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TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

Public Works DEPARTMENT

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

April
4th March 1881, No. 911 W.

Buildings and Roads.
Civil Works.

Read the following papers:—

No. From W. T. HOLMES, Esq., Honorary Secretary, Chamber of Commerce, Cochin, to the Secretary to Government, Public Works Department, dated Cochin, 19th February 1881, No. 87.

REFERRING to the meeting which the members of this Chamber had with you and Captain Taylor, R.N.R., on Saturday the 5th instant, I now, by desire, have the honor to offer the following observations on the various points which you left for further consideration by the Chamber.

2. The first in order is the question whether the floods in the backwater bring down such silt as, depositing outside the entrance, now forms the bar. The Chamber has already expressed a very decided opinion that no such silt is discharged from the backwater, and its opinion on this point was not in any degree shaken by the opposite views expressed at the meeting referred to.

3. At the meeting there were produced by the Chamber two bottles of flood-water taken from the mouth of backwater on the 4th December last. Between that date and the 20th November preceding there had been a fall of upwards of 8 inches of rain over the district between Cochin, Alleppey, and the Travancore hills, and the rivers from the hills being in heavy flood, there was being discharged from the mouth of the backwater an usual monsoon flood.

4. The samples of water which were drawn in the presence of the Master Attendant of the Port were as bright and clear as water can be. A few particles of substance were contained in them, but not sufficient to form the thinnest film over the bottoms of the bottles, or when shaken up to at all cloud or discolor the water. The taste of the water was but slightly brackish, a fact which may be noted as a proof of its being flood-water, for in the absence of floods the backwater becomes salt to a distance of 30 to 35 miles from Cochin.

5. The appearance of this water was not considered by you as at all confirmatory of the Chamber's statement, because (1) you deemed it probable that the silt, being heavy, might not be held in suspension by the waters, but by the strength of the current might be rolled along the bottom of the backwater, and (2) because inside the backwater you had observed along the shore obstructions placed with a view to causing reclamations by deposit of silt.

6. In reply to the first objection, the Chamber begs to observe that such rivers as the Hoogly, Godavari, Cauvery, Indus, and perhaps all other rivers that are known to bear down silt, and, in consequence, to have bars at their mouths, run during flood time in turbid streams which discolor the sea for considerable distances from shore. In like manner run the rivers which discharge into the Cochin backwater.

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7. But the Cochin backwater ranges from 2 to 15 miles in width, and over these broad areas, some of which are from 30 to 50 feet deep, the current is necessarily slow, and in passing them the flood-waters deposit all their silt. If, however, it can be urged that the current over such places is so strong as to roll heavy silt from the bottoms of such deep pools and over steep banks, it must be admitted that it is also strong enough to keep in suspension lighter particles of silt, in which case the flood-waters discharged from the mouth of the Cochin backwater ought to present the appearance of the floods from the rivers which have been referred to. The fact that they do not present such appearance is proof, in the Chamber's opinion, that the objection of rolling silt on the bottom of the backwater is untenable.

8. With reference to the second objection, it may be mentioned that during the monsoon months there is of necessity a wash from the lands on the margin of the backwater, and where there are no protective works there must be some attrition of the shore, regulated by the strength of the current. During flood-tide, too, a certain amount of sand is rolled in from the sea along the shores. These are the materials which form the reclamations referred to, aided by mud excavated by hand from the bottom of other parts of the backwater. In this view, which the Chamber believes to be the correct one, the reclamations lend support to the statement that no silt is discharged from the mouth of the Cochin backwater which, by depositing outside, forms the bar.

9. The next point to be considered is the objection that the construction of the works proposed by the Chamber would not alter the direction and strength of present forces, and that, therefore, the bar must reform, the time required for it to do so being regulated by the length of the breakwaters.

10. The Chamber is not prepared to allow that, with groynes thrown out to the length and depth contemplated, the present forces will remain unaltered. The bar is now formed and reformed by sand forced into mechanical suspension in the water owing to the action of the surf on the coast, and then being carried by the littoral current across the backwaters' mouth where, meeting with opposing currents, the sand is at once deposited. This being so, the groynes once prolonged beyond the effect of the surf on the bottom, the reforming action becomes, at any rate for a time, impossible.

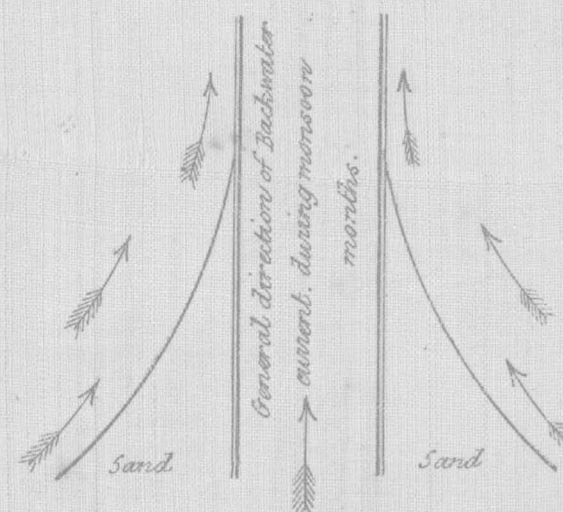
Mr. Robertson says, page 31 of his report:—"Were the current to be kept together in full strength till it got into such a depth of water that the action of the waves was not sufficiently powerful to stir up the bottom there would be no decided bar."

11. If it be urged that the littoral currents would still bring up the sand and deposit it north and south of the groynes, increasing the breadth of the beach until the profile of the coast extended to the sea end of the groynes, and would there reform a bar, the Chamber submits that such action must be the work of a great length of time; that the coasts north and south would have to be eroded to an unprecedented extent before the materials could be obtained for such an extensive filling in; and these coasts are protected for some distance by the small groynes already in existence. Again, the bottom of the sea is nothing but mud, and could lend no material for the purpose.

12. The same action around the Madras Harbour Works has been estimated, the Chamber believes, to require about two hundred years; and at Cochin, where there is a slower littoral current and the proposed groynes longer, an equal time may be necessary, even though the depth of water be less.

13. Moreover, supposing this filling in to have taken place, the profile of the coast would then be altogether different to what it now is, for it would exhibit two tolerably sharp curves along the contour of which the littoral currents would be forced to sweep, and the sand which they would carry would be deposited, not in a line running at nearly right angles to the scour in and out of the river, but into lines which, with the assistance of that scour, would form for a long distance prolongations

of the groynes, and thus assist and not obstruct the endeavours to form a good harbour.



14. The common belief that the mud banks of Narrakal and Alleppey have been the work of rivers depositing their silt at these places is, the Chamber thinks, erroneous; as far as Alleppey is concerned, it has no river near it.

15. It is a well known fact that the bottom of most of the Cochin extensive backwaters is a deep bed of mud, similar in every respect to the mud composing the banks at Alleppey and Narrakal. It is also a pretty well ascertained fact that the strip of sand which separates the backwaters from the sea was a long distance further to the west than it now is, and that the sea has encroached. Nothing, therefore, is more likely than that the mud

banks of those two places were once bottoms of backwaters.

16. Some stress was laid on what was said to be a fact that in no part of the world had bars to rivers been got rid of. But the Chamber does not consider this to be an overwhelming argument against the proposed works for Cochin, for in the case of this port the circumstances to be dealt with are not such as are met with in other parts of the world. Cochin is an exception in many ways to every thing met with elsewhere—

- 1st. Cochin has no river strictly speaking, but only an opening from the backwaters to the sea.
- 2nd. The extent of backwater which has to be filled and emptied every tide is altogether unprecedented, thereby giving an impetus to the ebb and flood unknown elsewhere.
- 3rd. No ascertainable silt is deposited.
- 4th. The bottom of the sea is mud, not sand.
- 5th. Cochin has both to the north and south a safe anchoring ground in smooth water for vessels in case of weather so bad as to make it unwise to risk an entry into the harbour.
- 6th. The wind during bad weather is invariably fair for ships entering the harbour.
- 7th. Cyclones are absolutely unknown.

17. The Chamber, in its letter of 25th November 1880, No. 75, paragraph 16, estimated that about one-third of the trade of the port is conducted inside the mouth of the backwater, and allowed for the less lighterage such trade has to bear in the average of the lighterage paid on the whole trade of the port. The one-third includes both British and native trade, whether carried in British or native craft. The native craft, being of small tonnage, is able to come close in shore, and so to a large extent incurs much reduced lighterage, but the number of such vessels is rapidly diminish-

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ing owing to their inability to compete with the coasting steamers, and it is only a matter of a few years when the native carrying trade between all ports visited by steamers will practically have ceased to exist. The following figures warrant this anticipation:—

Native vessels frequenting the port of Cochin—

	No.	Tonnage.	Port Dues.
1876-77	863	45,224	4,234
1877-78	736	34,815	3,263
1878-79	741	35,010	3,282
1879-80	496	25,060	2,347

These vessels never venture to sea during monsoon weather, say, for five months in the year.

18. The Chamber is having prepared a statement of the value of the trade carried by this class of vessels during the past two years as compared with the total value of the trade of the port, which, when completed, will be forwarded to you.

19. A meeting of native merchants was convened by the Chamber on the 11th instant, when the Chamber's proposals to Government were formally laid before them for expression of their opinion thereon. To the most influential of the body the proposals had been fully explained some days previously, and they were requested to give them every publicity in the bazaar. At the meeting the following resolution was passed, and a certified copy of the proceedings is attached hereto:—

"Having had explained to us the details of the scheme for the improvement of the Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the native mercantile community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the native mercantile community in this matter can be safely left in the hands of the Chamber of Commerce."

20. In considering the claims of the respective interests, European and native, on Government in connection with the proposals for harbour improvement, it should be borne in mind that only few of the principal native merchants of Cochin reside and carry on business in British territory. The majority are subjects of the Native State of Cochin, and whilst enjoying all the advantages of a British port for their sea-borne trade, the opportunities for trade opened out by British enterprise, and, in fact, owing their whole prosperity as traders to their contiguity to a body of British merchants, contribute but little to the Imperial Revenues of India. On these grounds, if their views had been antagonistic to the proposals put forward for the improvement of the port, the Chamber would have been prepared to urge the prior claims of the interests of British subjects over those of a foreign State on the consideration of the British Government. Native merchants, however, have recognized that their interests are identical with those of British merchants in the Chamber's proposals.

21. The extra charge of one anna per ton proposed to be levied on vessels visiting the port ought to be specially assigned to the port, even though there be no change in the grouping of western ports. All that the Chamber has to propose is that the earnings of the port be applied to its improvement, and arrangements to effect this would seem a matter of account and not difficult.

22. In the present system of grouping the ports on this coast it does not follow that the amount of port dues collected in Cochin represents more than its proper earnings. Coasting vessels do not always pay their port dues in Cochin. Having paid the dues here once, the next time they become payable the vessel may be at any one of the other ports of the group, and there they are levied. Each port has its chance.

23. Whether the trade of the port can provide not only interest on the cost of construction, but also cost of maintenance of works and allowances to establishment,

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the Chamber cannot say, not having an estimate of the capital required. The Chamber has shown, on an average of the trade of the port for ten years, about what the port can now provide, and there is reason to believe that such improvements as have been proposed would increase the trade and also the revenue. On the figures which have been furnished it is for Government to decide, after obtaining estimate of cost, whether the trade can bear all the charges referred to.

24. But supposing the estimated revenue falls short of the required sum, the Chamber would urge that, as the proposals they have made merit the attention of Government from an Imperial point of view, Imperial Revenues should be charged with the deficiency, which it is anticipated cannot be large.

25. The Chamber in putting its views before Government do so in what is believed to be the interests of the port and the whole mercantile community. But at the same time cannot fail to notice the fact that the harbour improvements advocated, while benefiting the local trade, would also be of essential importance to the whole of South India, connected with it as the port is likely soon to be by rail.

26. In case of war with a naval power such a land-locked harbour, centrically situated between Bombay and Trincomallee, would be of inestimable value as a harbour of refuge where ships could repair and refit, and as a resort for our ships of war; and its nearness to Aden, being about two days nearer than Bombay by homeward bound steamer routes during monsoon months, points it out as a port possessing every capability for becoming of very considerable importance.

27. The Chamber had not had an opportunity of perusing Mr. Robertson's report on the port prior to your visit, and the copy kindly lent by Captain Taylor has been read with considerable interest. The favorable opinion of such an authority, the Chamber trusts, will have great weight with Government, and lead them, before deciding against the Chamber's schemes, to appoint a practical expert to inspect and report, if further report is thought necessary. If Mr. Parkes or Mr. Thorowgood of the Madras Harbour Works could be deputed to this duty, he would be able to make an approximate estimate of cost, and his practical experience would enable him to put a true value on the objections raised and the arguments used to overrule them. He would be able to properly estimate the great advantages of the port and suggest the best means of making the most of them.

28. Steps are being taken to obtain the views of Commanders of vessels visiting the port on the points on which a nautical opinion is desired, and the opinions which may be received will be forwarded to you.

Proceedings of a Meeting of European and Native Merchants of Cochin held in the Office of the Municipal Commissioners of Cochin on the 11th February 1881 to consider the interests of the Native Mercantile Community in the proposals made to Government by the Local Chamber of Commerce for the improvement of the Harbour of Cochin.

PRESENT:

G. BRUNTON, Esq., in the Chair.

J. H. ASPINWALL, Esq.
W. T. HOLMES, Esq.
G. A. JUNG, Esq.
O. M. RAPHAELS, Esq.
J. R. OUGHTERSON, Esq.
VEERJEE KANJEE, Esq. (Mooljee Jattah and Co.)
HASSARY DEVJEE, Esq. (Samjee Padomsee and Co.)
HADJEE MOOSAH HAJI HAMED, Esq.
DAMJEE RAMJEE, Esq. (Damjee Oookah and Co.)
MALJEE KASAVAJEE, Esq.
VISHNOO KASAVA SAMPLA, Esq.

JENARDINA GOVINDA GOKET, Esq. (Vishnoo Denaka Devada.)
PUNDALING RAMJEE, Esq.
HARRI VASODEVA PERBOO, Esq.
LECKMENA BABAJEE, Esq.
OPENDRA SHETTY GANAPATHY, Esq.
RAMACHENDRA MAHA DEVA, Esq.
T. V. PEECHOO PUTTER, Esq.
DHARSEE KETSEE, Esq.
C. A. PERREIRA, Esq.
P. VIETRA, Esq.
G. LAFRENAIS, Esq.

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The Chairman explained the details of the Chamber's proposals for harbour improvements, and invited any gentlemen wishing for further information to inquire for it; after some discussion it was proposed, in behalf of the Native mercantile community, by Mr. Hadjee Moosah Haji Hamed, and seconded by Mr. Veerjee Kanjee, that—

"Having had explained to us the details of the scheme for the improvement of Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the Native mercantile community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the Native mercantile community in this matter can be safely left in the hands of the chamber of Commerce."

The resolution on being put to the meeting was carried unanimously.

(Signed) G. BRUNTON,
Chairman.

REPORT ON THE COCHIN HARBOUR.

In compliance with the decision of Government conveyed in G.O. of 27th December 1880, No. 2,943 W., we, the undersigned, inspected the Cochin Harbour on the 4th and 5th instant, and on the latter date had the advantage of a very complete discussion of the several points at issue with the Chamber of Commerce, several of the leading native merchants being also present on the occasion.

2. Prior to our arrival the Chamber of Commerce had submitted their letter, G.O., No. 222 W., dated 26th January 1881. No. 81,* dated 20th January 1881, combating the views put forward by the Master Attendant in his letter of the 16th December 1880, No. 11,132, printed with the previously quoted Government Order, and again they have in a still later communication explained very fully their views in the Honorary Secretary's letter, No. 87, dated 17th instant, dealing with some of the most important points discussed in the conference of the 5th instant.

3. Unfortunately Commander A. D. Taylor, whose presence was specially desired by Government, and whose advice would have been most useful to us, was unavoidably detained in Calcutta. He has, however, telegraphed to the Master Attendant expressing general concurrence with his views regarding the Cochin Harbour.

4. On the whole, we believe that we have obtained a sufficient knowledge of the locality, and of the views of those who are most interested in the question of a harbour, to indicate the points on which future discussion must hinge, and thus at least narrow the issues in a way that will enable Government to obtain the opinion of experts like Commander A. D. Taylor in this country, and, if necessary, of professional men in England, before committing themselves to a final decision.

5. The previous printed reports, as also that by Mr. George Robertson in 1871, will have already sufficiently explained the physical features of the present port of Cochin and its exceptionally large backwater; we shall, therefore, at once proceed to state the facts that have come under our notice as bearing upon the question of the proposed harbour, and the inferences we have drawn there from.

6. On the morning of the 4th February 1881 we found two vessels anchored, as stated to us by the Port Officer, at not a less distance than $1\frac{1}{4}$ miles west of the bar, which again was not less than 1,300 yards in a direct westerly direction from Light-house point.

7. Our own small steamer, the *Margaret Northcote*, anchored 1 mile west of the bar, apparently just at the limit of the 5-fathom contour, as the soundings taken in proceeding inwards towards the bar clearly indicated.

8. The buoys at north and south ends of the bar showed it to be 385 yards in length, the water shoaling sensibly beyond this limit on either side. At half tide the minimum depth of water was found by us to be 14 feet or somewhat less than 13 feet at low water.

9. The last monsoon being of more than usual strength the bar seems to have been forced back 200 yards closer to the shore than during the previous year, when it

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was 1,500 yards west of Lighthouse point, and seems to have had a minimum depth in it of 16 feet.

10. Mr. Robertson, it will be observed, found only 11 feet on the bar, but as the Cruz Milagre Gap was then open, this may be considered as less than what may be fairly calculated on in ordinary seasons; but it must be borne in mind that very extensive reclamations have for a long time been in progress in the Cochin backwater, and as the area over which the flood tide has to spread is thus being gradually, though probably not as yet very sensibly, contracted, the volume of water poured out at the mouth has a tendency to be decreased, and with this decrement, both the velocity and scouring power must diminish. It must also be borne in mind that the whole of the backwaters being within native territory, the influence of the Madras Government in limiting or controlling the reclamations can at best be only indirect. These facts must have weight in deciding on any harbour scheme that may be devised.

11. Immediately on the bar we found the material brought up by a diver to consist of rather coarse sand and shells, but there is nothing here or in any of the surrounding country to indicate that laterite or any kind of rock underlies the bar at a depth that would call for removal. Outside to seaward there would appear to be mud in a very fine state of comminution not unlike that found at Narrakal to the north. This may, as supposed by the Chamber of Commerce, have anciently been a backwater though there is every reason to suppose that it also consists or has been added to by the continued though yearly small deposits of silt carried over the bar in the height of the monsoon.

12. North and south of the general run of the deep channel, between the actual mouth and the bar, the shoals, though necessarily varying somewhat in contour from time to time, continue pretty constant in extent and position, and, so far as we are able to judge, there is apparently no tendency for the effluent water to take any other direction or establish a new channel. The narrow channel adverted to by the Chamber of Commerce as passing in front of the long groyne at Vypeen point, and stated to be sometimes used for boats, is, we find, merely trifling excavation due to the swirl of the ebb water at the spot, and only to extend a few yards. Its existence can have no bearing on the question of a harbour.

13. There are seven long and one short groynes at intervals along the beach on the south side of the mouth (the Cochin side), and one long and nine short groynes on the Vypeen side. With the exception of the long one above mentioned (which rather requires looking after as it is not in good repair) they seem to have done the work fairly in correcting encroachment, but call for no remark in reference to the object of our immediate inquiry.

14. The pot-hole shown on all charts to exist within the immediate limits of the mouth, ranging from 28 to 48 feet in depth, still appears to exist in much the same form as in previous years, though possibly the actual line of deep channel here may vary a little. Holes of this character, due no doubt to down or reflex currents which are found to exist in all cases of obstruction like a bar to the effluent water (in bridge piers, &c.), are apparently very constant in all similar cases along the coast. Mr. Robertson notices the deep pot-hole which was found at the Cruz Milagre Gap while there was a bar outside with only 2 feet of water on it. Numberless other similar instances can be adduced, and we are satisfied that no arguments based on such facts, as the existence of holes of this character, can have any bearing on the feasibility or otherwise of forming a harbour. They are directly produced by the bar in front, and were this latter removed there would, in our opinion, be no down or reflex currents tending to form such holes, which consequently would in that case fill up to the uniform level of the bed throughout.

15. We now come to deal with the proposals put forward for the formation of a first-class harbour, and in regard to this we may at once say that the chief result of the conference held at Cochin on the 5th instant, has been the recognition of all concerned, as to the necessity which exists for carrying out any breakwaters that may be constructed, (with a view to confining the ebb stream and sweeping away the bar) into a depth 5 fathoms, it being clear that under no other conditions could it be expected

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the value of the harbour as one of refuge. Again all shipping inside the harbour as proposed would be exposed to the full force of these rollers, and the anchorage or wharfage be in consequence rendered extremely inconvenient if not unsafe.

(3) From the manner in which the breakwaters are proposed to be carried out we consider that no future dredging of any practical value would be possible.

22. In dealing with the first of the above difficulties, it may be as well at once to say that too much stress has been laid by the Chamber of Commerce, on the supposed formation of the bar as being directly caused by the deposit of silt brought down by the river.

23. No weight has ever been laid by us on this point which only incidentally cropped up in reference to Vizagapatam, (the Government Order connected with which was communicated to the Chamber of Commerce for general information only prior to our visit), the conditions of which are different, as it has a river often necessarily charged with silt discharging through the mouth.

24. No doubt the great Cochin backwater does act as a very complete settling bed for silt as urged by the Chamber of Commerce, but it cannot do so wholly, and we are unable to admit the argument employed by them as to the formation of the present reclamations inside the backwater, being due to sand carried in from the sea as stated with the flood tide. The ebb tide assisted by river freshets especially during the monsoon, must of necessity be a much more powerful agent for moving all matters in suspension (as being greater in volume and velocity) than the flood tide, and to suppose that more material is carried into the backwater, than is discharged from it, is opposed to all physical laws.

25. It is not, however, necessary to pursue this subject further. So far as the actual formation of the bar at Cochin is concerned, this factor may be entirely omitted, as the existence of this, like every other bar here and elsewhere in all parts of the world, is mainly, if not entirely, due to the action of the surf.

Mr. Robertson observes with reference to this that "the surf is always striving to restore the natural profile of conservancy of the shore. After the current has flowed out to sea for nearly a mile, it is no longer able to resist and keep down the ever working and powerful efforts of the waves to reform the profile of the coast, by continuing the beach line which has broken through the outgoing current."

26. In a paper by Mr. I. J. Mann, C.E., it is shown that while this statement would meet with very general acceptance of all professional men, the explanation of the causes leading to the establishment of bars has been various. It is, however, needless to advert to more than one of the various authorities on this subject, viz., Mr. D. Stevenson, who attributes the formation of all such bars solely to the action of the sea. "The waves" he observes, as is well known, throw up "a girdle of light or heavy material * * round every bay and headland of our (English) coast, and the entrances to rivers form no exception. The effect of this constant action of the sea is to form a continuous line of beach across the mouths of our tidal rivers and inlets." He does not appear to attach any importance to river currents as agents in the production of bars, observing that "a bar would be formed *although the outgoing current held not one particle of matter in suspension.*"

27. It only requires a glance at any good chart, exhibiting in detail the *debouchures* of all our rivers along both east and west coast on this Presidency to show that, wherever the shore is made up of sand or easily moved material, and is unconfined by rock or other obstruction, the tendency always is for rivers on approaching the coast to turn suddenly to the north, and often not for miles find an exit to the sea. This as well known is due to the superior power of the south-west monsoon which by induced sea currents, driving the sand before it below the surface, and by the wind acting on all exposed sand above, advances the sand-spit at the mouth further and further northward till a certain point is reached, when the river bursts out again south and the advance northward recommences.

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28. In Mangalore we have lately been able to show that the movement northward of the river mouth due to this action, has apparently been pretty steady at the rate of 300 feet per annum during the last 54 years. But without multiplying instances it will probably suffice to note, as now clearly established—

1st,—that whether the effluent stream contains material in suspension or not, the tendency is for a bar to be formed, wherever the forces of the surf on one side and the stream on the other sufficiently neutralize each other;

2nd,—that the sand forming such bar is carried chiefly from south to north across the line of the normal direction of the debouching river. The contention of the Chamber of Commerce, in paragraph 13 of their letter No. 87 of the 19th instant, that "the currents and deposits at the ends of the proposed groynes would thus assist and not obstruct the endeavours to form a good harbour" is therefore in our opinion not borne out by the facts as now explained.

29. It may, of course, be fairly contended that there is a certain depth below the surface at which the wave action is *nil*, and there is no sensible amount of sand in movement at such depth. This is practically the contention of the Chamber of Commerce, and it is at first sight supported by the following observation of Mr. Robertson to warrant consideration, viz., that "were the current kept together in full strength till it got into such a depth of water that the action of the waves was not sufficiently powerful to stir up the bottom, there would be no decided bar."

30. Mr. Robertson does not, it will be noted, say at what depth of water such action may be expected to cease, and in the plan he proposes for a harbour at Cochin he evidently considers that the groynes suggested would not reach this undisturbed depth, as he observes that "a little dredging or raking" will be needed to preserve the depth of channel. (In connection with this remark it may be parenthetically observed that Mr. Robertson considered that the effect of the works suggested by himself would only secure a depth of from 20 to 21 feet at low water, which it is unnecessary to say would be wholly insufficient for a first-class harbour.)

31. Without a series of very carefully conducted experiments, it would be impossible to decide this point in a manner sufficiently conclusive to satisfy every one, but in the paper before adverted to by Mr. Mann, there is a good deal of evidence to show that wave action is felt at depths hitherto apparently unsuspected.

32. Without overburthening our report with quotations, it may be sufficient to say that among the evidence adduced, it seems that on the banks of Newfoundland the agitation during storms has been known to affect the bottom at a depth of over 80 fathoms; at St. Jean de Luz in the Bay of Biscay over 160 fathoms; and at Land End the lobster traps are frequently filled with coarse sand and shingle during heavy ground swells in depths of 30 fathoms. Sir G. Airey mentions also that ground swells frequently break in a depth of 100 fathoms.

33. We do not wish it for a moment to be understood that looking to the general character of the seasons on the west coast, and the immunity which it appears to enjoy from cyclones, that disturbance may be expected at depths such as these; but accepting the fact that the south-west monsoon sets in at times with considerable abruptness and strength, we are not prepared to say that in such occasions the sea bottom is not agitated at 5 fathoms in depth. In fact we incline to the opinion that unless there be some very direct proof to the contrary, such may be accepted as almost certain to be the case, especially considering the very shelving character of the west coast, which in this respect differs materially from that found near Madras, and most of the east coast, and that it would therefore behove Government to hesitate in adopting a scheme which, perhaps a single season of an unusually heavy monsoon, might render nugatory.

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34. Dredging, as we shall presently show, is not apparently available for deepening channels situated like the one proposed with mouth open to the sea and exposed to swell; consequently if it be desired to give a prolonged life to the harbour with works of this character, it would be desirable not to stop the groynes in 5 fathoms, but to run them out another half a mile into $7\frac{1}{2}$ fathoms (which is the same as that adopted for the Madras harbour) as the best available expedient.

35. We now beg to turn to the second set of difficulties which has presented itself to us, viz., those which would probably be felt by every master of a vessel, approaching a harbour of the proposed character during the south-west monsoon, or in fact at any time when there was a heavy sea and wind.

36. It will be remembered that the essence of the proposed scheme is to preserve an uniform section of channel into deep water, so as to maintain, as far as possible, intact the scouring power of the effluent water, and keep the whole as clear as possible of deposits. However the direction of the groynes might be varied, this must in the main be the guiding principle so as to sustain the validity of the grounds on which the scheme is based.

37. But if this be so, there must be an exposed mouth and a long channel up which the seas must sweep with uninterrupted swing, till they gradually die away or become dispersed by the shoals of the backwater, at the extreme east end of the harbour. Mr. Robertson clearly indicates this difficulty, when he observes that, "it must be remembered that in reducing a bar we take away a kind of breakwater in front of an entrance and introduce a bigger wave."

38. A strong opinion has already been expressed by the Master Attendant on this point, and statements have reached us of the extreme difficulties and dangers which comparatively small craft have experienced in approaching the present mouth of the port in the monsoon, though having plenty of sea room to work in and able by their small draught to double sharp round to south-east end of the channel, after passing through the mouth and bring up in a perfectly sheltered anchorage, none of which advantages would be open to large vessels entering the harbour under the proposed scheme.

39. As directly bearing on this point, we would now quote the following observations from a report by Commander A. Dundas Taylor in reference to the proposed ship canal between Ceylon and India, dated 28th July 1871, viz., "To examine the sea approaches and thus to determine the accessibility of a port, is a first essential, and comes within the province of the Marine Surveyor. A glance at the plan which exhibits the sites of all proposed schemes (for Pámban) will explain how unreasonable would be the tax upon a Master Mariner's skill, in seamanship and navigation, when attempting to enter either of the openings, which were submitted to the consideration of the Parliamentary Committee * * * I am convinced that mishaps would have attended any attempt to shoot the canal's mouth when the monsoon swell and current accompanied the steamer."

40. It is needless to say that the dangers thus foreseen with reference to Pámban, would have equally to be counted on and disposed of, in dealing with any harbour scheme for Cochin.

41. The third and last difficulty as to the impossibility of carrying out satisfactorily dredging operations, in a channel exposed to heavy swell, is more easily disposed of. No dredge so far as we are aware has yet been devised for working satisfactorily in such positions. With all the adjustments that it may be possible to make, any sudden jerky movements in the vessel must communicate themselves to the bucket ladder, and produce strains which would very soon break up the strongest framing of this character. On a few quite still days, aggregating say six weeks in the year, a dredge like the Albuquerque might work, but it must be obvious that this would go but a small way to meet the requirements of the case. The Albuquerque dredge with her side anchors and cables would moreover by herself take up 800 feet in width of the channel when at work and thus seriously impede traffic.

42. After the foregoing exposition of our views, which owing to the very able manner in which the Chamber of Commerce have stated their case, we have found it desirable to detail at greater length than might under other circumstances have appeared necessary, it is needless to say that personally we feel ourselves unable to recommend the scheme put forward by that body, and that consequently it is at least at this stage unnecessary to go into any of the engineering details.

43. It does not, however, necessarily follow that the rejection of this particular scheme would invalidate all others. We are given generally to understand for instance that Mr. Parkes is under the impression from the papers sent him by the Chamber of Commerce, that a plan by which the bar might be sheltered and then removed by dredging, somewhat in the same way as in his Kurrachee harbour, might be feasible; and although it would probably take some time to mature a scheme of this nature, we are not prepared to say that with abundant means at disposal, a harbour based on this principle might not have a good deal to recommend it. The general principle whether applied in the form of a detached breakwater entirely shielding the bar from the action of the surf or otherwise, has certainly more to recommend it than the one we have been considering, though the latter might under certain conditions be either wholly or in part incorporated with it.

44. All we are now concerned with however is whether with this new light on the subject, it would be desirable to have the details of the scheme worked out by Mr. Parkes.

45. It can hardly be questioned that the cost of constructing such a breakwater out to sea as would admit of the bar being entirely sheltered, and of the whole of the stuff being dredged out (this would be by far the cheapest part of the operations) must of anything be greater than what we have before named as likely to be required in the scheme we have been obliged to condemn.

46. The question again therefore arises as to whether any Provincial or Imperial subsidy can be looked for in aid of the local resources, which would certainly be insufficient for the execution of a project of the kind. The Chamber of Commerce urge strongly their claims for a subsidy of this character, and in the late minute by the Honorable Sir Andrew Clarke, the necessity of creating a certain number of harbours of refuge along our shores, to meet the exigencies of war have been seriously pressed on the attention of the Government of India. It appears to us, however, that it would be exceedingly difficult to render an open place like Cochin defensible against an enemy's vessels, which stealing in sufficiently close at night could easily injure the place without running much risk themselves. Trincomalee is in fact so far as we are aware the only harbour between Bombay and Calcutta which naturally lends itself to such an object, and which would be at once perfectly secure and easy of access.

47. We can only therefore say that if the Government, after weighing what we have advanced, still consider these claims sufficiently well founded, and there be any probability that they will be recognized by the Government of India, it would be difficult to find a more able professional Harbour Engineer for drawing up a complete scheme, and framing an estimate of the probable cost, than Mr. Parkes.

48. There would in our opinion be no sufficient object gained in going minutely into a discussion of ways and means for meeting interest on outlay, at this stage of the enquiry especially as under the proposals put forward by the Chamber of Commerce in the letters printed with G.O., 27th December 1880, No. 2,943 W., there are several points involving not a little complexity, regarding which our information is incomplete.

49. We took advantage of our visit to Cochin to inspect the singular mud bank at Narrakal, situated some 6 miles to the north, and which for the last few years has been used by the merchants for shipping and landing goods throughout the monsoon.

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50. There is backwater all the way to within a quarter of a mile of Narrakal, where the Cochin Government have cut a boat canal across the sand-spit separating it from the sea, and constructed a covered passage with tramway from this close up to the beach, as also a small landing pier. The very serviceable condition of this latter work after three years wear and tear, shows that at least in that period there have been no heavy seas at this point.

51. The bank consisting of the very finest mud (of a greenish black color and very unctious to the touch) seems so far as can be ascertained to extend about three miles along the shore from south to north, and $4\frac{1}{2}$ miles out to sea. It has not apparently shifted its position as seems to have been the case with other similar banks, notably that which though known to have been at Alleppy some 20 years ago, has apparently moved 7 miles south to Porcad, and is still believed to be progressing gradually to the south.

52. The effect of the bank on the portion of sea covering it is singular, as at the first burst of the monsoon there is said to be the same surf as in other parts of the coast; the water is discolored and dark with the churned up mud. But after this stage has passed this seems to settle down and becomes clear like the rest of the neighbouring sea. Some persons consider the surface has an oily look at this time, and others that air bubbles stems and branches of apparently submerged trees rise to the surface, &c., but of none of these statements is there any distinct proof.

53. What, however, appears certain is, that the full characteristics of this tract in providing a perfectly quiet anchorage during the monsoon are not fully developed till the monsoon has sufficiently advanced to render the water in the backwater on the land side quite fresh, and that during this period the water on the bank out to sea is also so fresh, as to lead to the conclusion that such water at this time rises from the bottom under pressure.

54. The effects, however, are that the monsoon swell gradually subsides over the outer limits of the bank and vessels are thus enabled to run into comparatively quite still water at the height of the monsoon, thus providing Cochin with an unrivalled harbour during this period. So far as can be ascertained, no surf breaks along the margins of the bank; the seas merely die away.

55. There can of course be no question that there are a number of serious drawbacks to trade conducted in this manner, and that merchants suffer considerably by losses of goods exposed in the canal boats, and by fraud and carelessness on the part of the boatmen, but the fact remains that they are able to carry on trade at this period when all other west coast ports (except Porcad) are closed.

56. As considerable interest attaches to the conditions under which the mud banks alluded to exist on the coast, it is to be hoped that Mr. W. King, Assistant Superintendent, Geological Survey of India, who joined us, and secured some specimens of the mud for analysis, may be enabled to follow up the inquiry.

57. A chart giving general information about the Cochin anchorage and port, and also showing sufficiently the proposed scheme for a first-class harbour accompanies this report for facility of reference.

R. H. Sankar

Colonel, R.E.,
Chief Engineer, P.W.D.

R. N. R.
Lieut., R.N.R.,
Master Attendant.

MADRAS,
23th February 1881.

GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

4th April 1881, No. 912 W.

Buildings and Roads.
Civil Works.

Read the following paper:—

No. 15. From W. T. HOLMES, Esq., Honorary Secretary, Chamber of Commerce, Cochin, to the Secretary to Government, Public Works Department, dated Cochin, 19th February 1881, No. 87.

REFERRING to the meeting which the members of this Chamber had with you and Captain Taylor, R.N.R., on Saturday the 5th instant, I now, by desire, have the honor to offer the following observations on the various points which you left for further consideration by the Chamber.

2. The first in order is the question whether the floods in the backwater bring down such silt as, depositing outside the entrance, now forms the bar. The Chamber has already expressed a very decided opinion that no such silt is discharged from the backwater, and its opinion on this point was not in any degree shaken by the opposite views expressed at the meeting referred to.

3. At the meeting there were produced by the Chamber two bottles of flood-water taken from the mouth of backwater on the 4th December last. Between that date and the 20th November preceding there had been a fall of upwards of 8 inches of rain over the district between Cochin, Alleppey, and the Travancore hills, and the rivers from the hills being in heavy flood, there was being discharged from the mouth of the backwater an usual monsoon flood.

4. The samples of water which were drawn in the presence of the Master Attendant of the Port were as bright and clear as water can be. A few particles of substance were contained in them, but not sufficient to form the thinnest film over the bottoms of the bottles, or when shaken up to at all cloud or discolor the water. The taste of the water was but slightly brackish, a fact which may be noted as a proof of its being flood-water, for in the absence of floods the backwater becomes salt to a distance of 30 to 35 miles from Cochin.

5. The appearance of this water was not considered by you as at all confirmatory of the Chamber's statement, because (1) you deemed it probable that the silt, being heavy, might not be held in suspension by the waters, but by the strength of the current might be rolled along the bottom of the backwater, and (2) because inside the backwater you had observed along the shore obstructions placed with a view to causing reclamations by deposit of silt.

6. In reply to the first objection, the Chamber begs to observe that such rivers as the Hoogly, Godavari, Cauvery, Indus, and perhaps all other rivers that are known to bear down silt, and, in consequence, to have bars at their mouths, run during flood time in turbid streams which discolor the sea for considerable distances from shore. In like manner run the rivers which discharge into the Cochin backwater.

7. But the Cochin backwater ranges from 2 to 15 miles in width, and over these broad areas, some of which are from 30 to 50 feet deep, the current is necessarily slow, and in passing them the flood-waters deposit all their silt. If, however, it can be urged that the current over such places is so strong as to roll heavy silt from the bottoms of such deep pools and over steep banks, it must be admitted that it is also strong enough to keep in suspension lighter particles of silt, in which case the flood-waters discharged from the mouth of the Cochin backwater ought to present the appearance of the floods from the rivers which have been referred to. The fact that they do not present such appearance is proof, in the Chamber's opinion, that the objection of rolling silt on the bottom of the backwater is untenable.

8. With reference to the second objection, it may be mentioned that during the monsoon months there is of necessity a wash from the lands on the margin of the backwater, and where there are no protective works there must be some attrition of the shore, regulated by the strength of the current. During flood-tide, too, a certain amount of sand is rolled in from the sea along the shores. These are the materials which form the reclamations referred to, aided by mud excavated by hand from the bottom of other parts of the backwater. In this view, which the Chamber believes to

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State of Cochin, and whilst enjoying all the advantages of a British port for their sea-borne trade, the opportunities for trade opened out by British enterprise, and, in fact, owing their whole prosperity as traders to their contiguity to a body of British merchants, contribute but little to the Imperial Revenues of India. On these grounds, if their views had been antagonistic to the proposals put forward for the improvement of the port, the Chamber would have been prepared to urge the prior claims of the interests of British subjects over those of a foreign State on the consideration of the British Government. Native merchants, however, have recognized that their interests are identical with those of British merchants in the Chamber's proposals.

21. The extra charge of one anna per ton proposed to be levied on vessels visiting the port ought to be specially assigned to the port, even though there be no change in the grouping of western ports. All that the Chamber has to propose is that the earnings of the port be applied to its improvement, and arrangements to effect this would seem a matter of account and not difficult.

22. In the present system of grouping the ports on this coast it does not follow that the amount of port dues collected in Cochin represents more than its proper earnings. Coasting vessels do not always pay their port dues in Cochin. Having paid the dues here once, the next time they become payable the vessel may be at any one of the other ports of the group, and there they are levied. Each port has its chance.

23. Whether the trade of the port can provide not only interest on the cost of construction, but also cost of maintenance of works and allowances to establishment, the Chamber cannot say, not having an estimate of the capital required. The Chamber has shown, on an average of the trade of the port for ten years, about what the port can now provide, and there is reason to believe that such improvements as have been proposed would increase the trade and also the revenue. On the figures which have been furnished it is for Government to decide, after obtaining estimate of cost, whether the trade can bear all the charges referred to.

24. But supposing the estimated revenue falls short of the required sum, the Chamber would urge that, as the proposals they have made merit the attention of Government from an Imperial point of view, Imperial Revenues should be charged with the deficiency, which it is anticipated cannot be large.

25. The Chamber in putting its views before Government do so in what is believed to be the interests of the port and the whole mercantile community. But at the same time cannot fail to notice the fact that the harbour improvements advocated, while benefiting the local trade, would also be of essential importance to the whole of South India, connected with it as the port is likely soon to be by rail.

26. In case of war with a naval power such a land-locked harbour, centrically situated between Bombay and Trincomallee, would be of inestimable value as a harbour of refuge where ships could repair and refit, and as a resort for our ships of war; and its nearness to Aden, being about two days nearer than Bombay by homeward bound steamer routes during monsoon months, points it out as a port possessing every capability for becoming of very considerable importance.

27. The Chamber had not had an opportunity of perusing Mr. Robertson's report on the port prior to your visit, and the copy kindly lent by Captain Taylor has been read with considerable interest. The favorable opinion of such an authority, the Chamber trusts, will have great weight with Government, and lead them, before deciding against the Chamber's schemes, to appoint a practical expert to inspect and report, if further report is thought necessary. If Mr. Parkes or Mr. Thorowgood of the Madras Harbour Works could be deputed to this duty, he would be able to make an approximate estimate of cost, and his practical experience would enable him to put a true value on the objections raised and the arguments used to overrule them. He would be able to properly estimate the great advantages of the port and suggest the best means of making the most of them.

28. Steps are being taken to obtain the views of Commanders of vessels visiting the port on the points on which a nautical opinion is desired, and the opinions which may be received will be forwarded to you.

Proceedings of a Meeting of European and Native Merchants of Cochin held in the Office of the Municipal Commissioners of Cochin on the 11th February 1881 to consider the interests of the Native Mercantile Community in the proposals made to Government by the Local Chamber of Commerce for the improvement of the Harbour of Cochin.

PRESENT:

G. BRUNTON, Esq., in the Chair.

J. H. ASPINWALL, Esq.

W. T. HOLMES, Esq.

G. A. JUNG, Esq.

O. M. RAPHAELS, Esq.

J. R. OUGHTERSON, Esq.

VEERJEE KANJEE, Esq. (Mooljee Jattah and Co.)

HASSARY DEVIJEE, Esq. (Samjee Padomsee and Co.)

HADJEE MOOSAH HAJI HAMED, Esq.

DAMJEE RAMJEE, Esq. (Damjee Ookah and Co.)

MALJEE KASAVAJEE, Esq.

VISHNOO KASAVA SAMPLA, Esq.

JENARDINA GOVINDA GOKET, Esq. (Vishnoo Denaka Devada.)

PUNDALING RAMJEE, Esq.

HARRI VASOODEVA PREBBO, Esq.

LECKMENA BABAJEE, Esq.

OPENDRA SHETTY GANAPATHY, Esq.

RAMACHENDRA MAHA DEVA, Esq.

T. V. PEECHOG PUTTER, Esq.

DHARSEE KETSEE, Esq.

C. A. PERRERA, Esq.

P. VIETRA, Esq.

G. LAFRENAIS, Esq.

The Chairman explained the details of the Chamber's proposals for harbour improvements, and invited any gentlemen wishing for further information to inquire for it; after some discussion it was proposed, in behalf of the Native mercantile community, by Mr. Hadjee Moosah Haji Hamed, and seconded by Mr. Veerjee Kanjee, that—

"Having had explained to us the details of the scheme for the improvement of Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the Native mercantile community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the Native mercantile community in this matter can be safely left in the hands of the chamber of Commerce."

The resolution on being put to the meeting was carried unanimously.

(Signed) G. BRUNTON,
Chairman.

No. 16.

REPORT ON THE COCHIN HARBOUR.

In compliance with the decision of Government conveyed in G.O. of 27th December 1880, No. 2,943 W., we, the undersigned, inspected the Cochin Harbour on the 4th and 5th instant, and on the latter date had the advantage of a very complete discussion of the several points at issue with the Chamber of Commerce, several of the leading native merchants being also present on the occasion.

2. Prior to our arrival the Chamber of Commerce had submitted their letter, G.O., No. 222 W., dated 26th January 1881. No. 81,* dated 20th January 1881, combating the views put forward by the Master Attendant in his letter of the 16th December 1880, No. 11,132, printed with the previously quoted Government Order, and again they have in a still later communication explained very fully their views in the Honorary Secretary's letter, No. 87, dated 17th instant, dealing with some of the most important points discussed in the conference of the 5th instant.

3. Unfortunately Commander A. D. Taylor, whose presence was specially desired by Government, and whose advice would have been most useful to us, was unavoidably detained in Calcutta. He has, however, telegraphed to the Master Attendant expressing general concurrence with his views regarding the Cochin Harbour.

4. On the whole, we believe that we have obtained a sufficient knowledge of the locality, and of the views of those who are most interested in the question of a harbour, to indicate the points on which future discussion must hinge, and thus at least narrow the issues in a way that will enable Government to obtain the opinion of experts like Commander A. D. Taylor in this country, and, if necessary, of professional men in England, before committing themselves to a final decision.

5. The previous printed reports, as also that by Mr. George Robertson in 1871, will have already sufficiently explained the physical features of the present port of Cochin and its exceptionally large backwater; we shall, therefore, at once proceed to state the facts that have come under our notice as bearing upon the question of the proposed harbour, and the inferences we have drawn there from.

6. On the morning of the 4th February 1881 we found two vessels anchored, as stated to us by the Port Officer, at not a less distance than $1\frac{1}{4}$ miles west of the bar, which again was not less than 1,300 yards in a direct westerly direction from Lighthouse point.

7. Our own small steamer, the *Margaret Northcote*, anchored 1 mile west of the bar, apparently just at the limit of the 5-fathom contour, as the soundings taken in proceeding inwards towards the bar clearly indicated.

8. The buoys at north and south ends of the bar showed it to be 385 yards in length, the water shoaling sensibly beyond this limit on either side. At half tide the minimum depth of water was found by us to be 14 feet or somewhat less than 13 feet at low water.

9. The last monsoon being of more than usual strength the bar seems to have been forced back 200 yards closer to the shore than during the previous year, when it was 1,500 yards west of Lighthouse point, and seems to have had a minimum depth in it of 16 feet.

10. Mr. Robertson, it will be observed, found only 11 feet on the bar, but as the Cruz Milagre Gap was then open, this may be considered as less than what may be fairly calculated on in ordinary seasons; but it must be borne in mind that very extensive reclamations have for a long time been in progress in the Cochin backwater, and as the area over which the flood tide has to spread is thus being gradually, though probably not as yet very sensibly, contracted, the volume of water poured out at the mouth has a tendency to be decreased, and with this decrement, both the velocity and scouring power must diminish. It must also be borne in mind that the whole of the backwaters being within native territory, the influence of the Madras Government in limiting or controlling the reclamations can at best be only indirect. These facts must have weight in deciding on any harbour scheme that may be devised.

11. Immediately on the bar we found the material brought up by a diver to consist of rather coarse sand and shells, but there is nothing here or in any of the surrounding country to indicate that laterite or any kind of rock underlies the bar at a depth that would call for removal. Outside, to seaward there would appear to be mud in a very fine state of comminution not unlike that found at Narrakal to the north. This may, as supposed by the Chamber of Commerce, have anciently been a backwater though there is every reason to suppose that it also consists or has been added to by the continued though yearly small deposits of silt carried over the bar in the height of the monsoon.

12. North and south of the general run of the deep channel, between the actual mouth and the bar, the shoals, though necessarily varying somewhat in contour from time to time, continue pretty constant in extent and position, and, so far as we are able to judge, there is apparently no tendency for the effluent water to take any other direction or establish a new channel. The narrow channel adverted to by the Chamber of Commerce as passing in front of the long groyne at Vypeen point, and stated to be sometimes used for boats, is, we find, merely trifling excavation due to the swirl of the ebb water at the spot, and only to extend a few yards. Its existence can have no bearing on the question of a harbour.

13. There are seven long and one short groynes at intervals along the beach on the south side of the mouth (the Cochin side), and one long and nine short groynes on the Vypeen side. With the exception of the long one above mentioned (which rather requires looking after as it is not in good repair) they seem to have done the work fairly in correcting encroachment, but call for no remark in reference to the object of our immediate inquiry.

14. The pot-hole shown on all charts to exist within the immediate limits of the mouth, ranging from 28 to 48 feet in depth, still appears to exist in much the same

form as in previous years, though possibly the actual line of deep channel here may vary a little. Holes of this character, due no doubt to down or reflex currents which are found to exist in all cases of obstruction like a bar to the effluent water (in bridge piers, &c.), are apparently very constant in all similar cases along the coast. Mr. Robertson notices the deep pot-hole which was found at the Cruz Milagre Gap while there was a bar outside with only 2 feet of water on it. Numberless other similar instances can be adduced, and we are satisfied that no arguments based on such facts, as the existence of holes of this character, can have any bearing on the feasibility or otherwise of forming a harbour. They are directly produced by the bar in front, and were this latter removed there would, in our opinion, be no down or reflex currents tending to form such holes, which consequently would in that case fill up to the uniform level of the bed throughout.

15. We now come to deal with the proposals put forward for the formation of a first-class harbour, and in regard to this we may at once say that the chief result of the conference held at Cochin on the 5th instant, has been the recognition of all concerned, as to the necessity which exists for carrying out any breakwaters that may be constructed, (with a view to confining the ebb stream and sweeping away the bar) into a depth 5 fathoms, it being clear that under no other conditions could it be expected that the harbour should prove of use to vessels of large draught during the south-west monsoon or whenever there was any swell. In regard to this point it is only necessary to refer to the statement contained in paragraph 4 of letter No. 81, from the Honorary Secretary, Chamber of Commerce, dated 20th January 1881, where it is observed that their proposals "provide a channel of 30 feet deep into the same depth of water."

16. The reasons which have led to this decision have already been sufficiently dwelt on in the letter from the Master Attendant of the 16th December, and need not be recapitulated; but it must be observed that the acceptance of the principle, alters materially the question regarding which we have been called on to offer our opinion; as the extra expense due to the additional two miles of breakwater (one mile on north and the same at least south) which on the suggested plan would have to be carried out, so as to reach the five fathom contour line, renders it hopeless to expect that the funds derivable solely from local imposts could possibly suffice to defray the $4\frac{1}{2}$ per cent. on capital outlay as required by the Government of India for including the work under the head "Productive."

17. In the absence of a complete estimate an opinion of this kind can of course be only accepted for what it is worth, but we have no reason to think that the Chamber of Commerce themselves would be indisposed to accept this view, as in their correspondence they have dwelt on the necessity of economising on the outlay proposed for their original scheme, embracing certainly not half the work now seen to be essential, in order to bring it within their local means.

18. From 50 to 60 lakhs would in our opinion be the least which such works would in all probability cost, and if to this be added the usual indirect charges for interest of money while the work is under construction, &c., as ordered by Government to be shown in all like cases, we feel we are not in any way overstating the matter when we affirm that 70 lakhs is the least amount which the works would cost; and as the local imposts would have to meet not only the interest charge of $4\frac{1}{2}$ per cent. on this but also provide means for covering such extra charges for maintenance, establishment, &c., as may be necessary, for the future, there is no hope of this being done in the manner suggested by the Chamber of Commerce, solely from local resources.

19. But as it is quite open to the Government to deal with the work as one of sufficient Provincial or even Imperial importance, a view that the Chamber of Commerce have strongly pressed, we feel it right to point out certain considerations which under this aspect of the question seem to us to call for attention, before it would in our opinion be desirable to frame any estimate.

20. In this sense we will consider the scheme in its present form to consist of the construction of two long breakwaters running parallel to each other or nearly so, say 400 or 450 yards apart, into 30 feet depth of water, so as to concentrate such scour-

ing power as may exist in the ebb tide, with a view to the removal of the present bar, and to maintaining this depth throughout the year.

21. The difficulties we have felt to exist in regard to any scheme of this character are—

(1) The construction of breakwaters on this plan would neither change the volume nor the velocity of the stream which now issues through the mouth, in spite of which the present bar has been formed. The natural and inevitable tendency would therefore be to the reconstruction of the bar, and gradual reproduction of much the same condition of matters as now exists only a little further out to sea.

(2) The removal of the bar were such ultimately possible, would allow of rollers, entering the new mouth during the south-west monsoon, to advance unchecked right up to the easternmost extremity of the harbour so formed; and we are thus of opinion that the entrance of any vessels at such periods between the pier heads would be an extremely hazardous and even dangerous proceeding; excepting during ebb tide with steamers or sailing vessels assisted by steam tugs. This condition would seriously diminish the value of the harbour as one of refuge. Again all shipping inside the harbour as proposed would be exposed to the full force of these rollers, and the anchorage or wharfage be in consequence rendered extremely inconvenient if not unsafe.

(3) From the manner in which the breakwaters are proposed to be carried out we consider that no future dredging of any practical value would be possible.

22. In dealing with the first of the above difficulties, it may be as well at once to say that too much stress has been laid by the Chamber of Commerce, on the supposed formation of the bar as being directly caused by the deposit of silt brought down by the river.

23. No weight has ever been laid by us on this point which only incidentally cropped up in reference to Vizagapatam, (the Government Order connected with which was communicated to the Chamber of Commerce for general information only prior to our visit), the conditions of which are different, as it has a river often necessarily charged with silt discharging through the mouth.

24. No doubt the great Cochin backwater does act as a very complete settling bed for silt as urged by the Chamber of Commerce, but it cannot do so wholly, and we are unable to admit the argument employed by them as to the formation of the present reclamations inside the backwater, being due to sand carried in from the sea as stated with the flood tide. The ebb tide assisted by river freshets especially during the monsoon, must of necessity be a much more powerful agent for moving all matters in suspension (as being greater in volume and velocity) than the flood tide, and to suppose that more material is carried into the backwater, than is discharged from it, is opposed to all physical laws.

25. It is not, however, necessary to pursue this subject further. So far as the actual formation of the bar at Cochin is concerned, this factor may be entirely omitted, as the existence of this, like every other bar here and elsewhere in all parts of the world, is mainly, if not entirely, due to the action of the surf.

Mr. Robertson observes with reference to this that "the surf is always striving to restore the natural profile of conservancy of the shore. After the current has flowed out to sea for nearly a mile, it is no longer able to resist and keep down the ever working and powerful efforts of the waves to reform the profile of the coast, by continuing the beach line which has broken through the outgoing current."

26. In a paper by Mr. I. J. Mann, C.E., it is shown that while this statement would meet with very general acceptance of all professional men, the explanation of the causes leading to the establishment of bars has been various. It is, however, needless to advert to more than one of the various authorities on this subject, viz., Mr. D. Stevenson, who attributes the formation of all such bars solely to the action of the sea. "The waves," he observes, as is well known, throw up "a girdle of light or heavy material" * * round every bay and headland of our (English) coast, and the

entrances to rivers form no exception. The effect of this constant action of the sea is to form a continuous line of beach across the mouths of our tidal rivers and inlets." He does not appear to attach any importance to river currents as agents in the production of bars, observing that "a bar would be formed *although the outgoing current held not one particle of matter in suspension.*"

27. It only requires a glance at any good chart, exhibiting in detail the debouchures of all our rivers along both east and west coast on this Presidency to show that, wherever the shore is made up of sand or easily moved material, and is unconfined by rock or other obstruction, the tendency always is for rivers on approaching the coast to turn suddenly to the north, and often not for miles find an exit to the sea. This as well known is due to the superior power of the south-west monsoon which by induced sea currents, driving the sand before it below the surface, and by the wind acting on all exposed sand above, advances the sand-spit at the mouth further and further northward till a certain point is reached, when the river bursts out again south and the advance northward recommences.

28. In Mangalore we have lately been able to show that the movement northward of the river mouth due to this action, has apparently been pretty steady at the rate of 300 feet per annum during the last 54 years. But without multiplying instances it will probably suffice to note, as now clearly established—

1st,—that whether the effluent stream contains material in suspension or not, the tendency is for a bar to be formed, wherever the forces of the surf on one side and the stream on the other sufficiently neutralize each other;

2nd,—that the sand forming such bar is carried chiefly from south to north across the line of the normal direction of the debouching river. The contention of the Chamber of Commerce, in paragraph 13 of their letter No. 87 of the 19th instant, that "the currents and deposits at the ends of the proposed groynes would thus assist and not obstruct the endeavours to form a good harbour" is therefore in our opinion not borne out by the facts as now explained.

29. It may, of course, be fairly contended that there is a certain depth below the surface at which the wave action is nil, and there is no sensible amount of sand in movement at such depth. This is practically the contention of the Chamber of Commerce, and it is at first sight supported by the following observation of Mr. Robertson to warrant consideration, viz., that "were the current kept together in full strength till it got into such a depth of water that the action of the waves was not sufficiently powerful to stir up the bottom, there would be no decided bar."

30. Mr. Robertson does not, it will be noted, say at what depth of water such action may be expected to cease, and in the plan he proposes for a harbour at Cochin he evidently considers that the groynes suggested would not reach this undisturbed depth, as he observes that "a little dredging or raking" will be needed to preserve the depth of channel. (In connection with this remark it may be parenthetically observed that Mr. Robertson considered that the effect of the works suggested by himself would only secure a depth of from 20 to 21 feet at low water, which it is unnecessary to say would be wholly insufficient for a first-class harbour).

31. Without a series of very carefully conducted experiments, it would be impossible to decide this point in a manner sufficiently conclusive to satisfy every one, but in the paper before adverted to by Mr. Mann, there is a good deal of evidence to show that wave action is felt at depths hitherto apparently unsuspected.

32. Without overburthening our report with quotations, it may be sufficient to say that among the evidence adduced, it seems that on the banks of Newfoundland the agitation during storms has been known to affect the bottom at a depth of over 80 fathoms; at St. Jean de Luz in the Bay of Biscay over 100 fathoms; and at Land End the lobster traps are frequently filled with coarse sand and shingle during heavy ground swells in depths of 30 fathoms. Sir G. Airey mentions also that ground swells frequently break in a depth of 100 fathoms.

33. We do not wish it for a moment to be understood that looking to the general character of the seasons on the west coast, and the immunity which it appears

to enjoy from cyclones, that disturbance may be expected at depths such as these; but accepting the fact that the south-west monsoon sets in at times with considerable abruptness and strength, we are not prepared to say that in such occasions the sea bottom is not agitated at 5 fathoms in depth. In fact we incline to the opinion that unless there be some very direct proof to the contrary, such may be accepted as almost certain to be the case, especially considering the very shelving character of the west coast, which in this respect differs materially from that found near Madras, and most of the east coast, and that it would therefore behove Government to hesitate in adopting a scheme which, perhaps a single season of an unusually heavy monsoon, might render nugatory.

34. Dredging, as we shall presently show, is not apparently available for deepening channels situated like the one proposed with mouth open to the sea and exposed to swell; consequently if it be desired to give a prolonged life to the harbour with works of this character, it would be desirable not to stop the groynes in 5 fathoms, but to run them out another half a mile into $7\frac{1}{2}$ fathoms (which is the same as that adopted for the Madras harbour) as the best available expedient.

35. We now beg to turn to the second set of difficulties which has presented itself to us, viz., those which would probably be felt by every master of a vessel, approaching a harbour of the proposed character during the south-west monsoon, or in fact at any time when there was a heavy sea and wind.

36. It will be remembered that the essence of the proposed scheme is to preserve an uniform section of channel into deep water, so as to maintain, as far as possible, intact the scouring power of the effluent water, and keep the whole as clear as possible of deposits. However the direction of the groynes might be varied, this must in the main be the guiding principle so as to sustain the validity of the grounds on which the scheme is based.

37. But if this be so, there must be an exposed mouth and a long channel up which the seas must sweep with uninterrupted swing, till they gradually die away or become dispersed by the shoals of the backwater, at the extreme east end of the harbour. Mr. Robertson clearly indicates this difficulty, when he observes that, "it must be remembered that in reducing a bar we take away a kind of breakwater in front of an entrance and introduce a bigger wave."

38. A strong opinion has already been expressed by the Master Attendant on this point, and statements have reached us of the extreme difficulties and dangers which comparatively small craft have experienced in approaching the present mouth of the port in the monsoon, though having plenty of sea room to work in and able by their small draught to double sharp round to south-east end of the channel, after passing through the mouth and bring up in a perfectly sheltered anchorage, none of which advantages would be open to large vessels entering the harbour under the proposed scheme.

39. As directly bearing on this point, we would now quote the following observations from a report by Commander A. Dundas Taylor in reference to the proposed ship canal between Ceylon and India, dated 28th July 1871, viz., "To examine the sea approaches and thus to determine the accessibility of a port, is a first essential, and comes within the province of the Marine Surveyor. A glance at the plan which exhibits the sites of all proposed schemes (for Pámban) will explain how unreasonable would be the tax upon a Master Mariner's skill, in seamanship and navigation, when attempting to enter either of the openings, which were submitted to the consideration of the Parliamentary Committee * * * I am convinced that mishaps would have attended any attempt to shoot the canal's mouth when the monsoon swell and current accompanied the steamer."

40. It is needless to say that the dangers thus foreseen with reference to Pámban, would have equally to be counted on and disposed of, in dealing with any harbour scheme for Cochin.

41. The third and last difficulty as to the impossibility of carrying out satisfactorily dredging operations, in a channel exposed to heavy swell, is more easily disposed of. No dredge so far as we are aware has yet been devised for working satisfactorily in such positions. With all the adjustments that it may be possible to make, any sudden

jerky movements in the vessel must communicate themselves to the bucket ladder, and produce strains which would very soon break up the strongest framing of this character. On a few quite still days, aggregating say six weeks in the year, a dredge like the Albuquerque might work, but it must be obvious that this would go but a small way to meet the requirements of the case. The Albuquerque dredge with her side anchors and cables would moreover by herself take up 800 feet in width of the channel when at work and thus seriously impede traffic.

42. After the foregoing exposition of our views, which owing to the very able manner in which the Chamber of Commerce have stated their case, we have found it desirable to detail at greater length than might under other circumstances have appeared necessary, it is needless to say that personally we feel ourselves unable to recommend the scheme put forward by that body, and that consequently it is at least at this stage unnecessary to go into any of the engineering details.

43. It does not, however, necessarily follow that the rejection of this particular scheme would invalidate all others. We are given generally to understand for instance that Mr. Parkes is under the impression from the papers sent him by the Chamber of Commerce, that a plan by which the bar might be sheltered and then removed by dredging, somewhat in the same way as in his Kurrachee harbour, might be feasible; and although it would probably take some time to mature a scheme of this nature, we are not prepared to say that with abundant means at disposal, a harbour based on this principle might not have a good deal to recommend it. The general principle whether applied in the form of a detached breakwater entirely shielding the bar from the action of the surf or otherwise, has certainly more to recommend it than the one we have been considering, though the latter might under certain conditions be either wholly or in part incorporated with it.

44. All we are now concerned with however is whether with this new light on the subject, it would be desirable to have the details of the scheme worked out by Mr. Parkes.

45. It can hardly be questioned that the cost of constructing such a breakwater out to sea as would admit of the bar being entirely sheltered, and of the whole of the stuff being dredged out (this would be by far the cheapest part of the operations) must of anything be greater than what we have before named as likely to be required in the scheme we have been obliged to condemn.

46. The question again therefore arises as to whether any Provincial or Imperial subsidy can be looked for in aid of the local resources, which would certainly be insufficient for the execution of a project of the kind. The Chamber of Commerce urge strongly their claims for a subsidy of this character, and in the late minute by the Honorable Sir Andrew Clarke, the necessity of creating a certain number of harbours of refuge along our shores, to meet the exigencies of war have been seriously pressed on the attention of the Government of India. It appears to us, however, that it would be exceedingly difficult to render an open place like Cochin defensible against an enemy's vessels, which stealing in sufficiently close at night could easily injure the place without running much risk themselves. Trincomalee is in fact so far as we are aware the only harbour between Bombay and Calcutta which naturally lends itself to such an object, and which would be at once perfectly secure and easy of access.

47. We can only therefore say that if the Government, after weighing what we have advanced, still consider these claims sufficiently well founded, and there be any probability that they will be recognized by the Government of India, it would be difficult to find a more able professional Harbour Engineer for drawing up a complete scheme, and framing an estimate of the probable cost, than Mr. Parkes.

48. There would in our opinion be no sufficient object gained in going minutely into a discussion of ways and means for meeting interest on outlay, at this stage of the enquiry especially as under the proposals put forward by the Chamber of Commerce in the letters printed with G.O., 27th December 1880, No. 2,943 W., there are several points involving not a little complexity, regarding which our information is incomplete.

49. We took advantage of our visit to Cochin to inspect the singular mud bank at Narrakal, situated some 6 miles to the north, and which for the last few years

has been used by the merchants for shipping and landing goods throughout the monsoon.

50. There is backwater all the way to within a quarter of a mile of Narrakal, where the Cochin Government have cut a boat canal across the sand-spit separating it from the sea, and constructed a covered passage with tramway from this close up to the beach, as also a small landing pier. The very serviceable condition of this latter work after three years wear and tear, shows that at least in that period there have been no heavy seas at this point.

51. The bank consisting of the very finest mud (of a greenish black color and very unctious to the touch) seems so far as can be ascertained to extend about three miles along the shore from south to north, and $4\frac{1}{2}$ miles out to sea. It has not apparently shifted its position as seems to have been the case with other similar banks, notably that which though known to have been at Alleppy some 20 years ago, has apparently moved 7 miles south to Porcad, and is still believed to be progressing gradually to the south.

52. The effect of the bank on the portion of sea covering it is singular, as at the first burst of the monsoon there is said to be the same surf as in other parts of the coast; the water is discolored and dark with the churned up mud. But after this stage has passed this seems to settle down and becomes clear like the rest of the neighbouring sea. Some persons consider the surface has an oily look at this time, and others that air bubbles stems and branches of apparently submerged trees rise to the surface, &c., but of none of these statements is there any distinct proof.

53. What, however, appears certain is, that the full characteristics of this tract in providing a perfectly quiet anchorage during the monsoon are not fully developed till the monsoon has sufficiently advanced to render the water in the backwater on the land side quite fresh, and that during this period the water on the bank out to sea is also so fresh, as to lead to the conclusion that such water at this time rises from the bottom under pressure.

54. The effects, however, are that the monsoon swell gradually subsides over the outer limits of the bank and vessels are thus enabled to run into comparatively quite still water at the height of the monsoon, thus providing Cochin with an unrivalled harbour during this period. So far as can be ascertained, no surf breaks along the margins of the bank; the seas merely die away.

55. There can of course be no question that there are a number of serious drawbacks to trade conducted in this manner, and that merchants suffer considerably by losses of goods exposed in the canal boats, and by fraud and carelessness on the part of the boatmen, but the fact remains that they are able to carry on trade at this period when all other west coast ports (except Porcad) are closed.

56. As considerable interest attaches to the conditions under which the mud banks alluded to exist on the coast, it is to be hoped that Mr. W. King, Assistant Superintendent, Geological Survey of India, who joined us, and secured some specimens of the mud for analysis, may be enabled to follow up the inquiry.

57. A chart giving general information about the Cochin anchorage and port, and also showing sufficiently the proposed scheme for a first-class harbour accompanies this report for facility of reference.

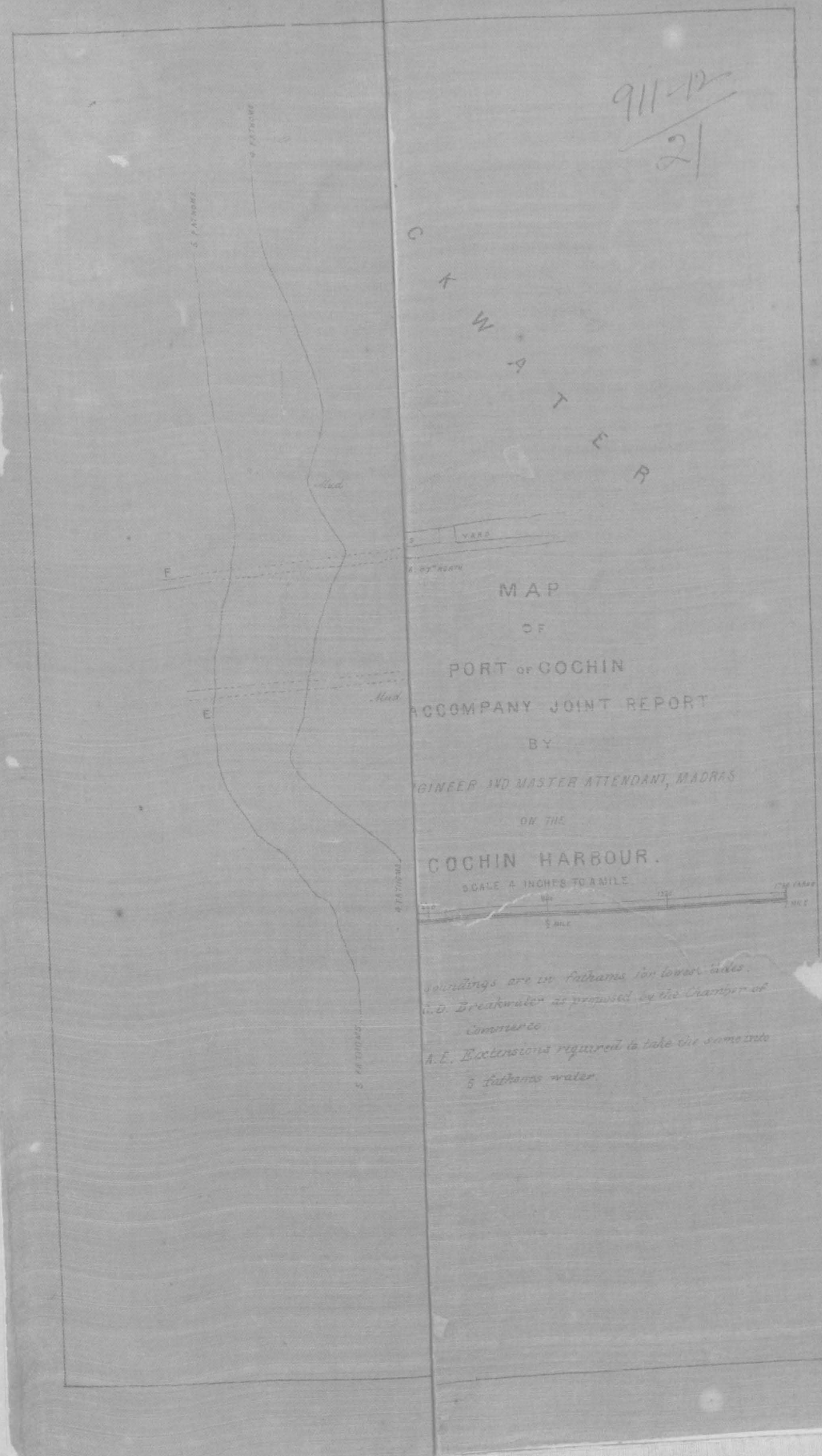
(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.

(Signed) J. H. TAYLOR, Lieut., R.N.R.,
Master Attendant.

MADRAS,
28th February 1881.

No. 17. From W. T. HOLMES, Esq., Honorary Secretary, Chamber of Commerce, Cochin, to the Secretary to Government, Public Works Department, dated Cochin, 17th March 1881, No. 88.

SINCE addressing you on the 19th ultimo the Chamber has had the port inspected by Mr. Parkes, M.I.C.E., Chief Engineer of the Madras Harbour Works, and I have the honor to forward a copy of his report for the information of Government.



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7. A chart giving general information about the Cochin anchorage and port, so showing sufficiently the proposed scheme for a first-class harbour accompanies report for facility of reference.

(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.
(Signed) J. H. TAYLOR, Lieut., R.N.R.,
Master Attendant.

(Signed) J. H. TAYLOR, Lieut., R.N.R.,
Chief Engineer, P.W.D.
Master Attendant.

From W. T. HOLMES, Esq., Honorary Secretary, Chamber of Commerce,
Cochin, to the Secretary to Government, Public Works Department, dated
Cochin, 17th March 1881, No. 88.

NCE addressing you on the 19th ultimo the Chamber has had the port inspected
Parkes, M.I.C.E., Chief Engineer of the Madras Harbour Works, and I have
to forward a copy of his report for the information of Government.

2. It will be observed that Mr. Parkes is of opinion that the bar can be permanently removed and the port converted into a first-class harbour; but the works he considers necessary to accomplish this will be more extensive and costly than hitherto estimated. Such works, however, Mr. Parkes informed the Chamber in conference, would give Cochin a harbour equal to that of Bombay and capable of indefinite extension at the moderate cost of dredging within the backwater.

3. The cost of the works proposed is estimated at 81 lakhs of rupees, and it is scarcely necessary to remark that this is much beyond the ability of the existing trade of the port to provide four and-a-half per cent. interest on. But the facilities which a first-class harbour and railway communication would provide might certainly be expected to increase the trade of the port from year to year, which would be attended by an increased revenue on harbour works.

4. There may, however, be Imperial interests involved in the conversion of this port into a first-class harbour which may induce the Government of India to expend, without immediate expectation of interest thereon, that portion of the cost for which the present trade of this port cannot provide, and the Chamber begs leave to mention what appear to it a few of the more important of those interests.

5. It is generally understood here that the Government of India are desirous to have a first-class harbour or harbour of refuge on this coast between Bombay and Ceylon, and that Marma Goa and Carwar have been recommended as suitable sites. The cost of harbour works at either of those places would be considerable, and neither place has yet a trade that could return any appreciable revenue on the outlay. A railway to connect the port with the railway system of India would also have to be constructed either as a State work or under a State guarantee.

6. Against Marma Goa there is the special objection that it is not in British territory.

7. The Chamber begs to urge in favor of the selection of the port of Cochin as the site for such a harbour that it is more centrally situated between Bombay and Ceylon than either of the ports named; that it is already a port of considerable trade, being fifth in importance in India and second in the Madras Presidency, and able to pay about two per cent. interest on Mr. Parkes' estimate of the cost of the required works; that it is probable it will soon be connected with the railway system of India at a very moderate liability by way of guaranteed interest to the British Government, and that the total cost of harbour works here might not impose on Government a greater liability than would the harbour and railway works at either of the other places mentioned. The nearness by railway of this port to the principal Military Stations in the Madras Presidency and also its nearness to Aden would seem points of importance in connexion with the movements of troops.

8. Mr. Parkes, when in conference with the Chamber, expressed a wish that his report and suggestions might be submitted for the opinion of another Marine Engineer; for whilst there is no doubt that the Cochin bar can be permanently removed, it is possible that another competent authority might be of opinion that this could be accomplished by less extensive and costly works than now projected. The Chamber does not see its way to making such a reference, and feels that it must now leave any further proceedings in the matter deemed necessary in the hands of Government. In what it conceives to be the interest of the port the Chamber has ventured to urge the subject on the attention of Government and trusts that it will be accorded due consideration.

From N. PARKES, Esq., M.I.C.E., to the Honorary Secretary, Chamber of Commerce, Cochin, dated Cochin, 11th March 1881.

HAVING now carefully perused the documents referring to the proposed improvement of the Harbour of Cochin which you have laid before me, having received much valuable information on the subject from various gentlemen on the spot, and having made such personal inspection as was possible during my short stay, I beg now to lay before you, for the information of the Members of the Chamber of Commerce, the conclusions at which I have arrived.

Your questions to me are substantially the following:—

1. Can improvements commensurate with the cost be made for a sum not exceeding £250,000 for such improvements of the entrance as would enable the class of ships at present frequenting the port to come at all seasons to the inner harbour when fully loaded instead of lying in the roads or at Narrakal as at present?
2. Is Cochin capable of being made into a first-class port accessible to the largest ships at all times, and if so, by what means and at what cost?

With regard to the first question, I feel compelled after much consideration and with very great reluctance to give a negative answer. I think that such works as could be carried out for the sum named would be in any case ineffectual and probably injurious. Works to be really efficient must be carried out on a much larger scale, but if so carried out they would render Cochin such a port as is contemplated in the second question, to which therefore my reply is affirmative.

Proposals appear to have been considered by the Chamber for carrying out piers from Cochin and Vypeen respectively so as to concentrate the scour on the bar.

This is correctly supposed would form for itself a channel between the piers equal in sectional area to that existing in the present entrance, as far as their ends, and for some distance beyond. It is further supposed that, if this distance beyond the piers be such as to reach the depth of water in which the wave will not act upon the bottom so as to heap up another bar similar to the present one, there will be such a continuous depth throughout as the scour may produce.

The piers described in paragraph 5 of your letter to the Secretary to Government, Public Works Department, of 25th November 1880, appears to be laid down upon this principle, and they terminate in a depth of 24 feet. Their cost would, as I estimate, be about 50 lakhs of rupees.

I agree in very much of the principles upon which these lines were laid down, but there are some important respects in which I think the plan requires to be modified and supplemented, and these will further increase the cost.

In the first place, the process of obtaining the increased depth by scour in the face of the waves is a hazardous one. A large quantity of material would be disturbed and driven out beyond the piers; some of it would be deposited in the eddies near their unfinished ends, and would consist of heavier and coarser material than that of which the bar is now composed, and would therefore, under the influence of the waves, remain at least temporarily at a higher level. From this cause the navigable depth over the bar would be temporarily reduced, and the contour of the depth within which the wave has injurious action would be permanently pushed out to sea. These anticipated difficulties may at first sight appear hypothetical, but they are suggested by the experience of my own practice both at Kurrachee and at Madras. At the former place the attempt to remove the bar by scour in the face of the sea produced a great aggravation of the evils. Another objection to the lines as laid down is that there is no room for the wave to spend itself between the piers, so that the seas entering between their ends would be propelled in almost full force to the ships' berths. At present the seas are broken by the bar and the shallow water on either side and this advantage would be lost.

To avoid these two evils it would be necessary to start the piers from the shore at a much greater distance apart, and they should be kept at such a distance from the existing navigable channel that any disturbance or accumulation that may take place around their advancing ends may not affect the channel. They should begin to approach one another only when they have arrived in the depth of water in which the bottom is not affected by the wave. Thus there would be no disturbance of the existing bottom in the navigable channel by increased scour. It may appear to be throwing away a natural advantage not to effect the required deepening by natural scour, but the cost of dredging it would be under 3 lakhs of rupees—a small sum for avoiding the evils consequent on an excess of scour.

A more important source of economy would be sacrificed by carrying the lines of the piers away from the land spits which, more especially on the south side, lie parallel with the channel and placing them in deepest water north and south; but I can see no alternative to surrendering the advantage. To do so, however, would necessarily increase the cost of the piers by about 8 to 10 lakhs.

Then comes the question of the depth in which they are to terminate. I think 24 feet is too near the outside limit of wave action to be thoroughly safe, but a more imperative reason for a greater depth is that required for navigation. Twenty-four feet, with 2 feet rise of tide, is sufficient in smooth water, but it is not enough where a ship is liable to a lift and drop of 5 or 6 feet by the waves. I think 27 feet is the least that should be allowed for the ends of the piers.

In order to carry out the principles here laid down therefore I would propose to remove the north pier to a distance of 900 yards northward from the shore of the channel, and the south pier 1,100 yards southward, giving with the width of the channel itself a total width between them of 2,700 yards; that they be carried out parallel to one another in a due westerly direction to a depth

of 24 feet, and then, curving towards one another, terminate in 27 feet with a distance between them of 900 yards or double that of the channel between Cochin and Vypeen. Having a uniform depth of 27 feet, the new entrance would have also nearly double the sectional area of the Vypeen channel, there would be consequently only half the velocity of current, and no disturbance of the bottom.

The piers as I have described them, one 10,600 feet and the other 11,330 feet, or each over two miles in length, together with the dredging of the channel, I estimate to cost 81 lakhs of rupees. Their execution would make Cochin a first-class port, and utilize the fine anchorage 3,000 yards long by 250 yards and upwards wide, with more than 24 feet depth. Thirty steamers of the largest size could be moored in this space in a single row of 15 on either side with ample width between them for passage, and in some parts there is room for double rows. Besides this there is practically unlimited space of shallower water, the depth of which could be increased to any required extent by dredging. It would likewise be in direct communication with an immense extent of inland navigation by means of the backwater.

These advantages already exist, but they are unavailable by reason of their inaccessibility from the sea.

It is no part of my duty to express any opinion as to whether the acquisition of such a harbour is ever likely to justify the outlay required for it; but it is at any rate desirable that the capabilities of the place should be known. It is unfortunate that from the nature of the case it is impossible to recommend a plan for a smaller measure of improvement at or proportionally smaller cost. The swell from every direction between south-west and north-west must be reduced before the bar can be even lowered, and that can only be done by breakwaters two miles from shore.

No. 18.

ORDER THEREON, 4th April 1881, No. 911 W.

THE Government are compelled to accept the unanimous opinion of the Chief Engineer, Public Works Department, the Master Attendant, and Mr. Parkes that no permanent improvement to the Harbour of Cochin is attainable except at a cost, the interest of which could not possibly be met by the trade of the port, even allowing for the increase that might reasonably be expected.

2. Nor do the Government consider that such a work could justifiably be undertaken from Provincial Funds, or recommended to the Government of India for execution as a productive work.

3. It is for the Government of India to decide whether the construction of a first-class harbour at this port is of sufficient importance from an Imperial point of view to justify its construction without reference to financial results, and the papers will therefore be forwarded to that Government for consideration.

(True Extract.)

(Signed) R. H. SANKEY, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Chief Engineer, Public Works Department.

,, Master Attendant.

,, Marine Department.

,, Chairman, Chamber of Commerce, Cochin.

No. 19.

(DOCKET No. 912 W., dated 4th April 1881.)

Forwarded.

(Signed) R. H. SANKEY, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. T. O'Connor.

Spare Copies



BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of 1881 Madras
PUBLIC WORKS.

To

THE SECRETARY TO THE
GOVERNMENT OF INDIA.

Dated April, 4th.

Issued

Recd.

Encl.

G. O., 4th April 1881, No. 912 W.

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From W. T. HOLMES, Esq., Honorary Secretary, Chamber of Commerce, Cochin, to the Secretary to Government, Public Works Department, dated Cochin, 19th February 1881, No. 87.

REFERRING to the meeting which the members of this Chamber had with you and Captain Taylor, R.N.R., on Saturday the 5th instant, I now, by desire, have the honor to offer the following observations on the various points which you left for further consideration by the Chamber.

2. The first in order is the question whether the floods in the backwater bring down such silt as, depositing outside the entrance, now forms the bar. The Chamber has already expressed a very decided opinion that no such silt is discharged from the backwater, and its opinion on this point was not in any degree shaken by the opposite views expressed at the meeting referred to.

3. At the meeting there were produced by the Chamber two bottles of flood-water taken from the mouth of backwater on the 4th December last. Between that date and the 20th November preceding there had been a fall of upwards of 8 inches of rain over the district between Cochin, Alleppey, and the Travancore hills, and the rivers from the hills being in heavy flood, there was being discharged from the mouth of the backwater an usual monsoon flood.

4. The samples of water which were drawn in the presence of the Master Attendant of the Port were as bright and clear as water can be. A few particles of substance were contained in them, but not sufficient to form the thinnest film over the bottoms of the bottles, or when shaken up to at all cloud or discolor the water. The taste of the water was but slightly brackish, a fact which may be noted as a proof of its being flood-water, for in the absence of floods the backwater becomes salt to a distance of 30 to 35 miles from Cochin.

5. The appearance of this water was not considered by you as at all confirmatory of the Chamber's statement, because (1) you deemed it probable that the silt, being heavy, might not be held in suspension by the waters, but by the strength of the current might be rolled along the bottom of the backwater, and (2) because inside the backwater you had observed along the shore obstructions placed with a view to causing reclamations by deposit of silt.

6. In reply to the first objection, the Chamber begs to observe that such rivers as the Hoogly, Godavari, Cauvery, Indus, and perhaps all other rivers that are known to bear down silt, and, in consequence, to have bars at their mouths, run during flood time in turbid streams which discolor the sea for considerable distances from shore. In like manner run the rivers which discharge into the Cochin backwater.

7. But the Cochin backwater ranges from 2 to 15 miles in width, and over these broad areas, some of which are from 30 to 50 feet deep, the current is necessarily slow, and in passing them the flood-waters deposit all their silt. If, however, it can be urged that the current over such places is so strong as to roll heavy silt from the bottoms of such deep pools and over steep banks, it must be admitted that it is also strong enough to keep in suspension lighter particles of silt, in which case the flood-waters discharged from the mouth of the Cochin backwater ought to present the appearance of the floods from the rivers which have been referred to. The fact that they do not present such appearance is proof, in the Chamber's opinion, that the objection of rolling silt on the bottom of the backwater is untenable.

8. With reference to the second objection, it may be mentioned that during the monsoon months there is of necessity a wash from the lands on the margin of the backwater, and where there are no protective works there must be some attrition of the shore, regulated by the strength of the current. During flood-tide, too, a certain amount of sand is rolled in from the sea along the shores. These are the materials which form the reclamations referred to, aided by mud excavated by hand from the bottom of other parts of the backwater. In this view, which the Chamber believes to

be the correct one, the reclamations lend support to the statement that no silt is discharged from the mouth of the Cochin backwater which, by depositing outside, forms the bar.

9. The next point to be considered is the objection that the construction of the works proposed by the Chamber would not alter the direction and strength of present forces, and that, therefore, the bar must reform, the time required for it to do so being regulated by the length of the breakwaters.

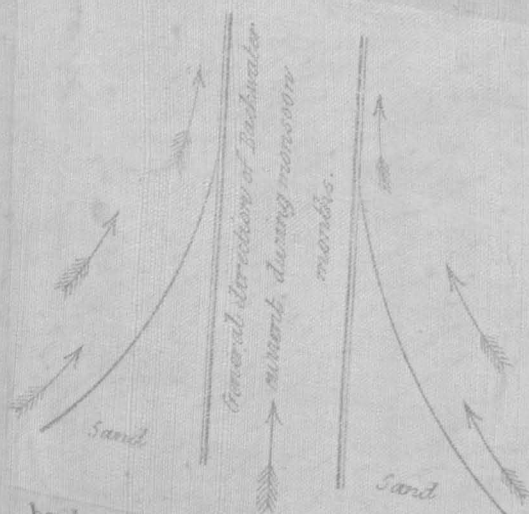
10. The Chamber is not prepared to allow that, with groynes thrown out to the length and depth contemplated, the present forces will remain unaltered. The bar is now formed and reformed by sand forced into mechanical suspension in the water owing to the action of the surf on the coast, and then being carried by the littoral current across the backwaters' mouth where, meeting with opposing currents, the sand is at once deposited. This being so, the groynes once prolonged beyond the effect of the surf on the bottom, the reforming action becomes, at any rate for a time, impossible.

Mr. Robertson says, page 31 of his report:—"Were the current to be kept together in full strength till it got into such a depth of water that the action of the waves was not sufficiently powerful to stir up the bottom there would be no decided bar."

11. If it be urged that the littoral currents would still bring up the sand and deposit it north and south of the groynes, increasing the breadth of the beach until the profile of the coast extended to the sea end of the groynes, and would there reform a bar, the Chamber submits that such action must be the work of a great length of time; that the coasts north and south would have to be eroded to an unprecedented extent before the materials could be obtained for such an extensive filling in; and these coasts are protected for some distance by the small groynes already in existence. Again, the bottom of the sea is nothing but mud, and could lend no material for the purpose.

12. The same action around the Madras Harbour Works has been estimated, the Chamber believes, to require about two hundred years; and at Cochin, where there is a slower littoral current and the proposed groynes longer, an equal time may be necessary, even though the depth of water be less.

13. Moreover, supposing this filling in to have taken place, the profile of the coast would then be altogether different to what it now is, for it would exhibit two tolerably sharp curves along the contour of which the littoral currents would be forced to sweep, and the sand which they would carry would be deposited, not in a line running at nearly right angles to the scour in and out of the river, but into lines which, with the assistance of that scour, would form for a long distance prolongations of the groynes, and thus assist and not obstruct the endeavours to form a good harbour.



banks of those two places were once bottoms of backwaters.

14. The common belief that the mud banks of Narrakal and Alleppey have been the work of rivers depositing their silt at these places is, the Chamber thinks, erroneous; as far as Alleppey is concerned, it has no river near it.

15. It is a well known fact that the bottom of most of the Cochin extensive backwaters is a deep bed of mud, similar in every respect to the mud composing the banks at Alleppey and Narrakal. It is also a pretty well ascertained fact that the strip of sand which separates the backwaters from the sea was a long distance further to the west than it now is, and that the sea has encroached. Nothing, therefore, is more likely than that the mud

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16. Some stress was laid on what was said to be a fact that in no part of the world had bars to rivers been got rid of. But the Chamber does not consider this to be an overwhelming argument against the proposed works for Cochin, for in the case of this port the circumstances to be dealt with are not such as are met with in other parts of the world. Cochin is an exception in many ways to every thing met with elsewhere—

1st. Cochin has no river strictly speaking, but only an opening from the backwaters to the sea.

2nd. The extent of backwater which has to be filled and emptied every tide is altogether unprecedented, thereby giving an impetus to the ebb and flood unknown elsewhere.

3rd. No ascertainable silt is deposited.

4th. The bottom of the sea is mud, not sand.

5th. Cochin has both to the north and south a safe anchoring ground in smooth water for vessels in case of weather so bad as to make it unwise to risk an entry into the harbour.

6th. The wind during bad weather is invariably fair for ships entering the harbour.

7th. Cyclones are absolutely unknown.

17. The Chamber, in its letter of 25th November 1880, No. 75, paragraph 16, estimated that about one-third of the trade of the port is conducted inside the mouth of the backwater, and allowed for the less lighterage such trade has to bear in the average of the lighterage paid on the whole trade of the port. The one-third includes both British and native trade, whether carried in British or native craft. The native craft, being of small tonnage, is able to come close in shore, and so to a large extent incurs much reduced lighterage, but the number of such vessels is rapidly diminishing owing to their inability to compete with the coasting steamers, and it is only a matter of a few years when the native carrying trade between all ports visited by steamers will practically have ceased to exist. The following figures warrant this anticipation:—

Native vessels frequenting the port of Cochin—

	No.	Tonnage.	Port Dues.
1876-77	863	45,224	4,234
1877-78	736	34,815	3,263
1878-79	741	35,010	3,382
1879-80	496	25,060	2,347

These vessels never venture to sea during monsoon weather, say, for five months in the year.

18. The Chamber is having prepared a statement of the value of the trade carried by this class of vessels during the past two years as compared with the total value of the trade of the port, which, when completed, will be forwarded to you.

19. A meeting of native merchants was convened by the Chamber on the 11th instant, when the Chamber's proposals to Government were formally laid before them for expression of their opinion thereon. To the most influential of the body the proposals had been fully explained some days previously, and they were requested to give them every publicity in the bazaar. At the meeting the following resolution was passed, and a certified copy of the proceedings is attached hereto:—

"Having had explained to us the details of the scheme for the improvement of the Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the native mercantile community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the native mercantile community in this matter can be safely left in the hands of the Chamber of Commerce."

20. In considering the claims of the respective interests, European and native, on Government in connection with the proposals for harbour improvement, it should be borne in mind that only few of the principal native merchants of Cochin reside and carry on business in British territory. The majority are subjects of the Native

State of Cochin, and whilst enjoying all the advantages of a British port for their sea-borne trade, the opportunities for trade opened out by British enterprise, and, in fact, owing their whole prosperity as traders to their contiguity to a body of British merchants, contribute but little to the Imperial Revenues of India. On these grounds, if their views had been antagonistic to the proposals put forward for the improvement of the port, the Chamber would have been prepared to urge the prior claims of the interests of British subjects over those of a foreign State on the consideration of the British Government. Native merchants, however, have recognized that their interests are identical with those of British merchants in the Chamber's proposals.

21. The extra charge of one anna per ton proposed to be levied on vessels visiting the port ought to be specially assigned to the port, even though there be no change in the grouping of western ports. All that the Chamber has to propose is that the earnings of the port be applied to its improvement, and arrangements to effect this would seem a matter of account and not difficult.

22. In the present system of grouping the ports on this coast it does not follow that the amount of port dues collected in Cochin represents more than its proper earnings. Coasting vessels do not always pay their port dues in Cochin. Having paid the dues here once, the next time they become payable the vessel may be at any one of the other ports of the group, and there they are levied. Each port has its chance.

23. Whether the trade of the port can provide not only interest on the cost of construction, but also cost of maintenance of works and allowances to establishment, the Chamber cannot say, not having an estimate of the capital required. The Chamber has shown, on an average of the trade of the port for ten years, about what the port can now provide, and there is reason to believe that such improvements as have been proposed would increase the trade and also the revenue. On the figures which have been furnished it is for Government to decide, after obtaining estimate of cost, whether the trade can bear all the charges referred to.

24. But supposing the estimated revenue falls short of the required sum, the Chamber would urge that, as the proposals they have made merit the attention of Government from an Imperial point of view, Imperial Revenues should be charged with the deficiency, which it is anticipated cannot be large.

25. The Chamber in putting its views before Government do so in what is believed to be the interests of the port and the whole mercantile community. But at the same time cannot fail to notice the fact that the harbour improvements advocated, while benefiting the local trade, would also be of essential importance to the whole of South India, connected with it as the port is likely soon to be by rail.

26. In case of war with a naval power such a land-locked harbour, centrally situated between Bombay and Tincomallee, would be of inestimable value as a harbour of refuge where ships could repair and refit, and as a resort for our ships of war; and its nearness to Aden, being about two days nearer than Bombay by homeward bound steamer routes during monsoon months, points it out as a port possessing every capability for becoming of very considerable importance.

27. The Chamber had not had an opportunity of perusing Mr. Robertson's report on the port prior to your visit, and the copy kindly lent by Captain Taylor has been read with considerable interest. The favorable opinion of such an authority, the Chamber trusts, will have great weight with Government, and lead them, before deciding against the Chamber's schemes, to appoint a practical expert to inspect and report, if further report is thought necessary. If Mr. Parkes or Mr. Thorowgood of the Madras Harbour Works could be deputed to this duty, he would be able to make an approximate estimate of cost, and his practical experience would enable him to put a true value on the objections raised and the arguments used to overrule them. He would be able to properly estimate the great advantages of the port and suggest the best means of making the most of them.

28. Steps are being taken to obtain the views of Commanders of vessels visiting the port on the points on which a nautical opinion is desired, and the opinions which may be received will be forwarded to you.

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Proceedings of a Meeting of European and Native Merchants of Cochin held in the Office of the Municipal Commissioners of Cochin on the 11th February 1881 to consider the interests of the Native Mercantile Community in the proposals made to Government by the Local Chamber of Commerce for the improvement of the Harbour of Cochin.

PRESENT:

G. BRUNTON, Esq., in the Chair.

J. H. ASPINWALL, Esq.
W. T. HOLMES, Esq.
G. A. JUNG, Esq.
O. M. RAPHAELS, Esq.
J. R. OUGHTERSON, Esq.
VEERJEE KANJEE, Esq. (Mooljee Jattah and Co.)
HASSARY DEVJEE, Esq. (Samjee Padomsee and Co.)
HADJEE MOOSAH HAJI HAMED, Esq.
DAMJEE RAMJEE, Esq. (Damjee Ookah and Co.)
MALJEE KASAVAJEE, Esq.
VISHNCO KASAVA SAMPLA, Esq.

JENARDINA GOVINDA GOKET, Esq. (Vishnoo Denaka Devada.)
PUNDALING RAMJEE, Esq.
HARRI VASODEVA PREDDO, Esq.
LECKMENA BANAJEE, Esq.
OPENDRA SHETTY GANAPATHY, Esq.
RAMACHENDRA MAHA DEVA, Esq.
T. V. PRECHOO PUTTER, Esq.
DHARSEE KETSEE, Esq.
C. A. PERREIRA, Esq.
P. VIEYRA, Esq.
G. LAFRENAIS, Esq.

The Chairman explained the details of the Chamber's proposals for harbour improvements, and invited any gentlemen wishing for further information to inquire for it; after some discussion it was proposed, in behalf of the Native mercantile community, by Mr. Hadjee Moosah Haji Hamed, and seconded by Mr. Veerjee Kanjee, that—

"Having had explained to us the details of the scheme for the improvement of Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the Native mercantile community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the Native mercantile community in this matter can be safely left in the hands of the chamber of Commerce."

The resolution on being put to the meeting was carried unanimously.

(Signed) G. BRUNTON,
Chairman.

REPORT ON THE COCHIN HARBOUR.

In compliance with the decision of Government conveyed in G.O. of 27th December 1880, No. 2,943 W., we, the undersigned, inspected the Cochin Harbour on the 4th and 5th instant, and on the latter date had the advantage of a very complete discussion of the several points at issue with the Chamber of Commerce, several of the leading native merchants being also present on the occasion.

2. Prior to our arrival the Chamber of Commerce had submitted their letter, No. 81,* dated 20th January 1881, combating the views put forward by the Master Attendant in his letter of the 16th December 1880, No. 11,132, printed with the previously quoted Government Order, and again they have in a still later communication explained very fully their views in the Honorary Secretary's letter, No. 87, dated 17th instant, dealing with some of the most important points discussed in the conference of the 5th instant.

3. Unfortunately Commander A. D. Taylor, whose presence was specially desired by Government, and whose advice would have been most useful to us, was unavoidably detained in Calcutta. He has, however, telegraphed to the Master Attendant expressing general concurrence with his views regarding the Cochin Harbour.

4. On the whole, we believe that we have obtained a sufficient knowledge of the locality, and of the views of those who are most interested in the question of a harbour, to indicate the points on which future discussion must hinge, and thus at least narrow the issues in a way that will enable Government to obtain the opinion of experts like Commander A. D. Taylor in this country, and, if necessary, of professional men in England, before committing themselves to a final decision.

5. The previous printed reports, as also that by Mr. George Robertson in 1871, will have already sufficiently explained the physical features of the present port of Cochin and its exceptionally large backwater; we shall, therefore, at once proceed to state the facts that have come under our notice as bearing upon the question of the proposed harbour, and the inferences we have drawn there from.

6. On the morning of the 4th February 1881 we found two vessels anchored, as stated to us by the Port Officer, at not a less distance than $1\frac{1}{4}$ miles west of the bar, which again was not less than 1,300 yards in a direct westerly direction from Lighthouse point.

7. Our own small steamer, the *Margaret Northcote*, anchored 1 mile west of the bar, apparently just at the limit of the 5-fathom contour, as the soundings taken in proceeding inwards towards the bar clearly indicated.

8. The buoys at north and south ends of the bar showed it to be 385 yards in length, the water shoaling sensibly beyond this limit on either side. At half tide the minimum depth of water was found by us to be 14 feet or somewhat less than 13 feet at low water.

9. The last monsoon being of more than usual strength the bar seems to have been forced back 200 yards closer to the shore than during the previous year, when it was 1,500 yards west of Lighthouse point, and seems to have had a minimum depth in it of 16 feet.

10. Mr. Robertson, it will be observed, found only 11 feet on the bar, but as the Cruz Milagre Gap was then open, this may be considered as less than what may be fairly calculated on in ordinary seasons; but it must be borne in mind that very extensive reclamations have for a long time been in progress in the Cochin backwater, and as the area over which the flood tide has to spread is thus being gradually, though probably not as yet very sensibly, contracted, the volume of water poured out at the mouth has a tendency to be decreased, and with this decrement both the velocity and scouring power must diminish. It must also be borne in mind that the whole of the backwaters being within native territory, the influence of the Madras Government in limiting or controlling the reclamations can at best be only indirect. These facts must have weight in deciding on any harbour scheme that may be devised.

11. Immediately on the bar we found the material brought up by a diver to consist of rather coarse sand and shells, but there is nothing here or in any of the surrounding country to indicate that laterite or any kind of rock underlies the bar at a depth that would call for removal. Outside to seaward there would appear to be mud in a very fine state of comminution not unlike that found at Narrakal to the north. This may, as supposed by the Chamber of Commerce, have anciently been a backwater though there is every reason to suppose that it also consists or has been added to by the continued though yearly small deposits of silt carried over the bar in the height of the monsoon.

12. North and south of the general run of the deep channel, between the actual mouth and the bar, the shoals, though necessarily varying somewhat in contour from time to time, continue pretty constant in extent and position, and, so far as we are able to judge, there is apparently no tendency for the effluent water to take any other direction or establish a new channel. The narrow channel adverted to by the Chamber of Commerce as passing in front of the long groyne at Vypeen point, and stated to be sometimes used for boats, is, we find, merely trifling excavation due to the swirl of the ebb water at the spot, and only to extend a few yards. Its existence can have no bearing on the question of a harbour.

13. There are seven long and one short groynes at intervals along the beach on the south side of the mouth (the Cochin side), and one long and nine short groynes on the Vypeen side. With the exception of the long one above mentioned (which rather requires looking after as it is not in good repair) they seem to have done the work fairly in correcting encroachment, but call for no remark in reference to the object of our immediate inquiry.

14. The pot-hole shown on all charts to exist within the immediate limits of the mouth, ranging from 28 to 48 feet in depth, still appears to exist in much the same

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form as in previous years, though possibly the actual line of deep channel here may vary a little. Holes of this character, due no doubt to down or reflex currents which are found to exist in all cases of obstruction like a bar to the effluent water (in bridge piers, &c.), are apparently very constant in all similar cases along the coast. Mr. Robertson notices the deep pot-hole which was found at the Cruz Milagre Gap while there was a bar outside with only 2 feet of water on it. Numberless other similar instances can be adduced, and we are satisfied that no arguments based on such facts, as the existence of holes of this character, can have any bearing on the feasibility or otherwise of forming a harbour. They are directly produced by the bar in front, and were this latter removed there would, in our opinion, be no down or reflex currents tending to form such holes, which consequently would in that case fill up to the uniform level of the bed throughout.

15. We now come to deal with the proposals put forward for the formation of a first-class harbour, and in regard to this we may at once say that the chief result of the conference held at Cochin on the 5th instant, has been the recognition of all concerned, as to the necessity which exists for carrying out any breakwaters that may be constructed, (with a view to confining the ebb stream and sweeping away the bar) into a depth 5 fathoms, it being clear that under no other conditions could it be expected that the harbour should prove of use to vessels of large draught during the south-west monsoon or whenever there was any swell. In regard to this point it is only necessary to refer to the statement contained in paragraph 4 of letter No. 81, from the Honorary Secretary, Chamber of Commerce, dated 20th January 1881, where it is observed that their proposals "provide a channel of 30 feet deep into the same depth of water."

16. The reasons which have led to this decision have already been sufficiently dwelt on in the letter from the Master Attendant of the 16th December, and need not be recapitulated; but it must be observed that the acceptance of the principle, alters materially the question regarding which we have been called on to offer our opinion; as the extra expense due to the additional two miles of breakwater (one mile on north and the same at least south) which on the suggested plan would have to be carried out, so as to reach the five fathom contour line, renders it hopeless to expect that the funds derivable solely from local imposts could possibly suffice to defray the $4\frac{1}{2}$ per cent. on capital outlay as required by the Government of India for including the work under the head "Productive."

17. In the absence of a complete estimate an opinion of this kind can of course be only accepted for what it is worth, but we have no reason to think that the Chamber of Commerce themselves would be indisposed to accept this view, as in their correspondence they have dwelt on the necessity of economising on the outlay proposed for their original scheme, embracing certainly not half the work now seen to be essential, in order to bring it within their local means.

18. From 50 to 60 lakhs would in our opinion be the least which such works would in all probability cost, and if to this be added the usual indirect charges for interest of money while the work is under construction, &c., as ordered by Government to be shown in all like cases, we feel we are not in any way overstating the matter when we affirm that 70 lakhs is the least amount which the works would cost; and as the local imposts would have to meet not only the interest charge of $4\frac{1}{2}$ per cent. on this but also provide means for covering such extra charges for maintenance, establishment, &c., as may be necessary, for the future, there is no hope of this being done in the manner suggested by the Chamber of Commerce, solely from local resources.

19. But as it is quite open to the Government to deal with the work as one of sufficient Provincial or even Imperial importance, a view that the Chamber of Commerce have strongly pressed, we feel it right to point out certain considerations which under this aspect of the question seem to us to call for attention, before it would in our opinion be desirable to frame any estimate.

20. In this sense we will consider the scheme in its present form to consist of the construction of two long breakwaters running parallel to each other or nearly so, say 400 or 450 yards apart, into 30 feet depth of water, so as to concentrate such scour-

ing power as may exist in the ebb tide, with a view to the removal of the present bar, and to maintaining this depth throughout the year.

21. The difficulties we have felt to exist in regard to any scheme of this character are—

- (1) The construction of breakwaters on this plan would neither change the volume nor the velocity of the stream which now issues through the mouth, in spite of which the present bar has been formed. The natural and inevitable tendency would therefore we consider be to the reconstruction of the bar, and gradual reproduction of much the same condition of matters as now exists only a little further out to sea.
- (2) The removal of the bar were such ultimately possible, would allow of rollers, entering the new mouth during the south-west monsoon, to advance unchecked right up to the easternmost extremity of the harbour so formed; and we are thus of opinion that the entrance of any vessels at such periods between the pier heads would be an extremely hazardous and even dangerous proceeding; excepting during ebb tide with steamers or sailing vessels assisted by steam tugs. This condition would seriously diminish the value of the harbour as one of refuge. Again all shipping inside the harbour as proposed would be exposed to the full force of these rollers, and the anchorage or wharfage be in consequence rendered extremely inconvenient if not unsafe.
- (3) From the manner in which the breakwaters are proposed to be carried out we consider that no future dredging of any practical value would be possible.

22. In dealing with the first of the above difficulties, it may be as well at once to say that too much stress has been laid by the Chamber of Commerce, on the supposed formation of the bar as being directly caused by the deposit of silt brought down by the river.

23. No weight has ever been laid by us on this point which only incidentally cropped up in reference to Vizagapatam, (the Government Order connected with which was communicated to the Chamber of Commerce for general information only prior to our visit), the conditions of which are different, as it has a river often necessarily charged with silt discharging through the mouth.

24. No doubt the great Cochin backwater does act as a very complete settling bed for silt as urged by the Chamber of Commerce, but it cannot do so wholly, and we are unable to admit the argument employed by them as to the formation of the present reclamations inside the backwater, being due to sand carried in from the sea as stated with the flood tide. The ebb tide assisted by river freshets especially during the monsoon, must of necessity be a much more powerful agent for moving all matters in suspension (as being greater in volume and velocity) than the flood tide, and to suppose that more material is carried into the backwater, than is discharged from it, is opposed to all physical laws.

25. It is not, however, necessary to pursue this subject further. So far as the actual formation of the bar at Cochin is concerned, this factor may be entirely omitted, as the existence of this, like every other bar here and elsewhere in all parts of the world, is mainly, if not entirely, due to the action of the surf.

Mr. Robertson observes with reference to this that "the surf is always striving to restore the natural profile of conservancy of the shore. After the current has flowed out to sea for nearly a mile, it is no longer able to resist and keep down the ever working and powerful efforts of the waves to reform the profile of the coast, by continuing the beach line which has broken through the outgoing current."

26. In a paper by Mr. I. J. Mann, C.E., it is shown that while this statement would meet with very general acceptance of all professional men, the explanation of the causes leading to the establishment of bars has been various. It is, however, needless to advert to more than one of the various authorities on this subject, viz., Mr. D. Stevenson, who attributes the formation of all such bars solely to the action of the sea. "The waves," he observes, as is well known, throw up "a girdle of light or heavy material" * * round every bay and headland of our (English) coast, and the

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entrances to rivers form no exception. The effect of this constant action of the sea is to form a continuous line of beach across the mouths of our tidal rivers and inlets." He does not appear to attach any importance to river currents as agents in the production of bars, observing that "a bar would be formed *although the outgoing current held not one particle of matter in suspension.*"

27. It only requires a glance at any good chart, exhibiting in detail the *debouchures* of all our rivers along both east and west coast on this Presidency to show that, wherever the shore is made up of sand or easily moved material, and is unconfined by rock or other obstruction, the tendency always is for rivers on approaching the coast to turn suddenly to the north, and often not for miles find an exit to the sea. This as well known is due to the superior power of the south-west monsoon which by induced sea currents, driving the sand before it below the surface, and by the wind acting on all exposed sand above, advances the sand-spit at the mouth further and further northward till a certain point is reached, when the river bursts out again south and the advance northward recommences.

28. In Mangalore we have lately been able to show that the movement northward of the river mouth due to this action, has apparently been pretty steady at the rate of 300 feet per annum during the last 54 years. But without multiplying instances it will probably suffice to note, as now clearly established—

1st,—that whether the effluent stream contains material in suspension or not, the tendency is for a bar to be formed, wherever the forces of the surf on one side and the stream on the other sufficiently neutralize each other;

2nd,—that the sand forming such bar is carried chiefly from south to north across the line of the normal direction of the debouching river. The contention of the Chamber of Commerce, in paragraph 13 of their letter No. 87 of the 19th instant, that "the currents and deposits at the ends of the proposed groynes would thus assist and not obstruct the endeavours to form a good harbour" is therefore in our opinion not borne out by the facts as now explained.

29. It may, of course, be fairly contended that there is a certain depth below the surface at which the wave action is *nil*, and there is no sensible amount of sand in movement at such depth. This is practically the contention of the Chamber of Commerce, and it is at first sight supported by the following observation of Mr. Robertson to warrant consideration, viz., that "were the current kept together in full strength till it got into such a depth of water that the action of the waves was not sufficiently powerful to stir up the bottom, there would be no decided bar."

30. Mr. Robertson does not, it will be noted, say at what depth of water such action may be expected to cease, and in the plan he proposes for a harbour at Cochin he evidently considers that the groynes suggested would not reach this undisturbed depth, as he observes that "a little dredging or raking" will be needed to preserve the depth of channel. (In connection with this remark it may be parenthetically observed that Mr. Robertson considered that the effect of the works suggested by himself would only secure a depth of from 20 to 21 feet at low water, which it is unnecessary to say would be wholly insufficient for a first-class harbour).

31. Without a series of very carefully conducted experiments, it would be impossible to decide this point in a manner sufficiently conclusive to satisfy every one, but in the paper before adverted to by Mr. Mann, there is a good deal of evidence to show that wave action is felt at depths hitherto apparently unsuspected.

32. Without overburthening our report with quotations, it may be sufficient to say that among the evidence adduced, it seems that on the banks of Newfoundland the agitation during storms has been known to affect the bottom at a depth of over 80 fathoms; at St. Jean de Luz in the Bay of Biscay over 160 fathoms; and at Land End the lobster traps are frequently filled with coarse sand and shingle during heavy ground swells in depths of 30 fathoms. Sir G. Airey mentions also that ground swells frequently break in a depth of 100 fathoms.

33. We do not wish it for a moment to be understood that looking to the general character of the seasons on the west coast, and the immunity which it appears

to enjoy from cyclones, that disturbance may be expected at depths such as these; but accepting the fact that the south-west monsoon sets in at times with considerable abruptness and strength, we are not prepared to say that in such occasions the sea bottom is not agitated at 5 fathoms in depth. In fact we incline to the opinion that unless there be some very direct proof to the contrary, such may be accepted as almost certain to be the case, especially considering the very shelving character of the west coast, which in this respect differs materially from that found near Madras, and most of the east coast, and that it would therefore behove Government to hesitate in adopting a scheme which, perhaps a single season of an unusually heavy monsoon, might render nugatory.

34. Dredging, as we shall presently show, is not apparently available for deepening channels situated like the one proposed with mouth open to the sea and exposed to swell; consequently if it be desired to give a prolonged life to the harbour with works of this character, it would be desirable not to stop the groynes in 5 fathoms, but to run them out another half a mile into $7\frac{1}{2}$ fathoms (which is the same as that adopted for the Madras harbour) as the best available expedient.

35. We now beg to turn to the second set of difficulties which has presented itself to us, viz., those which would probably be felt by every master of a vessel, approaching a harbour of the proposed character during the south-west monsoon, or in fact at any time when there was a heavy sea and wind.

36. It will be remembered that the essence of the proposed scheme is to preserve an uniform section of channel into deep water, so as to maintain, as far as possible, intact the scouring power of the effluent water, and keep the whole as clear as possible of deposits. However the direction of the groynes might be varied, this must in the main be the guiding principle so as to sustain the validity of the grounds on which the scheme is based.

37. But if this be so, there must be an exposed mouth and a long channel up which the seas must sweep with uninterrupted swing, till they gradually die away or become dispersed by the shoals of the backwater, at the extreme east end of the harbour. Mr. Robertson clearly indicates this difficulty, when he observes that, "it must be remembered that in reducing a bar we take away a kind of breakwater in front of an entrance and introduce a bigger wave."

38. A strong opinion has already been expressed by the Master Attendant on this point, and statements have reached us of the extreme difficulties and dangers which comparatively small craft have experienced in approaching the present mouth of the port in the monsoon, though having plenty of sea room to work in and able by their small draught to double sharp round to south-east end of the channel, after passing through the mouth and bring up in a perfectly sheltered anchorage, none of which advantages would be open to large vessels entering the harbour under the proposed scheme.

39. As directly bearing on this point, we would now quote the following observations from a report by Commander A. Dundas Taylor in reference to the proposed ship canal between Ceylon and India, dated 28th July 1871, viz., "To examine the sea approaches and thus to determine the accessibility of a port, is a first essential, and comes within the province of the Marine Surveyor. A glance at the plan which exhibits the sites of all proposed schemes (for Pamban) will explain how unreasonable would be the tax upon a Master Mariner's skill, in seamanship and navigation, when attempting to enter either of the openings, which were submitted to the consideration of the Parliamentary Committee * * * I am convinced that mishaps would have attended any attempt to shoot the canal's mouth when the monsoon swell and current accompanied the steamer."

40. It is needless to say that the dangers thus foreseen with reference to Pamban, would have equally to be counted on and disposed of, in dealing with any harbour scheme for Cochin.

41. The third and last difficulty as to the impossibility of carrying out satisfactorily dredging operations, in a channel exposed to heavy swell, is more easily disposed of. No dredge so far as we are aware has yet been devised for working satisfactorily in such positions. With all the adjustments that it may be possible to make, any sudden

jerky movements in the vessel must communicate themselves to the bucket ladder, and produce strains which would very soon break up the strongest framing of this character. On a few quite still days, aggregating say six weeks in the year, a dredge like the Albuquerque might work, but it must be obvious that this would go but a small way to meet the requirements of the case. The *Albuquerque* dredge with her side anchors and cables would moreover by herself take up 800 feet in width of the channel when at work and thus seriously impede traffic.

42. After the foregoing exposition of our views, which owing to the very able manner in which the Chamber of Commerce have stated their case, we have found it desirable to detail at greater length than might under other circumstances have appeared necessary, it is needless to say that personally we feel ourselves unable to recommend the scheme put forward by that body, and that consequently it is at least at this stage unnecessary to go into any of the engineering details.

43. It does not, however, necessarily follow that the rejection of this particular scheme would invalidate all others. We are given generally to understand for instance that Mr. Parkes is under the impression from the papers sent him by the Chamber of Commerce, that a plan by which the bar might be sheltered and then removed by dredging, somewhat in the same way as in his Kurrachee harbour, might be feasible; and although it would probably take some time to mature a scheme of this nature, we are not prepared to say that with abundant means at disposal, a harbour based on this principle might not have a good deal to recommend it. The general principle whether applied in the form of a detached breakwater entirely shielding the bar from the action of the surf or otherwise, has certainly more to recommend it than the one we have been considering, though the latter might under certain conditions be either wholly or in part incorporated with it.

44. All we are now concerned with however is whether with this new light on the subject, it would be desirable to have the details of the scheme worked out by Mr. Parkes.

45. It can hardly be questioned that the cost of constructing such a breakwater out to sea as would admit of the bar being entirely sheltered, and of the whole of the stuff being dredged out (this would be by far the cheapest part of the operations) must be of anything be greater than what we have before named as likely to be required in the scheme we have been obliged to condemn.

46. The question again therefore arises as to whether any Provincial or Imperial subsidy can be looked for in aid of the local resources, which would certainly be insufficient for the execution of a project of the kind. The Chamber of Commerce urge strongly their claims for a subsidy of this character, and in the late minute by the Honorable Sir Andrew Clarke, the necessity of creating a certain number of harbours of refuge along our shores, to meet the exigencies of war have been seriously pressed on the attention of the Government of India. It appears to us, however, that it would be exceedingly difficult to render an open place like Cochin defensible against an enemy's vessels, which stealing in sufficiently close at night could easily injure the place without running much risk themselves. Trincomalee is in fact so far as we are aware the only harbour between Bombay and Calcutta which naturally lends itself to such an object, and which would be at once perfectly secure and easy of access.

47. We can only therefore say that if the Government, after weighing what we have advanced, still consider these claims sufficiently well founded, and there be any probability that they will be recognized by the Government of India, it would be difficult to find a more able professional Harbour Engineer for drawing up a complete scheme, and framing an estimate of the probable cost, than Mr. Parkes.

48. There would in our opinion be no sufficient object gained in going minutely into a discussion of ways and means for meeting interest on outlay, at this stage of the enquiry especially as under the proposals put forward by the Chamber of Commerce in the letters printed with G.O., 27th December 1880, No. 2,943 W., there are several points involving not a little complexity, regarding which our information is incomplete.

49. We took advantage of our visit to Cochin to inspect the singular mud bank at Narrakal, situated some 6 miles to the north, and which for the last few years has been used by the merchants for shipping and landing goods throughout the monsoon.

50. There is backwater all the way to within a quarter of a mile of Narrakal, where the Cochin Government have cut a boat canal across the sand-spit separating it from the sea, and constructed a covered passage with tramway from this close up to the beach, as also a small landing pier. The very serviceable condition of this latter work after three years wear and tear, shows that at least in that period there have been no heavy seas at this point.

51. The bank consisting of the very finest mud (of a greenish black color and very unctious to the touch) seems so far as can be ascertained to extend about three miles along the shore from south to north, and $4\frac{1}{2}$ miles out to sea. It has not apparently shifted its position as seems to have been the case with other similar banks, notably that which though known to have been at Alleppy some 20 years ago, has apparently moved 7 miles south to Porcad, and is still believed to be progressing gradually to the south.

52. The effect of the bank on the portion of sea covering it is singular, as at the first burst of the monsoon there is said to be the same surf as in other parts of the coast; the water is discolored and dark with the churned up mud. But after this stage has passed this seems to settle down and becomes clear like the rest of the neighbouring sea. Some persons consider the surface has an oily look at this time, and others that air bubbles stems and branches of apparently submerged trees rise to the surface, &c., but of none of these statements is there any distinct proof.

53. What, however, appears certain is, that the full characteristics of this tract in providing a perfectly quiet anchorage during the monsoon are not fully developed till the monsoon has sufficiently advanced to render the water in the backwater on the land side quite fresh, and that during this period the water on the bank out to sea is also so fresh, as to lead to the conclusion that such water at this time rises from the bottom under pressure.

54. The effects, however, are that the monsoon swell gradually subsides over the outer limits of the bank and vessels are thus enabled to run into comparatively quite still water at the height of the monsoon, thus providing Cochin with an unrivalled harbour during this period. So far as can be ascertained, no surf breaks along the margins of the bank; the seas merely die away.

55. There can of course be no question that there are a number of serious drawbacks to trade conducted in this manner, and that merchants suffer considerably by losses of goods exposed in the canal boats, and by fraud and carelessness on the part of the boatmen, but the fact remains that they are able to carry on trade at this period when all other west coast ports (except Porcad) are closed.

56. As considerable interest attaches to the conditions under which the mud banks alluded to exist on the coast, it is to be hoped that Mr. W. King, Assistant Superintendent, Geological Survey of India, who joined us, and secured some specimens of the mud for analysis, may be enabled to follow up the inquiry.

57. A chart giving general information about the Cochin anchorage and port, and also showing sufficiently the proposed scheme for a first-class harbour accompanies this report for facility of reference.

(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.

(Signed) J. H. TAYLOR, Lieut., R.N.R.,
Master Attendant.

MADRAS,
23th February 1881.

9/11-12/32 P1

N. 87 Chamber of Commerce,
Cochin, February 19, 1881

From
The Honorary Secretary,
Chamber of Commerce,
Cochin.

To, The Secretary to Government,
Public Works Department,
Madras.

Sir,
Referring to the meeting where
the members of this Chamber had
with you and Captain Taylor, R.
N.R. on Saturday the 5th instant,
I now by desire, have the honor
to offer the following observations
on the various points which you
left for further consideration by
the Chamber.

1. The first in order is the question
whether the floods in the
backwater bring down such
silt, as, depositing outside the
entrance, now forms the bar.
The Chamber has already ex-
pressed a very decided opinion
that

that no such silt is discharged from the Backwater, and its opinion on this point was not in any degree shaken by the opposite views expressed at the meeting referred to.

3— At the meeting there were produced by the Chamber two bottles of flood water taken from the mouth of Backwater on the 14th December last. Between that date and the 20th November preceding there had been a fall of upwards of eight inches of rain over the district between Cochin, Alleppey and the Travancore Hills, and the rivers from the Hills being in heavy flood, there was being discharged from the mouth of the Backwater an usual mountain flood.

4— The samples of water, which were drawn in the presence of the Master Attendant of the port, were as bright and clear as water can be. A few particles of substance were contained in them, but not sufficient to form the thinnest film over the bottoms

of the bottles or when shaken up to at all cloud or discolor the water. The taste of the water was but slightly brackish, a fact which may be noted as a proof of its being flood water, for in the absence of flood the Backwater becomes salt to a distance of 30 to 35 miles from Cochin.

5— The appearance of this water was not considered by you as at all confirmatory of the Chamber's statement, because (1) you deemed it probable that the silt, being heavy, might not be held in suspension by the waters, but by the strength of the current might be rolled along the bottom of the Backwater, and (2) because inside the Backwater you had observed along the shore obstructions placed with a view to causing reclamations by deposit of silt.

6— In reply to the first objection the Chamber begs to observe that such rivers as the Hooghly, Godavary, Cauvery, Indus, and perhaps all other rivers that are known to bear down silt, and, in consequence, to have bars

is the objection that the construction of the works proposed by the Chamber, would not, alter the direction and strength of present forces, and that therefore the bar must reform, the time required for it to do so being regulated by the length of the breakwaters.

10— The Chamber is not prepared to allow that with groynes thrown out to the length and depth contemplated, the present forces will remain unaltered. The bar is now formed and reformed by sand forced into mechanical suspension in the water owing to the action of the surf on the coast, and then being carried by the littoral current across the Backwaters' mouth where, meeting with opposing currents, the sand is at once deposited. This being so, the groynes once prolonged beyond the effect of the surf on the bottom, the reforming action becomes, at any rate for a time, impossible.

Mr. Robertson says, page 31 of his report. "Where the current is kept together in full strength till it got into such a depth of water

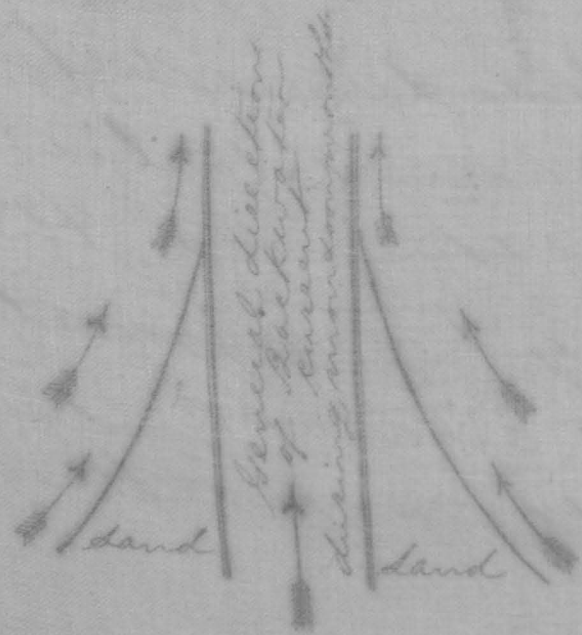
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"water that the action of the waves
"was not sufficiently powerful to
"stir up the bottom there would be
"no decided bar." 911-12

11— If it be urged that the littoral currents would still bring up the sand and deposit it north and south of the groynes increasing the breadth of the beach until the profile of the coast extended to the sea end of the groynes, and would there reform a bar, the Chamber submits that such action must be the work of a great length of time, that the coasts north and south would have to be eroded to an unprecedented extent before the materials could be obtained for such an extensive filling in, and these coasts are protected for some distance by the small groynes already in existence. Again the bottom of the sea is nothing but mud and could lend no material for the purpose.

12— The same action around the Madras Harbour works has been estimated, the Chamber believes, to require about two hundred years; and at Kochin, where there is a slower littoral current and

and the proposed groynes longer, an equal time may be necessary, even though the depth of water be less. —

13 — Moreover supposing this filling in to have taken place the profile of the coast would then be altogether different to what it now is, for it would exhibit two tolerably sharp curves along the contour of which the littoral currents would be forced to sweep and the sand which they would carry would be deposited, not in a line running at nearly right angles to the shores in and out of the river, but into lines which with the assistance of that scour would form for a long distance prolongations of the groynes and thus assist and not obstruct the endeavours to form a good harbour. —



14 — The common belief that the mud banks of Tarrakal and Ellephey have been the work of rivers depositing their silt at these places, is, the Chamber thinks, erroneous — as far as Ellephey is concerned, it has no river near it.

15 — It is a well known fact that the bottom of most of the Cochin extensive Backwaters is a deep bed of mud similar in every respect to the mud composing the banks at Ellephey and Tarrakal. It is also a pretty well ascertained fact that the strip of sand which separates the Backwaters from the sea was a long distance further to the west than it now is and that the sea has encroached. Nothing therefore is more likely than that the mud banks of those two places were once bottoms of Backwaters.

16 — Some stress was laid on what was said to be a fact that in no part of the world had bars to rivers been got rid of. But the Chamber does not

consider

Consider this to be an overwhelming argument against the proposed works for Cochin, for in the case of this port, the circumstances to be dealt with are not such as are met with in other parts of the world. Cochin is an exception in many ways to every thing met with elsewhere.

First - Cochin has no river strictly speaking, but only an opening from the Backwaters to the sea.

Second - The extent of Backwater which has to be filled and emptied every tide is altogether unprecedented thereby giving an impetus to the ebb and flood unknown elsewhere.

Third - No ascertainable silt is deposited.

Fourth - The bottom of the sea is mud not sand.

Fifth - Cochin has both to the north and south a safe anchoring ground in smooth water for vessels in case of weather so bad as to make it unwise to risk an entry into the harbour.

Sixth - The wind during bad weather is invariably fair for ships entering the Harbour.

Seventh - Cyclones are absolutely unknown.

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17 - The Chamber in its letter of 25th November 1880. No 75. para 16. estimated that about one-third of the trade of the port is conducted inside the mouth of the Backwater, and allowed for the less lightage such trade has to bear in the average of the lightage paid on the whole trade of the port. The one-third includes both British and Native trade whether carried in British or Native craft. The native craft, being of small tonnage is able to come close in shore, and so to a large extent incurs much reduced lightage, but the number of such vessels is rapidly diminishing owing to their inability to compete with the coasting steamers, and it is only a matter of a few years when the native carrying trade between all ports visited by steamers will practically have ceased to exist. The following figures warrant this anticipation.

Native

Native vessels frequenting the
port of Cochin.

	No	Tonnage	Port dues
1876-77	863	45224	4234.
1877-78	736	34815	3262.
1878-79	741	35010	3282.
1879-80	496	25060	2347.

These vessels never venture to sea
during monsoon weather pay for
five months in the year.

18— The Chamber is having pre-
pared a statement of the value
of the trade carried by this class
of vessels during the past two years
as compared with the total value
of the trade of the Port, which when
completed, will be forwarded to you.

19— A meeting of native mer-
chants was convened by the Chamber
on the 11th inst. when the Chamber's
proposals to Government were formally
laid before them for expression of
their opinion thereon. To the most
influential of the body the proposals
had been fully explained some
days previously and they were
requested to give them every
publicity in the Bazaar. At the
meeting the following resolution
was passed, and a certified copy
of the proceedings is attached
hereto.

Having

911-12
P15.
"Having had explained to us
the details of the scheme for the
"improvement of the Cochin Harbour
"which has been prepared by the
"Chamber of Commerce, we are of
"opinion that the proposals are
"in the interests of the Native
"Mercantile Community, and
"merit their support. We fully
"endorse the views expressed by
"the Chamber in their communi-
"cations to Government on the
"subject of the dues which the trade
"of the port can bear to pay interest
"on the cost of the proposed works,
"and are confident that the interests
"of the Native mercantile Com-
"munity in this matter can be
"safely left in the hands of the
"Chamber of Commerce."

20— In considering the claims
of the respective interests, European
and Native, on Government in
connection with the proposals for
Harbour improvement, it should
be borne in mind that only few
of the principal Native Merchants
of Cochin reside and carry on
business

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business in British Territory. The majority are subjects of the native state of Cochin, and whilst enjoying all the advantages of a British port for their sea borne trade, the opportunities for trade opened out by British enterprise, and, in fact, owing their whole prosperity as traders to their contiguity to a body of British merchants, contribute but little to the Imperial Revenues of India. On these grounds, if their views had been antagonistic to the proposals put forward for the improvement of the port, the Chamber would have been prepared to urge the prior claims of the interests of British subjects over those of a foreign state on the consideration of the British Government. Native merchants however have recognized that their interests are identical with those of British merchants in the Chamber's proposals.

21.—The extra charge of one anna per ton proposed to be levied on vessels visiting the port, ought to be specially assigned to the port even though there be no change in the grouping of Western ports.

All

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All that the Chamber has to propose is that, the earnings of the port be applied to its improvement, and arrangements to effect this would seem a matter of account and not difficult.

22.—In the present system of grouping the ports on this Coast, it does not follow that the amount of port dues collected in Cochin represents more than its proper earnings. Coasting vessels do not always pay their port dues in Cochin. Having paid the dues here once, the next time they become payable the vessel may be at any one of the other ports of the group, and there they are levied. Each port has its chance.

23.—Whether the trade of the port can provide not only interest on the cost of constructions but also cost of maintenance of works and allowances to establishment the Chamber cannot say, not having an estimate of the capital required. The Chamber has shown, on an average of the trade of the port for ten years, about what the port can now

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now provide, and there is reason
to believe that such improvements
as have been proposed would increase
the trade and also the revenue.
On the figures which have been
furnished it is for Government
to decide after obtaining estimate
of cost whether the trade can bear
all the charges referred to.

24.— But supposing the estimated
revenue falls short of the required
sum, the Chamber would urge
that, as the proposals they have
made merit the attention of Govern-
ment from an Imperial point
of view, Imperial revenues should
be charged with the deficiency which
it is anticipated cannot be large.

25.— The Chamber in putting its
views before Government do so
in what is believed to be the in-
terests of the port and the whole
mercantile Community. But
at the same time cannot fail
to notice the fact that the Har-
bour improvements advocated,
while benefiting the local trade,
would also be of essential im-
portance to the whole of South
India, connected with it as the
port is likely soon to be by rail.

211-12 817
26.— In case of war with a naval
power such a land locked harbour
centrically situated between Bombay
and Trincomalle, would be of
inestimable value as a harbour
of refuge where ships could repair
and refit and as a resort for our
ships of war; and its nearness
to Aden, being about two days
nearer than Bombay by home-
ward bound steamer routes during
monsoon months, points it out
as a port possessing every capa-
bility for becoming of very con-
siderable importance.

27.— The Chamber had not had
an opportunity of perusing Mr.
Robertson's report on the port
prior to your visit, and the copy
kindly lent by Captain Taylor
has been read with considerable
interest. The favorable opinion
of such an authority, the Chamber
trusts, will have great weight
with Government and lead them
before deciding against the
Chamber's schemes, to appoint
a practical expert to inspect
and report, if further report
is

P 18
is thought necessary. If Mr. Parker
or Mr. Thorowgood of the Madras
Harbour works could be deputed
to this duty he would be able
to make an approximate estimate
of cost, and his practical experience
would enable him to put a true
value on the objections raised and
the arguments used to overrule
them. He would be able to pro-
perly estimate the great advantages
of the port and suggest the best
means of making the most of
them.

28.— Steps are being taken to
obtain the views of Commanders
of vessels visiting the port on
the points on which a nautical
opinion is desired, and the
opinions which may be received
will be forwarded to you.

I have the honor to be
Sir,

Your most obedient servant

W. A. Smith

Honorary Secretary

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Proceedings of a meeting of
European and Native Merchants
of Cochin held in the Office of
the Municipal Commissioner
of Cochin on the 11th February 1881
to consider the interests of the
Native Mercantile Community
in the proposals made to Govern-
ment by the local Chamber of
Commerce for the improvement
of the harbour of Cochin.

Present

G. Brunton, Esq. in the Chair.

J. H. Aspinwall, Esq.

H. T. Holmes, Esq.

G. A. Jung, Esq.

O. M. Raphael, Esq.

J. L. Ogilbyson, Esq.

Keejee Kanyee, Esq. (Moogee Jattah & Co.)

Kassary Derjee, Esq. (Danyee Admire & Co.)

Kadjee Moosah Haji Hamed, Esq.

Danyee Danyee, Esq. (Danyee Ootah & Co.)

Maljee Kasavjee, Esq.

Fishnoo Kasava Sampala, Esq.

Jenardina Govinda Jokeh, Esq. (Hidma)

Demaka Devada

Pundaling Kanyee, Esq.

Karri Kasodeva Prebo, Esq.

Leekmena Babajee, Esq.

Opendra Shetty Ganapathy, Esq.

Kama Chundra Mata Deva, Esq.

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J. F. Peckham, Esq
Dharsee Khetsee, Esq
C. A. Pereira, Esq
P. Fierira, Esq
G. Lupermais, Esq

The Chairman explained the details of the Chamber's proposals for Harbour improvements and invited any gentlemen wishing for further information to enquire for it after some discussion it was proposed in behalf of the Native Mercantile Community by Mr Hadjee Moosah Hadjee Hamed and seconded by Mr Keesjee Khanjee that

"Having had explained to us the details of the scheme for the improvement of Cochin Harbour which has been prepared by the Chamber of Commerce, we are of opinion that the proposals are in the interests of the Native Mercantile Community and merit their support. We fully endorse the views expressed by the Chamber in their communications to Government on the subject of the dues which the trade of the port can bear to pay interest on the cost of the proposed works, and are confident that the interests of the

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"Native Mercantile Community in this matter can be safely left in the hands of the Chamber of Commerce."

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The resolution on being put to the meeting was carried unanimously.

Signed/ Geo. Beunton,
Chairman.

(True copy)

W. A. Jones
Honorary Secretary

S. W. C No 1184

Recd 24th Feby/87

Cochin Harbour

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Report on the Cochin Harbour.

211/12
1889

In compliance with the decision of Government conveyed in G.O. of 27th Decr 1880 N^o 2943 W we the undersigned inspected the Cochin Harbour on the 4th and 5th instant, and on the latter date had the advantage of a very complete discussion of the general points at issue with the Chamber of Commerce, several of the leading native merchants being also present on the occasion.

2. Prior to our arrival the Chamber of Commerce had submitted their letter

+ G.O. 222 W. d/26 Jan'y. 81.

N^o 81 d/20 Jan'y. 81 combating the views put forward by them

Master Attendant, in his letter of the 16th December 1880 N^o 11.132 printed with the previously quoted G.O. and again they have in a still later communication explained very fully their views in the Honorary Secretary's letter N^o 87 of 17th instant dealing with some of the most important points discussed in the Conference of the 5th instant.

3. Unfortunately ^{Commander} ~~Captain~~ A.D. Taylor, whose presence was specially desired by Government and whose advice would have been most useful to us, was unavoidably detained in Calcutta.

4. On the whole however we believe that we have obtained a sufficient knowledge of the locality

He has however telegraphed to the Master Attendant expressing ~~the~~ general concurrence with his views regarding the Cochin Harbour

~~and~~
~~to the~~
~~Master Attendant~~
~~in the~~
~~7th instant~~
~~and~~
~~generally~~

~~and~~
~~and~~
~~and~~

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and of the views of those who are most interested in the question of a harbour to indicate the points on which future discussion must hinge and thus at least narrow the issues in a way that will enable Government to obtain the opinion of experts like Captain A.D. Taylor in this country, and if necessary, of professional men in England, before committing themselves to a final decision.

5. The previous printed reports as also that by Mr. George Robertson in 1871 will have already sufficiently explained the physical features of the present part of Cochin and its exceptionally large back-water, we shall therefore, at once proceed to state the facts that have come under

our notice as bearing upon
the question of the proposed
harbour, and the inferences
we have drawn thereupon.

6. On the morning of the
4th February 1881 we found two
vessels anchored as stated
to us by the Port officers
at not a less distance than
 $1\frac{1}{4}$ miles west of the bar,
which again was not less
than 1,300 yards in a direct
westerly direction from Light-
house point.

7. Our own small steamer
the "Margaret Northcote"
anchored 1 mile west of
the bar apparently just
at the limit of the 5 fathoms
contour, as the soundings,
taken in proceeding inwards
towards the bar clearly
indicated.

8. The buoys at north

911-12 and south ends of the bar
showed it to be 385 yards
in length the water shoaling
sensibly beyond this limit
on either side. At half
tide the minimum depth
of water was 14 feet or
somewhat less than 13
feet at low water.

9. The last monsoon being
of more than usual strength
the bar seems to have been
forced back 200 yards closer
to the shore than during the
previous year when it was
1,500 yards west of Lighthouse
point, and seems to have
had a minimum depth in
it of 16 feet.

10. Mr. Robertson, it will
be observed, found only 11
feet on the bar, but as
the Cruz Milagre gap was

then open, this may be
considered as less than what
may be fairly calculated
on in ordinary seasons; but
it must be borne in mind
that very extensive reclama-
-tions have for a long time
been in progress in the
Cochin backwater, and as
the area over which the
flood tide has to spread
is thus being gradually,
though probably not as yet
very sensibly, contracted
the volume of water poured
out at the mouth has a
tendency to be decreased,
and with this decrement
both the velocity and scouring
power must diminish.

These facts must have weight
in deciding on any harbour
scheme that may be devised.

11. Immediately on the bar

It must also be borne
in mind that the
whole of the backwaters
being entirely within
native territory the influence
of the Madras Government
in limiting or controlling
the reclamations can at
best be only indirect

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we found the material
brought up to consist of
rather coarse sand and shells
but there is nothing here or
in any of the surrounding
country to indicate that
laterite or any kind of rock
underlies the bar
~~quite here~~. Outside to seaward
there would appear to be
mud in a very fine state of
commixture not unlike that
found at Karaikal to the
north. This may as supposed
by the Chamber of Commerce
have anciently been a back-
water (now depressed) though
there is also every reason to
suppose that it ^{also} consists or
has been added to by the
continued though yearly small
deposits of silt carried over
the bar in the height of
the monsoon.

12. North and south of the

general run of the deep
channel, between the actual
mouth and the bar, the
shoals though necessarily
varying somewhat in
contour from time to time
continue pretty constant in extent
and position, and so far
as we are able to judge
there is apparently no
tendency for the effluent
water to take any other
direction or establish a
new channel. The narrow
channel adverted to by
the Chamber of Commerce
as passing ^{in front of} the long groyne
at Vypeen point and stated
to be sometimes used for
boats is we find merely
a trifling excavation due
to the swirl of the
ebb water at the spot
and only to extend a few

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yards. Its existence can
have no bearing whatever
on the question of a harbour.
13. There are 7 long and
1 short groynes at intervals
along the beach on the
south side of the mouth
(the Cochin side) and 1 long
and 9 short groynes on
the Vypeen side. With the
exception of the long one
above mentioned (which
rather requires looking after)
they seem to have done the
work fairly in correcting
encroachment, but call
for no remark in reference
to the object of our immediate
inquiry.
14. The pot hole shown on
all charts to exist within
the immediate limits of the

mouth ranging from 28 to
48 feet in depth still appears
to exist in much the same
form as in previous years
though possibly the actual
line of deep channel here
may vary a little. Holes of
this character, due no doubt
to down or reflex currents
which are found to exist in
all cases of obstruction like
a bar to the effluent water
(in bridge piers &c) are
apparently very constant
in all similar cases along
the coast. Mr. Robertson
notifies the deep pot hole
which was found at the
Cruz Milagie Gap while
there was a bar outside
with only 2 feet of water
on it. Numberless other
similar instances can be

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adduced and we are satisfied
that no arguments based on
such facts as the existence
of holes of this character can
have any bearing on the
~~possibility~~^{feasibility} or otherwise of
forming a harbour. They
are directly produced by
the bar in front and were
this latter removed there
would in our opinion be no
down or reflex currents
tending to form such holes
which consequently would
fill up to the uniform
level of the bed throughout
15. We ^{now} come to deal with
the proposals put forward
for the formation of a
first class Harbour, and
in regard to this we may
at once say that the
chief result of the Conference

held at Wexham on the 5th
instant has been the
recognition of all concerned
as to the necessity which
exists for carrying out
any breakwater that may
be constructed with a view
to confining the ebb stream
and sweeping away the
bar into a depth 5 fathoms,
it being clear that under
no other conditions could
it be expected that the
harbour should prove of
use to vessels of large
draft during the South-
West Monsoon or whenever
there was any swell.

16. The reasons which have
led to this decision have
already been sufficiently
dwelt on in the letter
from the Master Attendant

In regard to this point
it is only necessary to
refer to the statement
contained in para 4 of
letter No 81 from the Hon
Secy Chamber of Commerce
dated 20 Jan. 1881 where
it is observed that the
proposals provide a
"Channel of 30 ft. deep
into the Lagoon deeper
of water"

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of the 16th December, and
need not be recapitulated,
but it is almost needless
to observe that the
acceptance of the principle
alter materially the
question regarding which
we have been called on
to offer our opinion as the
extra expense due to the
additional 2 miles of
breakwater (1 mile on north
and the same at least south)
which on the suggested
plan would have to be
carried out, so as to reach
the 5 fathom contour line,
renders it hopeless to ex-
pect that the funds
derivable from extra local
imports could possibly suffice
to defray the $4\frac{1}{2}\%$ on

capital outlay required by
the Government of India for
including the work under the
head "Productive".

17. In the absence of a
complete estimate an opinion
of this kind can of course be
only accepted for what it is
worth, but we have no reason
to think that the Chamber
of Commerce themselves would
be inclined to accept this
view as in their correspondence
they have dwelt on the
necessity of economising on the
outlay proposed for their original
scheme embracing ^{certainly} not half
the work, now seen to be
essential, in order to bring
it within their means.

18. From 50 to 60 lakhs
would in our opinion be the
least which such works would
in all probability cost, and

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if to this be added the small
indirect charges for interest
of money while the work is under
construction & a provision of
Establishment &c as ordered
by Government to be shown
in all like cases we feel
we are not in any way over-
-stating the matter when we
state that 70 lakhs is the
least amount which the works
would cost, and as the local
imports would have to meet
not only the interest charge
of $4\frac{1}{2}\%$ on this as also —
provide means for covering such
extra charges for maintenance,
Establishment &c as may be
necessary, there is no hope of
this being done in the manner
suggested by the Chamber of
Commerce solely from local
resources.

19. But as it is quite open

to the Government to deal
with the work as one of
sufficient Provincial or
even Imperial importance,
a view that the Chambers
of Commerce have strongly
expressed, we feel it right
to point out certain con-
siderations that under this
~~aspect~~ aspect of the question
seem to us to call for attention
before it would in our opinion
be desirable to frame any
estimate.

20. In this sense we will
consider the scheme in its
present form to consist of
the construction of two
long breakwaters running
parallel to each other or
nearly so, say 400 or 450
yards apart, ^{into} ~~with~~ 30 feet
^{depth of} ~~water~~ so as to concentrate

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such scouring power as may
exist in the ebb tide with a
view to the removal of the
present bar and to maintaining
this depth throughout the
year.

21. The difficulties we have
felt to exist in regard to
any scheme of this character are

(1) The construction of break-
waters on this plan would
neither change the volume
nor the velocity of the stream
which now passes through the
mouth, in spite of which the
present bar has been formed.
The natural and inevitable
tendency would therefore be
considered to be to the reformation
of the bar and gradual
reproduction of much the
same condition of matters
as now exist only a little

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further out to sea.

(2) the removal of the bar
would allow of rollers entering
the new mouth during the
S.W. monsoon to advance
unchecked right up to the
easternmost extremity of the
harbour so formed; and we
are thus of opinion that in
the first place the entrance
of vessels at such periods be-
tween the pier heads would
be an extremely hazardous
and even dangerous proceeding;
~~and would be a serious~~
~~impediment to the~~
~~navigation of the harbour~~
~~and would be a serious~~
~~impediment to the~~
~~navigation of the harbour~~
Lastly all shipping inside
the harbour as proposed
would be exposed to the
full force of these rollers

Excepting during ebb tide
with steamers or sailing vessels
assisted by steam tugs -

This condition would
seriously diminish the
value of the harbour as
a place of refuge

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163 or warfare.
and the anchorage ⁱⁿ ~~the~~ ^{extremely}
consequence rendered ~~extremely~~
inconvenient if not unsafe

(3) from the manner in which
the breakwaters are proposed
to be carried out we consider
that no future dredging of
any practical value would
be possible.

22. In dealing with the first
of the above difficulties it
may be as well at once to
say that too much stress
has been laid by the Chamber
of Commerce on the supposed
formation of the bar as directly
caused by the deposit of
silt brought down by the
river.

23. No stress has ever been
laid on this point which only
incidentally cropped up in
reference to Vizagapatam the
conditions of which are different

[the Government order connected
with which was communicated
in general information
only prior to our visit]

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as it has a river often
necessarily charged with silt
discharging through the mouth.

24. No doubt the great
Cochin backwater does act
as a very complete settling
^{as implied by the Chamber of Commerce}
bed, but it cannot do so
wholly and we are unable
to admit the argument
employed as to the formation
of the present reclamations
inside the backwater being
due to sand carried ^{from the sea} in as
stated with the flood tide.

The ebb tide assisted by
^{jets}
river ~~fresh~~ water especially
during the monsoon must
of necessity be a much more
powerful agent for moving
all matters in suspension as
being greater in volume and
velocity than the flood
tide, and to suppose that
more material is carried

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into the backwater than
is discharged is opposed to
all physical laws.

25. It is not however necessary
to pursue this subject further
~~so~~ far as the actual formation
of the bar at Cochin is
concerned this factor may be
entirely omitted, as ^{the existence of} this
like every other bar here
and elsewhere in all parts
of the world, is mainly if
not entirely due to the
action of the surf.

Mr. Robertson observes
with reference to this that
"the surf is always striving
to restore the natural pro-
-file of the conservancy of the
"shore. After the current
"has flowed out to sea for
"nearly a mile, it is no
"longer able to resist and

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"Keep down the ever working
"and powerful efforts of the
"waves to reform the profile
"of the coast by continuing
"the beach line which has
"broken through the out-
"going current."

26. In a paper by Mr. J. J.
Mann, C. E., it is shown
that while this statement
would meet with very general
acceptance of all professional
men, the explanation of the
causes leading to the establish-
ment of bars has been
various. It is however, need-
less to advert to more than
one of the various authorities
on this subject viz Mr. L.
Stevenson who attributes the
formation of all such bars
solely to the action of the
sea. "The waves" he observes,
as is well known, throw up
"a girdle of light or heavy

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"material" * * * round every
"bay and headland of our
"(English) coast, and the entrance
"to rivers forms no exception. The
"effect of this constant action
"of the sea is to form a con-
"tinuous line of beach across
"the mouths of our tidal rivers
"and inlets." He does not
appear to attach any impor-
tance to river currents as
agents in the production of
bars, observing that "a bar
"would be formed although
"the outgoing current held not
"one particle of matter in
"suspension."

27. It only requires a glance
at any good chart ^{exhibiting} showing
in detail the déboachures of
all our rivers along both east
and west coast on the Spani-
-deney to show that wherever
the shore is made up of
sand or easily moved material

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and is unconfin'd by rock
or other obstruction the ten-
dency always is for rivers
on approaching the coast
to turn suddenly to the
north, and often not far
miles find an exit to the
sea. This as well known
is due to the superior power
of the S. W. monsoon which
by induced sea currents
driving the sand before it
below the surface and by
the wind acting on all
exposed sand above, advances
the sand spit at the mouth
further and further northward.

28. In Mangalore we have
lately been able to show
that the movement north-
ward of the river mouth
due to this action has ap-
parently been pretty steady
at the rate of 300 feet per

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annum during the last 54
years. But without multi-
plying instances it will probably
suffice to note as now clearly
established

1st that whether the effluent
stream contains material in
suspension or not the tendency
is for a bar to be formed
wherever the forces of the
surf on one side and the
stream on the other sufficiently
neutralize each other.

2^d that the sand forming
such bar is carried chiefly
from south to north across the
line of the normal direction
of the debouching river. The
contention of the Chamber of
Commerce in para 13 of their
letter N^o 87 of the 19th instal
that "the currents and depositions"
"at the ends of the proposed"
"groynes would thus assist"
"and not obstruct the endeavours"
"to form a good harbour"

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is therefore in our opinion
not borne out by the facts
as now explained.

29. It may of course be fairly
contended that there is a
certain depth below the sur-
face at which the wave
action is nil, and there is
no sensible amount of sand
in movement at such depths.

This is practically the contention
of the Chamber of Commerce
and it is ^{at first sight} ~~sufficiently~~ supported
by the following observation

of Mr. Robertson to parry
reply viz. - he observes that
"were the current kept
together in full strength
"till it got into such a depth

of water that the action of
the waves was not sufficiently
powerful to stir up the bottom
there would be no decided
"bar"

30. Mr. Robertson does not
say at what depth of water

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In connection with this remark
it may be parenthetically observed
that Mr. Robertson considered that
the effect of the waves suggested by
himself would only secure a depth
of from 20 to 21 ft. at low water
which it is unnecessary to
say would be wholly in-
sufficient for a first class
harbour

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such action may be expected
to cease, and in the plan he
proposes for a harbour at
Lochin, he evidently considers
that the graver suggested
would not reach this depth,
as he observes that "a little
"dredging or raking" will be
needed to preserve the depth
of Channel.

31. Without a series of very
carefully conducted experiments,
it would be impossible to
decide this point in a manner
sufficiently conclusive to
satisfy everyone, but in the
paper before adverted to
by Mr. Main there is a
good deal of evidence to
show that wave action is
felt at depths hitherto
apparently unsuspected.

32. Without overburthening
our report with quotations,
it may be sufficient to say
that among the evidence

884
apparently available for
deepening channels situated
like the one proposed, with
mouth open to the sea and
exposed to swell; consequently
if it be desired to give a
prolonged life to the harbour
with works of this character,
it would be desirable
not to stop the groynes
in 5 fathoms, but to run
them out another half mile
into $7\frac{1}{2}$ fathoms (which is
the same as that adopted
for the Madras Harbour)
as the best available re-
-ficient.

35. We now beg to turn to
the second set of difficulties
^{which} ~~that~~ has presented itself to
us, viz, the nautical ones
which would probably be
felt by every master of a
vessel approaching a harbour
of the proposed character during

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the S.W. monsoon, or in fact
at any time when there was
a heavy sea and wind.

36. It will be remembered
that the essence of the pro-
-posed scheme is to preserve
an uniform section of channel
into deep water so as to
maintain as far as possible
intact the scouring power
of the effluent water and
keep the ^{as possible if deposit} whole clear. How-
-ever the direction of the
groynes might be varied,
this must in the main be the
guiding principle so as to
maintain the validity of the
grounds on which the scheme
is based.

37. But if this be so there
must be an exposed mouth,
and a long channel up which
the seas must sweep with
uninterrupted swing till they
broken and dispersed by the

only gradually die away
or become dispersed

shoals of the backwater
at the extreme east end
of the harbour.

Mr. Robertson clearly indicates
this difficulty when he observes
that "it must be remembered,
"that in reducing a bar,
"we take away a kind of
"breakwater in front of an
"entrance, and introduce a
"ligger wave."

38. A strong opinion has
already been expressed by
the Master Attendant on
this point and statements
have reached us of the
extreme difficulties and
dangers which comparatively
small craft have experienced
in approaching the present
harbour mouth in the mon-
-soon though having plenty
of sea room to work in,
and able ^{by the} small
draft to double sharp.

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round to S. E. end of ^{of the} channel
after passing through the
mouth, and lying up in a
perfectly sheltered anchorage,
none of which advantages
would be open to large vessels
entering the harbour under
the proposed scheme.

39. As directly bearing on
this point we would now
quote the following observation
from a report by Commander
A. Dundas Taylor in reference
to the proposed ship canal
between Ceylon and India
dated 28th July 1871 viz,

"To examine the sea approaches
"and thus to determine the
"accessibility of a port, is
"a first essential, and comes
"within the province of the
"Marine Surveyor. A glance
"at the plan which exhibits
"the sites of all proposed schemes

(for Pannabern) will explain
 "how unreasonable would be
 "the tax upon a Master
 "Mariner's skill in seamanship
 "and navigation when
 "attempting to enter either of
 "the openings which were sub-
 "mitted to the consideration
 "of the Parliamentary Com-
 "mittee. * * * I am
 "convinced that mishaps would
 "have attended any attempt
 "to shoot the Canal's mouth
 "when the monsoon swell
 "and current accompanied
 "the steamer."

40. It is needless to say
 that the dangers thus
~~to these which would be~~
~~to be caused by large sailing~~
~~vessels trying to make the~~
~~mouth of the port, and~~
~~obliged to use a steam~~
~~tug, and consequently~~

foreseen with reference
 to Pannabern would
 have equally been
 counted on and disposed
 of in dealing with any
 Harbour Scheme by
 Cochrane

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~~as follows to record our~~
~~debts to justice that he~~
~~the difficulty present~~
~~itself, this alone would be~~
~~fatal to the probability of~~
~~the scheme.~~

41. The third and last
 difficulty as to the impossi-
 bility of carrying out satis-
 -factorily dredging operations
 in a channel exposed to
 heavy swell is more easily dis-
 -posed of. No dredge so
 far as we are aware has
 yet been devised for working

Satisfactorily in such positions. With all
 the adjustments that it
 may be possible to make
 sudden jerky
 movements in
 respect must communicate
 themselves
 to the bucket ladder
 and produce strains ^{whipping} that
 would very soon break up
 the strongest framing of
 this character.

On a few quite still days aggregating say 6 weeks in the year a dredge like the Albuquerque might work, but it must be obvious that this would go but a small way to meet the requirements of the case.

The "Albuquerque" dredge with two side anchors and cables would by its self take up 800 feet in width of the Channel when at work and thus seriously impede traffic

42. After the foregoing exposition of our views, which owing to the very able manner in which the Chamber of Commerce have stated their case, we have found it desirable to deal with in greater detail than might under other circumstances have appeared necessary, it is needless to say that personally we do not feel ourselves able to recommend the scheme put forward by that body.

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and that consequently it is at least at this stage unnecessary to go into any of the engineering details.

43. It does not, however, necessarily follow that the rejection of this particular scheme would invalidate all others. We are given generally to understand for instance that Mr. Parker is under the impression that the papers sent him by the Chamber of Commerce that a plan by which the bar might be sheltered, and then removed by dredging somewhat in the same way as in his Curraichi Harbour might be feasible, and although it would probably take some time to mature a scheme of this nature we

are not prepared to say that with abundant means at disposal, a Harbour based on this principle might not have a good deal to recommend it. The general principle, whether applied in the form of a detached breakwater parallel to the coast and entirely shielding the bar from the action of the surf, or otherwise, has certainly more to recommend it than the one we have been considering, though the latter might, under certain conditions be either wholly or in part incorporated with it.

44. All we are now concerned with, however, is whether with this new light obtained on the subject, it would be desirable to have the details

of the scheme worked out by Mr. Parkes.

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45. It can hardly be questioned that the construction of such a breakwater out to sea as would admit of the bar being entirely sheltered and the whole of the stuff being dredged out (this would be by far the cheapest part of the operations) the total outlay must be greater than what we have before named as likely to be required in the schemes we have been obliged to condemn.

46. The question again therefore rises as to whether any Provincial or Imperial subsidy can be looked for in aid of the local resources which would certainly be insufficient for the execution

of a project of the kind,
The Chamber of Commerce
urge strongly their claims
for a subsidy of this
character, and in the late
minute by the Honble Sir
Andrew Clarke the necessity
of creating a certain number
of harbours of refuge along
our shores to meet the
 exigencies of war have been
seriously pressed on the
attention of the Govt of
India.

47. We can only therefore

say that if the Government
after weighing what we have advanced still
consider these claims sufficiently

well founded, and there

be any probability ^{that they} of ~~these~~
~~will be~~

being recognized by the

Govt of India, it would

be difficult to find a

more able professional

It appears to us however
that it would be exceedingly
difficult to render an
open place like Cochin
defensible against an
enemy's vessels which
stealing in sufficiently close
at night could easily
inject the place without
running much risk
themselves. Trincovalee
is in fact so far as we are
aware the only harbour
between Bombay & Calcutta
which naturally lends itself
to such an object, and which
would be at once perfectly
secure and easy of access

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Harbour Engineer for drawing
up a complete scheme
and framing an estimate
of the probable cost
than Mr. Parker.

48. There would in our
opinion be no sufficient
object gained in going
minutely into a dis-
cussion of ways and
means for meeting
interest an outlay
especially as under the
proposals put forward
by the Chamber of
Commerce in the
letter printed with L.C.
24th Dec 1850 No 27438
there are several points
involving not a little
complexity, but regarding

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which our information
is incomplete.

49. He took advantage
of our visit to Cochim
to inspect the singular
mud bank at Karakul
situated some 6 miles
to the north, and which
for the last few years
has been used by the
merchants for shipping
and landing goods
throughout the monsoon.

50. There is back water
all the way to within
a quarter of a mile
of Karakul where the
Cochim Govt. have cut
a boat Canal across
the sand spit separating
it from the sea and
constructed a covered

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passage with tramway
from this close up to the
beach, and have also
erected a small landing
pier. The very admirable
condition of this latter
work of the three years
wear and tear shows
that at least in that
period there have been
no heavy seas at this
point.

50. The bank consisting
of the very finest mud
of a granish black
colour and very unctious
to the touch seems so far
as can be ascertained
to extend about 3 miles
along the shore from
south to north and to
about $4\frac{1}{2}$ miles out

to sea. It has not apparently shifted its position as seems to have been the case with other similar banks - notably that which though known to have been at Allepy some 20 years ago, has apparently moved 7 miles south to Porced and is still believed to be progressing south.

51. The effect of the bank on the portion of sea covering it is singular as at the first burst of the monsoon there is the same surf as in other parts of the coast; the water is discoloured and dark with

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with the churned up mud, but after this stage has passed, it seems to settle down and become quite clear like the rest of the neighbouring sea. Some persons consider the surface has an oily look at this time, and others that stems and branches of apparently submerged trees rise to the surface, but of neither of these statements is there any distinct proof.

52. What however appears certain is that the full characteristicks of this tract in providing a still

anchorage during the monsoon are not ob-
servable till the mon-
soon has sufficiently
advanced to render the
water in the backwater
on the land side quite
fresh, and that during
this period the water
in this tract out to
sea is also very fresh,
as if such water at
this time rose from
the bottom.

53- The effects however
are that the monsoon
swell gradually subsides
over the outer limits
and vessels are thus
enabled to run into
comparatively quite

911 1/2
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still water at the height
of the monsoon, thus
providing Cochin with
an unrivalled harbour
during this period.
So far as can be
ascertained no surf
breaks along the margins
of the bank - the seas
merely die away.

54- There can of course
be no question that
there are a number
of serious drawbacks
to trade conducted in
this manner and that
merchants suffer con-
siderably by losses of
goods exposed in the
canal boats and by the

rascality and carelessness
of the boat men, but
the fact remains that
they are able to carry on
trade at this period
when all other West Coast
ports (except Poread)
are closed.

55. No considerable
interest attaches to the
conditions under which
the mud banks alluded
to exist on the coast
it is to be hoped
that Mr. H. King, Asst.
Supt. Geological Survey
of India, who joined us
and secured some speci-
mens of the mud for
analysis may be enabled
to follow up the enquiry.

A.

9/11-12/68

56. A chart giving in
general terms the latest
information about the
Cochin anchorage and
port and also showing
the proposed scheme
for a first class harbour
accompanies this report.

Colonel R. B.

Chief Engineer, P. I. D.

Lieut. R. B. R.

Master Attendant

Madras
28th Feb'y /81

2/11

Previous correspondence to

G.O. No. 911-12 w d/4 April/81.

G.O. No. 1567 d/12-6-71

— " — 1125 d/2-5-72

— " — 1449 d/12-6-72

— " — 1757 d/24-7-72

— " — 1323 d/13-5-73

— " — 2138 d/27-8-73

— " — 1792 d/4-7-74

— " — 119 d/15-3-74

— " — 27 d/7-1-75

— " — 397 d/12-2-75

— " — 1775 d/12-7-76

— " — 236 d/20-1-77

— " — 624 w d/22-8-77

C.R. No. 3593 d/29-10-77

G.O. No. 871 w d/21-2-78

— " — 1380 w d/18-3-78

— " — 2037 w d/3-5-78

— " — 2341 w d/31-5-78

— " — 2621 w d/24-6-78

— " — 2926 w d/19-7-78

— " — 3217 w d/12-8-78

— " — 3665 w d/16-9-78

hms. No. 3682 w d/19-9-78

G.O. No. 4013 w d/15-10-78

— " — 4046 w d/17-10-78

C.R. No. 4813 d/25-10-78

hms. No. 4373 w d/14-11-78

G.O. No. 1830 w d/12-7-79

C.R. No. 2550 d/17-7-79

G.O. No. 2249 w d/2-9-79

— " — 2277 w d/5-9-79

C.R. No. 1403 d/25-5-80

C.R. No. 161 d/15-6-80

G.O. No. 1557 w d/3-7-80

— " — 1558 w d/3-7-80

C.R. No. 1876 d/5-8-80

G.O. No. 2149 w d/13-9-80

hms. No. 592 d/27-10-80

T.O.

To the pub which stands
into the pipe of
Shower the pipe of
Ponding order
The water is
sent from the
as the water

G.O. No. 2722 w d/26-11-80.
 C.E. No. 2838 d/14-12-80
 G.O. No. 2943 w d/27-12-80
 2944
 G.O. No. 2943 w d/27-12-80
 — 222 w d/26-1-81
 C.E. No. 102 d/14-1-81.
 C. No. 7792 of 1880.

911-12
 69

The technical question involved
 in this discussion is one on which
 the opinion of the two experts
 can carry little weight. I
 express mine with hesitation.

The project is in effect to
 construct 2 parallel training
 bales overboard from the
 N.E. sides of the entrance
 to the Cochise backwater
 into 5 fathoms or 30 feet
 with the object of confining
 the current at ebb tide &
 to back away the shoals
 far on S. at the time of
 the inspection reported this
 was found little over 2 fathoms
 or 13 feet water at low
 tide.

The distance from the
 S.E. corner of the
 bar to the bar itself was
 1300 yards west of the
 lighthouse at the entrance
 so that the training bales
 will be in line 3000
 yards long - or 6000
 yds for the two. The work
 is well interest during
 construction is roughly.

W. H. Haskins
 H. E. in Journal

911-12
 70

In sending up the
 print report by Capt.
 Taylor and myself
 with reference to the
 Cochise barbers I
 have thought it
 better to wait till
 this and the connected
 documents could be
 printed so as to
 facilitate perusal
 by the members of
 Socy.

Our report will be
 found on pages 6
 to 13 inclusive of
 the accompanying
 printed Collection
 and is dated 28th
 Feb.

The work mentioned

in para 57 will
unfortunately not
be ready in 2 or
3 days, but with
the chart inserted
I would, and
that given in the
Robertson's Report
probably no incon-
venience will be
felt from its absence

Mr. Parker was
sent to Cochran at
the Solicitation of the
Committee of Commerce
and may probably
be back within a
week, but it is not
certain whether he
will produce a scheme
— and even if he does
it is almost certain
to be a much more
expensive one than
that which we

assumed it to be
super at least. It is true
a P. capital cost for the
the project in adv. &
current drain etc.

There seems to be no
question but that
local resources of the
activity in dredging & filling
the inlets.

The necessity of opening
out the Groyne to the open
soundings is it seems
admitted by the officers
of the project. In passing
reference to the probability
of the improvement that
the Bar shall not be improved
it is considered that a
extension into 7 1/2 fathoms
is necessary & essential
the clearing action of the
sea on the bottom. It is
of course the California
to the length of the Groyne

The objection to the
to dispute the necessity of
this. on the ground that
the bottom beyond the Bar
is composed of soft mud
but of course

The question however

then arises. How does the
material forming the bar come
from?

It is formed & consists
of coarse sand & shells.

and the A. is not that
it is not silt reaches it

The conclusion seems to
be inevitable that sand in
suspension is forced by the
littoral sea currents & that
unless the Groyne are extended
to the depth in P. the action
of the waves ceases & the turb
the bottom. The bar will
almost inevitably be reformed

As regards however the
feasibility of the project
from a financial point
of view. The project may be
postponed. as the less
extensive project is beyond
the power of local resources.

Whether the objection is
one fatal to it or not is
a question of opinion. It is
rather for higher authorities
to consider. After reports
have expressed this opinion

Then comes the question
whether if the Bar can be
removed in the manner
proposed, the result will be

have had to consider

In order of Govt.
are solicited in
the Report

~~Ally~~

9/3/87

9M-12
71

Natural breakwater is almost
of the unchickled entry of the
full force of the sea in the
S. W. division, with the large
evolution of sand that is
for works together. I confess
that I do not think the use of the
artificial channel under-
such circumstances. It is dangerous
in the future some portance

Supposing however the Channel
be maintained it is a great
form risk. But is the extent
of anchorage inside in S.
Ships drawing say 10 ft.
could lie at anchor at
low tide in positions offering
facilities for trade.

On the whole I cannot
but concur in the opinion

I purposed to report that the volume introduced
 could be recommended to Sir as a Practical
 & popular work. But the papers were not
 on the general question of improving Technical Education - but rather on the last point.

2. — It will be observed that Mr. Parkes is of opinion that the bar can be permanently removed and the port converted into a first class harbour; but the works he considers necessary to accomplish this will be more extensive and costly than hitherto estimated. Such works, however, Mr. Parkes informed the Chamber in conference, would give Cochin a harbour equal to that of Bombay and capable of indefinite extension.

at the moderate cost of dredging
within the Backwater.

3. The cost of the works proposed is
estimated at 81 Lacs of Rupees, and
it is scarcely necessary to remark that
this is much beyond the ability of
the existing trade of the port to provide
four and a half per cent interest on.
But the facilities which a first class
harbour and railway communica-
tion would provide, might certainly
be expected to increase the trade of
the port from year to year, which
would be attended by an increased
revenue on Harbour works.

4. There may however be Imperial
interests involved in the conversion
of this port into a first class Harbour
which may induce the Government
of India to expend without im-
mediate expectation of interest
thereon that portion of the cost for
which the present trade of this Port
cannot provide, and the Chamber
begs leave to mention what appear
to it a few of the more important
of those interests.

5. It is generally understood here
that the Government of India are
desirous to have a first class harbour
or harbour of refuge on this Coast
between Bombay and Ceylon, and

that Malacca, Gon and Carwar have
been recommended as suitable sites.

The cost of harbour works at either
of those places would be considerable,
and neither place has yet a trade that
could return any appreciable revenue
on the outlay. A railway to connect
the port with the railway system
of India would also have to be con-
structed either as a State work or
under a State guarantee. 9/11-12/78

6. Against Malacca, Gon there is
the special objection that it is not
in British territory.

7. The Chamber begs to urge in favor
of the selection of the port of Cochin
as the site for such a harbour that
it is more centrally situated be-
tween Bombay and Ceylon than
either of the ports named; that it
is already a port of considerable
trade, being fifth in importance
in India and second in the Madras
Presidency, and able to pay about
two per cent interest on Mr. Parker's
estimate of the cost of the required
works; that it is probable it will
be connected with the railway
system of India at a very moderate
liability by way of guaranteed
interest to the British Government,

PC
and that the total cost of harbour works here might not impose on Government a greater liability than would the harbour and railway works at either of the other places mentioned. The nearness by railway of this port to the principal military stations in the Madras Presidency and also its nearness to Aden would seem points of importance in connexion with the movements of troops.

8. — Mr. Parkes when in conference with the Chamber expressed a wish that his report and suggestions might be submitted for the opinion of another Marine Engineer, for whilst there is no doubt that the Lockin bar can be permanently removed, it is possible that another competent authority might be of opinion that this could be accomplished by less extensive and costly works than now projected. The Chamber does not see its way to making such a reference, and feels that it must now leave any further proceedings in the matter deemed necessary in the hands of Government. In what it conceives to be the interest of the port the

PS
Chamber has ventured to urge the subject on the attention of Government and trusts that it will be accorded due consideration.

I have the honor to be
Sir,
Your most obedt. Servant

W. J. Smith
Honorary Secretary

911-12
74

6.
M.C. 1855.

well

Received 23 March 81

MA

AP 7

Cochin, 11th March 1881

The Honorary Secretary,
Chamber of Commerce,
Cochin.

911-12
75

Sir,
Having now carefully perused the documents referring to the proposed improvement of the Harbour of Cochin which you have laid before me, having received much valuable information on the subject from various gentlemen on the spot, and having made such personal inspection as was possible during my short stay, I beg now to lay before you for the information of the members of the Chamber of Commerce the conclusions at which I have arrived.

Your questions to me are substantially the following:-
1. Can improvements commensurate with the cost be made for a sum not exceeding £250,000 for such improvements of the entrance as would enable the class of ships at present frequenting the port to come at all seasons to the inner harbour, when fully loaded instead of lying in the roads or at Parakkal as at present?

2. Is Cochin capable of being made into a first class port accessible to the largest ships at all times, and if so by what means and at what cost?

With regard to the first question
I feel compelled after much consideration
and with very great reluctance to give
a negative answer. I think that such
works as could be carried out for the
sum named would be in any case
ineffectual and probably injurious.
Works to be really efficient must be
carried out on a much larger scale,
but if so carried out they would
render Cochin such a port as is con-
templated in the second question,
to which therefore my reply is affirma-
tive.

Proposals appear to have been
considered by the Chamber for
carrying out piers from Cochin and
Tycoon respectively so as to concentrate
the scour on the bar.

This it is correctly supposed would
form for itself a channel between
the piers equal in sectional area to
that existing in the present entrance,
as far as their ends, and for some
distance beyond. It is further sup-
posed that, if this distance beyond
the piers be such as to reach the depth
of water in which the wave will not
act upon the bottom so as to heap up
another bar similar to the present
one, there will be such a continuous
depth throughout as the scour may
produce.

The piers described in para 5 of your
letter to the Secretary to Government
P. W. D. of 25th November 1880 appear to
be laid down upon this principle,
and they terminate in a depth of
24 feet. Their cost would as I estimate
be about 50 lacs of rupees. 911-12/16

I agree in very much of the principles
upon which these lines were laid down
but there are some important respects
in which I think the plan requires
to be modified and supplemented,
and these will further increase the cost.

In the first place, the process of
obtaining the increased depth by
scour in the face of the waves is a
hazardous one. A large quantity of
material would be disturbed and
driven out beyond the piers. Some
of it would be deposited in the edges
near their unfinished ends, and would
form new material for the waves to
act upon, and ~~thereby~~ ^{thereby} for new ac-
cumulations. It would also consist
of heavier and coarser material than
that of which the bar is now composed,
and would therefore, under the influ-
ence of the waves, remain at least
temporarily at a higher level. From
this cause the navigable depth over the
bar would be temporarily reduced,
and the contour of the depth within

which the wave has injurious action would be permanently pushed out to sea. These anticipated difficulties may at first sight appear hypothetical, but they are suggested by the experience of my own practice both at Thurrock and at Madras. At the former place the attempt to remove the bar by scour in the face of the sea produced a great aggravation of the evils.

Another objection to the lines as laid down is that there is no room for the wave to spend itself between the piers, so that the seas entering between their ends would be propelled in almost full force to the ships' berths. At present the seas are broken by the Bar and the shallow water on either side and this advantage would be lost.

To avoid these two evils it would be necessary to start the piers from the shore at a much greater distance apart, and they should be kept at such a distance from the existing navigable channel that any disturbance or accumulation that may take place around their advancing ends may not affect the channel.

They should begin to approach one another only when they have arrived in the depth of water in which the bottom is not affected by

the wave. Thus there would be no disturbance of the existing bottom in the navigable channel by increased scour. It may appear to be throwing away a natural advantage not to effect the required deepening by natural scour, but the cost of dredging it would be under 2 laes of rupees, a small sum for avoiding the evils consequent on an excess of scour.

A more important source of economy would be sacrificed by carrying the lines of the piers away from the land spits which, more especially on the south side, lie parallel with the Channel and placing them in the deepest water both north and south; but I can see no alternative to securing the advantage. To do so however would necessarily increase the cost of the piers by about 8 to 10 laes.

Then comes the question of the depth in which they are to terminate. I think 24 feet is too near the outside limit of war action. The thoroughly safe, but a more imperative readiness for a greater depth is that required for navigation. 24 feet, with 2 feet rise of tide, is sufficient in smooth water, but it is not enough where a ship is liable to a lift and drop

of 5 or 6 feet by the waves. I think 27 feet is the least that should be allowed for the ends of the piers.

In order to carry out the principles here laid down therefore I would propose to remove the North pier to a distance of 900 yards northward from the shore of the Channel and the South Pier 1100 yards southward giving with the width of the Channel itself a total width between them of 2700 yards; that they be carried out parallel to one another in a due westerly direction to a depth of 24 feet, and then, curving towards one another, terminate in 27 feet with a distance between them of 900 yards or double that of the Channel between Cochin and Tycoon. Having an uniform depth of 27 feet, the new entrance would have also nearly double the sectional area of the Tycoon Channel, there would be consequently only half the velocity of currents and no disturbance of the bottom.

The Piers as I have described them, one 10,600 feet, and the other 11,320 feet, or each over two miles in length, together with the dredging of the Channel, I estimate to cost 81 lacs of Rupees. Their execution

would make Cochin ⁹¹¹⁻¹² a first class port, and utilize the fine anchorage 2000 yards long by 250 yards and upwards wide, with more than 24 feet depth. Thirty steamers of the largest size could be moored in this space in a single row of 15 on either side with ample width between them for passage, and in some parts there is room for double rows. Besides this there is practically unlimited space of shallower water, the depth of which could be increased to any required extent by dredging. It would likewise be in direct communication with an immense extent of inland navigation by means of the backwaters already existing.

These advantages already exist but they are unavailable by reason of their inaccessibility from the sea.

It is no part of my duty to express any opinion as to whether the acquisition of such a harbour is ever likely to justify the outlay required for it, but it is at any rate desirable that the capabilities of the place should be known. It is unfortunate that from the nature of the case it is impossible to recommend a plan for a smaller

ST 16
measure of improvement at
or proportionally smaller cost.
The swell from every direction
between South West and North
West must be reduced before
the Bar can be even lowered,
and that can only be done by
Breakwaters two miles from
shore.

Not to be

I have the honor to be
Sir,
Your most obedt. servant
Signed / s. V. Parker.

(True Copy)

W. H. M. S.
Honorary Secretary

GOVT

TA

P. W. DEPARTMENT.

Read the following:—

From the Honorary Secretary Cham-
ber of Commerce No. 88 dated
14th March 1881. 911-2
79

FOR ORDERS.

The enclosed
letter from the Cochin
Chamber of Commerce
has been received since
the circulation of
Colonel Sautrey's and
Captain Laylor's re-
ports, but it in no
way alters the posi-
-tion, as Mr. Parker's
opinion coincides
to a remarkable degree
with that of the
former officers.
2. He estimates the
Cost

cost of a first class
harbour even higher
than they do (81 lacs
to 90 lacs); and as
regular estimates
invariably turn out
higher than approxi-
mate ones, it is pro-
bable that the actual
cost of the works
would be not much
short of one hun-
dred lacs.

3. With regard to
para 3 of the Cham-
ber's letter, it may
be observed that
there is a limit to
the possible ex-
-pansion of the trade
of the port, in the
producing and ab-
-sorbing powers
of the country be-
hind it. The best
harbour

911-12/80 harbour in the
world could not
make the trade of
Cochin approach
that of Bombay
or even of Madras.

John Perry
Major R.R.
for Secy to Govt
P.W.D.

FOR ORDERS.

Hon. W. Huddleston
The Rt Hon the Governor

4/11
4/12 } W

C 243. B. 24.

N^o 911 W

PUBLIC WORKS DEPARTMENT.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

From the Hon. Secy. Cochin Ch. of Commerce 4th April 81
Joint Report by the Master Attendant & Chief Eng^r: P. W. D. of 28 Feb'y 1881
From the Honorary Secy: Chamber of Commerce 17th March 1881.

The Government
are compelled to ac-
cept the unanimous
opinion of the Chief
Engineers Public Works
Department, the
Master Attendant,
and Mr. Parkes that
no permanent im-
provement to the
harbours of Cochin is
attainable except at
a cost the interest
of which could not
possibly be met
by the trade of the
port,

part, even allowing for the increase that might reasonably be expected.

2. Nor do the Govt consider that such a work could justifiably be undertaken from Provincial Funds, or recommended to the Govt of India for execution as a Productive Work.

3. It is for the Govt of India to decide whether the construction of a first class harbour at this port is of sufficient importance from

from an Imperial point of view to justify its construction without reference to financial results, and the papers will therefore be forwarded to that Government for consideration.

L₂/3

H.S. No. 912W of 4 April/87

Forwarded

- To The Ch. Secy P.W.D. ✓
- " Under Secretary ✓
- " Marine Dept ✓
- " Chairman, Ch. Plonamune Cochin.
- " Comdg. Engrs for Ry ✓

Desd
23-4-87

Desd
23-4-87

10/9/87

14/12/80

18-11-11

1153

Gobt. of (1881) Madras.

PUBLIC WORKS.

To

Dated

Issued

Recd.

Encl.

G. O., 4 April 1881, No. 911/2

Nos. 15-19

Cochin Harbour & Orders
in papers regarding the
improvement of the

114/5

50/2

911-12
84

2-13 ✓
2-15 ✓
26-7-20 Btl
25-11-20 Btl

MADRAS RECORD OFFICE.
Government Records.

Public Works Department.

G. O. (Printed).

Dated *4-4-1881*.

No. *911-912 W*

B N^o 15-19