction of from ½ to 1½′ in the height of the piers and wing-walls would effect a very slight saving.

		Head through sluices.
Vettaur head.....	1·12	1 44
Coriyaur.....	1 68	·88
Paundaviyaur.....	·84	·75
Velliyaur.....	·45	·6

10. From statements B., C., D., and E. it will be observed how the heights of the shutters have been arrived at, and provision has been made for lifting them clear of the maximum flood and leaving a small margin as directed in paragraph 6 of Memorandum No. 315. The raising of the river-banks, if closed works are to be built, will be provided from the ordinary allotment for repairs.

11. With regard to the solid shutters proposed, I must admit I am very apprehensive that difficulties will arise in opening and closing them, and that they may become clogged, for, even when the ordinary baulk shutter has been down for some days, it is often most difficult to remove the first plank owing to the accumulations of silt, straw, brushwood, &c., which are brought down in floods.

12. If the shutters became clogged and could not be raised, or even if some of the shutters became injured, the result might be very disastrous, and regulation in low floods would be impossible, for in all the regulators portions of vents would have to be closed under every condition of the supply in the rivers. This would be specially the case as regards the regulator at the Paundaviyaur head. As stated in paragraph 3 of No. 983,* the Paundaviyaur has to carry, in the highest floods, 55 per cent. of the water in the main stream, and in low floods only 22 per cent. From statement D. it will be observed that in the main stream the water-level must be raised to 93·1′ to admit of the Vennaur receiving a full theoretical supply† for the land dependent upon it, while to pass the theoretical supply‡ down the Paundaviyaur the water need be raised to only 89·35′; but, as the water-level must be raised to 93·1′ to supply the Vennaur, portions of the Paundaviyaur regulator must be closed. No less than seven of the eight vents would have to be closed, for, with a theoretical supply passing down the Paundaviyaur, the water below the regulator would stand at 89·1, while the water above would be at 93·1, and with a head of 4′ and with the cill of the sluice at 87. One vent would discharge 457·6 cubic feet per second or the full theoretical supply, so that, for the greater part of the season, seven of the Paundaviyaur vents would have to be closed. Now, if the shutters of two of these vents were injured so that they could not be used, all regulation as regards the theoretical supply

* Dated 25th November.

† 1,574 cubic feet per second.
‡ 454 ,, ,,

would be at an end. Primitive and unscientific though the baulk shutters may be, the facility in their management and the almost impossibility of their being injured or rendered non-effective if a few spare baulks are kept on hand induces me still to advocate their use.

13. With regard to your remark in paragraph 8 of No. 315, "It is very doubtful whether the diversion of the whole supply even when only one-third or one-fourth of that quantity* will ever be permitted" and to which you add "but this point need not be discussed now," I would observe that the chief object of constructing closed regulating works is to admit of a full theoretical supply being thrown down either stream alternately when the water in the main or undivided stream falls below the quantity required for both branches, so that water may reach the extreme limit of the cultivation when the supply is below a full theoretical. The question, therefore, whether the entire control of the regulation is to be entrusted to the Officers of the Department Public Works or not, so far from being a question which "need not be discussed now" appears to me to strike at the very root of the question of the nature of the regulating works to be provided, for if regulating works may not be opened and closed at the discretion of the Public Works Officer at all times and under all circumstances, the closed works are useless, for they cease to be regulating works in any sense; for, as shown above relative to the Paundaviyaur, the closed regulators, which must necessarily provide for the discharge of the maximum floods, will not divide the water in proportion to the cultivation in low floods unless some of the shutters are down or parts of the vents are closed; and so, if there is any doubt about the question of the regulation by the Public Works Officer, it would be far better to provide open works which will distribute the supply in proportion to the area of the land dependent upon each branch until the theoretical supply is passing down each branch and which will distribute the water, when it exceeds the theoretical supply, in proportion to the capacities of the rivers and to their requirements as regards the scouring of bars, &c., than to expend large sums on closed works. There appears to be so much uniformity in the times at which the crops are sown, and the double† crops are so small, that it is very improbable that the areas requiring water would vary in any appreciable degree from the proportion of the total areas dependent upon each branch.

* Theoretical supply.

† About 4 per cent.

14. Independently of the question relative to the control of the regulation by the Public Works Officer, I am of opinion that closed works should not be provided at the Vettaur and Coriyaur heads at present for reasons stated in my No. 983.

15. As stated in No. 617, about 7½ per cent. on the estimates would probably be sufficient to cover the cost of superintendence, for which no special provision has been made in the estimates.

16. Provision is made in the estimate for a shed* at each work for stores, &c., in a portion of which the Inspecting Officer might find accommodation for a day if necessary.

* 30′ × 16′.

17. As directed by you, Rupees 250 have been provided for the shutter and gearing for each vent, and, as I am not able to judge what establishment will be required for the working of the sluices, I have been unable to submit an estimate for the establishment. As the works at the Arasalar and Veerasholen heads have already been completed and that at the Codamoorty head will be completed this season, I beg that establishment† proposed for these works may be passed at once, or there will be no possibility of registering the gauges during the next season, when it is proposed to determine what quantity of water is passing over or through each work by means of gauges in the reaches both above and below the works.

† No. 617, dated 30th August.

18. I still advocate the raising of the tambogyee or lower step of the upper anicut. As stated in paragraph 9 of No. 617, the wastage at the lower anicut must be gauged by the discharge over the anicut. The quantity of water which enters the Coleroon between the upper and lower anicuts cannot be calculated; but, besides receiving surplus water, or water which is wasted on both sides of the river, the Coleroon receives the drainage of a very large area‡ in the Trichinopoly District, and hence in the north-east monsoon particularly, as stated in No. 617, there is sometimes more water passing over the lower Coleroon anicut than is passing into the river over or through the upper anicut. No difficulty is apprehended with regard to the supply of the wants of the lands dependent upon the Coleroon by means of the sluices, for the water returns of passed years would enable us to judge with very tolerable accuracy the quantity of water to be passed down the river, and very short experience in the use of the sluices would admit of the regulation being rendered almost perfect. In June, July, and August no regulation would be required, for there is, as a rule, water passing over both the upper and lower anicuts in those months. Again, in October and the early part of November, the monsoon or local rain appears to supply all the water that is required by the lands dependent on the Coleroon; in September only would much care be required in passing down a requisite supply for the lands dependent upon the Coleroon, for in December as a rule the water rises but seldom over the tambogyee or lower step of the upper anicut, and under these circumstances now no water is allowed to pass through the anicut, and yet the supply to the lands dependent upon the Coleroon does not fail.

‡ About 900 square miles.

19. With a view of calculating what quantity of water was required for the lands dependent on the lower anicut in the South Arcot District, I called upon the Collector for a return of the cultivation under the Vadanaur and North Rajen Channel on the 21st October, but have not yet received a reply; but I believe those lands are not less liberally provided for than those dependent on the

No. 838.

South Rajen Channel and Kumukmuniyaur in the Tanjore District, and I find that the South Rajen Channel sluice* is capable of passing nearly double the theoretical supply required by the lands dependent upon it when water stands to the level of the lower anicut and nearly 1½ times the supply when water is 2' below the crown of the dam so that, even if a few days' water was below the crown of the anicut, no harm would be done; and, as there is a Monigar at both the anicuts, when water fell below the crown a daily report might be sent from the lower anicut to the Superintending Engineer and to the Monigar at the upper anicut, and the latter might regulate the opening and closing of the sluices accordingly under rules laid down for his guidance, and would receive especial instructions in cases in which the rules did not meet the requirements of the moment.

20. In regulating the supply to the Peruvelly and Iyen channels and also to the Vadavaur and Anunda Cauvery which receive the drainage of large areas, the Monigars do not wait to receive written orders to close the head-sluices when heavy rain appears to be falling but act at once, and no inconvenience has arisen from their doing so; and so it is believed that the Monigars by corresponding daily would be able to regulate the supply from the upper for the lower anicut so as to cause the minimum of wastage and unless in very exceptional seasons it is believed that no difficulty would arise in supplying the Coleroon lands fully without wastage and there would certainly be no more difficulty in effecting this than in distributing the water to the lands dependent upon each stream by the regulating works now proposed for the Vennaur.

* Four vents 4' × 5'.

B.

Memorandum relative to the proposed regulating work at the Vettaur head showing how the water would be raised, and what moveable shutters would be required, etc.—Vennaur sluice 30 vents of 10 feet—Vettaur slaice 17 vents of 10 feet.

Names of Rivers.	Quantities.		Level at which water in river now stands.	Velocity in undivided river above separation in feet, per one inch.	To pass quantities in column 2 with water as in column 4, water to be raised.		Remarks.
	In Cubic yards per hour.	Cubic feet per one inch.			Shutters in.	Shutters out.	
1	2	3	4	5	6	7	8
I. Vennaur	2,039,700	15.298	17	5·5	21	18·44	I.—In a 12 feet flood at Cauvery head.
I. Vettaur	1,250,200	9,378			22·25	18·64	
II. Vennaur	1,520,300	11,402	16·08 correctly 16 taken.	5·25	19·5	17·18	II.—Maximum when Cauvery head sluice has been completed or regulated supply.
II. Vettaur	1,013,600	7,602			21·25	17·52	
III. Vennaur	731,200	5,484	14·5	*4 nearly 3·64	†17·28	†15	III.—Theoretical supply required for cultivation under the rivers.
III. Vettaur	270,600	2,030	13·5	2·25 *3·25	‡17·55	‡13·86	

* Velocities below separation with quantities in column 3.
† Thus to pass full theoretical supply down Vennaur, the Vettaur sluice must be closed up to 15, or shutters must be 5 feet high, floor being at 10.
‡ For do. do. shutters must be 4 feet high in Vennaur.

(Signed) R. F. OAKES, Captain, R.E.,
Superintending Engineer, 6th Division.

TANJORE,
24th January 1870.

C.

Memorandum showing the quantities of water to be disposed of, and the heights of water in streams as they are, and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.

Names of Rivers.	Quantities.		Level at which water in river now stands.	To pass quantities in column 2 with water as in column 4, water to be raised.		Remarks.
	In Cubic yards per hour.	In Cubic feet per second.		With shutters.	Without shutters	
1	2	3	4	5	6	7
Vennaur...	917,600	6,880	52·6	56	53·68	
Coriyaur...	623,900	4,680	52·75	.....	53·93	
Paumaniyaur...	293,600	2,202	52·2	.....	53·64	In a 12 feet Cauvery flood at Serungham head.
Vennaur...	657,900	4,934	51·3	54·8	52·11	Maximum when Cauvery head sluice has been completed or regulated supply.
Coriyaur...	447,300	3,355	51·37	.....	52·25	
Paumaniyaur...	210,500	1,579	50·8	.....	51·9	
Vennaur...	302,560	2,270	49	51·75	49·41	Theoretical supply ; shutters must be 4½ in all.
Coriyaur...	226,980	1,700	49·12	.....	49·73	
Paumaniyaur...	99,360	745	48·6	.....	49·2	

Vennaur has 14 vents—Paumaniyaur 4 vents—Coriyaur 9 vents, and floor is to be placed at 44½ instead of 45.

Tanjore,
24th January 1870.

(Signed) R. F. OAKES, Captain, R.E.,
Superintending Engineer, 6th Division.

D.

Memorandum showing the quantities of water to be disposed of, and the heights of water in streams as they are, and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.

Names of Rivers.	Quantities.		Level at which water in river now stands.	To pass quantities in column 2 with water as in column 4, water to be raised.		Remarks.
	In Cubic yards per hour.	In Cubic feet per second.		Shutters out.	Shutters in.	
1	2	3	4	5	6	7
Vennaur...	384,000	2,880	94·84	95·6	96·28	In a 12 feet flood at Cauvery head.
Paundaviyaur	479,300	3,595	94·75	96	99	
Vennaur...	344,300	2,582	94·44	95·16	95·76	In a maximum regulated flood.
Paundaviyaur	249,300	1,870	92	92¾	96·8	
Vennaur...	209,840	1,574	92·6	*93·1	.....	With theoretical supply.
Paundaviyaur	60,570	454	89·1	†89·35	.....	

† Floor is at 87 ; so Vennaur shutters must be. 2½ feet and

* Paundaviyaur shutters ... ... 6 feet.
Padugay level is... 94
Bank level, ... 97 to 97·8

(Signed) R. F. OAKES, Captain, R.E.,
Superintending Engineer, 6th Division.

Tanjore,
24th January 1870.

E.

Memorandum showing the quantities of water to be disposed of, and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.

Names of Rivers.	Quantities.		Level at which water in river now stands.	To pass quantities in column 2 with water as in column 4, water to be raised.		Remarks.
	In Cubic yards per hour.	In Cubic feet per second.		Shutters out.	Shutters in.	
1	2	3	4	5	6	7
Velliyaur...	141,400	1,061	89·9	90·32	94·75	In a 12 feet flood at Cauvery head.
Vennaur	240,700	1,805	89·9	90·55	95·5	
Velliyaur...	126,700	950	89·5	89·9	.....	In a maximum regulated flood.
Vennaur	215,700	1,618	89·5	90·1	.....	
Velliyaur...	88,380	663	88·6	*88·9	93·37	With theoretical supply.
Vennaur	120,520	904	88·2	*88·56	93·43	

* Shutters must be... ... ... 4¼ feet high.
Paddigay is at .... 89·5
Top of bank 95
Floor at... .... 84½

(Signed) R. F. OAKES, Captain, R.E.,
Superintending Engineer, 6th Division.

TANJORE,
24th January 1870.

NOTE BY THE ACTING CHIEF ENGINEER FOR IRRIGATION.

IN August last the Superintending Engineer of the 6th Division forwarded plans and estimates for the regulation of the principal branches of the Vennaur. It was considered that some further information was necessary before the proper designs for regulating works could be decided on; and at the end of September I visited the Tanjore District and saw the Kodamurty and Arasalaur regulators on the Cauvery, which had recently been under construction; the latter being, with the exception of some trifling work, completed, and the former partially built. I had also the opportunity of discussing with Captain Oakes the requirements of such works of regulation, and the result was the selection of a design which appeared to me to fulfil the required conditions, and upon this the plans, for which estimates are now forwarded by the Superintending Engineer, have been prepared.

Proceedings Madras Government of the 12th October 1869, No. 3,292.

2. It will be seen that Captain Oakes does not feel at all sure that the arrangements, provided for in the estimates, are such as should be adopted; and, as the importance of avoiding any serious errors in carrying out works, upon which very considerable interests will depend, can hardly be over-rated, I propose to explain the opinions I have formed, and the circumstances of the rivers as fully and clearly as possible, while, in order that all that has been urged by the Superintending Engineer may be duly considered, the correspondence which has taken place will be appended to this Note.

To Superintending Engineer, No 269, 14th September 1869.
From Superintending Engineer, ,, 983, 25th November, with enclosures
To Superintending Engineer, ,, 315, 4th December.

3. The regulating works, recently under construction on the Cauvery, are open dams, and their arrangement may be briefly described as follows:—In the centre of each dam an opening down to the river-bed is left; the width of the opening being proportional to the area of land irrigated by each river, and these openings are intended to divide the water-supply, when that does not exceed three cubic yards per acre per hour for the whole area, in direct proportion to the areas concerned. When the rivers are in fresh, and carrying a greater supply than that named, the raised portions of the regulators are so arranged as to divide the surplus with reference to other considerations; the principal one being the capability of the rivers to carry flood-waters without risk of damage.

4. Captain Oakes proposed to construct similar works on the Vennaur, but it appeared to me that, while works of this kind would certainly very greatly improve the condition of the rivers, they would not secure that control over the water-supply which it seemed desirable to obtain, and which I thought might be provided for by other arrangements. A work of a similar kind to the open dams was constructed many years ago at the head of the Vennaur, and when I was in Tanjore in the years 1862—64, I had many opportunities of observing its action, and I became convinced that it could not be expected to act efficiently. The rivers of Tanjore are, for the quantities of water carried, broad shallow streams, and the state of their beds is constantly changing; so that at one time the deep bed is in one position, and a few weeks, or perhaps days, afterwards, according to the character of the intervening freshes, the circumstances might be altogether different. The consequence is that

open dams are liable to be obstructed by sand banks, which at once altogether alter their action, and prevent their being capable of effecting the division of the supply as intended. To obviate this inconvenience at the Vennaur head, planks were provided to be placed on the crest of the dams as circumstances might require, so as to increase or diminish the waterway of either branch, and these planks were to be placed in position from the roadway of the bridge over the regulators. This arrangement proved impracticable, and the consequence was that no use could be made of the planking, except when the river was so low as to allow of the planks being carried down into the river-bed, and placed in position by the kotens (lascars), while at other times nothing could be done to secure a proper distribution of the water.

5. The new works on the Cauvery are an improvement on the design adopted at the Vennaur head, and they will be far more efficient. Nevertheless, when I visited them in September, evidence was not wanting that they would not accomplish all that was expected of them; for there were marked variations in the level of the water at different parts, which necessarily vitiated the calculations of discharge based upon the arrangement of the dams. Captain Oakes had been endeavouring to take the actual discharge of the Cauvery, with a view to ascertain the effect of the works, but he found that there were very material differences in the quantities obtained, and that the sum of the discharges of the several rivers did not at all agree with the supply in the Cauvery above.

6. The regulating works on these rivers must be capable of passing all the water brought down in floods, without materially raising the flood-level immediately above the works: they should further be capable of distributing any given quantity in such proportions as the particular requirements of cultivation, capacity of the rivers to carry water, etc., may show to be necessary. It appeared to me therefore that assuming open dams to be unobjectionable as regards the former necessity,* it would be comparatively easy to provide for this by simply dividing the open dam into a number of parts by piers, and furnishing each part or vent with a moveable shutter of about the same height as the masonry wall of the open dam, while the power of varying the relative proportion of the water-way at the heads of the two rivers to be regulated, would meet the second requirement. It was found, however, that such a work, providing, as it would do with all the shutters removed, a far larger waterway than the open dam, would be unnecessarily expensive, and a modification of this arrangement was consequently decided upon; the conditions to be provided for being that, even should all the shutters be, from mismanagement, left in the vents, the water at its maximum should be able to pass through the latter and over the shutters, without raising its level to such an extent as to cause imminent danger of breaches in the artificial banks, while, with the shutters all removed, that level should be raised to but a trifling extent, or but a few inches at most higher than with the open dams.

* The passage of flood-waters.

7. To fulfil the former of these two conditions, it is obviously necessary to have shutters working in grooves in the piers, for the top of the shutters must be much below the level of floods, and therefore still more below the level of the platform or roadway from which they must be worked. I propose to use rolling shutters, *i. e.*, shutters running on wheels which will move on the back of the grooves in the piers. The position of these shutters at all levels between the sluice cills and a margin above raised flood will be regulated either by screw gearing or by a bar worked by a lever. The screw gearing has recently been experimented upon with good results, and it will shortly be applied to a sluice which has to be worked under far greater pressure than can ever be met with at the river-regulators. It is, indeed, as far as I can judge at present, far more powerful than will be necessary in Tanjore, for one man can overcome an upward or downward pressure of more than four tons, and I think the rolling shutters will render any such force unnecessary. I am having a shutter, in all respects similar to those intended to be used for the Vennaur regulators, made up, and from experiments upon this, it will be ascertained in what way the working-power can best be applied.

8. The Superintending Engineer doubts whether such shutters as those I have just described can be so arranged as to ensure their removal from the sluice vents when necessary. He much prefers baulk shutters; that is, vertical planks placed side by side, and resting against cross bars. Such shutters have been almost universally used at all sluices in Tanjore, and, of course, the people are familiar with the method of managing them; but this is all that can be said in their favour, for they would close the whole vent, whereas only the lower part need at any time be shut; and at these regulators it is of importance, and, indeed, a necessary condition, that carelessness or mismanagement should not cause the flood-level to be unduly raised. The cross bars occupy a considerable area in the vents, and this is a further objection to their use, while a minor, though not unimportant, drawback is that the discharge, through sluices furnished with cross bars and such shutters, cannot be accurately determined.

9. Another point mentioned by the Superintending Engineer is that the more complete regulator is more expensive than the less perfect open dam. This is indisputable, but if an efficient work can be obtained at a moderate cost it would seem to be better to so construct it than to be content with a description of regulator which only very partially secures the objects for which it would be built. The estimates for the revised designs are for the—

Vennaur—Vettaur regulator	Rupees	82,140
The acreage under the Vennaur is		241,296
Do. do. Vettaur		89,285
		330,581
Cost of regulators per acre under 4 annas.		
Vennaur, Paumaniyaur, and Corayaur... ...	Rupees	62,400
	..	75,962
Acreage under Vennaur...	...	32,789
Do. Paumaniyaur	...	98,786
Do. Corayaur	...	207,537

Cost of regulators per acre Annas 4·81.

Vennaur and Pandaviyaur	Rupees	30,180
Acreage under Vennaur...		69,247
Do. Pandaviyaur...		19,895
		89,142

Cost of regulators per acre Annas 5·42.

Vennaur and Vellyaur...	Rupees	24,730
Acreage under Vennaur...		39,770
Do. Vellyaur...		29,163
		68,933

Cost of regulators per acre Annas 5·74.

Also taking the whole acreage and the cost of the four regulators, the outlay proposed, when compared with the area to be affected, is—

Total area ... ... Acres 330,581
Do. outlay ... ... Rupees 1,99,450

or Annas 9·65 per acre; and the estimates, moreover, include bridges which will be of considerable value in facilitating traffic. This must, I think, be considered a moderate outlay, and one which, if it be thought that it will secure the objects proposed, will be readily sanctioned. I do not, however, wish it to be supposed that these regulators are all that will be needed to place the rivers in an efficient state. A glance at the plans or surveys will show that much more has to be done, and, had longitudinal sections of the embankments been given, it would have been seen that these also need reformation. The restriction of the river-beds, and the bringing of the embankments to a proper level and cross section, with the rectification of their alignment where faulty, are, however, works, which would be equally necessary, though more difficult, were the construction of regulators not to be undertaken, and they will be carried out from the funds provided for the up-keep of the irrigation works. Those funds have borne but a very small proportion* to the revenue, and nothing but the most emergent work could consequently be undertaken; a somewhat more liberal grant will be available for next year, and it is hoped that when the allotments are more in proportion to the magnitude of the revenue, the rivers will be speedily brought into better order.

*Average of 1866-67 to 1868-69, three per cent.

10. I will now endeavour to show what are the circumstances of the rivers at each of the proposed works of regulation. The first of these works is for the division of the water at the head of the Vettaur. From Statement B. it will be seen that, with twelve feet of water on the gauge at the head of the Cauvery at the upper anicut, the level at which the water stands in the Vennaur immediately above the head of the Vettaur is seventeen; the cill of the regulator is to be at ten, which is a little below the average deep bed. The flood-water to be discharged is 3,289,900 cubic yards an hour, or 24,674 cubic feet a second. The proportions of flood-water which the rivers are considered capable of carrying are—

The Vennaur...	63
Vettaur...	37
	100

for the flood-water abovementioned the number of vents of ten feet span required would be forty-one, but as it is stated that in high floods the present embankments in the upper part of the delta breach, and therefore all the water does not come down the river, it has been considered better to allow forty-seven vents, of which thirty will be allotted to the Vennaur and seventeen to the Vettaur. It is intended to bring all the embankments to a proper level, and then probably about 28,500 cubic feet a second will have to be provided for. The regulators as designed will raise the flood-level on their upper side in a twelve feet flood, one foot ten inches. The natural banks of the river here are about six inches above normal flood-level, so that the head of water against the artificial banks will be about one foot four inches, or, say, in an extraordinary flood, when entirely confined between embankments, one foot nine inches. The flood velocity in the Vennaur at present is $5\frac{1}{2}$ feet a second, and that through the vents will be 7·5 feet, with a possible maximum of 8·66 feet. In the next place the result of leaving all the shutters in the vents, supposing such neglect possible, and it is really not so as at no time would all the shutters be required to be down, may be noticed. It is proposed to have for the—

Vennaur...	20 shutters	4	feet high	(centre.)
	10 do.	5	do.	(sides.)
Vettaur.....	9 do.	4	do.	(centre.)
	8 do.	5	do.	(sides.)

and the water would then have to rise to $3\frac{3}{4}$ feet above normal flood-level to allow of the whole being passed through the vents over the shutters. Even under such circumstances there need be no serious risk, for all that would be necessary would be to make the artificial banks for about $1\frac{1}{2}$ miles up the river a little higher than they are required to be at present, and to take care that their alignment is fairly parallel to the axis of the stream. Indeed, it is quite certain that there would be far less risk of damage at this point than there is, and always will be, at many other parts of the Vennaur, where the bed of the river is much less below the natural level of the ground. The roadway over the regulator is intended to be nine feet above normal flood-level.

11. The next regulating work will be for the Vennaur, the Corayaur, and the Paumaniyaur. The flood-waters of the Vennaur immediately below the regulator at the head of the Vettaur will be 15,296 cubic feet a second. The estimated flood discharge of the Vennaur, immediately above the regulators now to be considered, is 13,762 cubic feet a second, the difference being taken up by the sluices between the first and second regulators. The whole quantity is to be divided thus:

Vennaur...	24,674	
Deduct Vettaur.	9,378	
Vennaur below Vettaur	15,296	

		C. FEET.
	Vennaur	6,880
Vide Appendix C.	Corayaur	4,680
	Paumaniyaur	2,202

and the work proposed is shown in Plan No. VA., and it is similar as regards the general arrangements to that already described for the first regulator. Twenty-seven vents of ten feet span each are intended to be allowed, of which,

14 vents are for the Vennaur.
9 Do. do. Corayaur.
4 Do. do. Paumaniyaur.

The normal flood-level is at present for the first river 52·6, for the second 52·75, and for the third 52·2. The present head of the Paumaniyaur is at a short distance above the Corayaur, and a new head will therefore be cut, as shown in Plans IVA. and IVB.; the eastern line being that, after examination, found to be more advantageous than the shorter line first chosen. The effect of the proposed regulators will be to raise the normal flood-level slightly more than one foot, supposing all the shutters to be raised clear of the water, and about 2·75* feet were the shutters all to be left down on the cills. The roadway† is to be 7·9 feet above normal flood-level, 6·82 feet above raised flood, and 5·15 feet above the greatest height to which the water would rise with all the shutters left in. The shutters are shown five feet in height on the Plan (VA.); they should be 4½ feet, as will be seen from Appendix C, and that height will be, if anything, more than sufficient.

*Captain Oakes gives 3·40, but this would seem to be too much perhaps five feet shutters were taken.

† 60·50.

12. The next branch of the Vennaur is the Pandaviyaur. Out of the 6,880 cubic feet a second, carried by the Vennaur at the preceding division, 6,475 cubic feet have to be disposed of here, and will be divided into—

	C. FEET.
For the Vennaur	2,880
Do. Pandaviyaur...	3,595

The regulator, as designed by the Superintending Engineer, provides eight vents of ten feet span each for either river. The circumstances of the rivers here are peculiar. The Vennaur is required to carry less flood-water than the Pandaviyaur in the proportion of four to five, while the supply for purposes of irrigation, when the undivided stream is carrying just enough for both, should be for the former, compared with the latter, as seventy-seven to twenty-three nearly. At present, the irrigation-water is so improperly divided that the Vennaur gets but little more than half its proper share, and the Pandaviyaur nearly three times as much as its cultivation requires. Such being the case, the Pandaviyaur would, if the flood-waters were to be divided exactly as Captain Oakes considers to be advisable, have ten vents instead of eight; but as the difference between the ordinary full irrigation supply level, and that of normal flood in the Vennaur is but 2¼ feet, and as the regulators will raise the latter only nine inches, it is thought that the proper proportion of the flood-water may be adjusted by means of the shutters without difficulty. The Superintending Engineer proposes to give shutters 2½ feet high to the Vennaur sluices, and six feet high to those of the Pandaviyaur, but this arrangement would not be a proper one. The mean width of the Vennaur does not materially differ from the waterway, eighty feet, given in the sluices at its head, and it may be assumed therefore that the irrigation supply will pass without obstruction. It is said* that the depth of water in the Vennaur to supply its cultivation properly must be 5·6 feet,† but with this depth, it would seem that about half as much again as the 1,574 cubic feet per second required would be carried, and as far as I can judge, about 4½ feet of water would suffice.

* Appendix D.

† 92·6
87·0
5·6

If so, the difference in level between the water in the two rivers at such times would be (3·5—1·1) 2·4 feet, and to pass the 454 cubic feet a second required in the Pandaviyaur, 55 square-feet of opening below the surface of the water in this river on the lower side of the sluices must be given, and all the shutters raised 8¼ inches would secure this; so that it would seem to suffice to make the shutters (4′-6″—8″) 3′-10″ high, or, say, four feet high; while those of the Vennaur sluices may be 2½ feet high. Except as regards the effect of the shutters being left in when the rivers are in high flood, the height of the shutters is a matter of detail, which will be settled as soon as it has been ascertained whether 5·60 feet are really required in the Vennaur here, when some miles higher up, and with a flatter slope of bed 4½ feet only are stated to be necessary.

13. The last of the proposed regulators is for the head of the Vellyaur. Out of 2,880 cubic feet a second passed into the Vennaur at the third regulator, 2,866 have here, in floods, to be distributed, and of this quantity the—

	C. FEET.
Vennaur is to take	1,805
Vellyaur do.	1,061
While for irrigation the Vennaur requires	904
Vellyaur „	663

Eight vents of ten feet are provided in the design, (Plan VIII-A.) for the Vennaur, and six vents for the Vellyaur, and the work will raise the water in normal floods to but a nominal extent. The shutters of half the vents may be four feet high, and of the other half, three feet, which will suffice for purposes of regulation, and at the same time do away with all risk from carelessness on the part of the establishment.

14. It will be observed that the Superintending Engineer is of opinion that works of the class now proposed for sanction would be comparatively useless, unless these regulators may be opened and closed at the discretion of the Public Works Officer; and he advocates, moreover, the turning of the whole undivided supply down either branch alternately, whenever that supply falls below the quantity required for the irrigation under both branches. It may be as well that I should state what object I propose to secure by these works of regulation:—

See correspondence and especially paragraph 13 of No. 1,235, 24th ultimo.

1*st*,—As the most necessary, the due distribution of flood-waters;

2*ndly*,—Complete control over the supply for irrigation;

3*rdly*.—A knowledge of the actual supply given to each river.

With regard to the first point, there is no difference of opinion between Captain Oakes and myself. His designs for open dams would, in a great measure, provide for the proper sub-division of the water in floods. I think also that as regards the second requirement, we differ chiefly only as to the time and manner of exercising the control which regulating works would render possible. In the first place, the officers of the Irrigation Department will need much more information than they now possess, and this will be in part obtained directly from the regulators, before they will be competent to deal effectively with the question of regulation. The conditions of things will be considerably changed by the mere fact of the unutilized surplus of one river being transferred to meet the deficiency in another. An example may be of use: there have been great complaints of want of water in the

Vellyaur, and the papers, which have been laid before, and are now submitted to Government, show that there must have been good grounds for such complaints. This river wants 663 cubic feet a second, but it will be seen that the Vennaur at the bifurcation of the Pandaviyaur gets but 40 instead of 77 per cent. of the supply when there is just enough for both: consequently, at the Vellyaur head there is but little more than half of the proper quantity to be divided. The remissions for short supply under the Vellyaur averaged for the eleven years 1858 to 1868 19,231 rupees, while for the talook (Negapatam), they amounted to Rupees 27,173. This was the loss to Government, but I find that in one year (1867-68) Rupees 27,372 were levied on lands which could not be cultivated, but which were retained by the ryots; so that in the interests of this one talook alone the proposed arrangements will be of the very greatest importance. At present, there is practically no regulation. Something is occasionally done when matters have become extremely bad, and when perhaps it is too late to do much good, to turn a supply down one of these minor rivers by means of temporary groynes; but such steps are usually not taken, except upon the urgent representations of the Revenue officers, who are supposed to be alone empowered to alter the distribution, and to divert water to the cultivation which at the moment may be in the greatest need of a supply. What I propose to do then is, to make the registration of the actual supply passing down each river a regular part of the duties of the Irrigation Department; secondly, to obtain from the Revenue officers the best information available as to the order in which the villages or channels under each river are entitled to receive water when there is not enough for all, and to put this information into such a shape as will admit of its being readily made use of; thirdly, to provide for the communication, by the Talook Revenue officials to the Executive Engineers, of such information as may enable the latter from time to time to deal with the actual circumstances, and meet the wants of the several areas of irrigation; and, fourthly, it is proposed to endeavour to improve the arrangements for the supply and drainage of all the lands wherever there may be found to be any considerable need of reformation. In carrying out such improvements it is to be expected that opposition will be met with from individual land-holders; and, in order that the Irrigation Department may have the best prospect of success, and may secure the confidence of those who are interested in the efficiency of the arrangements made, I propose that operations shall be commenced in those sections of the delta which are now confessedly very badly supplied. The irrigation under the Vellyaur may first be taken up and thoroughly inquired into, not only as regards the levels of its lands and the circumstances of its supply and drainage channels, but also the local customs and interests, which need not necessarily be allowed to bar improvements, but which should be clearly understood in order that they may not be interfered with, unless for good and sufficient reasons. Then the officers of the department will be in a position to decide what arrangements will be most advantageous, and it may be hoped that, where so many will gain tangible benefits, and where none will be allowed to suffer any diminution of their just rights, it will not be difficult to carry out the alterations and im[illegible]ments required. Other parts of the Negapatam Talook should be similarly treated, [illegible] Myaveram Talook will require to be dealt with in the same manner, and it ou[illegible]ach the same facilities in consequence of the present unsatisfactory state of its irrigation. It will be seen, then, that I contemplate the gradual substitution, throughout the delta, of complete and intelligent regulation for the very unequal and inequitable arrangements of the present and past; that it is proposed to commence where interference is most urgently called for and where consequently opposition may most easily be overcome; that action will be preceded by full investigation and inquiry; and that the proposed arrangements will be carefully reviewed before they are carried out. By proceeding in this manner there will be the best assurance that those in whose hands the regulation will be placed will be fully competent to manage it satisfactorily, and, moreover, the actual facts will always be ascertainable, and it will be readily seen not only how the water is distributed, but whether that distribution is what it should be. Complaints there must, of course, be for at least a considerable time to come, but one great advantage will be that representations, if worthy of attention, will lead to the application of such remedies as may be necessary, whereas now all alike are too often powerless to effect any useful results, partly from lack of information and partly from the absence of the means of regulation. I could go much more into detail, but I trust I have said enough to show—

1*st*.—Why works capable of securing complete regulation are needed; and

2*ndly*.—Why it is intended to substitute order and system in a gradual manner, rather than to require Irrigation Officers to undertake, all at once, a duty which it is impossible that they should perform satisfactorily, until a great deal of preliminary work and investigation have been done.

15. Captain Oakes, in paragraph 17 of his last letter, asks for sanction for the establishments required for the regulators on the Cauvery at the heads of the Codamurty, Arasalar, and Veerasholen, and he has been requested to transmit a separate application in the prescribed form.

16. With these remarks I beg to submit the estimates, Rupees 1,99,450, for the four sluice-regulators for the sanction of Government, and to recommend that the Government of India be asked to authorize their construction, as in the case of the Cauvery regulators, from Loan Funds. It will be observed that Captain Oakes has, in the margin of paragraph 1 of his letter, shown a proposed outlay of Rupees 150 at the head of the Athiveraramanar; but it is not necessary to include so trifling a work in these estimates, and it can be carried out on local sanction in due course.

17. The Superintending Engineer has, in paragraphs 18 and 19 of his letter submitting the revised estimates, replied to paragraph 2 of the Order of Government of the 12th October last, No. 3,292, and he has explained that it is generally only in September that it would be necessary, were the tambogyee or low crest of the upper anicut raised, to regulate by the under-sluices in that work the supply to the lands below and under the lower anicut. He further shows that he proposes to establish communication between the Monigars at the two anicuts, so that, when water is required for the lower irrigation, and when the supply in the river at the upper anicut is not more than one foot below the level of the crown of that dam, the requisite regulation of the under-sluices may be carried out. Under this arrangement the upper anicut Monigar would be instructed to comply with demands made by the lower anicut Monigar to the extent of the supply which, were the tambogyee retained, would pass the upper dam, and there will be

no difficulty in preparing a table to admit of the sluices being regulated with sufficient accuracy under all circumstances of the river. The only likely cause of inconvenience will be the time occupied in the communications between two Monigars sixty miles apart.

As at present valuable water is sometimes wasted, I think that, upon the explanations now given, the estimate, Rupees 800, submitted by the Superintending Engineer in August last, may be sanctioned from the reserve under Agricultural.

18. Captain Oakes has not submitted plans and estimates for the proposed regulation of the Cauvery at the Grand Anicut and for giving a new head to the Vennaur. The circumstances of these works were discussed when I was in Tanjore, and I think that it will be as well to bring them forward as soon as they can be sent up in a complete shape. At the same time, after giving the subject full consideration, I have come to the conclusion that it would not be advisable to postpone the construction of the Vennaur regulators until the flood-volume of the waters entering it shall have been reduced, and that it will be the best plan, and will save revenue in excess of the extra cost, if the regulation of the Vennaur and its branches be carried out at once, so as to provide for the disposal of the maximum freshes under existing circumstances. I propose, therefore, to report on the regulation of the Cauvery at the Grand Anicut at a future date.

(Signed) J. MULLINS, Major, R. E.,
Acting Chief Engineer for Irrigation.

No. 269.

Observations on the project for providing regulators for the Vennaur and its main branches, which was received with the letter, No. 617, of the 30th ultimo, from the Superintending Engineer, 6th Division.

1. What is the extreme flood discharge of the Vennaur immediately above the head of the Vettaur, also what is the intended maximum discharge should the river be regulated at a new head close to the Grand Anicut? The only information bearing on the former point to be found among the papers is the memorandum on Plan 3, which appears to indicate that the water is not expected to rise above 19·50 referred to the datum level there used.

2. It appears to the undersigned advisable to design these regulators now, so that they may be capable of affording a complete control over the river-supply until the lands have, what Captain Oakes terms, the theoretical supply. It may be impracticable, though it does not appear to the undersigned to be so, to construct them in this way, while the discharge in floods is so great as it now is; but the Acting Chief Engineer thinks that the plans should show the complete design with its cost, the part to be immediately executed, and that to be deferred until the Vennaur itself is brought under regulation, and further there should be some information as to the saving in the cost of the lower regulators, which would result were that at the head of the Vennaur carried out simultaneously.

Three cubic yards per acre per hour.

3. As nearly as can be guessed, the flood discharge of the Vennaur is some five millions of cubic yards an hour, in which case, with the division contemplated by Captain Oakes, the Vennaur would have to carry 31,50,000 and the Vettaur 18,50,000, and the mean velocities over the open regulators would then be pretty nearly equal.

Vennaur..... 8,217.
Vettaur ..... 8,366.

4. The widths, 400 and 300 feet, allowed respectively for the Vennaur and Vettaur regulators between the abutments, do not appear to be correct with reference to future arrangements. If the Vennaur head be left open for the present, the lengths of these regulators ought to be in proportion to the maximum discharges, otherwise it will be difficult to give sluice-vents hereafter. The total length in the designs received is 700 feet, which should be modified to suit future requirements, whatever may be done at present. Now, if 759 feet be allowed, and be divided between the Vennaur and the Vettaur in the proportions of 477 and 282 feet respectively, these lengths will do for thirty-seven vents of nine feet with four feet piers for the one and twenty-two vents of nine feet for the other, which will preserve the proper proportions.

5. It may here be remarked that with sluices, as above indicated, having their cills at 10·50 and the vents nine feet high, the head, in addition to velocity of approach required to discharge the quantities above named, would be 10 inches, while with the open dams or regulators the head would be 7 inches. If, therefore, there be only some small difference of this kind, it would seem to be advisable to provide works capable of complete regulation once for all.

Paragraph 3.

6. Before, however, any arrangement can be finally decided upon, it is necessary that the ultimate intentions with regard to the Vennaur should be stated and discussed. What is eventually to be the maximum discharge, and what are considered to be the proper width and depth for that discharge, should be stated. Without information on these points it does not seem to be possible to make out a proper design for the Vennaur-Vettaur regulator.

7. It is observed that Captain Oakes has provided, in the estimates for another of the regulators, baulk shutters supported by railway irons. This arrangement would doubtless be approximately efficient as regards the control of the supply; but it would be impracticable, or nearly so, with baulks to register accurately the area of waterway open, and it is intended that, on all the irrigation works throughout the country, an accurate register should be kept. This being the case, it will be requisite to record daily, or oftener if necessary, the exact area of waterway open, and the levels of the water above and below each regulator, and to do this the shutters must be so designed as to show at once the desired information. It is considered that nine-feet openings may, with the head of water generally to be dealt with at these regulators, be easily managed: a design has been prepared for the gearing of some sluices near Madras and, should this be found successful, the lifting apparatus will probably be found capable of extended application. At any rate, when the regulating works have been designed, the details of the shutters and apparatus will be worked out in this office in communication with the Superintendent of the Government Workshops at Chepauk.

8. On the longitudinal and cross sections of the rivers shown in Plan No. 2, the levels of the water when three cubic yards per acre per hour for the full areas of cultivation are going down should be shown, as also the levels of the extreme discharge with the Vennaur head as at present, and after regulation at the Grand Anicut; the sectional area of waterway and the hydraulic mean depth, under each of these latter conditions, should likewise be noted. These particulars must be ascertained, and it saves much labour if they are duly noted on the plans.

Vennaur and Vettaur.

9. Remarks similar to those made on the Vennaur and Vettaur regulators apply to those proposed to be built at the heads of the three rivers. Plan 5 does not at all indicate how sluices would afterwards be added to the open dividing dams, and whatever works may be decided upon in the first instance, it is altogether preferable that the arrangements ultimately intended should be shown; as, without actually putting them on paper, it must be extremely difficult to provide fully for the requirements of the more complete system. The supply of the Harrichundranuddi from the Vennaur instead of from the Coriyaur will be a great improvement. It is, however, stated that no new works are required for this purpose and, at C. on the Sketch Map, an apparently existing regulator is shown. It is requested that a plan of this work may be furnished, in order

Vennaur, Pamaniyaur, and Coriyaur.

that it may be seen whether it is likely to be suitable: the levels from A. on the Coriyaur to C. and from B. to C. should also be given.

10. It is not quite clear that the alignment of the new head for the Pamaniyaur is the best that could be chosen. Were its lower end to be placed fifteen chains to the eastward, the water would enter the river in a much better direction, and apparently it is merely a question of a slight additional expense, which would perhaps be more than compensated for by facility of maintenance of the river itself. The line which appears preferable has been marked in pencil on Plan 4.

330 yards.

11. The particulars referred to in paragraph 8 above should be noted for these rivers also.

12. The next work is the regulator at the head of the Paundaviyaur, and here it is proposed to build sluices at once. It is said that the Vennaur above the head of the Paundaviyaur will never be likely to carry more than 5,000 cubic feet a second. It is observed that cross and longitudinal sections of these rivers at and near the bifurcation, with discharges at different levels, have not been furnished with the plans, though this is very necessary, neither have the levels of the theoretical and maximum supplies been marked on the plans of the regulators. Probably 96·50, the level of the springing of the arches, is intended to be that of extreme freshes. If so, there will be 1,368 square feet of waterway in the sluice-vents or, deducting the spaces* occupied by the railway irons, 1,278 square feet of opening, which would make the velocity very nearly four feet a second; and as this corresponds to a hydraulic mean depth of six feet with a fall of 1 foot 9 inches per mile only, it is probably not much, if at all, in excess of the velocity in the river above the works during extreme floods, and the design, with the addition of small water-wings something like those shown in front between the two heads and with improved shutters, would do probably very well. It will be necessary to show, however, what the maximum discharge would probably be were the Vennaur regulated at the Grand Anicut, in order that it may be understood what difference of arrangement would be induced were that regulation carried out simultaneously. It is also not clearly understood how it happens that the extreme discharge of the Vennaur immediately above the Paundaviyaur is 5,000 cubic feet a second, the supply of the area of irrigation at three cubic yards per acre per hour being 2,028 cubic feet a second, or, in round numbers, two-fifths of the maximum, while at the head of the Vettaur the maximum is five times the theoretical supply. It will be well, therefore, to show in a tabulated statement how the water is to be disposed of, and the following form will be convenient:—

Vennaur. Paundaviyaur.

* 90 square feet.

Cultivation, 7,438 cubic feet a second.
Discharge, 37,500 ,, ,, (about).

Maximum flood discharge of Vennaur above each Regulator in cubic feet a second.	Distribution of Flood Waters.								
	1st Regulator.		2nd Regulator.			3rd Regulator.		4th Regulator.	
	Vennaur.	Vettaur.	Vennaur.	Coriyaur.	Pamaniyaur.	Vennaur.	Paundaviyaur.	Vennaur.	Velliyaur.
	.....								
	.....								
	.....								

and this statement should be followed by one in the same form exhibiting like particulars of the distribution that would be proper were the Vennaur regulated at the Grand Anicut.

13. The design for the regulators at this point are generally suitable, and when information has been given as to the discharges to be provided for immediately, and in the future, it will be easy to determine exactly what is to be done.

Vennaur and Velliyaur.

14. With regard to the remark near the end of the Superintending Engineer's memorandum, it may be noticed that plans with longitudinal and cross sections of the rivers below the second regulator have not been received.

15. It should be stated what course is intended to be followed with regard to the regulation of these rivers and their branches farther to the eastward. There is doubtless much need of regulation, and this need will in some cases be even more imperative, than it is now, when the distribution up above has been brought under command.

16. At the end of the memorandum on the Pamaniyaur dam it is said that the bed of the river below the new cut will require to be reduced, and that this will be done from repair funds. This will be quite proper, but the Acting Chief Engineer thinks that all such work should be put on paper, and that every mile of every river should have its fixed alignment, width, and maximum depth, and that measures should be taken to ensure such improvements being carried out in a systematic manner, and as rapidly as the labour available will allow. He will be prepared to do all in his power to provide the Superintending Engineer with such funds as may be requisite if Captain Oakes will furnish him with tracings of the drawings made for the guidance of the Executive Engineers, and explain in what order he proposes to take up the work, and what amount, in addition to the ordinary repair grant, can be well laid out each year. It is not expected that all that has to be done can be shown at once, and it will be sufficient if from time to time the arrangements of sections of 10, 15, or 20 miles of a river be reported on. It should not be forgotten that some of the rivers will require permanent groynes to keep the deep channel in its proper position, and, where suitable material is not obtainable from the Tanjore Fort or elsewhere at no great distance, cubes of brickwork, or, which would be better, blocks of concrete, should be employed for the purpose.

17. With regard to paragraph 2 of Captain Oakes' letter, the undersigned thinks that the subject of the provision of a head sluice for the Cauvery and regulation for the Vennaur at a new head near the Grand Anicut should be brought forward for consideration as soon as possible. There will, it is thought, be no difficulty in designing an efficient work, and no insurmountable difficulty in arranging for its being so carried out as to interfere as little as possible with the cultivation under the several rivers during the time that the works are in progress, and when, therefore, there will neither be the excessive supply under no regulation, or a diminished supply under command. The interval will occasion difficulty there can be no doubt; but the best arrangements possible for the supply of all the irrigated lands must be made, and with care and forethought, and by making the regulating works pass also an excessive supply for a time, if necessary, even at some risk of minor injury, it is hoped that all serious inconvenience will be avoided.

No. 617.

18. In the meantime the undersigned proposes to recommend that 30,000 rupees be placed at the Superintending Engineer's disposal for the preparation of materials, and he hopes that every effort will be made to get the project ready in all respects at an early date, so that the sanction of the Government of India may be obtained by the time the materials for commencing work can be got ready.

19. It is thought that the floors of the sluice-vents for a distance of two feet above, and, at least, six feet below, the shutters should be of stone, as at this part the wear and tear of the water, charged as it often is with sand, is

Say for the length of the short piers.

very considerable. Concrete would probably be a valuable material in the construction of these hydraulic works. For the lower parts of foundations and retaining walls and under masonry aprons, also for covering arches, filling in spandrils, etc., it can be used with much advantage, and sometimes at a great saving of expense for unwatering foundations. Hydraulic mortar and vitreous laterite gravel make excellent concrete, and, when the latter cannot be easily obtained or brought to the works, vitrified brick is a good substitute. Lime is an important element in the successful carrying out of the lower parts of these regulators, and it would be well, therefore, to ascertain by experiment what proportions of lime and particular clays will make good hydraulic mortar at the different river-heads, and then to arrange for the substitution of concrete for brick masonry in all the work which is more than a couple of feet or so below the river-bed.

(Signed) J. MULLINS, Major, R.E.,
Acting Chief Engineer for Irrigation.

From the Superintending Engineer, 6th Division, to the Acting Chief Engineer for Irrigation and Joint Secretary to Government, Public Works Department, dated Tanjore, 25th November 1869, No. 983.

With reference to your personal instructions relative to the provision of closed works for the regulation of the supply of water to the Vennaur and its branches and to your proposal, first to regulate the supply by means of shutters which would admit of the theoretical supply for the lands under either branch being thrown down the branches alternately when the water in the main stream above the points of separation fell below the supply required for the lands under both branches, and second to provide vents which would admit of the maximum supply the rivers are likely to receive being discharged through the vents of the sluices or regulating works even supposing that it were found impracticable to remove the shutters during high floods, I have the honour to submit memoranda showing what would be the effect of such shutters as you propose at each particular head, and from the memoranda you will observe that, unless the regulating works were made far larger than is contemplated and than is at all necessary if the ordinary baulk shutters were used or any other shutter the opening and closing of which could be entirely depended upon under any and every condition of the floods, the water would be raised with shutters to a level with the tops of the present artificial banks, and far above the level of the Padugay and of the adjacent country during high floods; and even, when the theoretical supply only was passing down the streams, were there any difficulty in removing the shutters, the water-level would be raised to, or a few inches above, the ordinary Padugay level. Raising the level of the water in this manner would be exceedingly dangerous.

Reply to Acting Chief Engineer's memorandum, No. 219, dated 14th September 1869.

A. Memorandum showing cultivation under the Vennaur and its branches
B. Memorandum relative to proposed regulating work at the Vettaur head.
C. Memorandum showing quantities of water in the Vennaur, Coriyaur and Paumaniyaur.
D. Memorandum showing quantities of water in the Paundaviyaur and Vennaur.
E. Memorandum showing quantities of water to be disposed of, etc., in the Velliyaur and Vennaur. Three Plans, Nos. 2, 4 and 6.

2. It must be borne in mind that the objects of the regulating works are two-fold.

1*st*. To regulate the supply to each branch in proportion to the cultivation under it when the theoretical supply only is passing down the main stream.

2*nd*. During high floods to permit as large a quantity of water to pass down each stream as the streams can carry without danger. The reasons for this have already been explained elsewhere.

3. In effecting these two objects in some states and conditions of the floods, one stream has to carry off a far larger proportion of the supply than it has to carry under other conditions: thus, for example, in the highest floods the Paundaviyaur has to carry 55 per cent. of the supply in the main river, and in low floods only 22 per cent; in the various stages of transition between these extremes it is absolutely necessary that portions only of some of the vents should be closed, and this can, in my opinion, be most effectually and certainly done by means of the ordinary baulk shutter. I am not aware whether, with the shutter you propose, it will be possible to close a vent partially, *i.e.*, were the shutter five feet high and were the water-level above the sluice four feet, whether the shutter could be suspended as it were in the vent to reduce the height of the opening to one foot or two feet; if this cannot be done, such shutters as you propose are not suitable for the regulating works in the Vennaur and its branches.

4. From Statement A. it will be observed that the Vennaur is liable to receive about 33 per cent. of water in a high flood above the maximum quantity it is to receive when the regulating work at the Cauvery head is completed, and that the difference at the Paumaniyaur head is even greater, now the quantity to be passed down the Vennaur, when the Cauvery regulator has been built, is the maximum supply that the river can carry with safety, and with this supply the water in the Vennaur at the head of the Vettaur is six feet deep or at sixteen above datum, and here the level will be raised to 17⅜ feet by the work proposed; this is three-eighths of a foot above the level to which the water would rise in a twelve-feet flood in the unobstructed stream, but it will rise to 18¾ inches above the proposed regulating work with all shutters removed and to twenty-one with shutters in. The differences at the Paumaniyaur head will be similar, while at the Paundaviyaur head the difference is much smaller, being only about ¾ feet, and hence it is clear that while a closed work may without danger be supplied at the Paundaviyaur head, the works at the Vettaur, Paumaniyaur and Coriyaur heads must, for the present, be open works. They may, however, be so arranged as to admit of the works being closed hereafter, and, if so, the works should be as follows:—

Vide Statement C.
Do. D.

Vennaur	26 Vents of ten feet	= 260
	25 Piers of four feet	= 100
		360
Vettaur	19 Vents of ten feet	= 190
	18 Piers of four feet	= 76
		266
Vennaur	14 Vents of ten feet	= 140
	13 Piers of four feet	= 52
		192
Paumaniyaur ...	3 Vents of ten feet	= 30
	2 Piers of four feet	= 8
		38
Coriyaur	8 Vents of ten feet	= 80
	7 Piers of four feet	= 28
		108

I beg that you will inform me whether you wish the estimates of the works to be re-cast so as to provide for them as proposed above, and, if so, whether the foundations of the piers are to be put in when the dams are built.

5. I would take the opportunity of observing that you appear to have misapprehended the memoranda which accompanied my letter, No. 617, for, in paragraph 3 of your note* to Government, you state that the open regulating works proposed are "incapable of regulating the supply according to the demands of the moment, so that invaluable water might and would certainly be going unused down one river while crops were perishing under another." This statement is altogether inaccurate; until the water-supply in the main stream rises to a full theoretical supply required for the cultivation under the two branches, the water is distributed to each branch by the regulating works in proportion to the cultivation dependent upon each branch, and hence it cannot be said that water would be going unused down one stream while it was

30th August.

* In G. O., No. 3,292, 12th October.

required under the other; on the contrary the water would be fairly distributed in proportion to the cultivation under each branch until the full theoretical supply was passing down each stream. When the water in the undivided stream exceeded the theoretical supply required by the branches, the water would be distributed so as to take advantage of the capacity of each branch to discharge the flood-waters, but the excess in either branch above the proportion of the cultivation would rise very gradually when the supply exceeded the theoretical supply but little, and so it is *never* likely that water required by lands under one branch would be running to waste by the other.

6. The only advantage which a closed work would have over an open one would be that when the supply in the undivided stream fell short of the theoretical supply required by both branches, the whole of the water might be thrown down either branch alternately, and thus water would reach lands farther to the eastward than they could do with the open regulating works; but at the same time it must be remembered that, though the more eastern crops might thus be saved, it would only be at the expense of the crops more to the westward which would thus be deprived of a full supply. I am myself an advocate for closed works, but I am of opinion that the time has not arrived for their construction, and that they cannot be provided for the larger streams till the Cauvery head-sluice has been built, and the water which shall be permitted to enter the Vennaur can be limited to the quantity which that river and its branches are known to be able to carry with safety, and then only if the shutter used can be worked with positive certainty as is the case with the baulk shutters.

7. Owing to the distribution of the water above the Paundaviyaur head and to the capacity of the Paundaviyaur river below its head, the difference in the level of the water above the sluice or regulator to admit of the maximum supply which may now be received being discharged and the level to which the water must rise to admit of the maximum regulated supply being discharged, is so small that it is not necessary to postpone the construction of a closed work at the Paundaviyaur head till the Cauvery head sluice has been built, and hence my proposition to construct a closed work there at once, and there the new shutter may be tried and the experience there obtained may be taken advantage of in constructing closed regulating works at the heads of the Vettaur, the Paumaniyaur, and the Coriyaur.

96
95·16
0·84
Vide Statement D.

No. 315.

MEMORANDUM.

The undersigned has the honour to acknowledge the receipt of the letter, No. 983, of the 25th ultimo, with its accompaniments, from the Superintending Engineer, 6th Division, and to inform him in reply that the calculations of the effect of the proposed regulators on the Vennaur have, as regards those at the bifurcation of the Vettaur, been checked, and that results closely approximating with those given by Captain Oakes have been obtained.

2. It is not quite clear why the number of ten-feet vents for the Vettaur regulator is put at nineteen in paragraph 4 of the memorandum.* In paragraph 8 fourteen are mentioned, and this was, it is believed, the number fixed when the undersigned was in Tanjore. Supposing that the proportion of flood-waters to be carried by the two rivers is as sixty-three to thirty-seven, it would seem to be proper, if twenty-six vents be allotted to the Vennaur, to allow fifteen for the Vettaur.

* In reply to this Office Memorandum, No. 269, of the 14th September last.

3. With the above per-centage of flood for the Vennaur, the Acting Chief Engineer finds that, in the absence of regulation at the Grand Anicut and of a new head to the Vennaur, the water in twelve-feet floods at Seringham would be raised one foot ten inches, which closely approximates with the 1¾ feet mentioned in paragraph 5 of Captain Oakes' memorandum. If the flood discharge be correct therefore, and, inasmuch as it appears to require a mean velocity of 4·77 feet a second in the Vennaur just above the Vettaur head, it is probably not far from the truth, the construction of a regulator with vents instead of an open dam is quite feasible.

4. The Superintending Engineer seems to think that the raising of the flood-waters 1¾ feet would be very dangerous, but in the Appendix B. to his letter he shows that the river banks (natural) are here at about six inches above extreme flood-level, and consequently the artificial embankments would have to retain a depth of only about 1¼ feet. Were the depth double the risk might readily be reduced to a minimum by very ordinary works, and there are certainly hundreds of places in Tanjore where far greater depths, above the natural surface of the country, are retained by very poor embankments indeed.

5. It is stated that when the water rises above twelve feet on the upper anicut gauge the Vennaur, at the Vettaur head, does not receive much more water owing to breaches in the upper parts of the Delta. As, however, as improvements are carried out, such breaches will probably become less frequent, it may be well to allow somewhat more waterway than that mentioned in paragraph 2 above, especially as it would appear from the cross sections of the rivers near the bifurcation that there is plenty of room for some enlargement. The following dimensions may, therefore, be adopted:—

For Vennaur... ... ... 30 vents of ten feet.
,, Vettaur ... ... 17 do. do.

6. The roadway or shutter-platform should be at twenty-six.* The river embankments should be at the same level at the regulator, and in the upper reaches should be brought everywhere to six feet above the maximun flood-level. It is here supposed that the Cauvery regulation at the Grand Anicut will not, for some time to come, be carried out.

* Cill at...	10
Maximum depth of water ...	8¼
For shutter	5
Increase of margin	2¼
	26

On the other hand if there is a probability of that part of the project for the improvement of Tanjore being sent in shortly, with the information necessary for its disposal, the arrangements at the Vettaur head would be susceptible of considerable modification. The regulators might then have the following dimensions:—

Vennaur ... ... 24 vents of ten feet.
Vettaur... ... ... 14 do. do.

It would be well, therefore, to show for these regulators the saving that would be effected by cutting out nine vents, and to give similar information for the works of regulation lower down.

7. The undersigned regrets that, when speaking of leaving the gate shutters, which he intends to recommend for use on these regulators, in their places, he did not, as it would seem, make it quite clear to Captain Oakes that such neglect was never contemplated as probable, but that it would nevertheless be desirable to see what the results would be, and to design the arrangements so that even then damage might be avoided. It is manifestly extremely improbable that forty-seven shutters would all be left at the bottom of their vents, for, as the river rose, it would be the duty of the establishment in charge, to regulate them, and on its reaching a certain height to lift them clear of the maximum flood-level. Now with gate shutters the greatest evil that could result would be the raising of the flood-level some four feet,† a result it is true not at all desirable but nevertheless not very formidable if the embankments be at the level and in the order in which they should be maintained. All that is really required is that the neglect to raise all the shutters quite clear of the water in proper time should not be attended with any serious risk, and this the arrangements proposed will ensure. With baulk shutters the risk instead of being lessened would, in the event of neglect, be very largely increased: baulks block the entire waterway, and, were even a few vents left closed, much damage would be inevitable.

† It would be somewhat less with the increased number of vents.

8. It is considered that at the Vennaur-Vettaur regulator the shutters may be of these heights—

Vennaur	20	shutters of four feet	in	height.	
	10	do. of five	,,		do.
Vettaur.....	9	do. of four	,,		do.
	8	do. of five	,,		do.

It will never be necessary to shut off the whole of the supply from either river when the Vennaur above the bifurcation is carrying a quantity at all approaching to the theoretical supply required for the whole area of cultivation. Indeed, it appears to be very doubtful whether the diversion of the whole supply, even when only but one-third or one-fourth of that quantity, will ever be permitted, but this point need not be discussed now. As regards the working of the shutters, the undersigned has already stated that a design is being carried out for sluices near Madras, and, when that has been fully tried, the details of the sluice gearing for the Tanjore regulators will be determined. It may here be mentioned, in order to remove the impression which Captain Oakes appears to have received, that the gate-shutters will be lifted and lowered by screws ; that they will run on iron wheels in stone grooves ; and that they will be capable of being suspended at any level above the cill which may be desirable.

9. If Captain Oakes will read again paragraph 3 of the Acting Chief Engineer's note, referred to in paragraph 5 of his letter under reply, he will observe that the supply for the total irrigated areas belonging to each river is in contrast with the demand of the moment, viz., the supply required for the areas actually under irrigation. An open regulator will divide the theoretical supply between the total acreage under the Vennaur and Vettaur respectively, but it will not enable half that supply to be divided according to the areas actually in want of water at the moment, and these may be, and probably often are, in quite different proportions to the total areas under the rivers. Complete regulation means, or was intended to mean, an effective control of the water-supply at all times to the extent likely to be necessary. It may without difficulty be carried out by the arrangements which the undersigned has proposed, and he is quite prepared to accept all the responsibility of their suitability, assuming the data on which they have been based to be correct.

10. The other regulators should be designed in a similar manner and with proportionate capacities.

11. The Superintending Engineer's original designs and estimates with the opinions he has expressed will, if he wishes it, be laid before Government when the revised arrangements are submitted for sanction. The undersigned desires the fullest discussion ; but, having satisfied himself that such regulators as have recently been sanctioned and partly carried out on the Cauvery and its branches are imperfect ; that a much more complete system of regulation is perfectly practicable ; and that it is extremely desirable and necessary that the Irrigation Department should have the means of exercising a complete control over the supply, he can have no hesitation in advising the Government to sanction the more, instead of the less, perfect arrangements.

12. The Acting Chief Engineer will recommend sanction for the employment of two Surveyors for completing the surveys and levels of the Vennaur on a separate application accompanied by particulars of the amount of work to be done, and of the probable time that this work will occupy, being sent in. Mean sea-level should be the datum used for all levels throughout the district, and levels already taken should be connected* with this datum and on all plans a note showing the connection should be recorded.

* As opportunities occur.

In connection with these surveys and with the remarks made by Captain Oakes in paragraph 16 of his memorandum, the undersigned must observe that he is sorry to differ in opinion from the Superintending Engineer as to what is proper and necessary for the right management of the rivers of Tanjore ; but as the Acting Chief Engineer has no doubt of the necessity for conformity to the instructions which he has given, and as he believes that on the one hand the capacity of the rivers for safely carrying flood discharges will be increased by confining their beds to the best alignment which may be available, and that on the other hand no work, whether it be simply planting up

bends with nanel, fixing the position of groynes, or altering the existing arrangements in any other way, can be successfully and economically carried out without large-scale surveys or charts of the rivers, on which the works which may be designed and executed may be shown and the results recorded, and then used as the basis for determining further operations, he must ask the Superintending Engineer to aid him in carrying his views into effect. A great deal of time and money has been thrown away in Tanjore from the omission to take the steps which have been indicated before making straight cuts, etc., and money is spent yearly on temporary protective works which ought to be rendered unnecessary by the removal of the causes of erosion or other damage. It is a mistake to suppose that a permanent groyne necessarily becomes useless on its being thrown into backwater when it has accomplished its purpose of transferring the deep stream away from the point threatened. A good survey, coupled with an inspection of a river, will show very clearly where sets may always be expected to recur, while at other places it may probably be correctly decided that, if the course of the river be once rightly determined, expensive permanent works will not be required, and, in such cases, temporary and inexpensive works may properly be constructed. It should be remembered also that much of the costly material of a permanent groyne may be transferred elsewhere when the stream has been diverted, and that then it will generally suffice if a few yards in length of solid nose be left and if the rest of the groyne be formed of earth turfed or covered with durbar revetment, and in some places perhaps where most exposed in high floods merely pitched with stone. Where, too, rough-stone is too expensive for use, substitutes should be sought for, and it has already been pointed out that concrete blocks, which in the prismatic form have been very successfully used in Italy, might be found to answer. Wherever sand and hydraulic lime, or sand, rich lime and clay are procurable, the Engineer should not be long at a loss for a suitable material.

13. With regard to the proper line for the Pamaniyaur new head, it may be remarked that paragraph 10 of Captain Oakes' memorandum is not a sufficient answer to the suggestion made by the undersigned. The difference of length in the revised line is as fifty-six to thirty-six, and no doubt, therefore, the area of land would be increased in about the same proportion as also the cost of the cutting. The actual difference of cost on these accounts can easily be stated, and the Acting Chief Engineer will then be very glad of the Superintending Engineer's opinion as to which line is, on the whole, preferable.

(Signed) J. MULLINS, Major, R. E.,
Actg. Chief Engineer for Irrigation.

4th December 1869.

To the Superintending Engineer, 6th Division.

P.W. 1870 Dept

(1) No. 173.

From
The Actg Chief Engineer
for Irrigation.

To The Secretary to Govt
P. W. Dept.

Dated 7th February 1870
Despd 17th March "
Rec'd 17th "
No 27.
106 Encls

Encl: 40

+ Plans 1 and 16 Encls
were sent to Lt Cowp
Surveyor Vide Do 357/73
15-7-73

Note on the revised estimates & for the regulating works for the branches of the Vernaur.

Nos 1144 & 1145 - 29 April 70.

No 448

R.C. 5 April 70 No. 8
" 28 March 1870 R-2 enclosed

Supg. Engineer's Office 6 Division
No 983 Sanjore 25th November 1869.

From,
Captain R. F. Oakes R.E.
Supg. Engineer 6th Division

To,
Major J. Mullins R.E.
Acting Chief Engineer for Irrigation
and Joint Secretary to Govt P.W.D.

Sir,

With reference to your personal instructions relative to the provision of class d works for the regulation of the supply of water to the Vernaur and its branches and to your proposal I to regulate the supply by means of shutters which would admit of the theoretical supply for the lands under either branch being thrown down the branches alternately when the water in the main stream above the points of separation fell below the supply required for the lands under both branches and II to provide Vents which would admit of the maximum supply the Rivers are likely to receive being discharged through the Vents of the Sluices or regulating works even when opposing

Enclosure No. 9-

A — Ripley & Oakes Chir Engineer Minute No 219 dated 31st October 1869.
B —
C —
D —
E —

x 3 Plans Nos 2 — 2 — 6

x Sent to the Govt Office 9 Dec 69

supposing that it were found impracticable to remove the shutters during high floods.

I have the honor to submit Memoranda showing what would be the effect of such Shutters as you propose at each particular head and from the Memoranda you will observe that unless the regulating works were made far larger than is contemplated and there is at all necessary if the ordinary bank Shutter were used for any other Shutter the opening and closing of which could be entirely depended upon under any and every condition of the floods, the water would be raised with Shutters to a level with the tops of the present artificial banks and far above the level of the passage and of the adjacent Country during high floods; and even when the theoretical supply only was passing down the Streams were there any difficulty in removing the Shutters the water level would be raised to, or a few inches above, the ordinary passage level. Raising the level of the water in this manner would be exceedingly dangerous.

2—— It must be borne in mind that the objects of the regulating works are two fold.

1st To regulate the supply to each branch in proportion to the cultivation under it when the theoretical supply only is passing down the main stream.

2nd During High floods to permit as large a quantity of water to pass down each stream as the streams can carry without danger.

The reasons for this have already been explained elsewhere.

3—— In effecting these two objects in some states and conditions of the floods our stream has to carry off a far larger proportion of the supply than it has to carry under other conditions. Thus for example in the highest floods the Pandaravayaur has to carry 55 per cent of the supply in the main River and in low floods only 22 per cent. in the various stages of transition between these extremes it is absolutely necessary that portions only of some of the Vents should be closed and this can in my opinion be most effectually and certainly done by means of the ordinary bank shutter

I am not aware whether with the Shutter you propose it will be possible to close a Vent partially i.e. were the shutter 5' high and were the water level above the Sluice 4' whether the Shutter could be suspended, as it were, in the Vent to reduce the height of the opening to 1' or 2' if this cannot be done such Shutters as you propose are not suitable for the regulating works in the Vennaur and its branches.

4—— From Statement A it will be observed that the Vennaur is liable to receive about 33 percent of water in a high flood above the maximum quantity it is to receive when the regulating work at the Cavery head is completed and that the difference at the Pamanyam head is even greater, now the quantity

quantity to be passed down the Vennaur when the Cavery regulator has been built is the maximum supply that the River can carry with safety and with this supply the water in the Vennaur at the head of the Vettaur is 6' deep & at 16 above datum and here the level will be raised to 17 3/8 by the work proposed this is 3/8 of a foot above the level to which the water would rise in a 12' flood in the undisturbed stream but it will rise to 18 3/4 above the proposed regulating work with all shutters removed and to 21 with shutters in; the differences at the Vennaniyaur head will be similar while at the Vandaviyaur head the difference is much smaller being only about 3/4' and hence it is clear that while a closed work may without danger be supplied at the Vandaviyaur head — the works at the Vettaur Vennaniyaur and Coviyaur heads must, for the present, be open works, they may however be so arranged as to admit of the works being closed hereafter and if so the works should be as follows.

Vennaur ——	26 Vents of 10'	=	260
	25 Piers of 4'	=	100
			360.
Vettaur ——	19 Vents of 10'	=	190
	18 Piers of 4'	=	76
			266
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			192
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	2 Piers of 4'	=	8
			38.
Coviyaur ——	8 Vents of 10'	=	80
	7 Piers of 4'	=	28
			108

I beg that you will inform me whether you wish the Estimates of the works to be re cast so as to provide for them as proposed above and if so whether the foundations of the Piers are to be put in when the dams are built.

5 —— I would take the opportunity of observing that you appear to have misapprehended the Memoranda which accompanied my letter No 617 for in para 3 of your Note to Government you state that the open regulating works proposed are "incapable of regulating the supply according to the demands of the moment, so that invaluable water might, and would certainly be, going unused down one River while crops were perishing under another." This statement is altogether inaccurate; until the water supply in the main stream rises to a full theoretical supply required for the cultivation under the 2 branches the water is distributed to each branch by the regulating works in proportion to the cultivation dependent upon each branch and hence it cannot be said that water would be going unused down one Stream while it was required under the Other; on the contrary the water would be fairly distributed in proportion to the cultivation under each branch until the full theoretical supply was passing down each stream; when the water in the undivided stream exceeded the

the theoretical supply required by the
branches the water would be distributed
so as to take advantage of the capacity
of each branch to discharge the flood
waters, but the excess in either branch
above the proportion of the cultivation would
rise very gradually when the supply exceeds
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I am myself an advocate for closed works
but I am of opinion that the time has
not arrived for their construction and
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has been built and the water which shall
be

be permitted to enter the Vennaur can be
limited to the quantity which that
River and its branches are known to be
able to carry with safety and then only
if the shutters used can be worked with
positive certainty as is the case with the
baulk shutters -

7 — Owing to the distribution of the
water above the Pandaviyaur head
and to the capacity of the Pandaviyaur
River below its head the difference in the
level of the water above the Sluice or
regulator to admit of the maximum
supply which may now be received being
discharged and the level to which the
water must rise to admit of the maximum
regulated supply being discharged
is so small that it is not necessary to
postpone the construction of a closed work
at the Pandaviyaur head till the Cavery
head Sluice has been built, and hence
my proposition to construct a closed work there
at once and there the new Shutter may be
tried and the experience there obtained
may be taken advantage of in constructing
closed regulating Works at the heads of the
Vettaur, the Pannaniyaur and the Cotiyaur.

I have the honor to be
Sir
Your Most Obed.t Servant

F. Pate Captain R.E.
Supt Engineer 6th Division

E.

Memo Showing the Quantities of Water to be disposed of and the heights of water in Streams as they are and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.—

Name of River.	Quantities. In Cubic Yards per hour	Quantities. In cubic feet per Second	Level at which water in River now Stands.	To pass Quantities in Column 2 with water as in Column 4. Water to be raised— Shutters out	Shutters in—	Remarks.
1	2	3	4	5	6	7
Velliyaur	141,400	1,061	89·9	90·32	94·75	In a 12' flood at { every head
Vennaur	240,700	1,805	89·9	90·55	95·5	
Velliyaur	126,700	950	89·5	89·9		In a Maximum regulated flood.
Vennaur	215,700	1,618	89·5	90·1		
Velliyaur	88,380	663	88·6	88·9	93·37	With theoretical Supply—
Vennaur	120,520	904	88·2	88·56	93·43	

Shutters must be 4½' high.
Parapet is at — 89·5
Top of bank — 95—
Floor at — 84½—

Supt Engr's Office 6th Division
Tanjore 24th January 1870.

W. F. Nasse Captain R.E.
Supt Engineer 6th Division.

To the Supt Engr of the
2nd N. 31 S. of 4th
Decr/69.

From
The Supt Engr of
6th Division.

To
The Acting Chief Engr
for Irrigation &
Joint Secretary &
Govern. to G. P.W.

Dated 25th
Recd 29th } Forwarded
No 1083. } 1870.

Enclosure 9.

Reports on the subject of the alterations proposed by the A/g Chief Engr for Irrigation in the design of the proposed Regulating works for the distribution of the waters of the Vennaur, and forwards Statements &c. in connection with the same

Enclosure in a letter from the Supt Engr 6th Division to the Acting Chief Engr for Irrigation - No 1235 dated 24th January 1870.

1073
W 353/70

E.

Memo Showing the quantities of water to be disposed of & the heights of water in Streams as they are & the height to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.

D.

Memo showing the quantities of water to be disposed of and the heights in Streams as they are & the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given. —

Name of Distributary.	Quantities. The cubic feet per second given.	Quantities. The cubic feet per second given.	Gauge given in Column 2 as it is with Shutters on. Gauge given in Column 4 as it is with Shutters on.	Gauge given in Column 2 as it is with Shutters on. Gauge given in Column 4 as it is with Shutters on.
1	2	3	4	5
Umaun Pandoriyaun	584,000 479,800	2880 3595	94·84 94·35	95·6 95
Umaun Pandoriyaun	344,320 249,340	2582 1870	94·44 92	95·16 92 3/4
Umaun Pandoriyaun	209,840 60,570	1574 454	92·6 89·1	93·1 89·55

Bills theoretical Supply
{ Upon 1st at 97.2 Umaun Shutters must be 92½, &
Pandoriyaun Shutters off.
Supply due in 1st
Gauge due in 1st 97.8.

96·28 99	} 1st 12 Gates at Canary Head	95·76 96·8	} 1st 8 Sluices separated Head

C.

Memo showing the quantities of water to be disposed of and the heights of water in Streams as they are and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.—

Name of River.	Quantities. In Cubic Yards per hour.	In Cubic feet per second.	Level at which water in River was Stands.	To pass quantities in Column 2 with water as in column 4 the water to be raised. With Shutters	Without Shutters	Remarks.
1	2	3	4	5	6	7
Vemaun ———	917,600	6880	52·6	56	53·68	
Coryaun ———	623,900	4680	52·75		53·93	
Pamanyan —	293,600	2202	52·2		53·64	In a 12' Canery flood at Serunghaun Head.
Vemaun ———	657,900	4934	51·3	54·8	52·11	Mean immum when Canery Head Sluice has been completed & Regulated Supply.
Coryaun ———	447,300	3355	51·37		52·25	
Pamanyan —	210,500	1579	50·8		51·9	
Vemaun ———	302,560	2270	49	51·75	49·41	Theoritical Supply — Shutters must be 4½ in all.—
Coryaun ———	226,980	1700	49·12		49·73	
Pamanyan —	99,360	745	48·6		49·2	

Vemaun has 14 Vents - Pamanyan 4 Vents, Coryaun 9 Vents & floor is to be placed at 44½ instead of 45.—

Supt Engs' Office 6th Div.
Cuttack 24th January 1870

H. F. Baker Captain R.E.
Supt Engineer 6th Division

Enclosed in a letter from the Supt Engineer 6th Div. to the acting Chief Engr. for Irrigation No 1235 of the 24th January 1870.

D.

Memo showing the Quantities of Water to be disposed of and the heights of Water in Streams as they are and the heights to which water must rise to discharge the quantities to be disposed of under each condition of the floods given.—

B.

Memo relative to the proposed Regulating work at the Vettaun Head showing how the water would be raised and what moveable Shutters would be required &c. — Vemmaun Sluice 30 Vents of 10'. — Vettaun Sluice 17 Vents of 10'. —

Name of Rivers.	Quantities. In cubic yards per hour	Quantities. Apart per 1"	Level at which Water in Rivers was Stands.	Velocity in undivided Rivers above Separation in feet per 1"	To pass Quantities in Column 2 with Water as in Column 4 Water to be raised. Shutters in	Shutters out	Remarks.
1	2	3	4	5	6	7	8
I Vemmaun	2039700	15298	17	5·5	21	18·44	I In a 12' flood at Canary Head
Vettaun	1250200	9378			22·25	18·64	
II Vemmaun	1520300	11402	16·08 Correctly 16 taken	5·25	19·5	17·18	II Maximum when Canary Head Sluice has been completed on regulated Supply —
Vettaun	1013600	7602			21·25	17·52	
III Vemmaun	731200	5484	14·5	4 nearly. 3·64	17·28	15	III Theoretical Supply required for cultivation under the Rivers. —
Vettaun	270600	2030	13·5	2·25 3·25	17·55	13·86	

Velocities below Separation with quantities in Column — 3.

Thus to pass full theoretical Supply down Vemmaun the Vettaun Sluice must be closed upto 15.
or Shutters must be 5' high sloon being at 10. —

Vettaun do do do Shutters must be 4' high in Vemmaun. —

Supt Engrs Office 6th Div.
Tanjore 24th January 1870.

J. F. Waters Captain R.E.
Supt Engineer 6th Division.

Enclosed in a letter from the Supt Engineer 6th Div. to the Secty Chief Engr. for Irrigation No 1235 dated 24th January 1870.

C.

Memo showing the Sanctioned Water Supply to be distributed down the Vemmaun & Vettaun Rivers in Cusecs and the highest they can and the highest which can ordinarily run at present with the given Velocity and the Velocity of running with full supply.

2 24/7½/70

Enclosure in a letter from the Supt Engr 6th Div to the Acting Chief Engr for Irrigation No 1235. of 24 January 1870.

107B.
P/W 353/70
Rec'd 29 April 1870 in 2448.

B.

Notes relative to the proposed regulating work at the Nemaan Head showing how the water would be raised and what moveable shutters would be required &c —

Supts Engr's Office 6th Division
Tenjore 24th January 1870.

No 1235

47

From,
Captain R. H. Oakeley R.E.
Supt Engineer 6th Division.

To,
Major J. Scullies R.E.
Acting Chief Engineer for Irrigation
& Joint Secretary to Govt P.W.D.

Sir,

With reference to the Papers noted in the margin, I have the honor to submit Revised Estimates for the Regulating works for the Branches of the Nemaan providing:—

1 — Closed Sluices for all the New Regulators

2 — Such Alterations to the Original work for the Pandavaiman Head is very trifling consisting merely of

of the raising of the plat form from which the Shutters are to be worked and extending the arch over the Sluice Piers. it has been found necessary to alter the Bridges for Road No 58 Connected with the Head Work as the height given to those Bridges affords sufficient Space to lift the Shutters clear of the highest water mark.—

	Revised.
	82,140
	62,400
	30,180
	24,730
	150
	199,600

3 —— The Velliyaar Head work is precisely similar in character to that for the Pandaviyaar, the work is to be built in Connection with the Bridge on Road No 58.—

4 —— The Estimate for the Pandaviyar Head work inclusive of Bridges is Rs 30,180, if built according to the design adopted for the Vellaar Head work the cost would be Rs 27,410, and half the cost of the Bridges will be defrayed from Local Funds, the Construction of the Regulator in Connection with the Bridges will effect a Saving of Rs 5180 while the Bridges in rear will prove a Source of Strength to the work and will afford a Safe plat form from which to work the Sluices.—

5 —— For the Velliyaar Head it was proposed to complete the Bridge over the Velliyaar only & to lay the foundations and raise the Piers for a Bridge over the Vennaar as a Bridge over the latter River is not required for traffic at present; in now providing a closed Regulator at the Velliyaar Head the Completion of the Bridge will be necessary. this will add but Rs 1110- to the Estimate for the Bridge and doubtless the Revenue Board will Sanction a moiety of this sum in addition to the Rs 5,450 already Sanctioned: As in the Pandaviyar the Saving effected on the Velliyaar Regulator

Regulator if built in
Connection with the
Bridges will be Rs. 4135,
as per Margin :-

6 ——— In the open work originally
Estimated for the Velligaum Head the
Crest of the Dam or retaining wall
was placed at 85 above datum, in
providing Closed works the floor or Sills
of the Sluices are placed at 84½ so as
to form as little of an obstruction as
possible & as the tendency of all Works
across Rivers is to lower the bed of the
River immediately below the works
the floor of the Bridges which former the
Aprons to the Sluices has been placed
1' below the floor of the Sluices—

7 ——— For the works at the Heads of the
Vattaru, Panamuiyaru and Coriyaru
where Bridges for traffic are not re-
quired the Plan of Sluice proposed by
you has been adopted. I have however
placed the Aprons 1 foot lower than
than the Sills of the Sluices. The Esti-
mate has been prepared so as to provide
for

for one Vent, one Pier & the apron &
appertaining thereto, so that there will
be no difficulty in altering the Esti-
mate if the number of Vents pro-
posed is not approved. The alteration
of the number of Vents in the Vemaru
& Vattaru from 26 & 14 to 30 & 17 re-
spectively, reduces the Head of water
through the Sluices but little as will
be observed by comparing the Column
headed Shutters out in Forms B now
submitted with that despatched on
the 25th November :-

8 ——— From Form C submitted on the
25th November - it will be observed
that a head of 1' was required to
discharge the theoretical Supply through
the Panamuiyaru and nearly
2' to discharge the proportion of water
to be carried off by the Panamuiyaru
in a 12' flood & the Head in the Coriyaru
for the same discharges was higher
than that required for the Vemaru;
to assimilate the Heads as nearly as
possible I have proposed to add one
Vent to the Sluices for the Coriyaru
and Panamuiyaru & to provide

the

the new cutting for the Pamaniyam with a bottom width of 52' instead of 40'. I have also placed the floors of the Sluices at 44½ instead of at 45 & hence Statement C has been revised & the levels of the water as indicated in the Plans 2, 4, & 6, will have to be altered as shown on the longitudinal Sections of the Rivers now sent. I have recently inspected the Pamaniyam relative to the alteration in the direction of the New Head, the bed of the River has been considerably altered, since Captain Mead's Survey was made, by the cutting away of an Island & the planting up of the elbow as is clearly shown in the enlarged Plan of the River herewith sent. The direction marked on the plan for the new Head appears to be preferable to that suggested by Capt.n Mead & has been provided for accordingly in the Revised Estimate now submitted.

* See Plan 4 Sent on 25th November.

† 4. B.

9 —— From Statements B. C. D. & E. now sent it will be observed that the difference

difference of the water level between the Maximum 12' flood and the Maximum regulated flood is as per margin. while the head of water through the Sluices is as indicated so that it would not be well to reduce the number of vents whether the Canery Head Sluice be built or not & the mere reduction from ½ to 1 2/3' in the height of the Piers and wing walls would effect a very slight saving.—

10 —— From Statement B. C. D. E. it will be observed how the heights of the Shutters have been arrived at and provision has been made for lifting them clear of the Maximum flood and leaving a small margin as directed in para 6 of Memo No. 315. The raising of the River banks & closed works are to be built will be provided from the ordinary allotment for repairs.—

11 —— With regard to the solid shutters proposed I must admit I am very apprehensive

apprehensive that difficulties will arise in opening and closing them and that they may become clogged for even when the ordinary baulk Shutter has been down for some days it is often most difficult to remove the first plank owing to the accumulations of silt straw brushwood &c which are brought down in floods —

12 —— If the Shutters became clogged & could not be raised or even if some of the Shutters became injured the result might be very disasterous & regulation in low floods would be impossible for in all the regulators portions of Vents would have to be closed under every Condition of the supply in the Rivers — This would be specially the case as regards the regulator at the Pandaviyans head. As stated in para 3 of No 983 the Pandaviyans has to carry in the highest floods, 55 per Cent of the water in the Main Stream & in low floods only 22 per Cent - From Statement D it will be observed that in the main Stream the water level must be raised to 93·1 to admit of the Peninsular receiving a full theoretical supply for the land dependent upon it while to pass the theoretical supply down the Pandaviyans the water need be raised to only 89·35 but as the water level must be raised to 93·1 to supply the Peninsular, portions of the Pandaviyans regulator must be closed - No less than 7 of the Vents would have to be closed; for with a theoretical supply passing down the Pandaviyans the water below the regulator would stand at 89·1 while the water above would be at 93·1 with a head of 4' with the Sill of the Sluice at 87 - the Sill of the Vents would discharge 457·6 Cft per second or the full theoretical supply so that for the greater part of the season 7 of the Pandaviyans Vents would have to be closed - now if the Shutters of 2 of these Vents were injured so that they could not be used, all regulation as regards the theoretical supply would be at an end. Primitive and unscientific though the baulk Shutters may be, the facility in

raised

in their management and the almost impossibility of their being injured or rendered non-effective if a few spare banks are kept on hand induce me still to advocate their use.—

13——— With regard to your remark in para 8 of No. 315 "It is very doubtful whether the diversion of the whole supply even when only ⅓ or ¼ of that quantity will ever be permitted" & to which you add "but this point need not be discussed now" I would observe that the chief object of constructing closed regulating works is to admit of a full theoretical supply being thrown down either stream alternately when the water in the main or undivided stream falls below the quantity required for both branches so that water may reach the extreme limit of the cultivation when the supply is below a full theoretical: the question, therefore, whether the entire control of the regulation is to be entrusted to the officers of the D.P.W. or not, so far from bring a question which need not be discussed now appears to me to strike at the very root of the nature of the regulating works to be provided for if regulating works may not be opened & closed at the discretion of the D.P.W. officer, at all times and under all circumstances, the closed works are useless, for they cease to be regulating works in any sense; for as shown above, relative to the Pandaiyans, the closed regulators, which must necessarily provide for the discharge of the maximum floods will not divide the water in proportion to the cultivation in low floods unless some of the shutters are down or parts of the units are closed and so, if there is any doubt about the question of the regulation by the P.W. officer, it would be far better to provide open works which will distribute the supply in proportion to the area of the land dependent upon each branch until the theoretical supply is passing down each branch

branch and which will distribute the water when it exceeds the theoretical supply in proportion to the Capacities of the Rivers and to their requirements as regards the scouring of bars &c. than to expend large sums on closed Wks.

There appears to be so much uniformity in the times at which the crops are sown & the double crops are so small that it is very improbable that the areas requiring water would vary in any appreciable degree from the proportion of the total areas dependant upon each branch.—

14—— Independently of the question relative to the Control of the regulation by the P.W. officer, I am of opinion that closed works should not be provided at the Vettaur & Koriyaur heads at present for reasons stated in my No 983.—

15—— As stated in No 617 about 7½ per cent on the Estimates would probably be sufficient to cover the cost of Superintendence for which no Special

Special provision has been made in the Estimates.—

16—— Provision is made in the Estimate for a *Shed at each work for Stores &c. in a portion of which the inspecting Officer might find accommodation for a day if necessary.—

*30'×16'

17—— As directed by you Rs 250, have been provided for the Shutter and gearing for each vent and as I am not able to judge what Establishment will be required for the working of the Sluices I have been unable to submit an Estimate for the Establishment. As the Works at the Arasalar & Veerasholan heads have already been completed & that at the Coleroon head will be completed this Season I beg that Establishment proposed for these works may be taped at once or there will be no possibility of registering the wages during the next Season when it is proposed to determine

what

what quantity of water is paping over or through each work by means of Gauges in the reaches both above and below the works.-

18—— I still advocate the raising of the Tamboyer or lower step of the Upper Anicut - As stated in parag of No 617 the wastage at the lower Anicut must be guaged by the discharge over the Anicut; the quantity of water which enters the Coleroon between the Upper & Lower Anicuts cannot be calculated, but besides receiving surplus waters or waters which is wasted on both sides of the River, the Coleroon receives the drainage of a very large area in the Trichinopoly District & hence in the North East Monsoon particularly, as stated in No 617, there is sometimes more water paping over the lower Coleroon Anicut than is paping into the River over or through the Upper Anicut. No difficulty is apprehended with regard to the supply of the wants of the lands dependent upon the Coleroon by

by means of the Sluices for the Water Returns of paped years would enable us to judge with very tolerable accuracy the quantity of water to be paped down the River & very short experience in the use of the Sluices would admit of the Regulation being rendered almost perfect - In June, July & August no regulation would be required, for there is, as a rule, water paping over both the Upper & Lower Anicuts in those months - Again in October and the early part of November the Monsoon or local rain appears to supply all the water that is required by the lands dependent on the Coleroon; in September only would much care be required in paping down a requisite supply for the lands dependent upon the Coleroon for in December as a rule the water rises but seldom over the Tamboyer or lower step of the Upper Anicut & under these Circumstances, now, no water is allowed

allowed to pas through the Anicut and yet the supply to the lands dependent upon the Coleroon does not fail.—

19—— With a view of calculating what quantity of water was required for the lands dependent on the Lower Anicut in the South Arcot District I called upon the Collector for a return of the Cultivation under the Vadavaur & North Rajan Channel on the 21st October, but have not yet received a reply, but I believe those lands are not less liberally provided for than those dependent on the South Rajan Channel & Kinnikinnimiyan in the Tanjore district and I find that the South Rajan Channel Sluice is capable of paping nearly double the theoretical supply required by the lands dependent upon it when water stands to the level of the Lower Anicut & nearly 1½ times the supply when water is 2' below the Crown of the Dam so that even if a few days water was below

the

the Crown of the Anicut no harm would be done and as there is a Monigan at both the Anicuts, when water fell below the Crown a daily report might be sent from the Lower Anicut to the Superintending Engineer & to the Monigan at the Upper Anicut & the latter might regulate the opening & closing of the Sluices accordingly under rules laid down for his guidance & would receive Especial instructions in cases in which the rules did not meet the requirements, of the moment.

20—— In regulating the supply to the Permanent and Dyen Channels and also to the Vadavaur and Annada Canery which receive the drainage of large areas, the Monigans do not wait to receive written orders to close the Head Sluices when heavy rain appears to be falling but act at once & no inconvenience has arisen from their doing so & so it is believed that the Monigans by corresponding daily would be able to regulate the supply from

the

the Upper for the Lower Anicut so as to cause the Minimum of wastage & nulap in very Exceptional Seasons it is believed that no difficulty would arise in supplying the Colroon lands fully without wastage & there would certainly be no more difficulty in effecting this than in distributing the water to the lands dependent upon each stream by the regulating works now proposed for the Vemaur.—

I have the honor to be
Sir
Your most obd.t Serv.t
W. F. Ward Capt. R.E.
Supt. Engineer 6.th D.n

P.W. 1870 Dept.

L. Dis. No. 3552

From, Pres. of Govt. in Appl

The Supt. Engineer.

6th Division.

To, The Acting Chief Engr.
for Irrigation and
Joint Secretary to
Government P.W.D.

P.W. 1073/70.

Pres. 29th April 1870 in Lr 448.

Dated 24th

Rec'd 27th January 1870.

No 1235.

Enclosures. 80

Submits Revised Estimates for the regulating works for the branches of the Vennaur providing Closed works for all the New Regulators.

No 1146

P. W. Department.

No 1146

Proceedings of the Madras Govt.

Under date the 29th April 1870.

Read the following.

From. The Ag: Chief Engineer for Irrigation, } No. 2707 "February 1870.

The papers printed in these Proceedings relate to the provision of regulators for the Vennaur, the principal branch of the Cauvery in the Tanjore District. The Supt. Engineer in the first instance prepared estimates amounting to Rs. 93,150 for building regulating dams of a description similar to those which have been recently under construction at the heads of the branches of the Cauvery below

N.

A/A

I. D.S.

I pass the draft as the understanding that the "regulators" of the water supply completed by Major Mullens do exist in the

below the Veiraur, but the Chief Engr. for Irrigation considered that works of this kind, though they would very greatly improve the condition of the irrigation and make the distribution far more equitable than it is at present, would not allow of such a control over the water being exercised as is advisable, and that it would be better therefore to provide at once for sluice regulators, by which the quantity of water entering each river might be determined, within such limits as are necessary,

at

its "Distribution" which in any judgment shall be left entirely at present exclusively to the Revt. Commissioner of the District. I refer Govt. generally to para. 14. of Major Mullins' (undated & unnumbered) letter. I do not understand why no opinion has been sought from the Collr or the Chief Engr. on the subject - for though Major Mullins considers the anticipated deficiency at the head of some of the Tanks and the Tanjore actually takes the Engineering form of litigation I do

I am not quite clear that the advantages are worth the extra cost. They entail practically the original est: was Rs 93,150. The revised Rs 199,450.

I do

at all states of the rivers. These more perfect arrangements are necessarily more expensive, and the estimates for the revised design is increased to Rs 199,450.

2. Four regulators are provided for in these estimates, and they are proposed for construction at the head of the

Vettaur

Vairavanpiyaur & Coriyaur

Pandaviyaur

Vellyaur.

The total area irrigated by the Veiraur and its branches is acres 33,581, and the cost of providing regulation by means of sluices is therefore annas 9-65 per acre. There

Can-

cannot be any doubt, the Govt. consider, that if com-
plete regulation can be pro-
vided at a small comparative outlay, it will be
well worth while to construct
works enabling this to be
effected as early as possible.

3. The requirements of the
works have, it appears from
the papers submitted, been
fully and carefully considered,
the Supt. Engineer of the Division
and the Chief Engr. for Ir-
rigation are agreed as to the
effects of such works in
altering the level of the flood
waters, but they differ in
opinion as to the propriety
of making such an alteration,

as

as also with regard to the de-
scription of shutters to be used
the former officer preferring
baulk, or plank, shutters,
which would close the whole
of each vent when in, while
the latter recommends small
gate shutters which would re-
quire only a small portion of
each vent, and which, if not
properly worked, or regulated
during high freshes, would
not even then be likely to
raise the water level so much
as to occasion great risk of
damage.

4 – Complete information as
to the direct returns derivable
from bringing the irrigation
supply

supply under control has not been afforded, but it may be observed; first, that such improvements as those contemplated must produce very tangible beneficial results when the area concerned is so large; secondly, that the peninsins under the Vellyaur alone have averaged nearly 10 per cent on the total amount of the larger estimates, so that for the improvement of the irrigation under that one river it would probably be worth while to do all the work proposed, and that river waters but little more than ½ of the whole area

in-

intended to be benefitted. The Govt. consider therefore that there is good reason to expect that the returns from the outlay proposed to be made will be ample.

5. His Excellency the Governor in Council therefore resolves to sanction the estimate Rs. 1,99,450 for the construction of sluices regulators, in accordance with the recommendation of the Supt. Chief Engr. for Irrigation, and the Govt. of India, who have already sanctioned the preparation of materials for these works, will be requested to permit their execution from loan funds.

6. The

6. The Govt. agree with the Chief Engineer that much caution will ~~be required~~ needed in carrying out the improved regulation of the water supply of that part of the Tanjore District which is under the Vennaur; and the attention of the Supt. Engr., I. Division will be specially called to para 14 of the note by the former Officer.

7. The explanations afforded by the Supt Engr., as to the measures he proposes to take for ensuring a proper supply of water to the Coleroon below the Upper Anicut, are sufficiently satisfactory to enable the Govt. to sanction the closing of the tambogge in that Anicut, or in other words the raising of that part of its crest, which is 1 foot below the general level, to that level. The estimate for this work amounts to Rs. 800, and funds for it will be provided from the Reserve under Agricultural for 1870-71. The Govt. consider however that special care should be taken to note the effect of this alteration and they desire that the

State

stake of the water supply at both the Upper and Lower Annicuts be very carefully registered, and compared with that which past records show to have existed under the circumstances now about to be changed.

The Monegar of the Upper Annicut shall further receive very careful instructions as to the way in which the supply through the under sluices is to be regulated.

A report should be made at the close of the next irrigation season, or earlier if required, on the effect of closing the tambuggee, and on the practical efficiency of the arrangements made.

To

The Secy. to the
Govt. of India.

No 1145

Sir,

In continuation of my letter No 3293 dated 12th Oct/69 I am directed to transmit for the information of the Govt. of India a copy of the Proceedings of the Madras Govt., No 1744 dated 29th April/70 sanctioning estimates, amounting to Rs 1,99,450, for the Construction of 4 regulating works on the several branches of the Vennaur, which river is the principal branch of the Cauvery, and water

$30,581

To
The S. Engr. & Dy.
" Controller
" Revenue Depn.
" Chf. Engr. for Irrigation.
Despe 6/5/70.

330,581 acres, or about one
half the Tanjore Delta, and
to request the permission
of the Govt. of India to the
execution of these works
from Loan Funds. Rs 1,00,000
have been provided in the
Budget of 1870-71 under
Extraordinary, vide item
102, and I am to remind
you that the Govt. of India
have sanctioned the prepara-
tion of materials for these
regulators (No. 238 A.S. D/29 Nov/69).
The proposed outlay will
amount to annas 9-65 per
acre, and I am to state
that it is probable that
a return of nearly 10 per

Cent

Cent on the expenditure con-
templated will be obtained
from a saving of percolation
under the river, the Vellaiyur
alone, and the area there to
be affected is but a little
more than 1/12th of the whole
acreage under the Vennaur.
The necessity for bringing
the rivers of the Tanjore
District under regulation
has been so fully recog-
nized, that it is unnecessary
to dwell upon the general
question here again, but
I am to invite your atten-
tion to the discussions con-
tained in the Proceedings
now forwarded, and

which

which have resulted in the adoption of the particular form of regulators provided for in the estimates. A tracing of the Vernaux Vethaux regulator is enclosed.

Lieut. 25/3/70

Desp^2. 9/5/70 with a Copy of Gov^t. No. 1146 of 1870 & a tracing of the Vernaux Regulator desp^2 16/5/70 —

34 Spare Copies of Gov^t. No. 1146 of 1870 desp^2 19/5/70 —

15

21/9/1871

2/3/04 ✓ ✓28-5-24 Bdx ✓

Original Cue 1073

Cost. of 1870 3d Nos.

PUBLIC WORKS.

To The Superintending Engineer

C. C. Division

1144+1145 W

29-4-1870

Dated

Recd.

Encl. 26 Plans. 21

G. O. 29th April 1870. Nos. 1106+1145.

Nos. 1148 & 1149-1150

Regulations for the Pannam

Replying orders on papers relative to the provision of regulators for the Pannam, the principal boundary the Cauvery in the Tanjore Dist.

Regulations for the Pannam

Copy of Ltr dated no. relative to the provision of regulators for the Pannam, the principal branch of the Cauvery in the Tanjore Dist, forwarded to the Govt. in original with Remarks.