

MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No.	<i>500</i>	Press Mtr.
<i>27-3</i> Dated	<i>27-3-</i>	<i>1868</i>

Not to be folded or roughly handled

*Proceedings of the Madras Government, Revenue Department,
27th March 1868.*

No. 497. Read the following Proceedings of the Madras Government in the
Public Works Department :—

Forwarding to Government of India a Memo-
randum of the Chief Engineer for Irrigation,
conveying the replies of the Superintending
Engineer, 6th Division, and of Captain Mead
to the remarks of the Inspector General of
Irrigation Works on the condition of the
channels in Tanjore, } (Here enter 18th March 1868, No. 882.)

No. 498. ORDER THEREON, 27th March 1868, No. 800.

Irrigation, No. 6.

Communicated to the Revenue Board.

(True Extract.)

(Signed) F. BRANDT,
Under Secretary to Government.

To the Board of Revenue, with Proceedings Public Works Department, No. 882.

Ed. S. T. Augustin.

*Proceedings of the Madras Government, Public Works Department,
18th March 1868.*

Read the following papers:—

No. 388. From Captain R. F. OAKES, R. E., Superintending Engineer, 6th Division, to the Chief Engineer and Joint Secretary to Government, Public Works Department, dated Tanjore, 7th January 1868, No. 1,464:—

1. I have the honor to reply to G. O., No. 3,248, dated 19th October 1867, and in doing so I will avail myself of the opportunity to make some observations on G. O., No. 775, dated 14th March 1867, which reached the District after I was taken ill.

2. While sanctioning the regulating works at the heads of the various branches of the Cauvery, Government postponed the consideration of the subject of regulating the supply which shall enter the Cauvery during the occurrence of heavy

G. O. No. 775.

floods, pending the completion of the investigations for the formation of reservoirs in the upper basin of the Cauvery, and it has now been suggested that the increase of the waterway of the Upper Anicut, by extending the anicut half across the island between the north and south branches, may admit of the discharge of the flood-waters which now enter the delta and injure the deltaic rivers.

3. In a 12 feet flood the difference of level between the water above and below the anicut is as per margin, and as the waterway of the anicut, inclusive of sluices, is 2,120 feet, while the waterway of the Cauvery is 1,950 feet; were the anicut removed entirely, the water level in the Cauvery and Coleroon would only be reduced by about 4 of a foot, or a 12 feet flood would be reduced to an equivalent of an 11.6 feet flood. It will not, therefore, be surprising that the extension of the anicut across the island* would reduce

a 12 feet flood to an equivalent of a flood somewhat above an 11.65 feet flood in the Cauvery, and that the construction of sluices across the island would reduce a 12 feet flood to an equivalent to one somewhat below an 11.65 feet flood, as shown in the accompanying Memorandum A. The deltaic rivers cannot receive with

* 660 feet.

per hour at the Cauvery head, while the quantity which would enter the Cauvery with an 11.65 feet flood would be 16,630,000 cubic yards per hour. It is clear, therefore, that the extension of the anicut across the island would afford no appreciable relief to the deltaic rivers from the destructive effects of a 12 feet flood, and less still from the effects of a still higher flood, and it is against the highest floods that the delta must be protected.

4. In my letter of the 25th May 1866, it was pointed out that the formation of reservoirs capable of materially

influencing the high floods, and of reducing the quantity of water which shall enter the delta to within a safe limit, was out of the question. From Memorandum B. it will be observed that on the occurrence of the July flood of 1865, when for eleven days the water stood near or above 16 feet on the Cauvery gauge, reservoirs containing 273½ millions of cubic yards of water would have been required to retain

No. 133, embodied in G. O. No. 1,894, dated 16th June 1866.

tion of reservoirs capable of materially

the superfluous water above the equivalent of a 10 feet flood supposing that the reservoirs had been empty when the water first rose above the equivalent to a

10 feet flood. The delta may, therefore, be regarded as in an unsafe condition, unless reservoirs* capable of containing at least 400 millions of cubic yards of water can be provided. The formation of such reservoirs in the upper basin of the Cauvery I believe to be impossible, and hence the necessity of devising works at or near the head of the delta itself, to limit the supply of water which shall enter the delta.

5. I would not wish it to be supposed that I am in any way opposed to the formation of reservoirs in the upper basin of the Cauvery; on the contrary, I would strongly advocate their formation to admit of a supplemental supply being thrown into the delta when in the lull between the south-west and north-east monsoons, or after the latter, the supply in the river falls far below what I term the theoretical or standard supply.

Three cubic yards per hour per acre.

Form F.

By 150 yards Calingish	1,237,000
Grand Amount	3,104,000
Covillal	801,000
Vaduvigudi	413,000
	5,578,000

6. In a 10 feet flood at the Cauvery head 11,850,000 cubic yards of water enter the river per hour, and of this quantity 5,578,000 cubic yards are discharged by the surplus works, and only 6,272,000 cubic yards enter the delta proper, if I may so term it, and of this 2,426,000, leaving 3,746,000 in the

two streams, according to the latest revised statement, is as per margin, and the area under the Vennaur capable of being brought under cultivation, were water forthcoming, is larger than that under the Cauvery. The Vennaur does not now receive a theoretical supply for the lands dependent upon it until 6.5 feet of water are passing over the Cauvery dam, while the Cauvery receives a theoretical supply even when the water has fallen below 5 feet on the Cauvery dam, and then the Vennaur is receiving only half its theoretical supply.

Cauvery	50,033
Vennaur	52,000
Vanna — 6.5 Acres	

under the Cauvery. The Vennaur does not now receive a theoretical supply for the lands dependent upon it until 6.5 feet of water are passing over the Cauvery dam, while the Cauvery receives a theoretical supply even when the water has fallen below 5 feet on the Cauvery dam, and then the Vennaur is receiving only half its theoretical supply.

1,126,000

1,807,000

7. It has been suggested that the quantity of water which shall be permitted, under any circumstances, to enter the Cauvery shall be reduced to 5 cubic yards per hour per acre, or to 3,500,000 cubic yards per hour; my objections to this proposition are as follows —

1st. — That the supply in the Cauvery is irregular, and that we cannot be certain of obtaining 5 cubic yards per hour per acre throughout the season. At present, when the high flood have passed, advantage is taken by the cultivators of any rise in the river to receive a supply for several days. This is retained on the fields and

state of the crops, while the supply in the river is insufficient to reach the extremity of the delta.

2nd. — That the regulation of some 6,000 sluices would be a matter of infinite difficulty in streams with constantly varying heads of water, and in a district in which there has hitherto been no regulation as regards the actual supply taken through the sluices; a reduction in the size of the sluices, and the attempt to limit the discharge to the actual theoretical requirements of the lands, would be most strongly opposed, and could not be carried out without the passing of a special Act rendering interference on the part of the Department Public Works legal.

3rd. — That the reduction of the quantity of water which enters the delta would materially reduce the fertilizing matter brought down in suspension by the waters, and which now is allowed to be deposited on the fields, clear water only being allowed to pass off as surplus. It is impossible to obtain manure for 1,000 square miles of irrigated land, which would soon be exhausted were it not for the rich deposit brought down in suspension by the waters.

4th. — That the discharge of a comparatively small volume of water through the deltaic rivers would probably cause most of the bars at the river mouths to rise, and the mouths would probably be closed during the dry months. It is true there is but little use made of the rivers for navigation, most of the rivers having been sacrificed to irrigation, but the Adanur, the Cadavoyar, the Vettar, the Arasalar, and the Tirumalajar, and others, in a less degree, are used by boats which would otherwise have to discharge their cargoes on the beach at a distance from the towns. The French would object strongly to any diminution of the flood-waters in the Arasalar; indeed, they have already made enquiries relative to the effect of the Arasalar regulating dam.

5th. — That the reduction of the water supply would render it necessary, at least in the eastern portion of the delta, to retain all water that was received, and instead of a more or less constant flow of water passing over the delta, the water would stagnate, and the delta would probably become unhealthy. This is a point which does not appear to be sufficiently considered in estimating the quantity of water required for irrigating rice lands. Stagnation of water on a small area of land may not materially affect the healthiness of the neighbourhood, particularly if the villages are situated on high lands, apart from the cultivation, but in a delta in which the towns and villages are necessarily surrounded by irrigated land, it is worthy of consideration what would be the probable effect of allowing water to stagnate over an area of 1,000 square miles.

8. Taking it, then, for granted that 6½ millions of cubic yards of water may be permitted to enter the delta, if reservoirs may be formed to contain 400,000,000 cubic yards of water, and thus to prevent more than an equivalent to a 10 feet flood reaching the

head of the delta, a head sluice might be constructed at or near the site of the Cauvery dam, and the Coleroon will be capable of carrying between Seringham head and the Grand Anicut the 16½ millions of cubic yards of water to be discharged

22,530,000	In Agunda Cauvery.
6,250,000	To enter Cauvery head.
16,280,000	

Proceedings of the Madras Government, Public Works Department.
18th March 1863.

over the Upper Anicut, as it is but little more than the river now carries in a high flood. If, however, reservoirs cannot be formed to retain all water above an equivalent to a 10 feet flood, we must calculate upon discharging 26,100,000 cubic yards per hour over the Upper Anicut, and to carry this between the Upper Anicut and the Grand Anicut, the surface level of the water in the Coleroon would be raised by 2.7 feet, or from 8.3 feet to 11 feet, or say by 3½ feet or to 11.9 feet as we may have a higher flood to dispose of than a 12.3 feet flood. The river banks for 17 miles would have to be raised and to be protected at a cost of about Rupees 50,000. To discharge 26,100,000 cubic yards of water per hour, the water level above the crown of the anicut would be raised 4 feet above the level of water in a 12 feet flood, and the difference of head of water above and below the head sluice would be 8½ feet.

9. In order that the water level may not be unnecessarily raised in low freshes, the head sluice should have a lineal waterway of 1,000 feet, and the Tambogye in the south branch should be closed; the difference of the head of water above and below the sluice in a 3.5 feet flood would be only 6 inches, while the delta was receiving about 1½ of the standard supply; and when receiving an equivalent to a 10 feet flood in the delta proper, or three times a standard supply, the difference of head would be only 1½ feet. Powerful scouring sluices should be provided near the southern end of the anicut, as the head sluice would undoubtedly cause the bed above it to silt up, and sluices should be built across the island between the north and south branches.

10. The water in the Coleroon would rise above the crowns of the surplus works as per margin, and they would have to be closed, 1 and 3, permanently by means of an earthen embankment, and No. 2 by a wall, and scouring sluices should be built in the Grand Anicut to discharge silt when the difference of level would admit of this being done. Under many of the arches of the Vennaur and Cauvery dams, sluices would have to be provided to admit of the regulation of the water which shall enter each stream.

11. Supposing the head sluice to be built at an angle of about 120° to the Upper Anicut, I estimate the cost of the works approximately as follows:—

Head sluice	4½ lacs.
Embanking in river bed and connecting sluice with south bank of Cauvery, &c.	¾ "
Embanking above anicut	¾ "
Do. below do. and protecting banks	¾ "
Providing scouring sluices in anicut near south end	1 "
Placing sluices in island between north and south branches of Anicut	1½ "
Closing surplus works and putting sluices into Grand Anicut	1 "
Altering Vennaur Dam	1 "
Total	9½ lacs.
say 10 lacs.	

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12. The alternative scheme, supposing reservoirs cannot be formed to retain all water above an equivalent to a 10 feet flood, is to place a head sluice for the Cauvery at or near the Grand Anicut—a very powerful work, by means of which any quantity of water might be discharged. In a 12 feet flood the Coleroon Over Upper Anicut ... 13,070,000 below the Grand Anicut is carrying off By 150 yards Calingulah ... 2,040,000 upwards of 20 millions of cubic yards Over Grand Anicut ... 5,080,000 per hour, in a 12 feet 3 inches flood it carries off 21,150,000, and in the highest floods has probably carried off 22½ or 23 millions of cubic yards per hour. Taking the 12.3 feet flood, as in the last case, we find that the quantity of water which must be disposed of is 26 millions of cubic yards per hour, or the Coleroon would have to carry only about 14 per cent. more water than it now carries east of the Grand Anicut, but little would be required to enable it to do this, and the Cauvery surface level would only have to be raised 1.5 feet in extreme floods.

13. As the Vennaur river branches from the Cauvery at about 2½ miles above the Grand Anicut, it would be necessary to place sluices under some of the arches of that work to admit of the waterway being reduced when the river was in flood, so as to prevent more water than the river can carry without danger entering it. When the water in the river was low, it would be necessary to supplement the supply by a head sluice in the bank of the Cauvery, which would be adjacent to the Cauvery head sluice near the Grand Anicut, and as in low freshes the surface level of the Vennaur is about one foot above that of the Cauvery, it would be necessary partially to close the Cauvery head sluice by means of shutters to throw a supplemental supply into the Vennaur: by means of these sluices the whole available supply may, when necessary, be thrown down either river.

14. The following works would be required were this scheme adopted:—

Head sluice for Cauvery	2 lacs
Do. Vennaur	1 "
Lock for Cauvery and cutting channel from Cauvery to Vennaur	¾ "
Under-tunnel for drainage and sluices for channels	1½ "
Alterations to Vennaur dam and other works	1½ "
Providing scouring sluices in anicut near south end	1 "
Placing sluices in island between north and south branches of Upper Anicut	1½ "
Total	7½ lacs.
say 7½ lacs.	

15. Of the alternative schemes, that of placing the head sluice near the Grand Anicut appears to have the following advantages:—

	Head at Cauvery dam or near Upper Anicut.	Head at Grand Anicut.
1st—As regards cost.	10 lacs.	7½ lacs.
2nd—As regards possible damage to banks.	Water level in Aganda Cauvery raised 4 feet. In Coleroon between Upper Anicut and Grand Anicut 4 feet.	Water raised in Cauvery 1½ foot at Grand Anicut. In Coleroon below Grand Anicut 1½ foot.
3rd—As regards water thrown off sluices.	Head of water at head sluices in high floods. 8.5 feet.	6.75 feet.

16. It is difficult to determine which scheme would tend to cause least silting of the bed of the Cauvery. With the head sluice near the Upper Anicut, and the water thrown back from 6 inches in a 5.5 feet flood to 4 feet in an extraordinary flood, the deposit in the Aganda Cauvery would be very considerable, while with a difference of head of from 6 inches in a 5.5 feet flood to 8½ feet in an extraordinary flood, large quantities of silt would pass through the head sluice, and there would be no means of getting rid of any deposit from the Cauvery when the water had once entered it. Securing sluices near the south end of the anicut and the sluices proposed in the island would do much in keeping down the accumulations above the anicut, but they are common to both schemes.

17. In the scheme for placing the head sluice near the Grand Anicut, it is true that nearly three times the volume of water enters the Cauvery as in the other scheme; nearly one-sixth of this is discharged by the 150 yard calingulah, 3 miles below the head; another one-sixth would be conveyed away by the Vennaur dam where the velocity would be checked, and nearly half would be discharged at the Grand Anicut in which there are now ten sluices. Additional sluices might be placed in the Grand Anicut, and with the capacity of the Cauvery and complete control over the Vennaur in comparatively low freshes, a considerable scour might be obtained through the Grand Anicut sluices and through the Vadavagudi sluices. Vents might also be opened in the 150 yard calingulah if found to be necessary; but the Goviladi calingulah could not be converted into a scouring work without entire re-modelling, we should, however, have the site available for the construction of powerful sluices should it eventually be found necessary to provide them. None of these surplus works could be used in connection with the scheme of placing the head sluice near the Upper Anicut except the Grand Anicut, and that, but seldom, owing to the comparatively small quantity of water available for scouring purposes. Under these circumstances, even as regards the prospect of diminishing the tendency of the river bed to become silted up, the advantage appears to be in favor of the scheme for placing the head sluice near the Grand Anicut.

18. Below the head sluices, the Colamoorthy, Arasalar, and Veerasholan dams will regulate the supply which enters each stream, and to prevent silting in these streams the beds of the rivers should be planted up so as to render the section as uniform as possible, and as the volume of water diminishes, owing to the quantity taken off by small branches or sluices, the section of the streams should be reduced so as to prevent as much as possible a diminution of the bed. The deposit would then be carried into the minor channels, and would be distributed over the surface of the country instead of being left in the rivers.

19. An attempt, but by no means a successful one, has been made to reduce the waterway where, owing to bonds in the rivers and the destruction of the Padogars, the breadth has been considerably increased; but without an efficient government establishment, and entire control over the rivers, it is impossible to effect much improvement, for the Mitassidars are only bound to feed their cattle on the bank and thus destroy it, and in the minor streams particularly, they do much damage by encroaching upon the beds of the streams. In fact in this case a very small amount of land has been gained, while any attempt to cut away the banks has been attended with the most disastrous results. It is within certain limits that may be

made to mean anything, are the only standard by which encroachments of late years may be judged of, and as nobody but the village Curnum can understand them, it is but seldom that an encroachment can be proved to be so.

20. In paragraph 90 of his report, Captain Mead proposed that certain channels should be provided with head sluices, and that a regulating dam should be provided for the Mootapen Cauvery. It is to the east of Mayaveram that the defective supply is chiefly complained of. A regulating dam for the Mootapen Cauvery might be constructed, as proposed by Captain Mead. The next channel, the Puvendran voical, branches at 81 miles, here a small dam might be raised, and rajah voicals be taken from it on both sides, from which four channels, branching between the 81st and 83rd miles, might be supplied on the north side, and seven channels on the south side between 83½ and 87 miles. On the south side, the cultivation lower down consists of only

South bank 77½ miles from head.

N.

664 Vaylies.

ing between the 81st and 83rd miles, might be supplied on the north side, and seven channels on the south side between 83½ and 87 miles. On the south side, the cultivation lower down consists of only

1,176 Vaylies.

twenty vaylies; on the north side, no channel branches between the 83rd and 92nd miles, at the latter a dam at the head of the Periyar voical might be constructed to supply five channels between the 92nd and 95th miles, below the latter

377 Vaylies.

there is no branch on the north side. In the new channels branching from the main channels, the supply taken off might be regulated by the area of the sluices. It is probable that the formation of these dams will be much opposed, though there can be no doubt that they will be of the greatest possible advantage, but every proprietor will want the dam to be placed just below the head of his own channel.

21. With regard to the gradual silting up of the Cauvery, I fear there can be but little doubt; unfortunately the sections of the river taken at various times have not been taken on the same lines, and cannot be reduced to one datum. Judging from a section of the Cauvery and Coleroon, taken at the 150 yard calingulah in 1841, by Assistant Revenue

Tracing No. 2.

Surveyor Stoddard, and from a section

taken in December 1867, it would appear that the Cauvery river bed has risen at a distance of three miles from its head 2.16 feet, and the Coleroon has become deepened by 0.64 of a foot during the last twenty-six years. From sections taken over the

		Feet.
1	863	90.28
1	865	90.59
1	867	90.47

Cauvery dam in 1863, 1865, and 1867, it would appear that the bed had risen 0.3 feet from 1863 to 1865, and had fallen 0.1 foot between 1865 and 1867, or was in 1867 only 0.2 of a foot higher than in 1863.

22. That the bed of the Cauvery has silted up more rapidly at or near its head, and that it has done further to the eastward may, I think, be concluded from the information afforded in Memorandum D. and it must not be forgotten that the delta soil is rising annually owing to the alluvium brought down in suspension

by the waters, and which is retained on the fields for the purpose of fertilizing them; it is difficult to ascertain how much the lands rise annually, but lands are constantly being lowered owing to their having risen above the feeding channels, and the Natives state that it is necessary to lower their fields six inches or nine inches in every ten or twelve years: it is probable, therefore, that the lands in the delta are rising almost, if not quite, as rapidly as the river beds, except perhaps at or near the head of the Cauvery itself.

23. The obvious method of preventing the silting up of the Cauvery bed, which would perhaps first suggest itself to a person unacquainted with the Cauvery, would be the widening of the stream as it approached the coast, so as to admit of the river bed being scoured during high floods. The objections are, first, the enormous cost of enlarging and embanking the stream; and, second, the difficulty in forcing a sufficiently large body of water so far down the Cauvery to have any appreciable effect, the more so as the water must all be received through the Cauvery itself, as the river receives no supplemental supply from surplus streams or from local drainage with one trifling exception, viz., by the Iyavayanaur, and it is probable that water would not, under any circumstances, reach the coast for more than twenty-five or thirty days in a year, and then only for four or five days together, and at long intervals. This method, if practicable, might relieve the Cauvery in some degree, but only at the expense of some of its branches, but what it is desirable to provide for is to prevent, as far as possible, not only the silting up of the Cauvery, but that of all the high level or irrigating streams in the delta, and to effect this I would suggest,—

1st.—The opening of powerful sluices in the Upper Anicut near the southern extremity, and the construction of sluices across the island. With regard to the small effect attributed to the existing sluices in the Upper Anicut, I would observe that it is not surprising that when the rivers are dry there should appear to be but trifling indications of the effect of the scour produced by them, inasmuch as, probably, for the last six weeks of the season, or as soon as the water falls below the crown of the anicut, all the sluices are closed in order to divert all the water available into the Cauvery; the deep channels formed in the bed of the river when the sluices were open are then speedily effaced, the more so inasmuch as all or almost all the silt brought down in suspension by the waters is then deposited, as the water is in a great measure at rest or nearly so. That very large quantities of sand pass through the sluices I am sure, as even in a high flood when the water is very turbid, that there is far more deposit in the water which passes through the sluices than in that passing over the anicut can be easily detected by the eye.

2nd.—The contraction of the high level or irrigating streams as water is drawn off from them, so as to maintain the velocity of the current as far as possible, and—

3rd.—The clearing of the irrigating channels, but this should not be done at the cost of Government, but at the cost of the property who can best be

execute the work, the cost of which in many cases falls far short of 5 per cent. on the return from the channels, and is
Vide paragraph 100 of Captain Mead's Report in G. O. No. 775, dated 14th March 1867. work which was formerly carried out by the villagers.

24. No improvements of a permanent nature can be made in the rivers, no extension of cultivation on a comparatively large scale can be undertaken, and in fact no improvement to existing cultivation to the eastward of the delta can be effected unless a special Act is passed authorizing the servants of Government to project and undertake any works which they may deem beneficial to the community at large, and to alter the dimensions of sluices or dams, without subjecting themselves to an action in the Civil Courts, as I have already reported more than once. Letter No. 1,018, dated 26th November 1866. The members of the Public Works Department, or at least the senior local officer should have power to remove encroachments on the river beds, to remove trees, hedges, and other obstructions from the river beds or banks, and to punish magisterially all persons who in any way encroach upon or injure river beds, banks, or sluices, and other masonry works. The members of the department should also have power to open or close sluices which are carrying off an unnecessarily large supply when water is urgently required lower down, or in fact the complete regulation of the supply of water should be vested in the Department of Public Works, regardless of all previous usages and supposed rights, and if interference in these respects cannot be rendered legal without the passing of a special Act, the sooner such an Act is passed the better.

25. With regard to the Vennaur and its branches, it will be observed from Memorandum C., that the water now drawn off by the various streams is not at all in proportion to the cultivation under each stream, and no time should be lost in carrying out the regulating works required. Unfortunately information regarding the cultivation under the branches of the Vennaur and under the minor channels, which derive their supply directly from the Vennaur, was not obtained from the Revenue Department till after Captain Mead had been removed from the Division. Hence designs for the regulating works have not been made.

26. With the exception of the Pandavayaur and Vellayaur, which may be bridged at their heads in connection with the Railway feeder from Koradacherry to Road No. 23 at Letchmangoody, bridges are not required at any of the heads of the other streams in connection with the communications of the district, and even at the Pandavayaur and Vellayaur heads, bridges are not required across the Vennaur as the road skirts its north bank. After a careful consideration of the subject, I have come to the conclusion that regulating dams only need be built across the Vennaur, Corayaur, and Panamayaur, but at the Vettaur, Pandavayaur, and Vellayaur heads, bridges should be constructed over those streams, and some of the arches of the bridges should be provided with sluices to admit of the waterway being considerably diminished, should occasions arise, during low freshes, on which it became necessary to throw all or almost all the water available into one stream; for this purpose the sluices would be placed on a low level, and the dams across the Vennaur would be built with walls or floors on a level with the average bed of the stream.

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27. The outcry regarding the non-receipt of a sufficient supply of water in connection with the cultivation under the Vennaur, usually arises from the proprietors of lands under the Mooligaur, Iyanaur and Harichandranadi, which are branches of the Corayaur, and it will be observed that this river, though the cultivation under it bears a per-centage of 47.5, receives a per-centage of only 32 of the water in the Vennaur above its head, and there is but little doubt that when the regulating works are completed, the minor streams adjoined to above will receive an ample supply. The banks of the Corayaur will have to be raised.

28. In conclusion, I would observe that it is much to be regretted that the exigencies of the service should have rendered Captain Mead's removal from the district necessary before estimates had been submitted for the regulating works in the Vennaur, and it would have been well if he had remained in the district to superintend the most important of the works in connection with the regulation of the waters of the Cauvery and Vennaur.

MEMORANDUM A.

In a 12 feet flood the difference of level between the water in the north branch above and below the ancient is only 8 of a foot. In the south branch, the difference is only 6 of a foot. In higher floods the difference would be less; so that in a high flood, were the ancient taken away altogether, the difference of level of the water in the Agunda Cauvery would not be reduced more than 3 or 4 of a foot.

The island between the north and south branches of the ancient is 660 feet

17 for estimate
177
were a dam constructed across the island on a mean level between the crowns of the north and south branches, the discharge into the Coleroon would raise the level of water into the Cauvery to the equivalent of somewhat above an 11.75 flood in the Cauvery; and were sluices put in, the flood level would be reduced to an equivalent of somewhat below an 11.65 flood nearly in the Cauvery. Were sluices provided over the dam, or were the dam built like the rest of the ancient, the available waterway of the new portion would be 5861 feet; with sluices the available waterway would be only 499 feet. By calculation it is found that by providing a dam and sluices, the discharge in a 12 feet flood would be as follows: supposing that the level of the water in the Agunda Cauvery is lowered by .35 of a foot, no notice being taken of the rise of the surface level in the Coleroon, owing to the larger body of water being discharged into it, the difference, therefore, here stated is rather above the actual difference which would result from the extension of the dam across the island, or the construction of sluices.

Discharges in an equivalent to an 11.65 flood in Agunda Cauvery in cubic yards per hour.

South Branch.	
Over Dam	5,111,600
Through Sluices	2,833,500
Through Sluices	815,580
North Branch.	
Over Dam	1,694,400
Through Sluices	480,000
Over new Dam	2,074,400

Water in Agunda Cauvery in 12 feet flood	15,926,430
Left in Cauvery	30,320,000
Discharge	16,433,830
Do. in 12 feet flood	17,750,000

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nearly, the difference for 1 being 320,000, or the water left in the Cauvery is equivalent to an 11.7 flood nearly, i. e., that the flood is reduced to an equivalent of one somewhat higher than an 11.65 flood in the Agunda Cauvery, or the effect of the dam will not lower the water so much as .35 of a foot.

If sluices are provided we have—

Discharge through new sluices	3,421,800
Over Ancient as above	10,965,030
	14,386,830
In Agunda Cauvery	30,820,000
Left in Cauvery	16,433,830
Do. in 12 feet flood	17,750,000
	1,317,830
	1,280,000 — difference

therefore 16,433,830 is equivalent to an 11.6 flood in the Cauvery, or the sluices will lower the water rather more than .35 of a foot.

4. As the difference by which the water in the Cauvery will be lowered is so small, it is not worthwhile tracing the effect of the rise of the level of the water in the Coleroon on the discharge by the surplus works in the Cauvery, viz., by the 150 yards Calingulah, by the Grand Ancient, and by the Covilady Calingulah, but had the extension of the ancient increased the discharge over that work, so as materially to affect the level of the water in the Cauvery, much of the effect would have been lost owing to the diminution of the discharge over the Cauvery surplus works due to the reduction in the difference of level between the water in the Coleroon and Cauvery, and the quantity of water which would actually have passed down the Cauvery below the Grand Ancient would have been due to a flood considerably higher than that represented by the reduction in the level of the water at the Cauvery head.

TANJORE,
7th January 1868.

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

*Proceedings of the Madras Government, Public Works Department,
18th March 1868.*

10

Memorandum showing the water which should have been retained in reservoirs to limit the quantity which reached the Upper Anicut during the flood of July 1865 to an equivalent to a 10 foot flood.

Height of shed.	Water in Aguada Canvey in thousands of cubic yards per hour.				
12 feet	...	...	...	...	30,820
11 "	...	...	...	...	25,720
10 "	...	...	...	...	22,530
					Difference for 0.1 foot 510
					Difference for 0.1 " 319

Date.	Height of water on Gaucery gauge.	Parts above 10 feet.	Quantity of water in excess of a 10 feet flood.
6th	19.4	$4 \times 319 =$	1,276
7th	10.4	$4 \times 319 =$	1,276
8th	10.8	$8 \times 319 =$	2,552
9th	10.2	$2 \times 319 =$	638
10th	9.6		
11th	9.1		
12th	10		
13th	10.5	$5 \times 319 =$	1,595
14th	11.3	$3 \times 510 =$	1,530
15th	11		3,190
16th	10.1	$1 \times 319 =$	3,190
			319
		Total ..	$15,566 \times 24 = 373,584$
		or	373,584,000 cubic yards to be excluded from the Delta.

TANTORE,
7th January 1868.

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

Y. C. Ho

C.
Memorandum showing the cultivation under the Pennaur and its branches with the percentage of water taken off by the parent stream and each branch at present.

	Vaylies.	Per-cent.	Water divides.
Vettatur	18,528	27	From 38 to 58
Vennaur	36,569	73	" 62 to 42
Pannaur	4,968	16	25
Cerayur	14,967	47.5	32
Vennam	11,509	36.5	43
Panchayyur	3,028	30.6	*61
Vonnaur	6,873	69.4	*49
Vellyaur	4,419	61.7	73.7
Vonnaur	2,107	35.3	63

* In low freshes 30 to 20, with 2 feet water 30 to 50
† In low freshes, 40 to 45, with 2 feet water 60 to 100

(Signed) R. P. OAKES, Chief
Superintending Engineer, M.V.

TANIGUCHI,
Johnny, 1968

*Proceedings of the Madras Government, Public Works Department,
13th March 1868.*

Measurement showing the height of water at various points in the river, at intervals of five years, during the south-west monsoon

Name	Distance below head in miles.	In 1846.		In 1851.		In 1856.		In 1861.		In 1866.		Remarks.
		21st to 25th July 5 days.	26th August to 4th September, 10 days.	10th to 17th August 8 days.	25th to 30th July 6 days.	1st to 11th July 8 days.	14th to 25th July 10 days.	10th to 19th August 10 days.	15th to 27th August 12 days.			
1	2	3	4	5	6	7	8	9	10			11
Camper Dam Vannair dam in Can- vally side.	14½	Ft. In. 6 8½	Ft. In. 6 8½	Ft. In. 5 8½ 4 7½	Ft. In. 6 8 4 7	Ft. In. 6 7½ 4 1½	Ft. In. 6 8½ 4 2	Ft. In. 6 6 3 5½	Ft. In. 6 6 3 6			
In Camper at Grand Arist abscement. Cause under bridge at Orizabacon.	17½ 58	2 0½	1 9½	2 0½ 7 0	1 11 8 3	1 8 6 2	1 9 5 9½	1 4½ 5 0½	1 4 5 0½			
Vannair dam built in 1851; in the water returns of 1846 and 1861 the depth at Camper dam bridge is not given. * There are alterations in the Register book and this would appear to be an error. The figures in columns 3 to 10 represent the average height of water during the period specified at the head of each column.												

Water remains at the same height, or nearly at the same height for so few days together, that it is not possible to select more than six or eight days together from which to judge of the variation of the water level at different points in the river. It will be observed that the results of the two periods, as obtained in each year correspond with tolerable accuracy; it may, therefore, be inferred that the differences which appear at the interval of five years are due to alterations in the river bed.

Thus, rejecting fractions, we find a 6 feet 8 inches fresh gaving, at the Comaicoomun bridge, a depth of 7 feet in 1856, of 6 feet in 1861, of 5 feet in 1868. It may be inferred, therefore, that the river bed, at the head, having risen a smaller supply entered the river in 856 than in 1856, when the gauge read the same, and as the water is lower at the Comaicoomun bridge in 1866 than in 1856 under similar readings on the gauge at the Convery head, it may, I think, also be inferred that the Convery bed has risen more rapidly at or near its head than it has done further eastward; and this is what might have been expected, and what the readings at the Vennour head and Grand Anicut appear to confirm.

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

THE UNIVERSITY OF CHICAGO

No. 389. From Captain R. F. OAKES, R. E., Superintending Engineer, 6th Division, to the Chief Engineer and Joint Secretary to Government, Public Works Department, dated Tanjore, 7th January 1868, No. 1,469.

1. With reference to your Memorandum No. 1, dated 29th November, I have the honor to observe that my opinion relative to the Cauvery and its branches and to the remedies which should be adopted, being fully detailed in letter No. 1,464, dated 7th instant, it appears to be necessary here to reply only to that portion of Colonel Strachey's letter which refers to the silting up of the Cauvery and of the channels near Trichinopoly.

2. That the Cauvery has silted up in some degree there is no doubt. In a river one-third of a mile broad, it cannot be expected that the bed will be of a uniform level; in so broad a stream there must be shoals. There are shoals at present varying from 0 to a maximum of $4\frac{1}{2}$ feet, and the average bed of the river is $2\frac{3}{4}$ feet above the floor of the bridge, which, as usual, was probably placed somewhat below the deep bed of the stream, and was probably when built at least a foot or $1\frac{1}{2}$ foot below the average bed of the river. The springing line of the arches of the bridge is 10 feet above the floor; the average bed is, therefore, $7\frac{3}{4}$ feet below the springing line.

3. The important channels in the neighbourhood of Trichinopoly are the Wevadandan, the Peravally, the Iyen, and the Nautoo voical. Colonel Strachey's observation that 'in some cases the bottom of the channel is now nearly on a level with the spring of the arches' can refer only to the Nautoo voical; the bridge over which was originally placed on a very low level with the view, apparently, of not raising the level of the roadway over the channel, and the floor was placed far below the natural bed of the stream to admit of a large body of water passing through the bridge when the river Cauvery was in flood. The bridges were built before the channel was provided with a head sluice; the water in the channel is now completely under control, and the supply received by the channel is ample and sufficient for the cultivation under it. The Range Officer, in reporting upon the present condition of the four main channels at or near Trichinopoly, mentioned above, states, "as a rule, they are all in excellent order, and have this year afforded a very ample supply of water, there being a good stream in each of them when there was but one foot of water in the Cauvery."

4. The channel banks are in some places much obstructed by trees and brushwood, which renders it difficult to inspect the channels; much, however, has of late been done by the late Acting Collector Mr. Vans Agnew to clear away obstructions in the beds and on the banks of the streams. The Conservancy establishment is under the orders of the Collector, nor am I anxious to have this arrangement disturbed, because it is necessary when the rivers are low to construct coromamboos or banks formed with brushwood, straw or namul and sand, to divert water into the channel heads; these coromamboos can only be formed effectively by the employment of a large number of coolies at a time, and they are collected by the Revenue Department more easily than they would be by the Department Public Works; some of them employed on the coromamboos have, however, and are obliged to assist in their maintenance, but for the most part the aid afforded is voluntary, and has been so for many years.

No 390. From Captain H. R. MEAD, R. E., Executive Engineer, to the Chief Engineer for Irrigation, dated Bangalore, 7th December 1867.

1. With reference to G. O., No. 3,683, dated 27th November 1867, and your Memorandum No. 2 of the 29th November, I regret to report that, as I did not go with Colonel Strachey to Trichinopoly, I am unable to give as complete an explanation as I could wish. As, however, in 1859, 1860, and 1861, I was in charge of Trichinopoly talook, and am, therefore, acquainted with the country there, I hope I may be able to afford some.

2. With regard to paragraph 6, I am at a loss to know what bridges Colonel Strachey can refer to. I think by "large bridges across the Cauvery" he must refer to the Cauvery and Coleroon bridges on the Madras Trunk Road No. 9. The former bridge (I speak only from memory) has about seven arches, the rough stone floors of which are always kept clear of sand by the water. The northern arches are, and have been ever since I have known the bridge (since 1858), more or less covered with sand: the north one having, I should fancy, as much as 4 or 5 feet of sand in the basement. The Coleroon bridge is similar. I have taken sections at both bridges, which can be called for from the 6th Division Office.

3. The main channels near the town of Trichinopoly must be the Wayacondan and the Iyen channels. Neither have been examined by me; the former has its head about 7 miles above the Upper Anicut, it is an old high level channel, and its bed always has to, and must, be kept down by manual labor. There is no doubt but that the bed has risen since it was first cut; but I do not think it can be in as bad a state as represented by Colonel Strachey, because about half a mile west of Trichinopoly there is, on the north side of it a calingulah* for the passage of the Corayaur water of, I think, upwards of half a mile long. The capacity of the channel below the crown of this calingulah used to be sufficient to pass a fair supply to the irrigated land under the channel east of it, and I expect it is so now.

4. The Iyen channel has its head at the Upper Anicut, it formerly drew its water from a head in the north bank of the Coleroon, about 9 miles below the anicut. This will account for a rise of bed. It was, and I believe is now, one of the best supplied in the district.

5. Besides these Colonel Strachey might have seen three small channels, the heads of which are in the south bank of the Cauvery, about one mile west, one mile east, and three miles east of the Upper Anicut, by name the Ramavithelay, the Yendavithelay, and the Podavithelay respectively. These channels are very ancient, and there is no doubt but that their beds are higher than when first cut; the beds are now, I should think, as much as five feet above the sills of the head sluices, which are very old Native works; how much these sills were originally built below bed is of course unknown; the beds are, however, not in any way raised above the level of the country; they are, and must be, kept clear by manual labor, and all three have to be supplied, when the river is low, by means of coromamboos or temporary banks of sand and namul grass.

6. As regards the bridges, as I have not seen them for some years, I can say nothing. It is, however, that if encumbrances were made and sections taken, it would not be surprising if there had been a great rise of bed the last thirty years.

7. As Colonel Strachey states that he thinks my views do not materially differ from his and Captain Forbes, I think it as well to state what they are. I would first remark that the only large bridge that Colonel Strachey saw at Tanjore in my company (from the 25th to 28th of March) was the Vennaur bridge, two miles north of Tanjore, and over this bridge there was what I might term a slight discussion, as to whether the river had silted or not since the bridge was built.

8. My opinion, which I expressed to Colonel Strachey, was this: That the state of a river bed with reference to the springing level of the old bridges in Tanjore district was evidence of but little value with regard to a bed of a river having risen or not.

9. These bridges were built when there was but one Engineer Officer in the Tanjore and Trichinopoly districts, and many were built lower than they should have been. Again, they were some of the first large spans built in India, and a high rise was necessary, flat arches not being considered safe. To avoid extreme height of roadway the springing levels were kept very low, many of the arches being semi-ellipses enabled this to be done without contracting waterway much; and I believe, as a rule, the basement level placed at least one foot below the deep bed of river, which in the wide and shallow delta rivers would be five and six feet in some cases below the high bed.

10. I consider (with I believe most) that the bed of the Cauvery is rising, and eventually we must lose some of our bridges, more especially as unfortunately from 1833 to 1858 there was but one extraordinary flood,* and it was during this time that most were built. But I also think that the evidence we have shows that the rise is very gradual, and we need be under no apprehensions of a serious catastrophe.

11. In 1803, Sir J. L. Caldwell wrote very similarly to Colonel Strachey with regard to Tanjore. In 1836 the remedy was found by Sir A. Cotton in the anicuts. I think that the information afforded in my report shows that the remedy is still effectual. Should at some future time the beds of the rivers be found to have risen so as to affect the action of the anicuts, I see no reason why they should not be raised.

12. I see no fear of eventually the rivers rising to a dangerous height above the country for this reason. The country on each side is irrigated by the rivers, and as, I believe, rising almost as fast as the river beds.

13. I have already expressed my opinion that there has been no material change during the last twenty years in the Cauvery bed from the Upper Anicut to the sea (see paragraphs 3 and 22),†

but I do consider that the action of the anicut, by throwing a larger stream down the Cauvery from the Upper Anicut to Coxillady calingulah (about 19 miles), has slightly widened the river and raised the bed, but I think the area of the water section is much the same in ordinary freshet. This can be corrected by raising the anicut as proposed in paragraph 34 of my report. I regret that I cannot from the old records furnish any positive evidence of this, but I believe it to be a matter of common sense.

14. I would remark with reference to paragraph 7 of Colonel Strachey's Memorandum, that the fall of the Agunda Cauvery is 3.4 feet per mile,‡ of the Cauvery below the Upper Anicut 3.2,§ and that of Coleroon 3.3 feet per mile. That the Cauvery has a very uniform decreasing slope to the sea; that the difference of level of the Cauvery and Coleroon in high floods at the grand channel is but 2 feet, and, I think, there is but little doubt but that the Coleroon bed is rising as rapidly as the Cauvery.

15. I regret that I am unable to give more explanations than the above, most of which are matters of opinion, and not facts that I can prove. Had we complete records of the delta the matter could easily be decided, but we have not. The only connected levels ever taken in the delta are, I believe, the ones I have done, and they are only down one river viz., the Cauvery proper. I think, however, there is enough to show that the cultivation of Tanjore is not likely to be for years injured by the rising of the beds of the rivers; and should, at some remote period, it be the case, we have a remedy, viz., raising the anicuts. I trust that Government will consider the above satisfactory.

No. 301.

MEMORANDUM.

1. The foregoing letters convey the replies of the Superintending Engineer of the 6th Division and of Captain Mead to the remarks of the Inspector General of Irrigation Works on the condition of the channels in Tanjore. Captain Oakes has also submitted a report which was called for in paragraph 2 of G. O., No. 3,248, dated 19th October 1867, on a suggestion offered by the Secretary of State for disposing of the flood waters of the Cauvery; and has compared the probable results of giving effect to it with those of the other alternative schemes which have been brought forward. The two subjects—the condition of the bed of the Cauvery, and the control of the flood waters—are so closely connected with each other, that it will be convenient to take them into consideration together.

2. As regards the condition of the channels, Colonel Strachey has brought to the notice of the Government of India that he observed extensive accumulations of silt in the Cauvery near Trichinopoly and in other channels, the precise locality of which is not specified. The conclusions drawn by the Inspector General from his observations at these and other points were to the effect that a process of deterioration is going on in the Cauvery which, if not checked by timely remedial measures, will in his opinion be sure to result in some serious catastrophe.

3. Both Captain Oakes and Captain Mead, who have had long experience in Tanjore and Trichinopoly, while quite ready to admit that the silt which is brought in annually from the main river must have the effect of more or less raising the bed of the Cauvery, can not allow that any injurious results have been produced, and they are of opinion that raising of the bed is accompanied by a raising of the delta generally by the distribution of a large proportion of the silt to the irrigated

lands, a process which goes on in every delta, and which must have been in operation in Tanjore itself for many centuries past.

4. I would observe that the eye alone is not a safe guide in judging of the condition of the bed of a river, and although no one can dispute the correctness of Colonel Strachey's observations, to the effect that extensive accumulations of silt have occurred, it does not follow therefrom that the channels are in such a state as to be, or likely to become, in any way unfitted for the conveyance of the full supply of water required for the irrigation of the lands under them; and fallacious deductions might be made if their efficiency were judged by the standard of artificial channels, in which accumulations of silt would generally indicate an absolute reduction of capacity. Is there anything to show that the Cauvery has lost carrying capacity? There are accumulations of sand under some of the arches of the bridge at Trichinopoly; but it will be seen from an inspection of the accompanying section of the Coleroon, also opposite Trichinopoly, that there are precisely similar accumulations there, although one would naturally expect that if the Cauvery deteriorates under the influence of the ancient nine miles above Trichinopoly, the Coleroon would have improved. Another section of the Coleroon (the only one at hand) opposite the lower extremity of Seringham Island is also furnished, and it will be seen that it likewise displays great irregularities. Such irregularities in the profile are the natural condition of the channel, due no doubt in great measure to its great fall, and it is but reasonable to expect that similar accumulations would present themselves in the Cauvery which has almost exactly the same rate of fall as the Coleroon, and which is but little inferior to it in magnitude.

5. My opinion, which is formed after a careful examination of Captain Mead's survey of the Cauvery, is that the main channel has ample capacity, and the only point where there is reason to apprehend that any injurious silting may be going on is immediately at the head. There is, however, no certainty about it. Captain Oakes considers there are indications of the rise of the bed being greater at the head of the Cauvery than at various points at a distance from it, but these are far from constituting a proof to that effect. On the other hand, hardly any sensible rise can be discerned at the dam across the head of the Cauvery, in the course of the last four years; and there has been no complaint, or apparently even a suspicion, of any insufficiency on the part of the Cauvery to draw off from the main river at the head of Seringham Island, the supply required for the irrigation of Tanjore, either during low or high freshes. It is true that Captain Mead proposed to raise the central portion of the ancient to the same level as the rest of the work, and thus to obtain a larger supply for the Cauvery, but this was not to make up for any loss which had occurred from a change in the bed of the river, but to withdraw the proportion of the water which the channels from the Coleroon had been accustomed to receive during low freshes, and to leave them dependent on the higher freshes. The change he recommended would, if carried out, have given an absolute addition to the customary supply of the Cauvery. It did not appear to Captain Mead, however, after a most careful survey that silting had taken place either at the head of the Cauvery or any point lower down the delta, and he was anxious to expose the slight insufficiency in the way of the Coleroon as a necessary consequence of the action

supply in the main river, which it might be desired to appropriate for the use of delta channels.

6. That the capacity of the Cauvery is ample throughout, and that there is at present no obstacle to the free passage of the water, may be shown from other considerations. It is estimated that three cubic yards per hour per acre may be regarded as the standard supply required for the irrigation in the delta. This quantity is drawn off from the Agunda, or main Cauvery, when the depth of water on the sill of the dam at its mouth rises to five feet. But the quantity of water which can be carried off safely by the Cauvery and its branches is represented by a ten and a half feet fresh at the head of the river. The whole volume of water which then passes into the river is not, however, carried over the delta. A portion of it is discharged into the Coleroon by surplus sluices, of which there are several. But after the discharge of a large quantity of water, there still remains three times the standard supply, or about nine cubic yards per hour per acre. There are upwards of 700,000 acres of irrigated land under the Cauvery and its branches, the standard supply of three cubic yards per acre is equal to about 2,200,000 cubic yards per hour, or 16,500 cubic feet per second for the whole area, and the safe maximum supply is three times as much, or nearly 50,000 cubic feet per second. Surely the Cauvery cannot be in a very hopeless state of deterioration when it can thus, after voiding an enormous volume of water into the Coleroon, still dispose of about ten times the present ordinary supply of the Ganges canal. I would respectfully solicit attention to this fact. It is a remarkable one, which I believe has no parallel in any part of the world, and which is of itself sufficient to show that if there are numerous defects in Tanjore, and no one denies that there are many, there is still a good deal to be learnt and admired there.

7. I would add that the complaints of want of water in the Myavaram and Shealy taluoks, in the north-east corner of the district, near the mouth of the Cauvery, do not refer to any deficiency in the quantity drawn off from the Agunda Cauvery, but to an unequal distribution of that quantity to the different channels in the delta. The revenue authorities naturally enough attributed the failure of water to an absolutely defective condition of the channel for the last 20 miles of its course; but the Engineers have long been aware that the real defect lay in the want of masonry works at the heads of the great branches. The subject has been so fully discussed in Captain Mead's late report that I need not further refer to it.

8. It is much to be regretted that the records concerning the condition of the Cauvery in former years are so defective. There is now an average depth of 2½ feet of sand on the dam at the head of the river, but there is really nothing to show that the dam was not as much below the average level of the bed at the time it was built (1845). In fact, the time and attention of the Engineers in Tanjore have been so fully taken up in battling with the delta rivers, and in meeting difficulties which beset them on all sides, both in preventing damage from floods, and in meeting by temporary expedients the defective distribution of water, that questions which had no immediate practical bearing on the work before them were either overlooked or disregarded as unimportant. It is to be hoped the improvement which has within the last few years been initiated in the compilation of information regarding the delta channels will be steadily continued, and that Captain

Mead's services will shortly be available for the preparation of surveys and levels of all the great branches of the Cauvery in the same full and complete manner as those of the Cauvery itself have already been carried out. Annual measurements should also be made at the head of the Cauvery in order that any change which may be in operation may be traced, and if necessary counteracted, and should there be any signs of a falling off of the supply during low freshes, the most certain method of ascertaining whether it is real or imaginary is to gauge periodically the quantity passing down the river, say at Trichinopoly, for a certain reading of the register at the Cauvery dam at the head. Reports and discussions on matters connected with river or channel improvements are, in my opinion, most unprofitable unless referred to the results of surveys and levels.

9. As regards the disposal of flood-water, Captain Oakes shows that no possible extension of the anicut would afford any appreciable relief to the delta, and that reservoirs would also be ineffectual. He is, therefore, of opinion that works should be devised at or near the head of the delta to limit the supply of water which shall enter it. He estimates the maximum supply required for the delta at 6½ million cubic yards per hour, or at the rate of nearly 9 cubic yards per hour per acre. This may appear an inordinate allowance, but it would certainly be unwise to reduce the quantity supplied to the delta lands below what is found in practice to be beneficial for them; and even if it were found practicable hereafter to reduce the quantity without seriously injuring them, the change would have to be made gradually, and with the consent of the people. They should have as much water as they want, provided that it can be carried with safety by the channels; and it is on this principle that Captain Oakes' calculations are based.

10. Of the sites which have been mentioned as suitable for the construction of regulating works, it would appear to me that the choice must lie between the head of the Cauvery itself and the Grand Anicut. The great advantage of the latter site is that the Cauvery is available for the conveyance of flood-water so far, and that the Grand Anicut with certain improvements would be capable of discharging into the Coleroon whatever quantity should not be required for the use of the delta channels. If a sluice were built at the head of the Cauvery, the Coleroon would have to carry at times from 10 to 12,000,000 cubic yards per hour, or about 50 per cent. in excess of its present volume; this forms the first escape to the end of Seringham. The discharge over the anicut, and for three miles of the Coleroon below it, would be nearly doubled.

11. The Upper Anicut would have to be greatly strengthened; powerful under-sluices in the south flank would be necessary to keep a channel clear in front of the head sluice, and extensive additions would be required to the embankments on the Coleroon throughout the whole length of Seringham island and for a distance of some miles above the anicut. Captain Oakes estimates the outlay required to carry out this project at ten lacs, which is probably under the mark. The only object to be gained by carrying it out in preference to the other would be to obtain a more complete control over the Cauvery than could be established at any point at a distance from the head, and if it can be satisfactorily established that no controlling power at the head is required beyond that afforded already by the anicut and the regulating dam, the preference should be given to the site at

the Grand Anicut, where the Coleroon would have to discharge during the highest flood only 14 per cent. in excess of its present volume.

12. I conclude that Government, before they accord their approval to a scheme requiring for its execution an outlay of from seven to ten lacs of Rupees, will require fuller information than has as yet been afforded of its probable financial effect in preventing loss of revenue and in saving expenditure in repairing the damage which is caused periodically in the delta by excessive floods. Sufficient information is, however, before them to enable them to decide whether the project now brought forward is of such a character as to justify its being worked out in detail, whether in short they consider it safe to divert a large proportion of the floods of the Cauvery from their natural course, and to treat that river and its branches as if they were artificial channels. The outlay contemplated is not, in my opinion, larger than might have been expected considering the enormous extent of land to be irrigated by means of the supply of water drawn from the main river by a single head, and although a sluice of 1,000 feet lineal waterway, or what in practice might be 165 vents, each 6 feet wide, may appear at first sight an extravagant proposal, it should be recollected that the dimensions are only in proportion to the land to be irrigated, and that if, as is really the case, the area under the Cauvery is equal to that now irrigated in the Godavery and Kistna Deltas united, it is not unreasonable that the head sluice of the Cauvery should be equal to the aggregate dimensions of the separate head sluices of those two systems. As regards expense of first construction and of working, it must be less in proportion for the large sluice than for the smaller ones; and although great care and good management would be necessary to meet the constant fluctuation in the level of the Cauvery, the working of the sluices would in some respects be easier than is the case in the Godavery and Kistna, as the depth of water would never exceed 16 feet, while in the latter it is sometimes as much as 22 or 23 feet. The great importance of the Cauvery irrigation would moreover justify the introduction of some improvement on the ordinary mode of fitting and working the sluice shutters which, without necessitating any great expense, would allow of their being opened and closed with facility and despatch.

13. The scheme has doubtless much in its favor. It would allow of a complete system of regulation and distribution of water being established throughout the delta, and enable the supply which it is thought of supplementing by means of reservoirs, to go very much further than it does at present by being distributed in times of scarcity to the different channels by turns. The exact level of water to be dealt with being known, the embankment might be placed on a secure footing, and repairs reduced to a minimum. Instead of their being anything to apprehend as regards silting, there would be an immense gain in this respect; for the main channels which have now to carry off the highest floods, would have an excess of capacity for the discharge of the quantity which would be allowed to enter the delta under the new arrangements, and this would afford an extensive receptacle for the deposit of silt for many years to come. I would not advocate the use of scouring sluices, unless where local drainage has to be disposed of. In any irrigation system, which is under control, it is of opinion that no water should be allowed to enter the main sluice except what is actually required for use, and scouring or

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surplus sluices should only be designed with the object of providing against the contingency of their being insufficient time to shut off water from the head, when there may be heavy local rain, and for disposing of any excess over the demands of the cultivators which the latter may occasion. It appears, however, unnecessary to enlarge on this subject at present.

14. I propose to report on the works recommended by Captain Oakes in paragraphs 9 and 23 of the above report after an inspection of the localities.

15. In paragraph 24, Captain Oakes points out the futility of attempting to introduce any considerable improvements in the works in the delta, while the people have the power to put a veto on them. The extraordinary difficulties which the Engineer's labor under in this respect are fully explained in a former letter of the Superintending Engineer, No. 1,018, dated 26th November 1866, and I trust measures will be adopted to introduce a special Act, which will empower the local officers to carry out such improvements as are calculated to benefit the district without being liable to be sued for damages, and in short to exercise complete control over the waters of the Cauvery. The Government referred the question more than a year ago for the opinion of the Revenue Board, but up to this time no further action appears to have been taken.

16. The Government will observe from the concluding paragraphs of Captain Oakes' report that the preparation of designs for regulating works on the Vennaur, similar in character to those which have already been sanctioned for the regulation of the supply to the branches of the Cauvery, has been postponed in consequence of Captain Mead's removal from the district.

(Signed) J. C. ANDERSON, Lieut.-Colonel, R. E.,
Chief Engineer for Irrigation.
FORT ST. GEORGE,
11th February 1868.

No. 392. ORDER THEREON, 18th March 1868, No. 882.

IRRIGATION, No. 16.

Ordered that these papers be forwarded to the Government of India with the following letter:—

(Here enter No. 883, dated 18th March 1868.)

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R. E.,
Secretary to Government.

To the Superintending Engineer, 6th Division.

Col. S. T. Agnew.

Revenue 1868. Oct 1st
No. of hours of day 906.

Proceedings of the
Court. 906.

Oct 1st 1868. 3 hours
Revenue 1868.

W. 882

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