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MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 453.

Press

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Not to be folded or roughly handled

No. 311. Read the following letter from the Committee appointed to report on the Cochin Harbour, to the Secretary to Government, Public Works Department, dated Madras, 9th December 1868, No. 445 :—

1. We have the honour to report, for the information of Government, that in compliance with the request contained in the third paragraph of their Order, dated the 19th September last, No. 2,967, we lately visited Cochin, and after making careful inspections of the harbour and of the Narrakal anchorage, we beg to submit our opinion as to the capabilities of the port, and as to the works which should be carried out to secure its effectual protection.

2. In our visit to Cochin we were accompanied by the Agent and Manager of the Madras Railway, and in forming our opinion we had the advantage of receiving his assistance and advice.

3. We also had the advantage of perusing Mr. Dalrymple's report upon the Port of Cochin, which was referred to us by Government upon the 10th ultimo, and which with its accompanying documents we have now the honour to return.

4. The enclosed report is accompanied by a copy of the chart of the coast, between Cochin and Narrakal, surveyed by Captain Castor in April 1865, on which have been marked the present line of coast, and the positions of the protective works, &c., to which allusion is made in the report.

REPORT ON THE COCHIN HARBOUR.

1. POSITION OF TOWN.—The town of Cochin is situated upon a narrow strip of land, which separates an extensive lagoon or backwater from the Indian Ocean. This backwater forms one of a connected series which stretches along the West Coast of India to the south of the town of Ponany, and which communicates with the sea at several points; but the only channel navigable for ships of large size is that upon the south bank of which the town of Cochin is situated. It is said that this channel had no existence before the fourteenth century, during which it was formed by a sudden inundation in the large river, which till then had its sole exit about seventeen miles to the north. However this may be, there is little doubt that from the date of the first Portuguese settlement at Cochin, early in the sixteenth century, the character and condition of the port has till within the last few years sustained but little change.

2. INNER HARBOUR.—The inner harbour, including not only the channel which communicates directly with the sea, but also that portion of the backwater which adjoins the town of Cochin, is of considerable depth, the greater part of it averaging from twenty to forty feet at low tide. The whole of the available space has ample depth for the accommodation of any vessel which can enter from the sea.

3. THE BAR.—The bar at the mouth of the channel is a remarkably narrow ridge of sand, with twelve feet of water over it at low tide. In the year 1835, as appears from a survey of the port taken then by Lieutenant Robinson, there were fifteen feet of water over the bar at low tide; and the survey taken in the year 1858 by Lieutenant Taylor shows a depth of thirteen feet. It would appear from this that one foot in depth has been lost during the last ten years; but Captain Castor,

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

the Master Attendant at Cochin, states that during the fifteen years of his connection with the port there has not been, to his certain knowledge, any variation in the depth over the bar; that he accompanied Lieutenant Taylor when the survey was being made, and that he protested then both against the mode in which the soundings were ascertained, and against the results which they gave.

4. The distance of the bar from the shore at the Light-house is about 2,000 yards; and not only is the channel which leads to it deep and easy of access for vessels, but an examination of the charts will show with what singular rapidity the water deepens upon either side of it, giving to it the character rather of an abrupt and steep rocky reef than of a sandy bar at the mouth of an Indian river.

5. RISE AND FALL OF TIDE.—The rise and fall of tide at Cochin varies from one and a half to three feet, so that vessels drawing from twelve to thirteen feet can safely cross the bar at spring tides in calm weather. The records show that the port is frequented by vessels as large as from 800 to 900 tons burden. As a general rule, the larger vessels take in the greater part of their cargoes in the inner harbour, and complete their lading in the outer roads. Among many other vessels which were lying in the harbour during our short visit, the ship "Premier," registered at tons, completed her cargo, and, with a draft of thirteen feet, was to cross the bar the day after our departure.

6. LITTORAL CURRENTS.—The principal current by which the coast near Cochin is affected is one which flows from south to north. This is felt in its greatest force during the south-west monsoon; but even at other times of the year, when northerly winds are prevalent, and when the set of the outer coast current is from north to south, a strong ebb current flows inshore from south to north, off the town and harbour.

7. OUTER ROADS.—The outer roads form a perfectly safe anchorage during the greater part of the year, i. e., from September till May, and vessels drawing upwards of twenty feet can be within a short distance of the bar. It is stated by the Master Attendant* that even during the three monsoon months, June, July, and August, "occasions have not been unfrequent when communication with the shore has been maintained with perfect ease and safety."

* Vide Captain Castor's Report, dated 7th October 1868.

8. NARRAKAL ANCHORAGE.—The very remarkable anchorage at Narrakal, which during the prevalence of the south-west monsoon forms an excellent auxiliary port to Cochin, has been so fully described by Captain Castor in the papers printed with the Orders† of Government noted in the margin, that it is unnecessary to give here a detailed account of it, especially as, at the time of our visit, none of its peculiar phenomena were observable.

9. The Narrakal anchorage commences at a point about five and a half miles to the north of Cochin, and extends about three miles along the coast, and about an equal distance out to sea, within which limits ships can anchor in from three to five fathoms. The facts which so remarkably distinguish it during the months of June, July, and August, are that while upon the immediately adjoining coast the sea breaks at that time of the year with great violence, the water, within the des-

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

cribed limits, is not only almost perfectly still and smooth, enabling vessels to anchor and to take in or discharge their cargoes with ease and safety, but is also sweet and fresh, and quite different in character from that of the ocean.

10. The only other place where similar conditions are known to exist is off the town of Alipee, about thirty miles to the south of Cochin. Several theories have been brought forward to account for the abnormal state of the sea during the monsoon months at these two places. Of these theories the most plausible seems to be one which was, we believe, suggested by the late General Cullen: that when the level of the backwater is raised by the heavy rain of the south-west monsoon to a considerable height above that of the sea, the fresh waters find an exit at each of these points by some subterraneous channels, and rising by reason of their less specific gravity through the salt water of the sea, stir up the deep bed of singularly soft black mud, which is a peculiar feature of these two localities, and that this mud, while held in suspension, forms a natural bulwark and breakwater against the violence of the sea.

11. Whatever may be the correct explanation of the phenomena, the facts are beyond all doubt, and with the evidence before us, we have no hesitation in stating that we consider Narrakal to be throughout the year a perfectly safe natural anchorage, and a most valuable auxiliary to the port of Cochin.

12. A statement appended to this report, of the number and description of vessels which have visited Narrakal during the south-west monsoon in the last four years, will show how steadily the appreciation of its value has risen.

13. The distances of the coast at Narrakal from the backwater is about 1,000 yards, and a narrow channel, sufficiently large to admit boats, was excavated some years ago to within a few yards of the sea beach. The sides of this channel have now fallen in many places, and we recommend that it should be widened and deepened throughout. It would be well to give it a minimum width of ten yards, and a minimum depth, at low water, of four feet. In the backwater, from the point where the channel joins it, to the town of Cochin, there is always plenty of water.

14. CRUZ MILAGRE GAP.—Till the year 1862, there never was, so far as can be affirmed from records and tradition, a second communication between the backwater and the sea nearer to Cochin than the one above referred to, about seventeen miles to the north. During that year the sea, which had been for some years previously making gradual inroads upon the coast to the north of the town, broke through into the backwater at a point called "Cruz Milagre," (or the Miraculous Cross, from a church of that name which formerly stood there and which had been submerged,) about a mile and a quarter to the north of the Cochin channel; and the gap then formed, though it has varied in size from year to year, has never been closed. At present the average width of the gap is nearly 300 yards, and at the time of our visit it was increasing in size every hour. The depth of water at low tide exceeds twenty-one feet in some places.

15. There can, in our opinion, be no question as to the danger with which the very existence of the port of Cochin is threatened, so long as this gap remains open; and although the depth of water in the greater portion of the Cochin channel and inner harbour remains unaltered, and no sensible diminution has yet occurred over the bar, the effect of the escape to the sea, through this gap, of so large a volume of water which would otherwise have contributed its force to scour the

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

Cochin channel, has already become manifest by the gradual silting up of the southern* margin of that channel, immediately opposite to the north-west angle of the town of Cochin.

* At the point marked S on accompanying Map.

16. ENCROACHMENT OF SEA TO THE NORTH.—The gradual encroachment on the coast to the north of the town of Cochin, to which reference has above been made, has been in progress since the year 1854, and has now assumed a very serious aspect. An examination of the accompanying chart will show that the encroachment commenced at a point about four miles to the north of Cochin, and that in some places the portion of the coast which has been submerged is no less than 400 yards in width. The "Cruz Milagre" gap, to which allusion has been made, is one of the results of this unimpeded encroachment; and at several other points where the coast, by the action of the sea, has been greatly reduced in width, there is much danger that similar results will follow. At one of these points the sea actually broke into the backwater during the month of June last, and but for the prompt and energetic action taken by the Master Attendant, there can be little doubt that the breach would by this time have equalled in size that at the "Cruz Milagre" gap.

17. ENCROACHMENT OF SEA TO THE SOUTH.—Upon the south side of the Cochin channel, in the immediate vicinity of the town, the encroachments made by the sea during the years 1867 and 1868 were very considerable. In former years a beach of sand, from 200 to 300 yards in width, has generally existed between the site of the new Light-house and the margin of the sea; but during the latter half of 1867 this beach entirely disappeared, and the sea washed freely against the bastion on which the Light-house was built. In the year 1850, a similar erosion of the beach at this spot occurred; and on that occasion, when danger to the town seemed imminent, the sea suddenly receded without any apparent cause, and the beach resumed its normal position. Whether upon the recent occasion also the sea would have retired of its own accord, it is of course impossible to say; but there can be little doubt that the town of Cochin was for some time in an extremely critical situation, and that its present safety is chiefly due to the untiring energy and perseverance of its Master Attendant, who, without assistance, devised and carried on the protective works which have already produced such beneficial results.

18. PROTECTIVE WORKS NOW IN PROGRESS.—These works, which are still in progress, consist of six groynes† of rough stone on the south side of the entrance to the harbour, run out into the sea in such directions as most effectually to intercept the eroding currents, and to encourage the formation of a new beach by the deposit of silt. Upon the north side of the harbour, near the promontory called "Vypeen Point," two‡ similar groynes are in process of construction. The effect produced by all of these works, in their unfinished state, was at the time of our visit most distinct and satisfactory. Some of the groynes had been exposed to the full force of the south-west monsoon without sustaining any injury, and the beach was rapidly forming as the work progressed.

19. The length of the groynes was calculated by Captain Castor at 120 feet; and we observe that Mr. Dalrymple has endorsed a recommendation made by the

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

Cochin merchants to the effect that they should be extended to 150 feet, and that a seventh† groyne, of the same length, should be constructed on the south side of the harbour, near the Telegraph Office. While we strongly advocate these additions to the originally proposed works, we are not satisfied that they will be sufficient to protect permanently the town and harbour of Cochin.

§ Numbered 7 on Map.

20. PROTECTIVE WORKS RECOMMENDED TO THE SOUTH.—We have carefully and attentively studied the position and direction of each of these works, and with reference to the influence which each is likely to exert upon the littoral current and upon the line of beach, we beg to submit the following recommendations. Taking the groynes from south to north, in the order in which they are numbered on the accompanying map, we are of opinion that No. 2 groyne should be carried out to a total length of 200 feet; that Nos. 3 and 4 groynes, situated in front of the new Light-house, should each have a total length of 300 feet; that No. 7 groyne, the one near the Telegraph Office, the construction of which has lately been recommended by the Cochin merchants, should also be carried out to a distance of 300 feet; and that No. 9 groyne, at Vypeen Point, should have a total length of 600 feet. To this last named groyne, No. 9, we attach special importance. Of late years the current has set round Vypeen Point with great force, and the coast has been washed away to the extent of about 300 yards. We are confident that a groyne here of the length proposed by us will have the double effect of driving the sea back to its old limits, and of causing a considerable increase to the strength of the scouring current which passes over the bar.

21. PROTECTIVE WORKS RECOMMENDED TO THE NORTH.—Mr. Dalrymple has also recommended the immediate closing of the "Cruz Milagre" gap, by the construction

* Numbered 15 and 16 on Map.

† Numbered 10 to 13 on Map.

of two* groynes, one being run from the north and the other from the south side, and the subsequent construction of four† additional groynes for the

protection of the coast between the gap and Vypeen Point. We entirely concur with him. We consider that the security of the Cochin harbour depends, in great measure, upon the early execution of this work, and we trust that no time may be

‡ In the position numbered 16 on the Map.

lost in undertaking it. We recommend that a groyne‡ be run out, in the first instance, from the east end of the north bank of the gap, as the work will not only be carried on in comparatively shallow water, but will, in our opinion, more effectually intercept the strong ebb current, and cause a rapid deposit of silt. The

§ See number 15 on Map.

second§ groyne, from the southern bank of the gap, can afterwards be run out.

22. With regard to the groynes recommended between the "Cruz Milagre" gap and Vypeen Point, we consider that they will prove of great service in strengthening and reclaiming the beach. We would make them five instead of

|| Numbered 17 on Map.

four in number, and in addition to them, we are of opinion that one|| groyne should also be constructed to the north of the gap, each groyne to be carried to a length of 250 feet.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

23. The works alluded to in the last two paragraphs will all be constructed within the territory of His Highness the Maharajah of Cochin; and in the course of several interviews which we had with the Dewan of Cochin, we were assured that His Highness was not only anxious that the proposed works should be carried out, but would be prepared to contribute materially towards defraying their cost. The Dewan said that the Cochin State had sustained serious loss, not only by the extent of valuable land which had been submerged, but also by the injury done to the rice fields in the neighbourhood of the gap by the influx of salt water.

24. MODE OF CONSTRUCTION.—In the construction of all the groynes which have been recommended, we strongly advocate the use of lines of light rail to convey the stone from the points at which it is landed to the site of each groyne. The quarries, which we regret we were unable to visit, are situated up the backwater at a distance of some twelve miles from Cochin; and we recommend that three convenient spots be selected for landing the stone, one near the Telegraph Office, for the groynes on the south side of the harbour; one near Vypeen Point, for the works between that and the gap; and a third to the north of the gap, for the remaining works. At these points cranes or other suitable appliances for removing the stone from the boats should be erected, and the lines of light rail above referred to should connect the landing places with the site of each groyne. We are convinced that this will effect a considerable saving in the cost of the work.

25. We do not feel called on to give an opinion as to the agency by which the works which have been recommended should be carried out. It would be scarcely possible for any man to have shown more energy and zeal, or to have carried out what has been done more efficiently, than Captain Castor; but it is not unlikely that the extensive works which have been recommended could not be undertaken by him without seriously interfering with his other duties.

26. Whatever course may be adopted with regard to these works, we think it our duty to bring prominently forward the importance which we attach to the permanent representation of the Public Works Department at Cochin, by a professional Officer of some experience being stationed there. Owing doubtless to its peculiarly isolated situation as regards the rest of this Presidency, the interests of Cochin have been, perhaps, unavoidably, neglected; but the fact of its being the only harbour within the limits of this Presidency, together with its unquestionable capabilities for improvement, and the probability that important questions of an engineering nature, demanding often immediate action, may from time to time arise, render it, in our opinion, essential that an Officer competent to deal with them should be always available on the spot.

27. STEAM DREDGE.—Mr. Dalrymple has recommended that, after the completion of the works, a steam dredge should be permanently attached to the port. In this recommendation we cordially concur. We have alluded to the remarkable nature of the bar at the mouth of the Cochin river, to its singular narrowness, and to the abruptness with which the water deepens on either side of it. We are well aware that in the case of most Indian rivers, the expense of maintaining a steam dredge for the purpose of deepening the passage over the bar would scarcely be justified by the results, but we have no hesitation in expressing our belief that the case of Cochin is very peculiar, and our confident expectation that, by the use of a steam dredge of moderate power, the passage over the bar may be deepened by at least two feet.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

28. We do not think it necessary to enter here upon the advisability of providing Cochin with docks and quays, although we entertain little doubt that the question will come forward in due time if the protective works which have been recommended are carried out.

(Signed) B. ANDERSON,
Chief Engineer Madras Railway Company.

(Signed) J. H. M. SHAW STEWART, Major, R. E.,
Consulting Engineer for Railways.

MADRAS,
9th December 1868.

Statement showing the number and description of vessels which have visited Narrakal during the south-west monsoon in the years 1864 to 1867.

Date.	Steamers.		Sailing vessels.		Total.	
	No. of vessels.	Tons.	No.	Tons.	No.	Tons.
From June 6th to Sept. 8th 1864 ...	8	5,421	5	2,131	13	7,552
„ May 29th to Aug. 30th 1865 ...	15	10,642	6	3,576	21	14,218
„ 19th to Oct. 23rd 1866 ...	17	13,132	5	1,959	22	15,091
„ March 6th to Dec. 13th 1867 ...	30	17,698	8	2,147	38	19,845

COCHIN.
23rd November 1868.

(Signed) JOHN CASTOR,
Master Attendant.

(True Copy.)
(Signed) J. H. M. SHAW STEWART, Major, R. E.,
Consulting Engineer for Railways.

From H. D. E. DALRYMPLE, Esq., Master Attendant, to the Chief Secretary to Government, Marine Department, Fort St. George, dated Madras, 26th October 1868, No. 4,208.

1. In pursuance of the Orders of Government, No. 256, dated 10th ultimo, I have the honour, on my return from Cochin, to submit the following report, accompanied by the papers and Charts as specified in the margin.

Letter from the merchants of Cochin, to the Chief Secretary to Government, dated 15th August 1868.

Extracts from Administration Reports for the years 1865-66, 1866-67, and 1867-68.

A paper on the state and requirements of Cochin Harbour, &c., by Captain Castor, dated Cochin, 7th October 1868.

Copy of letter from Captain Castor, to Master Attendant, Madras, dated 20th October 1868, No. 216.

Estimate for extension of groynes on both sides of Harbour of Cochin.

Chart of Cochin, &c., by Lieutenant Taylor, I. N.

Chart of Coast from Cochin to Narrakal, by Captain Castor.

* Dated 19th September 1868, No. 2,967, Public Works Department.

2. In the first place, I must respectfully explain that, as it was of much importance that the works in progress at Cochin should be inspected at the close of the south-west monsoon, and as I found the gentlemen named in the orders of Government* were not prepared to visit the West Coast till November, I was obliged to proceed to my destination without them.

3. I arrived at Cochin on the 7th instant, and on that evening began inspecting the port and the works in progress, under the superintendence of Captain Castor, the Master Attendant, and during my stay there, from day to day, took means,

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

both from personal observation and extensive enquiries among the residents, to obtain all trustworthy information required, on which to form decided opinions as to the capabilities of the port and its requirements.

4. I have also to report that I visited the following places, viz., that on the Vypeen side, where the breach occurred in June last, which was immediately closed by Captain Castor. The breach now open at "Cruz Milagre," which I shall further report on; the granite quarries situated about twelve or thirteen miles up the river, from whence the stone is brought for the construction of the groynes; and the port of Narrakal.*

5. I may observe that I visited Cochin twenty-four years ago, when on sick leave, and was then much struck with the natural advantages of the locality as a sea-port; on visiting it on this occasion, I was greatly surprised to find such a port, the only one of the sort in the Madras Presidency, should have been so much neglected.

6. I found that the late encroachments of the sea, the traces of which are too apparent, must have imperilled the existence of the town of Cochin and the port itself, but owing to the energy displayed by the Master Attendant, and the ready support obtained from His Excellency the Governor of Madras, who happened most fortunately to be on the spot, the township was saved, and the Cochin affairs have now assumed a brighter aspect.

† Vide Chart of Cochin by Lieut. Taylor, I. N.
† Nos. 1 and 4 completed to 120 feet.
† Nos. 2 and 3 in progress.
† Nos. 5 and 6 will soon be commenced.

7. All the groynes,† which are completed,‡ (as per sanctioned measurement;) and even those in progress of construction have already acted most beneficially on the formation and extension of the beach on both sides of the harbour, and I strongly recommend that the construction of an additional groyne to the north eastward of the Telegraph Office,§ and the extension of the others to 150 feet in length, as recommended by the mercantile community, be sanctioned by Government, and carried out as speedily as possible.

8. I now beg particularly to call the attention of Government to the breach effected by the inroads of the sea at Cruz Milagre|| on the Vypeen side, about two miles from the port of Cochin. and was reported on before the close of the year by Captain Bean, R. E., vide extract from his report quoted in the margin, and has been persistently reported on yearly by Captain Castor, no steps have yet been taken to remedy this disaster, which has threatened the existence of Cochin as a sea port.

9. In consequence of this non-interference for years past with the inroads of the sea at this point, the gap has

Extract from letter from Capt. Bean, R. E., District Engineer, Malabar, to Lieut.-Colonel J. Ouchterlony, R. E., Deputy Chief Engineer, Southern Circle, D. P. W. Para. 15.—"A permanent opening at this port (Cruz Milagre) would prove disastrous for the interests of the commercial community of Cochin, for though I do not believe that it could ever draw off all the river floods and volumes of water which pour over the bar, it diminishes very much the flow of the river in Cochin Harbour, and tends to silt up the sand bank which form at the river's mouth and consequently the channels for vessels entering the port."

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

greatly extended, causing the escape of the stream from the backwater to the sea, and thereby depriving the harbour of Cochin of the full volume of water, and force of scour, of which it previously had the advantage of during the ebb tides and the freshes from the hill ranges.

10. However, it is not too late to remedy this evil, and I respectfully recommend that the permission of the Rajah of Cochin be obtained as soon as possible to run out, in the first instance, two groynes, one on the north, and the other on the south side of the gap at "Cruz Milagre," and* afterwards, for the preservation of the spit of land between the gap and Vypeen point, to run out four additional groynes.†

* Vide Captain Castor's Chart.

† Do. do.

11. I also strongly recommend that Captain Castor be authorized at once to begin these works, for before the next monsoon great results will be effected: the accounts with the Cochin Sirkar can be afterwards adjusted.

12. The breach, a short distance to the northward of Vypeen, caused by the sudden encroachment of the sea in June last,* was taken at the nick of time by Captain Castor, and effectually stopped, the whole of the stones used for the purpose being now deeply embedded in the sand, and an extensive beach created; if the same prompt action had been taken when the breach at "Cruz Milagre" was first made, that encroachment of the sea would have been stopped, and much expense saved.

* Vide Captain Castor's letter to Superintendent of Marine, dated 10th June 1868, No. 122.

13. I beg further to explain that the extension of 100 feet to the length of the principal groyne on the Vypeen point* is of the utmost importance, the effect produced by this extension† when the breach at "Cruz Milagre" is closed, will be to throw the full strength of scour through the proper channel, and the soundings on the bar will be increased.‡ I am confident that if this be done the Port of Cochin will be restored to its former prosperity, and if a communication by rail through the Travancore and Cochin territories to Ernacollum be opened, that it will become the most flourishing outlet of commerce in the Madras Presidency.

* Vide Lieutenant Taylor's Chart of Cochin.

† NOTE.—If 50 or 60 feet of extension be found sufficient the work may be stopped.

‡ NOTE.—Soundings on the bar have not varied of late, though direction of entrance channel is slightly altered.

14. I would strongly recommend, when all the works are completed, that a steam dredge should be attached to the Port of Cochin. Even now ships of 700 tons come inside the harbour, but with the service of a good steam dredge, to be worked from time to time over the bar, I have no doubt sufficient depth of water would be obtained for vessels of 1,000 to 1,200 tons burthen.

15. I cannot conclude this report without prominently bringing to the notice of Government, the energy and ability displayed by Captain Castor in his prosecution of the works for the preservation of Cochin. When on the spot, I saw every hour of the day the works steadily progressing, showing the results of his great powers of organization and untiring supervision, and I would respectfully urge

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

the absolute necessity of having sufficient funds always available for the current expenses of the operations now in progress, for if money be not forthcoming every Saturday to pay boatmen and coolies, they leave the service, and the works are retarded.

From the Merchants of Cochin, to the Chief Secretary to Government, Madras, dated Cochin, 15th August 1868.

1. We the undersigned Merchants intimately connected with the trade and shipping of the Port of Cochin, and representing landed interests of considerable value in that town, beg respectfully to submit, for the favorable consideration of Government, the following suggestions relative to the works now under construction for the protection of the place from the ravages of the sea.
2. We have observed with much satisfaction and thankfulness the prompt and effectual measures considerably undertaken by Government to meet the exigency, and we have no doubt that but for this timely interposition, the loss of property and the direct injury to the harbour would have been incalculable.
3. We beg, however, deferentially to suggest, that the groynes which we now understand are to be run out to a distance of only 120 to 130 feet, be extended to 150 feet, and that one additional groyne be constructed to the north-eastward of that commenced in the vicinity of the Telegraph Office. These modifications, we believe, will effectually tend to the security of the town, and offer the best possible resistance to the evil which has been steadily gaining ground for some years past.
4. The length we propose would not have been necessary had the work been undertaken at an earlier period when a foreshore still existed, but there having been no solid ground to build upon, and operations having to be commenced in water with the inner end of the groynes abutting on the town, it is essential that the groynes be carried out sufficiently long to ensure the formation of a permanent beach.
5. We are not unmindful that the recommendation herein made will be attended with heavy expense, yet, with the immediate prospect of the extension of the Railway to Cochin, the rapid development of trade that may be reasonably anticipated will, we are sure, amply compensate for any outlay towards the conservation of the finest harbour in the Presidency.
6. We trust that, in making these suggestions, we may not be understood as wishing to detract in any way from the merits of what is being accomplished; on the contrary, we may freely say that the work has been pushed forward with an intelligence and energy equal to the occasion, in the face of a heavy monsoon; but we simply feel that the work if carried out on a somewhat more enlarged scale, will afford permanent security and give a more certain promise of success.

COCHIN,
15th August 1868.

Section 13 of the Administration Report for the year 1865-66, Marine Department, Cochin.

13. CRUZ MILAGRE.—This gap has gradually become a permanent opening, with a wide and deep channel. Loaded boats freely use this channel, and a ferry is now established to transport the passengers from one side to the other. This breach will, I fear, yet prove a source of danger to this harbour. Any remedial measures to be adopted with reference to this gap, and the abrasion of the coast at Vypeen, must be carried out in co-operation with the Cochin Government, as by far the greater portion of the land lies in their territory.

COCHIN,
30th April 1866.

(Signed) J. CASTOR,
Master Attendant.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

Section 11 of the Administration Report for the year 1866-67, Marine Department, Cochin.

11. CRUZ MILAGRE GAP.—The danger to this harbour from the existence of this gap is increasing every year. The tidal water escaping through it is abrading away the coast to the south as well as to the north. Vypeen, which is the name of the village on the north bank of the harbour, may now be called an island, so formed by the gap on the north, and this estuary to the south. Already some parts of the ridge, dividing the backwater from the sea, are being washed over by the surf, premonitory of breaches being formed at those places, and the inhabitants are emigrating to other parts of the country. Such an opening in the immediate vicinity of this harbour must divert a large volume of the tidal stream which formerly passed through the ship channel over the bar, and thus diminish the scouring power so essential to the preservation of the depth at its entrance.

COCHIN,
31st March 1867.

(Signed) J. CASTOR,
Master Attendant.

Section 10 of the Administration Report for the year 1867-68, Marine Department, Cochin.

10. VYPEEN POINT.—The encroachments of the sea at Cochin have, for many years, formed a subject of the gravest apprehension. The ravages commenced on the Vypeen side of the harbour and a large tract of land was gradually engulfed, carrying away with it oil yards, cocoanut plantations, and substantial houses. Some inconsiderable and futile experiments were made under the direction of the Department Public Works, but they were manifestly unequal, from the unsuitableness of the work, to resist the formidable marine action to which they were exposed. At length a breach occurred across a narrow ridge of sand that intervened between the sea and the backwater, about two miles north of this harbour, and a deep channel was soon established, which, by diverting a large volume of the tidal stream that hitherto found an outlet over this bar, diminished the scouring force in the ship channel, and will soon pave the way to its speedy deterioration.

COCHIN,
31st March 1868.

(Signed) J. CASTOR,
Master Attendant.

Memorandum on Cochin Harbour, by Captain J. CASTOR, Master Attendant, Cochin.

1. The Proceedings of Government in the Public Works Department, No. 2,967, dated 19th September 1868, having been forwarded to me, from which I find that the Master Attendant of Madras, and other professional gentlemen have been deputed by Government to investigate the present circumstances and future prospects of this port, with a view to determine the expediency of the extension of the South-West Line of Madras Railway to Cochin, I beg leave to submit a few observations which I trust may tend to assist in the solution of the question.

2. Some doubts appear lately to have been entertained as to the probability of Cochin maintaining its position as an "Ocean Port," and it would appear from the papers forwarded to me, that these doubts have arisen from the recent action of the sea, and the consequent apprehension of sudden and extensive changes in the condition of the port.

3. Before entering into this important question, I beg to draw attention to the peculiar features of this port. It has not only a smooth outer roadstead, where any number of ships of any size may find a safe anchorage, but an inner harbour, which adds vastly to the convenience of commerce and shipping. From Ganjam, the northernmost port on the East Coast in this Presidency, to Mangalore, on the Western Coast, there is not a harbour into which a moderate sized ship could enter, and Cochin remains alone in this respect, and in the singular advantages it affords for repairing and refitting.

4. With reference to the question of Cochin continuing "to maintain its position as an "Ocean Port, available at all times of the year for vessels of considerable size," I would explain that the advantages offered are of two kinds. First, as an "Ocean Port," or if I understand the definition right, a safe, open roadstead. Secondly, the capabilities and facilities of the inner harbour.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

5. In respect to the first—the roadstead of Cochin is perfectly safe and convenient, embracing every facility for landing and shipping, from September to May. The months of June, July, and August are exceptional, yet even in these months occasions have not been unfrequent when communication with the shore has been maintained with perfect ease and safety. Vessels of any size could avail themselves of this anchorage during the greater part of the year, as already noticed; but should interruption arise during the very small interval of three months, (and such exceptional periods are not uncommon in many first class ports,) there exists an auxiliary port, Narrakal, at a short distance of only five miles, possessing the *tried* remarkable properties of convenience and security, qualities more conspicuously developed, as shown by experience, during the worst period of the south-west monsoon. In proof of this, I beg reference to the statistics of the shipping at Narrakal for the last three years, herewith forwarded; and in order to show that at Cochin the port is more open than shut in August, the shipping for that month of this year is marginally noted.

Ship	Tons.
"Morning Star"	521
Do. "Humayoon Shah"	873
Barque "Raleigh"	567
Schooner "Mabé"	111
Barque "Satellite"	476
Do. "Tyrol"	517
Do. "Warrior"	398
Ship "Ethereal"	795
One Pattimar	73
Out of the above vessels the following entered the inner harbour :	
Barque "Raleigh"	
Schooner "Mabé"	
Barque "Satellite"	
Do. "Tyrol"	

6. Now, in respect to the second point, vessels varying from 200 to 800 or 900 tons enter the inner harbour at draughts of from twelve to fourteen feet, receive cargoes at the wharves of the merchants, and recross the bar at the same draughts, completing their lading outside. The convenience thus afforded of landing and shipping cargoes in smooth water, and at the very warehouses of the merchants, is a feature which has no precedent in any port of the Madras Presidency. The facilities of refitting or repairing ships of any size, and the mechanical appliances and skilled labour available at Cochin, are considerations that will not the less recommend themselves in determining the question at issue.

7. The bar at the mouth of this harbour has a depth of twelve feet at low water, and fifteen at high water, and during my tenure of office, *i. e.*, since 1855, there has been no diminution of these depths, although the channel over it takes a course a little to the north or south occasionally, a common feature in all bar harbours. But this narrow ridge is susceptible of improvement.

8. It must be admitted that the encroachment of the sea has been very remarkable since April 1867, and that a great extent of beach to the south, and portion to the north of this estuary has been abraded away; but it is an undoubted fact that, notwithstanding all these vast changes, the depth of water in the ship-channel has not been affected, and the harbour has continued to afford the same facilities to the shipping as formerly. To give this statement a stronger significance, I may mention that ships have this year had ingress and egress at periods of the season almost unprecedented.

9. An extended experience of the fluctuations of the seaboard at this entrance of this harbour has not yet realized any essential changes practically affecting the capabilities of the port.

* I have since obtained the correspondence, and I find the encroachment was in 1850. Some sixteen* years ago, the advance of the sea on the southern side of the harbour was as considerable as at present, but it receded to its normal condition, and continued unchanged till last year. The immense volume of tidal water discharged through the mouth of this estuary, gathering its scouring power from the various tributaries that flow into this continued stream along a very vast expanse of water, which is swelled during the rains to one fearful irresistible torrent, offers an antagonistic force that may well account for the unimpaired condition of the channel, and the pertinacity with which the accumulating silt has been cleared away.

10. By this it will be observed how remote the probabilities are of any serious or permanent deterioration of the harbour, and the natural action that operates favorably to its security.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

I may further observe that, even in the event of any unforeseen contingency that may militate against free navigation in the ship channel, the value of Cochin as an "Ocean Port" cannot possibly be impaired.

11. The roadstead of Cochin will still continue to afford the same facilities and conveniences for shipping and landing, and it must be admitted that, purely as a roadstead, its natural advantages are superior to those of any other in this Presidency. Again, assuming the very improbable result of the harbour being rendered impracticable for moderate sized vessels crossing in and out, the inconvenience could be altogether neutralized by the employment of a steam-tug, that could at all times maintain communication between the Railway Terminus at Ernacollum, and the roads.

12. In regard to the future condition of Cochin, I respectfully venture to offer a few remarks, but I do so with great diffidence considering the peculiar nature of the subject, which can only be competently dealt with by professional experience. I nevertheless trust that my remarks, based as they are upon close personal observation in many parts during a rather lengthened period, may not be altogether unworthy of consideration.

13. Without entering into the question of vital improvement to the harbour with the aid of modern scientific appliances, that must incalculably enhance its natural advantages, a subject involving considerations of large expenditure, and which must be treated more at length than can be conveniently done in this paper. I shall simply advert to the important fact, that the preservation of this harbour mainly, I may say solely, depends on that terrific scouring action over the channel which nature has so wonderfully provided, and cannot fail as long as the monsoons and rain-fall on this coast continue to exert their power. The primary object should, therefore, be to maintain this scour, and efforts be directed to remove all influences hostile to its permanence. This being secured, there need be no apprehension as to the future of this harbour.

14. The only influence that threatens the diminution of this necessary corroding power in process of time, is the Cruz Milagre gap, which certainly diverts a large portion of the stream which, till very recently, found its natural outlet through the Cochin Bar. But this evil by no means presents any insuperable obstacles to its removal, and the stopping up of the breach may be easily accomplished at a trifling cost.

15. The groynes which are now being thrown out on the southern side, will no doubt, when completed, check the further advance of the sea in this direction, and, to no small extent, restore the foreshore that formerly existed. The only remedy for the evil which experience suggests as likely to be most effectual, is now being applied, and a most favorable result may be confidently anticipated from what has been observed of the effects of similar works in other parts. If these expectations be realised, all apprehension as to the safety of the harbour on the southern side will be removed.

16. With reference to the northern or Vypeen side of the harbour, two groynes are now under construction within British limits, and their good effects are already very conspicuous. If the larger of these groynes be extended further seaward, it would meet the bank that is now forming in this quarter, and form a perfect barrier of protection to the harbour on the northern side, and by confining the tidal stream within the narrow channel, add to its impetuosity and scouring force.

17. It is remarkable that the encroachments of the sea extend only some two miles to the north of the harbour, Malliporum, and other places beyond being free from the effects of this injurious action. Considering the comparatively larger extent of Sirkar's territory lying within the area of these encroachments, and the tendency to breaches forming across the narrow ridge in some parts, I would earnestly urge the necessity of active co-operation on the part of the State in the perfection of the necessary measures for the protection of the coast. A few groynes along this line of coast, and the stopping up of the Cruz Milagre gap being accomplished, no reasonable doubt can possibly exist as to the security of the harbour on the northern side. It is no

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

less the interest of the Cochin Sirkar than its duty to preserve a large portion of its territory from destruction. Material for the construction of groynes and labour are available in abundance, and at very moderate rates.

18. With these protective measures, and the natural unfailing agency of the tidal stream in preserving the depths in the ship-channel, I see no reason to doubt of this harbour maintaining its normal character. But even did Cochin not possess the facilities of an inner harbour, I have already shown that from the characteristics of the outer roadstead, it will still hold its position as an "Ocean Port," and present itself as a natural terminus of a railway on the Western Coast.

19. With a view to afford the fullest information in my power for the determination of this question, I beg to be permitted to submit a few facts for consideration.

20. British Cochin itself, confined as it is within the very limited area of about three miles, barely contributes towards the revenue of the port, but there is no doubt that the exports, which form the principal source of revenue, are all derived from the produce of the Native States.

21. The benefits of a Railway to Cochin may primarily affect the wealthy and populous districts of the Travancore and Cochin States through which it may pass, but the intrinsic advantages of this extension are not confined to the population of these States, but are intimately connected with British interests and commerce. The produce of the Native territories finds its natural outlet at the port of Cochin, and although hitherto the transit of this produce to the seaboard has been fraught with difficulties, the completion of the Railway will operate in producing a wider development of the traffic, and amply compensate Government by increased Customs Revenue and an influx of shipping.

COCHIN,
7th October 1868.

(Signed) J. CASTOR,
Master Attendant.

From Captain J. CASTOR, Master Attendant, Cochin, to the Master Attendant in charge of the Office of Superintendent of Marine, Madras, dated Cochin, 20th October 1868, No. 216.

1. I have the honour to submit estimates for extending six groynes, thirty feet each, and for the construction of a new groyne, 150 feet long on the Cochin side. Also for the extension, seventy feet, of the smaller groyne on the Vypeen side. This will complete the modifications shown in my letter No. 184, dated 1st September 1868, in the Proceedings of Government* dated 16th September 1868, No. 261.

* Marine Department.

2. After your inspection of the main groyne at Vypeen, you were of opinion that this important work should be carried out a hundred feet beyond the length originally sanctioned; and agreeably to your desire, I have provided for this extension in the estimates.

3. The cost of these extensions is necessarily somewhat larger than the expenditure at the earlier stages of the progress of the work, for it will be observed that it will now have to be carried on in continually increasing depths of water, varying from four to ten feet, and no precise calculation reducible to cubic measurement can be arrived at. The estimates, however, have been framed as nearly as possible in accordance with ascertainable data.

4. There is no public ground at Vypeen where the stones could be landed, and although I was at first permitted the free use of private premises for this purpose, the proprietor has recently made a charge of 15 Rupees per month, which forms a new item in the estimates.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

Proximate estimate for extending six Groynes, 30 feet each, and constructing one Groyne of 150 feet on the Cochin side.

	RS.	A.	P.	RS.	A.	P.
To 3,630 Tons of Granite Boulders at 3 Rupees per ton.	10,893	0	0			
Cooly labour for constructing the Groynes	807	0	0			
Iron Nails, Screws, &c., for Jetties, Tramways, Bridges, &c.	115	0	0			
82 Candies of Timber for Tramways, Bridges, &c., at 6 Rupees per Candy	492	0	0			
Carpenters for constructing Wharves, Tramways, Jetties, &c.	150	0	0			
Sawyers, sawing 82 Candies Timber, at 2½ Rupees per Candy	205	0	0			
Blacksmith hire	70	0	0			
Grease for carts	5	0	0			
Tackling for hoisting in stones, 3 Candies at 50 Rupees per Candy	150	0	0			
3 Double and 3 single Purchase Blocks, at 12 Rs. each	72	0	0			
Contingencies for repairing carts, Jetties, &c.	82	0	0			
				13,038	0	0
<i>Proximate Estimate for extending one groyne to 100 feet and one to 70 feet, in British Vypeen.</i>						
To 1,942 Tons of Granite Boulders, at 3½ Rupees per Ton	6,811	8	0			
30 Candies Timber for Jetties, Wharves, Tramways, &c., at 6 Rupees per Candy	180	0	0			
Iron Nails, Screws, &c., for Jetties, Tramways, Bridges, &c.	39	0	0			
Carpenters for constructing Jetties, Wharves, Tramways, &c.	60	0	0			
Sawyers sawing 30 Candies Timber, at 2½ Rupees per candy	75	0	0			
Grease for carts	2	0	0			
Yard rent for landing stones for six months, at 15 Rupees per month	90	0	0			
Contingencies	36	0	0			
				6,793	8	0
Total				19,831	8	0

(Signed) J. CASTOR,
Master Attendant.

COCHIN,
20th October 1868.

FORWARDED to the Committee appointed in G. O., Public Works Department, dated the 19th September last, No. 2,967, to investigate the present circumstances and future prospects of the Port of Cochin.

(Signed) C. G. WALKER,
FORT ST. GEORGE,
16th November 1868.
Under Secretary.

MEMORANDUM.

1. With reference to the proposal in these papers to endeavour to close the Cruz Milagre gap by means of groynes thrown out from either bank and on either side of the opening, in the manner shown in the plan, the undersigned would remark that it appears to him very doubtful whether groynes so placed would do what is expected of them to the extent of causing the accumulation of so much sand as will close the gap. It seems to the undersigned more probable that the

only effect of groynes so placed will be to make the opening tortuous and deeper. Groynes made of stone are very costly, and, though they may be necessary on a beach exposed to the lash of the sea, there seems to be no reason why their use should be resorted to when the object is only the temporary one of checking an ordinary flow of water through an opening while a strong bank of sand or earth is being formed across it. The undersigned is of opinion that a cheaper and more readily applicable method of closing the gap should be tried, and he would recommend that an attempt should be made to accomplish the desired object in the manner practised in Tanjore and other localities for closing breaches in river and channel banks by means of "Modussils," made of palmyrah or cocoanut trees, and by brushwood, grass, and earth. Such breaches are seldom of the extent of the Cruz Milagre gap, but they have always rushing through them a torrent in comparison with which the stream through the gap at Cochin would probably be as nothing, since at the latter place no considerable head of water can exist or would be produced as the work of closing the opening progressed.

2. The closing of such a breach as the Cruz Milagre gap would, the undersigned believes, be easily effected in Tanjore, but perhaps at Cochin, where the people are not accustomed to such work, difficulties may be found. Much however will depend upon the person superintending the work, and on the experience he may have had of such operations.

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

No. 312.

ORDER THEREON, 11th February 1869, No. 453.

CIVIL WORKS, No. 38.

1. The President during his tour in the early part of last year having visited Cochin and, by personal inspection, satisfied himself that the operations which had there been for some time in progress, under the direction of the Superintending Engineer of the 7th Division, for arresting the encroachment of the sea at that place were not of a sufficiently extensive character to ensure the safety of the light-house and the town and the maintenance of the harbour, His Lordship, on his return, brought the subject under the notice of the Government, and orders were immediately passed for suitable measures to be at once adopted for the construction at right angles to the line of the coast of a series of stone groynes, which, having been elsewhere found to afford effectual protection to the beach against the inroads of the sea, were believed to be likely to effect the same object at Cochin.

2. No money, however, being available in the Public Works Department, and no agency of that Department being stationed at Cochin, the necessary funds were provided in the Marine Department, and the supervision of the work was entrusted to the Master Attendant of the Port.

3. A number of groynes were accordingly immediately commenced, and, under the energetic management of the Master Attendant, they have been advanced so far as to show, it is believed, a marked effect in staying the further abrasion of the beach. There is therefore every encouragement to persevere with their con-

struction, but the outlay involved is likely to be so great that, before taking its sanction into consideration, the Government thought it advisable to have a professional opinion on the circumstances and future prospects of Cochin as a port, and resolved to await the reports which, in Proceedings of the 19th September last, No. 2,967, the Master Attendant of Madras, the Consulting Engineer for Railways, and an Engineer of the Madras Railway were requested to favor the Government with.

4. The papers at the head of these Proceedings are the reports of the gentlemen named, and from them the Government are glad to learn that the work already done, consisting of six groynes on the south side of the entrance to the harbour, and two on the north side near the spit of land known as "Vypeen point," has produced, even in its unfinished state, a most distinct and satisfactory effect. Some of those groynes had been exposed to the full force of the south-west monsoon without sustaining any injury, and all of them being run out into the sea in such directions as most effectually to intercept the eroding currents, and to encourage the formation of new beach, their action has resulted in a rapid extension of the shore seaward as the work progressed.

5. The original intention was that these groynes should be carried out to a uniform length of 120 feet, but the merchants of Cochin, supported by Mr. Dalrymple, urge that they should be extended to 150 feet. Even this great length is, however, not deemed sufficient in all cases by Major Shaw Stewart and Mr. Beresford Anderson, the Chief Engineer of the Madras Railway, who, after carefully studying the position and direction of each groyne with reference to the influence it is likely to exert on the littoral current and on the line of beach, recommend that, taking the groynes from south to north in the order in which they are numbered on the map, which is submitted with their report, irrespective of their having been begun or only now recommended, No. 2 should be prolonged to a length of 200 feet, that Nos. 3 and 4, situated in front of the new Light-house, should be extended to 300 feet, as also No. 7 near the Telegraph Office, and that No. 9 at "Vypeen point" should be carried out to a distance of 600 feet. Further, these gentlemen record their opinion that, as the existence of the opening formed in 1862 between the backwater and the sea called the "Cruz Milagre Gap" by allowing the flow of a large volume of water to be diverted from the course it would otherwise take through the channel forming the entrance of the harbour, has a tendency to weaken the force of the stream on the bar, and, as a consequence, to lessen the depth of water over it, measures should be taken to endeavour to close this gap. With this view they endorse Mr. Dalrymple's suggestion that two groynes should be run out, one from the north and the other from the south side of the opening; and, as a very large quantity of stone will be required to complete these groynes of the dimensions considered to be necessary, Major Shaw Stewart and Mr. Beresford Anderson recommend the use of light lines of rails to carry the stone from the points where it must be landed after being brought in boats across the backwater from the quarries which are situated some twelve miles from Cochin, and those gentlemen point out three convenient landing places where cranes for lifting the stone from the boats should be erected, and from whence the lines of light rails should carry it to the sites of the several groynes.

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

6. With respect to the agency by which the operations should be conducted, the same gentlemen, after eulogizing the zeal and energy displayed in the management of the work already done by the Master Attendant of the Port, give their opinion that the Public Works Department should be represented at Cochin by the permanent location there of an Officer.

7. Finally, it is recommended that a stream dredge should be attached to the port, in order that by its employment on the bar the depth of water might there be increased by at least two feet, which it is confidently expected may be accomplished by a dredge of very moderate power.

8. The Government have perused these reports with much interest, and approve of all the suggestions and recommendations they contain with the exception of the construction of the two groynes marked Nos. 15 and 16 at the "Cruz Milagre Gap," which His Excellency the Governor in Council thinks may be omitted under the advice of the Secretary for the Department of Public Works. It is very important that there should be no delay in carrying out to completion all the works that are so satisfactorily shown to be indispensable for the preservation of a port, which, necessary as Cochin is to the trading interests of the country, is likely to be made of still more value by being selected as the ocean terminus to the west of the extensive railway system of this Presidency. The outlay involved in carrying out the works on the proposed scale is likely, however, to be far larger than it will be possible to meet with funds provided from the ordinary allotment for the Public Works of this Presidency, and it will be necessary to address the Government of India with an application for a special grant. To admit of this being done with success it is essential that the application should be submitted with the fullest information, and be accompanied by plans and estimates in the complete form required by the Government of India. For the preparation of those plans and estimates it will be requisite to depute a thoroughly qualified and experienced professional Officer of the Public Works Department to Cochin, and His Excellency the Governor in Council accordingly resolves to select Mr. J. O'Shaughnessy for this important duty, and with that object in view, to direct that he be temporarily transferred from the North Arcot to the Malabar District.

9. As it would appear that all apprehension of any further serious encroachment of the sea at present is removed by the effect of what has been done under the direction of the Master Attendant, the work at all the groynes, except the one at "Vypeen point" will be stopped pending the decision of the Government of India, and all expenditure will be concentrated on that groyne, which is obviously the most important of the series, and on the closing of the "Cruz Milagre Gap," which the Government are satisfied, it is absolutely necessary to stop to prevent the ill effects that the loss of water through that opening must sooner or later have on the scouring force of the current through the channel to the harbour. These two works should be proceeded with with such funds as may be made available for them either in the Marine or the Public Works Department.

10. As respects the mode of closing the "Cruz Milagre Gap," the Government resolve on the recommendation of their Secretary to direct that, before adopting the more costly expedient of constructing stone groynes, the simple and inexpen-

*Proceedings of the Madras Government, Public Works Department,
11th February 1869.*

sive method by which breaches in river and channel banks are closed in Tanjore by means of Modussils should be tried. It is observed that brushwood and all the requisites for carrying out this process abound at or in the immediate neighbourhood of Cochin.

11. The question of the provision of a Steam Dredge will lie over for future consideration.

(True Extract.)

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

To the Marine Department.

- .. Committee on Cochin Harbour.
- .. Consulting Engineers for Railways.
- .. Superintending Engineer, 4th and 7th Divisions.
- .. Controller of Public Works Accounts.

Ed S. T. Augustin.

Enclosure to Letter No. 4208
of 26 October 1868 from the
Master Attendant to Govt

P. M. 4 011/68

Trans. 15 July 1869 in L. 311.

In Mar 1869
L. 219

39

Statement showing the number and description of vessels which have visited
 Narragansett during the south-west monsoon in the years 1864, to 1867.

From	Date.	Steamers.		Sailing vessels.		Total		Remarks.
		No. of vessels.	Tons.	No.	Tons.	No.	Tons.	
From June 1 st to Sept 8 th 1864		8	5,421	5	2,131	13	7,552	
May 29 th to Aug 20 th 1865		15	10,642	6	2,576	21	14,218	
May 19 th to Oct 23 rd 1866		17	13,132	5	1,959	22	15,091	
March 6 th to Dec 13 th 1867		30	17,698	8	2,147	38	19,845	

Master Attendants Office
 Cocoon 23rd November
 1868

(True copy)
 McCullough Major R. E.
 Comd' Engrs for Railways

(Signed) John. Castor
 Master Attendant.

P. W. F. P. 11, '18.
From 11 Feb 119 to 2311.

Enclosure to letter No. 4208
of 16th October from the
Master Attendant to Govt.

P. W. 4 811/82
From 11th Feb 1869 and L. 24.

Enclure 882
No 419

14

The Proceedings of Government
in the Public Works Department,
No 2067, dated 19th September 1868,
having been forwarded to me, from
which I find that the Master
Attendant of Madras, and
other professional gentlemen
have been deputed by Govern-
ment to investigate the present
circumstances and future prospects
of this Port, with a view to de-
termine the expediency of the
extension of the S.W. line of the
Madras Railway to Cochin,
I beg leave to submit a few ob-
servations which I trust may tend
to assist in the solution of the
question.

Some doubts appear lately
to have been entertained as to
the probability of Cochin
maintaining its position as an
"open port," and it would ap-
pear from the papers forwarded

to me that, these doubts have arisen from the recent action of the sea, and the consequent apprehension of sudden and extensive changes in the condition of the Port.

Before entering into this important question, I beg to draw attention to the peculiar features of this Port. It has not only a smooth outer roadstead where any number of ships of any size may find a safe anchorage, but an inner harbour which adds vastly to the convenience of Commerce and Shipping. From Calcutta, the northernmost Port on the East Coast in this Presidency, to Mangalore on the Western Coast, there is not a harbour into which a moderate sized ship could enter, and Cochin remains alone in this respect and in the singular advantage it affords for repairing and refitting.

With reference to the question of Cochin continuing to maintain its position as an Ocean port available at all times of the year for vessels of considerable size

would explain that the advantages offered are of two kinds. First, as an "Ocean port," or if I understand the definition aright, a safe open roadstead. Secondly, the capabilities and facilities of the inner harbour.

In respect to the first, the roadstead of Cochin is perfectly safe and convenient, embracing every facility for landing and shipping, from September to May. The months of June, July and August are exceptional, yet even in these months occasions have not been infrequent when communication with the shore has been maintained with perfect ease and safety. Vessels of any size could avail themselves of this anchorage during the greater part of the year, as already noticed; but should interruption arise during the very small interval of three months (and such exceptional periods are not uncommon in many first class Ports) there exists an auxiliary Port, Varrakel at a short distance of only five

Miles, possessing the tried remarkable
 properties of Convenience and security,
 qualities more conspicuously de-
 veloped, as shewn by experience
 during the worst period of the
 SW Monsoon. In proof of this,
 I beg reference to the statistics
 of the Shipping at Namatal. *Shipping at Namatal*
 for the last three years, viz. 1854, 1855, 1856
 tonnage forwarded; and in order to shew that at
 Cochin the port is more open than shut in
 August, the shipping for the month of that
 month of this year is marginally noted.

Shipping at Namatal	1854	1855	1856
for the last three years, viz.	1567	1111	476
tonnage forwarded; and in order to shew that at			
Cochin the port is more open than shut in			
August, the shipping for the month of that			
month of this year is marginally noted.			

Out of the above tonnage
 the following entered
 the inner harbour:
 1854 1855 1856
 1854 1855 1856
 1854 1855 1856

Now, in respect to the
 Canal point - Vessels varying from
 300 to 800 or 900 tons enter the
 inner harbour at draughts of
 from 12 to 14 feet, receive cargoes
 at the wharves of the Merchants,
 and recross the Bar at the
 same draughts completing their
 loading on tacle. The convenience
 thus afforded of landing and
 shipping cargoes in smooth water,
 and at the very warehouses of

the Merchants, is a feature which
 has no precedent in any Port of
 the Madras Presidency. The facilities
 of refitting or repairing ships of
 any size, and the mechanical ap-
 pliances and skilled labor avail-
 -able at Cochin, are considerations
 that will not the less recommend
 themselves in determining the ques-
 -tion at issue.

The Bar at the mouth of
 this harbour has a depth of 12 feet
 at low water, and 15 at high water,
 and during my tenure of office, i.e.
 since 1855, there has been no de-
 -minution of these depths, although
 the Channel over it takes a course
 a little to the north or south
 occasionally, a common feature
 in all Bar harbours. But this
 narrow ridge is susceptible of
 improvement.

It must be admitted that
 the encroachment of the sea
 has been very remarkable since
 April 1861 and that a great ex-
 -tent of beach to the south, and
 a portion to the north of this

Estuary has been a track away, but it is an undoubted fact that notwithstanding all these vast changes, the depth of water in the ship channel has not been affected, and the harbor has continued to afford the same facilities to the shipping as formerly. To give this statement a stronger significance I may mention that ships have this year had ingress and egress at periods of the season almost unprecedented.

An extended experience of the fluctuations of the seaboard at this entrance of the harbor has not yet realized any essential changes practically affecting the capabilities of the port. Some ^{sixteen} years ago, the advance of the sea on the southern side of the harbor was as considerable as at present, but it receded to its normal condition and continued unchanged till last year. The immense volume of tidal water discharged through the mouth of the Estuary, gathering its driving power from the various tributaries

that flow into this continued stream along a very vast expanse of water, which is swelled during the rains to one fearful irresistible torrent, offers an antagonistic force that may well account for the unimpaired condition of the channel, and the pertinacity with which the accumulating silt has been cleared away.

By this it will be observed how remote the probabilities are of any serious or permanent deterioration of the harbor; and the natural action that operates favorably to its security. I may further observe that even in the event of any unforeseen contingency that may militate against free navigation in the ship channel, the value of Behm as an "Ocean port" cannot possibly be impaired.

The roadstead of Behm will still continue to afford the same facilities and conveniences for shipping and landing, and it must be admitted that, purely as a roadstead, its natural advantages are superior to those of any other in this Presidency.

Again, assuming the very improbable
 result of the harbour being rendered
 impracticable for moderate sized vessels
 crossing in and out the inconvenience
 could be altogether neutralized by
 the employment of a Steam tug,
 that could at all times maintain
 communication between the Rail-
 way Stations at Enayathur, and
 the Harbour.

In regard to the future condition
 of the harbour, I respectfully venture to
 offer a few remarks, but I do so with
 great diffidence considering the peculiar
 nature of the subject which can
 only be competently dealt with by
 professional experience. Nevertheless
 I trust that my remarks, based
 as they are upon close personal obser-
 vation in many parts during a rather
 lengthened period, may not be al-
 together unworthy of consideration.

Without entering into the
 question of vital improvement to
 the harbour with the aid of modern
 scientific appliances that must in-
 calculably enhance its natural
 advantages, - a subject involving

Considerations of large expenditure and which
 must be treated more at length than
 can be conveniently done in this paper.
 I shall simply advert to the important
 fact that the preservation of this har-
 -bour mainly, I may say solely depends
 on that terrific scouring action over
 the Channel which nature has so
 wonderfully provided, and cannot
 fail as long as the monsoons and rain-
 -fall on this Coast continue to exert
 their power. The primary object
 should therefore be to maintain
 this scour, and efforts be directed
 to remove all influences hostile to
 its permanence. This being secured,
 there need be no apprehension as
 to the future of this harbour.

The only influence that threatens
 the diminution of this necessary scour-
 -ing power in process of time, is the
 Cruz Milage gap, which certainly
 vents a large portion of the stream
 which, till very recently found
 its natural outlet through the
 Cochin Bar. But this evil by no
 means presents any insuperable ob-
 -stacles to its removal, and the stopping

side of the breach may be easily accomplished at a fishing boat.

The groynes which are now being thrown out on the southern side will no doubt, when completed, check the further advance of the sea in this direction, and to no small extent restore the foreshore that formerly existed. The only remedy for the evil which experience suggests as likely to be most effectual, is now being applied, and a most favorable result may be confidently anticipated from what has been observed of the effects of similar works in other parts. If these expectations be realized, all apprehension as to the safety of the harbour on the southern side will be removed.

With reference to the northern or Wyke side of the harbour, two groynes are now under construction within British limits, and their good effects are already very conspicuous. If the larger of these groynes be extended further seaward,

it would meet the bank that is now forming in this quarter, and form a perfect barrier of protection to the harbour on the northern side, and by confining the tidal stream within the narrow channel, add to its impetuosity and scouring force.

It is remarkable that the encroachments of the sea, extend only some two miles to the north of the harbour. Mulhousum and other places beyond being free from the effects of this injurious action. Considering the comparatively larger extent of Sark's territory lying within the area of these encroachments, and the tendency to breaches forming across the narrow ridge in some parts, I would earnestly urge the necessity of active co-operation on the part of the Fookin State in the perfection of the necessary measures for the protection of the coast. A few groynes along this line of coast, and the stopping up of the long Mulhousum gap being accomplished, no reasonable doubt can possibly exist as to the security of the harbour on the northern side. It is no less the interest of the Fookin Sark, than its duty

to preserve a large portion of its territory from destruction. Material for the construction of frigates and labor are available in abundance, and at very moderate rates.

With these protective measures, and the ~~natural~~ ^{unfailing} agency of the tidal stream in preserving the depths in the ship channel, I see no reason to doubt of this harbor maintaining its normal character. But even did Cochin not possess the facilities of an inner harbor, I have already shown that from the character of the outer roadstead, it will still hold its position as an "Ocean port," and present itself as a natural terminus of a Railway on the Western Coast.

With a view to afford the fullest information in my power for the determination of this question, I beg to be permitted to submit a few facts for consideration.

British Cochin itself, occupies as it is mentioned the very limited area of about three miles, barely contributing towards the revenue of the Port, but there is no doubt that the exports,

which form the principal source of revenue are all derived from the produce of the Native States.

The benefits of a railway to Cochin may primarily affect the wealthy and populous districts of the Travancore States through which it may pass, but the intrinsic advantages of the extension are not confined to the population of these States, but are intimately connected with British industry and commerce. The produce of the Native Territories finds its natural outlet at the Port of Cochin, and although hitherto the transit of the produce to the seaboard has been fraught with difficulties, the completion of the railway will operate in producing a wider development of the traffic, and amply compensate government by increased Customs, Revenue and an influx of shipping.

W. Munro
Master Attendant

Cochin
7th October
1868

Administrative Department

Madras
Master Attendant's Office
26th October 1868.

N^o 4208.

From H. D. E. Dalrymple Esquire
Master Attendant

To
The Honorable R. S. Ellis Esq
Chief Secretary to Government
Marine Department
Fort Saint George.

Sir

In pursuance of the orders
of Government, N^o 256, dated 10th ultimo, I have the

Letter from the Merchants of Cochin to the Chief Secretary to Government dated 15th August 1868

Extracts from Administration Reports for the years
1865/66 - 1866/67 - 1867/68.

A paper on the state of and requirements
of Cochin Harbour &c by Captain Castor,
dated Cochin 7th October 1868.

Copy of letter from Captain Castor to Master
Attendant Madras dated 20th October 1868.

Estimate for extension of groynes on both
sides of Harbour of Cochin.

Chart of Cochin &c by Lieutenant Taylor
J. R.

Chart of Coast from Cochin to Karakal
by Captain Castor.

in the margin.

2 In the first place, I must
respectfully explain that, as it was of
much

C. P. Dalrymple
Master Attendant
26th Oct 1868

Recd
26th Oct 1868

Received from the
Master Attendant's Office
26th Oct 1868

much importance that the works in progress at Cochin should be inspected at the close of the S. W. Monsoon, and as I found the gentlemen named in the orders of Government were not prepared to visit the West Coast till November, I was obliged to proceed to my destination without them.

* Dated 19th Sep.
 * Cember 1868
 Public Works Dept

3 I arrived at Cochin on the 7th instant, and in that evening began inspecting the Port and the works in progress, under the superintendence of Captain Castor, the Master Attendant, and during my stay there, from day to day, took means, both from personal observation and extensive enquiries among the Residents, to obtain all trustworthy information required; on which to form decided opinions as to the capabilities of the Port and its requirements.

I

19
 4 I have also to report that I visited the following places, viz^t that on the Vypren side, where the Breach occurred in June last, which was immediately closed by Captain Castor. The Breach now open at "Cruz Milagree", which I shall further report on:— the granite quarries situated about 12 or 13 miles up the river, from whence the stone is brought for the construction of the groynes; and the Port of Narakal.

* Separate report in Narakal will be sent in.

5 I may observe that I visited Cochin 24 years ago, when on sick leave, and was then much struck with the natural advantages of the locality as a Sea Port—on visiting it on this occasion, I was greatly surprised to find such a Port, the only one of the sort in the Madras Presidency, should have been so much neglected.

I

All the groynes, which
are completed, (as per sanctioned
measurement) and even those in
progress of construction, have alrea-
dy acted most beneficially on the
formation and extension of the Beach
on both sides of the Harbour, and
I strongly recommend that the con-
struction of an additional groyne
to the North Eastward of the Telegraph
Office

8
vide Captain
Carter's Chart
of Coast from
Cochin to Stora
hal.

8 I now beg particularly to call the attention of Government to the breach effected by the inroads of the sea at Cruz Milagree on the Vypren side, about 2 miles from the Port of Cochin. Although this breach was effected by the inroads

Extract from letter from Captain Bean R.E. of the sea in
District Engineer Malabar to Lieutenant May or June
Colonel J. Ouchterlong R.E. Deputy Chief 1862, and was
Engineer Southern Circle. D.P.W.
Para 15. "A permanent opening at this reported on
port (Cruz Milagres) would prove dis- before the
-astrous for the interests of the Com- close of the
-mercial Community of Cochin for though year by Capt.
I do not believe that it could ever draw tain Bean
off all the river floods and volumes of R.E. vide
water which pour over the Bar it di- Extract from
-minishes very much the flow of the his report
river in Cochin Harbour and tends to quoted in the
silt up the sand banks which form
at the rivers mouth and consequently
the Channels for vessels entering the Port"

margin

up of the breach may be easily accomplished at a trifling cost.

The groynes which are now being thrown out on the southern side will no doubt, when completed, check the further advance of the sea in this direction, and to no small extent restore the foreshore that formerly existed. The only remedy for the soil which experience suggests as likely to be most effective is now being applied, and a most favorable result may be confidently anticipated. From what has been observed of the effects of similar works in other parts. If these expectations be realized, all apprehension as to the safety of the harbour on the southern side will be removed.

With reference to the northern or Lyffeen side of the harbour, two groynes are now under construction within British limits, and their good effects are already very conspicuous. If the larger of these groynes be extended further seaward,

it would meet the bank that is now forming in this quarter, and form a perfect barrier of protection to the harbour on the northern side, and by confining the tidal stream within the narrow channel, add to its impetuosity and scouring force.

It is remarkable that the encroachments of the sea, extend only some two miles to the north of the harbour Mullaporum and other places beyond being free from the effects of this injurious action. Considering the comparatively larger extent of Subarctic territory lying within the area of these encroachments, and the tendency to breaches forming across the narrow ridge in some parts, I would earnestly urge the necessity of active co-operation on the part of the Lochin State in the perfection of the necessary measures for the protection of the Coast. A few groynes along this line of Coast, and the stopping up of the Cruz Mulage gap being accomplished, no reasonable doubt can possibly exist as to the security of the harbour on the northern side. It is no less the interest of the Lochin Sirkar than its duty

margin, and has been persistently reported on yearly by Captain Castor, no steps have yet been taken to remedy this disaster, which has threatened the existence of Cochin as a sea Port.

9 In consequence of this non interference for years past with the inroads of the sea at this point, the gap has greatly extended, causing the escape of the stream from the Backwater to the sea, and thereby depriving the Harbour of Cochin of the full volume of water, and force of scour, of which it previously had the advantage of during the ebb tides and the freshes from the Hill ranges.

10 However it is not too late to remedy this evil, and I respectfully recommend that the permission of the Rajah of Cochin be obtained as soon as possible to run out, in the first instance, two

vide Captain
Castor's Chart

*
vide Captain
Castor's Chart

21
two groynes, one on the North and the other on the South side of the gap at Cruz Milagree, and afterwards, for the preservation of the spit of land between the gap and Vyppen point, to run out four additional groynes.*

11 I also strongly recommend that Captain Castor be authorized at once to begin these works, for before the next monsoon great results will be effected: the accounts with the Cochin Sirkar can be afterwards adjusted.

12 The Breach, a short distance to the Northward of Vyppen, caused by the sudden encroachment of the sea in June last, was taken at the nick of time by Captain Castor, and effectually stopped, the whole of the stones used for the purpose being now deeply embedded in the sand, and an extensive breach

*
vide Captain
Castor's letter
to Superintendent
of allarme
dated 10th June
1868 No. 122.

breach created - if the same prompt action had been taken when the breach at Cruz Milagres was first made, that encroachment of the sea would have been stopped and much expense saved.

13 I beg further to explain that the extension of 100 feet to the length of the principal groyne on the Vysean point is of the utmost importance - the effect produced by this extension when the breach at Cruz Milagres is closed, will be to throw the full strength of scour through the proper channel and the soundings on the bar will be in-

I think
increased

I think
increased

Vide Lieutenant
Taylor's sketch
of Cochin.

State
of 50 or 60 feet
of extension be
found sufficient
the work may
be stopped.

State
soundings in
the Bar have
not varied of
late though the
section of water
channel is slightly
altered.

creased. - I am confident that, if this be done, the Port of Cochin will be restored to its former prosperity, and if a communication by rail through the Travancore and Cochin territories to Eracollum be

be opened that it will become the most flourishing outlet of Commerce in the Madras Presidency.

14 I would strongly recommend, when all the works are completed, that a steam dredge should be attached to the Port of Cochin. Even now ships of 700 tons come inside the Harbour - but with the service of a good steam dredge to be worked from time to time over the Bar, I have no doubt sufficient depth of water would be obtained for vessels of 1000 to 1200 tons burthen.

15 I cannot conclude this report without prominently bringing to the notice of Government the energy and ability displayed by Captain Laster in his prosecution of the works for the preservation of Cochin. When on the spot, I saw every hour

of

of the day the works steadily pro-
-gressing, showing the results of
his great powers of organization
and untiring supervision — and
I would respectfully urge the
absolute necessity of having suf-
-ficient funds always available for
the current expenses of the operations
now in progress, — for if money
be not forthcoming every Saturday
to pay boatmen and coolies they
leave the service, and the works are
retarded.

I have the honor to be

Sir

Your most obedient Servt

M. D. S. Dalrymple
Master Attendant

Report on the Cochin Harbour

Position of Town

The town of Cochin is situated upon a narrow strip of sand which separates an extensive lagrow or backwater from the Indian Ocean. This backwater forms one of a connected series which stretches along the west coast of India to the south of the town of Ponany, and which communicates with the sea at several points; but the only channel navigable for ships of large size is that upon the south bank of which the town of Cochin is situated. It is said that this channel had no existence before the 14th century, during which it was formed by a sudden inundation in the large river which till then had its sole exit about 17 miles to the

north.

10 Sept 1885 25-26

Received by the Discharge

from

The Master Attendant

Administrative Dept

The & his Secretary to

Government

Marine Department

Port of George

Place 26th } October

Recd 29

These

5th 11th 19th

Administrative Dept

The works being executed

to prevent the inundation

of the sea at certain

places

11th 19th 19th

Forwarded to the Committee
appointed in P.O. Public Works
Department dated the 19th September
last. No 2974, to investigate the
present circumstances and future
prospects of the port of Cochin

For the Secy
16 Nov 1885

W. L. Walker
Under Secretary

Major & R. R. Shaw Stewart
Lt. Col. M. M. M. M. M.
13. Anderson, Secy.

29 Oct
1904

Forwarded

north. However this may be, there is little doubt that from the date of the first Portuguese settlement at Cochin, early in the 16th century, the character and condition of the port has till within the last few years sustained but little change.

2. The inner harbour, including not only the channel which communicates directly with the sea, but also that portion of the backwater which adjoins the town of Cochin, is of considerable depth, the greater part of it averaging from 20 to 40 feet at low tide. The whole of the available space has ample depth for the accommodation of any vessel which can enter from the sea.

3. The bar at the mouth of the channel is a remarkably narrow ridge of sand, with 12 feet of water over it at low tide. In the year 1835, as appears from

Inner Harbour.

The Bar.

28
a survey of the port taken then by Lieutenant Robinson, there were 15 feet of water over the bar at low tide; and the survey taken in the year 1858 by Lieutenant Saylor shows a depth of 13 feet. It would appear from this that one foot in depth has been lost during the last ten years; but Captain Castor, the Master-Attendant at Cochin, states that during the 15 years of his connection with the port there has not been, to his certain knowledge, any variation in the depth over the bar, that he accompanied Lieutenant Saylor when the survey was being made, and that he protested then both against the mode in which the soundings were ascertained and against the results which they gave.

4. The distance of the bar from the shore at the Light-House is about 2000 yards, and

and not only is the channel which leads to it deep and easy of access for vessels, but an examination of the charts will show with what singular rapidity the water deepens upon either side of it, giving to it the character rather of an abrupt and steep rocky reef than of a sandy bar at the mouth of an Indian river.

5. The rise and fall of tide at Cochin varies from $1\frac{1}{2}$ to 3 feet, so that vessels drawing from 12 to 13 feet can safely cross the bar at spring tides in calm weather. The records show that the port is frequented by vessels as large as from 800 to 900 tons burden. As a general rule the larger vessels take in the greater part of their cargoes in the inner harbour, and complete their loading in the outer roads. Among many other vessels which were lying in the harbour during our short visit, the ship "Premier", registered at Louis, completed

Rise and Fall of Tide

ebb Currents. 6.

The coast near Cochin is affected is one which flows from south to north. This is felt in its greatest force during the south-west monsoon, but even at other times of the year, when northerly winds are prevalent, and when the set of the outer coast current is from north to south, a strong ebb current flows inshore from south to north off the town and harbour.

Outer Roads. 7.

The outer roads form a perfectly safe anchorage during the greater part of the year, i. e. from September till May, and vessels drawing upwards of 20 feet can lie within a short distance of the

Vide Captain
noted report
dated 7th October
'8.

bar. It is stated by the Master Attendant that even during the three monsoon months, June, July, and August, "occasional"

her cargo, and, with a draft of 13 feet, was to cross the bar the day after our departure.

"have not been unfrequent when communi-
-cation with the shore has been maintained
"with perfect ease and safety."

8. The very remarkable anchorage
at Narrakab, which during the prevalence
of the south-west monsoon forms an ex-
-cellent auxiliary port to Cochin, has been
so fully described by Captain Cretor in
the papers printed with the orders of Govern-
-ment noted in the margin, that it is
unnecessary to give here a detailed account
of it, especially as, at the time of our
visit, none of its peculiar phenomena
were observable.

9. The Narrakab anchorage
commences at a point about $5\frac{1}{2}$ miles to the
north of Cochin, and extends about 3 miles
along the coast and about an equal
distance out to sea, within which limits
ships can anchor in from 3 to 5 fathoms.
The facts which so remarkably distinguish
it

Narrakab
Anchorage

No 242 dated
26th July 1861
No 430 dated
20th December 1861

it during the months of June, July and
August, are that while upon the immedi-
-ately adjoining coast the sea breaks at
that time of the year with great violence,
the water, within the described limits, is
not only almost perfectly still and smooth,
enabling vessels to anchor and to take in or
discharge their cargoes with ease and
safety, but is also sweet and fresh and
quite different in character from that
of the ocean.

10. The only other place where
similar conditions are known to exist
is off the town of Aliper, about 80 miles
to the south of Cochin. Several theories
have been brought forward to account
for the abnormal state of the sea during
the monsoon months at these two places.

Of these theories the most plausible seems
to be one which was we believe suggested by
the

the late General Cullen: that when the level of the backwater is raised by the heavy rain of the south-west monsoon to a considerable height above that of the sea, the fresh waters find an exit at each of these points by some subterraneous channels, and rising by reason of their less specific gravity through the salt water of the sea, stir up the deep bed of singularly soft black mud which is a peculiar feature of these two localities, and that this mud, while held in suspension, forms a natural bulwark and breakwater against the violence of the sea.

11. Whatever may be the correct explanation of the phenomena, the facts are beyond all doubt; and with the evidence before us, we have no hesitation in stating that we consider Narrakal to be throughout the

34
the year a perfectly safe natural anchorage, and a most valuable auxiliary to the port of Cochin.

12. A statement appended to this report of the number and description of vessels which have visited Narrakal during the south-west monsoon in the last 4 years will show how steadily the appreciation of its value has risen.

13. The distances of the coast at Narrakal from the backwater is about 1000 yards, and a narrow channel, sufficiently large to admit boats, was excavated some years ago to within a few yards of the sea beach. The sides of this channel have now fallen in many places, and we recommend that it should be widened and deepened throughout. It would be well to give it a minimum width of 10 yards, and a minimum depth, at low water, of 4 feet. In the backwater, from the

Report on the Cochin Harbour

The town of Cochin is situated upon a narrow strip of sand which separates an extensive lagrow or backwater from the Indian Ocean. This backwater forms one of a connected series which stretches along the west coast of India to the south of the town of Ponnay, and which communicates with the sea at several points; but the only channel navigable for ships of large size is that upon the south bank of which the town of Cochin is situated. It is said that this channel had no existence before the 14th century, during which it was formed by a sudden inundation in the large river which till then had its sole exit about 17 miles to the

north.

Position of Town

10 Sept 1855 25-26

10 Sept 1855 25-26

From

The Master Attention

Administrative Dept

The & Miscellaneous

Government

Marine Department

Port of George

State 26th Oct 1855

Recd 27

27 Oct 1855

5-11-55

Richard's Island respecting

the works being necessary

to prevent the inundation

from the sea at certain

times

27 Oct 1855

7-11-55

Forwarded to the Committee

appointed in P.O. Public Works.

Forwarded also to the 19th Dec 1855

last. No reply to investigate the

present circumstances and future

prospects of the port of Cochin.

16 Nov 1855

W. A. L. A.

Under Secretary.

10 Oct 1855

Major & M. M. M. M. M.

Mr. B. B. B. B. B.

Mr. B. B. B. B. B.

Mr. B. B. B. B. B.

of the town of Cochin.

16. The gradual encroachment on the coast to the north of the town of Cochin, to which reference has above been made, has been in progress since the year 1854, and has now assumed a very serious aspect. An examination of the accompanying chart will show that the encroachment commenced at a point about 4 miles to the north of Cochin; and that in some places the portion of the coast which has been submerged is no less than 400 yards in width. The "Cruz Milagre" Gap, to which allusion has been made, is one of the results of this unimpeded encroachment; and at several other points where the coast, by the action of the sea, has been greatly reduced in width, there is much danger that similar results will follow. At one of these points the sea

Encroachment of Sea to the North.

actually

actually broke into the backwater during the month of June last, and but for the prompt and energetic action taken by the Master Attendant, there can be little doubt that the breach would by this time have equalled in size that at the "Cruz Milagre" Gap.

Encroachment of Sea to the South.

17. Upon the south side of the Cochin channel, in the immediate vicinity of the town, the encroachments made by the sea during the years 1867 and 1868 were very considerable. The former years a beach of sand, from 200 to 300 yards in width, has generally existed between the site of the new Light-House and the margin of the sea; but during the latter half of 1867 this beach entirely disappeared, and the sea washed freely against the bastion on which the Light House was built. In the year 1850 a similar erosion of the beach at this spot occurred,

occurred; and on that occasion, when danger to the town seemed imminent, the sea suddenly receded without any apparent cause, and the beach returned to its normal position. Whether upon the recent occasion also the sea would have retired of its own accord, it is of course impossible to say; but there can be little doubt that the town of Cochin was for some time in an extremely critical situation, and that its present safety is chiefly due to the untiring energy and perseverance of its Master Attendant, who without assistance devised and carried on the protective works which have already produced such beneficial results.

18. These works, which are still in progress, consist of six groynes of rough stone on the south side of the entrance to the harbour, run out into the

Protective Works now in progress.

* Numbered from 166 on a separate map.

* Numbered 8 and 9 on map.

sea in such directions as most effectually to intercept the eroding currents, and to encourage the formation of a new beach by the deposit of silt. Upon the north side of the harbour, near the promontory called "Vypeen Point," two six-mile groynes are in process of construction. The effect produced by all of these works, in their unfinished state, was at the time of our visit most distinct and satisfactory. Some of the groynes had been exposed to the full force of the south-west monsoon without sustaining any injury, and the beach was rapidly forming as the work progressed.

19. The length of the groynes was calculated by Captain Castor at 120 feet; and we observe that Mr. Dalrymple has endorsed a recommendation

tion made by the Cochin merchants to the effect that they should be extended to 150 feet, and that a seventh groynes, of the same length, should be constructed on the south side of the harbour near the telegraph office. While we strongly advocate these additions to the originally proposed works, we are not satisfied that they will be sufficient to protect permanently the town and harbour of Cochin.

20. We have carefully and attentively studied the position and direction of each of these works, and with reference to the influence which each is likely to exert upon the littoral current and upon the line of beach we beg to submit the following recommendations. Taking the groynes from south to north, in the order in which they are numbered on

* Numbered 7 on map.

Protective Works recommended to the South.

35 35
The accompanying map, we are of opinion that No 2 groyne should be carried out to a total length of 200 feet; — That Nos 3 and 4 groynes, situated in front of the new Light-House should each have a total length of 300 feet; — That No 7 groyne, the one near the telegraph office, the construction of which has lately been recommended by the Cochin merchants, should also be carried out to a distance of 300 feet; — and that No 9 groyne, at Vypren Point, should have a total length of 600 feet. To this last named groyne, No 9, we attach special importance. Of late years the current has set round Vypren Point with great force, and the coast has been washed away to the extent of about 300 yards. We are confident that a groyne here of the length proposed by us will have the double effect of

driving the sea back to its old limits, and of causing a considerable increase to the strength of the scouring current which passes over the bar.

21. Mr. Dalrymple has also recommended the immediate closing of the "Cruz Milagros" Gap, by the construction of two groynes, one being run from the north and the other from the south side, and the subsequent construction of four additional groynes for the protection of the coast between the Gap and Vypeen Point. We entirely concur with him. We consider that the security of the Cochin harbour depends in great measure upon the early execution of this work, and we trust that no time may be lost in undertaking it. We recommend that a groyne be run out in the first instance from the east end

Protective
Works recom-
mended to
the North.

* Numbered 11, 12, and 13 on map.

* Numbered 14, 15, and 16 on map.

* Numbered 17 on map.

* In the position
numbered 18
on the map.

27 36
end of the north bank of the Gap, as the work will not only be carried on in comparatively shallow water, but will in our opinion more effectually intercept the strong ebb current, and cause a rapid deposit of silt. The second groyne, from the southern bank of the Gap, can afterwards be run out.

22. With regard to the groynes recommended between the "Cruz Milagros" Gap and Vypeen Point, we consider that they will prove of great service in strengthening and reclaiming the beach. We would make them five instead of four in number, and in addition to them we are of opinion that one groyne should also be constructed to the north of the Gap: each groyne to be carried to a length of 250 feet.

23. The works alluded to in the last two paragraphs will all be constructed within the territory of His Highness the Maharajah of Cochin; and in the course of several interviews which we had with the Dewan of Cochin, we were assured that His Highness was not only anxious that the proposed works should be carried out, but would be prepared to contribute materially towards defraying their cost. The Dewan said that the Cochin State had sustained serious loss, not only by the extent of valuable land which had been submerged, but also by the injury done to the rice fields in the neighbourhood of the Gap by the influx of salt water.

24. As to the construction of all the groynes which have been recommended we strongly advocate the use of lines of light rail to convey the stone from the points Mode of Construction

points at which it is landed to the site of each groyne. The quarries, which we regret we were unable to visit, are situated up the backwater, at a distance of some 12 miles from Cochin; and we recommend that three convenient spots be selected for landing the stone, — one near the telegraph office, for the groynes on the south side of the harbour, — one near Vypeen Point, for the works between that and the Gap, — and a third to the north of the Gap, for the remaining works. At these points cranes or other suitable appliances for removing the stone from the boats, should be erected, and the lines of light rail above referred to should connect the landing places with the site of each groyne. We are convinced that this will effect a considerable saving in

in the cost of the work.

25. We do not feel called
on to give an opinion as to the agency by
which the works which have been recom-
-mended should be carried out. It
would be scarcely possible for any man
to have shown more energy and zeal, or
to have carried out what has been done
more efficiently, than Captain Castor; but
it is not unlikely that the extensive
works which have been recommended
could not be undertaken by him without
seriously interfering with his other duties.

26. Whatever course may be
adopted with regard to these works, we
think it our duty to bring prominently
24. forward the importance which we attach
the to the permanent representation of the
Public Works Department at Cochin, by
lig.

a professional Officer of some experience
being stationed there. Owing doubtless
to its peculiarly isolated situation as regards
the rest of this Presidency, the interests of
Cochin have been, perhaps unavoidably, co-
neglected; but the fact of its being the
only harbour within the limits of this
Presidency, together with its unquestionable
capabilities for improvement, and the pro-
-bability that important questions of an
Engineering nature, demanding often im-
-mediate action, may from time to time
arise, render it in our opinion essential
that an Officer competent to deal with
them should be always available on the
spot.

Steam Dredge

27. Mr Dalrymple has
recommended that, after the completion of

of the works, a steam dredge should be permanently attached to the port. In this recommendation we cordially concur.

We have alluded to the remarkable nature of the bar at the mouth of the Cochin river, to its singular narrowness, and to the abruptness with which the water deepens on either side of it. We are well aware that in the case of most Indian rivers, the expense of maintaining a steam dredge for the purpose of deepening the passage over the bar would scarcely be justified by the results, but we have no hesitation in expressing our belief that the case of Cochin is very peculiar, and our confident expectation that, by the use of a steam dredge of moderate power, the passage over the bar may be deepened by at least 2 feet.

£ 28.

We do not think it necessary
to

to enter here upon the advisability of providing Cochin with docks and quays, although we entertain little doubt that the question will come forward in due time if the protective works which have been recommended are carried out.

Wm. Ansell.

Chief Engineer. Madras Ry.
Company.

Wm. Stewart Major, R.E.
Cons. Eng^r for Railways.

Madras -
9th December
1868 }

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for orders.

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Ed. H. George?
Dec 18 88

I think that their Paper should be submitted
 to the attention of the Govt of India in connection
 with the Report of the Consulting Engineer for
 Railways in favour of a decision of the
 Madras Railway & the Cochin Harbour.
 and that the Govt of India should be earnestly
 requested to make a special grant in
 favour of works destined actually to
 secure the existence of the harbour of Cochin
 & dispossessing local interests but also
 with a view to the creation of a new
 terminus on the Western Coast, the only
 one possible in the territory of this
 Presidency. Pending the decision of the
 Govt of India I would stop the work
 at all the groups except the one at
 Syke's Point, leaving the canal
 & the pier & the whole length
 & expenditure on doing the great gap
 at Cochin & Malabar. In prosecuting this
 work I think the Govt should appoint
 an execution officer of the S. P. W.
 acquainted with the methods of action
 suggested by the Council of the last
 Council. If the grant requested for the
 Govt of India is allowed an officer of the
 Govt should be charged with the execution
 of the general scheme of new works during

13 Oct 1867

No. 445.
 From
 42

Beresford Anderson Esquire
 Chief Engineer Madras Ry. Company
 and Major J. W. de Shaw Stewart R.E.
 Consulting Engineer for Railways

To
 Colonel C. A. Orr R.E.
 Secretary to Government
 Public Works Department
 Fort Saint George

Sir,
 We have the honour to report
 for the information of Government that in
 compliance with the request contained in
 the third paragraph of their order dated
 the 19th September last, No. 2967, we have
 visited Cochin, and after making careful
 inspections of the harbour and of the
 Narrakal anchorage, we beg to submit
 our opinion as to the capabilities of the port

and
 more

and as to the works which should be carried out to secure its effectual protection.

2. In our visit to Cochin we were accompanied by the Agent and Manager of the Madras Railway, and in forming our opinion we had the advantage of receiving his assistance and advice.

3. We also had the advantage of perusing Mr. Dilguy's report upon the port of Cochin which was referred to us by Government upon the 10th ultimo, and which with its accompanying documents we have now the honour to return.

4. The enclosed report is accompanied by a copy of the chart of the coast between Cochin and Narrikal, surveyed by Captain Castor in April 1865, on which have been marked the present line of coast, and the positions of the protective works, &c., to which allusion is made

in the report.

We have the honour to be,

Sirs,

Madras
9th (December)
1868

Your most obedient Servants,
Blissful Ancher.
Chief Engineer. Madras Ry. Company
Major R. E.
Consulting Engineer for Railways

12th Feb 1868
The Consulting Engineer
for Railways.

To
The Secretary to Govt
P. W. Dept
Fort St. George

Dated 9th } Dec 1st / 68.
Rec^d 11 / 10

No 445.

Submitting a
Report on the
Harbour.

No 453-12th Feb 1869

For Orders

4th
Memorandum.

With reference to
the proposal in these papers
to endeavour to close the
Crzy. Nilagre gap by means
of groynes thrown out from
either bank and on either
side of the opening in the
manner shown in the
plan, the undersigned has
remarked that it appears to
him very doubtful whether
groynes so placed would
do what is expected of them
to the extent of causing the
accumulation of so much
sand as will close the gap.
It seems to the undersigned

Wm
A. A.
Wm

16011
R.C. 18th Jan 1869. 2.26m
R.C. 18th Jan 1869. 2.26m

more probable that the
only effect of jroynes is to
be placed will be to make
the opening narrower and
deeper. Jroynes
made of stone are very
costly, and though they
may be necessary on a
beach exposed to the
lash of the sea, there
seems to be no reason
why their use should
be resorted to when the
dijet is only the temporary
one of checking an ordi-
nary flow of water thro'
an opening while a strong
bank of sand or earth
is formed across it.
The undersigned is ~~decidedly~~
of opinion that a cheaper
and more readily appli-
cable method of closing it

the gap should be tried, and
he would recommend that
an attempt should be made
to accomplish the desired
object in the manner prac-
tised in Tanjore and other
localities for closing in
breaches in river and chan-
nel banks by means of
"Modussils", made of
palm-leaf or Coconut
trees, ^{and} brushwood, grass
and earth. Such breaches
are seldom of the extent
of the Cruz Milagre Gap,
but they have always
rushing through them a
current in comparison
with which the stream
through the Gap at
Cochin would probably

Permanent
 Secy
 11 May 69
 13

I think that this Paper should be submitted
 to the attention of the Govt of India in connection
 with the Dept of Public Works, Engineer for
 Railways in form of an Estimate of the
 Madras Railway & the Cochin Harbour.
 and that the Govt of India should be earnestly
 requested to make a special grant in
 favor of works declined actually to
 secure the existence of the harbour of Cochin
 & indispensably to local interests but also
 with a view to the creation of a new
 terminus on the eastern Coast, the only
 one possible in the territory of this
 Presidency. Pending the decision of the
 Govt of India I would stop the work
 at all the groups except the one at
 St. Peter's Point, showing the small
 & important & show the whole length
 & expenditure on doing the great gap
 at Cochin Melagney. & prosecuting this
 work I think the Govt should appoint
 an execution officer of the S. P. W.
 acquainted with the methods of action
 suggested by Council or at least the
 Council. If the grant requested for the
 Govt of India is allowed an officer of the
 Govt W. should be charged with the execution
 of the general scheme of new works during

No. 445-
 42
 From
 Beresford Anderson Esquire
 Chief Engineer Madras Ry. Company
 and Major J. H. de Shaw Stewart R.E.
 Consulting Engineer for Railways
 To
 Colonel C. A. Orr R.E.
 Secretary to Government
 Public Works Department
 Fort Saint George

Sir,
 We have the honour to report
 for the information of Government that in
 compliance with the request contained in
 the third paragraph of their order dated
 the 19th September last, No. 2967, we have
 visited Cochin, and after making careful
 inspections of the harbour and of the
 Narraikal anchorage, we beg to submit
 our opinion as to the capabilities of the port,
 and
 more

be as nothing, since at
the latter place no con-
siderable head of water
can exist or would be
produced as the work
of closing the opening pro-
posed.

The closing of such
a breach as the Cruz
Village gap would, the
undersigned believes,
be easily effected in
Luzon, but perhaps at
Cochin, where the people
are not accustomed to
such work, difficulties
may be found. Much
however will depend up-
on the person superin-
tending the work

and

47
and on the experience
he may have had
of such operations.

Public Works Department
No 453

Proceedings of the Madras Government
Under date the 12th ~~January~~ ^{February} 1869.
Read the following

Mr. Samuel Anderson, Chief Eng.
Madras Ry Co, and Messrs. J. A. & Co.
Messrs. J. A. & Co.
From the Consulting Engineer
for Railways.

No E dated 9th Decr/68 No 45

The President
during his tour in the
early part of last year
having visited Cochin, and
by personal inspection,
satisfied himself that the
operations which had there
been for some time in

R.
W.M.

I think the draft proposed under the direction
should be presented to the Superintendent of the
by a short memorandum Division, for arresting
under the signature the encroachment of the
of the existing work.
marking the adoption sea at that place were
of the workshop, not of a sufficiently
for stopping the very extensive character as
indicated by

to ensure the safety of the lighthouse and the
harbour and the maintenance

of the harbour, His Lordship,
on his return, brought the
subject under the notice
of the Government, and
orders were immediately
passed for suitable mea-
sures to be at once adopted

for the construction at
right angles to the line of the
Coast of a series of stone groynes,
which, having been elsewhere
found to afford effectual
protection to the beach
against the piracies of the
sea, were believed to be
likely to effect the same
object at Fochin.

No money, however,
being available in the
Public Works Department,

as the understanding
that such a sum was
with a prospect
of the order, I pass
the draft -

R. A.

I have suggested one
or two alterations
as the opportunity
that a sum of money
by the Secretary will
be involved in
proceeding

and no agency of that Dept.
being stationed at Fochin,
the necessary funds were
provided in the Marine
Dept., and the supervision
of the work was entrusted
to the Master Attendant
of the Port.

A number of groynes
were accordingly immedi-
ately commenced, and, un-
der the energetic manage-
ment of the Master Atten-
dant, they have been ad-
vanced so far as to show
it is believed, a marked
effect in staying the fur-
ther abrasion of the beach.
There is therefore every en-
couragement to persevere
with their construction,
but the outlay involved
is likely to be so great that
before

before taking its sanction
into consideration, the
Govt. thought it advisable
to have a professional opinion
on the circumstances and
future prospects of the
as a port, and resolved to
await the reports which
were in Proceedings of the 15th
September last, No 2957.
The Master Attendant of
Madras, the Consulting
Engineer for Railways, and
the Engineer of the Madras
Railway were requested
to favor the Govt. with

the papers at the
head of these Proceedings
are the reports of the Gen.
then named, and from
them the Govt. are glad
to learn that the work
is already done, consisting

49
of six groynes on the south
side of the entrance to the
harbour, and two on the
north side near the pro-
montory known as "Ty-
penn point", has produced,
even in its unfinished
state, a most distinct
and satisfactory effect.
Some of these groynes had
been exposed to the full
force of the South West
Monsoon without sustain-
ing any injury, and all of
them being run out into
the sea in such directions
as most effectually to in-
tercept the eroding currents,
and to encourage the forma-
tion of new beach, their ac-
tion has resulted in a ra-
pid extension of the shore
landward as the work pro-
gressed.

The

The original intention was that these groynes should be carried out to a uniform length of 120 feet, but the merchants of Rochin, supported by Mr. Dabrymple, urge that they should be extended to 150 feet. Even this great length is however not deemed sufficient in all cases by Major Shaw Stewart and Mr. Benceford Anderson, the Chief Engineer of the Madras Railway, who, after carefully studying the position and direction of each groyne with reference to the influence it is likely to exert on the littoral current and on the line of beach, recommends that, taking the groynes from south to

to

to north in the order in which they are numbered on the map which is submitted with their report irrespective of their having been begun or only now recommended, No 2 should be prolonged to a length of 200 feet, that Nos 3 and 4, situated in front of the new Light House, should be extended to 300 feet, as also No 7 near the Telegraph Office, and that No 9 at "Vypeen Point" should be carried out to a distance of 600 feet. Further, these gentlemen record their opinion that, as the existence of the opening formed in 1862 between the backwater and the sea called the "Cruz Vilagre Gap" by

al.

allowing the flow of a large volume of water to be diverted from the course it would otherwise take through the Channel forming the entrance of the harbour, has a tendency to weaken the force of the stream on the bar, and, as a consequence, to lessen the depth of water over it, measures should be taken to endeavour to close this gap. With this view they endorse Mr. Dalrymple's suggestion that two groynes should be run out, one from the north and the other from the south side of the opening; and, as a very large quantity of stone will be required to complete these groynes of the dimensions

Con.

54-51
considered to be necessary, Major Sam Stewart and Mr. Herisford Anderson recommended the use of light lines of rails to carry the stone from the points where it must be landed after being brought in boats across the backwater from the quarries, which are situated some 12 miles from Cochin, and those gentlemen point out three convenient landing places where cranes for lifting the stone from the boats should be erected, and from whence the lines of light rails should carry it to the sites of the several groynes.

With respect to the Agency by which the operations should be conducted, the same gentlemen, after

after eulogizing the zeal and energy displayed in the management of the work already done by the Master Attendant of the Port, give it as their opinion that the Public Works Department should be represented at Cochin by the permanent location there of an Officer.

Finally, it is recommended that a Steam Dredge should be attached to the port in order that by its employment on the bar the depth of water might there be increased by at least two feet, which it is confidently expected may be accomplished by a dredge of very moderate power.

insert -
"under the advice of the Secretary to the Dept of Public Works"

N.

I would say
"that the works recommended by the Secretary to Govt. in his memorandum above mentioned has been tried."

A. A.

The Government have perused these reports with much interest, and approve of all the suggestions and recommendations they contain with the exception of the construction of the two groynes marked Nos 15 & 16 at the Cruz Milagre Gap, which His Excellency the Governor in Council thinks may be omitted with another mode, to be mentioned hereafter, for closing the opening has been tried. It is very important that there should be no delay in carrying out to completion all the works that are so satisfactorily shown to be indispensable for the preservation of a port, which, necessary as Cochin is to the trading interests of the Country, is

likely

a likely to be made of still
more value by being selected
as the ocean terminus to
the West of the extensive
Railway System of this
Presidency. The outlay in-
volved in carrying out the
works on the proposed scale
is likely, however, to be
far larger than it will be
possible to meet with funds
provided from the (inade-
quate) ordinary allotment
for the Public Works of this
Presidency, and it will be
necessary to address the
Govt. of India with an
application for a special
grant. To admit of this
being done with success,
it is essential that the
application should be
submitted with the fullest
information, and be
accompanied by plans
and

omit.
N.
A.A.

and estimates in the com-
plete form required by
the Govt. of India. For the
preparation of those plans
and estimates it will be re-
quisite to depute a thoroughly
qualified and experienced
professional Officer of the
Public Works Department
to Cochin, and His Excellency
the Governor in Council
accordingly resolves to select
Mr. ^{J. P. M. M. M. M. M.} ~~J. P. M. M. M. M. M.~~ for this im-
portant duty, and with that
object in view, to direct
that he be temporarily
transferred from the ^{Malabar} ~~Malabar~~ ^{and} ~~Malabar~~
to the Malabar District.

As it would appear
that all apprehension of any
further serious incroach-
ment of the sea at present
is removed by the effect

of what has been done under
the direction of the Master
Attendant, the work at
all the groynes, except the
one at Vypeen point will
be stopped pending the de-
cision of the Govt. of India,
and all expenditure will
be concentrated on that
groyne, which is obviously
the most important of the
series, and on the closing of
the "Cruz Milage Gap",
On which the Government are
satisfied it is absolutely
necessary to stop the pre-
scent the ill effects that
the loss of water through
that opening must sooner
or later have on the scour-
ing force of the current
through the Channel to the
Harbour. These two works
should

54
should be proceeded with
with such funds as may
be made available for them
either in the Marine or
the Public Works Depart-
ment.

As respects the mode
of closing the "Cruz Milage
Gap", (the Govt. doubt whether
the groynes proposed to be
thrown out from either side
of it would produce any
other effect than narrow-
ing the Channel and
causing it to be corre-
spondingly deepened. As the
gap is described to be only
twenty feet in depth, its
closure, the Govt. are led
to believe, (should not be)
a very difficult under-
taking to persons who (have
ever witnessed) the manner
in which breaches in rivers
and

and Channel banks are closed in Tanjore by means of "Modupils", and, in a place like Cochin, where palmfruits, brushwood, and all other requisites abound, His Excellency the Governor in Council would wish a fair trial of this simple and inexpensive method to be made before recourse is had to the expensive and, may be, ineffectual employment of costly stone in the way of groynes.

The question of the provision of a steam dredge will lie over for future consideration.

I don't think there are any palmfruits at Cochin. A. A.

I would say the ports under the immediate jurisdiction of this Secretary to direct and before adopting the more costly expedient of constructing stone piers the simple & inexpensive method of which has been used in river & channel banks are closed.

in Tanjore by means of modupils shall be tried. It is assumed that brushwood & all the requisites for carrying out this process abound at present in the immediate neighbourhood of Cochin. A. A.

and Channel banks are

Cue 4811

Govt. of 1869 Madras.

PUBLIC WORKS.

The Marine Report.

Further Report of 20.4.71

Post

Recd

1.7

11.7.71 No. 153

Nos. 711* 312

Cochin Harbour Paper
orders on papers relative
to the Cochin Harbour, held
on 8th.