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MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 1270	Press ~~Mis.~~
476-477.	
Dated 24 - 4 -	1868.

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No. 476. Read the following letter from the Consulting Engineer for Irrigation and Canal Company, to the Secretary to Government, Department Public Works, dated Madras, 28th March 1868, No. 153 :—

1. In their Order of the 17th June last, No. 1,819, the Government sanctioned an advance of Rupees 60,000 for the works of the first Section Main Canal, pending the completion and submission of revised estimates, and I have now the honor to forward such estimates for the consideration of Government.

2. The previous sanctions for this section of the canal are as follow :—

Proceedings Madras Government of the 31st May	rs.
1861, No. 1,016, for earth and masonry works ...	4,60,000
Do. do. do. of the 15th April 1864, No. 1,074, for earth and masonry works ...	3,96,777
Do. do. do. of the 23rd March 1867, No. 917, for additional bridges ...	25,150
	8,81,927

The present revised estimates amount to Rupees 10,32,097, so that the further supplemental sanction asked for is Rupees 1,50,170.

3. The Agent and Manager, Madras Irrigation and Canal Company, has, with his letter No. 492, of the 10th instant, forwarded a book of cross sections of the canal, and the Chief Engineer's and Executive Engineer's reports on the estimates and works.

4. In the first place, the Chief Engineer has considered it advisable to read just the levels of the canal bed, in the manner shown in the table at the beginning of the book of cross sections, with a view to equalize the flow of water in the canal, and thus diminish the deposit of silt in the upper miles. For convenience of reference a table, showing the falls originally allowed for the several miles and those now proposed, is subjoined.

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Position.	Levels above datum according to original Sections.	Fall in each mile.	Proposed levels.	Fall in each mile.	Remarks.
Beginning of 1st mile.	32.25*	...	32.25	...	* Marked 38 on the section, but measuring 32.25 by scale.
End of 1st "	31.50	0.75	31.65	...	
Do. of 2nd "	30.50	1.00	30.75	0.60	
Do. of 3rd "	29.00	1.50	29.75	0.90	
Do. of 4th "	28.75	0.25	28.95	1.00	
Do. of 4½ "	28.58	0.33	28.65	0.80	
Do. of 5th "	28.42		28.45	0.50	
Do. of 6th "	28.25	0.17	28.20	0.25	
Do. of 7th "	27.75	0.50	27.85	0.35	
Do. of 8th "	27.42	0.33	27.55	0.30	
Do. of 9th "	26.92	0.50	27.05	0.50	
Do. of 10th "	26.67	0.25	26.80	0.25	
Do. of 11th "	26.42†	0.25	26.55	0.25	
Do. of 12th "	26.17	0.25	26.30	0.25	
Do. of 13th "	25.92	0.25	26.05	0.25	
Do. of 14th "	25.42	0.50	25.60	0.45	† Not marked in the copy in this office.
Do. of 15th "	25.01	0.41	25.20	0.40	
Do. of 16th "	24.26‡	0.75	24.80	0.40	‡ Entered at 24.29 in Chief Engineer's table. The level as originally laid out. § Do. as modified when the crossing of the Hindry was changed. Commencement of Hindry aqueduct.
Do. of 17th "	22.00	...	.....	...	
.....	22.61§	1.65	22.80	2.00	
17 miles and 387 yards	22.00	about 2.75 per mile.	Not given.		

According to the section in this office, the Chief Engineer's level for the head of the canal will agree with that originally intended. In the 4th mile there was originally a small water-spread, and the fall allowed was, therefore, small, but this part has silted up so much that it has now become necessary to give the water a higher velocity, which can be done by reducing the fall in the 1st* and 2nd* miles slightly, and that in the 3rd* mile considerably. The fall in the 5th mile is 2 to 3 inches, while in the 7th mile a reduction from 6 to 4 inches is proposed. Below the 7th mile the alterations are unimportant. I think that, on the whole, the revised levels will be an improvement on those originally put on paper, but, as it would appear, not fully adhered to in executing the works. It will, however, be seen in the sequel that the cross section of the canal has not been properly adjusted to the revised levels.

* 1st mile 0.15 of a foot.
* 2nd " 0.10
* 3rd " 0.50

5. The Chief Engineer mentions that it is not intended to put all the numerous calingulabs in working order. It has been already brought to the notice of Government that the capacity of the waste weirs of this section is out of all proportion to the extent of drainage, and it would not be worthwhile, therefore, to incur further expenditure in fitting them all with shutters, &c. The outlay incurred, or to be incurred, on the nine calingulabs of the section is Rupees 34,986, against Rupees 35,616 sanctioned; these figures show, however, that the expenditure proposed ought to have sufficed to have very nearly completed all the calingulabs, and no explanation has been given as to why the saving on the weirs left incomplete will be so small. Only on No. 9 calingulah is any further considerable expenditure proposed; on it the balance, Rupees 2,651, of the sanction is entered for work yet to be done.

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6. Taking first the earthworks in excavation and embankment, the comparative statement shows that in the first mile the estimate of 1864 allowed—

	C. Yds.	RS.
Earth and gravel	1,09,001	11,713
Rocky excavation	1,48,352	62,254
	2,57,353	73,967

the work done is—

Earth and gravel	1,80,743	23,437
Rocky excavation	1,45,812	44,049
Do. to be done	10,006	6,254
	3,36,561	73,740

These figures present considerable difficulties. The original estimate allowed cubic yards 2,91,875, and provided for a canal with a bottom width of 168 feet, and a width at water surface* of 184 feet where the sides were sloped, as

* 8 feet above bed.

was the case for 960 yards out of the mile, the rest having vertical sides. The estimate of 1864 reduced the quantities, the canal having been made of much smaller dimensions, as would appear from the cross sections; but this last estimate makes the quantities for the smaller canal very much greater than those for the larger one, and, moreover, the full depth of cutting is intended to be confined to a width of 90 feet, an arrangement not before contemplated, or of which no intimation has been given. I find that the requisite dimensions for a canal to discharge 4,00,000†

† More accurately 4,08,272.

cubic yards an hour, with a fall of 0.60 per mile, are 150 bottom width, with side slopes 1 to 1, or an equivalent cross section; and I do not think that any insufficient arrangement, such as that shown in the cross sections of this mile would appear to be, should be sanctioned, and the rather so, seeing that the quantities hewn as executed, or to be done, would more than have sufficed for the much larger canal of the original estimate.

Paragraph 5 of Chief Engineer's report.

I do not see how the alteration of levels of the canal in this mile can have increased the quantity of rock cutting, or indeed of excavation of any kind. According to the Chief Engineer's table, the bed through out has been raised, according to my table, the lower end only has been raised; whichever way the alteration has been made, the effect must be decrease of excava-

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tion. It is said, however, that the alteration has occasioned an increase of expense to the extent of Rupees (6,250—2,500) 3,750, but this increase cannot be upon the estimates based upon the longitudinal sections, for these have at no time shown the first half of the first mile of the canal on a dead level.

7. *2nd Mile.*—The quantities allowed in the present estimate are 2,50,843 cubic yards, those of the former being cubic yards 2,41,739. The difference would not require notice were it not that the cross section has been reduced. The original estimate provided cubic yards 1,64,590 of excavation, and 10,400 of embankment for a canal with a bottom width of 114½ feet, 1,440 yards of the mile having vertical sides, and 220 yards slopes of 1 to 1. The remaining 100 yards were in bank. These original figures were doubtless very roughly estimated, but at any rate those of 1864 may be presumed to have been sufficient for the full sized canal, and it is not understood how it has happened that a further increase of quantity is needed for a reduced cross section.

The canal, as proposed to be completed with the full depth excavated for a width of 90 or 91 feet only, would not, I think, be sufficiently capacious—120 feet bottom

* Discharge 4,12,444.

8. In the *3rd Mile* the comparative statements show the following particulars:—

Estimate of 1864,

	C. Yds.	RS.
Earth and gravel	...	...
Rocky excavation	...	...
	46,428	11,607
	1,52,218	48,084
Revised estimate,	1,98,646	59,691
Work done { Earth and gravel	46,681	6,469
Do. to be done { Rocky excavation	18,569	42,279
	30,729	15,360
	95,979	64,108

So far as I can judge, there is a considerable error in the statement of the quantity of rocky excavation already done. It is put at 18,569 cubic yards, but the cost being 42,279 Rupees, it seems probable that there is a mistake in quantity. The original estimate, taken in connection with the average cross section, appears to have provided for a canal 90 feet wide with vertical sides, and the quantity of earthwork allowed was cubic yards 1,44,800. That the estimate of 1864 did not intend any reduction of dimensions would seem to be evident, because the quantities were largely increased. Nevertheless, the cutting appears from the book of cross sections to have been taken out with a much smaller width than 90 feet. The actual width varies in each cross section, but the Chief Engineer (paragraph 7) says it "seems to have been constructed 65 feet wide," and "in order to prevent" the deposit of silt in the upper miles, it is now proposed to widen the Doodyalat cutting." The Executive Engineer in paragraph 4 of his report also says, "it is now proposed to make all cuttings uniformly 90 feet wide at bottom, excepting for "400 feet at the head-sluiques," as if, instead of the fact being that this was a

† The name of the village on the bank.

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minimum width in the former sanctions, it had never before been provided for any where. All this is very unsatisfactory, and not the less so that it is necessary to remove cubic yards 22,228 of spoil at a cost of Rupees 2,778-8-0, in order to allow of the widening of the cutting, whereas the sanctioned section allowed not only the full width of 90 feet for the cutting, but berms of 60 feet on each side.

The present intention seems to be to give the cutting a bottom width of 90 feet, with side slopes of 1½ to 1, and such a canal with a fall of 1 foot a mile will give a discharge of only cubic yards 3,40,907, which is very much under the 4,00,000 cubic yards required. The original cross section, with a fall of 18 inches per mile, gave a discharge of cubic yards 3,75,200, so that that also was too small, though to a less extent. Under present circumstances, as a further widening would involve the removal of more spoil, it will be necessary to make the fall greater than 1 foot a mile, and the required fall is 1 foot 4 inches a mile, which will make the discharge cubic yards 4,00,112.

9. *4th Mile.*—In this mile the quantities and amounts of earthwork in the several estimates are shown below:—

* If the banking of this estimate were corrected by the addition of ½, the figures would stand thus: Cubic yards 1,36,694, Rupees 21,816.

	C. Yds.	RS.
Original estimate	1,24,491*	20,291
1864 do. ...	1,37,163	18,893
Revised do. ...	1,21,784	20,249

The Chief Engineer's report of the 21st June 1866, paragraph 10, shows that on the 30th Sept. 1864, the accounts showed Rs. 16,790 paid for cubic yards 1,18,375, and Mr. Wilk's measurements, which were probably taken from the banks, gave cubic yards 97,503 as the quantity of work done.

The diminution of quantity in the last estimate appears to be due to a reduction of the cross section of the canal. The cutting for the first 4,200 yards of the mile is everywhere very small, and for only a few yards does it

exceed the depth—eight feet—of the water. The original width allowed for the cutting was 129 feet, with vertical sides against 90 feet, with slopes of 1½ to 1 allowed in the revised estimate; the fall originally was 0'25 feet, or 3 inches a mile, instead of 0'80, or 9½ inches, proposed by the Chief Engineer. This latter fall, however, would not give nearly the required discharge, and the 3rd mile will absorb 0'33 out of the 0'80, leaving 0'47 available, which may perhaps be increased by adjustment, to 0'50 or 6 inches; and, for this inclination, the bottom width of the cutting, where its depth is equal, or nearly equal to that of the water, must be 160 feet, instead of 90 feet, and it will be hardly worthwhile to make the rest of the cutting different, except where it has to be joined on to cross sections of another form.

10. *5th Mile.*—The figures given in the comparative statement for earthworks are as follow:—

	C. Yds.	RS.
Estimate of 1864—Embankment, earth	83,335	11,762
Revised estimate do. ...	65,864	8,592
Rocky excavation... ..	62,984	14,700
	1,28,848	23,292

The provision in the original estimate must also be considered, but, to the quantity there allowed for banking, one-fourth should be added to compensate for a deduction of one-fifth of the total of the measurements of embankments very erroneously made, under the idea that there would be such a difference between the volume occupied by the earth before and after excavation:—

Original Estimate—	C. yds.	Rs.
embanking	42,343½	5,293
Add one-fourth	10,585½	1,324
Rocky excavation	7,500	1,406
	2,667½	500
Quantity required for original design	63,096	8,523

The Chief Engineer's present report does not say much on the subject of the great increase shown. He, however, speaks of the intention to widen the cuttings to a "uniform bottom of 90 feet" at the parts where the out-spreads "had been reckoned on as water-way." This and some strengthening, I understand him to say, will absorb the greater part of the cubic yards 29,808 of rocky excavation remaining to be done. In forwarding, however, in 1866 the revised estimates of the second and third sections, Mr. Latham illustrated the circumstances, which he supposed had caused discrepancies there, by the facts ascertained when an examination was made of the first section by Mr. Wilks in 1864, and I subjoin the part of the Chief Engineer's report* which refers to the mile under notice:—

* Dated 21st June 1866, paragraphs 2 to 9.

"2. Some miles of the first section were carefully measured by Mr. Wilks, Assistant Engineer, in 1864, and as the measurements for payment of that section are very clear, I will, once for all, illustrate the method of constructing the banks, and of measuring them for payment, and the apparent discrepancies to which this method has given rise.

"3. On September 30th, 1864, the position of the 5th mile was as follows:—

	C. yds.	Rs.	A.	P.	Cubic yards average rate per Rupee.
"Earthwork, original estimate	52,510	7,199	3	2	7.3
"Do. revised estimate	87,335	11,762	2	3	7.4
"Do. done up to September 30th 1864	96,092	13,689	0	0	7.0
"Do. done by Mr. Wilks' measurement, 33,000 cubic yards less, indicating an over-measurement of 52 per cent., and a total standing of only 63,082.					
"4. The Range ledger of monthly payments in each mile is very clear. And the detail final measurement of the cuttings and pits was made on the 21st March 1862, and lies before me in detail. It shows them measured:—					
11,200 cubic yards at 3 Annas					2,100
50,344 " at 2 " "					6,293
61,544 " " " "					
"N. B.—1,000 cubic yards of cutting yet undone and the slopes, a part of bund near calin-gulah, rock cutting behind sluice, &c., altogether amounting to 3,376 cubic yards, for Rupees 490 still required.					
"5. The Range Officer's (Mr. Lowe) Mile ledger for April 1862 shows 58,366 cubic yards actually paid upon, and Rupees 6,879 paid subsequent to that; the excavation for sluice No. 1 was paid for in May, 4,238 cubic yards were transferred from the two Annas to the three Annas rate, and 594 cubic yards additional paid for in August, 560 cubic yards in September, and so on till when all these bits, deducted from the full measurement of March 1862, were completed, the Mile ledger for March 1863 shows the last payment of Rupees 15, viz.:—					
Excavation and earth 50,868 cubic yards at 2 Annas		6,358	8	0	
"Do. rocky 11,280 " at 3 " "		2,115	0	0	
"March 18th paid 80 " " "		15	0	0	
		62,228			
"The first two items are brought forward from February. This gives a total of 62,228 cubic yards for Rupees 8,488-8-0, averaging 7.4 cubic yards a Rupee.		8,488	8	0	

"6. Now, in the first estimate one-fifth of the contents of the banks was deducted, on the supposition that the earth from pits would expand a quarter when excavated and thrown into bank. In the final measurement the cutting and pits are measured, but the bank was only made up to the estimated section. After the admission of water, therefore, the banks would naturally turn out to be one-fifth too low, and a quarter as much again would need to be added. I distinctly remember that this bank was very much cut up for want of revetment, faces 5 feet vertical being washed in it.

"7. In making up the bank Rupees 5,201-8-0 were paid for 32,884 cubic yards, at an average rate of six and a quarter cubic yards a rupee. Since the cutting was full of water, and the bank irregular, and still affected by the water, when repairs commenced, no final measurement could be taken. The difficulty of finding the original surface of the ground in 1864, when Mr. Wilks measured it, may be readily believed.

"8. Here then we have the following:—

* Probably rough.

† The average area of sections of bank was taken for this estimate as the same as the section at the average height, of course too small.

"(1.) An original estimate based on sections* of the surface of the ground, but worked out on a supposition that the banks would require one-fifth less earth than they really would.†

"(2.) A revised estimate, founded on the same data, but without this erroneous supposition, and giving simply the correct total quantity necessary to make the banks to the specified section. The slopes were taken in some miles flatter than 1½ to 1, but not so in this, and no allowance made for repairs or re-making of the bank.

"(3.) The amount paid for, including the repairs of the bank after it had suffered considerable damage, by water, in the canal, and from the rains of two seasons. This quantity is 10 per cent. more than that in the revised estimate. The slopes have not stood at the steepness supposed in the revised estimate.

"(4.) The attempt of Mr. Wilks to measure the banks after all this exposure, by which he finds only two-thirds of the amount paid for.

"(5.) The final detail measurement of the pits when the bank was made up to section without any allowance for shrinkage, made by Mr. Lowe in March 1863, before he sent in his revised estimate, which shows that the soil required to make the banks of loose earth up to the bare final section was 61,544 cubic yards measured in pits, or only 1,538 cubic yards less than Mr. Wilks found, after all settlement and repairs, in the bank.

"9. I conclude the clear and careful measurements Nos. 2, 3, and 5, made under every advantage, and which are consistent together to be enough to set aside the measurement No. 4 made carefully, but under every disadvantage which is inconsistent with every one of the others."

11. I replied to these remarks of the Chief Engineer, and pointed out to him that I could not agree with the conclusions he had drawn. The banks of the mile required in round numbers, with 1½ to 1 slopes, 53,000 cubic yards; some 96,000 cubic yards were paid for, and, when Mr. Wilks measured them, he found only 63,000 cubic yards by bank measurement, which represented, therefore, a less quantity excavated from pits, according to the degree of settlement which still had to take place. Mr. Lowe's calculations and those of Mr. Wilks, taken in connection with the quantity allowed in the original estimate, and increased by one-fourth, appeared to me to show conclusively that the bank could not ever have had 96,000 cubic yards put into it; and that probably Mr. Wilks measurements gave as much as should have been paid for when the banks had taken their permanent form.

12. It may not be deemed necessary that I should go through all the miles in the same detail, and I will, therefore, give a tabulated summary of the earth-

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works, of all the miles, according to the several estimates, showing also the modification of the original estimate required to correct the error of the deduction of one-fifth for embankments, and I will then add such brief remarks on the 6th to the 18th miles as may appear to be needed:—

Miles.	ORIGINAL ESTIMATE.						Original estimated as corrected.		Estimate of 1864.		Estimate of 1868.	
	As submitted.		Correction by adding a quarter to embankment.									
	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.
1	2,91,875	45,049	None required.	225	2,91,875	45,049	2,57,353	73,966	3,36,561	73,740		
2	1,74,990	39,680	2,600	.....	1,77,590	40,005	2,41,739	49,732	2,50,834	42,509		
3	1,44,800	44,200	.....	.....	1,44,800	44,200	1,98,646	59,691	95,970	64,108		
4	1,24,491	20,291	12,203	1,525	1,36,694	21,816	1,37,163	18,893	1,21,784	20,249		
5	52,510	7,199	10,586	1,323	63,096	8,522	83,335	11,762	1,28,848	23,291		
6	93,809	14,986	20,827	3,254	1,14,636	18,240	1,50,600	23,719	2,40,935	42,424		
7	1,34,876	18,953	25,344	3,163	1,60,220	22,121	1,39,620	21,816	1,82,482	35,147		
8	1,24,284	21,145	25,896	4,316	1,50,180	23,461	1,59,930	28,133	1,71,941	40,164		
9	1,10,000	10,575	6,000	562	1,16,000	11,137	1,75,300	31,484	2,04,464	26,131		
10	1,07,496	16,890	24,624	3,848	1,33,120	20,738	2,09,600	33,250	2,00,037	32,929		
11	1,08,563	14,602	18,890	2,361	1,27,453	16,963	1,31,165	17,929	93,212	17,862		
12	83,100	10,518	10,908	1,704	94,008	12,222	1,47,720	18,965	2,83,505	25,766		
13	1,57,696	26,283	39,424	6,571	1,97,120	32,854	2,61,640	49,370	3,30,423	66,067		
14	1,36,065	23,955	17,600	2,750	1,53,665	26,705	1,44,080	27,575	2,19,302	35,811		
15	90,543	14,040	14,490	1,811	1,05,033	15,851	1,16,300	18,900	1,79,608	28,814		
16	1,39,726	21,912	29,631	4,484	1,69,357	26,396	1,65,142	25,638	1,53,970	22,759		
17	1,23,200	30,800	.....	.....	1,23,200	30,800	1,73,011	39,988	1,71,927	40,104		
18	1,01,333	16,889	25,333	4,222	1,26,666	21,111	1,22,555	24,711	1,17,412	25,254		
Additional earth for increase of slopes ...	.....	.....	.....	.....	.....	.....	1,70,483	26,638	.....	.....		
Total	22,99,357	3,97,967	2,84,356	42,224	25,83,713	4,40,191	31,86,442	5,92,180	33,90,003	6,63,129		
					Extra earthwork for breach in 6th mile }		21,000	4,000	31,85,115			
										5,96,180		

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13. In the 6th mile the increase of quantity is very large, but I do not find any special information in explanation of it in the Chief Engineer's report (paragraph 11). The breach for which separate provision was made, as shown at the foot of the statement, will account for 24,000 cubic yards out of the 90,000 increase, and there will be some due to increase of slopes, but the maximum section before allowed gave a top width of 18 feet with 2 to 1 slopes on both sides, and this would appear to exceed the dimensions of any of the new cross sections. The cuttings are very shallow, so that the water-spread will be great, and the water carried by the cuttings will be but little. At Section No. 3, however, the contraction to 90 or 91 feet, with a fall of only 3 inches a mile, would be prejudicial; and there, and in similar places, the full width required should be given, wherever the water-spread will not be so great as to allow of compensation. In the 7th mile the width of cutting at sections Nos. 38 to 45 is insufficient. Were the canal so formed, it could not, at the normal level, discharge the full quantity of water. The fall is intended to be 0.35 a mile, and the width should be about 200 feet. Paragraph 13 of the Chief Engineer's report hardly gives a clear idea of the circumstances of the 8th mile. The intended improvements to the banks may cost Rupees 651, but the excess of the present estimate earthworks is about 12,000 Rupees. Some further particulars regarding this mile, which were given in the Chief Engineer's report, dated 21st June 1866, on the second and third sections of the main canal, paragraph 11, are subjoined:—

"11. In the eighth mile the last entry in the ledger for June 1863 shows for banks:—

"1,56,488 cubic yards done for Rupees 22,973-12-0 up to September 1864, "2,45,524 are shown done in the progress certificates, including the repairs of the "heavy slip which occurred near the middle of the mile. There seems no doubt "that this measurement was made in the pits, the 13th and 18th being the only "miles in the first section measured up for payment in bank. It may be conjectured "that some mistakes were made in measuring up the new pits opened for raising "and repairing the bank. Mr. Wilks shows only 1,70,636 cubic yards, but I "cannot accept Mr. Wilks' sections as proving anything conclusively, for the "reasons shown in my remarks on the fifth mile."

The cutting at section 28 would be barely wide enough. The cross sections give no indication of the 64,000 cubic yards of rocky excavation entered in the comparative statement.

In the 9th Mile, at cross sections 11 to 28, the required width of cutting is 160 instead of 90 feet. At sections 29 to 35 also the width is generally much too small, and the banks have been placed too near. Section 36 is only about 1/4ths of the proper width. The last sheet of sections, with its plan, shows that the culvert will prevent the full width required being given throughout, but as much as possible of the canal should be made wide, and the narrow part shortened as much as may be.

In the 10th mile there is a reduction in quantity compared with the estimate of 1864, though the estimate still stands at 50 per cent. in excess of the corrected original estimate. In the 11th mile the quantity of earthwork done has not been entered. I have made an approximate calculation from the expenditure, but possibly

this is under the mark. The Chief Engineer has grouped this mile with the 12th mile, possibly because the large saving in quantity in the former had something to do with the 100 per cent. excess in the latter. I think that the quantities in the latter mile have been erroneously entered, as those stated would make the rate 13 yards a rupee nearly. Perhaps the quantity for the two miles is the cubic yards 2,83,505 set down against the one mile, and then it would correspond pretty nearly with the 2,78,885 cubic yards of the two miles in the estimate of 1864.

In the 13th mile, the Chief Engineer, paragraph 17, puts the total of the revised estimate at Rupees 80,893, against Rupees 81,412 in 1864, but so far as I can see the provision of the latter was—

	RS.
Earthworks	49,370
Revetment	11,250
Calingulah No. 7	3,385
Total	64,005

There is indeed an excess on earthworks of Rupees 16,700.

In the 14th mile the revised fall is 0.45, instead of 0.50 l. more. The width of cutting near the calingulah, sections 21 to 27, is altogether inadequate, and should be increased to about 165 feet, instead of 90 feet. In this mile also I do not see whence the Chief Engineer obtains the figures entered in paragraph 18, which are—

	Estimate 1864. RS.	Estimate 1868. RS.
Cost of mile	44,302	45,915
the comparative statement shows—		
Earthworks	27,575	35,811
Revetment	6,650	4,948
Masonry works, including bridge subsequently sanctioned	4,705	4,958
Removing spoil... ..	.....	198
	38,930	45,915

The excess on earthworks is, it will be seen, 8,000 Rupees. Similarly, in the 15th mile, the excess on earthworks is 9,900, and the excess on the mile is Rupees 7,587, instead of 193 Rupees, as shown in the Chief Engineer's paragraph 19. In the 16th mile there is a saving of 2,900 on earthworks, compared with the estimate of 1864. I do not know to what this is attributable, as the present is below the original estimate, as corrected for banking.

In the 17th mile there is a small reduction in quantity, and the proposed fall being now 2 feet a mile, instead of 1.68 feet, it will suffice if the width be not less than 81 feet, instead of 90 feet, as shown on the sections. The estimate has apparently been prepared for the canal on the reduced scale, vide Mr. Latham's paragraph 21. So far as I can judge, the quantity shown for this mile must be much in excess of that actually executed.

In the 18th mile there is a saving in quantity, and but a trifling excess in the cost of earthwork. It is proposed to reduce the fall in the mile from 1.15 to 1.00. I do not know how this will be distributed in practice, but were it equally distributed, the Hindry aqueduct would discharge less than three-quarters of a full supply.

14. The general result of these new estimates is, that there is an increase in the provision for earthworks to the extent of Rupees 71,000, or about 12 per cent. on the estimate of 1864. This would not, when compared with other sections, require much notice, were it not that the later estimate does not in reality provide for a canal of the same dimensions as that originally sanctioned, and, as will be gathered from the preceding remarks, the revised canal would not carry the requisite supply. The Chief Engineer attributes much of the excess to the increase of slopes which has been, or is intended to be, given; and but for the fact of reductions elsewhere, and for the provision made in the sanction of 1864 to provide slopes of 2 to 1, which have not been given throughout, this alteration would account to a great extent for the additional quantity* of earthwork entered in the present estimate. As it is, I am unable to consider that this part of the revised estimate has been supported by adequate explanations, and I think that a summary of the results of Mr. Wilk's examinations and measurements made in 1864, which has never yet been given, should be furnished for the information of Government.

* 1½ to 2½ lacs of cubic yards, the former if the omission opposite the 11th mile is covered by the supposed excess against the 12th, and the latter if that omission has to be supplied.

15. With regard to the want of sufficient capacity, which has been noticed in commenting on many of the miles, it should be pointed out that, with falls varying so considerably as those of this section of the canal, it is not possible that a uniform width of cutting should be capable of carrying one and the same quantity of water under different circumstances. There is no doubt that the conditions of the problem are much complicated by the varying depths and water-spreads, but wherever the water is confined to a cutting, the dimensions of the latter should be sufficient to allow of the supply being passed without loss of head, and this will evidently not be the case with the 90 feet widths of cutting where the fall is less than about 1.66 feet a mile. It appears to me, therefore, to be absolutely necessary that in such cases the arrangements proposed should be re-considered.

16. The estimate of 1864 was the first which provided for revetments; and, for the interior of the banks, it allowed Rupees 99,716½ for cubic yards 1,70,948 for the 5th to the 17th miles, and General Ludlow added 6,000 Rupees for river-side stone facing in the 4th mile, and Rupees 15,500 for a masonry revetment to the upper approach to the Hindry aqueduct. Against the former of these additional provisions Rupees 2,664 will altogether be expended, and near the aqueduct Rupees 6,354 are shown as the cost of the work when completed. On the other hand, a masonry revetment is now proposed to be constructed immediately below the head-sluice, at a cost of Rupees 2,482-8-0;† this is necessary, and the failure of previous work has been

† In addition to Rupees 3,895 provided under masonry.

already reported, but I am unable to check the entry, and if, as it would seem, the quantity required is cubic yards 1,245 (800' x 3½' x 12'), the expense ought to be less than 4,000 Rupees; also in the 2nd and 3rd miles, where no revetment was before provided, Rupees 382½ and Rupees 1,810 are intended to be laid out in protecting the slopes from wash, and I think this protection is required. Comparing the 5th to 17th miles of the two estimates, the quantity and amount of the

*Proceedings of the Madras Government, Public Works Department,
24th April 1868.*

former are given above, and those of the latter are cubic yards 1,64,523, Rupees 68,607. The quantities for the several miles differ considerably from those of the estimate of 1864, as for instance in the 13th mile, where the latter allows 18,000 cubic yards, and the present estimate cubic yards 32,011. There has been a saving, to some extent, by not carrying up the revetment to the level of the top of the bank, and to a further degree by substituting, in some places, shingling for stone pitching. In the 18th mile, where no ordinary revetment appears to have been before provided, the present estimate allows Rupees 1,606-4-2 for cubic yards 9,571. The quantities of work in the 11th mile are not given, but as the rate for the quantity in the 12th mile would be only Annas 2, Pice 10, I have supposed that that quantity should be referred to the expenditure in the 11th and 12th miles; the rate would then be 8½ Annas a cubic yard.

17. Another item of the present estimates is silt clearing, and the particulars of this description of work for the several miles are—

1st mile, cubic yards	55,806	...	...	...	Rupees	8,186
2nd "	34,884	...	...	...	"	7,241
3rd "	11,534	...	...	...	"	2,307
4th "	22,188	...	...	...	"	4,438
Total cubic yards	1,24,412				"	22,172

This work appears to have been finished. In sanctioning an advance in June last, it was left for future decision whether this clearing of the canal should be debited to Capital or Revenue. Properly, the latter should bear the whole, or nearly the whole, charge, as the water has been admitted chiefly for irrigation, and for the supply of Kurnool, though perhaps occasionally more than was needed for these purposes was passed down in order to partly fill, and so test the canal banks. However, as there are not enough revenue collections to meet the charge, and as no doubt the quantity of silt has been considerably increased by the imperfect and unfinished state of the canal, I would recommend that, on this occasion, the whole cost be debited to capital, but that for the future all charges for clearing silt from the first section be paid for out of Revenue. There is one point connected with this work which needs special attention, and that is the very high rate at which it has been done. The most reasonable rate is that in the first mile, where it is a little under 7 cubic yards a rupee, and it increases to a rupee for 4½ cubic yards in the 3rd mile, and in the 4th mile it is a rupee for less than 5 cubic yards. If the canal clearance is to cost 2 to 3½ Annas a cubic yard, maintenance will be a very expensive affair, and the Chief Engineer should see to this matter at once, so that the arrangements may be placed on a footing which will allow of the annual clearances being carried out at a more moderate cost.

18. I observe that the cost of temporary bridges has been entered at Rupees 2,104. No estimate has ever been prepared or, perhaps I should say, submitted, for these works, and I have no means of checking the expenditure. I am of opinion, however, that the sum shown is but a small part of that which has actually been expended upon these temporary works.

End of comparative statement.

*Proceedings of the Madras Government, Public Works Department,
24th April 1868.*

19. Rupees 63,000 are included in the present estimate for the "depreciation of value of tools, plant in use, stock, and of stores on stock," this description is rather vague, but I find that about Rupees 47,000 represent the value of stores issued for use on the works, and which ought to have been met from the rates; and about 15,000 have been debited to cover the depreciation of general plant in use on the works. Perhaps some of the cost of temporary bridges, such as their timber platforms, &c., has been included in the stores issued to the section, if so, it is not the proper way to account for the expenditure. The stores needed for a section such as this, in which there is nothing but the simplest description of work, could be neither numerous nor expensive, and working tools have, I believe, been issued under the name of general plant.

20. Subjoined is a general summary of the estimates of 1864 and 1868, showing the differences—

	Estimate of 1864.	Estimate of 1868.	Increase.	Decrease.
	RS.	RS.	RS.	RS.
Earthworks	5,96,179	6,63,130	66,951	.....
Revetments	1,05,717	78,153	.....	27,564
Masonry works	1,16,508	1,03,765	.....	12,743
Clearing silt	.....	22,172	22,172	.....
Removing spoil	.....	2,975	2,975	.....
Temporary bridges	.....	2,104	2,104	.....
Removing do.	.....	927	927	.....
Ferry boats	4,800	804	.....	3,996
Alteration of road	2,698	.....	.....	2,698
Superintendence and sundries	56,025	95,067	39,042	.....
Stores and Plant	.....	63,000	63,000	.....
	8,81,927	10,32,097	1,97,171	47,001
Net increase	.....	.....	1,50,170	.....

In the estimate of 1864 have been included additional works subsequently sanctioned, such as second and third class bridges, &c.

21. The abstract estimate shows that, according to the arrangements provided for, the expenditure, Rupees 59,588, on earthworks remaining to be incurred is about one-tenth of that already made. Should the Government desire it, those parts of the canal which do not require a re-adjustment of the levels may be gone on with, but it appears to me that the earthwork estimate is too defective to allow of its being sanctioned in its present state. Where also, as in the first mile, the alteration required in the estimate is the cutting out of the canal to a full, instead of to a reduced, width, the Chief Engineer may proceed with the work on his own responsibility, pending the approval of re-considered estimates, should he think fit to do so.

About Rupees 34,105 remain to be expended on masonry works, and for these the sanction already given is sufficient, so that they can be carried forward to completion.

The revetments also can be completed, as their cost will be within the amount sanctioned for them.

On the 1st January last, a little more than 35,000 Rupees of the advance sanctioned by Government for carrying on the works, pending the sanction of estimates, remained unexpended, and if, therefore, the Government will now, in order to place the Chief Engineer in funds, sanction the following items:—

Clearing silt	...	...	...	Rupees 22,172
Plant and stores	...	...	...	" 63,000

Total Rupees 85,172

the advance may be cancelled; and probably the balance remaining available will be sufficient for the continuation of the works until the part of the estimate which relates to earthworks shall have been re-considered.

No. 477. ORDER THEREON, 24th April 1868, No. 1,270.

IRRIGATION, No. 18.

1. Estimates amounting in the aggregate to Rupees 8,81,927 were sanctioned at various periods for the works of the first section of the Madras Irrigation and Canal Company's Canal from the 1st to the 18th mile, and revised estimates are now submitted for Rupees 10,32,097, exhibiting an excess of Rupees 1,50,170 or 17 per cent.

2. The increase is chiefly in the following items:—

Earthworks	...	...	...	Rupees 66,951
Clearance of silt	...	...	...	" 22,172
Superintendence and sundries	...	...	...	" 39,042
Depreciation of the value of stores and plant.	...	...	...	" 63,000

and savings on certain other items of the original estimate are shown to amount to Rupees 47,000.

3. The excess on "earthwork" is stated to be chiefly due to the increase of slopes to the banks, and to the re-adjustment of the levels of the bed of the canal in order to equalize the flow of water, and thus diminish the deposit of silt in the upper portions of the canal. The Consulting Engineer remarks that the excess in question, compared with that on other sections of the canal, would not require particular notice except for the fact that although the revised estimates provide in reality for a canal of smaller dimensions than that originally sanctioned, the quantities are very much greater than those for the larger one. Commenting on the points in which the present estimates differ from those already sanctioned, Captain Mullins shows that it is proposed to reduce the bottom width of the canal to 90 feet, which, with the inclination to be allowed to its bed, will not give it sufficient capacity to discharge the required quantity of water, and he points out that as the falls in this section vary considerably, a uniform width of cutting cannot possibly be capable of carrying one and the same quantity of water.

4. As regards the charge for clearing silt, the Government observe that, in submitting the application of the Agent for an advance of Rupees 60,000 pending the submission of supplemental estimates, Captain Mullins was of opinion that as

the silt was brought in by water used for cultivation and for the supply of the town, the cost of its removal was properly debitable to Revenue. As, however, the revenue collections are insufficient to meet the charge, he now recommends that the cost be debited to Capital, but that all future charges of the kind be defrayed from Revenue.

5. The excess in the item of stores and plant is stated to represent the value of stores issued for use on the works and an allowance to cover the depreciation of general plant in use. The Consulting Engineer considers that the stores needed for the first section could be neither numerous nor expensive, and he believes that working tools have been issued under the name of general plant.

6. The Government are very anxious to facilitate in every way in their power the operations of the Company for the completion of their canal, but they cannot consent to accord sanction to any estimates that do not provide for giving to that work the full capacity that is necessary to enable it to carry the full quantity of water which it has been designed to deliver, and without which its usefulness and its value for the purposes of irrigation will be greatly diminished. His Excellency in Council accordingly resolves to return the estimates now submitted, in order to their being revised with reference to the observations contained in the Consulting Engineer's letter above-recorded. Meanwhile, to prevent any impediment to the progress of works to which no objection has been raised, the Government resolve, in accordance with Captain Mullins' recommendation, to sanction the items

Clearing silt	...	...	Rupees 22,172	marginally noted, aggregating Rupees
Plant and Stores	...	...	" 63,000	85,172, and to cancel the advance
Total Rupees 85,172				authorized in G. O. of the 17th June
				1867, No. 1,819.

7. The proposal of the Consulting Engineer with regard to the outlay upon the clearance of silt is approved, and the attention of the Chief Engineer will be specially drawn to the high rates paid for that work, as noticed in paragraph 17.

(True Extract.)

Colonel, R. E.,
Secretary to Government.

To the Consulting Engineer for Irrigation and Canal Company, with six Enclosures.
,, Manager for do. do.

Exd. S. T. Augustin.

Memo

It is requested that the Original Enclosure of letter N^o 153 of the 28 March last, regarding the revised Estimates of the 1st Section Drain Canal, forwarded on the 27th ultimo for copies being taken for transmission to the Home Government, may be returned to this Office for comparison with the revised Estimates received from the Agent of the Madras Irrigation and Canal Company.

Consulting Engineer's Office
Irrigation & Canal Comp^y
Madras 5th June 1868.

M. P. Paul
Manager

To, The Chief Assistant & Registrar
Government Office to the

Estimate
of the
comparative state
of revised Estimates, and I have now the honor to forward such Estimates for the consideration of Government.

2. The previous sanctions for this Section of the Canal are as follow:-

Proceedings Madras Government of the	Rs.
31 st May 1861 N ^o 1016 for Earth & Masonry works	4,60,000
Do Do Do of the 15 th April 1864	396,777
N ^o 1074 for Earth and Masonry works.	
Do Do Do of the 23 rd March 1867	25,150
N ^o 917 for additional Bridges	
Total Rupees	88,1927

The present revised Estimates amount to Rupees 1,03,2097, so that the further supplemental sanction asked for is Rupees 1,50,170.

The

Consulting Engineer's Office
Irrigation & Canal Company
Madras, 28th March 1868.

N^o 153

From,
Captain, J. Mallin, R.E.
C. Congerford & Co.

To, The Secretary to Government
Department of Pub. Works.

Sir,

In their order of the 17th June last, N^o 1819, the Government sanctioned an advance of Rupees 60,000 for the works of the 1st Section Main Canal, pending the completion and submission of revised estimates, and I have now the honor to forward such estimates for the consideration of Government.

1 Estimate
1 Abstract of - do -
1 Comparative Stat^t.

2. The previous sanctions for this Section of the Canal are as follow:-

Proceedings Madras Government of the	Rs.
31 st May 1861 N ^o 1016 for Earth & Masonry works	46,000
Do Do Do of the 15 th April 1864 N ^o 1074 for Earth and Masonry works	39,677
Do Do Do of the 23 rd March 1867 N ^o 917 for additional Bridges	25,150
Total Rupees	88,192

The present revised estimates amount to Rupees 1,03,209, so that the further supplemental sanction asked for is Rupees 1,50,170.

The

The Agent and Manager Madras Irriga-
-tion and Canal Company has, with his letter,
N^o 492, of the 10th instant, forwarded a book of
Cross Sections of the Canal, and the Chief En-
-gineer's and Executive Engineers' reports on
the estimates and works.

4. In the first place the Chief Engineer
has considered it advisable to readjust the
levels of the Canal bed, in the manner shown
in the Table at the beginning of the book
of Cross Sections, with a view to equalize
the flow of water in the Canal and thus
diminish the deposit of silt in the upper
miles. - For convenience of reference a
table, showing the falls originally allowed
for the several miles and those now proposed,
is subjoined.

Position	Level above datum as according to original sections	Fall in each mile	Proposed Level	Fall in each mile	Remarks
Beginning of 1 st mile	32.25		32.25		
End of 1 st "	31.50	0.75	31.65	0.60	Marked 38 in the Section, but measuring 32.25 ft
" 2 nd "	30.50	1.00	30.75	0.90	
" 3 rd "	29.00	1.50	29.75	1.00	
" 4 th "	28.75	0.25	28.95	0.80	
" 4 1/2 "	28.58		28.65		
" 5 th "	28.42	0.33	28.45	0.50	
" 6 th "	28.25	0.17	28.20	0.25	
" 7 th "	27.75	0.50	27.85	0.35	
" 8 th "	27.42	0.33	27.55	0.30	
" 9 th "	26.92	0.50	27.05	0.50	
" 10 th "	26.67	0.25	26.80	0.25	
" 11 th "	26.42	0.25	26.55	0.25	
" 12 th "	26.17	0.25	26.30	0.25	
" 13 th "	25.92	0.25	26.05	0.25	
" 14 th "	25.42	0.50	25.60	0.25	
" 15 th "	25.01	0.41	25.20	0.40	
" 16 th "	24.26	0.75	24.80	0.40	
" 17 th "	22.00				
" 18 th "	22.60	1.60	22.80	2.00	
17 miles	22.00	about 2.75 per mile			
387 yards					

Intersect at 24.29 in Chief Engineer's Table.
The level as originally laid out.
do as marked in the copy in this office.

1st mile - 0.15 of a foot
2nd - 0.10
3rd - 0.50

According to the Section in this office, the Chief
Engineer's level for the head of the Canal will
be ~~approximately~~ ^{approximately} that originally intended.
In the 1st mile there was originally a small
water spread; and the fall allowed was therefore
small, but this part has settled up so much
that it has now become necessary to give the
water a higher velocity, which can be done by
reducing the fall in the 1st and 2nd miles slight-
ly and that in the 3rd mile considerably. - The
fall in the 5th mile is also intended to be increased
from 4 inches to 6 inches, and that in the 6th
mile from 2 to 3 inches, while in the 7th mile
a reduction from 6 to 4 inches is proposed. - Be-
low the 7th mile the alterations are unimportant.
I think that on the whole the revised levels -
will be an improvement on those originally
put on paper but, as it would appear, not fully
adhered to in executing the works. It will how-
ever be seen in the sequel that the cross section
of the Canal has not been properly adjusted to the
revised levels.

down down para 2. 5. The Chief Engineer mentions that it is
not intended to put all the numerous Calingulaks
in working order. - It has been already brought
to the notice of Government that the capacity
of the waste weirs of this Section is out of all
proportion to the extent of drainage, and it would
not be worth while therefore to incur further
expenditure in filling them all with shutter-stones.
The outlay incurred or to be incurred on the 9 Ca-
-lingulaks

Calingulaks of the Section is Rupees 34,936, —
 against Rupees 55,616 sanctioned. These figures show
 however that the expenditure proposed ought to have sufficed to have
 very nearly completed all the Calingulaks, and no explanation has been
 given as to why the saving on the works left incomplete will be
 so small. — Only on No. 9 Calingulak is any further con-
 siderable expenditure proposed; on it the balance, Rupees
 2,651, of the sanction is entered for work yet to be done. —

6. Taking first the Earthworks in excavation
 and embankment, the Comparative Statement
 shows that in, the first mile the estimate
 of 1864 allowed.

Earth and gravel	Cyds 109,001	Rs. 11,713
Rocky excavation —	14,8352	62254
	<u>257,353</u>	<u>73967</u>

the work done is

Earth and gravel	Cyds 180,743	Rs. 23,437
Rocky excavation —	14,5812	44,049
Do Do Done	10,006	6254
	<u>33,6561</u>	<u>73,740</u>

These figures present considerable difficulties.
 The original estimate allowed cubic yards 291,875
 and provided for a Canal with a bottom width
 of 168 feet, and a width at water surface of 184 feet above the
 feet where the sides were sloped, as was the
 case for 960 yards out of the mile, the rest
 having vertical sides. — The estimate of 1864
 reduced the quantities, the canal having been
 made of much smaller dimensions as would
 appear from the Cross Sections; but this last
 estimate makes the quantities for the smaller
 canal very much greater than those for the
 larger one, and moreover the full depth of
 cutting is intended to be confined to a width of
 168 feet.

40 feet, an arrangement not before contemplated
 or of which no intimation has been given. I
 find that the requisite dimensions for a canal
 to discharge 4,00,000 cubic yards an hour, with
 a fall of 0.60 per mile, are 150 bottom width
 with side slopes 1 to 1, or an equivalent Cross Sec-
 tion; and I do not think that any insufficient
 arrangement, such as that shown in the Cross
 sections of this mile would appear to be, —
 should be sanctioned, and the rather so, seeing
 that the quantities shown as executed, or to be
 done, would more than have sufficed for the
 much larger canal of the original estimate.

para 5 of Ch. Eng's report. I do not see how the alteration of levels of the
 Canal in this mile can have increased the quantity
 of rock cutting, or indeed of excavation of any kind —
 According to the Chief Engineer's table the bed through-
 out has been raised, according to my table the lower
 end only has been raised: whichever way the al-
 teration has been made the effect must be a
 decrease of excavation. — It is said however that
 the alteration has occasioned an increase of
 expense to the extent of Rupees (6250 - 2500) 3750,
 but this increase cannot be upon the estimate
 based upon the longitudinal sections, for these
 have at no time shown the first half of the
 first mile of the Canal on a dead level. —

7-2nd mile. The quantities allowed in the pre-
 sent estimate are 250,334 cubic yards, those of
 the former being cubic yards 241,739. The differ-
 ence would not require notice were it not that
 the Cross section has been reduced. — The original
 estimate

estimate provided cubic yards 1,64,590 of excavation and 10,400 of embankment for a canal with a bottom width of $114\frac{3}{4}$ feet = 1440 yards of the mile having vertical sides, and 220 yards slopes of 1 to 1. The remaining 100 yards were in bank. These original figures were doubtless very roughly estimated, but at any rate those of 1864 may be presumed to have been sufficient for the full sized canal, and it is not understood how it has happened that a further increase of quantity is needed for a reduced cross section.

The Canal as proposed to be completed with the full depth excavated for a width of 90 or 91 feet only would, not, I think, be sufficiently capacious. 120 feet bottom width, with slopes of 1 to 1, are a trifle in excess with a fall of 0.90 per mile - perhaps 118 feet would be more exact. - *Discharge 4,12,440*

In the 3rd mile the Comparative Statements show the following particulars

Estimate of 1864.			
Earth and gravel Cys	46,428	Rs.	11,607
Rocky excavation	152,218		4,8084
	<u>198,646</u>		<u>59,691</u>
Revised Estimate			
Earth and gravel Cys	46,681	Rs.	6,469
Rocky excavation	138,69		4,2279
	<u>307,29</u>		<u>13,360</u>
	<u>29,979</u>		<u>64,108</u>

So far as I can judge there is a considerable error in the Statement of the quantity of rocky excavation

the name of the village on the bank.

excavation already done. It is put at 1,35,69 cubic yards, but the cost being 4,22,79 Rupees it seems probable that there is a mistake in quantity. The original estimate, taken in connection with the average cross section, appears to have provided for a canal 90 feet wide with vertical sides and the quantity of earthwork allowed was cubic yards 144,800. That the estimate of 1864 did not intend any reduction of dimensions would seem to be evident because the quantities were largely increased. Nevertheless the cutting appears from the book of Cross Sections to have been taken out with a much smaller width than 90 feet. The actual width varies in each Cross Section, but the Chief Engineer (para 7) ^{says} "it seems to have been constructed 65 feet wide" and "in order to prevent" the "deposit of silt in the upper miles, it is now proposed to widen the Doodyala cutting". The Executive Engineer in para. 4 of his report also says "It is now proposed to make all cuttings uniformly 90 feet wide at bottom excepting for 400 feet at the Head Sluices" as if, instead of the fact being that this was a minimum width in the former sanction, it had never before been provided for anywhere. All this is very unsatisfactory, and not the less so that it is necessary to remove cubic yards 22,228 of spoil at a cost of Rupees 2,778 or in order to allow of the widening of the cutting, whereas

whereas the sanctioned section allowed not only the full width of 90 feet for the cutting, but berms of 60 feet on each side.

The present intention seems to be to give the cutting a bottom width of 90 feet with side slopes of $1\frac{1}{2}$ to 1, and such a canal with a fall of 1 foot a mile will give a discharge of only cubic yards 3,40,907, which is very much under the 4,00,000 cubic yards required.

The original Cross Section with a fall of 18 inches per mile gave a discharge of cubic yards 3,75,200, so that that also was too small, though to a less extent. Under present circumstances, as a further widening would involve the removal of more spoil, it will be necessary to make the fall greater than 1 foot a mile, and the required fall is $1\frac{1}{4}$ a mile, which will make the discharge cubic yards 4,00,112.

9- $\frac{1}{4}$ mile. In this mile the quantities and amounts of earthwork in the several estimates are shown below:

Original Estimate Cyls 124,491 Rs. 20,291

1864 do do 137,163 Rs. 18,393

Revised do do 121,784 Rs. 20,249

The diminution of quantity in the last estimate appears to be due to a reduction of the Cross Section of the Canal. The cutting for the first 4,200 yards of the mile is everywhere very small and for only a few yards does it exceed the depth of the water. The original width allowed for

if the banking of this estimate were corrected by the addition of $\frac{1}{4}$ the figures would stand thus Cyls 136,694 Rs. 21,816.

The Chief Engineer's report of the 21st June/66 para. 10 shows that on the 30th Sept/64 the accounts showed Rs. 16,790 paid for embankment 11,8375, and 17th Willis's measurements, which were probably taken from the banks, gave Cyls 97,502 as the quantity of work done.

the cutting was 129 feet, with vertical sides against 90 feet with slopes of $1\frac{1}{2}$ to 1 allowed in the revised estimate; the fall originally was 0'.25 feet or 3 inches a mile instead of 0'.30 or $9\frac{3}{5}$ inches proposed by the Chief Engineer. This latter fall however would not give nearly the required discharge, and the 3rd mile will absorb 0'.33 out of the 0'.80 leaving 0'.47 available, which may perhaps be increased by adjustment to 0'.50 or 6 inches, and for this inclination, the bottom width of the cutting, where its depth is equal, or nearly equal, to that of the water, must be 160 feet instead of 90 feet, and it will be hardly worth while to make the rest of the cutting different, except where it has to be joined on to cross sections of another form. 10- $\frac{5}{8}$ mile. The figures given in the Comparative Statement for Earthworks are as follow:

Estimate of 1864 - Embankment earth Cyls 23335 Rs. 11,762

Revised Estimate do do 65,864 Rs. 8,592

Rocky excavation do do 62,984 Rs. 14,700

128,848 Rs. 23,292

The provision in the original estimate must also be considered, but to the quantity there allowed for banking, one fourth should be added to compensate for a deduction of $\frac{5}{8}$ of the total of the measurements of embankments very erroneously made, under the idea that there would be such a difference between the volume occupied

occupied by the earth before and after excavation.

Original Estimate - Embanking C^y 423433 Rs. 5293
and one fourth 105858 1/4 - 1324
Rocky excavation 7500 - 1406
26673 - 500

Quantity required for original design C^y 63096 Rs. 8323

The Chief Engineer's present report does not say much on the subject of the great increase shown. He however speaks of the intention to widen the cuttings "to a uniform bottom of 90 feet at the parts where the outcrops had been reckoned on as waterway". This and some strengthening I understand him to say will absorb the greater part of the cubeyards 20,800 of rocky excavation remaining to be done. In forwarding, however, in 1866 the Revised estimates of the 2nd and 3rd Sections Mr. Vatham illustrated the circumstances which he supposed had caused discrepancies there by the facts ascertained when an examination was made of the 1st Section by Mr. Wilks in 1864, and I subjoin the part of the Chief Engineer's report which refers to the mile under notice.

2. "Some miles of the 1st Section were carefully measured by Mr. Wilks Assistant Engineer in 1864, and as the measurements for payment of that Section are very clear, small, once for all, illustrate the method of constructing the banks, and of measuring them for payment, and the apparent discrepancies to which this method has given rise."

3. "On September 30th 1864 the position of the

* dated 21 June 1864
paras. 269.

5th mile was as follows:

	Cub. Yds	Rs.	As.	Pais	Chads aneey rate for Rupees
"Earthwork original estimate	52,510	7199	3	2	7.3
"do revised estimate	37,335	11762	2	3	7.4
"do done up to Sept/30 th 1864	96,092	13,689			7.0
"do done by Mr. Wilks measurement					

33,000 cubeyards less, indicating an over measurement of 52 per cent. and a total standing of only 63,092. -
4. "The range ledger of monthly payments in each mile is very clear. - And the detail "final measurement" of the cuttings and pits was made on the 21st March 1862, and lies before me in detail. - It shows them measured -

11200 Cub yds @ 3 As.	Rs. 2100
50344	6293
61544	Total Rs. 8393

"N.B. 1000 cubeyards of cutting yet undone and the slopes, a part of bund near Calingulah rock cutting behind sluice No. 1 altogether amounting to 3376 cubeyards for Rupees 490 still required."

5. "The range officer's (Mr. Vorne) Mile ledger for April 1862 shows 58,366 cubeyards actually paid upon and Rupees 6,879 paid subsequent to that, the Excavation for Sluice No. 1 was paid for in May, 4,238 cubeyards were transferred from the 2 Amas to the 3 Amas rate, and 594 cubeyards additional paid for in August - 560 cubeyards in September and so on till when all these bits, deducted from the full measurement of March 1862, were completed, the mile ledger for March 1863 shows the last payment of Rupees

Ruppes 15 viz:

"Excavation & Earth 50860 Cy @ 2 As. = 6,358-8-

"Masonry 11280 " " 3 " = 2,115-

"March 18th paid 30 " " 15 " "
62228 Cy @ 2 As. = 8,488-8-

The first 2 items are brought forward from February. This gives a total of 62,228 cubic yards for Ruppes 8,488-8- averaging 7.4 cubic yards per Rupee.

Now in the first estimate, 1/5 of the contents of the banks was deducted on the supposition that the earth from pits would expand a quarter when excavated and thrown into bank. In the final measurement the cutting and pits are measured but the bank was only made up to the estimated section. After the admission of water, therefore, the banks would naturally turn out to be 1/5 too low, and a quarter as much gain would need to be added. I distinctly remember that this bank was very much cut up for want of revetment, faces 5 feet vertical being washed in it.

In making up the bank Ruppes 5,201-8- were paid for 32,384 cubic yards at an average rate of 6 1/4 cubic yards a Rupee. Since the cutting was full of water, and the bank regular, and still affected by the water, when repairs commenced, no final measurement could be taken. The difficulty of finding the original surface of the ground in 1864, when Mr. Wilks measured it may be readily believed.

3. Here

probably rough.

"The average area of Sections of bank was taken for this estimate as the same as the Section at the average height of course too small."

3. "Here then we have the following" -
 1. "An original estimate based on Section of the surface of the ground, but worked out on a supposition that the banks would require 1/5 less earth than they really would."
 2. "A revised estimate founded on the same data, but without this erroneous supposition and giving simply the correct total quantity necessary to make the bank to the specified Section. - The slopes were taken in some miles flatter than 1 1/2 to 1 but not so in this and no allowance made for repairs or re-making of the bank."
 3. "The amount paid for, including the repairs of the bank after it had suffered considerable damage, by water, in the Canal, and from the rains of 2 seasons. This quantity is 10 percent more than that in the revised estimate. - The slopes have not stood at the steepness supposed in the revised estimate."
 4. "The attempt of Mr. Wilks to measure the banks after all this exposure by which he finds only 2/3 of the amount paid for."
 5. "The final detail measurement of the pits when the bank was made up to Section without any allowance for shrinkage, made by Mr. Vorne in March 1863, before he sent in his revised estimate which shows that the soil required to make

make the banks of loose earth up to
 the bare final Section was 61544 cubic
 yards measured in pits or only 1533 cubic
 yards less than Mr. Wilks found, after
 "all settlement and repairs, in the bank."
 "I conclude the clear and careful mea-
 surements Nos 2, 3 and 5 made under every
 advantage and which are consistent together
 to be enough to set aside the measurement
 No 4 made carefully but under every dis-
 advantage which is inconsistent with
 every one of the others."
 I replied to these remarks of the Chief
 Engineer and pointed out to him that I could
 not agree with the conclusions he had drawn.
 The banks of the mile required in round
 numbers, with $1\frac{1}{2}$ to 1 slopes, 53,000 cubic yards;
 some 96,000 cubic yards were paid for, and when
 Mr. Wilks measured them, he found only 63,000
 cubic yards by bank measurement, which
 represented therefore a less quantity excavated
 from pits, according to the degree of settlement
 which still had to take place. - Mr. Jones's
 calculations and those of Mr. Wilks, taken in
 connection with the quantity allowed in the
 original estimate and increased by one fourth,
 appeared to me to show conclusively that the
 bank could not ever have had 96,000 cubic yards
 put into it, and that probably Mr. Wilks mea-
 surements gave as much as should have been
 paid for when the banks had taken their permanent

form.

12. It may not be deemed necessary that I
 should go through all the miles in the same
 detail, and I will therefore give a tabulated
 summary of the earthworks of all the miles
 according to the several estimates, showing
 also the modification of the original estimate
 required to correct the error of the deduction
 of $\frac{1}{5}$ th for embankments, and I will then add
 such brief remarks on the 6th to the 18th mile
 as may appear to be needed.

Original Estimate as submitted.		Correction by adding to embankment.		Original estimate as corrected.		Estimate of 1864.		Estimate of 1868.	
Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
1	291,875 45,049	None required		291,875 45,049		257,353 73,966	336,561	73,740	
2	174,990 39,680	2,600 325		177,590 40,005		241,739 49,732	250,834	42,509	
3	144,550 44,280	"		144,800 44,200		198,646 59,691	95,970	64,108	
4	124,491 20,291	12,203 1525		136,694 21,816		137,163 18,893	421,784	20,249	
5	52,510 7,199	10,586 1323		63,096 8,522		83,335 11,762	128,848	23,291	
6	93,809 14,986	20,827 3,254		114,636 18,240		150,600 23,719	240,935	42,424	
7	134,876 18,953	25,344 3,168		160,220 22,121		139,620 21,816	182,482	35,147	
8	124,284 21,145	25,896 4,316		150,180 25,461		159,930 28,133	171,941	40,164	
9	110,000 10,575	6,000 562		116,000 11,137		175,360 21,484	204,464	26,131	
10	107,496 16,890	24,624 3,848		133,120 20,738		209,600 33,250	200,037	32,929	
11	108,563 14,602	18,890 2,361		127,453 16,963		131,165 17,929	95,252	17,862	
12	83,100 10,518	10,908 1,704		94,008 12,222		147,720 18,968	283,505	25,766	
13	157,696 26,283	39,424 6,571		197,120 32,854		261,640 49,370	330,423	66,067	
14	136,065 23,955	17,600 2,750		153,665 26,705		144,080 27,875	219,302	35,811	
15	90,543 14,040	14,490 1,811		105,033 15,851		116,300 18,900	179,608	28,814	
16	139,726 21,912	29,631 4,484		169,357 26,396		166,142 25,658	153,970	22,759	
17	123,200 30,800	"		123,200 30,800		173,011 39,988	171,927	40,104	
18	101,333 16,889	25,333 4,222		126,666 21,111		132,555 21,711	117,412	25,254	
Earth increased slopes						170,483 26,638			
Total		2299,357 397,967		284,356 42,224		2583,713 440,191		3186,442 592,180	
						3390,003 663,129		(4,552,15)	
						Extra earthwork for Branch in 8th mile		24,000 4,000	
								3210,442 596,180	

13. In the 6th mile the increase of quantity is very large

large, but I do not find any special information in explanation of it in the Chief Engineer's report (para: 11). - The Breach for which separate provision was made as shown at the foot of the Statement will account for 24,000 cubic yards out of the 90,000 increase, and there will be some due to increase of slopes, but the maximum section before allowed gave a top width of 18 feet with 2 to 1 slopes on both sides, and this would appear to exceed the dimensions of any of the new Cross Sections. - The cuttings are very shallow, so that the water spread will be great and the water carried by the cuttings will be but little. At Section No. 3, however, the contraction to 90 or 91 feet with a fall of only 3 inches a mile would be prejudicial; and there, and in similar places, the full width required should be given, wherever the water spread will not be so great as to allow of compensation. -

In the 7th mile the width of cutting at Sections Nos 38 to 45 is insufficient. - Were the Canal so formed, it could not, at the normal level, discharge the full quantity of water. The fall is intended to be 0.35 a mile, and the width should be about 200 feet. - Para. 13 of the Chief Engineer's report hardly gives a clear idea of the circumstances of the 8th mile. - The intended improvements to the banks may cost Rupees 651, but the excess of the present estimate earthworks is about 12,000 Rupees. - Some further particulars regarding

regarding this mile which were given in the Chief Engineer's report, dated 21st June 1866, on the 2nd and 3rd Sections of the Main Canal, para 11, are subjoined. -

11. "In the 8th mile the last entry in the ledger for June 1863 shows for banks

"156,403 cubic yards done for Rs: 22,973-12-"
"up to September 1864, 2,45,524 are shown done in the progress Certificates including the repairs of the heavy slip which occurred near the middle of the mile. There seems no doubt that this measurement was made in the pits, the 13th and 18th being the only miles in the 1st Section measured up for payment in bank. - It may be conjectured that some mistakes were made in measuring up the new pits opened for raising and repairing the bank. - Mr. Wilkes shows only 1,70,636 cubic yards, but I cannot accept Mr. Wilkes' Sections as proving anything conclusively, for the reasons shown in my remarks on the 5th mile. -

The cutting at Section 28 would be barely wide enough. - The Cross Sections give no indication of the 64,000 cubic yards of rocky excavation entered in the Comparative Statement. -

In the 9th mile, at Cross Sections 11 to 28, the required width of cutting is 160 instead of 90 feet. - At Sections 29 to 35 also the width is generally much too small, and the banks have

have been placed too near. - Section 36 is only about $\frac{1}{16}$ of the proper width - The last sheet of Sections, with its plan, shows that the culvert will prevent the full width required - being given throughout, but as much as possible of the Canal should be made wide, and the narrow part shortened as much as may be -

In the 10th mile there is a reduction in quantity compared with the estimate of 1864, though the estimate still stands at 50 per cent in excess of the corrected original estimate.

In the 11th mile the quantity of earthwork done has not been entered. - I have made an approximate calculation from the expenditure but possibly this is under the mark.

The Chief Engineer has grouped this mile with the 12th mile, possibly because the large saving in quantity in the former had something to do with the 100 per cent excess in the latter. - I think ~~however~~ that the quantities in the latter mile have been erroneously entered, as those stated would make the rate 13 yards a Rupee nearly. - Perhaps the quantity for the two miles is the cubic yards 23,505 set down against the one mile, and then it would correspond pretty nearly with the estimate of 1864. -

In the 13th mile the Chief Engineer, para: 17, puts

into the total of the revised estimate at Rupees 80,893 against Rupees 81,412 in 1864 but so far as I can see the provision of the latter was

Earthworks Rs:	49,370
Revetment	11,250
Calingulah ^{1st}	3,385
Total	<u>64,005</u>

There is indeed an excess on earthworks of Rupees 16,700. -

In the 14th mile the revised fall is 0.45 instead of 0.50 before allowed - The width of cutting near the Calingulah, Sections 21 to 27, is altogether inadequate, and should be increased to about 165 feet, instead of 90 feet - In this mile also I do not see whence the Chief Engineer obtains the figures entered in para: 18, which are:

	Est ^d 1864	Est ^d 1868
Cost of mile	<u>44,302</u>	<u>45,915</u>
the Comparative Statement shows:		
Earthworks	27,375	35,811
Revetment	6,650	4,948
Masonry works including Bridge subsequently sanctioned	4,705	4,958
Removing spoil		198
	<u>38,930</u>	<u>45,915</u>

The excess on earthworks is it will be seen 8000 Rupees - Similarly in the 15th mile the excess on earthworks is 9,900, and the excess on the mile is Rupees 7,587 instead of 193 Rupees as shown in the Chief Engineer's para: 19. -

In the 16th mile there is a saving of 2,900 on earthworks compared with the estimate of 1864. I do not know to what this is attributable as

the present is below the original estimate, as corrected for banking -

In the 17th mile there is a small reduction in quantity, and the proposed fall being now 2 feet a mile, instead of 1.63 feet, it will suffice if the width be not less than 81 feet, instead of 90 feet as shown on the Sections.

The estimate has apparently been prepared for the Canal on the reduced scale, vide Mr. Nathan's para: 21. - So far as I can judge the quantity shown for this mile must be much in excess of that actually executed.

In the 18th mile there is a saving in quantity, and but a trifling excess in the cost, of earthwork. - It is proposed to reduce the fall in the mile from 1.15 to 1.00. - I do not know how this will be distributed in practice, but were it equally distributed the Hindry Aqueduct would discharge less than $\frac{1}{4}$ of a full supply.

14. The general result of these new estimates is that there is an increase in the provision for earthworks to the extent of Rupees 71,000, or about 12 per cent on the estimate of 1864. - This would not, when compared with other Sections, require much notice, were it not that the later estimate does not in reality provide for a canal of the same dimensions that originally sanctioned and, as will be gathered from the preceding remarks, the revised canal would not carry the requisite supply. - The Chief Engineer attributed much of the

to 2 3/4 laes of embankment
former of the omission
on opposite the Hindry
covered by the 4. off road
is against the 12th and
tated if that omission
to be supplied.

the excess to the increase of slopes which have been, or is intended to be, given; and but, for the fact of reductions elsewhere, and for the provision made in the sanction of 1864, provide slopes of 2 to 1 which have not been given throughout, this alteration would account to a great extent for the additional quantity of earthwork entered in the present estimate.

As it is, I am unable to consider that this part of the revised estimate has been supported by adequate explanations, and I think that a summary of the results of Mr. Wilks' examinations and measurements made in 1864, which has never yet been given, should be furnished for the information of Government.

15. With regard to the want of sufficient capacity, which has been noticed in comment on many of the miles, it should be pointed out that, with falls varying so considerably as those of this Section of the Canal, it is not possible that a uniform width of cutting should be capable of carrying one and the same quantity of water under different circumstances. - There is no doubt that the conditions of the problem are much complicated by the varying depths and water spreads, but wherever the water is confined to a cutting the dimensions of the latter should be sufficient to allow of the supply being passed without loss of head, and this will evidently not be the case with the 90 feet widths of cutting where the

the fall is less than about 1.66 feet a mile. - It appears to me therefore to be absolutely necessary that in such cases the arrangements proposed should be reconsidered.

16. The estimate of 1864 was the first which provided for revetments, and for the interior of the banks, it allowed Rupees 99,716½ for cubic yards 170,948 for the 5th to the 17th miles, and General Sudlow added 6,000 Rupees for river side stone facing in the 4th mile and Rupees 15,500 for a masonry revetment to the upper approach to the Hindy Aqueduct. - Against the former of these additional provisions Rupees 2,664 will altogether be expended, and near the Aqueduct Rupees 6,354 are shown as the cost of the work when completed. - On the other hand a masonry revetment is now proposed to be constructed immediately below the Head Sluice at a cost of Rupees 2,482-8-11; this ^{in addition to Rs. 3895} is necessary, and the failure of previous work ^{provided under masonry.} has been already reported, but I am unable to check the entry and if, as it would seem, the quantity required is cubic yards 12,45 (800' x 3½' x 12') the expense ought to be less than 4,000 Rupees; also in the 2nd and 3rd miles, where no revetment was before provided, Rupees 382½ and Rupees 1,810 are intended to be laid out in protecting the slopes from wash, and I think this protection is required. - Comparing the 5th to 17th miles of the two estimates, the quantity and amount of the former are given above, and those of the latter are cubic yards 1,64,523, Rupees 68,607. The quantities for the several miles differ considerably

considerably from those of the estimate of 1864, as for instance in the 13th mile, where the latter allows 18,000 cubic yards and the present estimate cubic yards 32,011. There has been a saving to some extent by not carrying up the revetment to the level of the top of the bank, and to a further degree by substituting in some places shingling for stone pitching. - In the 18th mile, where no ordinary revetment appears to have been before provided, the present estimate allows Rupees 1,606-4-2 for cubic yards 9,571. The quantities of work in the 11th mile are not given, but as the rate for the quantity in the 12th mile would be only 2-10, ^{as per} I have supposed that that quantity should be referred to the expenditure in the 11th and 12th miles; the rate would then be 8½ annas a cubic yard. -

17. Another item of the present estimate is still clearing, and the particulars of the description of work for the several miles are:

1 st mile	Cub yds 55,806	Rs. 8186
2 nd "	34,834	7241
3 rd "	11,534	2307
4 th "	22,188	4438
Total Cub yds 1,24,412		Rs. 22,172

This work appears to have been finished. - In P.M. No. 1819 of 17 June 1864, sanctioning an advance in June last, it was left for future decision whether this clearing of the Canal should be debited to Capital or Revenue. - Properly the latter should bear the whole

whole, or nearly the whole, charge, as the water has been admitted chiefly for irrigation, and for the supply of turnroot, though perhaps occasionally more than was needed for these purposes was passed down, in order to partly fill, and to test, the Canal banks. However as there are not enough Revenue Collections to meet the charge, and as no doubt the quantity of silt has been considerably increased by the imperfect and unfinished state of the Canal, I would recommend that on this occasion the whole cost be debited to Capital, but that for the future all charges for clearing silt from the 1st Section be paid for out of Revenue. There is one point connected with this work which needs special attention, and that is the very high rate at which it has been done. - The most reasonable rate is that in the 1st mile where it is a little under 7 cubic yards a Rupee, and it increases to a Rupee for 4 1/2 cubic yards in the 3rd mile, and in the 4th mile it is a Rupee for less than 5 cubic yards. If the Canal clearance is to cost 2 to 3 1/2 annas a cubic yard, maintenance will be a very expensive affair, and the Chief Engineer should see to this matter at once, so that the arrangements may be placed on a footing which will allow of the annual clearances being carried out at a more moderate cost. -

10. I observe that the cost of Temporary Bridges has been entered at Rupees 2104. - No estimate has ever been prepared, or, perhaps I should say, submitted, for these works, and I have no means of checking the expenditure. I am of opinion however that the sum shown is but a small part of that which has actually been expended upon these temporary works. -

11. Rupees 63000 are included in the present estimate for the depreciation of value of Tools, Plant in use, Stock, and of Stores on Stock. This description

is rather vague, but I find that about Rupees 47,000 represent the value of Stores issued for use on the works, and which ought to have been met from the rates, and about 15,000 have been debited to cover the depreciation of General Plant in use on the works. Perhaps some of the cost of temporary bridges, such as their timber platforms &c., has been included in the Stores issued to the Section. If so, it is not the proper way to account for the expenditure. The Stores needed for a Section such as this, in which there is nothing but the simplest description of work, could be neither numerous nor expensive, and working tools have, I believe, been issued under the name of General Plant.

20 Subjoined is a general summary of the Estimates of 1864, and 1868 showing the differences.

	Estimate of 1864	Estimate of 1868	Increase	Decrease
Earthworks	596,179	663,130	66,951	.
Revetments	105,717	78,153	.	27,564
Masonry works	116,508	103,765	.	12,743
Clearing Silt	"	22,172	22,172	.
Removing Spoil	"	2,975	2,975	.
Temporary Bridges	"	2,104	2,104	.
Removing - (A. - A.)	"	927	927	.
Ferry Roads	4,800	804	.	3,996
Alteration of Road	2,698	.	.	2,698
Superintendence and Sundries	56,025	95,967	39,942	.
Stores and Plant	.	63,000	63,000	.
	881,927	1,032,097	150,170	47,001
Net increase 150,170				

21. The Abstract Estimate shows that according to the arrangements provided for the expenditure, Rupees 59,588, on Earthworks remaining to be incurred is about 1/10th of that already made. Should the Government desire it, those parts of the Canal which do not require a readjustment of the levels may be gone on with, but it appears to me that the Earthwork Estimate is too defective to allow of its being sanctioned in its present state. Where also, as in the first mile, the alteration required in the Estimate is the cutting out of the Canal to a full instead of to a reduced width, the Chief Engineer may proceed with the work on his own responsibility, pending the approval of reconsidered Estimates should he think fit to do so.

The Investments also can be completed, as their cost will be within the amount sanctioned for them.

Clearing Silk ——— Pipes 22,172
 Plank and Stores ——— 63,000
 Total Pipes ——— 85,172

I have the honor to be,
Sir,

Yours most obedient servant
Wm Lindley Captain R.E.
Consulting Engineer S.W.B.



1270

No 1270

Under date the 24 April/68

Read the following

From the Song Days 1800.

(Here enter No. 153 dated 28 Mar 68)

Estimates amounting
in the aggregate to Rs
8,81,927 were sanctioned
various periods for the
works of the 1st Section
of the Machas Irrigation
and Canal Company's
Canal from the 1st to the
18th mile, and revised es-
timates are now sub-
mitted for Rs 10,32,09
exhibiting an excess of
Rs 1,50,170 or 17 per cent.

The increase is chiefly in the following items.

Copy in all letters to and from
of 30. May 18 of 1868

To Mr. Geo. W. Allen
 1101 Broadway, New York
 From J. W. Allen
 The Congregationalist
 The Secretary & Co. N.Y.

March 28th } March 1880
No. 2374 }

Encs: 6. Returned
9/6/68

Concord for the cause
of abolition of Slavery: Revised
Estimates of the 1st Section
Main Canal with certain
estimations thereon. —

1270-24 Official

e. bed June 1867 Dr. 15th

Earthworks	Rs 66,951
Clearance of silt	22,172.
Superintendence Sundries	39,042.
Depreciation of the value of Stores and Plant	63,000

and savings on certain other items of the original estimate are shown to amount to Rs 47,000.

The excess on "earth-work" is stated to be chiefly due to the increase of slopes to the banks, and to the readjustment of the levels of the bed of the Canal in order to equalize the flow of water, and thus diminish the deposit of silt in the upper portions of the Canal.

The Consulting Engineer remarks that the excess in question, compared with that on other sections of the

the Canal, would not require particular notice except for the fact that although the revised estimates provide in reality for a Canal of smaller dimensions than that originally sanctioned, the quantities are very much greater than those for the larger one. Commenting on the points in which the present estimates differ from those already sanctioned, Captain Mullins shows that it is proposed to reduce the bottom width of the Canal to 90 feet, which, with the inclination to be allowed to its bed, will not give it sufficient capacity to discharge the required quantity of water,

and he points out that
all the falls in this
section vary considerably,
and it is not possible
to cut a canal capable of carrying
one and the same quantity
of water.

As regards the charge
for clearing silt, the Govt.
observe that, in submitting
the application of the Agent
for an advance of Rs.
10,000 pending the sub-
mission of supplemental
estimates, Captain Mullins
was of opinion that as
the silt was brought in
by water used for cul-
tivation and for the
supply of the town the
cost of its removal was
properly debitable to
Revenue. As, however,
the revenue collections are

P. W. 186 . Department.

No.

PROCEEDINGS OF GOVERNMENT.

Dated

insufficient to meet the
charge, he now recom-
mends that the cost
be debited to Capital, but
that all future charges
of the kind be defrayed
from Revenue.

The excess in the item
of stores and plant is
stated to represent the value
of stores issued for use on
the works, and an allow-
ance to cover the depre-
ciation of General Plant
in use. The Congress
considers that the stores
needed for the 1st section
could be neither numerous
nor expensive, and he
believes that working tools
have been issued under
the name of General Plant.

The Government are very anxious to facilitate in every way in their power the operations of the Company for the completion of their Canal, but they cannot consent to accord sanction to any estimates that do not provide for giving to that work the full capacity that is necessary to enable it to carry the full quantity of water which it has been designed to deliver, and without which its usefulness and its value for the purposes of irrigation will be greatly diminished. His Excellency in Council accordingly resolves to

Clearing etc.	Rs 22,172.
Plant and Stores	63,000
Total Rs.	85,172.

to return the estimates now submitted, in order to their being pursued with reference to the observations contained in the Cong Engrs letter above recorded -
Meanwhile, to prevent any impediment to the progress of works to which no objection has been raised, the Government resolve, in accordance with Captain Mullins' recommendation, to sanction the terms marginally noted, aggregating Rs. 85,172, and to authorize in J. O. of the 17th June 1867 No. 1819.

The

The proposal of
the Consulting Eng^r
with regard to the outlay
upon the clearance of
silt is approved, and the
attention of the Chief
will be specially drawn
to the high rates paid
for that work, as noticed
in para 17.

(12)

W.B.

To

The Consulting Engineer
in S.C.C. with
Manager for S.C.C. Encl.

Dec 25/18

10/11/18
S.C.C. Encl.

c. 600/1867 R. 15

Copy in L. to England
of 30th May 1868

11-9-77

Pub: Works 1868 (Department)

Pro: of Govt for April

£ 12 70

Pro: of the Madras Govt.

of 21st April 1868

No 476-477