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MADRAS RECORD OFFICE.**Government of Madras.***Public Works* **DEPARTMENT.**

G.O. No.	617	Press Mis.
Dated	1-5-18	64.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
1st March 1864.*

Read the following papers:—

No. 24. From Colonel A. J. M. BOILEAU, R. E., Superintending Engineer, 4th Division, to Colonel C. A. ORR, R. E., Secretary to Government, Public Works Department, dated Madras, 25th January 1864, No. 4,720.

SIR,

1. In obedience to the Order of Government No. 3,233, dated 6th November 1863, I have the honor to forward a Plan and Estimate (in rough) for a Calingulah of the character, though not in accordance with the levels, proposed in the Minute of the Honorable the President of the Council, dated 29th October 1863. These have been prepared by the Executive Engineer, Presidency, whose report is enclosed.

2. The first thing that struck me on reading Sir W. Denison's Minute and also the order of Government No. 1,451, dated 24th June 1862, which alludes to the construction of Anicuts on the Cooum "to retain the *whole* of its flood-water," was that His Excellency, not ever, I believe, having had an opportunity of seeing the Cooum river in genuine flood, has considerably underrated its discharge, which is occasionally, as shown in paragraphs 5 and 6 of Captain Prendergast's report as much as three millions of cubic yards per hour. The Executive Engineer's Estimate of the hydraulic mean depth is somewhat in excess of that which I have allowed in my calculations, but on the other hand his "fall of river" is I think too small. By a line of levels which I have had taken between the 5th and 8th miles distant from the sea, I find it in some miles as much as 6 feet per mile. The Cooum, moreover, has at times to carry off not only its own waters but also a portion of those of the Cortilliar which come down through the Canal; this was the case on the 4th December last (when the Bar was cut open for the second time in the season); the Canal was then coursing along like a rapid river, full to the brink. This discharge, be it remembered, is not even taken into account by Captain Prendergast. Another Engineer Officer of great irrigation experience informed me that his calculations led him to the conclusion that we should allow for four millions of cubic yards per hour! Assuming, however three millions as the *maximum* discharge per hour, and taking the "data" laid down by His Excellency, which establishes the 3 feet mark on the gauge (or 2 feet above mean sea line) as the level of the floor of his Calingulah, and admits of a maximum depth for the water to flow off, of only 18 inches, a Calingulah of no less than 1,100 yards in length would be required, which with a section assimilating to that given in the work proposed by Captain Prendergast, in the accompanying Plan (and which appears to me not unnecessarily strong) would cost about 8 lakhs of Rupees.

3. The floor level fixed by His Excellency cannot well be lowered without losing sight of the 4th condition laid down in the Minute, viz: "The exclusion of all salt water," and of course the 4'-6" mark on the gauge cannot be overtopped, as by doing so, much of Madras would be under water; so that we become tied down to a work of the length above stated, and which it is obvious can never be constructed.

4. With a view to reduce this great length, the Executive Engineer has in the Plan now forwarded, placed the floor of his Calingulah nearly on the same level as low sea water line, giving up altogether the idea of sluice gates, and of excluding the sea water, and calculates for a work 730 feet long, over which he proposes to construct a platform bridge in 22 bays. The cost of such a work would be about 1½ lakhs of Rupees.

5. My opinion is that the site of the Cooum Bar is not that which should be chosen for any operation connected with the retention of fresh water in the river, as it is too near to the sea, with whose vagaries we are little acquainted to say nothing of the effect of sand drifts on the work. The gap should not be bridged, and a long standing reproach be thus removed from Madras. The ~~gap~~ commends itself to me as the most suitable means of crossing such a place is a Screw Pile Bridge similar to, but of lighter materials than, that used in the Pier and I think this is the first step to be undertaken.

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1st March 1864.

6. Plans I had have been already prepared, and will be matured by me in communication with Screw Pile Engineers at Home if Government approve. That would meet the 1st and 2nd points of Sir W. Denison's Minute. For a work to maintain a maximum amount of fresh water, and if practicable to exclude all salt water (the 3rd and 4th points) I would look to a different site than that proposed by His Excellency, and I do not see why such should not be formed in connection with the Government House and Wallajah Bridges, which would well bear (especially the latter) remodelling, enlarging of the waterway, and conversion into sluice bridges, the sluices being formed (if necessary) with two sets of shutters, of the ordinary kind in front, and self-acting in rear.

7. Should that arrangement be objected to, His Excellency might perhaps look favourably on a project of Colonel Horsley's for constructing two bridges at the "tail" of the island, the one communicating with the Band Beach, the other with the Government House Compound near the Marine Villa.

8. The Plans of these works are enclosed. Sluices could with great ease be built into them, when, as much waterway would still remain as is now found in the Government House and Wallajah Bridges.

9. I await further orders, only observing that until something permanent is authorised, Colonel Miller's temporary dams may be made very serviceable.

From Captain H. L. PRENDERGAST, R. E., Executive Engineer, Presidency, to Colonel A. J. M. BOILEAU, R. E., Superintending Engineer, 4th Division, Madras.
19th December 1863, No. 632.

Sir,

1. With reference to your Orders No. 3281 of the 15th November, I have the honor to report upon the proposition of building a Calingulah at the mouth of the Cooum river.

2. The valley of the Cooum extends over an area of 275 square miles; the heaviest fall of rain on record, took place in October 1816, when 20.58 inches fell at Madras during 24 hours. Allowing then for this maximum fall of 20½ inches, and supposing that one-fourth of the rain fall runs off towards the sea; an outlet is required for 5,012,292 cubic yards of water per hour.

3. In the Minute of the President in Council the surface of the floor of the Calingulah is taken at about the level of the 3 feet mark on the gauge, or 2 feet above mean sea level; and a level of 4'-6" on the gauge being considered a maximum height, at which it has been a standing rule to cut the Bar, there is left a height of 18 inches for the water to flow into the sea.

4. Now if it is supposed that the water in the river stands at the height of 3 feet on the gauge, and a maximum fall of rain comes on; the length of Calingulah necessary to carry off the volume of water of 5,012,292 cubic yards per hour at a depth of 18 inches, is by Neville's tables 5,702 feet or 1 mile and 412 feet of actual water-way neglecting the space occupied by the piers.

5. But it is known that an excessive fall of rain at Madras, does not extend far inland; and the area drained by the Cooum consists of a strip of country running nearly due west; so that little or no rain may be falling at the Cooum tank, when there is a maximum burst at Madras. There are no records to show, to what distance from the coast the Madras rains have extended, but on the assumption that there is a maximum fall of 20.5 inches over one-third of the drainage area, or 90 square miles, that one-half or 10.25 inches falls over the second-third of the area, and that one-third or 6.8 inches falls over the remaining area of 95 miles, considering also that one-fourth of the water that falls runs off the ground, the discharge to be provided for per hour, amounts to 3,059,558 cubic yards, and the length of Calingulah to carry off this volume of water at a depth of 18 inches, is 3,460 feet.

6. The above assumption, as to the extent of country over which the rain spreads, gives a result, not much differing from that obtained by calculating the volume that can be discharged by the river when quite full at a point close to the Harris Bridge. From a section of the river taken from the bridge on the Poonamallee road, down to its mouth, a distance of 6½ miles, the fall is 14.4 feet or at the rate of 2.13 feet per mile; but there being a deposit in the bed of the river near the Beach, the lowest point is found to be a short distance below the Government House Bridge; and the fall from the Poonamallee road Bridge to this point, is 17.2 feet; or a little less than 3 feet per mile. Again from the Poonamallee road Bridge to the Harris Bridge, the fall is 3½ feet per mile; while from the College Bridge to the Harris Bridge the fall is 3 feet in 1½ miles, or only 2 feet per mile. The most decided fall is in the first 2 miles from the highest point, in which it is 4 feet per mile. Considering the different slopes of the river's bed, I have taken for calculation the fall of the river at 2½ feet per mile; which is the actual fall in 1 mile, measured ½ mile both above and below the Harris bridge, and the sectional area being 3,390 square feet, and hydraulic mean depth 12.7 feet, the

B. discharge is 2,971,900 cubic yards per hour, and to admit of this body of water flowing into the sea at a depth of 18 inches,

the length of Calingulah must be 3,360 feet.

7. It appears therefore, that a depth of only 1½ feet of water, is insufficient to discharge a full flow of the river, without extending the Calingulah to an unreasonable length. By the least of the computations made above, 1,120 yards, the Calingulah would extend to a length, as great as from the Fort ditch to the Marine Villa. The depth of water over the level as determined for the floor, cannot be increased, without flooding the lower parts of the town; it is therefore necessary, to lower the level of the Calingulah floor.

Then you admit the salt water of high tides.

8. When the Bar is cut, the river in ordinary seasons makes an outlet of from 2 to 3 hundred feet in length, and the question suggests itself whether a length of Calingulah of 100 yards, will discharge a maximum fall of rain. The volume of water to be discharged being taken.

First vide A above, 5,012,292 cubic yards per hour: the depth at which the water must flow, to discharge the same quantity as at 18 inches depth over a length of 5,702 feet, is 10 feet 9 inches: and if the floor of the Calingulah be placed at mean sea level, the river water will be raised to 10½ feet above the mean sea level. By a glance at Captain O'Connell's map showing the levels of different parts of the town of Madras, it will be seen, that the river, standing at the

above height, would submerge the whole of Chintadrepett; the water would be 4 feet deep on the Poonamallee road north of Saint Andrew's Church; all the east side of Vepery would be under water and the flood would extend over the whole of the People's Park, to the Powder Mills and the Perambore Lines.

2nd. If the volume of water is taken at (B) 2,971,900 cubic yards per hour, the depth, for the same quantity, as would flow over a length of 3,360 feet, at 18 inches depth, is 7½ feet and the water thus flowing to sea at a height of 7½ feet above mean sea level, would rise over the left bank for some distance above and below the Saint Andrew's bridge, would surround Saint Andrew's Church, and also cover the People's Park, a strip of Vepery, part of Purswakum, &c.

9. The length of 100 yards is thus shown to be not sufficient to carry off the computed fall of rain, and as it is found by experience that the river water should not rise above 4'-6" on the gauge, the consideration follows, what length of Calingulah will then suffice.

The discharge being first taken at A, or 2,241,018 cubic feet per minute, the required length is 1,096 feet, and again for a discharge B, or 1,320,844 cubic feet per minute, the required length is 646 feet. The floor of the Calingulah being in both cases, on the level of the foot of the gauge or 1 foot below mean sea level. The least computed length being 646 feet of water-way, or 22 spaces of 30 feet each; the space occupied by 21 piers of 4 feet thickness,

The sea water would be admitted, and His Excellency's No. 4 condition lost sight of.

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adds 84 feet in length and makes a total length of 750 feet between the wing-walls; and as this length is required for a depth of water of 4½ feet, no account is here taken of the intermediate upright stones which would have to support the shutters, as contemplated in the order of Government and in consequence of which a further addition should have to be made to the work.

The enclosed pencil sketch, shows the Plan and Sections of one span of 30 feet, the piers being 4 feet thick and 5 feet high, and the foundations 7 feet deep, with a base of 12 feet, resting on two wells. The flooring is of brick in edge on a course of rough stone laid with concrete. On the river side, there is a retaining wall, built, as the piers on wells, and on the sea side a rough stone apron. The superstructure consists of joists 12 inches in depth, laid 1½ feet apart and 3" planting above, to carry the road metal. The rough Estimate is calculated for one pier, with the adjacent flooring, retaining wall, rear apron and superstructure, and amounts to the sum of Rupees 7,050.

Hence, taking the discharge A, and allowing a depth of water of 18 inches, the length of water-way being 5,702 feet or 190 spans of 30 feet, the cost of the work will be 11,59,200 Rupees.

Quite out of the question.

Do. do.

Taking the discharge B, and depth of water 18 inches; the length of water-way is 3,500 feet or 112 spans and the cost is 8,60,100 Rupees.

Again with a discharge A, and allowing a depth of water of 4½ feet, the length of water-way is 1,096 feet or 37 spans, and the cost Rupees 2,84,100. Also with a discharge B, and depth of water 4½ feet, the length of water-way is 646 feet or 22 spans, and the cost 1,78,900 Rupees.

This cannot be considered, as salt water would be allowed to come into the river.
Do. do.

No. 25. MINUTE BY THE HONORABLE THE PRESIDENT.

1. I have read Captain Prendergast's Memorandum on the subject of the Ancient or Bridge over the Cooum river, and Colonel Boileau's covering letter on the same subject, and I should infer from these that we have not as yet sufficient data to deal with the question fully.

2. In my Minute of 6th November 1863, I noted four points to which the attention of the Engineers should be drawn; and these I am still of opinion should be looked to as the objects which ought to be attained, if possible.

3. With regard to the first and second no question can be raised. The third is necessary for the comfort of those who may inhabit Government House, for the smell of the banks at the outlet of the sewer above Government House bridge is intolerable when these are left uncovered by the discharge of the water through the outlet when the bar is out.

4. The fourth is almost a corollary of the third, for if fresh water is kept in up to high water level salt water will not find an entrance.

5. In my Minute, however, of November 1863, I did not in any way intend to lay down any plan, or to decide as to the mode in which these four points should be attained, but merely to make a suggestion for the consideration of the Officers to whom the planning of the work might be entrusted. If the space (allowing any reasonable width for the calingulah) could have been obtained for the discharge of the flood-water even by doubling the height of the sluices the calingulah would have accomplished all the four objects, but it certainly would not be adequate to the discharge of a body of water in any way approximating to the quantity mentioned in Captain Prendergast's Memorandum.

6. I may observe, however, in the first place, that this is a very exceptional quantity, and that even when the bar was cut and a free opening left for the water a large portion of Madras was under water for some time.

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1st March 1864.

7. According to the statement given, and the calculations based upon that statement, it would seem that during the monsoon of 1846, 20½ inches of rain fell in 24 hours, and that, on the assumption that one-fourth of the quantity made its way to the out-fall, a body of water equal to five million cubic yards must have passed through the opening in the bar in every hour of that day, or at all events in every hour of some consecutive 24 hours. Now this is an hypothesis, the correctness of which I am inclined to doubt, at all events it is a matter to be verified by experiment. It would seem that at the Harris' bridge, with the rather extraordinary hydraulic mean depth of 12.7 feet, the discharge is 2,971,900 cubic yards, and if the sectional area of the Channel below Government House bridge, and the hydraulic mean depth there be taken the body of water flowing to the opening in the bar would, I imagine, be much less. I say imagine, for we want sections of the various places. We want experiments as to the velocity of the current during different periods of the monsoon. We want accurate sections of the depth of the stream at its outlet when the bar is opened.

8. It is stated by Captain Prendergast that in ordinary seasons the river makes an outlet of from 2 to 300 feet in width, and a marginal note says "running in parts 14 or 15 feet deep." Now, if any part of the channel is 14 feet deep for its whole length, it would cut a gap through the sand of the beach 10 feet deep, or rather 10 feet below low-water mark. My conviction is that nothing of the kind can take place. The head of water above high-water mark is too trifling to give it that amount of action, especially when it is considered that the specific gravity of fresh water is less than that of salt water, and even at low water with an additional 3 or 4 feet of fall, I very much doubt the extension of this action to any great depth below low water mark.

9. These, however, are mere hypotheses. The fact is one which stares us in the face every year, and it would be very desirable that we should deal with it practically, and ascertain what is the actual result of the action of the rush of water through the bar before we attempt to go into the details of a scheme, which, to be complete, should certainly fulfil the four conditions mentioned in my former Minute.

February 1864.

(Signed) W. T. DENISON.

No. 26. ORDER THEREON, 1st March 1864, No. 619.

1. In Proceedings of Government, No. 3,233 of the 6th November 1863, the Superintending Engineer of the 4th Division, was called upon to prepare and submit Plans and Estimates for permanently closing the mouth of the Cooum by a work which, excluding all salt water, and retaining a maximum quantity of fresh, should provide for the discharge of surplus water in floods and maintain uninterrupted the means of communication along the South Beach.

2. Such a work it was believed would be a masonry Calingulah, surmounted by a bridge having its road-way supported on piers on the level of the present Beach Road. Between the piers, shutters might be placed, and the crown of the Calingulah corresponding with 3 feet on the gauge, the upper edges of those shutters might be on a level with the 4'-4" mark on that gauge, or 3'-4" above mean tide.

3. Colonel Boileau now replies to that requisition by forwarding, with some observations and suggestions, a letter from the Executive Engineer of the Presidency reporting the result of the investigation which, in pursuance of his instructions, he had made into the subject, and which goes to show that, owing to the low level on which the greater part of the populous District of Madras is situated, not permitting of the level of the river being raised to give even a moderate head of discharge at the site of the proposed Calingulah, the construction of a work of that kind, even on a much lower level than that prescribed, is not practicable within any reasonable cost.

4. The catchment basin of the Cooum occupies an area of 275 square miles. Captain Prendergast has ascertained that the heaviest fall of rain on record occurred in October 1846, when 20.58 inches were measured at Madras in 24 hours. Assuming that this fall extended over

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1st March 1864.**

the surface of the whole valley, and allowing only one-fourth of it to run off. Captain Prendergast calculates that the discharge of the river may, in extreme cases, be as much as five millions of cubic yards per hour; but he thinks it probable that so great a rain fall cannot be very general, and he reduces his estimate of the quantity of water requiring to be provided with an outlet to three millions of cubic yards per hour, which he shows, in paragraph 6, closely corresponds with the river discharge as computed from the sectional area and slope of its channel at the Harris' Bridge.

5. The four points to which the Superintending Engineer's attention was directed in designing the required work were not laid down with any intention of their defining the plan, or the mode in which the objects in view should be attained, but merely as suggestions, and the Governor in Council is of opinion that they should still be looked to. If space for the discharge of the flood-water, even by doubling the height of the sluices, could be obtained, a work of the kind described would accomplish all four objects, but it would not certainly be adequate to the discharge of a quantity of water any thing like so vast as that estimated by Captain Prendergast occasionally to require outlet.

6. It appears to His Excellency in Council, however, that this is a very exceptional quantity, and though it would seem that during the few hours of the continuance of such floods as that represented to have taken place in October 1863, a large portion of Madras is necessarily under water, the Governor in Council is inclined to doubt the hypothesis on which the discharge at that time is supposed to have been five millions of cubic yards per hour, as well as the calculations, which, based on the sectional area and slope and on the hydraulic mean depth of the river at the Harris' bridge, make the discharge nearly three millions of cubic yards per hour in ordinary full freshes. His Excellency in Council thinks that if accurate measurements of the river be taken below Government House Bridge, the quantity of water flowing to the opening in the Bar will be found much less, and being of opinion that this question, on which the feasibility or otherwise of closing the Bar, as sketched out, must depend, cannot be satisfactorily settled without sections of the river at various places, and at the outlet of the stream through the Bar, and without the determination of its velocity by experiments at various periods, he resolves to direct the Superintending Engineer, 4th Division, to make arrangements for the preparation of the requisite sections, and for ascertaining the velocity of the stream at different depths from actual measurements of the speed of its surface current during next monsoon.

(True Extract)

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

To the Superintending Engineer, 4th Division.

Exd. T. Dur.

Superintending Engineer's Office,
Madras. 25th January 1864.

N^o 4720.

From,

Colonel A. J. M. Poileau, R.E.

Superintending Engineer, 4th Division.

To,

Colonel Charles A. Orr, R.E.

Secretary to Government, P. W. D.

Sir,

Enclosed.

- 1 Letter N^o 632
of 19th December/63
from the Executive
1 Rough Plan of
Calicutah -
1 Rough estimate
3 Plans of new
side bridges for
Bar -
2 Plans of necessary
bridges -

In obedience to the order of Government N^o 3233 dated 6th November 1863, I have the honour to forward a Plan and Estimate (in rough) for a Calicutah of the character, though not in accordance with the levels, proposed in the Minute of the Honourable the President of the Council dated 29th October 1863. These have been prepared by the Executive Engineer Presidency whose report is enclosed.

The first thing that struck me on reading Sir M. Denison's Minute and also the order of Government N^o 1451 dated 24th June 1862, which alludes to the construction of Aqueducts on the Krian

to

"to retain the whole of its flood water," was that His Excellency, not even, I believe, having had an opportunity of seeing the Krishna River in genuine flood, has considerably underrated its discharge, which is occasionally, as shown in Paras 5 and 6 of Captain Prendergast's Report as much as 3 Millions of Cubic Yards per hour. The Executive Engineer's Estimate of the Hydraulic Mean Depth is somewhat in excess of that which I have allowed in my Calculations, but on the other hand his 'fall of River' is I think too small. By a line of levels which I have had taken between the 5th and 8th Miles distant from the Sea, I find it in some miles as much as 6 feet per Mile. The Krishna, moreover, has at times to carry off not only its own water but also a portion of those of the Corstelia which come down through the Canal; this was the case on the 14th December last (when the Bar was cut open for the second time in the season) the Canal was then coursing along like a rapid river, full to the brim. This discharge, be it remembered, is not even taken into account by Captain Prendergast. Another Engineer Officer of great Irrigation experience informed me that his calculations led him to the conclusion that

that we should allow for 4 Millions of Cubic Yards per hour! Assuming, however, 3 Millions as the maximum discharge per hour, and taking the "data" laid down by His Excellency, which establishes the 3 feet mark on the gauge (or 2 feet above mean sea line) as the level of the floor of his Calingulak, and admits of a maximum depth for the water to flow off, of only 18 inches, a Calingulak of no less than 1,100 Yards in length would be required, which with a section assimilating to that given in the work proposed by Captain Prendergast, in the accompanying Plan (and which appears to me not unnecessarily strong) would cost about 8 Lakhs of Rupees.

3. The floor level fixed by His Excellency cannot well be lowered without losing sight of the 4th condition laid down in the Minute viz, "The exclusion of all salt water", and of course the ~~4th~~ ^{4'6"} mark on the Gauge cannot be allowed to be overtopped, as by doing so, much of Madras would be under water; so that we become tied down to a work of the length above stated, and which it is obvious can never be constructed.

4. With a view to reduce this great length; the

the Executive Engineer has in the Plan now forwarded, placed the floor of his building nearly on the same level as Low Sea water line, giving up altogether the idea of sluice gates, and of excluding the Sea water, and calculating for a work 730 feet long, over which he proposes to construct a platform bridge in 22 Bays. The cost of such a work would be about $1\frac{1}{2}$ Lakhs of Rupees.

5. My opinion is that the site of the Krishna Bar is not that which should be chosen for any operation connected with the retention of fresh water in the River, as it is too near to the sea, with whose vagaries we are little acquainted, to say nothing of the effect of sand-drifts on the work. The Gap should no doubt be spanned by a Bridge, and a long standing reproach be thus removed from Madras. That which commands itself to me as the most suitable means of crossing such a place is a screw Pile Bridge similar to, but of lighter materials than that used in the Pier and I think this is the first step to be undertaken.

6. Plans I find have been already prepared, and will be matured by me in communication with screw Pile Engineers at home if Government approve. That would meet the 1st and 2^d points of Sir

Sir W. Denison's Minute. For a work to maintain a maximum amount of fresh water, and if practicable to exclude all ^{salt} water (the 3^d and 4th points) I would look to a different site than that proposed by His Excellency, and I do not see why such should not be formed in connection with the 'Government House' and 'Wallajah' Bridges which would well bear (especially the latter) remodelling, enlarging of the waterway, and conversion into sluice Bridges, the sluices being formed (if necessary) with 2 sets of shutters, of the ordinary kind in front, and self-acting in rear.

7. Should that arrangement be objected to, His Excellency might perhaps look favorably on a project of Colonel Morsley's for constructing 2 Bridges at the "tail" of the Island, the one communicating with the Band Beach, the other with the Government House Compound near the Marine Villa.

8. The Plans of these works are enclosed. Sluices could with great ease be built into them, when, as much waterway would still remain as is now found in the Government House and Wallajah Bridges.

J

9. I await further orders, only observing
that, until something permanent is authorized,
Colonel Miller's temporary dams may be made
very serviceable.

Madras
25 January
1864.

I have the honor to be
Sir,
Your Most Obedt. Servant

A. B. B. Colouel RB

Suff. Engineer, 4th Div

To,
Colonel Charles A. Orr, RB
Secretary to Government
Public Works Department.

Int. Executive Engr's Office
Madras 19th December 1863.

N^o 632.

From.

The Executive Engineer
Presidency.

To.
The Superintending Engineer
1st Division.

Sir,

Enclosures. 2.

1. Pencil Plan
1. Rough Estimate.

With reference to your orders N^o 3281 of the 13th November, I have the honor to report upon the proposition of building a Calingula at the mouth of the Cooum river.

2. The valley of the Cooum extends over an area of 275 square miles; the heaviest fall of rain on record, took place in October 1846 when 20.58 inches fell at Madras during 24 hours. Allowing then for the maximum fall of 20½ inches, and supposing that $\frac{1}{4}$ th of the rain fall runs off towards the sea; an outlet is required for 5,042 - 292 cubic yards of water per hour.

3. In the Minute of the President in Council the surface of the floor of the Calingula is taken at about the level of the 3 feet mark on the gauge, or 2 feet above mean sea level; and a level of 4' 6" on the gauge being considered a maximum height, at which it has been a standing rule to put the Bars there is left a height of 18 inches for the water to flow into the sea.

Now.

1273/1864-65
The Engineer in Charge
Madras 19th Dec 1863

The Superintending Engineer
1st Division

To.

The Secretary to Government
Public Works Dept^y

Dated 25th
Dec 19th 1863

B.S. No. 4920.

Submitted to the Plan
and Estimate called

for the by O. No. 3283
dated 6th November 1863

for the construction of a
Calingula across the
Cooum River.

1273/1864-65

1553-54/64/02/1863

4. Now if it is supposed that the water in the river stands at the height of 3 feet on the gauge, and a maximum fall of rain comes on, the length of Calingula necessary to carry off the volume of water of 5,042.292 Cubic Yards per hour at a depth of 18 inches, is by Smith's Tables 5702 feet or 1 mile and 442 feet of actual water, was neglecting the space occupied by the River.

5. But it is known that an excessive fall of rain at Madras, does not extend far inland; and the area drained by the Cooum, consists of a strip of country running nearly from due West, so that little or no rain may be falling at the Cooum bank, when there is a maximum burst at Madras. There are no records to show, to what distance from the coast, the Madras rains have extended, but on the assumption that there is a maximum fall of 20.5 inches over one third of the drainage area, or 90 square miles, that one half or 10.25 inches falls over the second third of the area, and that one third or 6.8 inches falls over the remaining area of 95 miles. Considering also that $\frac{1}{5}$ of the water that falls, runs off the ground, the discharge to be provided for

per hour, amounts to 3,059.558 Cub. Yards - and the length of Calingula to carry off this volume of water at a depth of 18 inches, is 3460 feet.

6. The above assumption, as to the extent of country over which the rain spreads, gives a result, not much differing from that obtained by calculating the volume that can be discharged by the river when quite full at a point close to the Harris Bridge. From a section of the river taken from the Bridge on the Poonaallee road, down to its mouth, a distance of $6\frac{3}{4}$ miles; the fall is 11.4 feet or at the rate of 2.13 feet per mile - but there being a deposit in the bed of the river near the beach, the lowest point is found to be, a short distance below the Government ^{House} Bridge; and the fall from the Poonaallee road Bridge to this point, is 17.2 feet; or a little less than 3 feet per mile. Again from the Poonaallee road Bridge to the Harris Bridge, the fall is $3\frac{1}{2}$ feet per mile; while from the College bridge to the Harris bridge the fall is 3 feet in $1\frac{1}{2}$ miles, or only 2 feet per mile. The most decided fall is in the first 2 miles from the highest point, in which it is 4 feet per mile. Considering the different slopes of the river bed, I have taken for calculation the fall of

of the river at $2\frac{1}{2}$ feet per mile; which is the actual fall in 1 mile, measured $\frac{1}{2}$ mile both above and below the Harris bridge, and the sectional area being 3390 square feet, and Hydraulic mean depth 12.7 feet, the discharge is 2,971,900 Cubic yards..... (B) per hour, and to admit of this body of water flowing into the sea at a depth of 18 inches, the length of Calingula must be 3360 feet.

7. It appears therefore, that a depth of only $1\frac{1}{2}$ feet of water, is insufficient to discharge a full flow of the river, without extending the Calingula to an unreasonable length. By the least of the computations made above, 1120 yards, the Calingula would extend to a length, as great as from the Fort ditch to the Marine villa. The depth of water over the level as determined for the floor, cannot be increased, without flooding the lower parts of the town; it is therefore necessary, to lower the level of the Calingula floor.

8. When the bar is put, the river in ordinary seasons makes an outlet of from 2 to 3 hundred feet in length, and the question suggests itself, whether a length of Calingula of 100 yards, will discharge

Then you admit the salt water of fresh air.

Running in parts 14 or 15 feet deep.

a maximum fall of rain. The volume of water to be discharged being taken. 19

1st, wide A. above, 5,042,292 Cubic Yards per hour: the depth at which the water must flow, to discharge the same quantity as at 18 inches depth over a length of 5702 feet; is 10 feet 9 inches: and if the floor of the Calingula be placed at mean sea level, the river water will be raised to $10\frac{3}{4}$ feet above the mean sea level. By a glance at Captain O'Connell's map, shewing the levels of different parts of the town of Madras, it will be seen, that the river standing at the above height, would submerge the whole of Chintadripett; the water would be 4 feet deep on the Poonaallee road North of St. Andrews Church; all the East side of Vepery would be under water and the flood would extend over the whole of the People's Park, to the Powder Mills and the Perambore Lines.

2nd if the volume of water is taken at (B) 2,971,900 Cubic Yards per hour, the depth, for the same quantity, as would flow over a length of 3360 feet, at 18 inches depth, is $7\frac{1}{2}$ feet and the water thus flowing to sea at a height of $7\frac{1}{2}$ feet above mean sea level, would rise over the left bank for some distance above and below the St. Andrews Bridge.

The Vepery lines had knee deep water in them when we cut the Bar on the 6 Dec, the gauge standing at 4' 7" by rising to 4' 9" while cutting was going AB.

Bridge, would surround St. Andrews Church; and also cover the Peoples Park, a strip of Vepery, part of Pursuaniam &c.

9. The length of 100 yards is thus shown to be not sufficient to carry off the compact fall of rain: and as it is found by experience that the river water should not rise above 4. 6" on the gauge: the consideration follows, what length of Calingula will then suffice!

The discharge being first taken at A: or 2,241,018 Cub. feet per minute, the required length is 1096 feet and again for a discharge B, or 1,320,844 cubic feet per minute, the required length is 646 feet. The floor of the Calingula being in batts, cases, on the level of the foot of the gauge or 1 foot below mean sea level. The least computed length being 646 feet of water way, or 22 spaces of 30 feet each; the space occupied by 21 piers, of 1 foot thickness, adds 84 feet in length and makes a total length of 730 feet between the wing-walls; and as this length is required for a depth of water of $4\frac{1}{2}$ feet, no account is here taken of the intermediate upright stones which would have to support the shutters, as contemplated in the order of Government.

The sea water and
be admitted, and
the excellent
condition of light

Government; and in consequence of which a further addition should have to be made to the work.

10. The enclosed pencil sketch, shows the plan and sections, of one span of 30 feet, the piers being 4 feet thick, and 5 feet high, and the foundations, 7 feet deep, with a base of 12 feet, resting on 2 wells. The flooring is of brick in edge on a course of rough stone laid with concrete. On the riverside, there is a retaining wall, built as the piers, on wells, and on the sea side, a rough stone apron. The superstructure consists of joists 12 inches in depth, laid $1\frac{1}{2}$ ft. apart & 3" plating above, to carry the road metal. The rough estimate is calculated for one pier, with the adjacent flooring, retaining wall, rear apron and superstructure. and amounts to the sum of Rs. 7680.

The flooring should
entirely of
brick.

Quite out of the
question.

d. d.

This cannot be
considered as salt
water would be
allowed to come in to
the River.

Hence, taking the discharge A; and allowing a depth of water of 18 inches, the length of waterway being 5702 feet, or 190 spans of 30 feet; the cost of the work will be 14,59,200 Rupees.

taking the discharge B, and depth of water 18 inches; the length of waterway is 3360 feet, or 112 spans. and the cost is 8,60,160 Rs.

Again with a discharge A; and allowing a depth of water of $4\frac{1}{2}$ feet; the length of

of water-way is 1096 feet or 37 spans, and
 the cost \$2,84,160. - Also with a discharge
 B, and depth of water 1 1/2 feet; the length
 of water-way is 646 feet or 22 spans in all
 and the cost \$1,75,960 Rupees.

I have the honor to be,

Sir,

Your most obedient servant
 Henderson August Captain R.E.
 Executive Engineer Presidency.

The Govt. of Bengal
 25th Aug 1863

The Executive Engineer
 25th Aug 1863

Handwritten signature

25th Aug 1863
 25th Aug 1863

Handwritten signature
 25th Aug 1863

Handwritten signature
 25th Aug 1863

Report upon the

proposition of building

a Calingula at the mouth

of the Coombar river and

forwards a small

and rough estimate

Rs. 1080. For one set

of a tunnel

Minute - 23
 I have read Capt. Dunderg's
 Memorandum on the subject
 of the Armenton Bridge over
 the Coombar River, and Mr.
 Proctor's covering letter on
 the same subject, and I
 should infer from these that
 we have not as yet suffi-
 cient data to deal with
 the question fully.
 In my minute of 16th Nov 62
 I noted some points to which
 the attention of Mr. Engineer
 should be drawn; and
 there I am still of opinion
 should be looked to as the
 objects which ought to be
 attained if possible.
 With regard to the 1st & 2nd
 requisition can be raised.
 The 3rd is necessary for
 the comfort of those who
 may inhabit Govt. houses
 for the smell of the Banks
 at the outlet of the river
 above Govt. houses and
 is intolerable when there
 are left uncovered by the
 discharge of the water
 through the outlet when
 the bar is cut - -
 The fault is almost a
 corollary of the third for
 if fresh water is kept in
 up to high water level
 salt water will not find

entrance. -

In my memo however
Nov 63 I did not in
any way intend to lay
down any plan or to
decide as to the mode in
which these four points
should be attained.

but merely to make a
suggestion for the con-
sideration of the officers to
whom the planning of the
work might be entrusted.

If the space (allowing any
reasonable width from

Calingula) could have been
obtained for the discharge
of the flood water even
by doubling the height of
the sluice the Calingula
would have accomplished

all the four objects. but
it certainly would not
be adequate to the discharge
of a body of water in any
way approximating to
the quantity mentioned
in Capt. Sander's
memo -

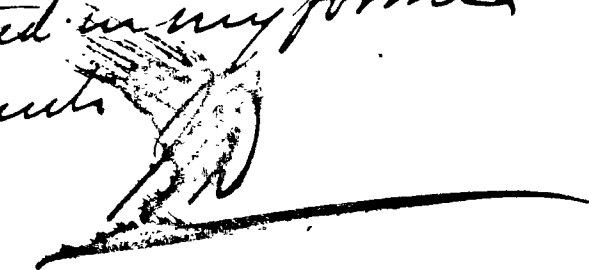
I may observe however in
the first place that this
is a very exceptional quan-
-tity, and that even
when the Bar was cut
and a free opening left
to the water, a large por-
-tion of Madras was under

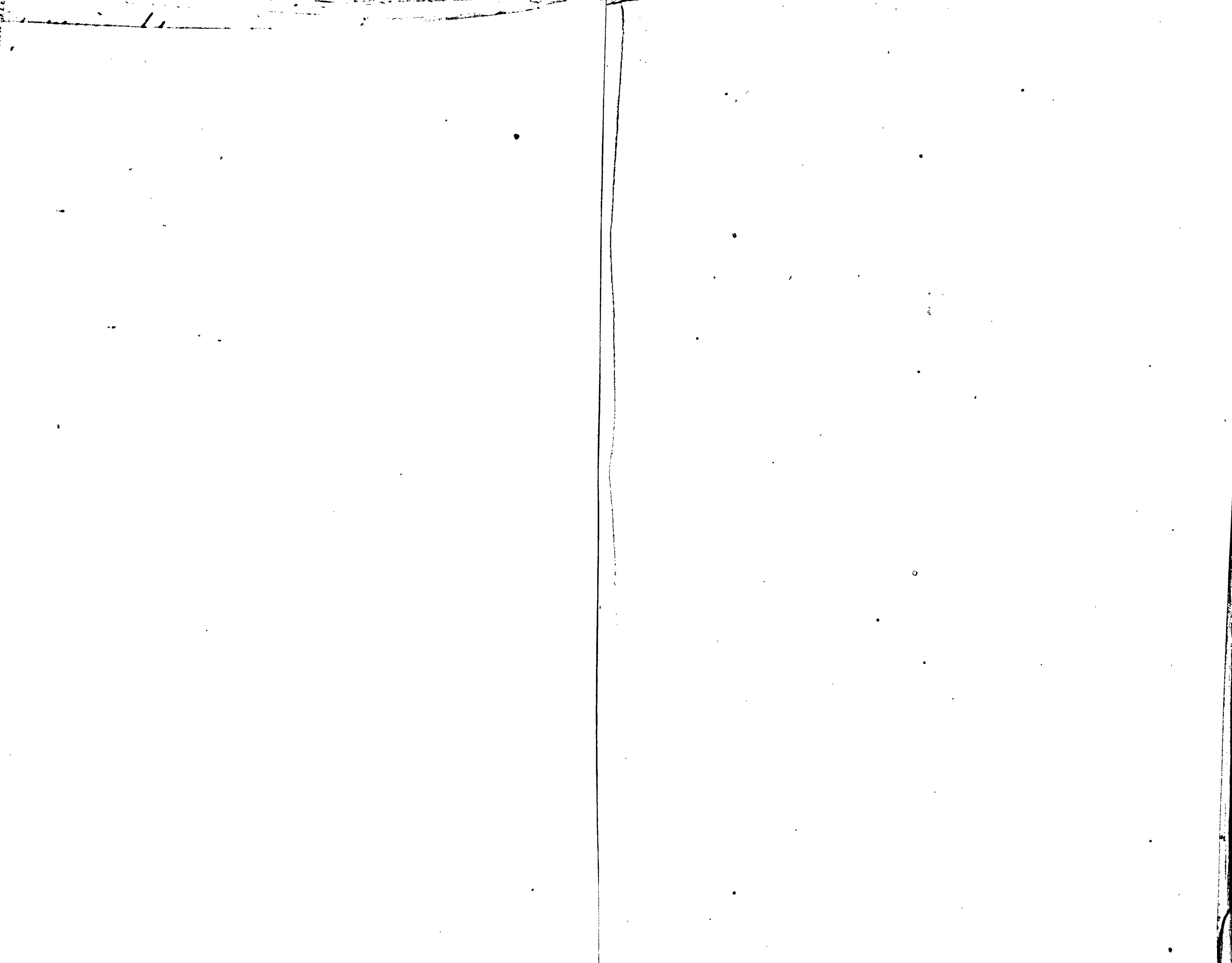
water for some time -
according to the statement
given and the calculations
based upon that statement
it would seem that ^{during the monsoon Feb 1846} 20 1/2
inches of rain fell in 24
hours and that, on the
assumption that one fourth
of the quantity made its
way to the outfall, a body
of water equal to 5 million
cubic fathoms must have
passed through the opening
in the bar in every hour
of that day - or at all events
in every hour of some con-
-secutive 24 hours - now
this is an hypothesis the
correctness of which I am
inclined to doubt at all
events it is a matter to
be verified by experiment
it would seem that the
discharge at the Stani
bridge with the rather
extraordinary hydraulic
mean depth of 12.7 feet
the discharge is 2,971,900
cubic fathoms and of
the sectional area of the
Canal below Gov. House
bridge and the hydraulic
mean depth there is taken
the body of water flowing
to the opening in the bar
would I imagine be
much less. I say, imagine
for we want details of the

in various places. we
want experiments as
to the velocity of the current
during different periods
of the monsoon. we
want accurate sections
of the depth of the stream
at its outlet when the
Bar is open. —

It is stated by Captⁿ
Drendyatt that in order
= many seasons the river
makes an outlet of from
2 to 300 feet in width
& a marginal note says,
"running in parts 14 or
"15 feet deep" now of
any part of the channel
is 14 feet deep for its
length. it would cut
a gap through the sand
of the beach 10 feet
deep or rather 10 feet
below low water mark.
my conviction is that
nothing of the kind can
take place. the head of
water above high water
mark is too trifling to
serve it. that amount
of action especially when
it is considered that
the specific gravity of
fresh water is less than
that of salt water. and
at low water with

an additional 3 or 4 feet
of fall I very much doubt
the extension of this action
to any ^{great} depth below low
water mark. —
there however are more
hypotheses. the fact is
one which starts us in the
face every year, and it
would be very desirable
that we should deal with
it practically, and at-
= certain what is the
actual result of the
action of the waves of
water through the Bar
before we attempt to go
into the details of a scheme
which to be complete
should certainly fulfil
the four conditions men-
= tioned in my former
minutes.





(N. 1864 50th
 700 of 1000 for March
 - 45380

Minutes by the
 Honorable the
 President

Dictated 6/18/64
 (Per 19)

Making certain de-
 -tions on Capt. Presidencia's Memo
 on the subject of the Amintor Bull
 over the Cozum River, Pucallpa.

No 25

No 619 - 1st March 1864

Proceedings of the
 619 Public Works Department
 Under date the 1st March 1864
 Read the following letter
 from the Super. Eng. 4th Div.

Submit a Plan and Es-
 -timate something similar
 to that called for in D.
 No. 3233 of 6th November
 1863 for the construction of a
 Calmuck across the
 Cozum River.

Minute by the Hon. the
 President

It is dated 28th January 1864
 No 4720

It is 9th Feb, 1864

In Proceedings of
 Government No 3233 of
 the 6th November 1863, the
 Superintending Engineer of
 the 4th Division was called
 upon to prepare and sub-
 -mit plans and Estimates
 for permanently closing
 the mouth of the Cozum
 by a work which, ex-
 -cluding all salt water,
 and retaining a maximum
 quantity of fresh, should
 provide for the discharge

M

See with at 1st
 comm -
 Pucallpa
 Cozum

of surplus water in
floods and maintain
uninterrupted the means
of communication along
the South Beach.

2. Such a wall,
it was believed, would
be a masonry Calingulak,
emounted by a bridge
having its roadway
supported on piers on
the level of the present
beach road. Between
the piers, shutters might
be placed, and the crown
of the Calingulak corres-
ponding with 3 feet on
the gauge, the upper
edges of those shutters
might be on a level with
the

the 11' 11" mark on
that gauge, 3' 4"
above mean tide.

3. Colonel Boileau
now replies to that re-
-question by, forgoing
ing, with some observa-
-tions and suggestions,
a letter from the Ec-
-cutive Engineer of
the Presidency report-
ing the result of the
investigation which, in
pursuance of his in-
-structions, he had
made ~~into~~ ^{into} the subject,
and which goes to show
that, owing to the low
level on which the
greater part of the pro-
-pulsive district of
Madras is situated,
not

not permitting of the
level of the River being
raised to give even a
moderate head of
discharge at the
site of the proposed
Calingulah, the con-
struction of a work
of that kind, even on
a much lower level
than that prescribed,
is not practicable
within any reasonable
cost.

4. The Catchment
Basin of the Corom.
occupies an area of
275 square miles -

Captain Pennington
has ascertained that

the heaviest fall of
rain on record occurred
in October 1846, when
20.58 inches were mea-
sured at Madras, in
24 hours. Assuming
that this fall extended
over the surface of the
whole Valley, and allow-
ing only one fourth
of it to run off -
Captain Pennington
calculates that the
discharge of the River
may, in extreme cases,
be as much as five
millions of cubic yards
per hour, but he thinks it
probable that so great
a rain fall cannot be
very general, and hopes
his

his estimate of the
quantity of water re-
quiring to be provided
with an outlet to three
millions of cubic yards
per hour, which he
shows, in para 6, closely
corresponds with the
River discharge as com-
puted from the sectional
area, and slope of its
Channel at the ^{Harris} ~~Barrage~~
Bridges.

5. The four points
to which the Superintend-
ing Engineer's attention
was directed in designing
the required work were
not laid down with
any intention of their
defining the plan of
the proposed work, or
the

the mode in which
the objects in view
should be attained,
merely as suggestions,
the Governor in C.
is of opinion that
should still be looked
to. Of space for the
discharge of the flood
water, even by doubling
the height of the sluice
could be obtained, a
work of the kind de-
scribed would accom-
plish all four objects
but it would not certainly
be adequate to the
discharge of a quantity
of water any thing
like so vast as that
estimated by Captain
Pendergast occasionally
to

to require outlet.
It appears to His
Excellency in Council
however, that this is
a very exceptional
quantity, and though
it would seem that
during the few hours
of the continuance
of such floods as
that represented to
have taken place
in October 1846, a
large portion of the
is necessarily under
water. The Governor
in Council is inclined
to doubt the hypothesis
on which the discharge
at that time is
supposed to have been
fixed.

five millions of
yards per hour, as
the calculation
which, based on the
sectional area and
and on the stream
mean depth of the
at the Barr's (Spa)
and the discharge
nearly three millions
of cubic yards per
hour in ordinary
floods. His Excellency
in Council thinks
that if accurate mea-
surements of the River
be taken below Post
Horse bridge, the
quantity of water flow-
ing to the opening in
the Bar will be found
much

much less, and
being of opinion
that this question ^{on which}
the feasibility of either
mode of closing the
bar, as sketched out,
must depend, cannot
be satisfactorily
settled without section
of the River at various
places, and at the
outlet of the Stream
through the bar, and
without the determination
of its velocity by
experiments at various
periods, the results
to direct the Super-
intending Engineer.

4th Division to make
arrangements for the
preparation of the sec-
tion, and for ascer-
taining the velocity of the
Stream at different
depths from actual
measurements of the
speed of its surface
current during next
monsoon.

The Superintending Engineer
with Plans & Estimate
23rd March

1864 Depo

No. of Geo. for March

No 619

No. of the Alport

Depo. of March 1864

March 30/65

Papers on the subject
of the Amineat or a
Bridge over the
Cannon river, Presidency
District.

No 24 @ 26.