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GOVERNMENT OF TAMIL NADU

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

28th May 1881, No. 1,341 W.

Buildings and Roads.
Civil Works.

Read the following paper :—

No. 62. JOINT REPORT by the Chief Engineer and Master Attendant on the Pámban Pass and proposals for a Ship Canal.

IN our late inspection of the important ports between Tuticorin and Madras, the Pámban Pass and the various schemes connected therewith for the establishment of such a ship canal as would save all steamers coming from Europe the voyage round Ceylon necessarily engaged our attention.

2. It may however be at once stated that neither the time nor the means at our disposal were sufficient for any but a very cursory investigation of the schemes which from time to time have with the above object been brought forward, and our remarks must therefore be of a very general nature, directed however in such a way to the salient points as may serve to narrow the issues for future special discussion, should it appear desirable to Government to take up the question at any time with a view to its practical solution.

3. In the first place, however, it may be as well to state generally the condition of the pass as it now exists.

4. The accompanying chart No. 1,184 of the "*approaches to the Pámban (Paumben) Pass*" shows that vessels from the south entering by the Kundugal channel (as is usual with the larger class of vessels) have, after passing north of "*Shingle*" island, to enter the so-called "*Sand bank channel.*" This latter, which has been all along kept open by dredging (the *Albuquerque* having been here engaged), is 2,100 feet long, has an average width of 60 feet, and a depth varying from a minimum of 10 at low water spring tides to a maximum of 15 feet. Tide rises from 2 to 3 feet, but irregularly.

5. The course after this for all vessels, whether entering by the "Sand bank channel" or, as is more frequently the case, with smaller craft, which, taking advantage of the protection afforded by the coral reefs, hug the coast of Madura and arrive by the western or Keelacany passage, is through the so-called "*Basin,*" which is an irregular channel running north-east, over 6,000 feet long, up to the north or rocky portion of the pass, and is kept open by the current.

6. The rock channel or "pass" has a length of 4,232 feet, a width varying from 60 to 90 feet and 130 feet in places, and depth from 11 to 15 feet.

7. During the north-east monsoon the level of the water to the north is generally 9 inches higher than at the south of the pass : precisely the reverse conditions existing during the south-west monsoon. The result of this inequality of level taken with other circumstances affecting the flow of water through the pass is that the velocity of the stream is often as much as 6 knots and has been even known to reach 10 per hour.

8. There would apparently be little difficulty in keeping the pass open did it all like the "Basin" consist of sand, or of metamorphic or other rock which once removed would give no further trouble ; but, unfortunately, it, to a great extent, consists of coral, which, as it is constantly growing, as constantly requires to be removed by blasting and dredging.

9. The work, now very systematically carried out by the Port Officer Captain Baker is done at a very reasonable cost, the outlay in the past year not having exceeded Rs. 1,649-6-6, and in the present state of the trade little more appears to be required.

10. Square rigged and other native craft, as shown by the following table drawing up to 10 feet of water, have availed themselves of the facilities of this channel, though of course from its want of depth it is quite useless for any of the ordinary coasting steamers and still less for vessels of greater draught:—

	Vessels.	Tonnage.
1876-77	2,165	217,253
1877-78	1,532	136,579
1878-79	1,618	154,113
1879-80	2,143	228,087
1880-81	1,953	223,623

11. An inspection of the chart will show that it would again be quite useless attempting to deepen either the "pass" or the Sand bank channel more than has already been accomplished, as throughout the approaches from the south, both by the eastern as well as the western channels, there are shallows which would have to be deepened "*pari passu*" in order to make the passage throughout available for vessels of greater draught.

12. It may thus be affirmed that (1) the channels as now and hitherto maintained are all that is required for the existing coasting trade, and (2) if a ship canal is ever to be constructed, the existing channels would not be thought of as being capable of adaptation with this object.

13. For much the same reason the old tortuous channel known as the "Dutch passage" between the island of Manaar and the main island of Ceylon, and again the direct cut which it is understood was proposed a little west of the present pass (where the sea is said to have breached through in 1814) would have to be rejected as unsuitable.

14. The various proposals for a ship canal between Ceylon and India, as carried down to 1871, are discussed in the annexed pamphlet (dated 28th July of that year) with chart by Commander A. D. Taylor, strongly advocating what is known as Sir James Elphinstone's scheme, consisting of a canal some $7\frac{1}{2}$ miles in length through the Ramnad promontory, situated about 10 miles west of the "pass."

15. The canal would have a north-east direction débouching on the north in Palk's bay where there is 5 fathoms of water, but affording apparently no shelter in the north-east monsoon, which blowing freely in would render the approach to the entrance difficult, unless thoroughly protected artificially. The débouchure to the south would be into a fine natural harbour* having a large area of 5 and 6 fathoms water, but as it is locked to the south by sand banks, if not by a coral reef, a second canal of over a mile in length would be needed, and to this the approach during the south-west monsoon would also be difficult if not similarly sheltered.

16. Having no longitudinal sections to refer to or trial-pits showing the nature of the material through which (especially in the Ramnad promontory) the canal would have to be excavated, it is impossible to hazard even a guess at the probable outlay, but we have no hesitation in saying that to render this in any way a complete scheme considerable lengths of breakwater would have to be carried out seaward so as to afford the requisite shelter to vessels making either the north or south ends of the canal; and that the cost of such work, taken with that of the canal itself, would make the scheme certainly more costly than some others, to which we will presently advert.

17. It must be borne in mind that the chief merit of the Ramnad project consists in its providing a sheltered harbour for south India which at present only possesses the imperfect port of Tuticorin. It has been supposed that given another railway from Madura down to this projected harbour (which is another very expensive work to be added to the canal cost) the trade in cotton and other exports and all imports for the south would at once resort to it. But even this is uncertain; trade is not easily directed or driven, as witness the expensive railway from Shoranur to Beypore which has never commanded any remunerative traffic.

* With reference to this Mr. George Robertson observes in his report—"There is a stretch of water here, 7 miles long by $4\frac{1}{2}$ miles wide, fairly well sheltered by reefs and islands, the greater part of which has a depth of 20 feet, and much of it 25, and even 30 feet of water.

"The entrance to this anchorage from the sea between Moosel island and Mooloe island has only about $2\frac{1}{2}$ fathoms, so that some deepening would be required before full advantage could be taken of the anchorage."

18. Mr. George Robertson, in his report on the harbours of this Presidency, (1871) alludes to this scheme in only very general terms, as he seems to have considered the state of the "pass" channel as alone falling within the scope of his inquiries, but what he does say leads to the conclusion that he was favorably impressed with it. He gives, however, no even approximate estimate or sufficient facts in support of this opinion, and we therefore consider it unnecessary to make further allusion to it.

19. Although not adverted to in his report we were pointed out a line running due north and south about half a mile east of the Pámban lighthouse which it is said Mr. Robertson thought might prove suitable for the proposed ship canal, and with a view to test which two or three trial-pits had been sunk.

20. There is no record so far as we are aware as to the nature of the material met with, though it is said that in the northernmost pit near the seashore gneiss rock was met with at no great distance from the surface.

21. The portion of the Rámesvaram island through which this line is carried is to all appearances very favorable for a work of the proposed character, being so far as can be judged composed mostly of drift sand overlaid to a great extent with just enough *humus* and sufficiently supplied with springs of fresh water to admit of cocoanuts and some other crops being raised, but in no place more than 20 feet (at least judging by the eye) above mean sea level.

22. This line is, however, so inferior as compared with the next line carried parallel to it north and south, two miles more to the eastward, the selection of which rightly or wrongly is attributed to Sir William Denison, that we are clearly of opinion this latter, or one which may possibly be selected close to it, presents much greater facilities for a work of the character proposed than any other.

23. Here the mouth of the ship canal both to the north and south could certainly be protected more conveniently than elsewhere, indeed as regards the former it would only seem necessary to run a short breakwater out north-west from the shore, which here trending towards the north affords as it is fairly good shelter from the west and north.

24. By connecting the "Pullie reef" with "Shingle island" and by running out seaward a breakwater south-east from the beacon on the latter, adequate shelter could no doubt be afforded.

25. A ship canal here through the island would not exceed $2\frac{1}{4}$ miles in length with excavation to 26 feet below mean sea level, also deepening for a mile north and south. For the latter an average of, say, 5 feet of material would have to be removed throughout.

26. Probably 3,000 feet of breakwater north and 10,000 feet south would at the outside be needed, making on the whole, in our opinion, much less work than that required for any of the other schemes.

27. This is the same line which, we are given to understand, was selected by Colonel Thomason in 1878, but there is nothing on record by that officer to refer to.

28. Both the last-named lines with also that close to the place where the sea is said to have broken through in 1814 are shown in red ink on the accompanying detailed chart of the "approaches to the Pámban pass."

29. Yet another line has been indicated to us as having been examined by Captain Hausard on the part of the Ceylon Government, but whether he approved of it or not we have no means of judging.

30. This line appears to run in a north-east direction some 6 miles south-east from the Rámesvaram temple across the sand-pit north-west of Adam's bridge at a point marked "*chatrams*" on the map, but not only would the northern end of a ship canal here be greatly exposed during the north-east monsoon, but the length of the canal to reach 5 fathom water on each side would be at least a mile longer than in Sir William Denison's line. The cost of this would, we consider, be greater, though in other respects it seems to stand next to the one mentioned.

31. In any case we have little hesitation in recording our opinion that if ever the scheme for a ship canal demand serious consideration, the choice so far as facility

of construction and economy are concerned will rest between, what for convenience may be termed, Sir William Denison's and Captain Hausard's lines. Special surveys, with the requisite levels and trial-pits carried down to the full depth of the proposed canal, would soon admit of a definite opinion being formed.

32. It is impossible, however, to conceal the fact that the works how or wherever undertaken must be very expensive; probably at best not less than 1 or $1\frac{1}{4}$ millions sterling for canal breakwaters north and south, lighthouses both here and along the bays on both sides, &c. Considering the intricacy of the whole passage, a very complete system of lighting would be required throughout.

33. It is very doubtful moreover, considering the inevitable delays of getting large ships through a canal of the proposed character, whether more than 12 hours of daylight would be saved to steamers passing through over those taking the passage round Ceylon, or that the trade for a very long time to come could afford to pay the extra dues which would necessarily have to be levied in order to make the work pay for its working expenses added to interest on capital sunk.

34. On other grounds it would also appear to be undesirable to urge on the construction of a work of this character till its advantages have been proved in a much more distinct manner than by the reasons which have come under our notice.

35. The introduction of coasting steamers has, as is now beginning to be distinctly perceived, had such effect on the old south Indian native coasting trade that the total extinction of the latter is now apparently inevitable, the single exception being the trade which now passes through and uses the Pámban pass.

36. Here as yet there has practically been no steamer competition, and as the late famine has shown the desirability of fostering diversity of occupation among the natives by all the means at the disposal of Government, we cannot but think it unadvisable to press the question of a ship canal prematurely accompanied, as such a measure would be by the inevitable destruction of what little there remains of the old native coasting trade in the southern portion of the Presidency.

(Signed) J. H. TAYLOR, Captain, R.N.R.,
17th May 1881. Master Attendant, Administrative Department.
(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.

No. 63. ORDER THEREON, 28th May 1881, No. 1,341 W.

THE Government are glad to learn that the Pámban Pass has hitherto been so well maintained and that its usefulness has by no means diminished of late years. They are however not prepared at present to consider the desirability of carrying out the costly works, which it appears would be necessary were a canal to be cut capable of meeting the requirements of vessels of large draught.

2. As a matter of general information it may be desirable to obtain a section with borings to 26 feet below mean sea level along the line apparently originally selected by Sir William Denison, about 2 miles east of the pass and running directly north and south through the Rámesvaram island, and if this can be arranged for by the Master Attendant in communication with the Chief Engineer, the Government will not object to sanction the small expense of the operation.

(True Extract.)

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

To the Master Attendant, Administrative Department.
" Marine Department.
" Superintending Engineer, Third Circle.
" Carrig Engr for Opn.

Exd. E. C. Shunker.
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1341/3

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1881} Madras.

PUBLIC WORKS.

To

THE MASTER ATTENDANT,
ADMINISTRATIVE DEPARTMENT.

&c., &c., &c.

Dated May, 28*th*

Issued

Recd. *Encl.*

G. O., 28*th May* 1881, *No.* 1,341 W.

MAY.

Nos. 62-63.

Pámban Pass.—Orders on joint report by the Chief Engineer, Public Works Department, and the Master Attendant, Administrative Department, on the — and proposals for a ship canal.

Appendix to G.O., No. 1,341 W., dated 28th May 1881.

ON THE PROPOSED SHIP CANAL BETWEEN CEYLON AND INDIA.

By Commander A. DUNDAS TAYLOR, F.R.G.S., late Indian Navy.

The Ceylon papers inform us that Pámban and its neighbourhood were visited in August last by Sir Hercules Robinson and Mr. Townsend, C.E., who expressed astonishment that a ship canal had not long ago been cut through Pámban. This, according to the newspaper, was after inspecting Sir James Elphinstone's proposed site for a cutting and three others; so I infer that engineering sympathy still leans towards the improvement of old Pámban passage, or a new cutting through Rámesvaram Island, which Mr. Townsend minutely examined.

The important question is, "which is the best site for a ship canal?" And it is my desire to show that no scheme as yet advanced can compare with that which has been brought into public notice by Sir James Elphinstone. The consideration of such a question demands a good general knowledge of the atmospheric and oceanic agencies that affect the approaches to the proposed canal. An expenditure of much time and money may result in the attainment of a pretty good harbour, but it is scarcely wisdom to leave the consideration of its accessibility to an after-thought; nor will a brief visit to the locality in the fine season give the Engineer the least insight into oceanic forces which are displayed on so grand a scale in the foul-weather season and more so in an exceptional cyclone.

The discussion of the practicability of forming a navigable passage from the Gulf of Manaar into Palk Strait dates from the very commencement of this century, when Colonel Manuel Martinez exchanged sentiments with Stephen Rumbold Lushington, of the Madras Civil Service, then in charge of the southern provinces of Madras, regarding a removal of the obstruction to the trade of Malabar, Coromandel, and Bengal, caused by the shallowness of the channel of Pámban. But Colonel De Havilland, of the Madras Engineers, was the first to recommend to the Marine Board a regular survey of the locality. In 1822 Ensign Arthur Cotton made a first examination of the pass and sent in an admirable report to Captain Fullerton, Civil Engineer of the Southern Division, who, in his turn, was instructed by De Havilland to inspect the Pámban passage, and reported the result in 1822 to Lieutenant-Colonel Caldwell, who had in the interim succeeded De Havilland as Inspector-General of Civil Estimates.

But then came the Burmese war, in the prosecution of which to a successful issue all the means and men at the disposal of the Madras Government were required for succeeding years. So the Pámban question was hushed for a time, until Stephen Rumbold Lushington had become Governor of Madras, and in 1828 wrote an official minute, in which he mentions having consulted with Colonel Garrard and Major Sim, whose sentiments entirely accorded with those of Arthur Cotton and the others; and he wrote as follows concerning the Pámban rocky barrier: "The calmness of the sea at some periods of the year, the quality of the stone which intersects the passage, and the presence of a large population of pearl-divers upon that part of the coast, seemed to offer peculiar facilities to the removal of a portion of this great obstruction to the navigation and commerce of our territories." At the same time the Bombay Government, and especially the Superintendent of Marine, Sir Charles Malcolm, entered warmly into the proposal of the Governor of Madras, as "one of the very greatest importance to the general coasting trade of Madras and Bombay," and they offered the use of a "cruiser to assist in *surveying the approaches* to the pass.

Sir Edward Barnes, the Governor of Ceylon, in the early part of 1829, directed an inspection of the several waterways between India and Ceylon, with a view to finding one that was capable of improvement for the passage of large vessels. The channels on both sides of Manaar

Island, and those through Adam's Bridge, were then surveyed by Captain Dawson, of the Royal Engineers, and Mr. Stewart, Master Attendant of Colombo. The preparation of the report, however, devolved upon the latter, owing to the untimely death of Captain Dawson, from "a disease contracted in the course of this service by exposure to the sun and the noxious exhalations from the stagnant waters in the old stopped-up channels at Manaar."

This happened in 1829, and the report of Major Sim, of the Madras Engineers, comprising three or four distinct schemes for removing portions of the rocky dam, came out in 1830. Thus were all the known channels inspected, viz., the old Dutch Manaar passage; the Tal-Manaar at the island's west point; one near the centre of Adam's Bridge; the Tanny-Cody at the east end of Rámesvaram Island; and the Pámban.

I cannot ascertain what hindered the acceptance of Sir Charles Malcolm's offer in 1828 of a "Bombay Marine" cruiser to survey the approaches to the various channels; but it was not till November 1837 that Powell and Ethersey, of the Indian Navy, in the schooners *Royal Tiger* and *Shannon*, commenced work on Rámesvaram Island and accurately delineated* the Pámban barrier and channels with all the off-lying reefs and islets, westward to Mootapetta, eastward to Manaar with the old Dutch channel between that island and Ceylon, and northward from Cape Tonitoray to Point Calimere; but before they had completed the soundings in Palk Strait their vessels were recalled to Bombay.

The report of Captain Stewart, the Master Attendant of Colombo, was emphatic against attempts at deepening any of the channels enumerated, except that of Pámban; and *that* only for *coasting craft*, as the expectation of gaining an average depth of 15 feet throughout was hopeless. It appears from his "Notes on Ceylon," published in 1862, that the Governor of that colony from 1832-37, Sir Robert Wilmot Horton, had already three surveys of Manaar when he made application to the East India Company to execute another (which was entrusted to Powell and Ethersey), consequent on an extraordinary proposition by an Assistant Civil Engineer to excavate a navigable channel for shipping through the island of Manaar, at the cost of 20,000*l*. This scheme was referred to the Hydrographer of the Admiralty, Sir Francis Beaufort, who, as a scientific mariner, advised an *accurate survey of the approaches* to Palk Strait and the Gulf of Manaar, which was partially effected, as just stated, under the orders of Sir Charles Malcolm. But unfortunately for India that distinguished Admiral and devoted geographer, before the survey was complete, was succeeded by an old sailor of the præ-scientific school, who, on receipt of the charts and report of the surveyors, allowed the former to go to Madras without taking copies, and the latter, through some inadvertence or misunderstanding, to be put on the shelf; thus were they buried in oblivion for more than thirty years. And we have proof in Stewart's "Notes on Ceylon" that a report was expected to accompany the charts; for on the preferment by the East India Company, in 1845, of a claim to remuneration from the Ceylon Exchequer, for the use of their surveying vessels, the Government of that colony demurred even to paying half the outlay, because "it nowhere appeared that the officers who conducted these surveys had made any *special report* on the island of Manaar or the approaches to the projected channel through it, nor on the *probable success* of such undertaking." But the report of Powell and Ethersey has at length been brought to light and printed in this year 1871, and comes most opportunely with information concerning the meteorology of the Gulf of Manaar, its currents and tides, as well as some of the geological features of its shores. The opinion of those Marine Surveyors was directly opposed to the expectation of success in attempts to deepen *any* of the channels through Adam's Bridge and Manaar Island, whilst they advocated the adoption of the Pámban Pass.

Major Sim's report in 1830, which concludes by mentioning the able services of his co-laborers from the Madras Engineers, the brothers Arthur and Frederick Cotton, presented three schemes; firstly, the clearance from rocks and straightening of the then existing principal opening; secondly, the still further deepening of that or another deep cutting through the dam further west; thirdly, a channel with 12 or 14 feet at high water, either at the last shown cutting through the rocks, or through the Ramnad Promontory, about two miles west of Point Ramen. Of these plans the first was adopted; and the Pámban channel, the general favorite, was gradually improved till 1834. From that year till 1837 the work was at a standstill; but, since then, has steadily but slowly advanced in the hands of the Madras Sappers and Miners, with a gang of convicts, under the direction of the Chief Engineer of that Presidency. In 1854, when Colonel Arthur Cotton held the latter office, he reported the great success of the undertaking, and argued for its more vigorous prosecution, with a view of rendering the passage navigable for vessels of large burthen, and in particular for the steamers of the Suez line; his estimate of the outlay was 15 lakhs of rupees, or 150,000*l*. But Captains Biden and Franklin, successive Master Attendants of Madras, doubted whether the mail steamers would take this inner passage even if it were made practicable for them. I also, as a marine surveyor of some experience amongst Indian monsoons, gave evidence before the Parliamentary Committee of 1862, against the practicability of deepening the Pámban, or of making another cutting through Rámesvaram Island (see plan) for the benefit of mail steamers or other large ships. And I ask the Government to examine that plan and then say whether the lines of equal soundings do not show plainly that *nowhere* between Manaar Island

* On a scale of one inch to the mile. The charts are now in Hydrographic Office, Admiralty.

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and Moosel Islet can be found a *practicable entrance* for a ship canal. But now look further west at the admirable harbour near Mootapetta, pointed out by Sir James Elphinstone, which (he tells me) has already been named "Port Lorne" by the Colombo merchants. This has a naturally deep entrance, which engineering science can improve and mark off by beacons and lights, and its capacity will suffice to meet the requirements of commercial traffic, even to the extent of an hundredfold increase in the shipping using the strait.

It must be borne in mind that the vicinity of Manaar Island suffers much from the violence of the south-west monsoon for at least two months of the year; is, in fact, a dead lee-shore, whilst the Madura coast is protected from the surf by barrier reefs. Rámesvaram has a large share of Manaar's troubles and but little of Mootapetta's security; for it must be apparent to everybody that the further we go westward the more shelter we get. But we must not pass over Mootapetta, which has such an admirable harbour, the area of which, for accommodating vessels of any size, is more than a dozen *square miles*, whereas (for the sake of comparison) the capacity of Galle harbour can only be reckoned by *cable lengths*, and that is all subject to the south-west monsoon surf.

Of course there will be a ground swell outside the barrier reefs of Mootapetta harbour between May and September, but not so for the rest of the year.

Thus I have endeavoured to give a summary of the various projects entertained for making a navigable passage between Ceylon and the Indian continent. Successive governors of Madras have, with prudence, sanctioned yearly outlays of money upon Sir Arthur Cotton's scheme, though to a smaller extent than its originator wished. But that little has enormously benefited the coasting trade and the revenues of Madras and Ceylon, whilst amply recompensing the State already for every expenditure incurred. Much has lately been said as to the apathy and parsimony of the Indian Government in not having, after the successful experiment of the Suez Canal, spent more money on a similar useful work; but time has shown that they exercised a wise discretion in the face of the arguments which more than one nautical authority of Indian experience had advanced against the probability of success.

But now rumours are current that the Indian Government no longer offers opposition to an effectual deepening of the Pámban channel; that those who formerly doubted the practicability of the scheme have now come round to the originator's way of thinking; and that a project, said to have been disowned for half a century, now bids fair to become an accomplished fact, and that very soon, for the projectors say there is neither nautical nor engineering difficulty to be overcome, and that no further examination of the approaches north and south of the canal is needed.

But what is the scheme? The India Office has no printed memoir or even MS. of Sir James Elphinstone's plan; and the newspaper accounts of the meetings whereat it was discussed are very vague and evidently confound the newborn one with its defunct ancestor the Pámban. Some correspondence, backed by an article in the editorial summary of the "Asiatic" weekly paper of June 20, 1871, advocates "the further and complete excavation of the Pámban passage as it has already been begun and carried forward to a considerable extent." Now, so far from this being the case with regard to Sir James Elphinstone's new and valuable project, the fact is that the site of the canal is not yet marked out or even decided upon, nor does anybody in this country know what a section across the Ramnad Promontory is likely to show as to the nature and quantity of material to be removed, so that no correct estimate of the expense can be framed. Understanding this fact, we shall comprehend the meaning of the Duke of Argyll's answer to the deputation from the East India Association on the 3rd of May, that although the responsibility of the construction of the ship canal should be shared by all three, Imperial, Colonial, and Indian Governments, yet "it would be well for the latter to take the initiative, so as to determine finally the *precise course* of the channel and its probable cost."

The state of matters is this. Several distinct plans have been advanced, as I have endeavoured to explain; two of these were chosen out of the mass, but were so far decided against by a Parliamentary Committee in 1862, that neither of them could be recommended for adoption. Then the subject was allowed to slumber for nine years, till Sir James Elphinstone, as a practical seaman, had personally investigated Pámban channel and discovered that such a tortuous passage, even if it could be deepened, would never do for long ships. His examination of the neighbourhood, in concert with Captain Donnan, Master Attendant of Colombo, led to the discovery of a well-sheltered area of anchorage, with soundings of five and six fathoms extending over five square miles, and thence gradually decreasing to four fathoms at less than half a mile from the Indian shore, where the canal's mouth is proposed. This harbour lies between Mootapetta Point and Moosel Islet lengthways on the plan, whilst its north and south limits are respectively at Poonamudum town and Moolee Islet. The entrance, in which there is now a depth of three fathoms at high water, is about a mile and a half to the east of the last-named islet. The anchorage is well protected against the southerly swell of the monsoon by coral islands and connecting reefs extending from Valinookam Point to Rámesvaram. This was the very thing to satisfy nautical demands, which in the previous schemes had not been attended to, though some few ship captains had heedlessly joined with landsmen in an opinion that there would be no nautical difficulty in running through the Pámban Pass, when deepened, or by a new deep cut through Rámesvaram Island, at all seasons of the year.

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, 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. For ten months of the year the sheltered situation of the cutting through Rámesvaram Island would have presented no difficulty to the approach of an ocean ship; but I am convinced that mishap would have attended any attempt to *shoot* the canal's mouth when the monsoon swell and current accompanied the steamer. And more than this I am persuaded that the mouth of a canal in that neighbourhood would be silted up during the first week of the south-west monsoon's violence past hope of recovery until those two monsoon months are over in the Gulf of Manaar.

The first project, viz., deepening Pámban passage for large ships, has now been set aside by its own advocates, in favor of the "Port Lorne" or Mootapetta scheme, which has such remarkable advantages as to claim the attention of the Governments and mercantile communities of Bengal, Madras, Bombay, and Ceylon. That Pámban mail-steamer-passage scheme was unfortunately introduced to public notice, and attempted to be carried through, without the co-operation of scientific naval men; nay, more, it was persevered with, contrary to the official opinion published in 1837, of the former Master Attendant of Colombo, Captain James Stewart, a nautical authority of great experience, in the Gulf of Manaar, who tells us in his "Notes" on Ceylon, that "he was clearly of opinion that the only channel capable of improvement was that of Pámban, on account of the comparative shelter it received from the adjacent isles; but that it would not be practicable even to improve *that* channel further than to deepen it sufficiently to admit of the safe passage of such vessels as were used in the coasting trade of Ceylon and the Presidency of Madras." It had been erroneously assumed that there is four fathoms of water and upwards up to the pass on both sides from the open ocean, so that there is "nothing to prevent the pass being entirely open for all vessels." The chart shows this statement to be incorrect. Outside of the Horse-shoe bank there is a sand flat with only 12 and 13 feet water at low tide, and extending this shallowness to the very coral islands. A depth of 24 feet is not found till you emerge from behind every vestige of such shelter as those islets and reefs can afford and find your vessel in the open Gulf of Manaar. Let the eye also scan the *approaches* to such a ship canal. Outlying shoals, too numerous to mark by buoys or lights, warn off the mariner; and who can say how many *unknown* sub-marine banks and rocks exist? The discarded surveyors of the old Indian navy well know that a more exact delineation of all shoals—both in the Gulf of Manaar and Palk Strait—is needed before that locality can become a great commercial highway.

And this seems the place to introduce a rapid sketch of the weather on opposite shores of this gulf, which, though only a hundred miles apart, are the scene of very different climatic conditions. Along the Tinnevelly and Madura coasts the south-west winds of May, June, and July blow as an along-shore wind which has been robbed of its moisture by the lofty interposing Travancore mountains. Thus the Indian shore from Cape Comorin to the River Cauvery has to wait till the end of October or beginning of November for its rainy season, with the north-east wind; while Colombo, on the Ceylon shore, has its greatest rainfall in May, with the south-west monsoon, and another, though less copious, in October and November, at the burst of what is called the Madras monsoon. The setting-in of that north-east monsoon gives a brief time of bad weather at Pámban, and experience expects the tail of a Madras cyclone to visit Palk Bay about once in 17 years. During one which occurred in 1814, the sea broke over and cut a channel across the Ramnad Promontory, at two miles distance from Point Ramen or Tonitory, which afterwards closed up. This, then, is a contingency that engineering skill must guard against; but, as a rule, the atmospheric disturbance is not so great at the setting-in of the north-east monsoon, as in May, with that from the south-west. When the monsoons change the currents also change, and the loose shifting sands, which form Adam's Bridge, are swept over to the opposite side. The north-east monsoon, being established in November, increases in steady strength towards Christmas. In January at its height, it decreases in February, and then the weather becomes calm, and the water so clear that at Pámban almost every pebble at the bottom can be seen. March is a calm month, with daily land and sea breezes, which vary with the trend of coast. In April the winds are variable and the weather hot and oppressive, but sometimes the end of this month gets a premature burst of the south-west monsoon; yet this more frequently sets in early in May, and with it a rush of northerly current over Adam's Bridge. In June the south-west wind increases in strength, and this is the most dangerous month for shipping in Colombo Roads; whilst along the Indian shore the winds are a little off the sea by day and rather off the land by night.

With regard to rainfall, Colombo has most, about 13 or 14 inches in May; about 8 or 9 in June, and only about 4 in July. But, whereas these three months constitute a wet season of the west coast of Ceylon, they form (with the months preceding and following) the dry season of Tinnevelly and Madura, as has been already stated. That lofty Travancore range, averaging 4,000 feet in altitude, and here and there mounting up to 6,000 feet, stands across the path of the rain clouds and wrings out their moisture. Then those clouds ascend and pass on over Tinnevelly, Madura, and Tanjore as dry winds. The northern districts of Ceylon likewise partake of a partial drought in the hottest months of the year and through the same cause.

And here I cannot resist the pleasure of recording a project in contemplation by the admirable irrigation engineers of Madras, which consists in damming off the upper waters of the Perryaur River (whose source is the unexplored mountain range that separates northern Tinnevelly from Travancore and whose outfall is just above Cochin on the Malabar Coast), and turning them into the Vigay River, the little Nile of Madura, thus producing a supply of water for irrigating the latter district at its period of greatest heat and drought. I only make passing allusion to this excellent scheme, as it scarcely comes within a sailor's province, but it promises benefit to Madura's inhabitants and to the revenues of India, and we can wish speedy success to the good work.

But to return to meteorology. July, though more boisterous generally than June, along the Canara and Concan coasts of Western India, is more moderate on the west coast of Ceylon. On the Indian shores of the Gulf of Manaar little wind is experienced, though the monsoon swell of the Arabian Sea rolls on to the south face of the islets and shoals which form a natural breakwater to Port Lorne and to the whole internal navigation (now made use of by coasting craft throughout the south-west monsoon) which extends from Valinookum, about 20 miles west of Mootapetta, to Rámesvaram. August and September are beautiful months, with light westerly breezes, in the Gulf of Manaar.

My object in giving these details being to show how the weather will affect the operations of engineers who have to construct the piers at the canal's northern entrance, with two minor piers on the south, as well as the dredging of a deeper passage between Moolee and Moosel Islets, I cannot do better than make the following extracts from the report of Major Sim's work in 1829-30:—"The best seasons for working, whatever plan be preferred, as far as can be judged from the experience of the present year, are from the beginning of March to the middle of May and from the end of August to the commencement of the north-east monsoon. There are occasional intervals of fine weather in the months of February and August, which might also be taken advantage of, but more than four or five months in the year cannot be calculated on for carrying on the work with advantage. The sea appears to be smoothest and least affected by currents from the beginning of September to the middle of October, and during that period the improvements to the north of the dam or promontory ought to be executed, for in the north-east monsoon the water there is generally too rough to admit of the work being prosecuted with much success. In the months of March, April, and May the rocks to the south of the main dam might be removed.

"There are good grounds for considering the undertaking to be practicable, but it is necessary to take into consideration the possibility of a partial or complete failure, for the project is so entirely new and so unlike anything that has hitherto been undertaken in India that no comparison can be made with the result of other works of the same kind, and no information, therefore, drawn from experience; while at the same time the nature of the currents, their strength and direction at different seasons of the year, and the manner in which they are affected by the opposite monsoons are all, in a great degree still to be learnt."

Since 1830 the Madras engineers have improved their knowledge of the currents and winds while carrying out the deepening of Pámban passage for the coasting traffic with such marked success. But, as a marine surveyor, it is my duty to point out that, before the ship canal can be opened for large vessels, the soundings in the Gulf of Manaar, between Rámesvaram and Cape Comorin must be completed; so also in Palk Strait, from four to eight miles north-west of Kara Teevo Island, and ten miles to northward of Tondimanaar off the Ceylon coast, where the northern end of the Point Pedro shoals is not laid down on the charts, and yet all ocean traffic will have to pass it.

During a survey of the above dangers the proper positions for lights and beacons should be determined and complete directions drawn up for the navigation of this new inner passage.

Then we want a first-class light near the Crocodile rock, which lies 16 miles to the west of Cape Comorin. A similar light on Minikoy Island, which, standing midway between the Laccadives and Maldives, is in the direct steamer track from Aden and was proposed as the point for a lighthouse several years ago after the wreck of the P. and O. steamer *Colombo* during a fog. The *short cut* through Ramnad Promontory will save a steamer 350 miles in the journey from the Red Sea to Madras and will bring the latter nearer to Bombay by about 370 miles. Then may Point de Galle give place to Colombo and "*farewell*" be said to the Basses rocks and their heavy light-dues. On the Ramnad shore the pilgrim traffic from all India to Rámesvaram will be cut across by the new canal, but a steam ferry in these fast days will make amends.

I have, as much as possible, confined my remarks to the nautical bearings of the question. Perhaps attention ought to have been called to this fact, that the five-fathom line of soundings runs closer to the high-water mark between the mouth of the Vigay River and Point Ramen (Tonitorai). This might be used an as argument that no silting-up process takes place there; and why? Because the Coromandel current of the north-east monsoon, from November to February travelling down the Indian shore of Palk Strait, is deflected eastward by the promontory and scours that piece of Ramnad shore before escaping into the Gulf of Manaar, partly through Pámban passage (in which it sometimes attains a velocity of more than five miles an hour) and partly over Adam's Bridge. But it is my opinion that the ship canal cannot be perfected without the formation of

a pier at its northern mouth, of one mile in length, with a lighthouse at its tip, and that when such a pier is thrown out (as absolute a necessity here as at Port Said in the Bay of Pelusium) the obstruction will cause a deposit till the angle is filled up, after which the current will convey, as formerly, its silt across the mouth further eastward, whilst dredging machines will be thoroughly able to keep the entrance clear. I trust it will be seen that I do not state this as any argument against the proposed scheme, but merely to show that all the opposing forces of nature have been taken into consideration before I openly announce myself an advocate of Sir James Elphinstone's ship canal through Ramnad Promontory near Mootapetta.

What more can I say to show my hearty concurrence in this new plan of bringing Bengal and Madras nearer to Bombay and Aden? Mootapetta point is already one of the *health-resorts* of the European residents of Madura, and the passing ships will give the sanitarium an additional charm. Madura District may soon be more amply irrigated and will need the new port as an outlet for the increase of her productions. A branch railway must also connect it with Madura town and Madras. But—better still for India's wants—canal communication *must be completed* along the east coast into the harbour of Mootapetta. Then may the words of Wassaf, the historian at the close of the 13th century, quoted in Colonel Yule's "Marco Polo," become true, that Ma'bar (Marava), that southern province, "is so situated as to be the key of Hind."

London, July 28th, 1871. A. D. TAYLOR.

P.S. February 1872.—Since the above was written, Messrs. Robertson and Townsend, eminent harbour-engineers, have separately inspected the Gulf of Manaar. The former draws the attention of Government to the great value of Mootapetta harbour, though not specially ordered to report upon it; whilst he writes about Pámban passage, "*it would be out of all question to attempt to make this pass fit for large ships, or to a greater depth than* 14 *feet.*" Mr. Townsend however, with few words, passes by the Mootapetta scheme and advocates the old Pámban site. Who shall decide when doctors disagree?

I have not a word to *alter* in the above paper on the best site for a canal; certainly not till I see Mr. Townsend's plan for making the *necessary straight cutting* near Pámban, and whether he will give us a harbour, and where. But I think it rather absurd that he should take exception to Mootapetta harbour because anticipating some difficulty in getting his dredge-buckets at work over the entrance barrier, to gain a depth of 30 feet at low water. If his Pámban Canal is to have that depth at its south entrance, he will have to construct an *artificial* breakwater to protect it, for he will not find so great a depth behind the *natural* shelter of the Shingle Islets.

I can moreover show him by Admiralty Charts that at two places off the north coast of Ceylon his big ships (wanting 30 feet depth) will not find more than 24 to 27 feet in crossing the shoals there, fully exposed to the ocean swell, without a particle of shelter from the north-east monsoon, and with a heavy ground-swell from the south-west monsoon as it rolls up the Bay of Bengal.

These serious impediments are—firstly, the north end of the Point Pedro shoal, with only 4 and 4½ fathoms, where it joins the Point Calimere sand-banks; secondly, the shallow water with only 3½ to 4½ fathoms (pointed out by me to the Parliamentary Committee in 1862), which extends—so far as has been surveyed—over the whole space of sea to north-west of Kara Teevo Island. Some of the then advocates for deepening Pámban passage termed this objection *puerile*; be it so; I am only still a student, though one for 30 years, in Indian hydrography.

The visit of Mr. Robertson to the Gulf of Manaar was too early in the year, but he witnessed the smoothness and natural advantages of Mootapetta harbour. The south-west monsoon's violence was over at Mr. Townsend's visit in August, but there was then a ground-swell at the entrance of Mootapetta. Neither gentlemen witnessed the burst of either south-west or north-east monsoon. But those whose task it will be to construct the canal will have to encounter the violence of those annual visitations.

A. D. T.

EXTRACT FROM A REPORT ON THE PAMBAN PASS BY MR. GEORGE ROBERTSON.

The present pass appears, from its tortuous nature, to be the original natural channel opened out and deepened. There are two distinct channels—the north or reef channel and the south or sand-bank channel.

The former is cut through a sandstone reef, partly dry at low water, which connects the main land of Madura with the Island of Rámesveram. The latter has been dredged through a sand-bank, nearly one-and-a-half miles to the south. The two channels are connected by a natural gullet in the sand-bank, which appears to maintain itself at a greater depth of water than there is in the channels.

The reef channel also keeps open and requires hardly any dredging, except for a few days at the end of each monsoon, as the current through the pass is usually very strong.

At the sand-bank channel the current and the tide set more across the channel, and there is in consequence a greater tendency to silt up.

Fortunately for this channel it is under the shelter of a large coral reef, dry at low water of springs, the three highest points of which form islands at high water. Were it not for this

protection, it would be difficult to keep open the sand-bank channel during the south-west monsoon.

The Master Attendant of Madras has furnished me with the last set of soundings, taken by Captain Daviot and Serjeant Sanderson during March 1870, which shows the present state of the works to be very nearly as follows:

The reef channel has a least depth, at any one section, of 11 feet at low water of neap tides, but the greater part is fully 12 feet in the centre, and some places are 13 and 14 feet and even more. Unless the high points have been reduced lately, it cannot be called a safe channel at high water for vessels drawing more than 12 feet, and that only in fine weather. A little more deepening would give a clear 12 feet at low water of springs.

The length of the reef channel is 4,232 feet. Its navigable width is called 80 feet; but a good part of it is more, soundings being taken for a width of 130 feet. Near the middle of the channel there is an extremely awkward angle, which is being taken off so as to widen the channel for a length of 1,300 feet. The tide often runs so strong that it is found extremely difficult to warp vessels through without their getting athwart the channel at this angle. The sandstone rock in the reef channel is said to be softer below than on the crust, and a good deal can be removed by the dredger alone without being blasted.

The sand-bank channel is 2,100 feet in length from buoy to buoy. The width on the plan appears to be rather more than that of the reef channel, soundings being taken for a width of 150 feet. The average depth in March 1870 was rather less than the depth of the reef channel, but the depth varies on account of the silting before alluded to.

The tides rise from two to three feet, but are very irregular, depending principally on the wind.

The water at the head of the Gulf of Manaar, at the point where the sand-bank channel enters, is not much, if at all, deeper than the channel itself. To reach a depth of 14 feet at low water of springs would require a good deal of dredging and would entail a considerable amount of yearly dredging in addition to what is already required. Looking at the character of the bay into which the Pámban passage opens, as well as the tortuous nature of the channel, it would be out of all question to attempt to make this pass fit for large ships, or to a greater depth than 14 feet. I am of opinion, moreover, that it is not worth while making it deeper than 12 feet at low water of spring tides. A depth of 14 feet would be of no use to the steam trade, and a depth of 12 feet at low water of springs would be sufficient for all the purposes of the local trade of the south of India as at present carried on.

During the last ten official years the average annual tonnage of vessels using the passage has been 173,894 tons. The number of vessels has averaged 2,101 per annum, which gives an average of 82 tons per vessel. The Government share of pilotage, exclusive of the share allowed to the pilots, has averaged 14,816 rupees per annum.

At Pámban the north-east monsoon sets in early in November with heavy squalls and rain. Up to December the weather is generally dark and cloudy, with a heavy sea on the north roadstead. During this time it requires much tact and care in running vessels through the pass. At the end of December the weather clears up, leaving a strong breeze, generally from N.N.E., up to the middle of February. It then moderates, with light variable winds up to the middle of April, when the southerly winds set in. The south-west monsoon commences to blow strong after the middle of May and continues so up to August, when light variable winds set in (with a couple of days of blowing weather at intervals) until the change in November.

During the strong winds vessels are delayed being warped through the pass, owing to the strong currents in the direction of the wind. The current has been known to have a velocity of six knots an hour, but is generally from 2½ to 3 knots.

During the first two or three months of either monsoon there is no change in the direction of the current, the prevailing winds influencing its course, although the tide ebbs and flows. During stormy weather the level of the sea on the weather side of the reef is generally 9 inches to 1 foot higher than on the lea side, the reef of rocks acting like a weir across the opening between Madura and Rámesveram.

In approaching Pámban from the south, the deep water channel is on the Rámesveram side of the Gulf of Manaar, but in gales of wind small vessels take advantage of an inner channel on the Madura side of the gulf.

From Keelacarry to Pámban and, to a certain extent, almost the whole way from Tuticorin the inner channel is sheltered by reefs and islands.

I would draw the attention of Government to an excellent anchorage in this channel, about ten miles to the west of Pámban, and situated between Moosel Island and Mootapetta Point. There is a stretch of water here 7 miles long by 4½ miles wide, fairly well sheltered by reefs and islands, the greater part of which has a depth of 20 feet, and much of it 25 and even 30 feet of water. The entrance to this anchorage from the sea, between Moosel Island and Moolee Island, has only about 2½ fathoms, so that some deepening would be required before full advantage could be taken of the anchorage. We passed through this natural harbour in the steamer *Margaret Northcote* entering from the Keelacarry end, where there is only from 10 to 14 feet of water.

On reaching England I found that the new ship canal proposed by Sir James Elphinstone is at this place. Should a ship canal ever be made between India and Ceylon, this long stretch of sheltered water will be of the greatest value as a coaling station for steamers, as it is far superior to Galle. The produce of the south of India could also be shipped here much easier than at Tuticorin or Negapatam, as the sheltered deep water comes within about half a mile of the shore.

In the excavation of any ship canal through Tonitorai Point, the probability is that a large amount of sandstone would be obtained; a portion of this would be required for works in connection with the canal, but the remainder might be deposited on the reefs, which to a great extent already protect this anchorage, so as to make the protection perfect. This could be done for the mere cost of carriage. Were this done and a cut made between Moosel Island and Moolee Island, I have no hesitation in saying that this anchorage would be second to none in India.

There is another fairly well-sheltered but much smaller piece of water at Valinookum Point, about eight miles to the west of Keelacarry. There is a little bay here, under shelter of the point and of two islands, where there is deeper water than at Tuticorin, with 5 fathoms in the entrance from the sea.

These anchorages are of little value at present, and it is always very difficult to divert trade from the outlets which have already been fixed upon by accident or circumstances. Still it is desirable to point out that there is at all events one good anchorage on the south coast of a Presidency singularly devoid of natural harbours or sheltered places, where trade can be carried on independent of the weather.

In connection with the approaches to Pámban from the south, it may not be out of place to draw attention to the great necessity there is for a light at the Crocodile Rock, about 17 miles to the west of Cape Comorin, and 2¾ miles from the shore at Cadipatam Point. This rock is much dreaded by the captains of steamers trading round the south of India and Ceylon and by native craft making for Pámban. It would not be easy to put a light on the rock itself, as it is barely awash at low water and is much exposed, but there are two small islands between it and the shore, on either of which a light could be placed. The shore is also high at this point and well suited for a lighthouse.

On the north side of Pámban I would strongly advise that a light should be put on Point Calimere where there is at present only a pillar. Vessels using the pass are liable to get embayed and into danger at Point Calimere. When the wind permits they have to leave Pámban at night, so as to make the point by day. In our little steamer, drawing only five feet, we experienced the want of a light at this place.

Appendix to L. B. No 13414 dated 28th May 1881.

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ON THE PROPOSED SHIP CANAL BETWEEN CEYLON AND INDIA.

By Commander A. DUNDAS TAYLOR, F.R.G.S., late Indian Navy.

The Ceylon papers inform us that Paumben and its neighbourhood were visited in August last by Sir Hercules Robinson and Mr. Townsend, C.E., who expressed astonishment that a ship canal had not long ago been cut through Paumben. This, according to the newspaper, was after inspecting Sir James Elphinstone's proposed site for a cutting and three others; so I infer that engineering sympathy still leans towards the improvement of old Paumben Passage, or a new cutting through Rameswaram Island, which Mr. Townsend minutely examined.

The important question is, "Which is the best site for a ship canal?" And it is my desire to show that no scheme as yet advanced can compare with that which has been brought into public notice by Sir James Elphinstone. The consideration of such a question demands a good general knowledge of the atmospheric and oceanic agencies that affect the approaches to the proposed canal. An expenditure of much time and money may result in the attainment of a pretty good harbour, but it is scarcely wisdom to leave the consideration of its accessibility to an after-thought; nor will a brief visit to the locality in the fine season give the engineer the least insight into oceanic forces which are displayed on so grand a scale in the foul-weather season and more so in an exceptional cyclone.

The discussion of the practicability of forming a navigable passage from the Gulf of Manaar into Palk Strait dates from the very commencement of this century, when Colonel Manuel Martinez exchanged sentiments with Stephen Rumbold Lushington, of the Madras Civil Service, then in charge of the southern provinces of Madras, regarding a removal of the obstruction to the trade of Malabar, Coromandel, and Bengal, caused by the shallowness of the channel of Paumben. But Colonel De Havilland, of the Madras Engineers, was the first to recommend to the Marine Board a regular survey of the locality. In 1822, Ensign Arthur Cotton made a first examination of the pass, and sent in an admirable report to Captain Fullerton, Civil Engineer of the Southern Division, who, in his turn, was instructed by De Havilland to inspect the Paumben Passage, and reported the result in 1822 to Lieutenant-Colonel Caldwell, who had in the interim succeeded De Havilland as Inspector-General of Civil Estimates.

But then came the Burmese war, in the prosecution of which to a successful issue all the means and men at the disposal of the Madras Government were required for succeeding years. So the Paumben question was hushed for a time, until Stephen Rumbold Lushington had become Governor of Madras, and in 1828 wrote an official minute, in which he mentions having consulted with Colonel Garrard and Major Sim, whose sentiments entirely accorded with those of Arthur Cotton and the others; and he wrote as follows concerning the Paumben rocky barrier: "The calmness of the sea at "some periods of the year, the quality of the stone which intersects the passage, and the presence of a "large population of pearl-divers upon that part of the coast, seemed to offer peculiar facilities to the "removal of a portion of this great obstruction to the navigation and commerce of our territories." At the same time the Bombay Government, and especially the Superintendent of Marine, Sir Charles Malcolm, entered warmly into the proposal of the Governor of Madras, as "one of the very greatest "importance to the general coasting trade of Madras and Bombay," and they offered the use of a "cruiser" to assist in *surveying the approaches* to the pass.

Sir Edward Barnes, the Governor of Ceylon, in the early part of 1829, directed an inspection of the several water-ways between India and Ceylon, with a view to finding one that was capable of improvement for the passage of large vessels. The channels on both sides of Manaar Island, and those through Adam's Bridge, were then surveyed by Captain Dawson, of the Royal Engineers, and Mr. Stewart, Master Attendant of Colombo. The preparation of the report, however, devolved upon the latter, owing to the untimely death of Captain Dawson, from "a disease contracted in the "course of this service by exposure to the sun, and the noxious exhalations from the stagnant waters "in the old stopped-up channels at Manaar."

This happened in 1829, and the report of Major Sim, of the Madras Engineers, comprising three or four distinct schemes for removing portions of the rocky dam, came out in 1830. Thus were all the known channels inspected, viz., the old Dutch Manaar Passage; the Tal-Manaar, at the island's west point; one near the centre of Adam's Bridge; the Tanny-Cody, at the east end of Rameswaram Island; and the Paumben.

I cannot ascertain what hindered the acceptance of Sir Charles Malcolm's offer in 1828 of a "Bombay Marine" cruiser to survey the approaches to the various channels; but it was not till November 1837 that Powell and Ethersey, of the Indian Navy, in the schooners "Royal Tiger" and "Shannon," commenced work on Rameswaram Island, and accurately delineated* the Paumben barrier and channels with all the off-lying reefs and islets, westward to Mootapetta, eastward to Manaar with the old Dutch channel between that island and Ceylon, and northward from Cape Tonitoray to Point Calymere; but before they had completed the soundings in Palk Strait their vessels were recalled to Bombay.

The report of Captain Stewart, the Master Attendant of Colombo, was emphatic against attempts at deepening any of the channels enumerated, except that of Paumben; and *that* only for *coasting craft*,

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* On a scale of one inch to the mile. The charts are now in Hydrographic Office, Admiralty.

as the expectation of gaining an average depth of 15 feet throughout was hopeless. It appears from his "Notes on Ceylon," published in 1862, that the Governor of that colony from 1832–37, Sir Robert Wilmot Horton, had already three surveys of Manaar when he made application to the East India Company to execute another (which was entrusted to Powell and Ethersey), consequent on an extraordinary proposition by an assistant civil engineer to excavate a navigable channel for shipping through the Island of Manaar, at the cost of 20,000*l*. This scheme was referred to the Hydrographer of the Admiralty, Sir Francis Beaufort, who, as a scientific mariner, advised an *accurate survey of the approaches* to Palk Strait and the Gulf of Manaar, which was partially effected, as just stated, under the orders of Sir Charles Malcolm. But unfortunately for India, that distinguished admiral and devoted geographer, before the survey was complete, was succeeded by an old sailor of the præ-scientific school, who, on receipt of the charts and report of the surveyors, allowed the former to go to Madras without taking copies, and the latter, through some inadvertence or misunderstanding, to be put on the shelf; thus were they buried in oblivion for more than 30 years. And we have proof in Stewart's "Notes on Ceylon," that a report was expected to accompany the charts; for on the preferment by the East India Company, in 1845, of a claim to remuneration from the Ceylon Exchequer, for the use of their surveying vessels, the Government of that colony demurred even to paying half the outlay, because "it nowhere appeared that the officers who conducted these surveys had made any *special report* on "the Island of Manaar or the approaches to the projected channel through it, nor on the *probable* "*success* of such undertaking." But the report of Powell and Ethersey has at length been brought to light and printed in this year, 1871, and comes most opportunely with information concerning the meteorology of the Gulf of Manaar, its currents and tides, as well as some of the geological features of its shores. The opinion of those Marine Surveyors was directly opposed to the expectation of success in attempts to deepen *any* of the channels through Adam's Bridge and Manaar Island, whilst they advocated the adoption of the Paumben Pass.

Major Sim's report in 1830,—which concludes by mentioning the able services of his co-labourers from the Madras Engineers, the brothers Arthur and Frederick Cotton,—presented three schemes: firstly, the clearance from rocks and straightening of the then existing principal opening; secondly, the still further deepening of that or another deep cutting through the dam further west; thirdly, a channel with 12 or 14 feet at high water, either at the last shown cutting through the rocks, or through the Ramnâd Promontory, about two miles west of Point Ramen. Of those plans the first was adopted; and the Paumben Channel, the general favourite, was gradually improved till 1834. From that year till 1837 the work was at a standstill; but, since then, has steadily but slowly advanced in the hands of the Madras sappers and miners, with a gang of convicts, under the direction of the chief engineer of that presidency. In 1854, when Colonel Arthur Cotton held the latter office, he reported the great success of the undertaking, and argued for its more vigorous prosecution, with the view of rendering the passage navigable for vessels of large burthen, and in particular for the steamers of the Suez line; his estimate of the outlay was 15 lakhs of rupees, or 150,000*l*. But Captains Biden and Franklin, successive Master Attendants of Madras, doubted whether the mail steamers would take this inner passage, even if it were made practicable for them. I also, as a marine surveyor of some experience amongst Indian monsoons, gave evidence before the Parliamentary Committee of 1862, against the practicability of deepening the Paumben, or of making another cutting through Rameswaram Island (see plan) for the benefit of mail steamers or other large ships. And I ask the Government to examine that plan, and then say whether the lines of equal soundings do not show plainly, that *nowhere* between Manaar Island and Moosel Islet, can be found a *practicable entrance* for a ship canal. But now look further west, at the admirable harbour near Mootapetta, pointed out by Sir James Elphinstone, which (he tells me) has already been named "Port Lorne" by the Colombo merchants. This has a naturally deep entrance, which engineering science can improve and mark off by beacons and lights, and its capacity will suffice to meet the requirements of commercial traffic, even to the extent of an hundredfold increase in the shipping using the strait.

It must be borne in mind that the vicinity of Manaar Island suffers much from the violence of the S.W. monsoon for at least two months of the year; is, in fact, a dead lee-shore, whilst the Madura coast is protected from the surf by barrier reefs. Rameswaram has a large share of Manaar's troubles and but little of Mootapetta's security; for it must be apparent to everybody that the further we go westward the more shelter we get. But we must not pass over Mootapetta, which has such an admirable harbour, the area of which, for accommodating vessels of any size, is more than a dozen *square miles*, whereas (for the sake of comparison) the capacity of Galle harbour can only be reckoned by *cable-lengths*, and that is all subject to the S.W. monsoon surf.

Of course there will be a ground swell outside the barrier reefs of Mootapetta harbour between May and September, but not so for the rest of the year.

Thus I have endeavoured to give a summary of the various projects entertained for making a navigable passage between Ceylon and the Indian continent. Successive governors of Madras have, with prudence, sanctioned yearly outlays of money upon Sir Arthur Cotton's scheme, though to a smaller extent than its originator wished. But that little has enormously benefited the coasting trade and the revenues of Madras and Ceylon, whilst amply recompensing the State already for every expenditure incurred. Much has lately been said as to the apathy and parsimony of the Indian Government in not having, after the successful experiment of the Suez Canal, spent more money on a similar useful work; but time has shown that they exercised a wise discretion in the face of the arguments which more than one nautical authority of Indian experience had advanced against the probability of success.

But now rumours are current that the Indian Government no longer offers opposition to an effectual deepening of the Paumben Channel; that those who formerly doubted the practicability of the scheme, have now come round to the originator's way of thinking; and that a project, said to have been disowned for half a century, now bids fair to become an accomplished fact, and that very soon, for the projectors say there is neither nautical nor engineering difficulty to be overcome, and that no further examination of the approaches north and south of the canal is needed.

But what is the scheme? The India Office has no printed memoir or even MS. of Sir James Elphinstone's plan; and the newspaper accounts of the meetings whereat it was discussed are very vague, and evidently confound the newborn one with its defunct ancestor the Paumben. Some correspondence, backed by an article in the editorial summary of the "Asiatic" weekly paper of June 20, 1871, advocates "the further and complete excavation of the Paumben Passage, as it has already been "begun and carried forward to a considerable extent." Now, so far from this being the case with regard to Sir James Elphinstone's new and valuable project, the fact is that the site of the canal is not yet marked out, or even decided upon, nor does anybody in this country know what a section across the Ramnâd Promontory is likely to show as to the nature and quantity of material to be removed, so that no correct estimate of the expense can be framed. Understanding this fact, we shall comprehend the meaning of the Duke of Argyll's answer to the deputation from the East India Association on the 3rd of May, that although the responsibility of the construction of the ship canal should be shared by all three, Imperial, Colonial, and Indian Governments, yet "it would be well for the latter to take "the initiative, so as to determine finally the *precise course* of the channel and its probable cost."

The state of matters is this.—Several distinct plans have been advanced, as I have endeavoured to explain; two of these were chosen out of the mass, but were so far decided against by a Parliamentary Committee in 1862, that neither of them could be recommended for adoption. Then the subject was allowed to slumber for nine years, till Sir James Elphinstone, as a practical seaman, had personally investigated Paumben Channel, and discovered that such a tortuous passage, even if it could be deepened, would never do for long ships. His examination of the neighbourhood, in concert with Captain Donnan, Master Attendant of Colombo, led to the discovery of a well-sheltered area of anchorage, with soundings of five and six fathoms extending over five square miles, and thence gradually decreasing to four fathoms at less than half a mile from the Indian shore, where the canal's mouth is proposed. This harbour lies between Mootapetta Point and Moosel Islet, lengthways on the plan; whilst its north and south limits are respectively at Poonamudum town and Moolee Islet. The entrance, in which there is now a depth of three fathoms at high water, is about a mile and a half to the east of the last-named islet. The anchorage is well protected against the southerly swell of the monsoon by coral islands and connecting reefs extending from Valinookam Point to Rameswaram. This was the very thing to satisfy nautical demands, which in the previous schemes had not been attended to, though some few ship-captains had heedlessly joined with landsmen in an opinion that there would be no nautical difficulty in running through the Paumben Pass, when deepened, or by a new deep cut through Rameswaram Island, at all seasons of the year.

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, 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. For ten months of the year the sheltered situation of the cutting through Rameswaram island would have presented no difficulty to the approach of an ocean ship; but I am convinced that mishap would have attended any attempt to *shoot* the canal's mouth when the monsoon swell and current accompanied the steamer. And more than this—I am persuaded that the mouth of a canal in that neighbourhood would be silted up during the first week of the south-west monsoon's violence past hope of recovery until those two monsoon months are over in the Gulf of Manaar.

The first project, viz., deepening Paumben Passage for large ships, has now been set aside by its own advocates, in favour of the "Port Lorne" or Mootapetta scheme, which has such remarkable advantages as to claim the attention of the governments and mercantile communities of Bengal, Madras, Bombay, and Ceylon. That Paumben mail-steamer-passage scheme was unfortunately introduced to public notice, and attempted to be carried through, without the co-operation of scientific naval men; nay, more, it was persevered with, contrary to the official opinion published in 1837, of the former Master Attendant of Colombo, Captain James Stewart, a nautical authority of great experience, in the Gulf of Manaar, who tells us in his "Notes" on Ceylon, that "he was clearly of opinion that the only "channel capable of improvement was that of Paumben, on account of the comparative shelter it "received from the adjacent isles; but that it would not be practicable even to improve *that* channel "further than to deepen it sufficiently to admit of the safe passage of such vessels as were used in the "coasting trade of Ceylon and the Presidency of Madras." It had been erroneously assumed that there is 'four fathoms of water and upwards up to the pass on both sides from the open ocean, so that there is "nothing to prevent the pass being entirely open for all vessels." The chart shows this statement to be incorrect. Outside of the Horse-shoe bank there is a sand flat with only 12 and 13 feet water at low tide, and extending this shallowness to the very coral islands. A depth of 24 feet is not found till you emerge from behind every vestige of such shelter as those islets and reefs can afford, and find your vessel in the open Gulf of Manaar. Let the eye also scan the *approaches* to such a ship canal. Outlying shoals, too numerous to mark by buoys or lights, warn off the mariner; and who can say how many *unknown* submarine banks and rocks exist? The discarded surveyors of the old Indian navy well know that a more exact delineation of all shoals, both in the Gulf of Manaar and Palk Strait,—is needed before that locality can become a great commercial highway.

And this seems the place to introduce a rapid sketch of the weather on opposite shores of this gulf, which, though only a hundred miles apart, are the scene of very different climatic conditions. Along the Tinivelly and Madura coasts the south-west winds of May, June, and July blow as an along-shore wind which has been robbed of its moisture by the lofty interposing Travancore mountains. Thus the Indian shore from Cape Comorin to the River Cauvery has to wait till the end of October or beginning of November for its rainy season, with the north-east wind; while Colombo, on the Ceylon shore, has its greatest rainfall in May, with the south-west monsoon, and another, though less copious, in October and November, at the burst of what is called the Madras monsoon. The setting-in of that north-east monsoon gives a brief time of bad weather at Paumben, and experience expects the tail of a Madras cyclone to visit Palk Bay about once in 17 years. During one which occurred in 1814, the sea broke over and cut a channel across the Ramnâd Promontory, at two miles distance from Point Ramen or Tonitory, which afterwards closed up. This, then, is a contingency that engineering skill

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must guard against; but, as a rule, the atmospheric disturbance is not so great at the setting-in of the north-east monsoon, as in May, with that from the south-west. When the monsoons change the currents also change, and the loose shifting sands, which form Adam's Bridge, are swept over to the opposite side. The north-east monsoon, being established in November, increases in steady strength towards Christmas. In January at its height, it decreases in February, and then the weather becomes calm, and the water so clear that at Paumben almost every pebble at the bottom can be seen. March is a calm month, with daily land and sea breezes, which vary with the trend of coast. In April the winds are variable and the weather hot and oppressive, but sometimes the end of this month gets a premature burst of the south-west monsoon; yet this more frequently sets in early in May, and with it a rush of northerly current over Adam's Bridge. In June the south-west wind increases in strength, and this is the most dangerous month for shipping in Colombo Roads; whilst along the Indian shore the winds are a little off the sea by day and rather off the land by night.

With regard to rainfall, Colombo has most, about 13 or 14 inches in May; about 8 or 9 in June, and only about 4 in July. But, whereas these three months constitute a wet season of the west coast of Ceylon, they form (with the months preceding and following) the dry season of Tinivelly and Madura, as has been already stated. That lofty Travancore range, averaging 4,000 feet in altitude, and here and there mounting up to 6,000 feet, stands across the path of the rain clouds and wrings out their moisture. Then those clouds ascend and pass on over Tinivelly, Madura, and Tanjore as dry winds. The northern districts of Ceylon likewise partake of a partial drought in the hottest months of the year and through the same cause.

And here I cannot resist the pleasure of recording a project in contemplation by the admirable irrigation engineers of Madras, which consists in damming off the upper waters of the Perryaur River (whose source is the unexplored mountain-range that separates northern Tinivelly from Travancore, and whose outfall is just above Cochin, on the Malabar coast), and turning them into the Vigay River, the little Nile of Madura, thus producing a supply of water for irrigating the latter district at its period of greatest heat and drought. I only make passing allusion to this excellent scheme, as it scarcely comes within a sailor's province, but it promises benefit to Madura's inhabitants and to the revenues of India, and we can wish speedy success to the good work.

But to return to meteorology. July, though more boisterous generally than June, along the Canara and Concan coasts of Western India, is more moderate on the west coast of Ceylon. On the Indian shores of the Gulf of Manaar, little wind is experienced, though the monsoon swell of the Arabian Sea rolls on to the south face of the islets and shoals, which form a natural breakwater to Port Lorne and to the whole internal navigation (now made use of by coasting craft throughout the S.W. mousoon) which extends from Valinookum, about 20 miles west of Mootapetta, to Rameswaram. August and September are beautiful months, with light westerly breezes, in the Gulf of Manaar.

My object in giving these details being to show how the weather will affect the operations of engineers who have to construct the piers at the canal's northern entrance, with two minor piers on the south, as well as the dredging of a deeper passage between Moolee and Moosel Islets, I cannot do better than make the following extracts from the report of Major Sim's work in 1829–30: "The best "seasons for working, whatever plan be preferred, as far as can be judged from the experience of the "present year, are from the beginning of March to the middle of May, and from the end of August to "the commencement of the N.E. monsoon. There are occasional intervals of fine weather in the "months of February and August, which might also be taken advantage of, but more than four or five "months in the year cannot be calculated on for carrying on the work with advantage. The sea appears "to be smoothest and least affected by currents from the beginning of September to the middle of "October, and during that period the improvements to the north of the dam or promontory ought to "be executed; for in the north-east monsoon the water there is generally too rough to admit of the "work being prosecuted with much success. In the months of March, April, and May the rocks to "the south of the main dam might be removed."

"There are good grounds for considering the undertaking to be practicable, but it is necessary to "take into consideration the possibility of a partial or complete failure, for the project is so entirely "new and so unlike anything that has hitherto been undertaken in India, that no comparison can be "made with the result of other works of the same kind, and no information, therefore, drawn from "experience; while at the same time, the nature of the currents, their strength and direction at "different seasons of the year, and the manner in which they are affected by the opposite monsoons, "are all, in a great degree, still to be learnt."

Since 1830, the Madras engineers have improved their knowledge of the currents and winds, while carrying out the deepening of Paumben Passage for the coasting traffic with such marked success. But, as a marine surveyor, it is my duty to point out that, before the ship canal can be opened for large vessels, the soundings in the Gulf of Manaar, between Rameswaram and Cape Comorin must be completed; so also in Palk Strait, from four to eight miles north-west of Kara-Teevo Island; and ten miles to northward of Tondimanaar off the Ceylon coast, where the northern end of the Point Pedro shoals is not laid down on the charts, and yet all ocean traffic will have to pass it.

During a survey of the above dangers, the proper positions for lights and beacons should be determined, and complete directions drawn up for the navigation of this new inner passage.

Then we want a first-class light near the Crocodile rock, which lies 16 miles to the west of Cape Comorin. A similar light on Minikoy Island, which, standing midway between the Laccadives and Maldives, is in the direct steamer track from Aden, and was proposed as the point for a lighthouse several years ago, after the wreck of the P. and O. steamer *Colombo* during a fog. The *short cut* through Ramnâd Promontory will save a steamer 350 miles in the journey from the Red Sea to Madras; and will bring the latter nearer to Bombay by about 370 miles. Then may Point de Galle give place to Colombo, and "*farewell*" be said to the Basses rocks and their heavy light-dues. On the Ramnâd shore the pilgrim traffic from all India to Rameswaram will be cut across by the new canal, but a steam ferry in these fast days will make amends.

I have, as much as possible, confined my remarks to the nautical bearings of the question. Perhaps attention ought to have been called to this fact, that the five fathom line of soundings runs closer to the

high-water mark between the mouth of the Vigay River and Point Ramen (Tonitorai). This might be used as an argument that no silting-up process takes place there; and why? Because the Coromandel current of the north-east monsoon, from November to February travelling down the Indian shore of Palk Strait, is deflected eastward by the promontory, and scours that piece of Ramnâd shore before escaping into the Gulf of Manaar, partly through Paumben Passage (in which it sometimes attains a velocity of more than five miles an hour), and partly over Adam's Bridge. But it is my opinion that the ship canal cannot be perfected without the formation of a pier at its northern mouth, of one mile in length, with a lighthouse at its tip; and that when such a pier is thrown out (as absolute a necessity here as at Port Said in the Bay of Pelusium) the obstruction will cause a deposit till the angle is filled up, after which the current will convey, as formerly, its silt across the mouth further eastward, whilst dredging machines will be thoroughly able to keep the entrance clear. I trust it will be seen that I do not state this as any argument against the proposed scheme, but merely to show that all the opposing forces of nature have been taken into consideration before I openly announce myself an advocate of Sir James Elphinstone's ship canal through Ramnâd Promontory near Mootapetta.

What more can I say to show my hearty concurrence in this new plan of bringing Bengal and Madras nearer to Bombay and Aden? Mootapetta Point is already one of the *health-resorts* of the European residents of Madura, and the passing ships will give the sanitorium an additional charm. Madura district may soon be more amply irrigated, and will need the new port as an outlet for the increase of her productions. A branch railway must also connect it with Madura town and Madras. But,—better still for India's wants,—canal communication *must be completed* along the east coast into the harbour of Mootapetta. Then may the words of Wassaf, the historian at the close of the 13th century, quoted in Colonel Yule's "Marco Polo," become true, that Ma'bar (Marava), that southern province, "is so situated as to be the key of Hind."

London, July 28th, 1871. A. D. Taylor.

P.S. February 1872.—Since the above was written, Messrs. Robertson and Townsend, eminent harbour-engineers, have separately inspected the Gulf of Manaar. The former draws the attention of Government to the great value of Mootapetta harbour, though not specially ordered to report upon it; whilst he writes about Paumben Passage, "*it would be out of all question to attempt to make this pass fit for large ships, or to a greater depth than 14 feet.*" Mr. Townsend however, with few words, passes by the Mootapetta scheme, and advocates the old Paumben site. Who shall decide, when doctors disagree?

I have not a word to *alter* in the above paper on the best site for a canal; certainly not till I see Mr. Townsend's plan for making the *necessary straight cutting* near Paumben, and whether he will give us a harbour, and where. But I think it rather absurd that he should take exception to Mootapetta harbour because anticipating some difficulty in getting his dredge-buckets at work over the entrance barrier, to gain a depth of 30 feet at low water. If his Paumben Canal is to have that depth at its south entrance, he will have to construct an *artificial* breakwater to protect it, for he will not find so great a depth behind the *natural* shelter of the Shingle Islets.

I can moreover show him by Admiralty Charts that, at two places off the north coast of Ceylon, his big ships (wanting 30 feet depth) will not find more than 24 to 27 feet in crossing the shoals there, fully exposed to the ocean swell, without a particle of shelter from the N.E. monsoon, and with a heavy ground-swell from the S.W. monsoon as it rolls up the Bay of Bengal.

These serious impediments are—Firstly, the north end of the Point Pedro shoal, with only 4 and 4½ fathoms, where it joins the Point Calymere sand-banks; Secondly, the shallow water with only 3½ to 4½ fathoms (pointed out by me to the Parliamentary Committee in 1862), which extends—so far as has been surveyed—over the whole space of sea to N.W. of Kara Teevo Island. Some of the then advocates for deepening Paumben Passage termed this objection *puerile*; be it so; I am only still a student, though one for 30 years, in Indian hydrography.

The visit of Mr. Robertson to the Gulf of Manaar was too early in the year, but he witnessed the smoothness and natural advantages of Mootapetta harbour. The S.W. monsoon's violence was over at Mr. Townsend's visit in August, but there was then a ground swell at the entrance of Mootapetta. Neither gentlemen witnessed the burst of either S.W. or N.E. monsoon. But those, whose task it will be to construct the canal, will have to encounter the violence of those annual visitations.

A. D. T.

Extract from a Report on the Paumeen Pass by Mr. George Robertson.

The present pass appears, from its tortuous nature, to be the original natural channel, opened out and deepened. There are two distinct channels,—the north or reef channel, and the south or sand-bank channel.

The former is cut through a sandstone reef, partly dry at low water, which connects the main land of Madura with the Island of Rameseram. The latter has been dredged through a sand-bank, nearly one and a half miles to the south. The two channels are connected by a natural gullet in the sand-bank, which appears to maintain itself at a greater depth of water than there is in the channels.

The reef channel also keeps open, and requires hardly any dredging, except for a few days at the end of each monsoon, as the current through the pass is usually very strong.

At the sand-bank channel the current and the tide set more across the channel, and there is, in consequence, a greater tendency to silt up.

Fortunately for this channel, it is under the shelter of a large coral reef, dry at low water of springs, the three highest points of which form islands at high water. Were it not for this protection it would be difficult to keep open the sand-bank channel during the south-west monsoon.

The master attendant of Madras has furnished me with the last set of soundings, taken by Captain Daviot and Serjeant Sanderson during March 1870, which shows the present state of the works to be very nearly as follows:

The reef channel has a least depth, at any one section, of 11 feet at low water of neap tides, but the greater part is fully 12 feet in the centre, and some places are 13 and 14 feet and even more. Unless the high points have been reduced lately it cannot be called a safe channel at high water for vessels drawing more than 12 feet, and that only in fine weather. A little more deepening would give a clear 12 feet at low water of springs.

The length of the reef channel is 4,232 feet. Its navigable width is called 80 feet; but a good part of it is more, soundings being taken for a width of 130 feet. Near the middle of the channel there is an extremely awkward angle, which is being taken off so as to widen the channel for a length of 1,300 feet. The tide often runs so strong that it is found extremely difficult to warp vessels through without their getting athwart the channel at this angle. The sandstone rock in the reef channel is said to be softer below than on the crust, and a good deal can be removed by the dredger alone, without being blasted.

The sand-bank channel is 2,100 feet in length from buoy to buoy. The width on the plan appears to be rather more than that of the reef channel, soundings being taken for a width of 150 feet. The average depth in March 1870 was rather less than the depth of the reef channel, but the depth varies on account of the silting before alluded to.

The tides rise from two to three feet, but are very irregular, depending principally on the wind.

The water at the head of the gulf of Manaar, at the point where the sand-bank channel enters, is not much, if at all, deeper than the channel itself. To reach a depth of 14 feet at low water of springs would require a good deal of dredging, and would entail a considerable amount of yearly dredging in addition to what is already required. Looking at the character of the bay into which the Paumben Passage opens, as well as the tortuous nature of the channel, it would be out of all question to attempt to make this pass fit for large ships, or to a greater depth than 14 feet. I am of opinion, moreover, that it is not worth while making it deeper than 12 feet at low water of spring tides. A depth of 14 feet would be of no use to the steam trade, and a depth of 12 feet at low water of springs would be sufficient for all the purposes of the local trade of the South of India, as at present carried on.

During the last ten official years the average annual tonnage of vessels using the passage has been 173,894 tons. The number of vessels has averaged 2,101 per annum, which gives an average of 82 tons per vessel. The Government share of pilotage, exclusive of the share allowed to the pilots, has averaged 14,816 rupees per annum.

At Paumben the N.E. monsoon sets in early in November, with heavy squalls and rain. Up to December the weather is generally dark and cloudy, with a heavy sea on the north roadstead. During this time it requires much tact and care in running vessels through the pass. At the end of December the weather clears up, leaving a strong breeze, generally from N.N.E., up to the middle of February. It then moderates, with light variable winds up to the middle of April, when the southerly winds set in. The S.W. monsoon commences to blow strong after the middle of May, and continues so up to August, when light variable winds set in (with a couple of days of blowing weather at intervals), until the change in November.

During the strong winds vessels are delayed being warped through the pass, owing to the strong currents in the direction of the wind. The current has been known to have a velocity of six knots an hour, but is generally from 2½ to 3 knots.

During the first two or three months of either monsoon, there is no change in the direction of the current, the prevailing winds influencing its course, although the tide ebbs and flows. During stormy weather the level of the sea, on the weather side of the reef, is generally 9 inches to one foot higher than on the lea side, the reef of rocks acting like a weir across the opening between Madura and Rameseram.

In approaching Paumben from the south, the deep water channel is on the Rameseram side of the Gulf of Manaar, but in gales of wind small vessels take advantage of an inner channel on the Madura side of the Gulf.

From Keelacarry to Paumben, and, to a certain extent, almost the whole way from Tuticorin, the inner channel is sheltered by reefs and islands.

I would draw the attention of Government to an excellent anchorage in this channel, about ten miles to the west of Paumben, and situated between Moosel Island and Moottupetah Point. There is a stretch of water here 7 miles long by 4½ miles wide, fairly well sheltered by reefs and islands, the greater part of which has a depth of 20 feet, and much of it 25 and even 30 feet of water. The entrance to this anchorage from the sea, between Moosel Island and Moolee Island, has only about 2½ fathoms, so that some deepening would be required before full advantage could be taken of the anchorage. We passed through this natural harbour in the steamer "Margaret Northcote" entering from the Keelacarry end, where there is only from 10 to 14 feet of water.

On reaching England I found that the new ship canal proposed by Sir James Elphinstone is at this place. Should a ship canal ever be made between India and Ceylon, this long stretch of sheltered water will be of the greatest value as a coaling station for steamers, as it is far superior to Galle. The produce of the South of India could also be shipped here much easier than at Tuticorin or Negapatam, as the sheltered deep water comes within about half a mile of the shore.

In the excavation of any ship canal through Tonitory Point, the probability is that a large amount of sandstone would be obtained; a portion of this would be required for works in connection with the canal, but the remainder might be deposited on the reefs, which, to a great extent, already protect this anchorage, so as to make the protection perfect. This could be done for the mere cost of carriage. Were this done, and a cut made between Moosel Island and Moolee Island, I have no hesitation in saying that this anchorage would be second to none in India.

There is another fairly well sheltered but much smaller piece of water, at Valinookum Point, about eight miles to the west of Keelacarry. There is a little bay here, under shelter of the Point and of two islands, where there is deeper water than at Tuticorin, with 5 fathoms in the entrance from the sea.

These anchorages are of little value at present, and it is always very difficult to divert trade from the outlets which have already been fixed upon by accident or circumstances. Still

it is desirable to point out that there is at all events one good anchorage on the south coast of a Presidency singularly devoid of natural harbours or sheltered places where trade can be carried on independent of the weather.

In connection with the approaches to Paumben from the South, it may not be out of place to draw attention to the great necessity there is for a light at the Crocodile Rock, about 17 miles to the west of Cape Comorin, and 2¾ miles from the shore at Cadipatam Point. This rock is much dreaded by the captains of steamers trading round the south of India and Ceylon, and by native craft making for Paumben. It would not be easy to put a light on the rock itself, as it is barely awash at low water, and is much exposed; but there are two small islands between it and the shore, on either of which a a light could be placed. The shore is also high at this point, and well suited for a lighthouse.

On the north side of Paumben I would strongly advise that a light should be put on Point Calimere where there is at present only a pillar. Vessels using the pass are liable to get embayed and into danger at Point Calimere. When the wind permits they have to leave Paumben at night, so as to make the point by day. In our little steamer, drawing only five feet, we experienced the want of a light at this place.

13

Joint Report by the Chief Engineer and Master Attendant on the Paumben Pass and proposals for a ship Canal.

In our late inspection of the important post to between Tuticorin and Madras, the Paumben pass, and the various schemes connected therewith for the establishment of such a ship Canal as would save all steamers coming from Europe the voyage round Ceylon, necessarily engaged our attention.

2. It may however be at once stated that neither the time nor the means at our disposal were sufficient for any but a very cursory investigation of the schemes which from time to time have with the above object been brought forward, and our remarks must therefore be of a very general nature, directed however in such a way to the salient points as may serve to narrow the issues

for future special discussion should it appear desirable to Government to take up the question at any time with a view to its practical solution.

3. In the first place however it may be as well to state generally the condition of the pass as it now exists.

4. The accompanying chart No 1184 of the "Approaches to the Pamban (Paumben) Pass" shows that vessels from the south entering by the Rundugal Channel (as is usual by the larger class of vessels) have, after passing north of "Shingle" Island, to enter the so called "Sand bank Channel" this latter which has been all along kept open by dredging (the "Albuquerque" having been here engaged) is 3100 feet long, has an average width of 60 feet, and a depth varying from a minimum of 10 at low water spring tides to a maximum of 15 feet. Tide rises from 2 to 3 feet but irregularly.

5. The course after this for all vessels whether entering by the "Sand bank Channel" or as is more frequently the case with smaller craft which taking advantage of the protection afforded by the Coral reefs lying the coast of Madura and arriving by the western or Kelacany passage, is through the so called "Basin" which is an irregular channel running North East, over 6000 feet long, up to the north or rocky portion of the pass, and is kept open by the current.

6. The rock channel or "Pass" has a length of 4,232 feet, a width varying from 60 to 90 feet and 130 feet in places and depth from 11 to 15 feet.

7. During the North East monsoon the level of the water to the north is generally 9 inches higher than at the south of the Pass: precisely the reverse condition existing during the south west monsoon. The result of this inequality of level taken with other circumstances affecting the flow of water through the pass is that the velocity of the stream

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is often as much as 6 Knots and has been even known to reach 10 per hour.

8. There would apparently be little difficulty in keeping the pass open did it all like the "Basin" consist of sand, or of metamorphic or other rock, which once removed, would give no further trouble, but unfortunately, it, to a great extent, consists of coral, which, as it is constantly growing, as constantly requires to be removed by blasting and dredging.

9. The work, now very systematically carried out by the Port officer Captain Baker is done at a very reasonable cost, the outlay in the past year not having exceeded Rs 1649-6-6, and in the present state of the trade, little more appears to be required.

10. Square rigged and other native craft as shown by the following table drawing up to 10 feet of water have availed themselves of the facilities of this channel though

of course, from its want of depth it is quite useless for any of the ordinary coasting steamers & still less for vessels of greater draught.

	Vessels	Tonnage
1876-77	2165	217253
1877-78	1532	136579
1878-79	1618	154113
1879-80	2143	228087
1880-81	1953	223623

11. An inspection of the chart will show that it would again be quite useless to attempting to deepen either the "Pass" or the Sand-bank channel more than has already been accomplished as throughout the approaches from the south both by the eastern as well as the western channels there are shallows which would have to be deepened "pari passu" in order to make the passage throughout available for vessels of greater draft.

12. It may thus be affirmed that (1) the channels as now and hitherto maintained are all that is required for the existing coasting trade, and (2) if a ship canal is ever to be constructed the existing channels would not be thought of as being capable of adaptation with this object.

13. For much the same reason the old tortuous channel known as the "Dutch passage" between the island of Manaar and the main island of Ceylon, and again the direct cut, which it is understood was proposed a little west of the present pass (where the sea is said to have breached through in 1814) would have to be rejected as unsuitable.

14. The various proposals for a ship canal between Ceylon and India, as carried down to 1871, are discussed in the annexed pamphlet (dated 28th July of that year) with chart by Commander W. D. Taylor, strongly advocating what is known as Sir James Talphin Shaw's scheme consisting of a canal some 7½ miles in length through the Rammad Promontory situated about 10 miles west of the "Pass".

15. The canal would have a north east direction debauching on the north west in Pal Pk's bay where there is 5 fathoms of water, but affording apparently no shelter in the North East monsoon, which blowing freely in, would render the approach to the entrance difficult, unless thoroughly protected artificially. The debauchure to the south would be into a fine

* Narrative &c.

With reference to this Mr Le Robertson also writes in his Report:-

"There is a stretch of water here
"4 miles long by 1½ miles wide
"fairly well sheltered by reefs
"and islands the greater part
"of which has a depth of 20
"feet, and much of it 25 and
"even 30 feet of water.

"The entrance to this anchorage
"from the sea between Inaccel
"Island and Inoola Island
"has only about 2½ fathoms
"so that some deepening would
"be required before full advan-
"-tage could be taken of the
"anchorage".

16. Having no longitudinal sections to refer to or trial pits showing the nature of the material through which (especially in the Rammad Promontory) the canal would have to be excavated, it is impossible to hazard even a guess at the probable outlay, but we have no hesitation in saying that to render this in any way a complete scheme, considerable lengths of breakwater would have to be carried out seaward so as to afford the requisite shelter to vessels making either the north or south ends of the canal, and that the cost of such work, taken with that of the

16 * fine in that part having a large area of 5 and 6 fathoms water, but as it is backed to the south by sand banks if not by a coral reef, a second canal of over a mile in length would be needed, and to this the approach during the south west monsoon would also be difficult, if not similarly sheltered.

canal

canal itself, would make the scheme as certainly more costly than some others to which we will presently advert.

17. It must be borne in mind that the chief merit of the Ramnad project consists in its providing a sheltered harbour for South India which at present only possesses the imperfect port of Tuticorin. It has been supposed that given another railway from Madura down to this projected harbour, (which is another very expensive work to be added to the canal cost) the trade in cotton and other exports and all imports for the south would at once resort to it. But even this is uncertain; trade is not easily directed or driven as witness the expensive railway from Shevaroys to Beypore which has never commanded any remunerative traffic.

18. Mr George Robertson in his Report on the harbours of this Presidency

(1871) alludes to this scheme in only very general terms as he seems to have considered the state of the "Pass" or channel as alone falling within the scope of his enquiries; but what he does say leads to the conclusion that he was favorably impressed with it. He gives however, no even approximate estimate or sufficient facts in support of this opinion, and we therefore consider it unnecessary to make further allusion to it.

19. Although not adverted to in his Report we were pointed out a line running due north and south about half a mile east of the Pamben Light-house which it is said Mr Robertson thought might prove suitable for the proposed ship canal, and with a view to test which two or three trial pits had been sunk.

20. There is no record so far as we are aware as to the nature of the

material met with, though it is said that in the northern most pit near the sea shore gneiss rock was met with at no great distance from the surface.

21. The portion of the Rameswaram Island, through which this line is carried is to all appearances very favorable for a work of the proposed character, being so far as can be judged composed mostly of drift sand, over laid to a great extent with just enough humus, and sufficiently supplied with springs of fresh water, to admit of cocoanuts and some other crops being raised; but in no place more than 20 feet (at least judging by the eye) above mean sea level.

22. This line is however so inferior as compared with the next line carried parallel to it north and south, two miles more to the eastward, the selection

of

of which, rightly or wrongly, is attributed to Sir William Denison, that we are clearly of opinion this latter, or one which may possibly be selected close to it, presents much greater facilities for a work of the character proposed, than any other.

23. Here the mouth of the ship canal both to the north and south could certainly be protected more conveniently than elsewhere; indeed as regards the former it would only seem necessary to run a short breakwater out North-west from the shore which here trending towards the north affords as it is, fairly good shelter from the west and north.

24. By connecting the "Pullie reef" with "Shingle Island" and by running out seaward a breakwater south east from the beacon on the latter, adequate shelter, could no doubt

be afforded -

25. A ship canal here through the Island would not exceed 2¼ miles in length with excavation to 26 fat below mean sea level, also deepening for a mile north and south - For the latter an average of say 5 feet of material would have to be removed throughout.

26. Probably 3000 feet of breakwater north, and 10,000 feet south would attain the ambide be needed, making on the whole, in our opinion, much less work than that required for any of the other schemes.

27. This is the same line which, we are given to understand, was selected by Colonel Thomason in 1878, but there is nothing on record, by that officer, to refer to.

28. Both the last named lines with also that close to the place

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where the sea is said to have broken through in 1814 are shown in red ink on the accompanying detailed chart of the "approaches to the Pamben Pass".

29. Yet another line has been indicated to us as having been examined by Captain Hansard on the part of the Ceylon Government, but whether he approved of it or not, we have no means of judging.

30. This line appears to turn in a north east direction, some 6 miles south east from the Rameswaram Temple across the sand-spit, north west of Adam's Bridge, at a point marked "Chatrams" on the map, but not only would the northern end of a ship canal here be greatly exposed during the north east monsoon, but the length of the canal to reach 5 fathom water on each side would

be at least a mile longer than in Sir W. Denison's line. The cost of this would, we consider, be greater, though in other respects it seems to stand next to the one mentioned.

31. In any case we have little hesitation in recording our opinion that if ever the scheme for a ship canal demand serious consideration, the choice so far as facility of construction and economy are concerned will rest between what for convenience may be termed Sir W. Denison's and Captain Bayard's lines. Special surveys with the requisite levels and trial pits carried down to the full depth of the proposed canal, would soon admit of a definite opinion being formed.

32. It is impossible, however, to conceal the fact that the works how or wherever undertaken must be very expensive; probably at least not less than 1 or 1¼ millions sterling for canal breakwaters north and south, light-houses both here and along the bays on both sides &c. &c. Considering the intricacy of the whole passage, a very complete system of lighting would be required throughout.

33. It is very doubtful moreover considering the inevitable delays of getting large ships through a canal of the proposed character more than 12 hours of daylight would be saved to steamers passing through over those taking the passage round Ceylon, or that the trade for a very long time to come could afford to pay the extra dues which would necessarily have to be levied in order to make the work pay for its working expenses added to interest on Capital sunk.

34. On other grounds it would also appear to be undesirable to urge on the construction of a work of this character till its advantages have been proved in a much more distinct manner than by the reasons which have come under our notice.

35. The introduction of coasting steamers has, as is now beginning to be distinctly perceived had such effect on the old South Indian native coasting trade that the total extinction of the latter is now apparently inevitable: the single exception being the trade which now passes through and uses the Pamben pass.

36. Here as yet there has practically been no steamer competition, and as the late famine has shown the desirability of fostering diversity of occupation among the natives by all

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all the means at the disposal of Government, we cannot but think it unadvisable to press the question of a ship canal prematurely, accompanied, as such a measure would be, by the inevitable destruction of what little there remains of the old native coasting trade in the southern portion of the Presidency.

J. W. Taylor
Captain R. & R.
Master Attendant
Administrative Depart.

17th May 81.

Col. W. Lawley Colonel R.E.
Chief Engineer
P. W. D.

Mrch 3007

(188) DEPARTMENT.

From

THE MASTER ATTENDANT,

ADMINISTRATIVE DEPARTMENT,

Madras.

To Colonel R H Sankey R.E. C.I.E.

~~THE CHIEF~~ SECY. TO GOVERNMENT,

P.W. ~~MARINE~~ DEPARTMENT,

~~*Fort Saint George.*~~

Cotacamund.

No. 418.

Dated 13 }
Received 28 } May 1881

No.

Subject.

Returning Joint Report on Pamban Pass duly signed.

Cir. 17/5/81. O.S. 4/5.

B 41 Works

No 1341 W 11

PUBLIC WORKS DEPARTMENT.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the 28 May 1881

Read the following :—

Joint Report by the Chief Engineer and Master Attendant on the Pamben Pass and proposals for a ship Canal - dated 17th May 81.

The Government are glad to learn that the Pamben Pass has hitherto been so well maintained, and that its usefulness has by no means diminished of late years. They are however not prepared at present to consider the desirability of carrying out the costly works which it appears would be necessary were a canal to be cut capable of meeting the

requirements of vessels of large draft-

2. As a matter of general information it may be desirable to obtain a section with borings to 36 feet below mean sea level along the line apparently originally selected by Sir William Denison about 2 miles east of the pass and running directly north and south through the Ramaswerum Island, and if this can be arranged for by the Master Attendant in communication with the Chief Engineer, the Govt will not object to sanction the small expense of the operation.

Cir 17/5/81.

17.5.81

Hon'ble Secretary
to Govt P.W.D.

Hon'ble Secretary
to Govt P.W.D.

with 2 Charts in
Tin Cases and pencil
Report by Commander
Dundas Taylor.

C 7 12
Mem circ
21/5/81

Master Attendant
Marine Department
Superintendent
Lighthouses
11-6-81

3007

2-8-81

Govt. of 1881 Madras.

PUBLIC WORKS.

From

Dated 30/5/81

Issued

Recd. Encl.

G. O., 28 May 1881, No. 1341

Nos. 62-63