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Government of Madras.

Public Works DEPARTMENT.
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Read the following letters.

No. 105. From F. B. ELTON, Esq., Collector of Nellore; to J. D. BOURDILLON, Esq., Secretary to Government, dated 28th March 1859.

SIR,

In obedience to the requisition in para. 7 of Extract Minutes of Consultation under date the 7th March 1859, I have the honor to submit a Report on the Revenue results of the Pennair Annicut for the past, and those to be anticipated in future.

2. There has been but little opportunity for the full development of the effects of the Annicut hitherto. It was only completed in 1855, and no subsidiary Channels have been since formed, while of the existing Channels one only, the Jaffer Saib, is under its influence.

3. There are 21 Villages irrigated by the Jaffer Saib Channel, and up to the present time it is from these alone that any increase of cultivation from the Annicut can be looked for. The wet lands cultivated in these Villages are given in the accompanying Statement No. 1 for 5 years previous to the erection of the Annicut, and for the 4 years, including the current Fusly, since it was finished.

4. During the short interval that has elapsed since the completion of the Annicut it has been twice breached, and the repairs have never been completed since it was first breached in November 1857. Notwithstanding these extremely unfavorable and exceptional circumstances the increase of cultivation has been considerable, except in Fusly 1267, when not only was the Annicut seriously injured, but the Tanks supplied by the Jaffer Saib Channel were extensively breached by a hurricane of extreme violence, which visited the District at that time. The Revenue also fell from the reduction of assessment carried out during that year, which under such unfavorable circumstances could not be made up.

5. The increase in Fusly 1266, over the average of the previous 5 years, excluding Fusly 1263, a year of drought, was Rupees 16,327, and the increase in the present year, after the re-

duction of assessment, is Rupees 10,591, with the Annicut still unrepaired. It is difficult to say how far these results are attributable to the Annicut, and how far to the stimulus that has been given by high prices of agricultural produce, and reduction of assessment.

6. As regards the Revenue results to be anticipated in future on the re-construction of the Annicut, and the formation of the subsidiary Channels, I beg to forward two Statements marked Nos. 2 and 3.

No. 2 shows the increase of Cultivation that may be expected with the present resources of the District, and the ordinary supply of water in the Pennair River: the anticipated increase of Revenue is in round numbers Rupees 24,000, which being added to Rupees 10,591 the increase already obtained, makes a Total of Rupees 34,591.

Statement No. 3 shows the entire cultivable area of the Government lands South of the Pennair, within the Rampairoo River, capable of being irrigated by the Annicut and subsidiary Channels, provided the water supply is sufficient. This however it is not anticipated would be the case, unless the project of turning the Toomboodra or Kistnah water by the Koondaur into the Pennair, now under Colonel Cotton's consideration, in connection with the Madras Irrigation Company is carried out. The Pennair not having its sources in the Western Ghauts, is at present imperfectly supplied with water during the South West Monsoon.

7. Besides this however some period should be allowed for procuring stock to cultivate the additional lands, and every facility should be given to others besides the Ryots of the Villages to take up the new lands, in cases where the latter may not at once be able to do so.

	Rs.
Total Wet Area (vide Statement No. 3).....	1,73,503.
Average wet cultivation	90,083.
Difference.....	83,420.
Deduct Estimated reduction of Assessment.....	12,774.
Remainder.....	70,646.

8. On these conditions the anticipated increase amounts to Rupees 70,000 in round numbers, as shown in the margin. It is also very probable that some of the pasture and dry lands may be irrigated, but on the other hand some portion of the total wet area may be left uncultivated, especially those lands situated in the beds of Tanks.

No. 1.

Statement shewing the increase of Wet Cultivation in the 21 Villages irrigated by the Jaffer Sahib Channel from the Pennair Annicut, Nellore District.

Mangauny cultivation before the construction of the Annicut inclusive of waste charged.			Do. subsequent to the construction of the Annicut.			Comparison between columns 5 and 6 and the average in columns 2 and 3.		Remarks.
Fuslies.	Extent.	Assessment.	Fuslies.	Extent.	Assessment.	Extent.	Assessment.	
1	2	3	4	5	6	7	8	9
	Acres.	Rs.		Acres.	Rs.	Acres.	Rs.	
1,260	10,747	62,820	1,265	11,172	64,015	*1,475	*8,773	
1,261	10,816	61,459	1,266	12,553	71,569	*2,856	*16,327	The amount of Assessment given in Column 6 is after the reduction of the Assessment, amounting for Fusly 1,267 to Rupees 7,149 and for Fusly 1268, to Rupees 7,496.
1,262	10,074	56,189	1,267	10,170	49,383	*473	—5,859	
1,263	5,994	34,612	1,268	13,619	65,833	*3,922	*10,591	
1,264	7,150	40,499	.....	.....	.....	.....	.....	
Average exclusive of 1263 Fusly.	9,697	55,242						

Nellore, Collector's Office, 28th March 1859.

(Signed) F. B. ELTON,
Collector.

No.

Statement of the increase of Revenue expected from the extension of

Talooks.	Villages.	Magany Ayacut.		Dittum.		Average cultivation.		Dittum
		Extent.	Assessment.	Extent.	Assessment.	Extent.	Assessment.	Extent.
		Acres.	Rs.	Acres.	Rs.	Acres.	Rs.	Acres.
Survapuly.	4. Villages under the present Survapully Channel.							
	1 Survapully	1,088	18,517	618	8,435	404	5,291	192
	2 Panooburty	228	5,659	111	2,557	74	1,760	37
	3 Brumhadavum	333	6,802	216	4,467	139	2,440	107
	4 Anecapully	140	2,390	85	1,552	62	1,159	23
	Total	1,789	33,398	1,090	17,011	679	10,653	359
	7. Villages under the proposed Kristnapatam branch.							
	1 Kristnapatam	113	2,602	33	651	20	396	13
	2 Pidthapoloor	153	2,338	127	1,856	74	1,201	53
	3 Pynumpoorum	99	1,835	90	1,680	70	1,355	20
	4 Nyalatoor	95	2,183	77	1,914	61	1,592	16
	5 Moottocoor	140	2,168	98	1,775	65	1,219	33
	6 Vulloor	162	2,602	118	2,402	95	1,553	53
	7 Lingapalem	21	216	17	188	9	95	8
	Total	783	14,271	590	10,466	394	7,413	196
	5 Villages to which the Survapully Channel was proposed to be extended.							
	1 Eapoor	592	10,150	397	6,230	300	4,967	97
	2 Eadagauly	219	3,978	122	1,971	55	960	67
	3 Cakerlapalem	22	185	22	185	5	50	17
	4 Poodypurty	119	3,261	63	1,550	32	858	31
	5 Goorevinthapoody	...	...	...	...	...	...	...
	Total	952	17,577	604	9,939	392	6,835	212
	3. Villages to which the Jaffer Saib's Channel has to be extended.							
Talamunchy. Nellore.	1. Coodithipaulem	99	1,876	42	720	31	539	11
	A portion of Wootoocoor	31	623	26	601	19	456	7
	2 Nadamoosily	76	1,015	69	925	58	766	11
	3 Varacavepoody	...	...	...	...	...	...	...
	Total	206	3,514	137	2,255	108	1,761	29
	Grand Total	3,730	68,763	2,421	39,671	1,573	26,662	796

Nellore,
Collector's Office,
28th March 1859.

2.

the Irrigation from the Pennair Annicut in the District of Nellore.

Expected increase from land. Assessment.	Amount Magany. Extent.	Amount Magany. Assessment.	Pasture lands. Extent.	Pasture lands. Assessment.	Total. Extent.	Total. Assessment.	Reduced Assessment.	Remarks.
Rs.	Acres.	Rs.	Acres.	Rs.	Acres.	Rs.	Rs.	
2,412	90	1,638	0	0	282	4,050	3,650	
797	21	467	25	490	83	1,754	1,481	
2,027	23	507	0	0	130	2,534	2,157	
393	0	0	0	0	23	393	337	
5,629	134	2,612	25	490	518	8,731	7,625	
255	10	180	10	257	33	692	552	
653	21	353	0	0	74	1,006	821	
325	18	287	23	414	61	1,026	858	
323	12	218	9	236	37	777	611	
556	41	689	20	265	94	1,510	1,299	
849	13	220	38	532	104	1,601	1,458	
92	5	58	4	46	17	196	173	
3,053	120	2,005	104	1,750	420	6,808	5,772	
1,263	195	3,920	30	690	322	5,873	4,905	
1,014	54	1,031	0	0	121	2,045	1,750	
135	0	0	0	0	17	135	127	
692	56	1,714	30	900	117	3,306	2,644	
...	...	...	...	...	...	...	...	The Ryots of this Village have not engaged for any increase of cultivation.
3,104	305	6,665	60	1,590	577	11,359	9,426	
189	28	586	0	0	39	775	675	The reduced Assessment for these three Villages is Estimated only, the accounts not being at hand.
146	4	40	6	130	17	316	276	
159	0	0	39	572	50	731	631	
...	...	...	...	...	...	...	...	The Ryots of this Village have not engaged for any increase of cultivation.
494	32	626	45	702	106	1,822	1,582	
12,280	591	11,908	234	4,532	1,621	28,720	24,405	

(Signed) F. B. ELTON,
Collector.

No.

Statement shewing the entire Ayacut &c., of the Villages which can be brought under the influence of the Pennair Annicut provided the water supply is sufficient.

	21 Villagers under Jaffer Saib's Channel.		3 Villages to which it has to be extended.		7 Villagers under the proposed Kistnapatam branch.	
	Acres.	Rs.	Acres.	Rs.	Acres.	Rs.
Total Area	51,304		3,128		15,810	
Deduct.						
Enams	9,031		397		2,537	
Sites of Villages, Tanks, and Topes	7,006		556		1,081	
Uncultivable lands being Sandy, &c	6,567		375		6,119	
Total	22,604		1,328		9,737	
Remainder	28,700		2,100		6,103	
Of which unassessed pasture lands	6,847		253		2,731	
Assessed.						
Dry	3,797	5,719	581	1,009	688	1,012
Wet	17,372	1,02,906	1,141	6,805	2,350	13,703
Garden	681	8,678	125	1,420	331	2,399
Total	21,853	1,17,303	1,847	9,234	3,372	17,114
Of which under occupation in Fusly 1261.						
Dry	1,928	2,860	306	495	341	520
Wet	13,954	80,785	850	5,108	1,847	10,435
Garden	453	4,832	72	864	96	920
Total	16,335	88,477	1,228	6,467	2,287	11,875
Under cultivation in Fusly 1261.						
Dry	1,753	2,563	297	479	322	492
Wet	10,816	61,578	765	4,663	1,559	9,058
Garden	431	4,399	69	772	87	854
Total	13,000	68,540	1,131	5,914	1,968	10,404
Average Cultivation of 5 Fuslies 1259 *to* 1264, *exclusive of Fusly* 1263.						
Dry	1,637	2,577	238	382	297	463
Wet	9,900	56,582	709	4,283	1,250	7,530
Garden	403	3,951	66	693	81	758
Total	11,940	63,110	1,013	5,358	1,628	8,751

Nellore,
Collector's Office,
28th March 1859.

3.

under the influence of the Pennair Annicut provided the water supply is sufficient.

4 Villages under the present Survapully Channel.		5 Villages to which it was proposed to be extended.		Total.		Remarks.
Acres.	Rs.	Acres.	Rs.	Acres.	Rs.	
23,159		20,275		1,14,006		
4,603		2,062		18,630		
2,078		3,047		13,768		
5,766		9,097		27,924		
12,447		14,206		60,322		
10,712		6,069		53,684		
4,681		1,869		16,381		
831	1,822	903	2,315	6,800	11,877	
5,053	30,934	3,135	19,155	29,051	1,73,503	
147	2,293	162	2,029	1,452	16,819	
6,031	35,049	4,200	23,499	37,303	2,02,199	
66	143	234	628	2,878	4,646	
3,003	16,184	2,522	14,519	22,176	1,27,031	
97	1,287	87	828	805	8,731	
3,166	17,614	2,843	15,975	25,859	1,40,408	
63	140	231	612	2,666	4,286	
2,575	13,406	1,968	11,280	17,683	99,985	
97	1,274	85	799	769	8,098	
2,735	14,820	2,284	12,691	21,118	1,12,369	
87	146	203	527	2,462	4,095	
2,403	12,679	1,525	9,009	15,787	90,083	
91	1,112	81	752	722	7,266	
2,581	13,937	1,809	10,288	18,971	1,01,444	

Signed) F. B. ELTON,
Collector.

No. 106. From Colonel A. T. COTTON, Commandant of Engineers to J. D. BOURDILLON, Esq., Secretary to Government, D. P. W., Fort St. George, dated 31st March 1859, No. 110.

SIR,

I have the honor to transmit a Memorandum on the repairs of the Pennair Annicut at Nellore, with certain suggestions thereon, for the consideration of Government.

Memorandum on the Repair of the Pennair Annicut at Nellore, by Colonel A. Cotton.

In obedience to the orders of Government in Minutes Consultation* I proceeded by the canal to Doogoorauzapatam, and thence to Nellore by land, where I arrived on the 11th.

* No. 592, dated 15th March 1859.

2. As the information I obtained from Captain Mullins and Mr. Elton, and on examination of the localities, was abundantly sufficient in my judgment to shew that the present work should be repaired, I wrote at once to that purport to Government, and telegraphed to know if I had authority to direct the commencement of the repairs, as I was not certain about the precise meaning of my instructions on this point. Having received an immediate reply, I saw the works begun on the following morning.

3. During the four remaining days that I was at Nellore, I went over the various points in the question with the Collector and Engineer, and gave instructions to the latter respecting the mode of restoring the annicut, &c., and requested him to make out the estimates, &c.

Before leaving I saw 250 Coolies, including boys, at work, and the embankment nearly carried across the channel of the river. Some progress had also been made in excavating on the line of the front retaining wall.

4. On the 17th, I left Nellore, and leaving Doogoorauzapatam on the 18th, was tracked to Madras against the S. W. wind in 27 hours, a distance of 70 miles. I may also mention that in the Doogoorauzapatam canal, I saw 48 boats, averaging about 25 tons, or in all 1200 tons of boats. This is sufficient to show the value of this work. If the boats remain on an average even six days in the the canal, this is equivalent to a traffic of 200 tons a day.

If this is the case now that the canal ends as it were at no place, for there is not even a bandy road from Doogoorauzapatam to the Northern road, we may be certain that the traffic will be very extensive when the present canal is connected with that from the Nellore Annicut, and a complete water transit is established, terminating in the Northern road at 108 miles from Madras, producing a saving, as compared with the land carriage, of 10 Rupees a ton, besides the enormous passenger traffic which there would be.

Ancient Works.

5. I found the Annicut in the state in which it had been left by the fresh. About one third of its length, with the two end sets of under sluices, the wing walls, and the head sluices of Jaffer Saib's Channel, was uninjured. Of the remainder not much was visible, most being covered with sand; the central under-sluices were visible, partially destroyed, and broken into large masses through the stone, showing the goodness of the masonry.

On pricking the line of the front retaining wall, no stone could be felt at 6 or 8 feet depth, for a distance of about 80 yards where the breach first occurred, and where, consequently, the sand was probably scoured out to a great depth. On the remaining 250 yards, we found stone at a foot or two deep in several places, so that probably the foundations have not been destroyed all along that part. As about 40,000 tons of stone have been used on this work, we may expect to find that, excepting at the 80 yards of breach, there is now substantial foundation for a new superstructure.

The Railway I found in excellent order from the river bank to the Quarry; a substantial road of bridge rails very much superior to the Dowlaishweram railways. There are 22 waggons, capable of carrying 4 or 5 tons each, and two good Cranes for 1½ tons; a large 5 ton Crane, lately sent out is found imperfect, it had not been put together and the parts did not suit.

The Quarry is of the very best description; the stone being in ample quantities, in moderate sized masses, and capable of being reduced into blocks of one or two tons by fire, at a small expense, breaking unto rhomboidal pieces of the best form for packing close.

6. Respecting the measures to be pursued, I think there can be no question about the present site, were it only on account of the great portion of the work remaining. But I think, also, that this was the correct site originally. It is, certainly, a very narrow part of the river, and therefore the work is exposed to a very great force of water, but there being an ample supply of the best stone at hand, which can be applied at a very low cost, a work can be constructed here to resist the water at no excessive expense. The case is thus similar to that of the Kistnah. The site is also objectionable on account of the bend immediately above; the consequent oblique action of the current must be counteracted by stone groynes run out from the annicut both above and below. I consider the advantages of the site greately counterbalance these disadvantages.

7. The first breach, I have no doubt, was owing to the mass of stone being insufficient. The surface stones also were not of sufficient size, or adequately packed; but I believe that no difference in this respect would have saved the work, but that, from want of breadth, the bed of the river below was scoured out to such a depth, that the work was swallowed up.

From the slope of the river, three feet a mile; the depth of water, 14 feet in the Channel below the work; the narrowness of the river at that point, 500 yards, about half of the average width and one-third of the greatest; and the height of the annicut, nine feet, nearly two-thirds of the natural depth of water in a high fresh, I calculate that the velocity of the water over the work would be at times 11 or 12 miles an hour, much more than that over the Godavery Annicut at any time, and nearly as much as that over the Kistnah; the latter is 66 yards broad, while this work was only 30 yards. There is no doubt that a work at this site required nearly as much mass and care as that at Bezwarah.

8. The second injury was no doubt immediately owing to the work being quite in an unfinished state, but I also consider that the breadth of the work was insufficient.

I do not concur in the change of section from the original mass of rough stone with one slope, to a series of vertical falls with laterite aprons. The complete success of the Kistnah works has decided me in favour of large masses of loose stone wherever it can be obtained cheaply, and where a vertical fall is used, I would have the whole fall in one, but there must then be a very strong apron of large stones, like the Pallaur Annicut near Arcot. With a succession of falls the water in high freshes has a slope, and is delivered with almost its full force on the bed of the river below. I speak, of course, of these rivers with sandy beds. Allowing the section that was given, or indeed any other, I consider the great mistake was attempting to make the work of the full height in that season. If the annicut had been left of one half of two-thirds the full height, the power of the water would have been very much less, and there would have been ample time to complete what was to be done. Had it been left 4½ or 6 feet high, it would have been fully effective that year, and the work might then have been completed at leisure the following season.

9. What I now therefore propose is,—1st That the work be constructed of rough stone with a breadth of 60 yards, and the former height, 3 yards. 2nd, that it be left only 1½ yards high this year, with a breadth of not less them 30 yards, but more, if the stone can be brought. 3rd, that it should have a front retaining wall, and also a line of wall in the slope to help to secure the packed stone on the upper part of the slope of the work. So far as I could judge at the time, there seemed no reason to doubt that this amount of work can be easily executed this year. But some additional waggons, and two more cranes, should be added as soon as possible. I find there are three good cranes procurable here at Madras, two of which should be sent immediately.

It must be observed, that the laterite masonry of the part of the Annicut that was not breached, has remained quite uninjured, though composed, in my opinion, of much too small stones. The cement will now be well set, and as the principal part of the annicut will be left low, I think this part may be left as it is this year.

Next year I would cover it all, excepting just the upper surface, with rough stone, so as to make it uniform with the rest.

10. The two end sets of under-sluices have been placed at some distance from the wing-walls—I do not know what was the reason of this. From both the Dowlaishweram and Bezoarah Works, it seems to me established that they ought to be placed close to the wing-walls, in order to scour the bed of the River as near the head-sluices as possible. I would, therefore, add, two new sets of under-sluices next year, adjoining the wing-walls, raising the masonry over them so as to allow of their being opened and shut when the River is in fresh. I would leave the present under-sluices. I do not see any use in the centre ones, and would not restore them. I would add the iron posts, as before, so as to allow of the water being raised to 2½ feet above the annicut.

11. The main points are, to give the works sufficient breadth (I propose 60 yards of slope, with 20 yards of level about 1 yard thick), and to have the upper part of the slope, where the great power of the water is, formed of large stones carefully packed, and wedged with small stones driven hard into the interstices, and concrete poured in wherever it will enter.

12. Captain Mullins estimates that rough stone can be placed in the work at 8 Annas a Ton or 10 annas per Cubic yard of rough stone work; at this rate, a mass of $500 \times 4\frac{1}{2} \times 60 = 67,500$ Cubic yards, would cost 42,000 Rupees; and the bed could be covered with stone to the depth of a yard, 20 yards broader, $20 \times 1 \times 500 = 10,000$ Cubic yards, for 8,000 Rupees, which would certainly be a great additional security. This will show what great mass may be given to those rough stone annicuts, without an excessive expense, or rather considering the enormous value of such works, at a cost quite insignificant. I think our mistake every where hitherto has been in being too sparing of so very cheap a material. I have requested Captain Mullins to prepare plans and estimates upon these principles.

13. My rough estimate of the work for the present year is:—

	Yards.	C. Yards.	
Masonry	350 × 3½ × 1½ =	2,000 at 3½ Rupees.	7,000
Rough stone	500 × 2½ × 1 × 30 =	26,000 at 10 Annas	16,000
Additional waggons, cranes, and sundries			5,000
		Rupees	28,000

And for next year:—

		C. Yds.		
Masonry	350 × 1½ × 1⅔ =	875 at 3½	=	2,000
	500 × 3 × 1 =	1,500 at 3½	=	5,000
Rough stone	500 × 60 × 1½ + 1 =	37,500		30,000
	500 × 20 × 1 =	$\frac{10000}{37500}$		
2 Sets of under-sluices				10,000
Sundries				5,000
		Total		52,000
		Grand total		80,000

Probably this sum would complete the work.

I would, however, press on the stone-work, and if possible have it more than 30 yards broad this year. By working the Railway at night, which was done very successfully at Dowlaishweram, a large additional quantity of stone could be deposited.

14. The next point is, the arrangement about the Survapilly Channel. This appears to me a very simple question.

1st. It *must* have a head-sluice; the destruction without it is intolerable.

2nd. The present head is, as has been shown in other papers, in a very bad position, and it is very desirable, on many accounts, to close it.

3rd. The water for it can be admitted by the Anicut head-sluice.

The only objection which seems to have been supposed to exist, was the cost of connecting the two Channels; but there has been a complete mistake about this, in consequence of the cost of the Channel necessary for conveying water to the Survapilly Channel being mixed up with that of forming the head of the Kistnapatam Channel, and also with that of conveying water to a much extended cultivation on the line of the Servapilly Channel.

A Channel *must* be cut from the Jaffer Saib's Channel towards Kistnapatam, and for some distance it will only be necessary to widen this; after which a separate Channel mut be cut to the Survapilly one. But the present cultivation under the latter is so small, only 2,000 Acres, that a stream 1 yard broad and 1½ deep will be sufficient, so that the amount of excavation actually required for it is very trifling, and will not cost more than 3,000 Rupees, including the lengthening of two Bridges. A new head-sluice would cost as much as this. It is evident that the enlarging the whole line of Channel so as to provide for extended cultivation is a separate question.

15. I would, therefore, certainly close the present Head of the Servapilly Channel, and make a cut connecting it with the Jaffer Saib's Channel; the present head sluice having a great capacity, sufficient for a much larger extent of cultivation.

The Engineer should be supplied with a sum of money to go on with this work this season, so that if at any time more Coolies come in than he can conveniently employ in the Annicut, or when there is a fresh on the River, he may have work at hand ready for them.

It would of course be very desirable to get this cut opened and the old head closed this season, but it is not probable that there will be sufficient labor for both it and the Annicut. A sum of 10,000 Rupees might be allowed this season for this cut.

The present head of the Servapilly Channel is situated at the bottom of a deep bight from which the water is thrown very obliquely in the Annicut, which was one of the objections to the site. When the Head is closed, by the formation of one are two groynes above, this bight may be in a great measure silted up, which will be an advantage.

The extent of irrigation and probable returns from the Annicut.

16. The next point is the extent of irrigation and probable returns from the Annicut. The total cost of the work, including the present estimate, will have been—

	Rs.
1st Estimate	1,17,000
2nd Do.	64,000
3rd Do.	80,000
	2,61,000

Respecting this cost I may state, that the cost of the Godavery Annicut may be taken at nine Lacs, including additions, for 4,000 yards of clear water way, or 225 Rupees per yard of length, for a wide part of the River, and consequently small force of water. The Kistnah, 7½ Lacs for 1,200 yards, or 625 Rupees per yard, for a very narrow part of the River, where the power of the water was enormous. This will have cost 2½ Lacs per 500 yards, or 500 Rupees a yard, where the power of the water is nearly equal to that of the Kistnah, but this work is much lower, and the rise of the River much less. There are, also, no locks included in the above sum, and only one head-sluice. The cost will, however, after all, not be so very great in proportion, if the present esitmated sum is sufficient.

17. The extent of country commanded by this work (to the height of 36 feet above the sea,) is so great, that there cannot possibly be any question about there being ample returns if the necessary Channels are cut. The Collector considers that irrrigated land here pays easily six Rupees an acre, or at least four Rupees for the water, so that 10 per cent. on the Capital would require about 6000 acres to be newly irrigated, about 15 square miles of country, an extent quite trifling compared with that to which the water could be led. Only as far as Goodoor, 28 miles S. of Nellore, includes an area of probably not less than 250 square miles irrigable, which is only the South side of the River.

The Collector gives me a return of only 16 Villages, in which the average wet cultivation has been 19,500 Rupees, and Ayacut wet only is 41,000, leaving 21,000 Rupees, besides all the dry land that could be irrigated, and of this, 16,000 Rupees is engaged to be taken up if the Annicut water is led to it, which alone would be 6 per cent. on the cost of the Annicut.

In another statement 40 Villages are included, in which 21,000 acres are given as dry or uncultivated wet land, which at 4 Rupees an acre would yield 84,000 Rupees, 30 per cent. on the cost of the annicut.

There can, thus, be no question about there being ample land fit for irrigation, commanded by the Annicut.

18. With respect to the preparedness of the people to make use of the water, the Collector gives a most satisfactory account of the District. Since the lowering of the high assessment, which by the testimony of several Collectors for a long series of years was, as in other Districts, entirely destructive of the prosperity of the District, the people have thrown off their despondency, and land is everywhere being taken up. As a specimen of this he gives me a return of the collections in 21 Villages under the Jaffer Sahib's Channel, which for the 5 years previous to 1855, yielded, on an average, 50,000 Rupees, and on the average since (omitting however the year of the hurricane) 66,000 Rupees. The Collector thinks that, at the rate of 6 Rupees per acre, the land will be eagerly taken up.

19. It is quite evident then, that *having an annicut*, the project may be carried out to a vast extent. The following is a rough estimate for a certain amount of Irrigation.

Annicut.....	2,60,000
Kistnapatam Channel.....	1,70,000
Widening Jaffer Sahib's Do. &c.....	54,000
Saboor Branch.....	30,000
Edoor Do.	27,000
	5,41,000

This is calculated to provide for 64,000 acres, which, at 4 Rupees, would give 2,50,000 Rupees of Revenue; of this about 1 70,000 acres is now watered, deducting which, the remainder at 4 Rupees an acre, gives 1,82,000 Rupees, or 35 per cent. on the expenditure. This, however, includes making the Kistnapatam Channel a first rate navigation, so that about a Lac of the above would be properly chargeable to navigation.

20. This seems quite sufficient to show that, whether carried out to a larger or smaller extent, there is ample ground for concluding that the returns will, as in other such cases, be abundant. By the above estimate, deducting the present watered lands, but including the cost of the Navigation works, it appears that the Capital per acre would be about 12 Rupees, and if 4 Rupees water-rate is levied, this will be 33 per cent. from which deduct about 3 per cent. for repairs.

21. In fact, we have now abundant and indisputable data respecting irrigation, to assure us that in all ordinary cases there can be no question about returns to Government for the capital, as well as returns in benefit to the people. Generally, we may safely reckon upon an increased value of produce of 15 Rupees per acre, out of which if the Government take 4, the people will have a gross benefit of 11, and if we take the capital per acre at 4 Rupees, as in the Godavery Delta, or 12 as here estimated, the return to Government will be from 30 to 100 per cent. And past experience shews that 12 Rupees per annum is a very high cost per acre. Probably on a large scale 12 Rupees per acre would include country containing great Engineering difficulties. And these rates include navigation also, which alone is certainly equivalent to a benefit of 2 Rupees an acre, where the distances to Port or Market are short, but in the interior districts it would be worth much more. For instance, taking the produce of an acre at two-thirds of a ton; there would be a saving of about 8 Rupees on 100 miles of water carriage as in Nellore, or 32 on 100,

as in the case of central districts. And this is besides the saving to the land owners on all articles they purchase which are brought from a distance.

These considerations put the question of returns in a very clear point of view. It is quite certain that it can only be in very extraordinary cases that Hydraulic works will not pay abundantly.

Remarks on the cause of the failure of the Anicut.

22. Before concluding this part of the subject, I would beg to offer some remarks on the failure of this work.

1st. The establishment of such works on these rivers without any thing solid for foundations is really no small matter. I have no doubt that English Engineers would either pronounce them impracticable, or go to an enormous expense in giving them very deep foundations. I feel confident that they would not have executed such works at any thing like the cost of those already executed.

2nd. In a serious work of this sort, the matter should not be left to any casual Officer either in the District or the Circle. The Officer most approved, from his experience in such works, should always be called in. In England, no great work is ever undertaken without the opinion of one of the leading men of the profession who has been most employed in the particular branch of Engineering.

Had Captain Orr, after his experience in controlling a similar powerful current, been sent to project this work, I do not think any accident would have occurred, though it was certainly a remarkable thing that the work should have been tried by a Hurricane in its first year, before there had been time to observe any partial defects.

3rd. With respect to the execution of such a work, I do not think it should be left to the care of a young Officer, who not only had never executed any considerable work before, but had never been under an experienced Officer while constructing such a work. A young officer may be very talented, energetic, and faithful, but it is not fair to expect of him what he might perhaps be equal to after 10 or 15 years more experience. If a district is under the charge, as several now are, of Officers quite too young and inexperienced for such an important duty, they should at least be relieved, for the time, if a work of the first class is to be constructed in their District, and an experienced man sent to execute it.

4th. We must not be discouraged by such occasional failures. Nothing like these works has ever been executed in other countries or ages.* They far exceed any thing in Europe, and no assistance could be obtained about them from books. They are works which the most experienced and talented Engineers of Europe would have puzzled over, and I have no doubt have spent 5 or 10 times as much on them as has been spent. Witness the Annicut on the Nile, which, I believe, cost one or two millions, and occupied many years. It is not so long as this annicut, which, including the accidents, will probably not cost more than 26,000£.

* Excepting that on the Nile, of late years.

Every failure adds to our experience and makes future ones less probable.

We have now executed seven of these great works, besides this; *viz.*, two on the Colleroon, one at the head of the Vennaur, one on the Vellaur, the Pallaur, the Godavery and the Krishna. These eight have now given us a good stock of experience, and, if we only take the palpable precaution of intrusting the planning and executing of future ones to experienced and approved men, we have no reason to fear any more failures, notwithstanding the incalculable floods with which we have to contend in this county.

5th. In judging of the section to be given to such a work, the following points should be compared with those in the case of works already executed:—

1st, Fall of river.
2nd, Average breadth.
3rd, Breadth at site.
4th, Depth in extraordinary floods.
5th, Height of work.
6th, Consequent proportion of average section of river obstructed.
7th, Consequent current over the work.

8th, Position of work, with respect to the course of the river there, that is whether the current will be perpendicular or oblique to the line of the work.

It must be remembered that Engineers here have no access to any well digested treatises on such works, as every Engineer in England has in the case of any of the works undertaken there.

6th. By making these works of a moderate height the first year, they can be safely constructed. It is not till they approach to their full height that the great force of the water is encountered, and in general a very low work will enable the Engineer with very trifling temporary works, to obtain the full benefit of the work, so that no returns will be lost.

7th. One great point in such works is, that unlike a bridge and most Engineering works, failures are only very partial, and the repair of a breach generally costs only a small sum compared with the original expenditure. The breach in the Godavery Annicut cost about one-thirteenth of the work itself.

8th. Another is, that they are so enormously remunerative that, as a native of Tanjore said to me, "it would not be a very great matter if it had to be built every year." Thus, if the Godavery Annicut waters 12 Lacs of acres, and the increase of produce is 15 Rupees an acre only, the results of it will be 180 Lacs a year, while the work cost 9 Lacs.

Remarks on the navigation of the Channels and other points connected with the Annicut.

23. I proceed to make some remarks on other points connected with this work. 1st, on the navigation.

It is evident that Nellore is an important point to reach in the line of the Northern canal; it would form one real termination of it. At present it ends at nothing. A road has been made from the Northern road at Goodoor to Kotah, which is eight miles from the head of the Canal; a very small sum would complete this, which would be a considerable point gained, as it would connect the canal with the interior. This, therefore, should be done immediately at all events.

An estimate has been prepared, and approved, for 20 miles to Kistnapatam, amounting to Rupees 1,40,000. This is a tide water canal, like the present one. To complete the communication to Nellore would then require 20 miles more, for which an estimate of 1,30,000 Rupees has been prepared.

This would be an Irrigation canal also, and would by means of Locks raise the Navigation to about 36 feet above the sea. It would irrigate at least 13,000 acres, yielding 52,000 Rupees of Revenue, and at 15 Rupees an acre, 2 Lacs of Rupees of produce.

24. The completion of these two canals is a very great object. The present traffic by the northern canal is 1,34,000 tons, and rapidly increasing. It yields to Government 33,000 Rupees a year. There can be no doubt that if extended to a real termination like Nellore on the northern road, the traffic would almost immediately increase to 200,000 tons, besides an immense Passenger traffic. This would be an increase of tolls of 16,000 Rupees a year, even if the present toll of ¼ Rupee only is collected on this long transit of 105 miles, equal to less than ½ pie a ton a mile. And the saving to the public would be about 10 Rupees a ton, or 6¼ Lacs per annum.

25. I must however, repeat here, the principle which I most earnestly insist upon, that it would be better policy to have all these great highways entirely free, and so encourage the greatest possible use of them, and collect whatever is required for Government on the water used for Irrigation, where it can be collected at the least expense, with the least danger of frauds, and the least annoyance to the payers, and where there is already a set of paid agents employed. To collect taxes in very small sums, and on things in motion, I consider contrary to two of the first principles of taxation.

26. The continuation of the canal to the Northward, to meet the vast system of internal navigation connected with the lower Kistnah and the Godavery, is evidently of incalculable national importance. It would bring the Government and the port of Madras into direct and rapid communication with Nagpoor, and with a vast extent of country, not less than 1,50,000 square miles, containing perhaps 15 millions of people. When the Kistnah high level channel is completed, it will leave only 100 miles between these districts and Nellore, without canal. This work could be executed for at most 10,000 Rupees a mile, or 10 lacs. The canals of the Kistnah and Godavery on the high level, 30 yards broad, have cost 7,000 Rupees. The level of the Kistnah annicut is 46 feet above the sea, so that there would be a fall along the canal, without locks, of 10

feet in 170 miles, or two-thirds of an inch per mile, which is about the fall allowed in the high level canals already constructed.

27. This canal would, of course, be replenished by the rivers it crossed in its course, and irrigate a vast extent of country. It would, in fact, command about 1,200 square miles, or 5 lacs of acres, the whole of which might be irrigated by storing water on the lines of the different rivers crossed.

There will be about 2,000 miles of navigation in the Deltas of the Kistnah and Godavery, and if the whole of the upper Godavery and its tributaries are improved, there will be 2,500 miles more, so that this link of 100 miles would connect Madras, (and all the South also by the Southern canal) with 4,500 miles of internal navigation.

To leave out so important a link as that could not be thought of.

It must be remembered, that the late Court of Directors fully recognized the project of improving the upper Godavery, and there seems no room for doubt that it will now gradually come into use.

28. Even were there no such a thing as navigation, it is evident that the extension of the canal to the Northward from the Nellore Annicut, and of the Kistnah canal to the Southward merely as canals of irrigation, must of course be carried out, for there is no reason at all now that we have by means of the Annicuts obtained the command of that tract for irrigation, that the minor works necessary for that purpose should not be executed.

The money thus required to connect the present canal with those of the Kistnah, is:—

Doorgoorauzepatam Kistnapatam canal, 20 miles	1,40,000
Kistnapatam to Nellore, 20 miles	1,70,000
North of Nellore, 100 miles	10,00,000
Total Rupees	13,10,000

29. Probably, there are few projects in India where 13 Lacs could be better expended than upon this. Besides the vast extent of Irrigation it would afford, if 100,000 tons were carried along it, there would be a saving, at 1½ Annas per ton per Mile, of 13 Lacs a year on goods only, besides passengers. And 100,000 tons is a very moderate estimate for the traffic of such a line leading, from the Capital to such a vast extent of country, by a line of navigation worked at about 2 Pie a ton a mile. It would, of course, also form the best possible communication for the conveyance of troops at a rapid rate to all the North and North West. They could be conveyed at 10 or 15 miles an hour, and far cheaper than by sea.

Connection of the Pennaur with the Upper Kistnah.

30. But the most important question of all, perhaps, in connection with this Annicut, is that of supplying the Pennaur with a more constant stream of water from the Kistnah.

At present the Pennaur receives first a single moderate fresh at the setting in of the S. W. Monsoon, but as its sources do not extend much to the westward of the Meridian of Bangalore, there is scarcely any accession of water during the greater part of that Monsoon, and the river is almost or quite empty generally in August and September. Its great freshes come in the North East Monsoon and it is thus not supplied with water sufficiently for more than one crop, and that one late in the year.

31. The Kistnah receives water before the South West Monsoon sets in on the Western coast, in consequence of partial rains in the neighbourhood of Kurnool, so that it always begins to rise in May, and from about the 20th of that month till December, there is abundance of water in it. In a full fresh the Kistnah has about 170 Millions of Cubic yards per hour, while the Irrigation under the Bezoarah Annicut will only require about one Million or perhaps 1¼ Million of cubic yards. Thus a very insignificant rise in that river affords ten times as much water as is now used, and an enormus supply is available for any new Irrigation. It is a remarkable fact that there is a very low ridge only dividing the basin of the Kistnah from that of the Pennaur, a fact, however, which is not singular, for it is similar to what is found in most of the rivers of the Peninsula; a peculiar feature, inviting, in the most marked manner, a complete connected system of Navigation and Irrigation, throughout the whole country.

32. By levels which have been sent me, it appears that the water-shed of the Kistnah and Koondaur (the Northern feeder of the Pennaur) is at its lowest point only 13 feet above the bed of the river at Kurnool, or perhaps 60 feet above that of the Kistnah at its confluence with the Toombudra. By throwing an Annicut, therefore, across either the Toombodra or the Kistnah, with only a few miles of Canal and a moderate cutting, the water of those rivers can be turned over the water-shed into the Koondaur, and without any works beyond the water-shed, a constant stream may thus be kept up, of any magnitude, in the Koondaur and Pennaur for 7 or 8 months in the year.

33. By such a work alone, therefore, all the present irrigation could be secured for two crops without the tanks in which the present Channels terminate, and all their beds might then be cultivated. Nellore would thus be made just like Rajahmundry; it would be far better supplied with water than Tanjore. It must be particularly observed that when once an Annicut is established, it opens the way for bringing in supplies of water from a great extent of country, for whether it is obtained by storing it in tanks, or by making a cut from another river, it makes no difference what distance it is brought, as it will come down the channel of the river without any expense. Thus, also, water for a summer supply, so as to keep the Pennaur and all its channels flowing throughout the year, might be stored in tanks wherever good sites could be found, throughout the country, even to the Western Ghauts.

34. This cut from the Kistnah would form part of the proposed project of the Madras Irrigation Company, and would be a complete project in itself, quite independent of the other works proposed. Of course, any amount of water could be thrown into the Pennar, but if we suppose that 200,000 acres were to be watered for one crop, begining in May, it would yield 8 lacs a year at 4 Rupees an acre; and it would cost, probably, under 10 lacs for the turning of the water into that river. If this work is executed by the Irrigation Company, of course the water might either be used by the Government to supply the present channels, and a price paid by Government to the Company per million cubic yards, or the Company might distribute part of it themselves.

I do not go further into this matter here, as it seems only necessary to show how enormously the value of this Annicut can be increased by such means as this.

35. I wish particularly to urge that we form a very insufficient estimate of the value of an Annicut, when we look upon it merely as turning the present supply of water in that particular river on to the land. It has, in fact, put it into our power to lay a vast extent of country under contribution for water, and it will be easy and very moderately expensive, wherever we have an annicut, to water both a much greater extent of country than before, and also to keep the channels full throughout the year, so as to form both perfect navigation, and also to raise all kinds of produce, including those which require water in every month.

36. There seems now no room for doubt that water can be stored at selected sites, at a cost of half a Rupee of Capital per 1000 cubic yards, (and certainly at much less in many situations), and which would give in Interest, Repairs, &c., 1 Rupee per 30,000 cubic yards, while, at 4 Rupees per acre, or for 6,000 cubic yards, the Government would receive 20 Rupees for that quantity, and with the number of annicuts now existing, nothing more is wanted than to construct the tanks, every where, so as to make such an enormous return.

37. I have only to add that, if the Irrigation Company carry out their project from the Toongabudra, it will connect the Canals from this Annicut with the whole basin of the Kistnah, from near Mangalore at the sources of the Toonga and Budra, to Poonah and Ahmedunggur, the sources of the Moottamoola and Seena, including probably 2,500 Miles of river and channel navigation, which with that in the basin of the Godavery, would make a total of 7,000 Miles, collecting the produce from more than 200,000 Square Miles of country, and a population of perhaps 20 Millions of people, and terminating by the Northern Canal, at the Port of Madras, which would thus also have direct water-communication with 10 or 12 Cantonments.

COMMANDANT OF ENGINEERS' OFFICE,
FORT SAINT GEORGE,
30th March 1859.

A. COTTON, COLONEL,
Commandant of Engineers

No. 107. From Colonel C. E. FABER, Chief Engineer; to J. D. BOURDILLON, Esq., Secretary to Government, dated 2nd April 1859, No. 9244.

SIR,

I have the honor to request that, in order to dissiminate not only as widely as possible but also with the smallest sacrifice of time, the very instructive and suggestive paper recently laid before Government by the Commandant of Engineers, Colonel A. T. Cotton, I may be permitted to have printed under my own eye in a pamphlet form, for departmental general circulation, an edition of 300 Copies of the "Memorandum on the Repair of the Pennair Annicut at Nellore," dated the 30th March 1859.

No. 108. ORDER THEREON, No. 982; dated 28th April 1859.

The Governor in Council approves and sanctions the measures detailed in paras. 9 to 15 of Colonel Cotton's Report for restoring the Annicut and securing and rendering efficient the Sarvapilly Channel. And he empowers the Collector of Nellore to advance to Captain Mullins the funds proposed to be expended during the current working season, amounting to Rupees 38,000; viz. 28,000 Rupees for the Annicut, (para. 13) and 10,000 for the Channel, (para. 15) should it be found expedient, eventually, to undertake more work this season than Colonel Cotton now proposes, the Government will be fully prepared to authorize a further advance.

2. Colonel Cotton's observations on the probable future returns from the Annicut, paras. 16 to 21 and the Collector's letter on the same subject, fully prove that there is no doubt that the Returns from the Annicut will be amply remunerative to Government as well as abundant to the Ryots; and Colonel Cotton's remarks in para. 22 leave as little room for doubt respecting the future stability of the Annicut, notwithstanding the two unfortunate disasters which have befallen it.

3. The remainder of Colonel Cotton's valuable Report paras. 23 to the end, treating of the Navigation to be secured by means of the Annicut Canals, and of the eventual connection of this Navigation with the upper Kistnah as well as with the Canals of the Kistnah and Godavery Deltas, well deserves the attentive perusal of all members of the Public Works Department as does also para. 22 which treats of the causes of the twice repeated failure of this Annicut, and of the means of preventing such accidents hereafter. The second and third articles in para. 22 should be borne in mind by the Chief Engineer in future similar projects; and it will be his duty with reference to article third, to watch carefully the progress of this Annicut during the current season.

4. Ordered to be communicated to the Board of Revenue, the Chief Engineer, the Accountant General and the Civil Auditor. The Chief Engineer will circulate the papers to the Officers of his Department.

(Signed) J. D. BOURDILLON,
Secretary to Government.

Fort St. George 1859 Dept.
Dy. A. Genl. 29 April

No. 982.

Inland Frontier Genl.

Read 28 April 59.

Ge. II — Sands 11 to 15 inc.
Col. E. Cotton's Memo.
Commd. 1859.

Comdt. of Engineers Office

No. 140.—

From,

The Commandant of Engineers

To,

J. D. Bourdillon Esqre
Secretary to Govt. D. P. W.
Fort Saint George.—

Sir,

I have the honor to transmit a Memorandum on the Repairs of the Pumair Anicut at Nellore with certain suggestions thereon for the consideration of Government.—

I have the honor to be,
Sir,
Your most obedient Servt.

Fort Saint George
31st March 1859

R. Cotton. Colonel
Comdt. of Engineers

The reasons for restoring the Channels, Sluices and securing the Upstream Apron of the Sarapilly Anicut, appear to me sufficient to justify the Estimate of Rupees 8,000 for which I have sanctioned drawing the amount, provided Government shall sanction the advance of Rupees 8,000 for the purpose.

Fort 15. 1. 15

Cons: 15th March 1859 No 127-128

Copy in a letter to C
d/ 23rd Nov: 1859 - No 68

Ord: Works 1859 Desp:
Do to Cons: 29th April
No 786

From
Capt: A. Cotton
Comdt: of Engineers

To
J. D. Bourdillon Esq:
Sec: to Govt
P. W. D.

Dated 31st March 1859
Rec: April 1
From Mr. Chief Engr Dy 2 Apl 59
No: 140 & No 793
Enclosed Cons:

Transmits a Memo
on the repairs of the
Pamaiv Anicut at
Nellore with certain
suggestions -

S.E. No: 982. 28th April 59

Copy in Mr Secy: & Bd
of Rev - 28 April
1859 -

No 106

15th April R 21st

Quittance
Collecteur Office
28th March 1859.

No 9.

Lieut. H.B.M. Civil Service
Collector of Kottah
To H.C. Bandillon Esqre
Secretary to Government
&c &c &c

Sir,

I have the honor to submit for the requisition of the Board of Revenue a Statement of the Amount of Outstandings in Kottah under date the 7th March 1859, and to solicit the Orders of the Board regarding the Amount of the Outstandings in question.

2. For the last Settlement of Kottah which was concluded in 1855, and was only completed in 1858, two Additional Camoolo Kauls were formed, while the Settlement of the Camoolo one only. The Settlement Roll of which is under distribution.

3. There are 21 Villages imparted by the Settlement Roll Camoolo and up to the present time it is

Fasc. Coll. Kottah No 31
Imacd 59 C. No 786 Cons.

Collection arrêtée le
31 Mars 1859 Jan. 57. 12 8

Pub. Note 1859 respectueuse
No 46 Cons 29 Apl.
Rs 793.

Pour Copie Conforme

Le Chef Secrétaire

Pub. 2d
Cons 2
No 9244

Pub 1859.

Officiers soussignés, membres du Gouvernement susdit, ont été convoqués en Conseil le 29 Avril 1859 en vertu d'un Ordre du Gouverneur en date du même jour.

Sd/ 2982, 28 Apl 1859

No 10 Jo

C 15 Cl Cal

from these alone that any increase of Cultivation from the Anicut can be looked for - The best lands cultivated in these Villages were given in the accompanying Statements at Rs. 4 for 5 years previous to the creation of the Anicut, & for the 4 years, including the current Fasly, since it was finished.

4. During the short interval that has elapsed since the completion of the Anicut it has been twice breached, & the repairs have never been completed since it was first breached in November 1857. Notwithstanding these extremely unfavorable & exceptional circumstances the increase of Cultivation has been considerable, except in Fasly 1267, when not only was the Anicut seriously injured, but the Tanks supplying by the Jaffer Saib Chanal were extensively breached by a hurricane of extreme violence, which visited the District at that time. The Revenue also fell from the reduction of assessment carried out during that year, which under such unfavorable circumstances could not be made up.

5. The increase in Fasly 1266 over the average of the previous 5 years, excluding Fasly 1263 a year of drought, was Rupees 1632, & the increase in the present year, after the reduction of assessment, is Rupees 1059, with the Anicut still unrepaired. It is difficult to say how far these results are attributable to the Anicut, & how far to the stimulus that has been given by high prices of Agricultural

source, & reduction of assessment.

6. As regards the Revenue results to be anticipated in future on the reconstruction of the Anicut, & the formation of the subsidiary channels alleged to forward his statements marking Nos 2 & 3.

No 2 shows the increase of cultivation that may be effected with the present resources of the District, & the ordinary supply of water in the Pennair River: the anticipated increase of Revenue is in round numbers Rupees 24000, which being added to Rupees 10591, the increase already obtained, makes a total of Rupees 34591.

Statement No 3 shows the entire cultivable area of the Government lands South of the Pennair, within the Ramsamoo river, capable of being irrigated by the Anicut & subsidiary Channels, provided the water supply is sufficient. This however it is not anticipated would be the case, unless the project of turning the Toombodra or Kistnah water by the Hondaur into the Pennair, now under Colonel Cotton's consideration, in connection with the Madras Irrigation Company is carried out. The Pennair not having its sources in the Western Ghauts, is at present imperfectly supplied with water during the South West Monsoon.

7. Besides this however some period should be allowed for procuring stock to cultivate the additional lands, & every facility should be given to others besides the Ryots of the Villages to take up the new lands, in cases where the latter may not at once be able to do so.

8. On these conditions the anticipated increase amounts to Rupees 70,000 in round Numbers,

as

as shown in the Margin. It is also very probable that some of the Cultivated & Dry lands may be irrigated, but on the other hand some portion of the total Wet area may be left uncultivated, Especially those lands situated in the beds of Lanka.

Total Wet area (Vide Statement No 8)	Ac. 73,503
Average Wet cultivation	50,083
Difference	23420.
Reduced Estimated Wet area	12774
Remainder	10646.

I have the honour to be,
Sir,
Your most Obedt Servt
J. Allen
Collector

Cons: 8 March 59 N° 7 & 8.

Copy and a letter to C
of 15 Sept. and 15 Oct. 58

N° 105.

C 15 April R 21st

1859 N° 10 Secret
1857
From the Collector
of Vellore
To the Secretary
to Government
Fort St. George
Dated 28th Feb. 1859.
Rec'd 31st
A. C.
3 Enclosures.
No. 9.
Reporting on the
Revenue results
of cash and future
of the Amair Circuit.
Sec. No. 982. 28th April 59.

Statement shewing the extent & Quantity of the Villages which can receive sufficient water supply & insufficient.

	21 Villages under present Channel		3 Villages to which it has been extended		7 Villages under the proposed Kiris Nagapattinam branch	
	Acres	Cts	Acres	Cts	Acres	Cts
Total Area	51304		3428		15840	
Deduct						
Inams	9031		397		2537	
Sites of Village Tanks & Topes	7006		556		1081	
Uncultivable lands being Carriage	6367		375		6119	
Total	22604		1328		9737	
Remainder	28700		2100		6103	
Of which unassessed Pialam lands	6847		253		2731	
Assessed						
Dry	3797	5719	551	1009	688	1012
Wet	17372	102906	1141	6805	2350	13703
Garden	654	8678	125	1420	334	2399
Total	21853	117303	1847	9234	3372	17114
Of which under occupation on Fusly 1261						
Dry						
Wet	1928	2860	306	495	344	520
Garden	13954	80785	850	5108	1847	10435
	453	4832	72	864	96	920
Total	16335	88477	1228	6467	2287	11875
Under Cultivation on Fusly 1261						
Dry						
Wet	1753	2563	297	479	322	492
Garden	10816	61578	765	4463	1559	9058
	431	4399	69	772	87	854
Total	13000	68540	1131	5914	1968	10404
Average Cultivation of 5 Fusles 1259 & 1264 inclusive & Fusly 1263						
Dry						
Wet	1637	2577	238	382	297	463
Garden	9900	56582	709	4283	1250	7530
	403	3951	66	693	81	758
Total	11940	63110	1013	5358	1628	8751

Comp[d] Wm Ware
Asst

Examined
Collectors Office
28th March 1871

No 3

brought under the influence of the Bonnar Anicut provided the

	4 Villages of the present Channel		5 Villages to which it was proposed to be extended		Total		Remarks.
	Acres	Cts	Acres	Cts	Acres	Cts	
Total Area	23159		20275		114006		
Deduct							
Inams	4603		2062		18630		
Sites of Village Tanks & Topes	2078		3047		13768		
Uncultivable lands being Carriage	5766		9097		27924		
Total	12447		14206		60322		
Remainder	10712		6069		53684		
Of which unassessed Pialam lands	4681		1869		16381		
Assessed							
Dry	831	1822	903	2315	6800	11877	
Wet	5053	30934	3135	19155	29051	173503	
Garden	147	2293	162	2029	1452	16819	
Total	6031	35049	4200	23499	37303	202199	
Of which under occupation on Fusly 1261							
Dry	66	143	234	628	2878	4646	
Wet	3003	16184	2522	14519	22176	127031	
Garden	97	1287	87	828	805	8731	
Total	3166	17614	2843	15975	25859	140408	
Under Cultivation on Fusly 1261							
Dry	63	140	231	612	2666	4286	
Wet	2575	13406	1968	11280	17683	99985	
Garden	97	1274	85	799	769	8098	
	2735	14820	2284	12691	21118	112369	
Average Cultivation of 5 Fusles 1259 & 1264 inclusive & Fusly 1263							
Dry	87	146	203	527	2462	4095	
Wet	2403	12679	1525	9009	15787	90683	
Garden	91	1112	81	752	722	7266	
	2581	13937	1809	10288	18971	101444	

Collector

Copy in a letter to G
dt 23rd Nov 1859 No 68

1859 Department

In a letter from the
Collector of Tellore
dated 28th March 1859
No 9.

00675/59

No 3

Statement shewing the
entire Ryacut Nos of the
Villages which can be
brought under the influence
of the Pennar Annicut &
provided the water supply
is sufficient.-

Statement of the increase of Revenue Expected from the Extension of the irrigation from the Periar Channel in the District of Madura

Taluks	Villages	Nanjah Wet land		Punjah		Average Cultivation		Expected increase from Punjah Lands		Annual increase from Nanjah Lands		Garden Lands		Total		Produce expected annually	Remarks.
		Extent	Expected annual	Extent	Expected annual	Extent	Expected annual	Extent	Expected annual	Extent	Expected annual	Extent	Expected annual	Extent	Expected annual		
	4 Villages under the present Periyar Vaigai channel	Cents	Grs	Cents	Grs	Acres	Grs	Acres	Grs	Acres	Grs	Acres	Grs	Acres	Grs	Grs	
Tirumangalam	1 Tirumangalam	1088	18547	618	8435	404	5294	197	2412	90	1638	"	"	282	4050	3850	
	2 Kanadukathy	228	3889	111	2557	74	1760	37	897	21	367	25	490	83	1754	1481	
	3 Kannadiankam	333	6807	246	4467	139	2440	107	2027	23	507	"	"	130	2834	2157	
	4 Kunnathur	140	2330	85	1552	62	1189	23	393	"	"	"	"	23	393	337	
	Total	1789	33398	1090	17011	679	10683	357	5829	134	2612	25	490	518	8731	7825	
	7 Villages under the proposed Kulnapalam branch																
	1 Kulnapalam	113	2602	33	651	20	396	13	255	10	180	10	257	33	692	552	
	2 Odaipatti	183	2338	127	1886	74	1103	53	653	21	353	"	"	74	1006	821	
	3 Vilampoovanum	99	1835	90	1680	70	1355	20	325	18	287	23	414	61	1026	858	
	4 Kilakudi	95	2183	77	1914	61	1592	16	323	12	218	9	236	37	777	611	
	5 Koodakoor	95	2183	77	1914	61	1592	16	323	41	689	20	265	94	1510	1299	
	6 Pullikoor	140	2468	98	1775	65	1219	33	556	13	220	38	532	104	1601	1458	
	7 Kongapatti	162	2602	118	2402	95	1585	53	849	5	58	14	46	17	196	173	
	Total	21	246	17	188	9	95	8	92								
	5 Villages to which the Tirumangalam channel was proposed to be extended	783	14274	570	10466	394	7413	196	3383	120	2005	104	1750	420	6808	5772	
	1 Kappur	592	10150	397	6930	300	4967	97	2963	195	3920	30	690	322	5873	4905	
	2 Kandagandy	719	3978	122	1974	55	960	67	1014	54	1031	"	"	121	2045	1780	
	3 Kakkalapatti	22	185	22	185	5	30	17	135	"	"	"	"	17	135	127	
	4 Kandy-pandy	119	3264	63	1550	32	858	31	692	56	1714	30	900	117	3306	2644	
	5 Government land	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	
	Total	952	17577	604	9939	392	6855	212	3104	305	6665	60	1590	577	11859	9426	
	3 Villages to which the proposed Channel should be extended																
Tirumangalam	1 Conde Kilapatti	99	1876	42	729	31	536	11	189	28	586	"	"	39	775	675	
	2 Portion of Koolamam	31	623	26	601	19	456	7	146	4	40	6	130	17	316	270	
										"	"	39	572	50	731	631	
Melur	3 Kadamoody	76	1015	69	923	58	766	11	159	"	"	"	"	"	"	"	
	Total	206	3514	137	2253	108	1761	29	494	32	626	45	702	106	1822	1582	
	Grand Total	3730	68365	2491	39677	1873	28662	796	12280	591	11908	234	4832	1621	28720	24405	

The Objects of this Village have not engaged for any increase of Cultivation.

The Proposed Assessment for these three Villages is to be made only by the Accountant not being at hand

The Objects of this Village have not engaged for any increase of Cultivation.

Madura
Collectors Office
28th March 1859

Collector

No 1

Statement shewing the increase of wet cultivation in the 21 Villages irrigated by the Jaffer Saheb Channel from the Pennar Annicut - Nellore District.

Wet cultivation before the construction of the annicut inclusive of waste Charged			Do subsequent to the construction of the Annicut			Comparison between Columns 5 & 6 & the average in Columns 2 & 3		Remarks.
Fusles	Extent	Assessment	Fusles	Extent	Assessment	Extent	Assessment	
1	2	3	4	5	6	7	8	9
	Acres.	Rupees		Acres.	Rupees	Acres	&c	
1260	10,747	62,820	1265	11,172	64,015	+1,475	+8,773	
1261	10,816	61,459	1266	12,533	71,569	+2856	+16,327	The amount of Assessment given in Column 6 is after the reduction of the Assessment amounting for Fusly 1267 to Rupees 7149, and for Fusly 1268 to Rupees 7496-
1262	10,074	56,189	1267	10,170	49,383	+ 473	-5,859	
1263	5,994	34,612	1268	13,619	65,833	+3922	+10,591	
1264	7,150	40,499						
Average exclusive of 1263 Fusly:-	9,697	55,242						

Nellore
Collectors Office
28th March 1859

W. Elliott
Collector

Compd
Thos Wards
Dt Accot

Collectors Letter to Board of Revenue dated 28th March 1859

1859 Department

From W. Elliott Esqr Collector of Nellore dated 28th March 1859 No 9.

Received 5th April 59

No 2

Statement shewing the increase of wet cultivation in the 21 Villages irrigated by the Jaffer Saheb Channel from the Pennar Anicut in the Nellore District.

Memorandum on the Report of the Commissioner
Annicut at Nellore, by Colonel A. Cotton.

No. 592
dated 15th March
1859.

Submitting to the orders of Government
Minutes of Council 23rd ultimo
proceedings of the Council in Department
Proceedings under the Collector
Report, with 2 enclosures, on the
the Commissioner's Conference
from Captain Williams and Mr Elton,
and examination of the Localities
more advantageous Anicut
proposed by Captain Price
Anicut to Chain Annicut
and Estimate for the
Annicut to Chain Annicut
one to Trust Funds
other to Revenue
Anicut to Chain Annicut
of the Revenue and Irrigation
Annicut to Chain Annicut
Irrigation on the Pennar
Received and communicated
Anicut to Chain Annicut
Irrigation on the Pennar
Commissioner of the Pennar
Anicut to Chain Annicut
Irrigation on the Pennar
Anicut to Chain Annicut
Irrigation on the Pennar

Copy of a Letter to Govt
dated 28th March 1859 No 3

1859 Department

In a letter from the
Collector of Nellore
dated 28th March 1859
No. 9.

0075/09

No. 1

Statement shewing the
increase of Wet cultivation
in the 21 Villages irrigated
by the Jaffer Saheb
Channel from the Pennar
Anicut Nellore
District.

him to make out the Estimates &c.

Before leaving I saw 250 Coolies including boys at work, and the embankment nearly covered across the Channel of the river. Some progress had also been made in excavating on the line of the front retaining wall.

On the 17th I left Nellore, and leaving Dongorunzapatnam on the 18th, was tracked to Madras against the S.W. wind in 27 hours, a distance of 70 miles. I may also mention that in the Dongorunzapatnam Canal, I saw 48 Boats averaging about 25 tons or in all 1200 tons of boats. This is sufficient to show the value of this work, if the boats remain on an average even 6 days in the Canal this is equivalent to a traffick of 200 tons a day.

If this is the case now that the Canal ends as it were in a plain, for there is not even a Bandy road from Dongorunzapatnam to the Northern road, we may be certain that the traffick will be very extensive when the present Canal is connected with that from the Nellore Anicuts and a complete water

2

water transit is established terminating in the Northern road at 108 miles from Madras, producing a saving as compared with the land carriage of 10 Rs. a ton, besides the enormous pressure traffick which there would be.

Anicut Works.

I found the anicut in the state in which it had been left by the freshe. About ⅓ of its length, with the two end ends of Undersluices, the wingwalls, and the Head-sluices of Pulicat Channel, was uninjured. Of the remainder not much was visible; most being covered with sand; the central undersluices were visible partially destroyed, and broken into large masses thro' the stone showing the goodness of the masonry.

On pricking the line of the front retaining wall, no stone could be felt at 6 or 8 feet depth, for a distance

2

of about 80 yards where the breach first occurred, and where consequently the Canal was probably formed out to a great depth. On the remaining 250 yards we found stone at a foot or two deep in several places, so that probably the foundations have not been destroyed all along that part. As about 40,000 tons of stone have been used on this work, we may expect to find that excepting at the 80 yards of breach, there is now substantial foundation for a new superstructure.

The Railway I found in excellent order from the river bank to the Quarry; a substantial road of bridge rails very much superior to the Dunkirkhamerman railways. There are 22 waggons capable of carrying 4 or 5 tons each, and 2 good cranes for 1½ tons. A large 5 ton Crane, lately sent out is found useless, first, it has not been put together and the parts did not suit.

The Quarry is of the very best description, the stone being in ample quantities, in moderate sized masses, and capable of being reduced into blocks of one or two tons by fire at a small expence, breaking into rhomboidal pieces of the best form for packing close.

Respecting the measures to be pursued, I think there can be no question about the present site, were it only on account of the great portion of the work remaining. But I think also that this was the correct site originally. It is certainly a very narrow part of the river and therefore the work is exposed to a very great force of water, but there being an ample supply of the best stone at hand, which can be applied at a very low cost, a work can be constructed here to resist the water at no excessive expence. The case is thus similar to that of the Rhetnah. The site is also objectionable on account of the bend immediately above; the consequent oblique action of the current must be counteracted by stone groynes run out from the summit both above and below. I consider the advantages of the site greatly counterbalance these disadvantages.

The first breach I have no doubt was owing to the mass of stone being insufficient. The curtine stones also were not of sufficient size or adequately packed but I believe that no difference

in

in this respect would have saved the work, but that from want of breadth the bed of the river below was scoured out to such a depth, that the work was swallowed up.

I calculate from the slope of the river 3 feet a mile, the depth of water 14 feet in the Channel below the work, the narrowness of the river at that point, 500 Yards, about half of the average width and $\frac{1}{5}$ of the greatest; and the height of the Anicut 9 feet is nearly $\frac{2}{3}$ of the natural depth of water in a high freshe, the velocity of water over the work would be at most times 11 or 12 miles an hour, much more than that over the Godavery Anicut at any time, and nearly as much as that over the Kistnah, the latter is 66 Yards broad, while this work was only 30 Yards. — There is no doubt that a work at this site required nearly as much mass and cost as that at Bezwarah.

The second virgin was no doubt immediately owing to the work being quite in an unfinished state, but I also consider that the breadth of the work was insufficient.

41x

I do not conceive in the change of section from the original mass of rough stone with one slope, to a series of vertical falls with Cataracts aprons: The complete success of the Kistnah works has decided me in favour of large masses of loose stone wherever it can be obtained cheaply. And where a vertical fall is used I would have the whole fall in one, but there must then be a very strong apron of large stones, like the Pallaveram Anicut near Madras. — With a succession of falls the water in high freshes has a slope and is delivered with almost its full force on the bed of the river below. I speak of course of these rivers with sandy beds. — Allowing the section that was given or indeed any other, I consider the great mistake was attempting to make the work of the full height in that season. — If the Anicut had been left of $\frac{1}{2}$ or $\frac{2}{3}$ the full height, the power of the water would have been very much less, and there would have been ample time to complete what was to be done. Had it been left 4½ or 6 feet high, it would have been fully effective that year, and the work might then have

have been completed at Leidure the following season.

What I now therefore propose is 1st That the work be constructed of rough stone with a breadth of 60 yards, and the former height 3 yards, 2nd that it be left only 1½ yards high this year, with a breadth of not less than 30 yards, but more if the stone can be brought; 3rd That it should have a front retaining wall, and also a line of wall in the slope to help to secure the packed stone on the upper part of the slope of the work. So far as I could judge at the time, there seemed no reason to doubt that this amount of work can be easily executed this year. But some additional waggons and a more [illegible] should be added as soon as possible. I find there are three good [illegible] which should be sent immediately.

It must be observed that the laterite masonry of the part of the Anicut that was not breached, has remained quite uninjured tho' composed in my opinion of much too small stones. The Cement will now be well set, and as the principal part of the Anicut will be left low, I think this part may be left as it is this year.

Next year I would cover it all, excepting just the upper surface, with rough stone so as to make it uniform with the rest.

The two end sets of under-

sluices have been placed at some distance from the Wing walls. I do not know what was the reason of this. From both the Pavlaicheveram and Rezgaiah Works, it seems to me established that they ought to be placed close to the Wing wall, in order to scour the bed of the River as near the Head Sluices as possible. I would therefore add two new sets of Under-sluices next year adjoining the Wing walls, raising the masonry over them, so as to allow of their being opened and shut when the River is in freshes. I would leave the present Undersluices. I do not see any use in the centre ones and would not restore them. I would add the two Pass as before, so as to allow of the River being raised to 2'6 feet above the Anicut.

The main points are to give the works sufficient breadth, (I propose 60 Yards of slope, with 20 yards of level about 1 Yard thick) and to have the upper part of the slope, where the great power of the water is, formed of large stones carefully packed, and wedged with small stones driven hard into the interstices, and concrete poured in wherever it will enter.

Captain Mullins estimates that the rough stone can be placed in the work at 8 annas a Saw or 10 Annas per Cubic ft of rough stone work; at this rate a Mass of 500×420½×60 = 6750000 Cyft would cost 42,000 Rupees and the bed could be covered [illegible] with stone to the depth of a yard 20 Yds broader

20×1×500 = 10,000 Cubic ft for 8000 Rupies, which would certainly be a great additional security — This will show what great mass may be given to these rough Stone Aunicuts, without an excessive expense, or rather considering the enormous value of such works, at a cost quite insignificant — I think our mistake every where hitherto has been in being too sparing of so very cheap a Material —

I have requested Captain Mullins to prepare Plans and Estimates upon these principles.

My rough Estimate of the work for the present year is:

Masonry 350 Gds × 3½ × 1½ = 2,000 C. yds at 3½ Rupees		7,000
Rough Stone 500 × 2½ ∩ 1 × 30 = 26,000 at 10 Annas		16,000
Additional Waggons, Crane & Sundries		5,000
	Rupees	28,000

And for next year —

Masonry 350 × 1½ × 1⅔ = 875 C. yds at 3½ =		2,000
500 × 3 × 1 = 1500 at 3½ =		5,000
Roughstone 500 × 60 × ½ ∩ 1 = 37500		30,000
500 × 20 × 1 = 10000		
47500		
2 Sets of Underslinces		10,000
Sundries		5000
Total		52,000

Probably this sum would complete the work —

I would however press on the Stone work, and if possible have it more than 30 yards broad this year —

By working the Railway at night which was done very successfully at Dowlaith weram a large additional quantity of Stone could be deposited.

The next point is the arrangement about the Surrapilly Channel. This appears to me a very simple question —

1st — It must have a head Sluice; the destruction without it is intolerable —

2nd — The present head is, as has been shown in other papers in a very bad position, and it is very desirable on many accounts to close it —

3rd — The water for it can be admitted by the Aunicut Head Sluice.

The only objection which seems to have been supposed to exist to, was the cost of connecting the two Channels, but there has been a complete mistake about this, inconsequence of the cost of the Channel necessary for conveying water to the Surrapilly Channel being mixed up with that forming the head of the Kistnapatam Channel and also with that for conveying water to a much extended cultivation on the line of the Surrapilly Channel

A Channel must be cut from the Jaffer Saheb Channel towards Kistnapatam, and for some distance it will only be necessary to widen this; after which a seperate Channel must be cut to the Surrapilly

Annicut. — A sum of 10,000 Rupees might be allowed this season for this Cut. —

The present Head of the Servapilly Channel is situated at the bottom of a deep bight from which the water is drawn very obliquely on the Annicut, which was one of the objections to the Site. When the Head is closed, by the formation of one or two Groynes above, this bight may be in a great measure silted up, which will be an advantage. —

The next point is the extent of irrigation and probable returns from the Annicut. —

The total cost of the work including the present Estimate will have been

1st Estimate	. .	1,17,000
2nd . . Do	. .	64,000
3rd . . Do	. .	80,000
		2,61,000

Respecting this cost I may state that the cost of the Godavery Annicut may be taken at 9 Lacs including additions for 4000 Yards of clear water way. or 225 Rupees per Yard of length, for a wider part of the River and consequently small force of water. — The Kistnah 7½ Lacs per 1,200 Yards or 625 Rupees per Yard, for a very narrow part of

Servapilly Channel. — But the present cultivation under the latter is so small only 2000 Acres, that a stream 1 Yard broad and 1½ deep will be sufficient. so that the amount of excavation actually required for it is very trifling and will not cost more than 3000 Rupees including the lengthening of two Bridges. — A new Head Sluice would cost as much as this. — It is evident that the enlarging the whole line of Channel so as to provide for extended cultivation is a separate question.

I would therefore certainly close the present Head of the Servapilly Channel and make a cut connecting it with the Jaffer Lahib Channel. the present head Sluice having a great capacity, sufficient for a much larger extent of cultivation. —

The Engineer should be supplied with a sum of money to go on with this work this season, so that if at any time more Coolies come in than he can conveniently employ in the Annicut, or when there is a freshe in the River he may have work at hand ready for them.

It would of course be very desirable to get this cut opened and the old head closed this season, but it is not probable, that there will be sufficient labor for both it and the Annicut

of the River where the power of the water was enormous. This will have cost 2½ Lacs per 500 yards, or 500 Rupees a yard, where the power of the water is nearly equal to that of the Kistnah, but this work is much lower, and the side of the River much less. — There are also no Locks included in the above sum and only one Head Sluice. The cost will however after all not be so very great in proportion, if the present estimated sum is sufficient. —

The extent of Country commanded by this work (to the height of 36 ft. above the sea) is so great, that there cannot possibly be any question about there being ample returns if the necessary Channels are cut. The Collector considers that irrigated land here pays easily 6 Rupees an Acre, or at least 4 Rupees for the water, so that 10 per Cent in the Capital would require about 6000 Acres to be newly irrigated, about 15 sq. Miles of the Country an extent quite trifling compared with that to which the water could be led. — Only as far as Goodoor, 28 miles S. of Nellore, includes an area of probably not less than 250 sq. Miles irrigable, which is only the South side of the River. —

The Collector gives me a return of only 16 Villages, in which the averaged wet cultivation last

has been 19,500 Rupees and Ayacut wet only is 41,000 leaving 21,000 Rupees, besides all the dry land that could be irrigated. And of this, 1600 Rupees is engaged to be taken up if the Annicut water is led to it, which alone would be 6 per Cent in the cost of the Annicut —

In another Statement 40 Villages are included, in which 21,000 Acres are given as dry or uncultivated wet land, which at 4 Rupees an Acre would yield 84,000 Rupees, 30 per Cent on the cost of the Annicut. —

There can thus be no question about there being ample land fit for irrigation, commanded by the Annicut. —

With respect to the preparedness of the people to make use of the water, the Collector gives a most satisfactory account of the District — since the lowering of the high Assessment, which by the testimony of several Collectors for a long series of years was as in other Districts entirely destructive of the prosperity of the District, the people have thrown off their despondency, and land is every where being taken up. — As a specimen of this he gives me a return of the collections in 21 Villages under the Jaffer Sahib Channel which for the 5 years previous to 1855, yielded on an average 50,000 Rupees, and on the average since (omitting however the year of the hurricane) 66,000 Rupees. — The Collector thinks that at the rate of 6 Rupees per Acre, the land will be eagerly taken up. —

It is quite evident then, that, having an Annicut, the project may be carried out

to

to a vast extent - The following is a rough Estimate for a certain amount of Irrigation. -

Annicut	2,60,000
Kistnapatam Channel	1,70,000
Widening Jaffer Sahibs Dr. Jaa	54,000
Labaur Branch	30,000
Odoor ... Dr	27,000
	5,41,000

This is calculated to provide for 64,000 Acres which at 4 Rupees would give 2,56,000 Rupees of Revenue, of this about 170000 Acres, is now watered, deducting which at 4 Rupees an Acre leaves 1,82,000 Rupees or 35 per Cent on the expenditure. This however includes making the Kistnapatam Channel a first rate navigation, so that about a Lac of the above would be properly chargable to navigation -

This seems quite sufficient to show that whether carried out to a larger or smaller extent, there is ample ground for concluding that the returns will as in other such cases be abundant. By the above Estimate deducting the present watered lands, but including the cost of the Navigation works, it appears that the Capital per Acre would be about 12 Rupees, and if 4 Rupees water rate is levied, this will be

33 per Cent, from which deduct about 3 per Cent for repairs. —

In fact we have many abundant and indisputable data respecting irrigation, to assure us that in all ordinary cases there can be no question about returns to Government for the Capital, as well as returns in benefits to the people. Generally we may safely reckon upon an increased value of produce of 15 Rupees per Acre and of this if the Government take 4, the people will have a gross benefit of 11; and if we take the Capital for Acre at 4 Rupees as in the Godavery Delta, or 12 as here estimated, the return to Government will be from 30 to 100 per Cent. — And past experience shews that 12 Rupees per Acre is a very high cost per Acre. — Probably on a large scale 12 Rupees per Acre would include ground country containing great Engineering difficulties - and these rates include irrigation also which alone is certainly equivalent to a benefit of 2 Rupees an Acre, where the distances to Border Markets are short, but in the interior districts it would be worth much more. — For instance taking the produce of an Acre at 2/3 ton; these would be a saving of about 8 Rupees on 100 Miles of water Carriage as in Bellore, or 32 on 400 as in the case of central districts — And this is besides the saving to the Landowners in all articles they purchase, which are brought from a distance. -

These considerations put the question of returns in a very clear point of view; it is quite certain that it can only be

had never executed any considerable work before, but had never been under an experienced Officer while constructing such a work— A young Officer may be very talented, energetic and faithfull, but it is not fair to expect of him what he might perhaps be equal to after 10 or 15 years more experience. If a district is under the charge, as several now are, of Officers quite too young and inexperienced for such an important duty, they should at least be relieved for the time, if a work of the first class is to be constructed within District, and an experienced man sent to execute it. —

4th We must not be discouraged by such occasional failures— Nothing like these works have ever been executed in other Countries or ages.* They far exceed anything in Europe, and no assistance could be obtained about them from books— They are works which the most experienced and talented Engineer of Europe would have puzzled over, and I have no doubt have spent 5 or 10 times as much on them as have been spent— Witness the Ammient on the Nile which I believe cost 1 or 2 Millions, and occupied many years. It is not so long as this Animal which including the accidents will probably not cost more than 25,000 £.

Every failure adds to our experience and makes future ones less probable—

We have now executed 7 of these great works, besides this, Viz. 2 on the Colleroon, one at the head of the Vemaur, one

* Excepting that in the Nile of late years.

be in any extraordinary case that Hydraulic works work may abound in.—

Before concluding this part of the subject I would beg to offer some remarks on the failure of this work.

1st The establishment of such a work upon the River without any thing solid for foundation is really no small matter. I have no doubt that an English Engineer would at once pronounce them impracticable, or go to an enormous expence in giving them very deep foundations.— I do confidently think that they would not have executed such works at any thing like the cost of those already executed.—

2nd In a serious work of this sort, the matter should not be left to any casual Officer sent to the District or the Circle— The Officer most approved, from his experience in such works, should always be called in— In England no great work is ever undertaken without the opinion of one of the leading men of the profession who has been much employed in that particular branch of Engineering.—

Had Captain Orr, after his experience in constructing a similar flower-ful current, been sent to project this work, I do not think any accident would have occurred, though it was certainly a remarkable thing that the work should have been tried by a Burramah in the first year, before there had been time to observe any partial defects.—

3rd With respect to the execution of such a work, I do not think it should be left to the care of a Junior Officer who not only

one

one on the Vellaur, the Pallaur, the Godavery and the Kistnah - These 8 have given us a good stock of experience, and if we only take the palpable precautions of entrusting the planning and executing of future ones to experienced and approved men, we have no reason to fear anymore failures, notwithstanding the unbalanced floods with which we have to contend in this country. —

5th In judging of the sections to be given to such a work, the following points should be compared with those in the case of works already executed.

1st Fall of river
2nd Average breadth —
3rd Breadth at Sea —
4th Depth in extraordinary floods.
5th Height of work
6th Consequent proportion of average section of river obstructed
7th Consequent current over the work
8th Position of Work, with respect to the course of the river there. that is whether the current will be perpendicular or oblique to the line of the work. —

It must be remembered that Engineers have no access to any published treatise on Dock making, as any Engineer in England has in the carrying on of the works undertaken there. —

6th By making these works of a moderate height the first year, they can be safely constructed, & this will they approach to their full height that the great force of the water will not

and

7

and in general a very low work will enable the Engineer with very trifling temporary works to obtain the full benefit of the work, so that no returns will be lost. —

7th One great point in such works is, that unlike a bridge and most Engineering works, failures are only very partial, and the repair of a breach generally costs only a small sum compared with the original expenditure. The breach in the Godavery Annicut cost about 1/20 of the work itself. —

8th Another is that they are exceedingly remunerative that, as a native of Tanjore said to me, "it would not be a very great matter if it had to be built every year." - Thus if the Godavery Annicut saves 12 Lacs of Rupees, and the increase of produce is 15 Rupees an Acre only, the results of it will be 180 Lacs a year, while the work cost 9 Lacs. —

I proceed to make some remarks on other points connected with this work.

1st On the Navigation.

It is evident that Nellore is an important point to reach in the line of the Northern Canal, it would form a good termination of it. At present it runs at nothing. — A Road has been made from the Northern Road at Gondoor to Nellore, which is 8 Miles from the head of the Canal; a very small sum would complete this, which would be a considerable point gained, as it would connect the Canal with the interior. This therefore should be done immediately at all events. —

An Estimate has been prepared and approved, for 20 Miles to Nellore passing

amounting to Rupees 140,000. This a tide water Canal like the present one. To complete the communication to Vellore would require 20 miles more for which an Estimate of 150,000 Rupees has been prepared.—

This would be an Irrigation Canal also, and would by means of Locks raise the Navigation to about 30 feet above the sea. It would irrigate at least 13,000 Acres, yielding 52,000 Rupees of Revenue, and at 15 Rupees an Acre 2 Lacs of Rupees of produce.

The completion of these two Canals is a very great object. The present traffic by the Vellore Anicut Canal, creating, and rapidly increasing. It yields to Government 33,000 Rupees a year.— There can be no doubt that if extended to a point of termination like Vellore on the Northern road the traffic would almost immediately increase to 200,000 at least besides an immense passenger Traffic.— This would be an charge of Tolls of 3 Rupees a year, and if the present Tolls of 2½ Rupees only is collected on this Canal and of 100 Miles, would be sufficient for the a Mile. And the saving to the Public would be about 10 Rupees a Ton or 62½ Lacs per Annum.—

I must however repeat here the principle which I have already laid down, that it would be better politically to have all these great highways entirely free, and to encourage the greatest possible use of them, and collect whatever is required for Government in the enhanced

for

for Irrigation, where it can be collected at the least expense with the least danger of frauds, and the least annoyance to the payers, and where there is already a set of paid agents employed.— To collect taxes in very small sums, and on things in motion, I consider contrary to two of the first principles of taxation.—

The continuation of the Canal to the Northward to meet the vast system of internal Navigation connected with the Lower Kistnah and the Godavery is evidently of incalculable National importance. It would bring the Government and the Port of Madras into direct and rapid communication with Nagpoor, and with a vast extent of Country, not less than 150,000 Square Miles, containing perhaps 15 Millions of people.— When the Kistnah high level Channel is completed it will leave only 100 Miles between those Districts and Vellore, without Canals. This work can be executed for at most 8,000 Rupees a Mile or 80 Lacs. The Canals of the Kistnah and Godavery on the high level, 30 yards broad have each 3000 Rupees.— The level of the Kistnah Anicut is 16 feet above the sea, so that there would be a fall along the Canal without Locks of 16 feet in 170 Miles, or 3 inches per Mile, which is about the fall allowed in the high level Canals already constructed.—

This Canal would of course be supplied by the Rivers it crosses in its course and irrigate a vast extent of Country. It would in fact command about 1200 Square Miles or 5 Lacs of Acres, the whole of which might be irrigated

by

by storing water in the Lines of the different Rivers crossed. —

There will be about 2000 Miles of Navigation in the Delta of the Kistnah and Godavery, and if the whole of the upper Godavery and the Tributaries are improved there will be 2500 Miles more, so that this link of 100 Miles would connect Madras, and all the South by the Southern Canal, with 4500 Miles of internal Navigation. —

To leave out so important a link as that could not be thought of. —

It must be remembered that the late Court of Directors fully recognized the project of improving the upper Godavery, and there exists no reason for doubt that it will now gradually come into use. —

Even when there no such a thing as Navigation, it is evident that the Extension of the Canal to the Northward from the Nellore Annicut and of the Kistnah Canal to the Southward more by an Canal of Irrigation must of course be carried out, for there is no reason not all now that we have by means of the Annicut obtained the command of that tract for irrigation, that the minor works necessary for that purpose, should not be granted. —

The money these required to connect the present Canal with the Heads of the Kistnah, is,

Progenauze Patam & Kistnah
Pattem Canal 20 Miles — 140,000
Venamia Patam & Nellore 20 Miles 140,000
Head of Nellore 100 Miles 700,000
Total Rupees 980,000
Probably

Probably there are few projects in India where 13 Lacs could be better expended than upon this. Besides the vast extent of Irrigation it would afford if 100,000 tons were carried along it, there would be a saving of 1½ Annas per ton per Mile, of 13 Lacs a year on goods only, besides passengers. And 100,000 tons is a very moderate Estimate for the traffic of such a line leading from the Capital to such a vast extent of Country by a line of Navigation worked at about ¼ pie a ton a Mile. — It would of course also form the best possible communication for the conveyance of troops at a rapid rate to all the Northern & North West. They could be conveyed at 10 or 15 Miles an hour and for Cheaper than by rail.

Connection of the Penaur with the Upper Kistnah

But the most important question of all perhaps of in connection with the Annicut, is that of supplying the Penaur with a more constant stream of water from the Kistnah

At present the Penaur receives first a single murderer to feed at the selfish aid of the S.W. Monsoon but as its sources do not extend much to the Westward of the Meridian of Bangalore there is scarcely any accession of water during the greater part of that Monsoon and the River is almost or quite empty generally in August and September. The great freshes come in the North East

Monsoon

Moondoo and it is there not susceptible
with water sufficiently for more than one
crop, and that one late in the year.

The Nishnah receives water before
the South West Moondoo rises in the Western
Creek in consequence of partial rains in
the neighborhood of Moondoo, so that
it already begins to rise in May and from
about the 20th of that Month, till December
there is abundance of water in it. — Its
full fresh the Nishnah has about 7/8 Millions
of Cubic yards per hour, whilst the Irrigation
under that Regnoriah Aqueduct will only
require about 1 Million or perhaps 1½ Million
of Cubic Yards. — Thus a very insignificant
rise in that River affords the latter as much
water as it now uses, and no enormous supply
is available for any new Irrigation. — It
is a remarkable fact that there is a very
low ridge only, dividing the heads of the
Nishnah, from that of the Pinnaur, a fact
however which is not singular, for it is
similar to what is found in most of the
rivers of the Peninsula a peculiar feature,
favoring in the most marked manner a com-
plete connected system of Navigation and
Irrigation, throughout the whole Country —

By Levels which have been taken
and, it appears that the water-shed of
the Nishnah and Moondaur (the N. E.
feeder of the Pinnaur) is at its lowest
point only 15 feet above the bed of the
river at Nunoor Or perhaps 20 feet above
that of the Nishnah at its confluence with
the Toombudra — By throwing an Aqueduct
therefore across the Toombudra in
the Nishnah, with only a few miles of

Canal

67.

Canal and a moderate cutting, the waters
of those rivers can be turned over the water-
shed into the Moondaur, and without any
works beyond the watershed, a constant
stream may there be kept up of any magnitude
in the Moondaur and Pinnaur for 3 or 4
Months in the year. —

By such a work alone therefore
all the present irrigated lands could be insured for
two Crops, without the tanks in which the
present Channels terminate, and all their
beds might then be cultivated. — Wells
would then be made just like Rajahmundry
it would be far better supplied with water than
Tanjore. — It must be particularly ob-
served that when once an Aqueduct is
established, it opens the way for bringing
in supplies of water from a great part
of Country, for whether it is obtained by
storing it in Tanks or by making a cut
from another river, it makes no difference
what distance it is brought, as it will
come down the Channels of the river
without any expence. — Thus also
water for the Summer supply to all
to keep the Pinnaur and all its
Channels flowing throughout the year,
might be stored in tanks wherever good
sites could be found, throughout the
Country down to the lowest Tanks. —

This cut from the Nishnah
would form part of the proposed
project of the Gladrar Irrigation (No. 1)
and would be a complete project in
itself quite independent of the other
works proposed. Of course any amount
of water could be thrown in to the Pinnaur
by

but if we suppose that 200,000 Acres were to be watered for one Crop, beginning in May, it would yield a Lack a year at 4 Rupees an Acre, and this would work probably under 10 Lacs for the turning of the water into that Tract. — If this work is executed by the Irrigation Co., of course the latter might be either deprived by the Government to supply the present Channels, and a price paid for Govern=ment to the Company per Million Cubic Yds. or the Co might distribute parts of it themselves. —

I do not go further into this matter here, as it seems only necessary to show how enormously the value of this Amicut can be increased by such means as this. —

I wish particularly to make that we form a very insufficient Estimate of the value of an Amicut, when we look upon it merely as turning the present supply of water in that particular River into the land. — It has in fact subject into our power to lay a vast extent of Country under contribution for water, and it will be very and very moderately if at all, when we have an Amicut to water both a much greater extent of country than before, and also to keep the Channels in better from the year, so as to form cattle proper Irri=gations, and also to raise all Manner of produce, including three crops watered in every Month. —

There seems now no doubt that water can be stored at little cost, at a Cost of 2½ Rupees p. Cubic Yards, and continually at much less than

situation, which would give an Interest, Repairs, &c., 1 Rupee per 30,000 Cubic yards, while at 4 Rupees per Acre or for 6000 Cubic Yards, the Government would receive 20 Rs for that quantity, and with the Number of Amicuts now existing, nothing more is wanted than to construct the channels where, so as to make such an enormous return. —

I have only to add that if the Irrigation Company carry out their pro=ject from the Coombhud, it will command the Canals from the Amicut with the whole basin of the Mootah, from near Manamboe at the source of the Tonga until Budra, to Poonah and Ahmednug=ur the source of the Mootah — Mulah and Sound, including probably 2500 Miles of River and Channel Navigation, which with that in the Basin of the Godavery, would make a total of 3000 Miles, collecting the produce from more than 200,000 of Square Miles of Country and a Population of perhaps 20 Millions of people and terminating by the Northern Canal, at the Port of Madras, which would thus also have direct water-communication with 10 or 12 Cantonments. —

Commandant of Engrs Office,
Fort Saint George,
30th March, 1859.

J. Cotton Colonel
Comdg Engineers

No. 982

Resolution of the Government of Madras

~~Extract from the Minutes of Consultation~~

Order dated the 28th April 1859

Read the following letter

From the Collector of Nellore.

(Here enter 28th December No 9)

From Colonel A Cotton
Commandant of Engineers

(Here enter 31st March 1859 No 140)

From the Chief Engineer

(Here enter 2d April 1859
No 9244.)

The Governor in Council approves and sanctions the measures detailed in Paras 9 to 15 of Colonel Cotton's report for restoring the anicut and securing and rendering efficient the Sarvapilly channel. And ~~they empower~~ He empowers the Collector of Nellore to advance to Captain

on the

to be e

Please send me a limited copy of this & for [illegible]

Copy in a letter to GG
dy 23d March 1859 No 168

Memorandum on the report of Captain Pennycuick submitting Nellore, by Colonel A. Cotton.

Mdy 7861/59.

the current working season, amounting to Rupees 38,000, viz 28,000 Rupees for the annicut, (Para 13) and 10,000 for the channel, (Para. 15) should it be found expedient, eventually, to undertake more work this season than Colonel Cotton now proposes, the Government will be fully prepared to authorize a further advance.

2. Colonel Cotton's observations on the probable future returns from the annicut, Paras 16 to 21, and the Collector's letter on the same subject,

that the Returns from the annicut will be amply remunerative to Government as well as abundant to the Ryots; and Colonel Cotton remarks in Para 22 leave as little room for doubt respecting the future stability of the annicut, notwithstanding the two unfortunate disasters which have befallen it.

3. The remainder of Colonel Cotton's valuable Report, Paras 23 to the end, treating of the navigation to be secured by means of the annicut canal, the

essential connection
of this navigation is with
the upper Kistnah
as well as with the
canals of the Kistnah
and Godavery Deltas,
will deserve the attent-
-tive perusal of all
members of the Public
Works Department.
as does also Para 22 which
treats of the causes
of the twice repeated
failure of this anni-
-cut, and of the means
of preventing such
accidents hereafter.
The second and third
articles in Para
22 should be borne
in mind by the
Chief Engineer in
[illegible] similar
[illegible] projects;

projects; and it will
be his duty with refer-
-ence to article third, to
watch carefully the
progress of this annicut
during the current season.

4. Ordered to be
communicated to the
Board of Revenue, the
Chief Engineer, the
Accountant General
and the Civil Auditor.
The Chief Engineer will
circulate the papers to
the officers of his Depart
-ment.

Cr. A. J. Cotton Esq. 28
3 = Bd. of Rev. r
10 = Ch. Engr. r
1 = Acct. Genl. r
1 Civ. Audr. r
[illegible]

105 - 9 - 108

Public Works 1859 Depttt.
Comrs 29. April

№ 982.

Extract Minutes of Comrs.
Dated 28. April 1859.

From the Chief Engr. Dated 30.
March 59. & Rec. 31st. in Comrs.

From the Chief Engr. 27th July 59.
C. No. 1981 in Comrs. 19.
Augt. & 89-85.

From Chief Engr. 19th January 60
C. No. 172. The measures for restoring
the Permanent and deepening
and rendering efficient the
Liverpool Channel, approved
and sanctioned - The Collector of
"
vance to Captain
38000 proposed
during the Current
in Comrs and
a further
Dexpedient