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(2) புதுக்கித் திருப்பிய நாள் [illegible]

(3) ஆதாரங்குறிப்பவர் கருக்கொப்பம் [illegible]

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—again the following paper:—

G.O., dated 28th July 1892, No. 2103 W., Public Works.

Read—the following Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George, dated India Office, London, 16th June 1892, No. 3 P.W.

I forward herewith, for the information of your Excellency's Government, copy of a despatch * which I have recently addressed to the Government of India enclosing a report by Mr. F. N. Thorowgood on the measures which he proposes for improving the harbour of Vizagapatam.

* No. 27 of 16th June 1892 and enclosure. (The plans referred to in the enclosure have been sent to the Government of India.)

ENCLOSURES.

Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, 16th June 1892, No. 27 P.W.

With reference to my Public Works Despatch, No. 62, dated the 15th October 1891 I forward herewith, for your Excellency's consideration, copy of a report* which has been submitted to me by Mr. F. N. Thorowgood on the results of his investigation into the condition of the harbour at Vizagapatam.

* Report, dated 25th May 1892, and two plans.

2. The measures proposed by Mr. Thorowgood for the improvement of the port are (1) the construction of a groyne from the shore north of the river mouth; (2) the excavation of some reclaimed land, with the object of increasing the tidal capacity of the estuary; and (3) the dredging of the mouth of the channel. The total outlay involved in these improvements, which need not be carried out at once to the full extent proposed, is Rs. 6,11,271.

3. A larger scheme, estimated to cost Rs. 43,27,272, is also proposed by Mr. Thorowgood, with the object of forming a deep sea harbour, enclosed by piers constructed from the shore north and south of the entrance to the river.

4. I have to request that I may be furnished with your Excellency's views, after consulting the Madras Government, on the suggestions made in this report. I have already, in a previous despatch, expressed my opinion that the connection of the port of Vizagapatam with the Indian railway system, on the construction of the East Coast Railway, will add new importance to the question of improving the harbour.

From F. N. THOROWGOOD, Esq., M. INST., C.E., to the Under-Secretary of State for India, dated Wimbledon, 25th May 1892.

[*Vizagapatam Harbour.*]

I have the honour to submit herewith my report upon forming a harbour at Vizagapatam, together with two plans (Nos. 1 and 2), in accordance with orders and instructions given in your letter of 8th October 1891, No. 1779 P.W.

2. *Arrival at Madras and Vizagapatam.*—I arrived at Madras on 25th November 1891, and at once reported myself to the Chief Secretary to Government, and had interviews with the Public Works Member of Council and Colonel Pennycuick, R.E., Chief Engineer, Public Works Department. I received a very large and most interesting batch of papers containing

all that had been written on the subject of Vizagapatam Harbour, commencing at the year 1858 together with plans and sections of the port and backwater. At Madras I was detained till 30th November, the coasting steamer being very late, and I arrived at Vizagapatam on the morning of 4th December.

3. *Previous opinions on the Harbour.*—I shall have to refer in some detail to the opinions of others who have advocated the construction of a harbour at this port, as the features of the coast are rather peculiar, and it is certainly curious to see what conflicting decisions have been arrived at. It is unnecessary for me to describe the town and situation of the port of Vizagapatam, as these are sufficiently indicated on Drawings Nos. 1 and 2. It differs, however, from any port on the Coromandel coast in this, that on the south side of the river mouth instead of a low flat sandy shore, there are almost precipitous cliffs, reaching a maximum height of 536 feet above high-water, the highest and boldest being known as the "Dolphin's Nose." This headland projects 1,500 feet eastward of the narrow entrance to the river or backwater, and thus protects it from the swell of the south-west monsoon. The water round this headland is deep, and more free from sand in suspension than is the case where the shore is low and flat.

4. *General features of Vizagapatam Port.*—At first sight it is impossible not to be struck with the natural advantages that the place possesses for making a harbour, the backwater offering a fine sheltered area hemmed in by hills, and capable of being made into docks, quays, wharves, &c., to accommodate a large trade. And it is absolutely distressing to see this fine backwater almost cut off from the sea by the long spit of sand which blocks the mouth, and is generally called the bar. On this sand spit or bar, except at high-water, on the smoothest day, there is a constant and most dangerous surf ever breaking. (See Drawing No. 1.) The removal of this bar has been the problem on which so many opinions have been offered, and I am obliged to come to the conclusion that many of these opinions have been arrived at on insufficient evidence.

5. *Other opinions as to methods of improving Port.*—In September 1858 Lieutenant Vertue, R.E., reports to the Government of Madras that "the bar is formed by material brought down by the river, and is composed of soft mud, not of sand," and that, "by means of a groyne of rough stone projecting seaward from the northern side of the river's mouth, ... the loose material of which the bar consists would be swept away."

6. Mr. E. T. Thomas, C.S., has taken a great interest in the port, and he describes it in a memorandum to the Madras Government, 24th September 1872, as "the most natural and the most easily formed port on the East Coast Peninsula;" and further says, "if the bar were removed, the harbour would be made."

7. Captain Waters, Master Attendant at Vizagapatam, proposes in 1873 a groyne, 700 feet long, run out from the *south* side of the river as the only means to render Vizagapatam a safe port.

8. Major Beatty, R.E., has gone into the matter very fully, and his proposal was a groyne on each side of the river mouth. On the north side 1,200 feet long, and on the south (from the Dutch battery) 1,000 feet long.

9. In 1880 Major-General R. H. Shankey, R.E., investigated the matter very thoroughly, and has placed on record that he does not believe in the efficacy of any groynes to scour away the bar, which would probably only be thus put further out to sea, and that "we should not only incur useless outlay, but do perhaps irreparable mischief," by such works.

10. The late Captain I. H. Taylor, Master Attendant of the Madras Presidency, advocated no artificial works at Vizagapatam, because he believed that close beneath the surface of the sand or mud was hard, uncompromising rock. There are numerous other opinions and suggestions on record which need not be noticed, except one which I refer to in paragraph 36, viz., the proposal of Mr. W. J. Addis, submitted to the Secretary of State for India, 23rd November 1891, and handed to me by the Government of Madras.

11. I have carefully considered all that has already been put forward on the subject of this harbour, and I commenced my investigation without prejudice in any direction.

12. *Bar removed by heavy floods.*—The bar or sand spit is occasionally removed by heavy rains, and I find an undoubted record of a series of soundings taken a few months after the cyclonic storm of 1876, on which is shown a channel from the Dutch battery up to the bridge (called now Turner's bridge, as shown on the Drawings Nos. 1 and 2), with from 18 to 27 feet of water at low-water throughout. It is most important to bear this in mind, as where there was in 1877 a depth of 16 to 18 feet at low-water there now stands the "Sand Island" shown plainly in Drawing No. 1. This "Sand Island" was formed mostly while I was at Vizagapatam.

13. But these scourings out by heavy rain are uncertain, and there has been no such action now for more than three years. The present state of the river mouth is most lamentable, being one mass of broken water, through which I can from experience state it is not only disagreeable, but very dangerous to pass. Yet this present state of things may go on for a further indefinite period and be a serious obstacle to any trade.

14. I have therefore come to the conclusion that in submitting any design for improving the port, the river Maonderu (as I find it called on former plans) must be regarded only as a tidal backwater, and the question of rainfall or catchment area may be disregarded, except in so far as to suggest no work that may be damaged by one of these heavy rain floods.

15. As a matter of fact the river is tidal for a distance of nearly eight miles from the mouth, and it is to the tidal ebb and flow that we must look for the active force moving sand outward or inward. The scour of a heavy rain is an occasional event which must not be reckoned on if a useful harbour is desired.

16. In his letter to Sir Juland Danvers, dated 8th July 1891, Sir A. M. Rendel says, speaking of the river at Vizagapatam, "small as its forces are, the river seems even now to be only just unable to cope with those of the sea, for the depth on the bar diminishes from its deepest to its shallowest limit but slowly." Nothing can better represent the truth of this than the survey I have lately made, and which I shall have to refer to in detail. With everything against it, the river has still been able to maintain an exit to the sea through which boats can pass at high-water.

17. *Conflicting opinions about Bar.*—My first aim on arrival was to try to ascertain, first, what was the cause of the bar; secondly, from what source did the material composing it come; and thirdly, was it easily moved from its position. With regard to the last point it is evident that conflicting opinions had been held many years ago, for I find that the District Engineer, writing officially on 9th March 1859, says, "that there is strong evidence that the depth of water on the bar has not varied, nor has its size and position during the recollection of the oldest inhabitant," while on 8th March 1871, Major Beatty, R.E., writes making proposals "in order to remedy the constant fluctuations that the bar is subject to, both with regard to the depth of water upon it and the position of the deep channel." I therefore approach the matter of the so-called bar with much caution, but with the belief that the conclusions I draw are correct.

18. *Sand supply to the Bar.*—I find that the chief source of sand supply is due to wave action during the period from October to February, when the wind and littoral current are both from the north of east. If there were no river at all the sand would be heaped up against the rocky coast on the south side of the mouth of the estuary. By reference to the detailed survey of December 1891, on Drawing No. 1, it will be seen that the one-fathom line (one-fathom below low-water spring tides) runs out as a spit of sand for a distance of 640 feet to the east of the old Dutch battery. Before the state of the sea would permit me to take any soundings, I observed this state of things by frequently ascending the Dolphin's Nose headland and looking at the sand through the clear water at flood tide. A careful survey confirms the opinion I inclined to from mere ocular observation.

19. There is also another source of sand supply to the so-called bar, and that is a movement of sand when the southerly winds set in from seaward in towards shore. This I believe to be common to all ports on the Coromandel coast, and at Madras it was very conspicuous during the construction of the harbour piers.

20. The sand in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand, and as a matter of fact it became extremely difficult at this spot to get a survey of the bottom of the sea which might be called accurate for two consecutive days during the time of general change of wind from north to south.

21. *Fresh-water springs disturb sand.*—This extreme mobility of the sand I find to be very greatly due to the fact that the bottom of the sea is pierced by numerous fresh-water springs, which when intercepted on shore by wells form the water-supply of the place. Of these wells there are no less than 22 within one-eighth mile of high-water mark, and in one mile of coast, and the level of the surface of water in them all is about the same at the same minute of time, being about three feet above low-water level. These springs, when not intercepted, percolate up from the sandy bottom of the sea and render the sand very unstable, as may be plainly seen at such times as the water is smooth and clear.

22. These two sources of sand-supply, one from the north, due mostly to wave action, and one directly towards shore, also mostly due to wave action on the sea bottom, form the serious obstruction known as the bar.

23. By again referring to Drawing No. 1, it will be seen that in February 1892, on repeating the survey of the sand spit with wind and current from the South, the contour line of one-fathom is driven backward a distance of 320 feet. I therefore come to the conclusion that the bar is and always has been caused by sand brought, as I have suggested, during the north-east monsoon, and afterwards flattened back over the mouth in the south-west monsoon.

24. The direction of the crests of the breaking waves hardly varies at all, being throughout the year as indicated on Drawing No. 1. I am supported in this belief by some most useful information given me by Captain Winckler, for many years Master Attendant at Vizagapatam, and now at Cochin.

25. *Currents outside mouth of river.*—With regard to tidal and littoral currents outside the mouth of the harbour; they vary so much and so frequently, but always with so low a velocity, that I think they may be passed over. I have shown on Drawing No. 1 how, on two days in February, the ebb tide, as observed with floats sunk very deep, took two quite opposite directions, the velocity, however, was never more than 44 feet per minute. In the Bay of Bengal the flood tide comes from the south, yet I found in December, with a northerly wind, the current at flood tide set distinctly towards the south, as recorded on Drawing No. 2. On several occasions I have been unable to detect any current in seven-fathom water when the tide has been running rapidly into or out of the river. I therefore discard currents, outside the immediate neighbourhood of the river mouth, as having no general effect on the sand spit or bar.

26. *Evil done by the reclamation work.*—There seems to be no doubt whatever that the depth of water in the river and its mouth within the one-fathom line has diminished since the year 1870, when the reclamation of some swamp land was commenced. To quote Major Beatty, R.E., again, on 24th December 1873, he writes to the Collector of Vizagapatam,—"that from the date when the bunds for reclaiming were constructed, the bar has been rising at an average of two feet per annum;" and, indeed, it is impossible to doubt that the excluding of 2½ square miles of lands from the tide, even if this area were only covered to a depth of six inches, would make a serious difference in the scour of the tide at the mouth of the estuary, for it would cut off nearly 38 million cubic feet of water. In March 1874 Colonel W. Farewell, Deputy Chief Engineer, Public Works Department, wrote on this subject,—"there can be no doubt that the deterioration of the harbour is due to the reduction of the tidal estuary . . . . that Government should repossess themselves of the swamp, so essential to the existence of the harbour." And Major-General Sankey, R.E., drew serious attention to this in his note of 13th August 1880 to the Madras Government.

27. As will be seen later on, I do not advocate handing the reclaimed swamp back again to the tide, because in the last 18 years, by cultivating portions of it, by using it for grazing buffaloes, by occasional flooding and silting, the level of the general area is hardly appreciably below high-water spring tides, as found by numerous levels and sections I had taken upon it. But I most strongly advocate some measures for increasing the tidal capacity of the river, and this to be done by excavating into the reclaimed land.

28. *Borings on the Bar.*—Much anxiety seems to be felt at Madras as to whether there is rock to be found in such positions as to prevent the forming of a harbour, and I have no doubt that locally disappointment was caused by my inability to take borings on the bar. As a matter of fact this is impossible without most elaborate and costly plant, such as the occasion did not justify my demanding.

29. *Rock.*—The question of rock in the backwater (except where the rock can be seen) need not be considered, as the soundings after the storm of 1876 already referred to in paragraph 12 sets that at rest. From two borings I took, shown on Drawing No. 1, it is very evident that there is nothing in the way of rock to prevent the making of an excellent harbour with 18 feet of water at low-water. I certainly discovered a solitary rock or boulder at three fathoms deep (at low-water spring tides) off the entrance of the river (marked *r* on Drawing No. 1), but by probing down round it two or three feet deeper I got no more rock, so I think it to be an isolated stone.

30. *Proposals to improve the Harbour. Dredging.*—Having now briefly described the state of affairs at Vizagapatam, I venture to put forward my proposals for improving the port. I first strongly urge the use of a sand-pump dredger to clear a channel as shown in Drawing No. 1, with a depth of 10 feet at low-water, and to dredge away the sand island, which is doing such harm to the port. The application of dredging has been found so beneficial to the neighbouring port of Cocanada (similarly hampered by silt from the north) that I would very strongly recommend the use of a dredger at Vizagapatam, to be worked during the smooth season, to remove the present obstructions to traffic, which are truly distressing to see. I do not put the cost of this dredger down in the estimate for a harbour, as I have good reason to believe the port of Cocanada are willing to share the cost of a dredger with Vizagapatam, and allow the machine to work at the latter port in January and February. I simply wish to draw attention to what I believe to be the simplest and most direct way of improving the port at present, so as to be better able to carry on its trade. The dredger "Wenlock" was to have been sent from Tuticorin to Vizagapatnam while I was there, but it had to go to Bombay for repairs, and so could not have arrived at Vizagapatam till the smooth season had passed.

31. The dredger when working should remove the point of sand at the river mouth, and indicated on the plan as "point to be removed." The removing of this point seems to me to be of great importance, as the very narrow channel at that place produces at spring tides an abnormal velocity of flood tide (nearly always aided by wind and wave), amounting to as much as 208 feet per minute. This rapid tide through a sandy channel carries material with it, and ultimately forms and increases the sand island inside.

32. The ebb tide is retarded by wind and wave and does not achieve so great a velocity as the flood, but I often measured 180 feet a minute by observation, and by calculation from the present tidal capacity of the backwater passing through the narrow section of exit the result would be 176 feet per minute.

33. *Cost of dredging.*—To dredge a channel as shown on Drawing No. 1 from near the two-fathom line at sea up to and beyond Sand Island, with a minimum depth of 10 feet at low-water, would involve the removal of about 28,000 cubic yards of sand, at a cost of not less than Rs. 14,000. A very heavy rain flood might do more than this without any expenditure at all, but who can say when the next heavy flood will come, and what is to be done if it be postponed for two years more? In the appendix A to this report I give a detailed estimate of work to be done, so arranged that this sum of Rs. 14,000 may be included or omitted.

34. *Construction of a groyne.*—The only work of actual construction that I propose is a groyne, not less than 1,420 feet long from the low-water line, as shown on both plans in red colour; and I should prefer to extend it 130 feet further, at an additional cost of Rs. 35,675, to ensure no sand passing round the end of it. The position and direction of this groyne have been carefully considered, and I do not think that any other situation or direction would attain the desired two-fold object of keeping back sand from the river mouth and allowing sufficient beaching ground for waves to break upon. A good extent of beaching ground is absolutely necessary, and while the proposed position of the groyne affords this, it at the same time will interrupt many of the breakers which now disperse themselves on the shore near the ice house.

35. *Construction of groyne.*—The first 870 feet of the groyne, and the whole of its base, I propose to form with large rubble stone taken from one of the neighbouring hills. The outer 550 feet is to be surmounted with a wall of concrete block, 24 feet in width, similar in size and shape to those used at Madras harbour subsequent to the year 1885. I do not think that any less substantial work should be attempted in so exposed a situation, and there is evidently not a long enough period of smooth water to justify an attempt at building with concrete *in situ*. I have supposed that to build this concrete wall plant will be available at a low cost from Madras, as indeed is hinted by Sir Alexander Rendel in his letter of 8th July 1891. The concrete blocks can be made at the spot indicated in Drawing No. 1 as "site for concrete block ground." Stone can be brought easily by the Railway to the site of the groyne and to the block-yard at a rate of less than one anna per ton per mile, and excellent sharp coarse sand is obtainable along the shore.

36. *Mr. Addis' scheme.*—If a solid groyne or pier were run out straight to sea from the corner of the river mouth, as indicated in the design of Mr. W. J. Addis, referred to in paragraph 10, the result would, I fear, be to convey the breakers right up to the Port Office of Vizagapatam, and to undermine the railway now under construction.

37. *Excavation of the reclaimed land.*—To add to the tidal capacity of the estuary, I propose to cut away the foreshore of the reclaimed land eventually right up to the inner bund on the south side of the reclamation. This, however, may be done by instalments, and need not be undertaken as a whole to begin with. In Appendix A I give two estimates — one for the whole excavation, and one for half of the ultimate quantity proposed to be moved. This excavation is to be carried to ordinary low-water level by cooly labour. If a dredger is available subsequently, the water may be deepened in place by degrees, and gradually the shore may be used as a landing place for cargo. But the first object is to add to the tidal capacity of the estuary by removing land that lies between high and low water level, the subsequent deepening being a matter for future consideration. The material excavated is to be levelled up on the reclaimed land within the bund.

38. *Tidal capacity of estuary.*—I calculate the present tidal capacity at spring tides of the estuary at only 67 million cubic feet, and this calculation agrees almost exactly with what should be the capacity theoretically according to a formula which proportions the tidal ebb and flow to the low-water section at a river's mouth. By excavating into the foreshore, as shown on Drawing No. 2 to the full extent, an addition of over 19 million cubic feet will be achieved, or nearly one third more. But this will be at a cost of Rs. 1,93,200. But half this amount of excavation might be carried out at first at a cost of Rs. 96,000, and the result watched. The whole work may be progressive, and in the estimates in appendix A, I endeavour to make this clear.

39. *Cost of the different works.*—At present, for the full work proposed, including dredging and excavating, the cost would be Rs. 6,11,271, as shown in Appendix A (1). Or if the dredging be postponed, and only half what I propose be excavated, the total would be Rs. 4,78,041 — see Appendix A (3). If the groyne alone be built, and no addition made to the tidal capacity by excavation, the cost would be Rs. 3,62,751 — see Appendix A (4).

40. *Pier on the south side not wanted.*—There is one more point in this scheme that I ought not to pass over, and that is the necessity or otherwise for a short pier on the south of the river mouth. I have given this most careful consideration, especially as such a work was mentioned by Sir Alexander Rendel in his letter of 8th July 1891. I found by close examination on the spot that the line of broken water hardly varies at all in direction in either monsoon, and is as indicated on my Drawing No. 1. Further, I find that the old Dutch battery, close to the water's edge on the south corner of the river mouth, is only built of bricks and mortar, and it is impossible to believe that this would have stood so many years if it were attacked by heavy

seas. I have, therefore, arrived at the conclusion that no work on the south side is necessary for a small inner harbour. If any further work be required, it will be the extension by 100 or 150 feet of the northern groyne.

41. *Comparative surveys of* 1883 *and* 1892.—Another point I wish to call special attention to is this:—It has sometimes been urged by many who have taken up the question of a harbour at Vizagapatam that any work short of a very large one will be sure to silt up. My belief is that never until now has the matter been thoroughly considered, and I think it will be admitted that we can now see that the sand trouble at the river mouth is very local, and is covered by my proposed groyne of 1,420 feet from low-water. On Drawing No. 2 I have shown the contour lines at sea taken from Commander Falle's exquisite survey of 1883, and in my own survey of 1892. I have, as nearly as I could, followed Commander Falle's traversing lines. So we have, I may say, for the first time, two accurate surveys at nine years' interval, showing that in this interval, and with the bar now in an extremely bad condition, there is practically no change whatever in depth from the nine-fathom to the one-fathom contour. With the bottom of the sea so constant as this, I do not fear that the groyne now proposed will silt up or do otherwise than keep the river mouth clear.

42. *Deep harbour.*—I have now to refer very briefly to a larger design shown in blue lines on Drawing No. 2. This gives a magnificent outer harbour with a 900 feet entrance in nearly nine-fathom water, and with a distance of 2,100 feet shoreward under cover of the south pier up to the four-fathom line. And, with regard to this design, it must be borne in mind that the bar is not the only obstacle for working cargo at Vizagapatam, but that the ground swell often interferes with discharging cargo from ships.

43. If this larger plan were to be carried out, there would be safe anchorage for certainly 20 ships in the outer harbour, and the backwater might then be converted into docks and quays, which would compare favorably with any port in India except Bombay. The groyne thrown out for the smaller design would be extended as shown for the larger one, and I again suppose that cranes and plant from Madras might be utilized here. In this case I would propose a railway along the foot of the Dolphin's Nose headland, and a concrete block ground on the plateau above the Dutch battery, with a wire rope incline down to the railway along the shore. I give in Appendix B an estimate of the cost of this, which of course is great, amounting to Rs. 43,27,272.

44. In conclusion, I should like to be permitted to record my thanks to all those with whom I came in contact officially during my stay at Vizagapatam, which ended on 22nd February 1892. To Mr. Willock, to Mr. F. B. Walker, Chief Engineer of the East Coast Railway, and his staff, to Captain Woodhouse, Port Officer, and to Mr. Gardiner, of the firm of Stuart, Hall and Co., my thanks are specially due for having given me all assistance possible, and indeed more than I ought to have expected.

APPENDIX A.—Estimate of cost of the four alternative plans for improving harbour, referred to in Report and Drawings Nos. 1 and 2.

(1) The full work proposed :—
Groyne—

	Rs.
Rubble stone in commencement and in base to end of groyne, 70,338 tons, at Rs. 1-8-0	1,05,507
Concrete blocks in outer portion, 7,822 cubic yards, at Rs. 10-8-0.	82,131
Setting ditto in position, 7,822 cubic yards, at Rs. 2-8-0	19,555
Excavation in swamp to full extent — 19,320,000 cubic feet, at Rs. 10 per 1,000 cubic feet	1,93,200
Dredging mouth of channel — 28,000 cubic yards, at 8 annas	14,000
	4,14,393
Add plant and preliminary work	80,000
Block ground	15,000
	5,09,393
Contingencies at 10 per cent.	50,939
Establishment and office at 10 per cent.	50,939
Total for whole plan (1) ...	6,11,271
(2) Work as above omitting dredging and proportional part of contingencies, &c.	5,94,471
(3) Work as above (1), omitting dredging, and only doing half proposed excavation	4,78,541
(4) Construction of groyne alone...	3,62,751

APPENDIX B.—Estimate for Deep Sea Harbour referred to in paras. 41 and 42 of Report.

	Rs.
Plant and preliminary work, supposing cranes are available from Madras	1,50,000
Approach to south pier	28,560
Block ground and incline, south side	30,000
Additional to north block ground	15,000
Complete south pier, 3,300 feet, at Rs. 500 per foot	16,50,000
" north pier, 3,465 feet, at Rs. 500 per foot	17,32,500
	36,06,060
Add contingencies, 10 per cent.	3,60,606
Establishment and office, 10 per cent.	3,60,606
Total cost ...	43,27,272

Order—dated 28th July 1892, No. 2103 W., Public Works.

Recorded.

2. The orders of the Government of India will be awaited.

(True Extract.)

(Signed) J. PENNYCUICK, Colonel, R.E.,
Secretary to Govt., P.W.D.

READ—also the following papers :—

From C. VINCENT, Esq., Under-Secretary to the Government of India, Public Works Department (Civil Works—Miscellaneous), to the Secretary to the Government of Madras, Public Works Department, dated Simla, the 29th August 1892, No. 328 M.

With reference to Lord Cross' despatch No. 3 P.W., dated the 16th June 1892, to the address of the Government of India may be favoured with an expression of the views of His Excellency the Governor in Council on the measures proposed by Mr. F. N. Thorowgood, M.I.C.E., for improving the Vizagapatam harbour.

2. The chart and plan referred to in Mr. Thorowgood's report are herewith forwarded. They should be returned to the Government of India when the views asked for in para. 1 above are furnished.

Note by the Acting Chief Engineer, Public Works Department.

There is no reasonable doubt that an excellent fine-weather outer harbour for large ships could be made at Vizagapatam on the general lines of the Madras harbour, and for such a work Mr. Thorowgood's proposals appear suitable; whether the rough estimate in appendix B of his report gives a reliable idea of the cost is a different matter; I do not think it does.

2. Vizagapatam lies in a track much affected by cyclones, and the seas which at such times roll in upon the proposed site for the harbour, are as violent as any along the whole east coast of the Presidency; the harbour walls would therefore have to be as well founded, as massive, and as well protected from wave action, as those at Madras. The Madras harbour with a total length of sea wall of somewhat under 8,000 feet was estimated to cost 49 lakhs, but will really cost upwards of 123 lakhs; Mr. Thorowgood's Vizagapatam harbour wall would have a total length of 6,765 feet and his estimated cost for the harbour is 43·27 lakhs; it seems not improbable that it would really cost at least half as much again.

3. The Vizagapatam harbour would, however, have this great advantage over the one at Madras; it would have in connection with it a natural inner harbour available for boats and small craft, and affording exceptional facilities for the construction of wharves and jetties suitable for landing and shipping all kinds of cargo, and in connection with the railway.

4. When railway communication with the Central Provinces is opened it is not unlikely that an enormous quantity of their produce may seek its outlet at Vizagapatam, and then the construction of a ship harbour such as one under consideration may become imperative; but as matters now stand, they do not appear to warrant an expenditure of certainly not less than 43¼ lakhs and probably more than 65 lakhs.

5. Passing now to the minor scheme dealt with by Mr. Thorowgood of merely improving the entrance to the backwater, or tidal estuary; he proposes to effect this at a cost of Rs. 6,11,271, by—

1*st. Dredging* a channel with a minimum depth of 10 feet at low-water from the two-fathom line to about 600 feet west of the landing stage (see paras. 30, 31 and 33 of report).

2*nd. Constructing a groyne* 1,420 feet (preferably 1,550 feet) long, north of the mouth of the estuary, in the line shown on the plans (see paras. 34 and 35 of report).

3*rd. Increasing the tidal capacity of the estuary* by excavation of some of the land "reclaimed" in recent years (see paras. 37 to 38 of report).

6. Taking these proposals *seriatim*, I would remark that the cost of the *dredging* is put down as only Rs. 14,000 (exclusive of "contingencies" and share of "Establishment") and does not provide* anything for cost, or share of cost, of the "sand pump dredger" which it is recommended should be used. Such a dredger, or indeed any dredger, suitable for the place (it would have to be of the "hopper" self-propelling type) would certainly cost† not less than 1¾ lakhs. It is possible that the dredger "Wenlock" already possessed by the Madras Government might do the work, but most certainly to form a channel 1,000 *yards* long by 50 wide "as shown on Drawing No. 1, from near the two-fathom line at sea up to and beyond the Sand Island with a minimum depth of 10 feet at low-water," would require the removal of many times the 28,000 cubic yards put down by Mr. Thorowgood as the quantity to be dredged, whilst to *maintain* such a channel would require frequent, if not constant, dredging, so that a special dredger would have to be kept at the place. Even if the proposed groyne did cut off all accumulation of sand from the north, the ceaseless action of the surf or breaking waves, the general direction‡ of which is from the south-east, would certainly fill in the excavated channel from the expanse of sand surrounding it. Mr. Thorowgood himself notes in his para. 20 that the sand "in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand and in para. 21 he notices "the extreme mobility of the sand" and how "very unstable" the sandy bottom is at the place. It is certain that no channel there dredged to some feet below the surrounding plain of easily moved sand, which is for ever disturbed and swept along by the action of waves, would maintain its form or depth for any length of time without frequently recurring, if not constant, clearing; whilst there would be in every year long periods during which heavy seas would render such clearance impossible and after such periods there would be but little trace left of the excavated channel. *Probably Mr. Thorowgood considers that the increased tidal scour resulting from the increased tidal capacity which he proposes to give to the estuary would keep his channel clear, but it may be accepted as an absolute certainty that this would not be the case. Before the

* The provision of Rs. 80,000 for plant and preliminary work appears to refer only to the plant, &c., required in connection with the construction of the groyne.

† The "Wenlock" cost £12,600 delivered at Pamban.

‡ See para. 24 of Report.

reclamations the tidal capacity of the estuary was greater than that to which Mr. Thorowgood proposes to now restore it, but even then it was not able to keep the entrance to half the depth of Mr. Thorowgood's proposed channel. The entrance was at times scoured out by violent land floods to a greater depth even than that now proposed by Mr. Thorowgood, but was always before long* again levelled up to its previous shallow state by the natural forces perpetually at work.

* By the flood resulting from the cyclonic rainfall of May 1877 the "bar" was scoured out to a depth of between 9 and 10 feet at low water; in June of the following year the Master Attendant, Madras, reported that the bar was in a worse state than he had ever "known or heard of before" (see his letter No. 4684, with Proceedings of the Madras Government, No. 337, dated 27th June 1878).

7. As regards the proposed *groyne*, which is estimated to cost about Rs. 2,48,630,† I would submit that there is no evidence as to its probable efficacy. Mr. Thorowgood apparently had no opportunity of making observations on the movement of the sand at the place during the south-west monsoon, which has a very important bearing on the question. Granting that the groyne would arrest the travel of sand from the north and that more sand travels from that direction than from the south, there is nothing to show that there is not also a considerable movement of sand from the south and east which the groyne would also arrest, causing at times a deposit on its south side in the very place which it is wished to deepen; indeed, in para. 19 of his report, Mr. Thorowgood himself says "there is also another source of sand supply to the so-called bar, and that is the movement of sand when the *southerly* winds set in from seaward towards the shore;" such experience also as we have on the Coromandel coast points to the extreme probability that the proposed groyne will greatly aggravate the evil which it is intended to remedy. (I may here mention that the training walls or groynes at Cocanada are under totally different conditions from those at Vizagapatam, being at the head of a deep bay on a foreshore, free from heavy surf and quite sheltered from all seas from the south).

			Rs.
† Rubble	...	...	1,05,507
Concrete blocks	...	...	82,131
Setting do.	...	...	19,555
Share of contingencies	...	...	20,719
Do. establishment, &c.		...	20,718
Total		...	2,48,630

8. The proposal to *increase the tidal capacity of the estuary* is undoubtedly based on thoroughly sound principles. For the last 20 years or so, every officer of this department who has had to deal with the matter has pointed out the injury that would be and has been caused by the "reclamation" of land which used to be covered by the tides. To the "reclamation" is undoubtedly due some deterioration of the entrance to the backwater, and the nearer the capacity of that tidal basin is brought back to what it was originally, the more nearly will the "bar" return to its former state. That state was by no means excellent, though somewhat better than it now is, and I do not for one moment suppose that the increase in tidal capacity proposed by Mr. Thorowgood would keep open an unenclosed channel to a depth of 10 feet at low water, but it might probably add a very important foot or two in depth to the worst places, and any work carried out in that direction would be useful, whatever might be the way in which it is hereafter decided to treat the outer harbour question.

9. It may, I think, be safely asserted that the conditions which obtain at the surf-beaten mouth of Vizagapatam backwater are such that with the small range of tide available for creating tidal scour no permanent improvement to the extent anticipated by Mr. Thorowgood from his scheme can be achieved until the place receives thorough protection from the never-ceasing action of the surf and from the effect of violent storms; such protection can only be given by long and massive sea walls and they would, of course, be most advantageously disposed so as to enclose an outer harbour; not till that is made, I fear, can the inner harbour have an entrance channel with anything like a minimum depth of 10 feet at low water, except for comparatively short periods after great land floods, which are of infrequent occurrence, have swept through the mouth of the estuary and scoured it out.

(Signed) G. T. WALCH.
Acting Chief Engineer, P.W.D.

27th October 1892.

Endorsement by the Under-Secretary to the Government of India, Public Works Department (Civil Works—Miscellaneous), dated Simla, 17th October 1892, No. 428 M.

The following, with copy of the letter referred to and of its enclosure, is forwarded to the Secretary to the Government of Madras, Public Works Department, for information with reference to the correspondence ending with Public Works Department letter No. 328 M, dated the 29th August 1889.

ENCLOSURES.

From the Government of India, Public Works Department, to the Executive Engineer, Public Works Department, Railway Branch, dated 17th October 1892, No. 427 M.

I am directed to acknowledge the receipt of your letter, dated the 21st September 1892, and of the memorandum therewith forwarded on the subject of improving the Vizagapatam harbour and to say that a copy of those documents has been forwarded to the Government of Madras for information.

From G. E. MOORE, Esq., Executive Engineer, Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 21st September 1892.

Understanding that the subject of improving the harbour of Vizagapatam is under the consideration of the Government of India, I have the honour to forward a memorandum embodying proposals which I venture to think are worthy of consideration.

2. The result aimed at is to allow of the substitution of large cargo boats and steam launches in the place of surf boats without in any way interfering with a larger scheme should it at any time be requisite.

3. The works that I propose to effect this are, first, a breakwater to protect the entrance from the sea and surf; secondly, a groyne or groynes to arrest the movement of the sands on the north side.

4. I have no hesitation in saying that however much opinion may vary regarding the position and details of construction of these works, that they are primarily essential to any improvement scheme and for reasons given in my memorandum how disastrous to the town would be the effect of any attempted improvement by a contraction of the entrance.

5. Believing it premature I have not attempted to give either detailed plans or estimates although I have prepared them.

Vizagapatam Harbour.

The construction of the East Coast Railway makes the improvement of the port accommodation at Vizagapatam an urgent necessity.

2. At present the only communication between ships and the shore is carried out by surf boats, expensive and dangerous.

3. The difficulty lies in getting over the bar at the entrance to the river which at times has as little as 3 feet of water on it and is always subject to a dangerous surf.

4. If the bar could be so protected from the surf that there should be smooth water on it, cargo boats could, without any further improvement, be used in the place of surf boats.

5. This can only be effected by the construction of a breakwater about 800 feet long on the south side, from the Dutch Fort on the Dolphin's Nose ending in about 12 feet of water.

6. Sir A. Rendel in his report suggests piers running out from one or both sides of the river with the idea of effecting a scour.

Considering the narrow range of tides and restricted area of the tidal backwater, this could have little effect unless made dangerously narrow when the probable effect would be the formation of a new bar just outside the piers. Besides no contraction of the entrance is permissible on account of periodic river floods, which occur every few years, flooding the lower parts of the town. These floods would be far more destructive were it not that they gradually enlarge the outlet by scouring away the sands accumulated since the previous flood. In the case of a groyne narrowing the entrance, it would have no more effect in improving the channel in ordinary years than the present sand bank, while in years of cyclonic floods, unless itself destroyed by the flood, the result to the town would be most disastrous.

7. In another paragraph he states "that it must not be forgotten that a bar is also a breakwater protecting the area within it from the sea." This bears out what I have always maintained that no scheme can be effectual that does not provide protection to the entrance from the south, the only exposed quarter. Only his proposed length of 200 feet does not go far enough.

8. Having protected the bar it can then be dealt with as required. No difficulty would be experienced in deepening it by dredging if considered necessary.

9. It is not enough, however, to clear away the bar without taking steps to prevent its reforming.

10. The bar consists of pure sea-sand, a considerable movement of which takes place up and down the coast varying according to winds, tides and currents, the greatest movement being between high and low water mark. The usual result of placing an obstruction on the shore of this coast is for the sand to slowly creep round it.

11. On the south side of Vizagapatam, owing to the peculiar rocky nature of the coast, there is no supply of sand available. On the north side, however, there is a stretch of sandy beach 3 miles in extent to Waltair point beyond which again the coast is rocky. This stretch of beach is broken up by five or six natural barriers of rock which, to some extent, impede and limit the movement of sand up and down.

12. During the south-west monsoon the movement is northwards, but has little effect close to the town owing to the protection afforded by the Dolphin's Nose. During the north-east monsoon the sand gradually shifts back again till arriving at the river mouth further progress southwards being stopped, it is forced up the river filling a large portion of the backwater opposite the Customs house, remaining then till washed out again by the aid afforded by the river after rain.

13. That this destructive movement of sand southward during the north-east monsoon which continues as long as north-east winds prevail up to January and February can be stopped there is no reason to doubt as we have shown that the supply of sand is limited.

14. Regardless of expense this could be effected at once by running out a breakwater into deep water. As, however, the movement of the sand is gradual and is almost entirely confined to between high and low water, it would be as effective and much less costly to throw out a groyne to just outside the line of surf into about 12 feet of water, and as the sand crept round the head to keep on lengthening the groyne so as always to keep the end in about 12 feet of water.

15. As this groyne would be at right angles to the wave line, it might be cheaply formed of large rubble only. In support of the practicability of this proposal, I would state that nearly fifty years ago the sea threatened the sea wall in front of the town, when three or four rubble groynes were at the suggestion of Sir Arthur Cotton thrown out to protect it at a cost of about Rs. 20,000. These have been entirely successful.

16. As regards the position of this groyne, it should not be too near the river entrance and I would suggest the lengthening of the first of Sir A. Cotton's groynes, which might be supplemented by the construction of one or two shorter groynes as might be thought necessary after careful local examination.

17. These two works being carried out, the breakwater on the south side to protect the entrance from the waves and surf, and the groyne on the north shore to stop the shifting of the sand, the effect would be that the bar, instead of deteriorating after the end of the ensuing south-west monsoon, would remain at the same depth all the year round, and, instead of perpetual surf, would have smooth water, rendering the port safe and practicable for cargo boats and steam launches in ordinary weather at all tides and times.

18. My estimate of the cost of these proposals is Rs. 95,000 or Rs. 1,45,000 according to the design of breakwater adopted.

Further note by the Acting Chief Engineer, Public Works Department.

It will, I think, be seen from my "note" written before the receipt of Mr. Moore's memorandum that I am in accord with him as well as with some other engineers who have considered the subject as to the absolute necessity for thoroughly protecting the entrance to the backwater from "the action * of the surf and from the effect of violent storms" before any permanent improvement is possible. Mr. Moore, however, anticipates that this can be effected by a "breakwater" some 800 feet long to the south of the entrance and a "groyne" to its north, both ending in "12 feet of water," whilst I have no doubt that the

* Para. 9 of note.

length of the protecting barriers would have to be much greater and that to be permanent they would have to be massively constructed "sea walls." I do not † believe that a "groyne" of "large rubble" even if carried out only to 12 feet depth of water at low tides would stand the seas to which it would be exposed during cyclones, or even in ordinary heavy weather; and if such a structure were destroyed its ruins would be heaped about the anchorage and the backwater entrance.

† See also para. 35 of Mr. Thorowgood's report.

2. Possibly it would not be necessary to construct a complete outer harbour to efficiently shelter the backwater entrance from the forces which now prevent its improvement, but I am convinced that the protective works required would be most advantageously disposed so as to form at all events part of a possible future harbour.

3. It has been suggested that the groynes or walls might be so constructed that they would enable the tidal scour and land water to keep a deep channel always open. This suggestion has received consideration at various times; it did so in 1873, see Captain Beatty's report with Proceedings of the Madras Government, No. 603, dated 25th February 1873, and again in 1880, see Colonel Chrystie's report with Proceedings of the Madras Government, No. 749, dated 22nd March 1880. I entirely agree with the views on the subject expressed in paras. 36 and 46 of Colonel Sankey's note with Proceedings of the Madras Government, No. 1939 W., dated 13th August 1880, and also with what Mr. Moore says in para. 6 of his memorandum.

4. In connection with this I would point out that for the greater part of every year there is absolutely no land water falling into the backwater, and often there are intervals of years during which the discharge of the river, even during the rains, is inconsiderable. As, however, the whole catchment basin of the little river lies within the influence of all cyclones which strike the coast in the neighbourhood, the discharge * See marginal remark at end of para. 6 of "note" and end of para. 9. is at times very heavy.* At such times the amount of silt brought down would probably cause some trouble in an enclosed outer harbour, necessitating dredging and the provision in the southern wall of powerful scouring vents to be kept open when the river was in flood.

MADRAS,
28th November 1892.

(Signed) G. T. WALCH,
Acting Chief Engineer, P.W.D.

ORDER—dated 22nd December 1892, No. 3512 W., Public Works.

Ordered that the Government of India be addressed.

[Here enter No. 3513 W., Public Works, dated 22nd December 1892.]

(True Extract.)

(Signed) G. T. WALCH,
Ag. Secretary to Govt., P.W.D.

To the Superintending Engineer, I Circle.
" Marine Department.

Exd. S. J. Pereira.
Spare Copies

Appendix to G.O., No. 3512 W., dated 22nd December 1892.

Precis.

In 1861 and 1862, two portions of the swamp at Vizagapatam, aggregating 79 acres in extent, were granted to a Mr. Warfield subject to the payment of an assessment of Rs. 12. Mr. Warfield sold this land to a native who resold it to the Right Rev. Dr. Tissot, the Roman Catholic Bishop of Vizagapatam. In 1868, Dr. Tissot applied for an additional piece of land which, together with that already purchased by him, he wished to convert into a model farm for the orphanage attached to his mission. This was granted subject to the payment of an assessment of Rs. 22 (G.O., dated 11th March 1868, No. 636). The extent of the land was not specified, but as it was proposed to assess it at the same rate as the lands granted to Mr. Warfield, the area has been calculated to be acres 145. In 1869, Dr. Tissot applied for a further grant of 1,000 acres of the swamp which he considered absolutely necessary to ensure success in the trial he was making to establish a model farm. This was also granted subject to the payment of an assessment of Rs. 88 and subject also to the condition that 100 acres should be reclaimed every year, one year being allowed for preparations (G.O., dated 17th March 1869, No. 722).

2. On a representation from Dr. Tissot, the Government modified its order of March 1869 so far as to allow him to hold the land (1,000 acres) free of assessment during the first ten years, and observed that he should still abide by the condition which bound him to reclaim at least 100 acres of the swamp every year (G.O., dated 22nd November 1869, No. 3007). In 1871, he applied for an extension of the time allowed for reclamation from 10 to 40 years and for the remission of assessment for the whole period, but the Government passed the following order:—

"The free grant for 10 years will be altered for a free grant for 21 years. A certain portion of the swamp (to be fixed by the Collector with the sanction of the Board) to be reclaimed triennially, in default the grant to lapse to the Government" (G.O., dated 7th July 1871, No. 1169 A.) Later on in the same year he applied to the Board to obtain a modification of these terms, but in its Proceedings, dated 30th October 1871, No. 4539, it declined to take further action observing "it is not to be supposed that the Government will show any rigour in the enforcement of the penalty of resumption if it can be proved that the Bishop has done his best at every triennial inspection of the undertaking by the Collector."

3. In 1874, the Collector and the District Engineer were of opinion that Dr. Tissot had not observed the terms of the grant, as only acres 13½ had been brought under cultivation and that as his action was prejudicial to certain proposed harbour works, the grant should be cancelled. The Advocate-General was consulted as to whether the land might be resumed, and, on his advice, the Board was directed to inform Dr. Tissot that the grant had been cancelled. The Government also expressed its willingness to consider favorably any fair claims for compensation (G.O., dated 8th May 1874, No. 567). Dr. Tissot protested on several grounds, one of which was that he undertook only to drain the lands and that he had reclaimed the whole swamp in the sense of rescuing it from the water. The Advocate-General, who was again consulted, advised an amicable settlement. The order of resumption was held in abeyance and Captain Taylor, Master Attendant at Madras, was directed to report on the effect which the reclamation had or was likely to have on the harbour (G.O., dated 17th October 1874, No. 1341). Captain Taylor's report was in favour of the reclamation and Dr. Tissot was, therefore, permitted by Government to proceed with his work (G.O., No. 509, dated 2nd April 1875).

4. In 1890, the Collector of Vizagapatam, understanding the word reclamation in a different sense, reported that Dr. Tissot's enterprise had proved a complete or almost complete failure, and that it was necessary, therefore, to cancel the grant. He observed "a little land along the upper or northern edge of the swamp has been brought under cultivation and a purposeless tank or two has been dug, but this is all that can be reasonably called reclamation. It is true that more or less effective bunds have been thrown up to prevent the tidal water from spreading across the lower portion of the swamp, and that it is less subject to inundations and becoming water-logged than it was, but this does not fairly fall within the meaning of the word." He accordingly proposed to call upon Dr. Tissot's successor to prove that the conditions under which the grant was made had been fulfilled. The Government, however, was of opinion that the word "reclamation" used in the correspondence relating to the grant of 1869 simply meant "drainage" and that the grant could not be cancelled, the conditions thereof having been fulfilled. The term of 21 years, for which exemption from assessment was conceded, having expired on the 28th December 1890, after allowing for the period of suspension of the work in 1874 and 1875, the Collector was directed to inform Dr. Tissot's successor that the land (1,000 acres) granted in 1869 was liable to assessment from fasli 1300 (1890-91) and to ascertain whether the mission was willing to retain possession of the land on payment of assessment (G.O., dated 13th April 1891, No. 305). Reverend J. M. Rossat (Dr. Tissot's successor) has intimated that the mission wishes to retain possession of the land and paid the assessment forthwith (G.O., dated 23rd July 1891, No. 4171). From the Collector's report submitting his letter it appeared doubtful whether the swamp was really drained as the Government supposed. A report on this point was therefore called for, and is still awaited.

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1892} Madras.

PUBLIC WORKS.

Dated December, 22nd.

Read.

Encl.

G.O., 22nd Dec. 1892, No. 3512 W.

DECEMBER.

Vizagapatam Harbour

Ordered that the Government of India be addressed on the subject of the improvement of the — with special reference to Mr. F. N. Thorowgood's proposals.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

LETTER—from

G. T. WALCH, Esq.,
Acting Secretary to the Government of Madras,
Public Works Department,

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
PUBLIC WORKS DEPARTMENT.

SIR,

In continuation of my letter No. 3450 W., dated 17th December 1892, I am directed to forward herewith, for the consideration of the Government of India, the accompanying collection of papers on the subject of the improvement of the Vizagapatam harbour with special reference to Mr. F. N. Thorowgood's proposals.

2. It will be seen from the note of the Acting Chief Engineer, Public Works Department, that, in his opinion, the proposals of Mr. Thorowgood will not effect the result which he anticipates from them, and that no considerable and permanent improvement of the entrance to the backwater can be secured unless the place be efficiently protected from the action of all heavy seas and surf.

3. I am also to forward a *précis* of the correspondence which has taken place on the subject of the scheme of land reclamation at the mouth of the river referred to by Mr. Thorowgood; also copies of the undermentioned Proceedings of Government quoted in the notes by the Chief Engineer:—

G.O., No.	603,	dated 25th Feb.	1873.
,, ,,	337,	,, 27th June	1878.
,, ,,	749,	,, 22nd March	1880.
,, ,,	1939 W.,	,, 13th Aug.	,,

I have the honour to be,
Sir,
Your most obedient servant,

(Signed) G. T. WALCH,
Ag. Secretary to Govt., P.W.D.

FORT ST. GEORGE,
22nd December 1892.

Esd. S. J. Pereira.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1892} Madras.

PUBLIC WORKS.

Dated December, 22nd.

Read. *Encl.*

22nd Dec. 1892, No. 3513 W.

DECEMBER.

Vizagapatam Harbour

Forwarding for the consideration of the Government of India a collection of papers on the subject of the improvement of the—with special reference to Mr. F. N. Thorowgood's proposals.

10006 10

CAW Vizag. Harbour

This paper is returned to Darg— under Colonel Pennycuick's orders. For submission to the Board.

C.L.
18/10/92

Pl. sent & Not yet received separately.
20.10.92

Submitted. C.S. 20.10.92

I send herewith
Pillai's letter
to me & the
Pennycuick
23/3/92

GOVERNMENT OF MADRAS

FORT ST. GEORGE,

3rd March 1892

My dear Pennycuick,

I send herewith
Thorowgood's demi-
official to me embody-
-ing his initial report
on the result of his
recent investigations
at Vizagapatam.

You will see from
Maclartie's note & the marks
on the cover that

enclosed that the D/o has been seen by His Excellency & Members.

Yours sincerely

Fred Whitshide

Col. J. Pennycuick R.E.

12

Calculated.

Mr. Horsford brought me the letter and I thereupon showed him the data on which he had to act. As the Govt. wished to see him I gave the letter back to Mr. J as he wished to show it to

27 Feb

Lieut
HCS
27 Feb

a 7lb pier or breakwater (the latter to choose from the various printed by Dr Johnson's house - with a view to bring the title to connect it with the harbour line. Attach to the sketch of the proposed Embankment

X+

GOVERNMENT HOUSE,

26 July 1892

CHIEF SECRETARY'S OFFICE
27 FEB 92
HONG-KONG

My dear Price

Please circulate

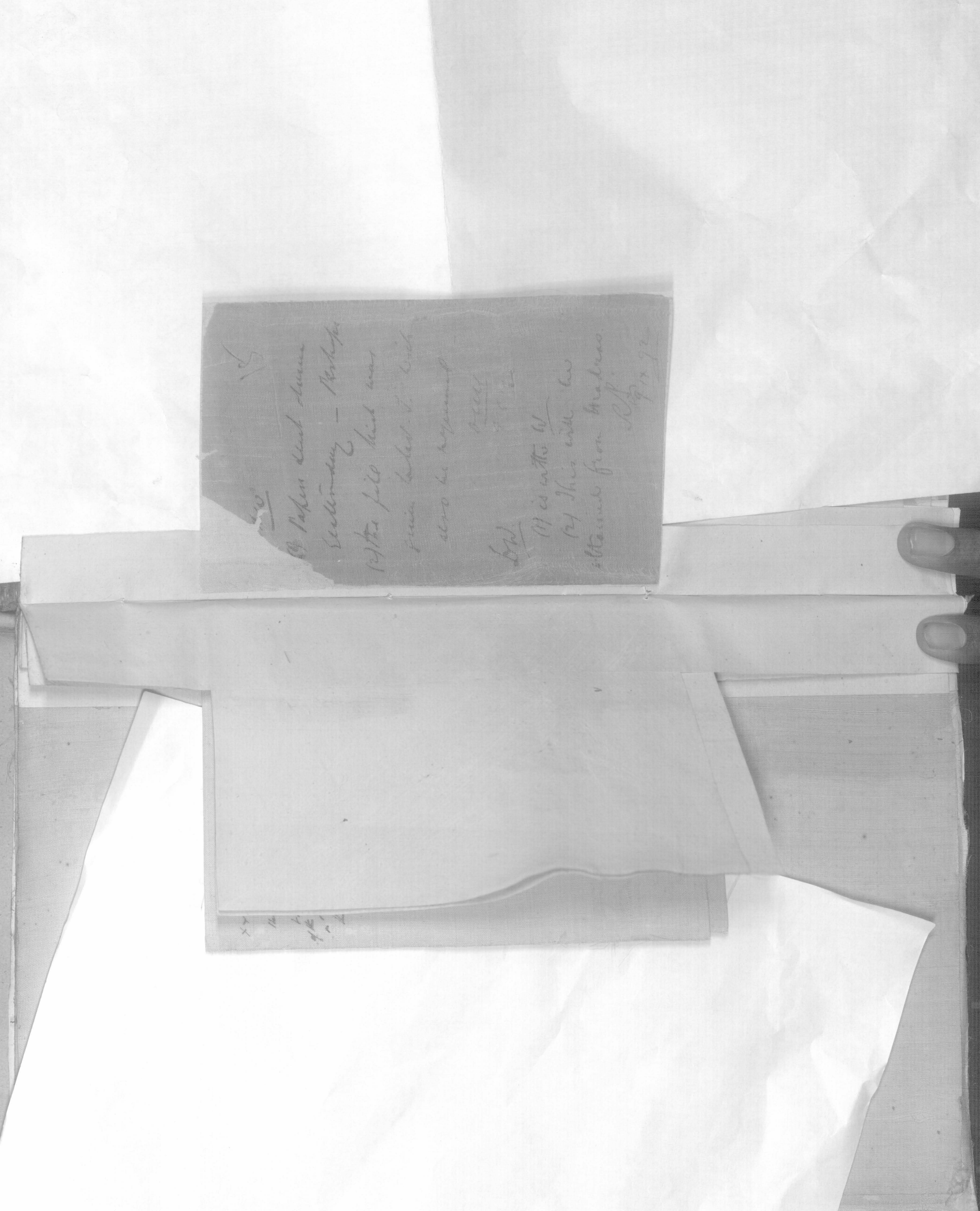
Thomas Goods Initial Report
on the Vizag Harbour
to H.M. The Governor
seem to me to be no
remarks to make
at present

J. Hall
Treasurer

xx recommended. Would not probably have ten lakhs of rupees to lend with both safety & advantage to the borrowers during the ensuing year.

C.H.S.

29/2/92



(1)

Manuscript - 9 Sheets

and Postal on Plan

ed.

The 9.w.d. bastard cane-thief

hopers ?/Reed Lupine Dr.

writtapert? - Wilderness Dr.

the Yelle Wood-sorrel Asarine

is wadded the Hopkins

are complete [illegible] is sent to

this by Rabbi D. in ordinary

course? 7.XII.16. 9/9

I have duly
wrote a "Note"
on Hammond's
report which is being
typed - the Clerk
went to write it
in Circulation -
But the telegram
might go on while
at the same time
suggesting that the
Clerk should be
sent back to this
office as soon as
possible in order
that the request
here contained may
be complied with

J

27/10/92

† I have entered
on my "Note for
orders" about
my "Note" that
the telegram is
sent forwith

J.

27/10/92

10006

19

The views of this Govt on Mr. Thornycroft's proposals for improving the Port of Beira appear to be as follows —

Mr. Thornycroft considers that the chief source of sand supply to this bar is from the sand moved down Mwenje the N.E. monsoon —

He therefore proposes to cut this off by the construction of a groyne, not less than 1620 feet in length, & perpendicular to the 15.50 feet —

In para 41 of his report he states that the sand from the river mouth is very local, that to

I think the Charts, or Tracings of them should be obtained & forwarded — If Mr Thornycroft desires to examine the depth &c as in former occasion — I see no objection I think and his case treated as the N. one is considered, this would probably be a favourable time to carry it out, as also the dredging proceeded for by Mr Thornycroft which Govt would be interested.

DMM
27.10.19

[illegible] carried by any proposed
Groyne" and he
also argues that
because this Groyne
taken down in times
of Gales there
that the entrance
will gently narrow
- first therefore his
Groyne will not do
up - But yet it is
stated that the chief
Sand subsides in this
river & from the Northern
Pier, then some sand
by the Groyne, must
be deposited after
it, and in course
of time extend to the
buoy &, which is now
in 3 fathoms

with be no necessity
to further increase
the Capacity of the
Tidal Basin -
As it is the Ebb tide
is nearly sufficient
in scouring with the
influx flood, & if
the Groyne prevents
the ocean flood
the mouth of the
River, the Ebb tide
as at present should
be sufficient to
keep the dredged
Channel open -
Existing Excavation,
the Groyne would
be one hindrance to the
Channel dredged

for about £4,000.00.

The dredge will prove whether or not the Groyne would silt up — I think it would in a very few years.

—

If the Groyne behind sketched out, the position of the arms would probably about correct — I am doubtful if any retaining can be placed under water — Horowpoti Estuary

The Coast line from the construction of the Groyne would enclose harbour

of 12 [illegible]

by the harbour arms, the sea has immediately cut into & eroded & a part behind the seaward horn of the harbour.

Some such action with probably take place at Tiparé — but planting East the Chief Land Supply & from the North the action of the S.W. monsoon may be & sweep away the sand accumulating brought down by the N.E. monsoon, & to prevent the Groyne from being silted up —

a passage has
been made through
the rock, and the
natural formation
must necessarily
be destroying, this
has been provided
for —
Mr. Thornycroft
further provides
for increasing
the capacity of the
Sidal Basin by
excavation —
I shall venture the
opinion that
Mr. Rendel is right in
considering, and
that if the depth
of the bar, the

The Retaining pier S.W.
Jetty is very
briefly alluded to in
para. 19 — Mr.
Thornycroft was not
at liberty at this
time period — At
Madras I shall
be commanded work
this thing and
movements take
place during this
season — Rivers
opening this Ela
are pushed further
both year after year,
until they close, &
the bar is then cut
as far both as
possible — At the
Madras harbour
the sand accumulates
between the S. Arm.

The Coast S. of Nipa
being rocky there
is absolutely little
land to move,
but the letter
answers & some
action (according to
Lt. Thurwood) the
waves break from
a S.E direction the
Mr Year round /
must have made
effect on the land
foreshore North
of the Groyne - The
Madras Harbour
has been to encroach
the land to the
North, & the land
supply to replace
this removed & am
having been

Ft. St. No. 328 M of
Aug. 92

For orders.

The plans have
not yet arrived.

There is a complete
file of previous papers on
the subject of this harbour
at Madras; which was
collected for Mr. Thorneycroft
This will be sent for, if
required.

C.S.
5.11.92

Might submit the
Chart & Plan which
I submitted [illegible] 92
Drawing No. 182
referred to by
Thornycroft - It
can also be seen if
the file is required -

D.W. D.W.B
Chart to this submitted.

The file has not yet been returned from Madras.

Dall
15/2

3512
2513

REVENUE SECRETARIAT.

No: 813

OFFICE NOTE.

Station Fort Saint George date 19th December 1892.

From The Secretary to Government
Rev: Department.

To The Secretary to Government,
P. W. Department.

With reference to office note dated 9th December 1892 No: 5235-6, the undersigned has the honor to forward the accompanying precis of the papers in the Revenue department about the reclamation of the Swamp at Vizagapatam and Dr. Tisot's lease

C. A. Acton
Secretary to Government.

25

Further Note on the Vizagapatam Harbour question, ~~called for in H.E. the Governor's receipt of 24th instant and "Note" 27.x.92.~~

It will I think be seen from my Note, written before the receipt of Mr Moore's memorandum, that I am in accord with him, as well as with some other Engineers who have considered the subject as to the absolute necessity for thoroughly protecting the entrance to the Backwater from the action of the surf and from

* para 9 of Note.

the effect of violent storms" before any permanent improvement is possible. Mr Moore however anticipates that this can be effected by a "breakwater" some 800 feet long to the north of the entrance and a "groyne" to its north, both ending in "12 feet of water", whilst I have no doubt that the length of the protecting barriers would have to be much greater, and that to be permanent they would have to be massively constructed sea walls. I do not believe that a groyne

* see also para 35 of Mr Thorowgood's report.

of "large" pebbles even if carried out only to 12 feet depth of water at low tides, would stand the seas to which it would be exposed during cyclones, or even in ordinary heavy weather; and if such a structure were destroyed its pieces would be heaped about the anchorage and the backwater entrance.

2. Possibly it would not be necessary to construct a complete outer harbour to efficiently shelter the backwater entrance from the forces

which now prevent
its improvement, but
I am convinced
that the protective
works required would
be most advantageously
disposed so as to form
at all events part
of a possible future
harbour.

"93. His Excellency
suggests that the groyne
or walls might be so
constructed that they
would enable the
tidal scour and
landwater to keep
a deep channel
always open. I did
not deal with this
branch of the subject
in my former note
as that was written
merely with reference
to Mr Throwgoods

Rough

— Note.

(1) There is no reasonable
doubt that an
excellent fair water
outer Harbor for Class
Ships could be made
at Urias adjacent
to the Seward limits
of the Lower
Harbor, and for
such a work the
Throwgood
proposals appear
suitable; & later
through Attention
to Appendix
D of his report gives
a reliable idea
of the cost- is a different
matter, I do not
think it does -

(2) Urias station lies
in a track usually
affected by Cyclones
and the seas which
spread & roll
upon the ~~Coast~~
proposed site
for the Harbour are
as violent as are
along the whole
Eastcoast of the

The Harbour wall, wall,
therefore seems to be as well founded,
as massive, and
as well protected
from wave action,
as Etarel at London.
The London Harbour
with a total length
of sea wall &
breakwater
5000 feet was estimated
to cost 49 lakhs, but
will really cost
upwards of £ 123 lakhs.
The Vizagapatam
Harbour will consist
of a total length
of 6,765 feet and
is estimated cost-for the Harbour
is 43.27 lakhs. It
seems not improbable
that the wall
will cost at least
half as much again
(3) The Vizagapatam
Harbour would cover
seven times the
area at London, it
would have to
contend with
a natural [illegible]
once Harbour for boats
small craft, the and
[illegible]

+ see Madras Mag. at end of para 6 & note 5 end of para 9

2

The discharge is at
times very large
at most times
the amount of
silt brought down
would probably
cause more
trouble in an
enclosed outer harbour,
which [illegible]
& necessitate
dredging, and
the provision in
the Southern wall
of powerful scouring
sluices, to be kept
open or clear the
river mouth in flood.

Gfr

27/11/97

Practical ... the
for the Construction
of two jetties
suitable for all
Classes of Ships
all kind of Cargo,
and in connection
with the railway.

(2)- When railway
Communication is
opened with
the Central Provinces
is opened it is not
unlikely that
an Enormous Quantity
of Timber will
seek its outlet
at Viz- ... abalam
& then the Construction
of a Ship Harbour
and a commercial
Communication and
numerous industries
but a matter and
Hand for due and
when Encouragement
an Expenditure of
certainly not less
than 4 3/4 Lakhs and
probably over the
65 Lakhs

5- Passing now to the various schemes dealt with by the Harbour Board of merely improving the entrance to the breakwater or tidal estuary. The proposes to effect this, at a cost of £ 6,11,271, by

(1st) Dredging a channel with a uniform depth of 30 feet at low water from the two fathom line, to about 600 feet within the breakwater -

(2nd) Constructing a groyne 1420 feet (subsequently 1550 feet) long south of the entrance of the Bluff in the line shown on the plan (see paras 34 & 35 of Report) -

3rd Removing the tidal Cataract of the Falloon & Creation of a channel 6 chains wide & 30 feet deep -

(5) 29

6 Taking these proposals seriatim I would remark that the cost of the Dredging is put down as only £ 14,000 (exclusive of Contingencies & other Offices) Establishment and does not provide any thing for Cartage or other costly Items. The Tidal pumping Dredger recommended should be used. Such a Dredger or Dredges as are suitable for the Plant of the Harbour Board would probably cost at least £ 13,000 each - It is possible that the Dredge "Benlock" already possessed by the Board might be worked on the work, but must at least be supplemented by a Dredge of 1000 tons burthen & 60 feet wide - As shown by the two-fathom line at 20 chains & beyond the said channel

* The provision of £ 50,000 for plant & pilotage must allow separately for the plant required in connection with the Construction of the Groyne

* Estimated cost £ 12,600 delivered at Port Lyttelton

with a continuous depth of 10 feet at low-water," would require the removal of a cubic area of 2,000,000 cubic yards by Mr Thomson and to the Trinity Board would probably mean to maintain such a channel would require frequent if not constant dredging. To start a channel would be the same as to maintain at the plane. Mr Thomson takes as the surface of the foreshore lying on each side of said from the centre line, the surface of the sand or banking which, the Board's direction of which is gradually from the S.E. would certainly fill in the Dredged Channel, from the shoals of said surrounding it - Mr Thomson

[illegible] 24 hours

(7)

at the Flood is a [illegible] "in the neighbourhood of the Virginia buoy South is very small and the slightest change in wind will make a change in the direction of the current" and upon it he states "the future probability of the channel" and how "of course the sandy bottom is at the plane. He is certain that [illegible] channel dredged 2 more feet below plane of proposed width would be disturbed or displaced by the action of waves would maintain form or depth for any length of time without frequent recurring, if at Constant, Cleaning Probably Mr Thomson considers that the increased tidal scour resulting from the increased tidal capacity will be sufficient to

by the Steering would keep the Channel clear, but it may be doubted as a absolute certainty that this would be the case. Before the recommendations of the Tidal Committee of the Steering were carried out it would be necessary to have Mr Thomson's opinion on them, but even then it was not able to keep the Channel & help the deepening of Mr Thomson's Channel by Velocity and Gravity

The Entrance was deepened by Mr Thomson but was shoaling again & will be necessary to be periodically attended to

7- In regard the proposed Scheme, which is estimated to Cost about £2,45,630 I would submit that there is no evidence as to the probable efficacy of Mr Thomson's proposed Scheme to deepen the Channel & no opportunity of making observations on the movement of the Sand at the place during the S. W. monsoon which is a very important season on the Entrance

Rubble	1,05,507
Concrete Block	82,131
Setting	19,585
Share of Contingencies	20,719
Establishment	20,718
	2,48,630

→ Marginal mark by the Cyclonic magnificent of May 1877 the "Star" was sunk at a depth of between 9 & 10 fathoms at low water in the following year the Mark was obliterated & Master Warren the Port Officer in charge reported that there was a mass of stone 6 feet high (see his letter 4684 M.C. P.W. 337 of 17/6/78)

Considering that the Groyne would arrest the travel of Sand from the North and that mischief would result from that direction from the South, there is nothing to show that there is not also a movement of Sand from the South & that the Groyne would also arrest the Sand travelling to Madras & Coromandel Coast

I also would submit that it is evident from the Sand Sections that the Sand moves in deeper water than 3 fathoms & that the Groyne would not arrest the movement of Sand in deeper water

Mr Thomson himself says "there is also another source of Sand supply to the so called bar, & that is the movement of Sand when the currents would set a-cross towards the Shore" I also would submit that the Groyne would not arrest the movement of Sand in deeper water than 3 fathoms

that the proposed
Scheme will partly
ameliorate the evil
which it is intended
to remedy. I am of
opinion that the
training walls or
Groynes at Cromer
as could be built
different combination
from those
at Hunstanton,
leaving at the head
of a deep bay or
harbour
free from Sand and
quite sheltered from
all seas from
the South —
I consider the tidal
Capacity of the
Estuary is undoubtedly
lessened materially by
Sand accumulation
for the last 20 years,
or so, since the
Erection of the
Embankment
which has caused the
waters to
scour out the
channel that formerly
existed, but the
Capacity
is not lessened
by the accumulation
of Sand which

11

to be covered by
the Tides — To the
reclamations
is undoubtedly
due some detriment
to the Estuary
& the backwaters,
and to lessen
the Capacity of
that tidal basin
Cromer is brought
back to what it
was originally, the
work already will be
[illegible] return to its
former State —
That state can by
no means be called
strong & consistent
before than it now
is, and I do not
for one moment
suppose that the
reclaimed is tidal
Capacity proposed
by Mr Norwood
would keep open
an Unencumbered
Channel of 12 feet
deep at low water
but it would probably
add a very important
foot or two in depth
to the mouth of the
harbour, and any work done

out in that direction would be useful, whatever [illegible] be the way in which it is to be decided to steal the Admiralty Harbour Question.

Q. It may, I think, be safely asserted that the condition to avoid obtaining at the Land-locked Harbour of Vigo as a place of refuge, as well as a factories, at such with the small means of Trade available for sustaining such Steam, is permanent inconvenient to the extent anticipated by Mr Thomson & for his scheme, can be achieved with the plane recommended protection from the heavy seas which the Effect of violent Storms; such protection can only be given by Cetas & artificial Harbours and breakwaters would of course be [illegible]

most advantageously disposed as a Caulone or Oil Harbour; but still that is unable, I fear, Can the inner Harbour be so far enlarged & deepened with anything like a convenient depth of 30 feet at low water, as well for Commercial Steam-ships as for Steam Vessels of War, & to admit of their turning round, & to afford shelter from the South & South-West Storms, & the mouth of the Harbour secured at all times?

Jno. 27/10/92

Waltair. 22 February 1892.

D/O No. 80.

CHIEF SECRETARY'S BRANCH
25 FEB 92
GOVERNMENT

34

To the Hon. J. F. Price, M. L.
Chief Secretary to Government.
Madras.

Dear Mr. Price.

I take advantage of the liberty accorded in the Order of Government No. 398/A W of 8th February 1892, and write a few remarks in a demi official manner about the Vizagapatam Harbour.

2. I have with great interest gone through all previous reports and memoranda upon the subject commencing from the year 1851, first before I had seen the place and now after I have thoroughly examined it. And notwithstanding that so much has been written and so many suggestions made I cannot help coming to the conclusion that no one has ever thoroughly investigated the subjects of the harbour, the backwater and the bar in detail. Mr. Thomas from his bungalow on the Kylasa Hill states positively that if the "bar be removed the Harbour is made", while Captain J. H. Taylor with equal certainty asserts that close beneath the water is nothing but hard "uncompromising rock". And the more competent authorities who have decidedly pronounced against attempting anything towards removing the bar really seem to have done so with the most meagre means

efforts to support their views.

3. There appears to have been no proper survey of the so-called Bar made at any time, although there are numerous references to "depths of water on the bar" some compared to "High Tide Level" and some to "Lowest Low Water". Some writers assert that the bar is formed of silt from the river; others say it is the result of the littoral current sweeping round from the South; but never does any one appear to have been at the trouble of having the bar or Sand-spit carefully surveyed and watched, and I understand how a final decision on the subject of Harbour or no Harbour can possibly be arrived at until this has been done.

4. The survey of 1883 (made as I further in consequence of the suggestions of the Late Mr. W. Parkes) is a most admirable one; none could be better and I have consequently used it as a basis for my traversing lines in the river and at sea. But this survey gives only a few soundings on the bar, from which soundings alone one can deduce nothing. A very finely finished plan by Mr. K. Nordemann dated 1873 has more soundings on the bar, but they are admittedly not very accurate owing to surf, and they are not enough in number to enable one to lay down the contour lines of the Sand accumulation; so again from this survey one cannot

arrive at any conclusion.

5. It is true a distressing sight to see, as at present, the Sand spread out over the mouth of the river, causing constant broken water and much danger to life and property when a good channel might be obtained at not an enormous outlay.

6. I have made a marine survey of about 3 miles of the coast as nearly as possible over the lines used by Commander P. J. Falle in 1883, and have extended the survey up the river for about 1½ miles, so that now we can make comparisons at 9 years interval. I have also been able to get two very careful surveys of the Bar in December and February, showing its exact shape with the prevailing winds from North of East and winds from South of East. I further have obtained a fairly complete set of current velocities and directions of tidal ebb & flow with different winds.

7. The Borings I have taken show me that the question of rock need not be considered so far as reaching an excellent boat harbour is concerned. There is no rock to interfere with a complete channel with 18 ft. at Low Water from the 3 fathom line at sea & right away above the bridge over the backwater.

8. Borings on the bar may be said to be out of the question unless a very heavy expenditure be incurred, by which I mean some two or three thousand rupees, for a readily permanent staging would have to be erected for each boring

and if worse, when done with, would have to be removed again. But no breakwater or other bar are necessary. There is a fast fast rock, probably a single boulder, between the three and three-and-a-half fathom lines at sea, about 750 ft. to the East North East of the Dutch Battery corner, but I can find no other rock near it when I probe down 3 ft. below the sand ~~which~~ near this one boulder.

9. The sand obstructing the mouth of the river is very fluid and traitorous and is moved about by every set of tide, wave or wind. A great reason for this extreme mobility is found in the numerous springs of fresh water which discharge below Low Water through the sand into the sea; causing the sand to bubble up in a semi floating condition, in which state it is moved hither & thither by every change of current. If the sand accumulations could be kept in a fairly fixed position a clear way might be obtained into the river or backwater. That the sand obstructing the river mouth is not constantly increasing is clearly shewn by the fact that even after this long period of drought and with the tidal capacity of the river reduced to a minimum by reason of sand driven in by the waves, the water way still remains open, and is still navigable although certainly dangerous at Low Water.

10. I consider that the simplest and best way of setting rid of the bar or sand spit (which is now in a dangerous state) is to dredge it away; and then to dredge into the backwater and take away the immense quantity

and that has accumulated there. I am convinced that the bar does not re-form at all quickly, and that by occasional dredging the present state of affairs would not easily occur again. Dredging with a Sand pump dredger could well be carried on during the months of January and February.

11. But in addition to this a mole or groyne must be projected from the North Shore, not commencing too near the river mouth, and carried in a South easterly direction into not less than 3 fathoms water. A training wall (such as proposed by Mr. Addis) would be all very well in a river or perpetually mouthed sea, but here it would have the effect of training the waves in any bad weather, and would be fatal to the proposed Rail railway along the side of the river mouth. The groyne must commence from a point further North than the river's mouth, and be carried in a direction diagonal to the line of the channel of the river. This will give beach room for the waves to expend themselves upon.

12. It may be found necessary or at any rate advisable to build a short breakwater from the South side of the mouth to protect the shore on the opposite side when the water is deeper than at present, but I do not think this need be provided for at first.

13. I am confident from my observations that in the first instance the sand which encumbers the mouth is borne in by the waves from * North to South, and undoubtedly would

* also the case at Coconada.

some a large spit reaching up to the cliffs at the base of the Dolphin's Nose headland, were it not that the ebb & flow of tide through the river mouth prevents the sand from actually joining the South Shore. This is plainly indicated by my survey of December - When currents change with change of wind from North & South of East the spit spoken of is driven further in and becomes more troublesome to boats by being flattened out, and thereby spreading more completely across the mouth. At the same time I find some sand, but not a great deal, comes in from seaward towards shore.

14. I see no reason to believe that a groyne projected as I describe into 3 fathoms water will carry the Bar out with it - The groyne once made, well enough to prevent passage of sand through it, and the Bar once cut away, the re-formation of it will be very slow indeed.

15. But to retard the re forming still more I most earnestly recommend adding to the tidal capacity of the river - I do not suggest that the whole of what is called Mr Twist's Reclamation be simply handed back to the tide - I have had this land carefully levelled and have discussed this point much with Mr. Willcocks - I find that now the general surface is very little below High Water level - To flood it again would theoretically add an immense quantity to the tidal capacity, but practically the water would spread so slowly over it's area that the whole would not be covered before the tide at the mouth had begun to recede.

16. I shall propose the scheme to cut into a large portion of this Reclaimed land and use the excavated material for raising the level of the remainder, afterwards using the dredger to deepen the excavation so as to be available for 50 ton cargo boats to lie alongside the quays formed along the embanked portion of the land. As a matter of fact some provision must be made for quay accommodation as the beach line of the Railway will contain the existing space considerably.

17. The situation of this port, however, lends itself to a scheme for making at a large cost a truly magnificent Harbour, by throwing out a pier from the Dolphin's Nose Headland, and another from near the Fort Flagstaff, and in reporting to the Secretary of State on the points mentioned above, I shall also go into the details of the larger plan which would render Vizagapatam as good a port as any in India, the main Harbour being outside and the inner Harbour being accommodated with quays, cranes and a floating dock.

18. I do not feel disposed to recommend making the backwater itself into an open dock or harbour for ships, as a very heavy land flood might suddenly cause great damage to vessels moored at quays, moreover the entrance is narrow for navigation unless a large outer Harbour be formed to insure smooth water.

19. I have been obliged to put off the completing of plans and estimates until my return to England - I have prepared 3 sheets of plans and many sections (as which I base my conclusions) but am unable to finish them in detail here

draughtsman who worked with me is utterly unused to such work, and the office accomodation is not suitable for close application to large drawings - But I must beg you to understand that I am not saying this in any spirit of complaint, but it is a fact - The draughtsman was a hard working and intelligent person who did his best, and my office room was the best that could possibly have been procured so near the Harbour, and was most courteously placed at my disposal by Mr. Gardiner of Stuart Hall & Co. who has assisted me in every possible way throughout -

21. With regard to estimates I must wait until the plans are quite completed, and until I have conferred with Sir H. Rendel as the class of work has to suit the situation, for there are many points which I cannot remark upon in a hurry. Such as, for instance, whether it is better in making a Northern groyne to begin it only with a view to the smaller scheme, or whether to construct it as the available for extension into the more imposing design of an Outer Harbour.

22. In conclusion I may say that I have done all that I can do out here, and if my stay were prolonged by another month I could do no more, as my last observations (February 19th.) were attended with great risk, the best period of the month's weather being apparently gone for this season at an abnormally early date, and the South winds having violently set in.

I am

Yours very truly

H. Harrington

P. W. Department.

28/10/92

Read the following:—

Letter 428/8 - 17/10/92

from Supt of Studies

FOR ORDERS—

(1) The above was received by me yesterday after completion of the note above - Vizagapatam Harbour -

(2) It will be seen that Mr Moore says the same as to the Southern as well as a Eastern "groyne" - I believe they would have to go over the walls suitable to form an outer harbour before the object desired from a Marine -

(3) Subject I will be sufficient to

Acknowledge the receipt of this letter & say that this Government is about to deal with a Treaty by the Chief Justice which deals with reference to Mr Thorburn's report will be forwarded & cover the Forwarded Favoured by Mr Moore.

C.O. W.

15/11 R 24/11

Better let this wait & deal with both together. If any it will not take much a few words to dispose of this apparently trivial subject

11/4
29 Oct

proposals and this did not form one of them. The suggestion has however received consideration at various times; it did so in 1873, see Captain Beatty's report with P.M.G. No 633 dated 25th July: 1873, and again in 1880, see Col: Chrystie's report with P.M.G. No 749 dated 22nd March 1880. I entirely agree with the views on the subject expressed in paras 36 & 46 of Col Sankey's note with P.M.G. No 1939 W dated 13th Aug: 1880, and also with what Mr Moore says in para 6 of his memorandum.

Nov 28 1882

4. In connection with this, and as regards one of the Hon. Sir Henry Stokes' remarks opposite my para 6, I would point out that for the greater part of every year there is absolutely no land water falling into the backwaters, and often there are intervals of years during which the discharge of the river, even during the rains, is so inconsiderable that it would be misleading to characterise any portion of them as the "flood season". As however the whole catchment basin of the little river lies within the influence of all cyclones which strike the coast in the neighbourhood the discharge is at times very heavy*. At such times the amount of silt brought down would probably cause some trouble in an enclosed inner harbour, necessitating dredging, and the provision in the southern wall of powerful scouring vents, to be kept open when the river was in flood.

C.F.

W

Madras
Nov 28 1892

* see marginal remark at end of para 6 of "Note" and end of para 9

P. W. D

12

Letter from the Govt of India No. 328 M

d/29. VIII. 92.

Note for the Hon:
Member:—

With reference
to the Hon: Member
Note of this day,
it is explained that
as far as Mr Thorn
goods proposals
go, these papers
are complete.

The file in
Madras contains
charts shewing
soundings taken
at different

circ 3/12 R 7/12
H.S. 28/11.R 3/12

the proposal
other officers
investigated
questions

L

19

For the note on
the Transportation
Question. Questions
called for in
Ot. 8 to forward
receipt of 24 Oct.
on Note 27/10/92.

1. It will I think be
seen from my "Note"
written before the
receipt of Mr Moore's
Memorandum, that
I am in accordance with
him, as well as with
some of the Engineers,
who considered the
subject as to the
absolute necessity
for so far lowering the
Causeway to the back-
-water from the outer
of the Jetty & from the
Effect of violent storms
before any permanent
improvement could be
effected. Mr Moore
however anticipates
that this can be
effected by a breakwater
some 500 feet long
to the South of the
Causeway & a groyne
to the North, both
reaching in 12 feet

Para 9 of
"Note"

ter", whilst I bear
a doubt that the
line of the protecting
barrier would be
to be found feasible, &
that to be permanent
they would have to be
effectively constructed
sea-walls. I do
not believe that
a proper & long
rubble mole even if
carried out only
to 12 feet depth of
water at low tides
would extend the
seas which it
would be favored
during Cyclones, or
even in ordinary
heavy weather
and if such a structure were
constructed, considerable
would be desired
about the anchorage
& the backwater
entrance.

2. Possibly it would
not be necessary to
construct a complete
outer harbour to
sufficiently shelter
the backwater entrance
from the forces which
now prevail. I am informed
but I am convinced

* see also p. 35 of Mr Normand's Report

that the protection
works required would
be most reduced & economy
disposed as to form
at all events part of
a possible future
harbour.

3. The following
suggestions that the
proposed moles or walls should
be so constructed
that they would enable
the tidal scour &
land water to keep
a deep channel
always open. I shall
not deal with these
branch of the subject
in any formal note as
that was written partly
with reference to Mr
Normand's proposals
and this did not form
part of them. The
suggestion has always
received attention
at various times; it
did so in 1873 see
Capt Beatty's report
with Plan S 603 25/2/73
& again in 1880, see
Coll. Angelo's report
with Plan S 749 dated 8/80
detailed

on the subject-
ment in para 36
to 46 of Col Parker's
letter with Mr SP 1934/
15/8/80, and also with
regard to Mr Moore's reply
in para 6 of his
memorandum.

4- Vaccination.
with their, and de-
sires a copy of the
Honble Sir Charles Stokes'
minute thereon
any para 6, should
plaintiff that for
the greater part of
any year there is
absolutely no land
water falling into
the backwaters, and
often there are intervals
of years during which
the discharge of the
river even during
the rains is so
inconsiderable
that it would be
inviting disease to
characterize any
portion of them as
the "flood season".
Moreover the whole
Catchment basin
of the little river lies
within the influence
of all cyclones which
strike the Coast in
the neighbourhood

P. W. Department,
~~Railway Branch.~~
Read the following :— 9/12/92

Note by W. on
the Unexplained
inner Harbour Portion
of the minute thereon by
H. E. the Governor and
the Honble Members—

FOR ORDERS.

(1) The further Note is
Yes. I suppose I so I
do. I will note the former
one, slightly modified
to make it run as a
Continuation and
add as a reply to the
remarks of H. E. the
Governor on the first
Note.

(2) On the question of
Yes, I Harbour about the
think so. Transportation
then needed to be waited for (it is
by any great now asked for from
delay. W the Rly Dept.) before
forwarding the note?

(3) From the minute
of the Hon'ble Mr Forsten
dy 8/12/92, it appears
that the views expressed
in the Note at the

9/12 R 10/12

FOR ORDERS.

(No copy need be retained.)

OFFICE NOTE.

To S. W.

Questions, &c.	Answers, information, &c.	Rejoinders, final instructions, &c.
Date 25/10/92	Date	Date
Can you fur[nish] the information on the following points, or fur[nish] us reference for obtaining it advice, ker —	(1) Estimate Amount Rs 49,00,000 The Expenditure to 31st Dec. 1884 was Rs 65,54,490	
(1) What was the Estimate for the Madras Harbour as originally sanctioned?	(2) Rs 1,23,83,386	
(2) What is now anticipated as the total cost?	(3) Survey work this information is obtainable anywhere, the Engr. in charge might be able to give an opinion in this but I fancy it would be a very rough one.	
(3) What is the Estimate cost per running ker foot, or yard, or other unit, for the walls		
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2 — 3 "		
3 — 4 "		
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25/10/92

P.T.O.

for

it is of peculiarly dark probable opinions effect of the Surrounds proposed Harbour for ships without a Harbour Sea wall is at variance with the opinion of the Noble Member which for the views formed in the Note above to be approved by H.E. the Governor & the Hon'ble Sir H. E. Stokes, under that circumstances Orders are requested as to what is to be issued in the letter to the Government of Madras —

C.J.W.

The point is a purely professional one in regard to which the Chief Engineer's opinion must stand or fall

Hd.

J. Ben

M No. 34 G.

28TH JULY 1892, No. 2103 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—the following paper :—

Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George, dated India Office, London, 16th June 1892, No. 3 P.W.

I forward herewith, for the information of Your Excellency's Government, copy of a despatch * which I have recently addressed to the Government of India enclosing a report by Mr. F. N. Thorowgood on the measures which he proposes for improving the harbour of Vizagapatam.

* No. 27 of 16th June 1892 and enclosure. (The plans referred to in the enclosure have been sent to the Government of India.)

ENCLOSURES.

Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, 16th June 1892, No. 27 P.W.

With reference to my Public Works Despatch, No. 32, dated the 15th October 1891, I forward herewith, for your Excellency's consideration, copy of a report * which has been submitted to me by Mr. F. N. Thorowgood on the results of his investigation into the condition of the harbour at Vizagapatam.

* Report, dated 25th May 1892, and two plans.

2. The measures proposed by Mr. Thorowgood for the improvement of the port are (1) the construction of a groyne from the shore north of the river mouth; (2) the excavation of some reclaimed land, with the object of increasing the tidal capacity of the estuary; and (3) the dredging of the mouth of the channel. The total outlay involved in these improvements, which need not be carried out at once to the full extent proposed, is Rs. 6,11,271.

3. A larger scheme, estimated to cost Rs. 43,27,272, is also proposed by Mr. Thorowgood, with the object of forming a deep sea harbour, enclosed by piers constructed from the shore north and south of the entrance to the river.

4. I have to request that I may be furnished with your Excellency views, after consulting the Madras Government, on the suggestions made in this report. I have already, in a previous despatch, expressed my opinion that the connection of the port of Vizagapatam with the Indian railway system, on the construction of the East Coast Railway, will add new importance to the question of improving the harbour.

From F. N. THOROWGOOD, Esq., M. INST., C.E., to the Under-Secretary of State for India, dated Wimbledon, 25th May 1892.

[*Vizagapatam Harbour.*]

I have the honour to submit herewith my report upon forming a harbour at Vizagapatam, together with two plans (Nos. 1 and 2), in accordance with orders and instructions given in your letter of 8th October 1891, No. 1779 P.W.

2. *Arrival at Madras and Vizagapatam.*—I arrived at Madras on 25th November 1891, and at once reported myself to the Chief Secretary to Government, and had interviews with the Public Works Member of Council and Colonel Pennycuick, R.E., Chief Engineer, Public Works Department. I received a very large and most interesting batch of papers containing

all that had been written on the subject of Vizagapatam Harbour, commencing at the year 1858, together with plans and sections of the port and backwater. At Madras I was detained till 30th November, the coasting steamer being very late, and I arrived at Vizagapatam on the morning of 4th December.

3. *Previous opinions on the Harbour.*—I shall have to refer in some detail to the opinions of others who have advocated the construction of a harbour at this port, as the features of the coast are rather peculiar, and it is certainly curious to see what conflicting decisions have been arrived at. It is unnecessary for me to describe the town and situation of the port of Vizagapatam, as these are sufficiently indicated on Drawings Nos. 1 and 2. It differs, however, from any port on the Coromandel coast in this, that on the south side of the river mouth instead of a low flat sandy shore, there are almost precipitous cliffs, reaching a maximum height of 536 feet above high water, the highest and boldest being known as the "Dolphin's Nose." This headland projects 1,500 feet eastward of the narrow entrance to the river or backwater, and thus protects it from the swell of the south-west monsoon. The water round this headland is deep, and more free from sand in suspension than is the case where the shore is low and flat.

4. *General features of Vizagapatam Port.*—At first sight it is impossible not to be struck with the natural advantages that the place possesses for making a harbour, the backwater offering a fine sheltered area hemmed in by hills, and capable of being made into docks, quays, wharves, &c., to accommodate a large trade. And it is absolutely distressing to see this fine backwater almost cut off from the sea by the long spit of sand which blocks the mouth, and is generally called the bar. On this sand spit or bar, except at high water, on the smoothest day, there is a constant and most dangerous surf ever breaking. (See Drawing No. 1.) The removal of this bar has been the problem on which so many opinions have been offered, and I am obliged to come to the conclusion that many of these opinions have been arrived at on insufficient evidence.

5. *Other opinions as to methods of improving Port.*—In September 1858 Lieutenant Vertue, R.E., reports to the Government of Madras that "the bar is formed by material brought down by the river, and is composed of soft mud, not of sand," and that, "by means of a groyne of rough stone projecting seaward from the northern side of the river's mouth, . . . the loose material of which the bar consists would be swept away."

6. Mr. E. T. Thomas, C.S., has taken a great interest in the port, and he describes it in a memorandum to the Madras Government, 24th September 1872, as "the most natural and the most easily formed port on the East Coast Peninsula;" and further says, "if the bar were removed, the harbour would be made."

7. Captain Waters, Master Attendant at Vizagapatam, proposes in 1873 a groyne, 700 feet long, run out from the *south* side of the river as the only means to render Vizagapatam a safe port.

8. Major Beatty, R.E., has gone into the matter very fully, and his proposal was a groyne on each side of the river mouth. On the north side 1,200 feet long, and on the south (from the Dutch battery) 1,000 feet long.

9. In 1880 Major-General R. H. Sankey, R.E., investigated the matter very thoroughly, and has placed on record that he does not believe in the efficacy of any groynes to scour away the bar, which would probably only be thus put further out to sea, and that "we should not only incur useless outlay, but do perhaps irreparable mischief," by such works.

10. The late Captain I. H. Taylor, Master Attendant of the Madras Presidency, advocated no artificial works at Vizagapatam, because he believed that close beneath the surface of the sand or mud was hard, uncompromising rock. There are numerous other opinions and suggestions on record which need not be noticed, except one which I refer to in paragraph 36, viz., the proposal of Mr. W. J. Addis, submitted to the Secretary of State for India, 23rd November 1891, and handed to me by the Government of Madras.

11. I have carefully considered all that has already been put forward on the subject of this harbour, and I commenced my investigation without prejudice in any direction.

12. *Bar removed by heavy floods.*—The bar or sand spit is occasionally removed by heavy rains, and I find an undoubted record of a series of soundings taken a few months after the cyclonic storm of 1876, on which is shown a channel from the Dutch battery up to the bridge (called now Turner's bridge, as shown on the Drawings Nos. 1 and 2), with from 18 to 27 feet of water at low-water throughout. It is most important to bear this in mind, as where there was in 1877 a depth of 16 to 18 feet at low-water there now stands the "Sand Island" shown plainly in Drawing No. 1. This "Sand Island" was formed mostly while I was at Vizagapatam.

13. But these scourings out by heavy rain are uncertain, and there has been no such action now for more than three years. The present state of the river mouth is most lamentable, being one mass of broken water, through which I can from experience state it is not only disagreeable, but very dangerous to pass. Yet this present state of things may go on for a further indefinite period and be a serious obstacle to any trade.

14. I have therefore come to the conclusion that in submitting any design for improving the port, the river Macndora (as I find it called on former plans) must be regarded only as a tidal backwater, and the question of rainfall or catchment area may be disregarded, except in so far as to suggest no work that may be damaged by one of these heavy rain floods.

15. As a matter of fact the river is tidal for a distance of nearly eight miles from the mouth, and it is to the tidal ebb and flow that we must look for the active force moving sand outward or inward. The scour of a heavy rain is an occasional event which must not be reckoned on if a useful harbour is desired.

16. In his letter to Sir Juland Danvers, dated 8th July 1891, Sir A. M. Rendel says, speaking of the river at Vizagapatam, "small as its forces are, the river seems even now to be only just unable to cope with those of the sea, for the depth on the bar diminishes from its deepest to its shallowest limit but slowly." Nothing can better represent the truth of this than the survey I have lately made, and which I shall have to refer to in detail. With everything against it, the river has still been able to maintain an exit to the sea through which boats can pass at high water.

17. *Conflicting opinions about Bar.*—My first aim on arrival was to try to ascertain, first, what was the cause of the bar; secondly, from what source did the material composing it come; and thirdly, was it easily moved from its position. With regard to the last point it is evident that conflicting opinions had been held many years ago, for I find that the District Engineer, writing officially on 9th March 1859, says, "that there is strong evidence that the depth of water on the bar has not varied, nor has its size and position during the recollection of the oldest inhabitant," while on 8th March 1871, Major Beatty, R.E., writes making proposals "in order to remedy the constant fluctuations that the bar is subject to, both with regard to the depth of water upon it and the position of the deep channel." I therefore approach the matter of the so-called bar with much caution, but with the belief that the conclusions I draw are correct.

18. *Sand supply to the Bar.*—I find that the chief source of sand supply is due to wave action during the period from October to February, when the wind and littoral current are both from the north of east. If there were no river at all the sand would be heaped up against the rocky coast on the south side of the mouth of the estuary. By reference to the detailed survey of December 1891, on Drawing No. 1, it will be seen that the one-fathom line (one-fathom below low-water spring tides) runs out as a spit of sand for a distance of 640 feet to the east of the old Dutch battery. Before the state of the sea would permit me to take any soundings, I observed this state of things by frequently ascending the Dolphin's Nose headland and looking at the sand through the clear water at flood tide. A careful survey confirms the opinion I inclined to from mere ocular observation.

19. There is also another source of sand supply to the so-called bar, and that is a movement of sand when the southerly winds set in from seaward in towards shore. This I believe to be common to all ports on the Coromandel coast, and at Madras it was very conspicuous during the construction of the harbour piers.

20. The sand in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand, and as a matter of fact it became extremely difficult at this spot to get a survey of the bottom of the sea which might be called accurate for two consecutive days during the time of general change of wind from north to south.

21. *Fresh-water springs disturb sand.*—This extreme mobility of the sand I find to be very greatly due to the fact that the bottom of the sea is pierced by numerous fresh-water springs, which when intercepted on shore by wells form the water-supply of the place. Of these wells there are no less than 22 within one eighth mile of high-water mark, and in one mile of coast, and the level of the surface of water in them all is about the same at the same minute of time, being about three feet above low-water level. These springs, when not intercepted, percolate up from the sandy bottom of the sea and render the sand very unstable, as may be plainly seen at such times as the water is smooth and clear.

22. These two sources of sand-supply, one from the north, due mostly to wave action, and one directly towards shore, also mostly due to wave action on the sea bottom, form the serious obstruction known as the bar.

23. By again referring to Drawing No. 1, it will be seen that in February 1892, on repeating the survey of the sand spit with wind and current from the south, the contour line of one-fathom is driven backward a distance of 320 feet. I therefore come to the conclusion that the bar is and always has been caused by sand brought, as I have suggested, during the north-east monsoon, and afterwards flattened back over the mouth in the south-west monsoon.

24. The direction of the crests of the breaking waves hardly varies at all, being throughout the year as indicated on Drawing No. 1. I am supported in this belief by some most useful information given me by Captain Winckler, for many years Master Attendant at Vizagapatam, and now at Cochin.

25. *Currents outside mouth of river.*—With regard to tidal and littoral currents outside the mouth of the harbour, they vary so much and so frequently, but always with so low a velocity, that I think they may be passed over. I have shown on Drawing No. 1 how, on two days in February, the ebb tide, as observed with floats sunk very deep, took two quite opposite directions, the velocity, however, was never more than 44 feet per minute. In the Bay of Bengal the flood tide comes from the south, yet I found in December, with a northerly wind, the current at flood tide set distinctly towards the south, as recorded on drawing No. 2. On several occasions I have been unable to detect any current in seven-fathom water when the tide has been running rapidly into or out of the river. I therefore discard currents, outside the immediate neighbourhood of the river mouth, as having no general effect on the sand spit or bar.

26. *Evil done by the reclamation work.*—There seems to be no doubt whatever that the depth of water in the river and its mouth within the one-fathom line has diminished since the year 1870, when the reclamation of some swamp land was commenced. To quote Major Beatly, R.E., again, on 24th December 1873, he writes to the Collector of Vizagapatam,—"that from the date when the bunds for reclaiming were constructed, the bar has been rising at an average of two feet per annum;" and, indeed, it is impossible to doubt that the excluding of 2½ square miles of lands from the tide, even if this area were only covered to a depth of six inches, would make a serious difference in the scour of the tide at the mouth of the estuary, for it would cut off nearly 38 million cubic feet of water. In March 1874 Colonel W. Farewell, Deputy Chief Engineer, Public Works Department, wrote on this subject,—"there can be no doubt that the deterioration of the harbour is due to the reduction of the tidal estuary . . . . . that Government should repossess themselves of the swamp, so essential to the existence of the harbour." And Major-General Sankey, R.E., drew serious attention to this in his note of 13th August 1880 to the Madras Government.

27. As will be seen later on, I do not advocate handing the reclaimed swamp back again to the tide, because in the last 18 years by cultivating portions of it, by using it for grazing buffaloes, by occasional flooding and silting, the level of the general area is hardly appreciably below high-water spring tides, as found by numerous levels and sections I had taken upon it. But I most strongly advocate some measures for increasing the tidal capacity of the river, and this to be done by excavating into the reclaimed land.

28. *Borings on the Bar.*—Much anxiety seems to have been felt at Madras as to whether there is rock to be found in such positions as to prevent the forming of a harbour, and I have no doubt that locally disappointment was caused by my inability to take borings on the bar. As a matter of fact this is impossible without most elaborate and costly plant, such as the occasion did not justify my demanding.

29. *Rock.*—The question of rock in the backwater (except where the rock can be seen) need not be considered, as the soundings after the storm of 1876 already referred to in paragraph 12 sets that at rest. From two borings I took, shown on Drawing No. 1, it is very evident that there is nothing in the way of rock to prevent the making of an excellent harbour with 18 feet of water at low-water. I certainly discovered a solitary rock or boulder at three fathoms deep (at low-water spring tides) off the entrance of the river (marked *r* on Drawing No. 1), but by probing down round it two or three feet deeper I got no more rock, so I think it to be an isolated stone.

30. *Proposals to improve the Harbour. Dredging.*—Having now briefly described the state of affairs at Vizagapatam, I venture to put forward my proposals for improving the port. I first strongly urge the use of a sand-pump dredger to clear a channel as shown in Drawing No. 1, with a depth of 10 feet at low-water, and to dredge away the sand island, which is doing such harm to the port. The [illegible] of dredging has been found so beneficial to the neighbouring port of Coconada (similarly hampered by silt from the north) that I would very strongly recommend the use of a dredger at Vizagapatam, to be worked during the smooth season, to remove the present obstructions to traffic, which are truly distressing to see. I do not put the cost of this dredger down in the estimate for a harbour, as I have good reason to believe the port of Coconada are willing to share the cost of a dredger with Vizagapatam, and allow the machine to work at the latter port in January and February. I simply wish to draw attention to what I believe to be the simplest and most direct way of improving the port at present, so as to be better able to carry on its trade. The dredger "Wenlock" was to have been sent from Tuticorin to Vizagapatam while I was there, but it had to go to Bombay for repairs, and so could not have arrived at Vizagapatam till the smooth season had passed.

31. The dredger when working should remove the point of sand at the river mouth, and indicated on the plan as "point to be removed." The removing of this point seems to me to be of great importance, as the very narrow channel at that place produces at spring tides an abnormal velocity of flood tide (nearly always aided by wind and wave), amounting to as much as 208 feet per minute. This rapid tide through a sandy channel carries material with it, and ultimately forms and increases the sand island inside.

32. The ebb tide is retarded by wind and wave and does not achieve so great a velocity as the flood, but I often measured 180 feet a minute by observation, and by calculation from the present tidal capacity of the backwater passing through the narrow section of exit the result would be 176 feet per minute.

33. *Cost of dredging.*—To dredge a channel as shown on Drawing No. 1 from near the two-fathom line at sea up to and beyond Sand Island, with a minimum depth of 10 feet at low-water, would involve the removal of about 28,000 cubic yards of sand, at a cost of not less than Rs. 14,000. A very heavy rain flood might do more than this without any expenditure at all, but who can say when the next heavy flood will come, and what is to be done if it be postponed for two years more? In the Appendix A to this Report I give a detailed estimate of work to be done, so arranged that this sum of Rs. 14,000 may be included or omitted.

34. *Construction of a groyne.*—The only work of actual construction that I propose is a groyne, not less than 1,420 feet long, from the low-water line, as shown on both plans in red colour; and I should prefer to extend it 130 feet further, at an additional cost of Rs. 35,675, to ensure no sand passing round the end of it. The position and direction of this groyne have been carefully considered, and I do not think that any other situation or direction would attain the desired two-fold object of keeping back sand from the river mouth and allowing sufficient beaching ground for waves to break upon. A good extent of beaching ground is absolutely necessary, and while the proposed position of the groyne affords this, it at the same time will interrupt many of the breakers which now disperse themselves on the shore near the ice house.

35. *Construction of groyne.*—The first 670 feet of the groyne, and the whole of its base, I propose to form with large rubble stone taken from one of the neighbouring hills. The outer 550 feet is to be surmounted with a wall of concrete blocks, 24 feet in width, similar in size and shape to those used at Madras Harbour subsequent to the year 1885. I do not think that any less substantial work should be attempted in so exposed a situation, and there is evidently not a long enough period of smooth water to justify an attempt at building with concrete *in situ*. I have supposed that to build this concrete wall plant will be available at a low cost from Madras, as indeed is hinted by Sir Alexander Rendel in his letter of 8th July 1891. The concrete blocks can be made at the spot indicated in Drawing No. 1 as "site for concrete block ground." Stone can be brought easily by the Railway to the site of the groyne and to the block-yard at a rate of less than one anna per ton per mile, and excellent sharp coarse sand is obtainable along the shore.

36. *Mr. Addis' scheme.*—If a solid groyne or pier were run out straight to sea from the corner of the river mouth, as indicated in the design of Mr W. J. Addis, referred to in paragraph 10, the result would, I fear, be to convey the breakers right up to the Port Office of Vizagapatam, and to undermine the railway now under construction.

37. *Excavation of the reclaimed land.*—To add to the tidal capacity of the estuary, I propose to cut away the foreshore of the reclaimed land eventually right up to the inner bund on the south side of the reclamation. This, however, may be done by instalments, and need not be undertaken as a whole to begin with. In Appendix A I give two estimates, one for the whole excavation, and one for half of the ultimate quantity proposed to be moved. This excavation is to be carried to ordinary low-water level by Coolly labour. If a dredger is available subsequently, the water may be deepened in place by degrees, and gradually the shore may be used as a landing place for cargo. But the first object is to add to the tidal capacity of the estuary by removing land that lies between high and low-water level the subsequent deepening being a matter for future consideration. The material excavated is to be levelled up on the reclaimed land within the bund.

38. *Tidal capacity of estuary.*—I calculate the present tidal capacity at spring tides of the estuary at only 67 million cubic feet, and this calculation agrees almost exactly with what should be the capacity theoretically according to a formula which proportions the tidal ebb and flow to the low-water section at a river's mouth. By excavating into the foreshore, as shown on Drawing No. 2 to the full extent, an addition of over 19 million cubic feet will be achieved, or nearly one third more. But this will be at a cost of Rs. 1,93,200. But half this amount of excavation might be carried out at first at a cost of Rs. 96,900, and the result watched. The whole work may be progressive, and in the estimates in Appendix A, I endeavour to make this clear.

39. *Cost of the different works.*—At present, for the full work proposed, including dredging and excavating, the cost would be Rs. 6,11,271, as shown in Appendix A (1). Or if the dredging be postponed, and only half what I propose be excavated, the total would be Rs. 4,78,541. See Appendix A (3). If the groyne alone be built, and no addition made to the tidal capacity by excavation, the cost would be Rs. 3,62,751. See Appendix A (4).

40. *Pier on the south side not wanted.*—There is one more point in this scheme that I ought not to pass over, and that is the necessity or otherwise for a short pier on the south of the river mouth. I have given this most careful consideration, especially as such a work was mentioned by Sir Alexander Rendel in his letter of 8th July 1891. I found by close examination on the spot that the line of broken water hardly varies at all in direction in either monsoon, and is as indicated on my Drawing No. 1. Further, I find that the old Dutch battery, close to the water's edge on the south corner of the river mouth, is only built of bricks and mortar, and it is impossible to believe that this would have stood so many years if it were attacked by heavy seas. I have, therefore, arrived at the conclusion that no work on the south side is necessary

for a small inner harbour. If any further work be required, it will be the extension by 100 or 150 feet of the northern groyne.

41. *Comparative surveys of 1883 and 1892.*—Another point I wish to call special attention to is this:—It has sometimes been urged by many who have taken up the question of a harbour at Vizagapatam, that any work short of a very large one will be sure to silt up. My belief is that never until now has the matter been thoroughly considered, and I think it will be admitted that we can now see that the sand trouble at the river mouth is very local, and is covered by my proposed groyne of 1,420 feet from low-water. On Drawing No. 2 I have shown the contour lines at sea taken from Commander Falle's exquisite survey of 1883, and in my own survey of 1892. I have, as nearly as I could, followed Commander Falle's traversing lines. So we have, I may say, for the first time, two accurate surveys at nine years interval, showing that in this interval, and with the bar now in an extremely bad condition, there is practically no change whatever in depth from the nine-fathom to the one-fathom contour. With the bottom of the sea so constant as this, I do not fear that the groyne now proposed will silt up or do otherwise than keep the river-mouth clear.

42. *Deep Harbour.*—I have now to refer very briefly to a larger design shown in blue lines on Drawing No. 2. This gives a magnificent outer harbour with a 900 feet entrance in nearly nine-fathom water, and with a distance of 2,100 feet shorewards under cover of the south pier bar is not the only obstacle for working cargo at Vizagapatam, but that the ground swell often interferes with discharging cargo from ships. [illegible], with regard to this design, it must be borne in mind that the

43. If this larger plan were to be carried out, there would be safe anchorage for certainly 20 ships in the outer harbour, and the backwater might then be converted into docks and quays, which would compare favourably with any port in India, except Bombay. The groyne thrown out for the smaller design would be extended as shown for the larger one, and I again suppose that cranes and plant from Madras might be utilized here. In this case I would propose a railway along the foot of the Dolphin's Nose headland, and a concrete block ground on the plateau above the Dutch battery, with a wire rope incline down to the railway along the shore. I give in Appendix B an estimate of the cost of this, which of course is great, amounting to Rs. 43,27,272.

44. In conclusion, I should like to be permitted to record my thanks to all those with whom I came in contact officially during my stay at Vizagapatam, which ended on 22nd February 1892. To Mr. Willock, to Mr. F. B. Walker, Chief Engineer of the East Coast Railway, and his staff, to Captain Woodhouse, Port Officer, and to Mr. Gardiner, of the firm of Stuart, Hall, & Co., my thanks are specially due for having given me all assistance possible, and indeed more than I ought to have expected.

APPENDIX A.—Estimate of cost of the four alternative plans for improving harbour, referred to in Report and Drawings Nos. 1 and 2.

(1) The full work proposed:—

Groyne—

	Rs.
Rubble stone in commencement and in base to end of groyne, 70,892 cubic yards at Rs. 1-8-0 ...	1,05,507
Concrete blocks in outer portion, 7,822 cubic yards at Rs. 10-8-0 ...	83,121
Setting ditto in position, 7,822 cubic yards at Rs. 2-8-0	19,555
Excavation in swamp to full extent,—	
19,320,000 cubic feet at Rs. 10 per 1,000 cubic feet	1,93,200
Dredging mouth of channel,—	
28,000 cubic yards at 8 annas	14,000
	4,14,393
Add plant and preliminary work	80,000
Block ground	15,000
	5,09,393
Contingencies at 10 per cent.	50,939
Establishment and office at 10 per cent.	50,939
Total for whole plan (1) ...	6,11,271

(2) Work as above omitting dredging and proportional part of contingencies, &c. 5,94,471

(3) Work as above (1), omitting dredging, and only doing half proposed excavation 4,78,641

(4) Construction of groyne alone 3,82,751

APPENDIX B.—Estimate for Deep Sea Harbour referred to in paras. 41 and 42 of Report.

	Rs.
Plant and preliminary work, supposing cranes are available from Madras	1,50,000
Approach to south pier	28,560
Block ground and incline, south side	30,000
Additional to north block ground	15,000
Complete south pier, 3,300 feet at Rs. 500 per foot	16,50,000
,, north pier, 3,465 feet at Rs. 500 per foot	17,32,500
	36,06,060
Add contingencies, 10 per cent.	3,60,606
Establishment and office, 10 per cent.	3,60,606
Total cost ...	43,27,272

ORDER—dated 28th July 1892, No. 2103 W., Public Works.

Recorded.

2. The orders of the Government of India will be awaited.

(True Extract.)

(Signed) J. PENNYCUICK, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintending Engineer, I Circle.
,, Consulting Engineer for Railways.
,, Marine Department.

Exd. J. P. Oliver.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1892} Madras.

PUBLIC WORKS.

Dated July, 28th.

Read.

Encl.

G.O., 28th July 1892, No. 2103 W.

JULY.

Harbour of Vizagapatam

Report by Mr. F. N. Thorowgood on the measures which he proposes for improving the —, recorded with remarks.

All communications should be addressed to the Secretary.

No. 328 M.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

CIVIL WORKS.

Miscellaneous.

To

The Secretary to the Government of Madras,
Public Works Department.

Simla, the 29th August 1892.

Sir,

With reference to Lord Cross' Despatch No. 3 Pub.
dated the 16th June 1892, to the address of the Government
of Madras, I am directed to request that the Government
of India may be favoured with an expression of the
views of His Excellency the Governor in Council on the
measures proposed by Mr. F. N. Thorowgood, M. Inst.
for improving the Vizagapatam Harbour.

2. The chart / plan referred to in Mr. Thorowgood's
report are herewith forwarded. They should be returned to the
Government of India when the views asked for in paragraph 1
above are furnished.

I have the honour to be
Sir
Your most obedient servant,

[illegible]

Under Secy. to the Govt. of India.

Documents accompanying
chart & plan to be returned

CURRENT No. [illegible]

Encls 2 Plans

Rec'd 5-9

No 2103 W dy 28-7-92
2787 W dy 23-10-91
2962 W dy 10-11-91
1769 W dy 10-4-78
4872 C dy 4-11-91
2534 C dy 14-5-92
2448 C dy 10-5-92
658 C dy 10-2-92
5768 C dy 20-11-91
749 W dy 22-3-80
1939 W dy 13-8-80
2294 W dy 27-5-78
Book of G.O's relating to Vizagapatam Harbour

A 1-5-9
Nov 9 L 9.

2/9/10

Sr Recd 9

— Note —

There is no reasonable doubt that an excellent fine-weather outer harbor for large ships could be made at Vizagapatam on the general lines of the Madras harbor, and for such a work Mr. Thorowgood's proposals appear suitable. Whether the rough estimate in appendix B of his report gives a reliable idea of the cost is a different matter; I do not think it does.

2. Vizagapatam lies in a track much affected by Cyclones and the seas which at such times roll in upon the proposed

Ans to Q. Chief Engineer re conveying as to the prospects of Mr Thorowgood's smaller project of a boat harbour, as to the cost of the Improvement. Estimated at Rs 2 lakhs however is beyond consideration at present. Q. as to the question one, it seems clear that the cost of purchasing & of maintaining a dredger will have to be taken into account, for although the work might possibly be [illegible] found in the first instance the Contractor always demands a very high price at the fair season — a very short one — when alone the work at the site. He cannot work to advantage & profit in much water.

I cannot venture an opinion as to the constancy of Mr Walsh's views as to the inefficiency of the proposed high groyne on the north side to prevent the accretion of sand upon the bar, in the event of southerly winds cannot be said to admit that it might be effective as regards movement of sand from the north. Mr. G.E. Moore of the E&R has submitted a memorandum

site for the harbor are as violent as any along the whole East Coast of the Presidency. the harbor walls would therefore have to be as well founded, as massive, and as well protected from wave action, as those at Madras. The Madras harbor with a total length of sea wall of somewhat more than 5000 feet was estimated to cost 49 lakhs, but will really cost upwards of 123 lakhs; Mr. Thorowgood's Vizagapatam harbor wall would have a total length of 6,765 feet and his estimated cost for the harbor is 43.27 lakhs; it seems not improbable that it

proposing a groyne on the south side. If this is necessary to protect the barge against action from that direction, it seems that the cost of Mr Thorowgood's small scheme will be at least double what this state, including the sand pumps & dredger.

There is nothing to be done but to forward the note to India.

HCS
29 Oct

I am sorry to find the W.
Chief Engr to object
Thorowgood's proposals.
He admits he provides
the Govt. has in hand
& shall also for Expenses
the Revd Dr. Downing for
some 30 years ago, the stamp
of the book 9 1/2 in. over
proposed harbour. I visited the
Roman Catholic Bishop in
town which I should mention
he objected, & how the
long line of the harbour
bar pier extended, & there
fore, as I think the
Govt, as (I think) under the
direction of the Govt to
proposed harbour.

10 pcea

least half as much again.

3. The Vizagapatam harbor would however have this great advantage over the one at Madras; it would have in connection with it a natural inner harbor available for boats and small craft, and affording exceptional facilities for the construction of wharves and jetties suitable for landing and shipping all kinds of cargo, and in connection with the railway.

4. When railway communication with the central Provinces is opened it is not unlikely that an enormous quantity of their produce may seek its outlet

proposed harbour
How far
the
Govt
Chief Engr
Govt
harbour shows
it
it appears that
his
harbour
bar
Chief Engr
harbour
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Chief Engr
Govt

outlet at Vizagapatam, and then the construction of a ship harbour such as one under consideration may become imperative; but as matters now stand they do not appear to warrant an expenditure of certainly not less than 1,3¼ lakhs and probably more than 65 lakhs.

5. Passing now to the minor scheme dealt with by Mr. Thorowgood of merely improving the entrance to the backwater, or tidal estuary; he proposes to effect this, at a cost of Rs 6,11,271, by 1st. Dredging a channel with a minimum depth of 10 feet at low water from the two fathom line to about 600 feet

x at least I do not think that his / do quite clears up the point

Groyne was going to prevent this. On the contrary I think his own illustration of the Madras harbour shows what the effect of throwing out Groynes into the sea on the Coromandel Coast is - viz: to cause accretion of sand on the side immediately south of the obstruction, and erosion on the north. At Vizagapatam possibly the accumulation of sand to the south might be disturbed if not prevented by the action of the land water, but still it does not appear that Mr. T's northern groyne would be likely to be a success. The Chief Engineer does not go fully into the question which is raised by Mr. Moore, and which apparently grows out of the decision that the one groyne will not be effective. The C.E. says that if you have two groynes or training walls virtually

the outer harbours or the larger scheme. I am not an engineer but I understand that these training walls will only be carried out into water 12 feet deep. The cost of the two groynes together being 7,25,502 - considerably less than the 65 lakhs estimated by the Chief Engineer. I have taken Mr. T's estimate for his northern groyne - and multiplied it by 2. The C.E. admits that the northern groyne might arrest the deposit of sand on the bar from the north - I should like to know if he does not think that a southern groyne would do the same from the south. and that if the ends of the groynes were carried out into deep water, the tidal scour & land water would prevent a deposit of sand. And so a channel would be always open there. I would be obliged to him, if he would give me his views on this point. Mr. Moore's may be a crude suggestion, and

11 pcea

west of the landing stage (See paras 30. 31 and 33 of Report)

2nd. Constructing a Groyne 1420 feet (preferably 1550 feet) long, south of the mouth of the Estuary, in the line shown on the plans (See paras 34 and 35 of Report)

3rd. Increasing the tidal capacity of the Estuary by excavation by some of the land "reclaimed" in recent years. (See paras 37 to 38 of Report)

6. Taking these proposals seriatim, I would remark that the cost of the Dredging is put down as only Rs 14,000 (exclusive of "Contingencies" and share of "Establishment")

and

and does not provide anything for cost, or share of cost, of the "Sand pump dredger" which it is recommended should be used. Such a dredger, or indeed any dredger suitable for the place (it would have to be of the "hopper" - self-propelling type) would certainly cost not less than 1 3/4 lakhs. It is possible that the dredger "Wenlock" already possessed by the Harbour Commissioners might do the work, but most certainly to form a channel 1000 yards long by 50 wide as shown on drawing no 1, from near the two-fathom line at sea up to and beyond the sand Island with a minimum depth of 10 feet at low-water, would ire the removal of many

+ the provision of Rs 8. for plant and preliminary work appears to refer only to the plant required in connection with the construction of the Groyne.

+ The "Wenlock" cost £ 12,600 delivered at Rangoon.

imperfectly worked out, but I am not sure that it does not contain the germ of the solution of the difficulty

W
24 hour

I am much obliged to Mr Walsh for his further note - from which I gather that he is opposed to anything in the shape of a groyne be it one or two - in Vizag harbour - as he considers the

but what is wanted, strong and massive would resist the action even of the ordinary heavy seas.

Although he considers that the tide should be allowed to flow over the reclaimed lands, he does not expect much benefit from this source. Still it is evident that if it is possible these lands should be allowed to revert to their pristine condition. I am not aware of the position with regard to these lands and Mr Tipson's case - enquiries into this should be made, and the subject considered. -

+ see para 24 of report

One thing however is evident, that no improvement can take place with regard to the bar - unless it is kept continually dredged, and even then it is doubtful if a dredger could be worked effectively. But if the local authorities like to try one - I believe the Maharajah of Vizianagram is willing to give them one - they might see what could be done. If after a complete trial - no

for Dr

S/1 12 pica

many times the 28,000 cubic yards put down by Mr Thorowgood as the quantity to be dredged whilst to maintain such a channel would require frequent, if not constant dredging, so that a special dredger would have to be kept at the place. Even if the proposed Groyne did cut off all accumulation of sand from the north, the ceaseless action of the surf or breaking waves, the general direction of which is from the south East, would certainly fill in the excavated channel from the expanse of sand surrounding it. Mr Thorowgood himself notes in his para 20 that the sand "in the neighbourhood of the Vizagapatam harbor

mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand" and in para 21 he notices "the extreme mobility of the sand" and how "very unstable" the sandy bottom is at the place. It is certain that no channel there dredged to some feet below the surrounding plain of easily moved sand, which is for ever disturbed and swept along by the action of waves, would maintain its form or depths for any lengths of time without frequently recurring if not constant, clearing: whilst there would be in every year long periods during which heavy seas would render such clearance impossible, and after such

good result is shown. The dredger might be purchased for Coconada where one is much wanted, and I believe several other places, whilst the "Wenlock" has not time to clear out.

I do not see that any other thing can be done in the way of much improving the small harbour at Vizagapatam. The only true remedy appears to be a large harbour - but the time is not ripe yet for such a great work.

This note might be sent to India.

(In spirit) 6/4 1 Dec.

But this action would cease after the groyne was built.

a short précis of the papers about the swamp reclamation & Tirot[illegible] Lane had better be drawn up in R.O. I thought the Lane had been put an end to.

With reference to Mr's remark about the dredger, the facts are these the Maharaja proposed to give the 70000 or 80000 Rs due to him for land compensation by the E.I.R. towards the purchase of a dredger which would cost about 2 lakhs. Cocanada wanted 50% to grant or lend the balance - to which, on the accep. tance of the Maharaja's offer (which was prompted by Mr Hollands) we agreed on our way:

Mrs Gibson

I know Vijayawada & I am inclined to think that W Moore is right in saying that owing to the rocky formation of the Dolphin Nose there is no outside harbour at Vizag, nor could one be built there. I like W. Thorpe's scheme of a breakwater from the rocks at the N. end of the town to the right bay & groyne and piling on the sand spit from the rocks. but this would

13 pages

such periods there would be but little trace left of the excavated channel. Probably Mr Thorowgood considers that the increased tidal scour resulting from the increased tidal capacity which he proposes to give to the Estuary would keep his channel clear, but it may be accepted as an absolute certainty that this would not be the case. Before the reclamations the tidal capacity of the Estuary was greater than that to which Mr Thorowgood proposes to now restore it, but even then it was not able to keep the entrance to half the depth of Mr Thorowgood's proposed channel. The entrance was at times scoured out by violent local floods to a greater depth

depth even than that now proposed by Mr Thorowgood but was always before long again levelled up to its previous shallow state by the natural forces perpetually at work.

As regards the proposed Groyne, which is estimated to cost about Rs 2,48,630, I would submit that there is no evidence as to its probable efficacy. Mr Thorowgood apparently had no opportunity of making observations on the movement of the sand at the place during the South West Monsoon, which has a very important bearing on the question. Granting that the Groyne would arrest the travel of sand from the north and that more sand travels from that direction than from the south, there

* By the flood resulting from the Cyclonic rainfall of May 18 the "bar" was scoured out to a depth of between 9 and 10 feet at low water; in June of the following year the Master Attendant Madras reported that the bar was in a worse state than he had ever known or heard of before (in his letter 4684 with O.M.G 33 dated 27 June 1878)

† Rubble ... 1,05,507
Concrete Blocks ... 82,131
Setting do ... 19,555
Share of contingencies ... 20,719
... Establt ... 20,718
2,48,630

h establishment & Dy
Estab from
d- Establ of

5/12/92

14 pieces

is nothing to show that there is not also a considerable movement of sand from the South and East which the Groyne would also arrest, causing at times a deposit on its south side in the very place which it is wished to deepen; indeed in para 19 of his report Mr Thorowgood himself says "there is also another source of sand supply to the so called bar, and that is the movement of sand when the southerly winds set in from seaward towards the shore"; such experience also as we have on the Coromandel coast points to the extreme probability that the proposed Groyne will greatly aggravate the

the evil which it is
intended to remedy. I
may here mention that
the training walls or
groynes at Coconada,
are under totally different
conditions from those
at Vizagapatam, being
at the head of a deep
bay on a foreshore free
from heavy surf and
quite sheltered from
all seas from the South.)

8. The proposal to increase the tidal capacity of the Estuary is undoubtedly based on thoroughly sound principles. For the last 20 years, or so, every officer of this Department who has had to deal with the matter has pointed out the injury that would be, and has been, caused by the "reclamation" of land which

15 feet

which used to be covered by the tides. To the "reclamation" is undoubtedly due some deterioration of the entrance to the backwater, and the nearer the capacity of that tidal basin is brought back to what it was originally, the more nearly will the "bar" return to its former state. That state though somewhat better than it now is, and I do not for one moment suppose that the increase in tidal capacity proposed by Mr. Thorowgood would keep open an unenclosed channel to a depth of 10 feet at low water, but it might probably add a very important foot or two in depth to the

wood

worst places, and any work carried out in that direction would be useful, whatever might be the way in which it is hereafter decided to treat the outer harbour question.

Q. It may, I think be safely asserted that the conditions which obtain at the surf-beaten mouth of Vizagapatam backwater are such that with the small range of tide available for creating tidal scour, no permanent improvement to the extent anticipated by Mr. Thorowgood from his scheme, can be achieved until the place receives thorough protection from the neverceasing action of the surf, and from the effect of violent storms; protection can

16 pces

only be given by long and massive sea walls and they would of course be most advantageously disposed so as to enclose an outer harbor; not till that is made, I fear, can the inner harbor have an entrance channel with anything like a minimum depth of 10 feet at low water, except for comparatively short periods after great land floods, which are of infrequent occurrence, have swept through the mouth of the Estuary and scoured it out

C. Lovelock

27/10/92

17 pieces

No. 428 M.

All communications should be addressed to the Secretary.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

CIVIL WORKS.

Miscellaneous.

Simla, the 17th October 1892.

The following, with copy of the letter referred to, and of its enclosure, is forwarded to the Secretary to the Government of Madras, Public Works Department, for information, with reference to the correspondence ending with Public Works Department letter No. 328 M, dated the 29th August 1892.

1000

By order,

C. Vincent

Under Secy to the Govt. of India.

1p

P. W. CURRENT No. 10571

185 pieces

No 427 M, dated the 17th October 1892.

From - The Government of India,
Public Works Department,

To - G. E. Moore, Esquire, C.E.,
Executive Engineer, Public Works
Department, Railway Branch.

Rec'd 2
Desp. 24-9-92

I am directed to acknowledge the receipt of your letter, dated the 21st September 1892, and of the memorandum therewith forwarded, on the subject of improving the Vizagapatam Harbour, and to say that a copy of those documents has been forwarded to the Government of Madras for information.

In 603 dy 25-2-73
" 156 dy 17-5-75
" 158 dy 17-5-75
" 2274 dy 27-5-76
" 749 dy 22-3-80
" 1939 dy 18-8-80
" 5147c dy 4-11-89
" 5503 cdy 20-12-90
" 2741 cdy 20-12-90
" 2787 dy 23-10-91
" 4872 cdy 4-11-91
" 2982 cdy 10-11-91
" 5165 cdy 20-11-91
" 688 cdy 10-2-92
" 2446 dy 15-5-92
" 2534 dy 14-5-92

19 pieces

From — Mr. George E. Moore,
Executive Engineer, Public
Works Department, Railway Branch

To — The Secretary to the Government
of India, Public Works Department.

Dated 21st September 1892.

Sir,

1. Understanding that the subject of improving the harbour of Vizagapatam is under the consideration of the Government of India, I have the honour to forward a memorandum embodying proposals which I venture to think are worthy of consideration.

2. The result aimed at is to allow of the substitution of large cargo boats and steam launches in the place of surf boats without in any way interfering with a larger scheme should it at anytime be requisite.

3. The works that I propose to effect this are first

first a breakwater to protect the entrance from the sea and surf, secondly a groyne or groynes to arrest the movement of the sands on the north side.

4. I have no hesitation in saying that however much opinion may vary regarding the position and details of construction of these works, that they are primarily essential to any improvement scheme. and for reasons given in my memorandum how disastrous to the town would be the effect of any attempted improvement by a contraction of the entrance.

5. Believing it premature I have not attempted to give either detailed plans or estimates although I have prepared them.

I have, &c.,

(Signed) George E Moore.

---

20 Spress

for Sir

Vizagapatam Harbours.

1. The construction of the East Coast Railway makes the improvement of the Port accommodation at Vizagapatam an urgent necessity.
2. At present the only communication between ships and the shore is carried out by surf boats, expensive and dangerous.
3. The difficulty lies in getting over the bar at the entrance to the river which at times has as little as three feet of water on it and is always subject to a dangerous surf.
4. If the bar could be so protected from the surf that there should be smooth water on it, Cargo boats could without any further improvement be used in the place of surf boats.
5. This can only be effected by the construction of a breakwater about 800 feet long on the south side, from the Dutch Fort on the Dolphin's nose ending in about 12 feet of water.
6. Sir A. Rendel in his report suggests piers

piers running out from one or both sides of the River with the idea of effecting a scour.
Considering the narrow range of tides and restricted area of the tidal backwater, this could have little effect unless made dangerously narrow when the probable effect would be the formation of a new bar just outside the piers. Beside no contraction of the entrance is permissible, on account of periodic floods, which occur every few years, flooding the lower parts of the town. These floods would be far more destructive were it not that they gradually enlarge the outlet, by scouring away the sands accumulated since the previous flood. In the case of a groyne narrowing the entrance, it would have no more effect in improving the channel in ordinary years, than the present sand bank, while in years of Cyclonic floods unless itself destroyed by the flood, the result to the

for Dr

the town would be most disastrous.
7. In another paragraphe he states "that it must not be forgotten that a bar is also a break water protecting the area within it from the sea". This bears out what I have always maintained that no scheme can be effectual that does not provide protection to the entrance from the South, the only exposed quarter. Only his proposed length of 200 feet does not go far enough.
8. Having protected the bar it can deepening it by dredging if considered necessary.
9. It is not enough however to clear away the bar without taking steps to prevent its reforming.
10. The bar consists of pure sea sand. A considerable movement of which takes place up and down the coast varying according to winds, tides and currents, the greatest movement being between high and low water mark. The usual result of placing an

an obstruction on the shore of this coast is for the sand to slowly creep round it.

11. On the South side of Vizagapatam owing to the peculiar rocky nature of the coast there is no supply of sand available. On the north side however there is a stretch of sandy beach three miles in extent to Waltair point beyond which again the coast is rocky. This stretch of beach is broken up by five or six natural barriers of rock which to some extent impede and limit the movement of sand up and down

12. During the S.W. Monsoon the movement is northwards but has little effect close to the town owing to the protection afforded by the Dolphin's Nose. During the N.E. Monsoon the sand gradually shifts back again till arriving at the river mouth, further progress southwards being stopped, it is forced up the river filling a large portion of the backwater opposite the Customs House, remaining there till washed out again by the aid afforded by the River after rain.

22 S. pea

13. That this destructive movement of sand southward during the N.E. monsoon which continues as long as N.E. winds prevail, up to January and February, can be stopped there is no reason to doubt as we have shown that the supply of sand is limited.

14. Regardless of expence this could be effected at once by running out a breakwater into deep water. As however the movement of the sand is gradual and is almost entirely confined to between high and low waters, it would be as effective and much less costly to throw out a groyne to just outside the line of surf into about twelve feet of water, and as the sand crept round the head to keep on lengthening the groyne so as always to keep the end in about twelve feet of water.

15. As this groyne would be at right angles to the coast line, it might be cheaply formed of large rubble only. In support of the practibility of this proposal I would state that nearly fifty years ago, the sea threatened the

Sea

sea wall in front of the town, when three or four rubble groynes were at the suggestion of Sir Arthur Cotton thrown out to protect it, at a cost of about Rs 20,000. Those have been entirely successful.

16. As regards the position of this groyne, it should not be too near the River entrance and I would suggest the lengthening of the first of Sir A. Cotton's groynes which might be supplemented by the construction of one or two shorter groynes as might be thought necessary after careful local examination.

17. These two works being carried out, the breakwater on the south side to protect the entrance from the waves and surf, and the groyne on the south shore to stop the shifting of the sand, the effect would be that the bar instead of deteriorating after the end of the ensuing S.W. monsoon would remain at the same depth all the year round and instead of perpetual surf would have smooth water - Rendering the Port safe and practicable

practicable for cargo boats and steam launches in ordinary weather at all tides and times.

18. My Estimate of the cost of these proposals is £95,000 or Rs 1,45,000 according to the design of breakwater adopted. -

(Sd) G. E. Broome

Septr 21st 1892

68 24 Pcls

Further Note on the Vizagapatam Harbour question with reference to Mr Moore's Memorandum dated 21st September 92 received with letter No 428 M dated 17th October 1892 from the Govt of India.

It will I think be seen from my "Note", written before the receipt of Mr Moore's memorandum, that I am in accord with him, as well as with some other Engineers

we have considered the subject as to the absolute necessity for thoroughly protecting the entrance to the backwaters from "the action of the surf and from the effect of violent storms" before any permanent improvement is possible. Mr Moore however anticipates that this can be effected by a breakwater some 600 feet long to the south of the entrance and a "groyne" to its north, both ending in "12 feet of water, whilst I have no doubt that the lengths of the protecting barriers would have to be much greater, and that to be permanent they would have to be massively constructed

× para 9 of Note.

× see also para 35 of Mr Shorwood's report.

"not believe that a "groyne" of large rubble even if carried out only to 12 feet depth of water at low tides, would stand the seas to which it would be exposed during cyclones or even in ordinary heavy weather; and if such a structure were destroyed its ruins would lie heaped about the anchorage and the backwater entrance

2. Possibly it would not be necessary to construct a complete outer harbour to efficiently shelter the backwater entrance from the forces which now prevent its improvement, but I am convinced that the protective works required would be most advantageously

disposed as as to forward
that all excess part of
a possible future
harbour.

3. It has been
suggested that the
groynes or walls might
be so constructed that
they would enable the
tidal ocean and land
water to keep a deep
channel always open.
This suggestion has
consideration at various
times; it did so in
1873, see Captain Beathy's
report with P. M. G. No.
603 dated 25th Feby.
1873, and again in 1880,
see Colonel Chrystie's
report with P. M. G. No.
749 dated 22nd March
1880. I entirely agree
with the views on the
subject expressed in
paras 36 & 46 of —

26 pros

67 Colonel Scratchley's note
with P. M. G. No. 1939 of
dated 13th August 1880,
and also with what
Mr Moore says in para
6 of his memorandum.

4 In connection
with this I would point
out that for the
greater part of every
year there is absolutely
no land water falling
into the harbour,
and often there are
intervals of years
during which the
discharge of the rivers,
even during the rains
is inconsiderable.
As however the whole
catchment basin
of the little rivers lies
within the influence
of all cyclones which
strike the coast

in the neighbourhood the discharge is at times very heavy.* At such times the amount of silt brought down would probably cause some trouble in an enclosed outer harbour, necessitating dredging, and the provision in the southern wall of powerful scouring vents, to be kept open when the river was in flood.

* see marginal remark at end of para 6 of "Note" and end of para 9.

Yours

E. W

Madras

1892

Print as an appendix to Proceedings

Precis of the papers about the reclamation of the swamp at Vizagapatam and D. Jiasoli'eme

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22 DECEMBER 1892, No. 3572 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—again the following paper:—

G.O., dated 28th July 1892, No. 2103 W., Public Works.

1 — *Read*—the following Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George, dated India Office, London, 16th June 1892, No. 3 P.W.

I forward herewith, for the information of your Excellency's Government, copy of a despatch * which I have recently addressed to the Government of India enclosing a report by Mr. F. N. Thorowgood on the measures which he proposes for improving the harbour of Vizagapatam.

* No. 27 of 16th June 1892 and enclosure. (The plans referred to in the enclosure have been sent to the Government of India.)

ENCLOSURES.

2 — Despatch from the Right Honorable Her Majesty's Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, 16th June 1892, No. 27 P.W.

With reference to my Public Works Despatch, No. 62, dated the 15th October 1891 I forward herewith, for your Excellency's consideration, copy of a report* which has been submitted to me by Mr. F. N. Thorowgood on the results of his investigation into the condition of the harbour at Vizagapatam.

* Report, dated 25th May 1892, and two plans

2. The measures proposed by Mr. Thorowgood for the improvement of the port are (1) the construction of a groyne from the shore north of the river mouth; (2) the excavation of some reclaimed land, with the object of increasing the tidal capacity of the estuary; and (3) the dredging of the mouth of the channel. The total outlay involved in these improvements, which need not be carried out at once to the full extent proposed, is Rs. 6,11,271.

3. A larger scheme, estimated to cost Rs. 43,27,272, is also proposed by Mr. Thorowgood, with the object of forming a deep sea harbour, enclosed by piers constructed from the shore north and south of the entrance to the river.

4. I have to request that I may be furnished with your Excellency's views, after consulting the Madras Government, on the suggestions made in this report. I have already, in a previous despatch, expressed my opinion that the connection of the port of Vizagapatam with the Indian railway system, on the construction of the East Coast Railway, will add new importance to the question of improving the harbour.

3 — From F. N. THOROWGOOD, Esq., M. INST., C.E., to the Under-Secretary of State for India, dated Wimbledon, 25th May 1892.

[*Vizagapatam Harbour.*]

I have the honour to submit herewith my report upon forming a harbour at Vizagapatam, together with two plans (Nos. 1 and 2), in accordance with orders and instructions given in your letter of 8th October 1891, No. 1779 P.W.

2. *Arrival at Madras and Vizagapatam.*—I arrived at Madras on 25th November 1891, and at once reported myself to the Chief Secretary to Government, and had interviews with the Public Works Member of Council and Colonel Pennycuick, R.E., Chief Engineer, Public Works Department. I received a very large and most interesting batch of papers containing

all that had been written on the subject of Vizagapatam Harbour, commencing at the year 1858, together with plans and sections of the port and backwater. At Madras I was detained till 30th November, the coasting steamer being very late, and I arrived at Vizagapatam on the morning of 4th December.

3. *Previous opinions on the Harbour.*—I shall have to refer in some detail to the opinions of others who have advocated the construction of a harbour at this port, as the features of the coast are rather peculiar, and it is certainly curious to see what conflicting decisions have been arrived at. It is unnecessary for me to describe the town and situation of the port of Vizagapatam, as these are sufficiently indicated on Drawings Nos. 1 and 2. It differs, however, from any port on the Coromandel coast in this, that on the south side of the river mouth instead of a low flat sandy shore, there are almost precipitous cliffs, reaching a maximum height of 536 feet above high-water, the highest and boldest being known as the "Dolphin's Nose." This headland projects 1,500 feet eastward of the narrow entrance to the river or backwater, and thus protects it from the swell of the south-west monsoon. The water round this headland is deep, and more free from sand in suspension than is the case where the shore is low and flat.

4. *General features of Vizagapatam Port.*—At first sight it is impossible not to be struck with the natural advantages that the place possesses for making a harbour, the backwater offering a fine sheltered area hemmed in by hills, and capable of being made into docks, quays, wharves, &c., to accommodate a large trade. And it is absolutely distressing to see this fine backwater almost cut off from the sea by the long spit of sand which blocks the mouth, and is generally called the bar. On this sand spit or bar, except at high-water, on the smoothest day, there is a constant and most dangerous surf ever breaking. (See Drawing No. 1.) The removal of this bar has been the problem on which so many opinions have been offered, and I am obliged to come to the conclusion that many of these opinions have been arrived at on insufficient evidence.

5. *Other opinions as to methods of improving Port.*—In September 1858 Lieutenant Vertue, R.E., reports to the Government of Madras that "the bar is formed by material brought down by the river, and is composed of soft mud, not of sand," and that, "by means of a groyne of rough stone projecting seaward from the northern side of the river's mouth, ... the loose material of which the bar consists would be swept away."

6. Mr. E. T. Thomas, C.S., has taken a great interest in the port, and he describes it in a memorandum to the Madras Government, 24th September 1872, as "the most natural and the most easily formed port on the East Coast Peninsula;" and further says, "if the bar were removed, the harbour would be made."

7. Captain Waters, Master Attendant at Vizagapatam, proposes in 1873 a groyne, 700 feet long, run out from the *south* side of the river as the only means to render Vizagapatam a safe port.

8. Major Beatty, R.E., has gone into the matter very fully, and his proposal was a groyne on each side of the river mouth. On the north side 1,200 feet long, and on the south (from the Dutch battery) 1,000 feet long.

9. In 1880 Major-General R. H. Shankey, R.E., investigated the matter very thoroughly, and has placed on record that he does not believe in the efficacy of any groynes to scour away the bar, which would probably only be thus put further out to sea, and that "we should not only incur useless outlay, but do perhaps irreparable mischief," by such works.

10. The late Captain I. H. Taylor, Master Attendant of the Madras Presidency, advocated no artificial works at Vizagapatam, because he believed that close beneath the surface of the sand or mud was hard, uncompromising rock. There are numerous other opinions and suggestions on record which need not be noticed, except one which I refer to in paragraph 36, viz., the proposal of Mr. W. J. Addis, submitted to the Secretary of State for India, 23rd November 1891, and handed to me by the Government of Madras.

11. I have carefully considered all that has already been put forward on the subject of this harbour, and I commenced my investigation without prejudice in any direction.

12. *Bar removed by heavy floods.*—The bar or sand spit is occasionally removed by heavy rains, and I find an undoubted record of a series of soundings taken a few months after the cyclonic storm of 1876, on which is shown a channel from the Dutch battery up to the bridge (called now Turner's bridge, as shown on the Drawings Nos. 1 and 2), with from 18 to 27 feet of water at low-water throughout. It is most important to bear this in mind, as where there was in 1877 a depth of 16 to 18 feet at low-water there now stands the "Sand Island" shown plainly in Drawing No. 1. This "Sand Island" was formed mostly while I was at Vizagapatam.

13. But these scourings out by heavy rain are uncertain, and there has been no such action now for more than three years. The present state of the river mouth is most lamentable, being one mass of broken water, through which I can from experience state it is not only disagreeable, but very dangerous to pass. Yet this present state of things may go on for a further indefinite period and be a serious obstacle to any trade.

14. I have therefore come to the conclusion that in submitting any design for improving the port, the river Maonderu (as I find it called on former plans) must be regarded only as a tidal backwater, and the question of rainfall or catchment area may be disregarded, except in so far as to suggest no work that may be damaged by one of these heavy rain floods.

15. As a matter of fact the river is tidal for a distance of nearly eight miles from the mouth, and it is to the tidal ebb and flow that we must look for the active force moving sand outward or inward. The scour of a heavy rain is an occasional event which must not be reckoned on if a useful harbour is desired.

16. In his letter to Sir Juland Danvers, dated 8th July 1891, Sir A. M. Rendel says, speaking of the river at Vizagapatam, "small as its forces are, the river seems even now to be only just unable to cope with those of the sea, for the depth on the bar diminishes from its deepest to its shallowest limit but slowly." Nothing can better represent the truth of this than the survey I have lately made, and which I shall have to refer to in detail. With everything against it, the river has still been able to maintain an exit to the sea through which boats can pass at high-water.

17. *Conflicting opinions about Bar.*—My first aim on arrival was to try to ascertain, first, what was the cause of the bar; secondly, from what source did the material composing it come; and thirdly, was it easily moved from its position. With regard to the last point it is evident that conflicting opinions had been held many years ago, for I find that the District Engineer, writing officially on 9th March 1859, says, "that there is strong evidence that the depth of water on the bar has not varied, nor has its size and position during the recollection of the oldest inhabitant," while on 8th March 1871, Major Beatty, R.E., writes making proposals "in order to remedy the constant fluctuations that the bar is subject to, both with regard to the depth of water upon it and the position of the deep channel." I therefore approach the matter of the so-called bar with much caution, but with the belief that the conclusions I draw are correct.

18. *Sand supply to the Bar.*—I find that the chief source of sand supply is due to wave action during the period from October to February, when the wind and littoral current are both from the north of east. If there were no river at all the sand would be heaped up against the rocky coast on the south side of the mouth of the estuary. By reference to the detailed survey of December 1891, on Drawing No. 1, it will be seen that the one-fathom line (one-fathom below low-water spring tides) runs out as a spit of sand for a distance of 640 feet to the east of the old Dutch battery. Before the state of the sea would permit me to take any soundings, I observed this state of things by frequently ascending the Dolphin's Nose headland and looking at the sand through the clear water at flood tide. A careful survey confirms the opinion I inclined to from mere ocular observation.

19. There is also another source of sand supply to the so-called bar, and that is a movement of sand when the southerly winds set in from seaward in towards shore. This I believe to be common to all ports on the Coromandel coast, and at Madras it was very conspicuous during the construction of the harbour piers.

20. The sand in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand, and as a matter of fact it became extremely difficult at this spot to get a survey of the bottom of the sea which might be called accurate for two consecutive days during the time of general change of wind from north to south.

21. *Fresh-water springs disturb sand.*—This extreme mobility of the sand I find to be very greatly due to the fact that the bottom of the sea is pierced by numerous fresh-water springs, which when intercepted on shore by wells form the water-supply of the place. Of these wells there are no less than 22 within one-eighth mile of high-water mark, and in one mile of coast, and the level of the surface of water in them all is about the same at the same minute of time, being about three feet above low-water level. These springs, when not intercepted, percolate up from the sandy bottom of the sea and render the sand very unstable, as may be plainly seen at such times as the water is smooth and clear.

22. These two sources of sand-supply, one from the north, due mostly to wave action, and one directly towards shore, also mostly due to wave action on the sea bottom, form the serious obstruction known as the bar.

23. By again referring to Drawing No. 1, it will be seen that in February 1892, on repeating the survey of the sand spit with wind and current from the South, the contour line of one-fathom is driven backward a distance of 320 feet. I therefore come to the conclusion that the bar is and always has been caused by sand brought, as I have suggested, during the north-east monsoon, and afterwards flattened back over the mouth in the south-west monsoon.

24. The direction of the crests of the breaking waves hardly varies at all, being throughout the year as indicated on Drawing No. 1. I am supported in this belief by some most useful information given me by Captain Winckler, for many years Master Attendant at Vizagapatam, and now at Cochin.

25. *Currents outside mouth of river.*—With regard to tidal and littoral currents outside the mouth of the harbour, they vary so much and so frequently, but always with so low a velocity, that I think they may be passed over. I have shown on Drawing No. 1 how, on two days in February, the ebb tide, as observed with floats sunk very deep, took two quite opposite directions, the velocity, however, was never more than 44 feet per minute. In the Bay of Bengal the flood tide comes from the south, yet I found in December, with a northerly wind, the current at flood tide set distinctly towards the south, as recorded on Drawing No. 2. On several occasions I have been unable to detect any current in seven-fathom water when the tide has been running rapidly into or out of the river. I therefore discard currents, outside the immediate neighbourhood of the river mouth, as having no general effect on the sand spit or bar.

26. *Evil done by the reclamation work.*—There seems to be no doubt whatever that the depth of water in the river and its mouth within the one-fathom line has diminished since the year 1870, when the reclamation of some swamp land was commenced. To quote Major Beatty, R.E., again, on 24th December 1873, he writes to the Collector of Vizagapatam,—"that from the date when the bunds for reclaiming were constructed, the bar has been rising at an average of two feet per annum;" and, indeed, it is impossible to doubt that the excluding of 2½ square miles of lands from the tide, even if this area were only covered to a depth of six inches, would make a serious difference in the scour of the tide at the mouth of the estuary, for it would cut off nearly 38 million cubic feet of water. In March 1874 Colonel W. Farewell, Deputy Chief Engineer, Public Works Department, wrote on this subject,—"there can be no doubt that the deterioration of the harbour is due to the reduction of the tidal estuary . . . . . that Government should repossess themselves of the swamp, so essential to the existence of the harbour." And Major-General Sankey, R.E., drew serious attention to this in his note of 13th August 1880 to the Madras Government.

27. As will be seen later on, I do not advocate handing the reclaimed swamp back again to the tide, because in the last 18 years, by cultivating portions of it, by using it for grazing buffaloes, by occasional flooding and silting, the level of the general area is hardly appreciably below high-water spring tides, as found by numerous levels and sections I had taken upon it. But I most strongly advocate some measures for increasing the tidal capacity of the river, and this to be done by excavating into the reclaimed land.

28. *Borings on the Bar.*—Much anxiety seems to be felt at Madras as to whether there is rock to be found in such positions as to prevent the forming of a harbour, and I have no doubt that locally disappointment was caused by my inability to take borings on the bar. As a matter of fact this is impossible without most elaborate and costly plant, such as the occasion did not justify my demanding.

29. *Rock.*—The question of rock in the backwater (except where the rock can be seen) need not be considered, as the soundings after the storm of 1876 already referred to in paragraph 12 sets that at rest. From two borings I took, shown on Drawing No. 1, it is very evident that there is nothing in the way of rock to prevent the making of an excellent harbour with 18 feet of water at low-water. I certainly discovered a solitary rock or boulder at three fathoms deep (at low-water spring tides) off the entrance of the river (marked *r* on Drawing No. 1), but by probing down round it two or three feet deeper I got no more rock, so I think it to be an isolated stone.

30. *Proposals to improve the Harbour. Dredging.*—Having now briefly described the state of affairs at Vizagapatam, I venture to put forward my proposals for improving the port. I first strongly urge the use of a sand-pump dredger to clear a channel as shown in Drawing No. 1, with a depth of 10 feet at low-water, and to dredge away the sand island, which is doing such harm to the port. The application of dredging has been found so beneficial to the neighbouring port of Cocanada (similarly hampered by silt from the north) that I would very strongly recommend the use of a dredger at Vizagapatam, to be worked during the smooth season, to remove the present obstructions to traffic, which are truly distressing to see. I do not put the cost of this dredger down in the estimate for a harbour, as I have good reason to believe the port of Cocanada are willing to share the cost of a dredger with Vizagapatam, and allow the machine to work at the latter port in January and February. I simply wish to draw attention to what I believe to be the simplest and most direct way of improving the port at present, so as to be better able to carry on its trade. The dredger "Wenlock" was to have been sent from Tuticorin to Vizagapatnam while I was there, but it had to go to Bombay for repairs, and so could not have arrived at Vizagapatam till the smooth season had passed.

31. The dredger when working should remove the point of sand at the river mouth, and indicated on the plan as "point to be removed." The removing of this point seems to me to be of great importance, as the very narrow channel at that place produces at spring tides an abnormal velocity of flood tide (nearly always aided by wind and wave), amounting to as much as 208 feet per minute. This rapid tide through a sandy channel carries material with it, and ultimately forms and increases the sand island inside.

32. The ebb tide is retarded by wind and wave and does not achieve so great a velocity as the flood, but I often measured 180 feet a minute by observation, and by calculation from the

present tidal capacity of the backwater passing through the narrow section of exit the result would be 176 feet per minute.

33. *Cost of dredging.*—To dredge a channel as shown on Drawing No. 1 from near the two-fathom line at sea up to and beyond Sand Island, with a minimum depth of 10 feet at low-water, would involve the removal of about 28,000 cubic yards of sand, at a cost of not less than Rs. 14,000. A very heavy rain flood might do more than this without any expenditure at all, but who can say when the next heavy flood will come, and what is to be done if it be postponed for two years more? In the appendix A to this report I give a detailed estimate of work to be done, so arranged that this sum of Rs. 14,000 may be included or omitted.

34. *Construction of a groyne.*—The only work of actual construction that I propose is a groyne, not less than 1,420 feet long from the low-water line, as shown on both plans in red colour; and I should prefer to extend it 130 feet further, at an additional cost of Rs. 35,675, to ensure no sand passing round the end of it. The position and direction of this groyne have been carefully considered, and I do not think that any other situation or direction would attain the desired two-fold object of keeping back sand from the river mouth and allowing sufficient beaching ground for waves to brake upon. A good extent of beaching ground is absolutely necessary, and while the proposed position of the groyne affords this, it at the same time will interrupt many of the breakers which now disperse themselves on the shore near the ice house.

35. *Construction of groyne.*—The first 870 feet of the groyne, and the whole of its base, I propose to form with large rubble stone taken from one of the neighbouring hills. The outer 550 feet is to be surmounted with a wall of concrete block, 24 feet in width, similar in size and shape to those used at Madras harbour subsequent to the year 1885. I do not think that any less substantial work should be attempted in so exposed a situation, and there is evidently not a long enough period of smooth water to justify an attempt at building with concrete *in situ*. I have supposed that to build this concrete wall plant will be available at a low cost from Madras, as indeed is hinted by Sir Alexander Rendel in his letter of 8th July 1891. The concrete blocks can be made at the spot indicated in Drawing No. 1 as "site for concrete block ground." Stone can be brought easily by the Railway to the site of the groyne and to the block-yard at a rate of less than one anna per ton per mile, and excellent sharp coarse sand is obtainable along the shore.

36. *Mr. Addis' scheme.*—If a solid groyne or pier were run out straight to sea from the corner of the river mouth, as indicated in the design of Mr. W. J. Addis, referred to in paragraph 10, the result would, I fear, be to convey the breakers right up to the Port Office of Vizagapatam, and to undermine the railway now under construction.

37. *Excavation of the reclaimed land.*—To add to the tidal capacity of the estuary, I propose to cut away the foreshore of the reclaimed land eventually right up to the inner bund on the south side of the reclamation. This, however, may be done by instalments, and need not be undertaken as a whole to begin with. In Appendix A I give two estimates — one for the whole excavation, and one for half of the ultimate quantity proposed to be moved. This excavation is to be carried to ordinary low-water level by cooly labour. If a dredger is available subsequently, the water may be deepened in place by degrees, and gradually the shore may be used as a landing place for cargo. But the first object is to add to the tidal capacity of the estuary by removing land that lies between high and low water level, the subsequent deepening being a matter for future consideration. The material excavated is to be levelled up on the reclaimed land within the bund.

38. *Tidal capacity of estuary.*—I calculate the present tidal capacity at spring tides of the estuary at only 67 million cubic feet, and this calculation agrees almost exactly with what should be the capacity theoretically according to a formula which proportions the tidal ebb and flow to the low-water section at a river's mouth. By excavating into the foreshore, as shown on Drawing No. 2 to the full extent, an addition of over 19 million cubic feet will be achieved, or nearly one third more. But this will be at a cost of Rs. 1,93,200. But half this amount of excavation might be carried out at first at a cost of Rs. 96,000, and the result watched. The whole work may be progressive, and in the estimates in appendix A, I endeavour to make this clear.

39. *Cost of the different works.*—At present, for the full work proposed, including dredging and excavating, the cost would be Rs. 6,11,271, as shown in Appendix A (1). Or if the dredging be postponed, and only half what I propose be excavated, the total would be Rs. 4,78,541 — see Appendix A (3). If the groyne alone be built, and no addition made to the tidal capacity by excavation, the cost would be Rs. 3,62,751 — see Appendix A (4).

40. *Pier on the south side not wanted.*—There is one more point in this scheme that I ought not to pass over, and that is the necessity or otherwise for a short pier on the south of the river mouth. I have given this most careful consideration, especially as such a work was mentioned by Sir Alexander Rendel in his letter of 8th July 1891. I found by close examination on the spot that the line of broken water hardly varies at all in direction in either monsoon, and is as indicated on my Drawing No. 1. Further, I find that the old Dutch battery, close to the water's edge on the south corner of the river mouth, is only built of bricks and mortar, and it is impossible to believe that this would have stood so many years if it were attacked by heavy seas. I have, therefore, arrived at the conclusion that no work on the south side is necessary

for a small inner harbour. If any further work be required, it will be the extension by 100 or 150 feet of the northern groyne.

41. *Comparative surveys of* 1883 *and* 1892.—Another point I wish to call special attention to is this:—It has sometimes been urged by many who have taken up the question of a harbour at Vizagapatam that any work short of a very large one will be sure to silt up. My belief is that never until now has the matter been thoroughly considered, and I think it will be admitted that we can now see that the sand trouble at the river mouth is very local, and is covered by my proposed groyne of 1,420 feet from low-water. On Drawing No. 2 I have shown the contour lines at sea taken from Commander Falle's exquisite survey of 1883, and in my own survey of 1892. I have, as nearly as I could, followed Commander Falle's traversing lines. So we have, I may say, for the first time, two accurate surveys at nine years' interval, showing that in this interval, and with the bar now in an extremely bad condition, there is practically no change whatever in depth from the nine-fathom to the one-fathom contour. With the bottom of the sea so constant as this, I do not fear that the groyne now proposed will silt up or do otherwise than keep the river mouth clear.

42. *Deep harbour.*—I have now to refer very briefly to a larger design shown in blue lines on Drawing No. 2. This gives a magnificent outer harbour with a 900 feet entrance in nearly nine-fathom water, and with a distance of 2,100 feet shoreward under cover of the south pier up to the four-fathom line. And, with regard to this design, it must be borne in mind that the bar is not the only obstacle for working cargo at Vizagapatam, but that the ground swell often interferes with discharging cargo from ships.

43. If this larger plan were to be carried out, there would be safe anchorage for certainly 20 ships in the outer harbour, and the backwater might then be converted into docks and quays, which would compare favorably with any port in India except Bombay. The groyne thrown out for the smaller design would be extended as shown for the larger one, and I again suppose that cranes and plant from Madras might be utilized here. In this case I would propose a railway along the foot of the Dolphin's Nose headland, and a concrete block ground on the plateau above the Dutch battery, with a wire rope incline down to the railway along the shore. I give in Appendix B an estimate of the cost of this, which of course is great, amounting to Rs. 43,27,272.

44. In conclusion, I should like to be permitted to record my thanks to all those with whom I came in contact officially during my stay at Vizagapatam, which ended on 22nd February 1892. To Mr. Willock, to Mr. F. B. Walker, Chief Engineer of the East Coast Railway, and his staff, to Captain Woodhouse, Port Officer, and to Mr. Gardiner, of the firm of Stuart, Hall and Co., my thanks are specially due for having given me all assistance possible, and indeed more than I ought to have expected.

APPENDIX A.—Estimate of cost of the four alternative plans for improving harbour, referred to in Report and Drawings Nos. 1 and 2.

		Rs.
(1) The full work proposed:—		
Groyne—		
Rubble stone in commencement and in base to end of groyne, 70,338 tons, at Rs. 1-8-0		1,05,507
Concrete blocks in outer portion, 7,822 cubic yards, at Rs. 10-8-0 ...		82,131
Setting ditto in position, 7,822 cubic yards, at Rs. 2-8-0		19,555
Excavation in swamp to full extent —		
19,320,000 cubic feet, at Rs. 10 per 1,000 cubic feet		1,93,200
Dredging mouth of channel —		
28,000 cubic yards, at 8 annas		14,000
		4,14,393
Add plant and preliminary work		80,000
Block ground		15,000
		5,09,393
Contingencies at 10 per cent.		50,939
Establishment and office at 10 per cent.		50,939
Total for whole plan (1) ...		6,11,271
(2) Work as above omitting dredging and proportional part of contingencies, &c.		5,94,471
(3) Work as above (1), omitting dredging, and only doing half proposed excavation		4,78,541
(4) Construction of groyne alone		3,62,751

APPENDIX B.—Estimate for Deep Sea Harbour referred to in paras. 41 and 42 of Report.

		Rs.
Plant and preliminary work, supposing cranes are available from Madras	... ...	1,50,000
Approach to south pier	... ...	28,560
Block ground and incline, south side	... ...	30,000
Additional to north block ground	... ...	15,000
Complete south pier, 3,300 feet, at Rs. 500 per foot	... ...	16,50,000
" north pier, 3,465 feet, at Rs. 500 per foot	... ...	17,32,500
		36,06,060
Add contingencies, 10 per cent.	... ...	3,60,606
Establishment and office, 10 per cent.	... ...	3,60,606
	Total cost ...	43,27,272

Order—dated 28th July 1892, No. 2103 W., Public Works.

Recorded.

2. The orders of the Government of India will be awaited.

(True Extract.)

(Signed) J. PENNYCUICK, Colonel, R.E.,
Secretary to Govt., P.W.D.

READ—also the following papers:—

From C. VINCENT, Esq., Under-Secretary to the Government of India, Public Works Department (Civil Works—Miscellaneous), to the Secretary to the Government of Madras, Public Works Department, dated Simla, the 29th August 1892, No. 328 M.

With reference to Lord Cross' despatch No. 3 P.W., dated the 16th June 1892, to the address of the Government of Madras, I am directed to request that the Government of India may be favoured with an expression of the views of His Excellency the Governor in Council on the measures proposed by Mr. F. N. Thorowgood, M.I.C.E., for improving the Vizagapatam harbour.

2. The chart and plan referred to in Mr. Thorowgood's report are herewith forwarded. They should be returned to the Government of India when the views asked for in para. 1 above are furnished.

Note by the Chief Engineer, Public Works Department.

There is no reasonable doubt that an excellent fine-weather outer harbour for large ships could be made at Vizagapatam on the general lines of the Madras harbour, and for such a work Mr. Thorowgood's proposals appear suitable; whether the rough estimate in appendix B of his report gives a reliable idea of the cost is a different matter; I do not think it does.

2. Vizagapatam lies in a track much affected by cyclones, and the seas which at such times roll in upon the proposed site for the harbour, are as violent as any along the whole east coast of the Presidency; the harbour walls would therefore have to be as well founded, as massive, and as well protected from wave action, as those at Madras. The Madras harbour with a total length of sea wall of somewhat under 8,000 feet was estimated to cost 49 lakhs, but will really cost upwards of 123 lakhs; Mr. Thorowgood's Vizagapatam harbour wall would have a total length of 6,765 feet and his estimated cost for the harbour is 43·27 lakhs; it seems not improbable that it would really cost at least half as much again.

3. The Vizagapatam harbour would, however, have this great advantage over the one at Madras; it would have in connection with it a natural inner harbour available for boats and small craft, and affording exceptional facilities for the construction of wharves and jetties suitable for landing and shipping all kinds of cargo, and in connection with the railway.

4. When railway communication with the Central Provinces is opened it is not unlikely that an enormous quantity of their produce may seek its outlet at Vizagapatam, and then the construction of a ship harbour such as one under consideration may become imperative; but as matters now stand, they do not appear to warrant an expenditure of certainly not less than 43¼ lakhs and probably more than 65 lakhs.

5. Passing now to the minor scheme dealt with by Mr. Thorowgood of merely improving the entrance to the backwater, or tidal estuary; he proposes to effect this at a cost of Rs. 6,11,271, by—

1*st. Dredging* a channel with a minimum depth of 10 feet at low-water from the two-fathom line to about 600 feet west of the landing stage (see paras. 30, 31 and 33 of report).

2*nd. Constructing a groyne* 1,420 feet (preferably 1,550 feet) long, north of the mouth of the estuary, in the line shown on the plans (see paras. 34 and 35 of report).

3*rd. Increasing the tidal capacity of the estuary* by excavation of some of the land "reclaimed" in recent years (see paras. 37 to 38 of report).

6. Taking these proposals *seriatim*, I would remark that the cost of the *dredging* is put down as only Rs. 14,000 (exclusive of "contingencies" and share of "Establishment") and does not provide * anything for cost, or share of cost, of the "sand pump dredger" which it is recommended should be used. Such a dredger, or indeed any dredger, suitable for the place (it would have to be of the "hopper" self-propelling type) would certainly cost † not less than 1¾ lakhs. It is possible that the dredger "Wenlock" already possessed by the Madras Government might do the work, but most certainly to form a channel 1,000 *yards* long by 50 wide "as shown on Drawing No. 1, from near the two-fathom line at sea up to and beyond the Sand Island with a minimum depth of 10 feet at low-water," would require the removal of many times the 28,000 cubic yards put down by Mr. Thorowgood as the quantity to be dredged, whilst to *maintain* such a channel would require frequent, if not constant, dredging, so that a special dredger would have to be kept at the place. Even if the proposed groyne did cut off all accumulation of sand from the north, the ceaseless action of the surf or breaking waves, the general direction ‡ of which is from the south-east, would certainly fill in the excavated channel from the expanse of sand surrounding it. Mr. Thorowgood himself notes in his para. 20 that the sand "in the neighbourhood of the Vizagapatam harbour mouth is very easily moved. The slightest change in wind will make a change in the disposal of the sand and in para. 21 he notices "the extreme mobility of the sand", and how "very unstable" the sandy bottom is at the place. It is certain that no channel there dredged to some feet below the surrounding plain of easily moved sand, which is for ever disturbed and swept along by the action of waves, would maintain its form or depth for any length of time without frequently recurring, if not constant, clearing; whilst there would be in every year long periods during which heavy seas would render such clearance impossible and after such periods there would be but little trace left of the excavated channel. Probably Mr. Thorowgood considers that the increased tidal scour resulting from the increased tidal capacity which he proposes to give to the estuary would keep his channel clear, but it may be accepted as an absolute certainty that this would not be the case. Before the

* The provision of Rs. 80,000 for plant and preliminary work appears to refer only to the plant, &c., required in connection with the construction of the groyne.

† The "Wenlock" cost £12,600 delivered at Pamban.

‡ See para. 24 of Report.

reclamations the tidal capacity of the estuary was greater than that to which Mr. Thorowgood proposes to now restore it, but even then it was not able to keep the entrance to half the depth of Mr. Thorowgood's proposed channel. The entrance was at times scoured out by violent land floods to a greater depth even than that now proposed by Mr. Thorowgood, but was always before long * again levelled up to its previous shallow state by the natural forces perpetually at work.

* By the flood resulting from the cyclonic rainfall of May 1877 the "bar" was scoured out to a depth of between 9 and 10 feet at low water; in June of the following year the Master Attendant, Madras, reported that the bar was in a worse state than he had ever "known or heard of before" (see his letter No. 4684, with Proceedings of the Madras Government, No. 337, dated 27th June 1878).

7. As regards the proposed *groyne*, which is estimated to cost about Rs. 2,48,630,† I would submit that there is no evidence as to its probable efficacy. Mr. Thorowgood apparently had no opportunity of making observations on the movement of the sand at the place during the south-west monsoon, which has a very important bearing on the question. Granting that the groyne would arrest the travel of sand from the north and that more sand travels from that direction than from the south, there is nothing to show that there is not also a considerable movement of sand from the south and-east which the groyne would also arrest, causing at times a deposit on its south side in the very place which it is wished to deepen; indeed, in para. 19 of his report, Mr. Thorowgood himself says "there is also another source of sand supply to the so-called bar, and that is the movement of sand when the *southerly* winds set in from seaward towards the shore;" such experience also as we have on the Coromandel coast points to the extreme probability that the proposed groyne will greatly aggravate the evil which it is intended to remedy. (I may here mention that the training walls or groynes at Cocanada are under totally different conditions from those at Vizagapatam, being at the head of a deep bay on a foreshore, [illegible] free from heavy surf and quite sheltered from all seas from the south).

				Rs.
† Rubble	...	...	...	1,05,507
Concrete blocks	...	...	...	82,131
Setting do.	...	...	...	19,555
Share of contingencies		...	...	20,719
Do. establishment,	&c.		...	20,718
		Total	...	2,48,630

8. The proposal to *increase the tidal capacity of the estuary* is undoubtedly based on thoroughly sound principles. For the last 20 years or so, every officer of this department who has had to deal with the matter has pointed out the injury that would be and has been caused by the "reclamation" of land which used to be covered by the tides. To the "reclamation" is undoubtedly due some deterioration of the entrance to the backwater, and the nearer the capacity of that tidal basin is brought back to what it was originally, the more nearly will the "bar" return to its former state. That state was by no means excellent, though somewhat better than it now is, and I do not for one moment suppose that the increase in tidal capacity proposed by Mr. Thorowgood would keep open an unenclosed channel to a depth of 10 feet at low water, but it might probably add a very important foot or two in depth to the worst places, and any work carried out in that direction would be useful, whatever might be the way in which it is hereafter decided to treat the outer harbour question.

9. It may, I think, be safely asserted that the conditions which obtain at the surf-beaten mouth of Vizagapatam backwater are such that with the small range of tide available for creating tidal scour no permanent improvement to the extent anticipated by Mr. Thorowgood from his scheme can be achieved until the place receives thorough protection from the never-ceasing action of the surf and from the effect of violent storms; such protection can only be given by long and massive sea walls and they would, of course, be most advantageously disposed so as to enclose an outer harbour; not till that is made, I fear, can the inner harbour have an entrance channel with anything like a minimum depth of 10 feet at low water, except for comparatively short periods after great land floods, which are of infrequent occurrence, have swept through the mouth of the estuary and scoured it out.

(Signed) G. T. WALCH,
Acting Chief Engineer, P.W.D.

27th October 1892.

8. Endorsement by the Under-Secretary to the Government of India, Public Works Department (Civil Works—Miscellaneous), dated Simla, 17th October 1892, No. 428 M.

The following, with copy of the letter referred to and of its enlosure, is forwarded to the Secretary to the Government of Madras, Public Works Department, for information with reference to the correspondence ending with Public Works Department letter No. 328 M, dated the 29th August 1889.

9. Enclosures.

From the Government of India, Public Works Department, to the Executive Engineer, Public Works Department, Railway Branch, dated 17th October 1892, No. 427 M.

I am directed to acknowledgment the receipt of your letter, dated the 21st September 1892, and of the memorandum therewith forwarded on the subject of improving the Vizagapatam harbour and to say that a copy of those documents has been forwarded to the Government of Madras for information.

10. From G. E. MOORE, Esq., Executive Engineer, Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 21st September 1892.

Understanding that the subject of improving the harbour of Vizagapatam is under the consideration of the Government of India, I have the honour to forward a memorandum embodying proposals which I venture to think are worthy of consideration.

2. The result aimed at is to allow of the substitution of large cargo boats and steam launches in the place of surf boats without in any way interfering with a larger scheme should it at any time be requisite.

3. The works that I propose to effect this are, first, a breakwater to protect the entrance from the sea and surf; secondly, a groyne or groynes to arrest the movement of the sands on the north side.

4. I have no hesitation in saying that however much opinion may vary regarding the position and details of construction of these works, that they are primarily essential to any improvement scheme and for reasons given in my memorandum how disastrous to the town would be the effect of any attempted improvement by a contraction of the entrance.

5. Believing it premature I have not attempted to give either detailed plans or estimates although I have prepared them.

11. *Vizagapatam Harbour.*

The construction of the East Coast Railway makes the improvement of the port accommodation at Vizagapatam an urgent necessity.

2. At present the only communication between ships and the shore is carried out by surf boats, expensive and dangerous.

3. The difficulty lies in getting over the bar at the entrance to the river which at times has as little as 3 feet of water on it and is always subject to a dangerous surf.

4. If the bar could be so protected from the surf that there should be smooth water on it, cargo boats could, without any further improvement, be used in the place of surf boats.

5. This can only be effected by the construction of a breakwater about 800 feet long on the south side, from the Dutch Fort on the Dolphin's Nose ending in about 12 feet of water.

6. Sir A. Rendel in his report suggests piers running out from one or both sides of the river with the idea of effecting a scour.

Considering the narrow range of tides and restricted area of the tidal backwater, this could have little effect unless made dangerously narrow when the probable effect would be the formation of a new bar just outside the piers. Besides no contraction of the entrance is permissible on account of periodic river floods, which occur every few years, flooding the lower parts of the town. These floods would be far more destructive were it not that they gradually enlarge the outlet by scouring away the sands accumulated since the previous flood. In the case of a groyne narrowing the entrance, it would have no more effect in improving the channel in ordinary years than the present sand bank, while in years of cyclonic floods, unless itself destroyed by the flood, the result to the town would be most disastrous.

7. In another paragraph he states "that it must not be forgotten that a bar is also a breakwater protecting the area within it from the sea." This bears out what I have always maintained that no scheme can be effectual that does not provide protection to the entrance from the south, the only exposed quarter. Only his proposed length of 200 feet does not go far enough.

8. Having protected the bar it can then be dealt with as required. No difficulty would be experienced in deepening it by dredging if considered necessary.

9. It is not enough, however, to clear away the bar without taking steps to prevent its reforming.

10. The bar consists of pure sea-sand, a considerable movement of which takes place up and down the coast varying according to winds, tides and currents, the greatest movement being between high and low water mark. The usual result of placing an obstruction on the shore of this coast is for the sand to slowly creep round it.

11. On the south side of Vizagapatam, owing to the peculiar rocky nature of the coast, there is no supply of sand available. On the north side, however, there is a stretch of sandy beach 3 miles in extent to Waltair point beyond which again the coast is rocky. This stretch of beach is broken up by five or six natural barriers of rock which, to some extent, impede and limit the movement of sand up and down.

12. During the south-west monsoon the movement is northwards, but has little effect close to the town owing to the protection afforded by the Dolphin's Nose. During the north-east monsoon the sand gradually shifts back again till arriving at the river mouth further progress southwards being stopped, it is forced up the river filling a large portion of the backwater opposite the Customs house, remaining then till washed out again by the aid afforded by the river after rain.

13. That this destructive movement of sand southward during the north-east monsoon which continues as long as north-east winds prevail up to January and February can be stopped there is no reason to doubt as we have shown that the supply of sand is limited.

14. Regardless of expense this could be effected at once by running out a breakwater into deep water. As, however, the movement of the sand is gradual and is almost entirely confined to between high and low water, it would be as effective and much less costly to throw out a groyne to just outside the line of surf into about 12 feet of water, and as the sand crept round the head to keep on lengthening the groyne so as always to keep the end in about 12 feet of water.

15. As this groyne would be at right angles to the wave line, it might be cheaply formed of large rubble only. In support of the practicability of this proposal, I would state that nearly fifty years ago the sea threatened the sea wall in front of the town, when three or four rubble groynes were at the suggestion of Sir Arthur Cotton thrown out to protect it at a cost of about Rs. 20,000. These have been entirely successful.

16. As regards the position of this groyne, it should not be too near the river entrance and I would suggest the lengthening of the first of Sir A. Cotton's groynes, which might be supplemented by the construction of one or two shorter groynes as might be thought necessary after careful local examination.

17. These two works being carried out, the breakwater on the south side to protect the sand from the waves and surf, and the groyne on the north shore to stop the shifting of the west monsoon, would remain at the same depth all the year round, and, instead of deteriorating after the end of the ensuing south-would have smooth water, rendering the port safe and practicable for cargo boats and steam launches in ordinary weather at all tides and times.

18. My estimate of the cost of these proposals is Rs. 95,000 or Rs. 1,45,000 according to the design of breakwater adopted.

Further note by the Acting Chief Engineer, Public Works Department.

It will, I think, be seen from my "note" written before the receipt of Mr. Moore's memorandum that I am in accord with him as well as with some other engineers who have considered the subject as to the absolute necessity for thoroughly protecting the entrance to the backwater from "the action * of the surf and from the effect of violent storms" before any permanent improvement is possible. Mr. Moore, however, anticipates that this can be effected by a "breakwater" some 800 feet long to the south of the entrance and a "groyne" to its north, both ending in "12 feet of water," whilst I have no doubt that the length of the protecting barriers would have to be much greater and that to be permanent they would have to be massively constructed "sea walls." I do not † believe that a "groyne" of "large rubble" even if carried out only to 12 feet depth of water at low tides would stand the seas to which it would be exposed during cyclones, or even in ordinary heavy weather; and if such a structure were destroyed its ruins would be heaped about the anchorage and the backwater entrance.

* Para. 9 of note.

† See also para. 35 of Mr. Thorowgood's report.

2. Possibly it would not be necessary to construct a complete outer harbour to efficiently shelter the backwater entrance from the forces which now prevent its improvement, but I am convinced that the protective works required would be most advantageously disposed so as to form at all events part of a possible future harbour.

3. It has been suggested that the groynes or walls might be so constructed that they would enable the tidal scour and land water to keep a deep channel always open. This suggestion has received consideration at various times; it did so in 1873, see Captain Beatty's report with Proceedings of the Madras Government, No. 603, dated 25th February 1873, and again in 1880, see Colonel Chrystie's report with Proceedings of the Madras Government, No. 749, dated 22nd March 1880. I entirely agree with the views on the subject expressed in paras. 36 and 46 of Colonel Sankey's note with Proceedings of the Madras Government, No. 1939 W., dated 13th August 1880, and also with what Mr. Moore says in para. 6 of his memorandum.

4. In connection with this I would point out that for the greater part of every year there is absolutely no land water falling into the backwater, and often there are intervals of years during which the discharge of the river, even during the rains, is inconsiderable. As, however, the whole catchment basin of the little river lies within the influence of all cyclones which strike the coast in the neighbourhood, the discharge is at times very heavy.* At such times the amount of silt brought down would probably cause some trouble in an enclosed outer harbour, necessitating dredging and the provision in the southern wall of powerful scouring vents to be kept open when the river was in flood.

* See marginal remark at end of para. 6 of "note" and end of para. 9.

(Signed) G. T. WALCH,
Acting Chief Engineer, P.W.D.

MADRAS,
28th November 1892.

No. 3512 W dy 22

PUBLIC WORKS DEPARTMENT.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

81

again
READ the following

P. C. No. 2103 W dated 28th July 1892 Read also—
om the Govt of India ... (Ltr No. 328 M d/29th Augt 1892)
te by the Ag Chief Engineer PWD (" " d/27 October 1892)
om the Govt of India (" " 428 M d/17 October 92)
ther note by the Ag Chief Engineer PWD (" " dated 28 November 92)

13

Ordered, that the Government of India addressed.

S. E. I circle
Marine dept

Rd 21/12/92 Ltr. No. 3513 W of 22nd Decr 1892

Ltd 21 Dec

To
The Secretary to the
Government of India
P. W. Department.

Sir,

In continuation of my letter No. 3450 W d/17th December 1892, I am directed to forward for the consideration the Government of

...company ing collection
...ers on the subject
... improvement of the
...zagapatam harbour
with special reference to
Mr. F. N. Thorowgood's
proposals.

It will be seen from
the note of the Acting
Chief Engineer P. W. Dept.
that in his opinion the
proposals of Mr. Thorow-
good will not effect the
result which he anticipates
...em, and that no
...siderable and permanent
...provement of the
...trance to the backwaters
...n be secured unless
...place be efficiently
...tected from the action
...ll heavy seas and surf.

I am also to forward
Précis of the corres-
dence which has
...place on the
...t of the scheme
... reclamation

Précis 157

Warfield & Co. 1868
Vizagapatam 35124 G
22-12-92.

In 1861 and 1862, two portions of the swamp at Vizagapatam aggregating 79 acres in extent were granted to a Mr. Warfield subject to the payment of an assessment of Rs. 12. Mr. Warfield sold this land to a rate who resold it to the Right Reverend Dr. Fissot, the Roman Catholic Bishop of Vizagapatam. In 1868, Dr. Fissot applied for an additional piece of land which together with that already granted by him he wished to convert into a model farm for the orphanage attached to his mission. This was granted subject to the payment of an assessment of Rs. 2 (Fd. D/11-3.68 No. 636). The extent of the land was not specified but as it was proposed to assess it at the same rate as the lands granted to Mr. Warfield

the area has been calculated
he acres 145. In 1869,
Tissot applied for a further
nt of 1000 acres of the swamp
hich he considered absolutely
ecessary to ensure success in
tual he was making to
stablish a Model farm. His
as also granted subject to
e payment of an assessment
Rs 88 and subject also to the
ndition that 100 acres should
e reclaimed every year, one
ear being allowed for prepara-
ons (G.O. 87 17-369 dt: 722)
. On a representation from Dr.
esot the Government modified
orders of march 1869 so far
to allow him to hold the
nd (1000 acres) free of assess-
ent during the first ten years,

And

and observed that he ca
State abide by the condition w
bound him to reclaim at least
100 acres of the swamp every year.
(G.O. 87 22-11-69, No 3007). In 1871,
he applied for an extension of the
time allowed for reclamation from
10 to 40 years and for the
remission of assessment for the
whole period but the Govern-
ment passed the following ord
"The free grant for 10 years to
be altered for a free grant for 2
years. A certain portion of th
swamp (to be fixed by the Collec
with the sanction of the Board)
to be reclaimed triennial
in default the grant to lap
to the Government" (G.O. 87-7-71 No
Later on in the same year
he applied to the Board to
obtain a modification of th

terms, but in its
of 30th October 1871 No: 4539
declined to take further
on observing "it is not to be
hoped that the Government
show any rigour in the en-
cement of the penalty of
emption, if it can be proved
the Bishop has done his
at every triennial inspection
the undertaking by the Collector"
In 1874, the Collector and the
trict Engineer were of opinion
Dr. Tissot had not observed
terms of the grant as
acres 13½ had been brought
cultivation and that his
on was prejudicial to certain
posed Harbour works, the
grant should be cancelled.
Advocate General was
Consulted

Consulted as to whether the land might be resumed and on his advice, the Board was directed to inform Dr. Tissot that the grant had been cancelled. The Government also expressed its willingness to consider favorably any fair claims claims for compensation (Go. J 8.5.74 No. 567).

Dr. Tissot protested on several grounds one of which was that he undertook only to drain the lands and that he had reclaimed the whole swamp in the sense of rescuing it from the water. The Advocate General, who was again Consulted, advised an amicable Settlement. The order of resumption was held in abeyance and Captain Taylor, Master attendant at Madras, was directed to report on the effect which the rection had or was likely to

to have on the harbour. (G.O. dy 17. 10. 74 No. 1341). Captain Taylor's report was in favor of the reclamation and Dr. Tissot was, therefore, permitted by Government to proceed with his work. (G.O. dy 2-4-75 No. 509).

4. In 1890, the Collector of Vizagapatam, understanding the word reclamation in a different sense, reported that Dr. Tissot's enterprise had proved a complete or almost couple failure and that it was necessary, therefore, to cancel the grant. He observed "a little land along the upper or Northern edge of the swamp has been brought under cultivation and a purposeless tank or two has been dug but

this is all that can be reasonably called reclamation. It is true that more or less effective bunds have been thrown up to prevent the tidal water from spreading across the lower portion of the swamp and that it is less subject to ~~inundation~~ inundations and becoming waterlogged than it was but this does not fairly fall within the meaning of the word." He accordingly proposed to call upon Dr. Tissot's successor to prove that the conditions under which the grant was made had been fulfilled. The Government, however, was of opinion that the word "reclamation" used in the correspondence relating to the grant simply meant "drainage"

"Drainage" & that the Grant could not be Cancelled, the conditions thereof having been fulfilled. The term of 21 years, for which exemption from assessment was conceded having expired on the 28th December 1890, after allowing for the period of suspension of the work in 1874 and 1875, the Collector was directed to inform Dr. Tissot's successor that the land (1000 acres) granted in 1869 was liable to assessment from fasli 1300 (1890-91) and to ascertain whether the Mission was willing to retain possession of the land on payment of assessment (P. of 13-4-91 No: 305). Reverend J. M. Rosset (Dr. Tissot's succes- has

ted

intimated that the Mission wishes to retain possession of the land and paid the assessment forthwith. (P. 23. No: 4171). From the Collector's report submitting his letter it appeared doubtful whether the swamp was really drained as the Government supposed. A report on this point was therefore called for and is still awaited.

Rev 10591 &c

Govt. of [1892] Madras.

PUBLIC WORKS.

Mem: 652 S. of 18-12-92

27-15 BD

Rejected

Letter

Read

Read

G.O. 29th December 1892 No. 3512 to 3513 Rd

Vizagapatam Harbour

Forwarding for the consideration of the Govt of India the collection of papers on the subject of the improvement of the —— with special reference to Mr H. A. Thorowgood's proposals.

22/12