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TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

P.W.D DEPARTMENT

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

—the following despatch from the Right Honorable the Secretary of State for India, to His Excellency the Right Honorable the Governor in Council, Fort St. George, dated India Office, London, 30th June 1885, No. 4, Public Works:—

Herewith is transmitted, for the information of your Government, copy of a report
Dated 23rd May 1885. which has been submitted to me by Mr. W. Parkes, C.E., on the operations nnection with the Madras Harbour Works, which have been carried on since the re storm of 1881 up to the 31st of March last.

2. The point raised by Mr. Parkes, in the 16th paragraph of his report, as to the manner of administering and utilising the funds derived from the rent of buildings ie land lying to the immediate north and south of the harbour will call for your deration, and I shall be glad to be furnished with an expression of the opinion of Excellency's Government on the subject.

ENCLOSURE.

MADRAS HARBOUR.

Report of Progress up to 31st March 1885.

In resuming the series of quarterly reports of the progress of the Madras Harbour Works, h has been suspended since the severe storm of November 1881, it may be convenient if I uence by a short *résumé* of the works which have been executed in the interval, distinguish- hose which were in pursuance of, or contingent on, the original design, and those which are tion of the supplementary design for restoration and completion now in course of execution.

2. *North Pier Surf Bank.*—Six hundred and fifty-five tons of rubble were deposited diately after the storm of 1881, and 300 tons in the latter part of 1883, to maintain the sea . The cost of this is the only charge which has been entered against this department of the since 1876, but it is probable that similar small expenditure may from time to time be ired as the rubble is wasted by the sea. No similar maintenance is required for the south surf bank as it is completely buried in sand.

3. *North Pier Rubble Base.*—In 1882, 4,782 tons of rubble were deposited on the outer shore where it had been scoured out by the heavy sea. No similar maintenance was required he south pier rubble base.

4. *North Pier Superstructure.*—The 2,200 feet of work left uninjured were strengthened by clamps connecting the blocks at the top, the top of the breakwater was levelled with a of concrete, and a line of broad gauge railway bedded in concrete laid nearly to the end. se works were completed in 1882.

5. *South Pier Superstructure.*—This was treated in the same way as the north pier by ping the blocks and levelling the top with concrete, but only a portion of the railway 80 feet out of 2,500) has been made, and that on the narrow gauge, being in immediate nection with the South Indian Railway, by which the rubble stone is conveyed. The total of the foregoing works was Rs. 75,029.

6. *Protective Works for the shore north of the Harbour.*—This is a work which was incomplete e time of the storm, and was not materially affected by it. Between November 1881 and uary 1883, 59,726 tons of rubble stone were deposited to form a revetment in addition to 44,180 tons previously deposited, and it may now be considered complete. It will probably ire some occasional feeding as the sea washes it down, but up to the present time only 65 have been so added to it, which was in November 1884.

7. *In pursuance of the design now under execution*, 43,357 tons of rubble have been deposited at the north pier and 19,538 tons at the south pier to widen the foreshore on the sea-side to receive the wave breaker of concrete blocks, the deposition of which will be commenced at the north pier as soon as the crane specially designed for the operation and now nearly completed by the manufacturers, Messrs. Ransomes and Rapier of Ipswich, has been erected. The positions in which this stone has been deposited at the two piers are shown on the accompanying plan.

8. In addition to this deposit of stone below water, the special protection referred to in paragraph 5 of my report of 21st August 1884, near the commencement of the north pier, has been completed. A bank of rubble was made for a length of about 140 feet to the level to the top of the breakwater, and on this 16 thirty-ton concrete blocks were built. The rubble was partially washed down in a heavy sea in November, and 12 out of the 16 blocks fell over upon the flattened slope as was anticipated. The next heavy sea will probably bring down the remainder, and the whole of the rubble and the superincumbent blocks will ultimately be lost to sight, but will remain an efficient protection to the foundation at that point.

9. As regards concrete block work, 313 blocks which were remaining in stock at the time of the destructive storm will now be utilised and 487 more were made in the course of the year 1882. Since then no blocks have been made, but the manufacture of them is about to be resumed.

10. The plant and machinery throughout the work has been thoroughly repaired and renewed where necessary, and the two titan cranes lost in the storm are being replaced by two new titans of a design somewhat modified to suit the new requirements. Of these, one is now ordered for shipment, and the other is nearly completed. A special crane for depositing blocks in the wave-breaker is also nearly complete. The first of these machines may be expected to be in working order in about three months from the present date and the other two in about four months, after which everything will be in readiness for carrying on the actual work in the sea with rapidity.

11. Mr. Thorowgood informs me that he has made contracts for several of the departments of the work on rather lower terms than previously, but the saving on the estimate thus effected will, I fear, be neutralised if the South Indian Railway Company substantiate their claim to a higher rate for the conveyance of stone from Pallávaram to Madras.

12. I alluded in paragraph 8 to the effect of a heavy sea in November 1884, in washing down the bank of rubble on the outer side of the north pier. This was the only effect produced upon any part of the work, except that three cargo boats belonging to the harbour works, which were moored to the south of the south pier, broke adrift, and two of them were carried into the harbour and wrecked; the third was saved. The sea was not of extreme force, but the circumstances were remarkable from the rapid change in the direction of the sea from north to south, the rubble bank being washed down in the early part of the night, and the boats which were then in comparative shelter being attacked in the early morning from the opposite direction. The latter disturbance was of a very exceptional character, the wind blowing from a very unusual quarter (S.S.W.) with a force greater than any that has been registered since 1872. Its velocity was 49 miles per hour as compared with 33 miles in the destructive storm of 1881.

13. I would now beg to direct attention to the changes in the coast line both south and north of the harbour. These changes have of course been proceeding quite independently of the suspension of the works, and they become more important as time goes on. On the accompanying lithographed plan I have shown the positions of the high-water mark when the accumulation was at its minimum each year (which is about the end of February) since the commencement of the works. This shows clearly the constantly diminishing rate of advance year by year which was originally anticipated, and it is worthy of remark that the advance effected in eight years is almost exactly that which I calculated upon on very slender data in 1876, and which will result, if it continue in the future as it has done in the past, in the 4-fathom line reaching the bend of the pier and permitting the sand to work towards the entrance, in about 100 years from the commencement of the works in 1876.

14. On another plan also appended I have shown the annual waste to the north of the harbour since 1880, also the position of the high-water line in 1876, before the harbour works could have had any effect upon it, and in 1862. In this case, the most shoreward position is in September each year. There is evidence of the coast line having been still further out at various earlier dates during the present century, and there have been considerable fluctuations, sometimes erosion and sometimes accumulation, so that it is no new thing for property abutting on the sea to be washed away and afterwards recovered, though of course the recovered areas are for some time comparatively valueless.

15. It is, however, clear that at the present time a process of erosion is going on which must be attributed to the harbour works, and, though the loss last year was not large, it cannot be assumed that erosion has reached its limits. It is uncertain whether it will in future years take the form of deepening the indentation of the bay, or whether the coast to the north will continue to retreat by parallel steps of decrement. The area coloured green has been purchased by the Government to anticipate either result, and this having been done, will evidently avoid for many years to come any question arising from the encroachment of the sea on private property.

16. The rents of the purchased land are collected and credited to the harbour works. Some parts of the reclaimed land to the south of the harbour are let at high rents by the Marine Department and the proceeds "credited to the harbour dues account in order to assist in meeting the interest on the construction of the harbour," the two revenues (of which I have no particulars, but which must now amount to an annual income worth consideration) being thus in the hands of different departments, while other departments and authorities claim the right to establish themselves on the land at their discretion. I would therefore beg to represent the increasing urgency for the recognition of these inevitable changes of the shore line and the expenditure and revenues connected with them as a ground for the establishment of some special suitable administration under which they should be placed, with a view to the land being utilised for the public service to the greatest possible extent.

17. I propose in future reports to resume my former practice of furnishing an abstract of the expenditure as compared with the estimate up to date, but on the present occasion it would be difficult to present such a statement in a form that it could be compared with the official statements, as the latter are not yet made out according to the new form which I suggested in August 1884, but which will be adopted as from the 1st April last.

23, Abingdon Street,
23rd May 1885.

(Signed) W. PARKES.

To the Under Secretary of State for India.

Order—dated 15th August 1885, No. 1889 W., Public Works.

Communicated to the Superintendent, Madras Harbour Works, and to the Marine Department.

2. The Secretary of State for India will be addressed on the subject of paragraph 2 of the foregoing despatch.

(Here enter No. $\frac{10}{1889}$ W., dated 15th August 1885.)

(True Extract.)

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintendent, Madras Harbour Works.
" Marine Department.
" Revenue "

Exd. J. Henricus.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1885} Madras.

PUBLIC WORKS

Dated August, 15th.

Recd. *Encl.*

G.O., 15th Aug. 1885, No. 1889 W.

AUGUST.

Madras Harbour Works

Despatch from the Secretary of State for India forwarding copy of report by Mr. Parkes on the operations in connection with the —, communicated to the Superintendent, Madras Harbour Works, and to the Marine Department.

1889
23

19TH NOVEMBER 1884, No. 2893 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—the following letter from F. N. THOROWGOOD, Esq., M. INST.C.E., Superintendent, Madras Harbour Works, to the Secretary to Government, Public Works Department, dated Madras, 4th November 1884, No. 25 W.:—

I have not submitted, for the information of His Excellency the Governor in Council, any report upon these works since 3rd October 1883 (G.O., dated 12th October 1883, No. 2875 W). The reason of this is that the work that has been done has, until the last few months, been confined to repairing machines and cranes. I now have the honor to submit a general report of the state of the works at present.

2. *North Pier—Foreshore Work.*—On 19th May last, in accordance with the sanction given in G.O., dated 25th April 1884, No. 1056 W., the work of tipping rubble foreshore to the north of the north pier was commenced. The position and section of the foreshore to be made up were such as was shown on the plans of the Home Committee under the presidency of Sir John Hawkshaw, and were in no way affected by what appeared at the time to be the somewhat doubtful question of the position of the entrance to the harbour. The South Indian Railway Company at first were able to provide only one train daily from the quarry at Pallávaram to the works, but after a time more wagons were available and two trains of 24 wagons each were sent down daily when the weather permitted of work being done.

3. The stone has been deposited in its place by means of large cargo boats and cooly labor, and I am inclined to think that if we can get a sufficiently strong fleet of these craft nothing in the way of hopper barges (either for hand or steam power) will be required. No provision for any special craft is yet made in England, nor was such a requirement anticipated when I left, on 20th August.

4. From 19th May to 11th October (at which date the sea put an end to work at the north pier) there were deposited in the foreshore 32,124 tons of stone. This amount has almost completed the extra section required from 250 feet to 1,925 feet from the commencement of the breakwater. At a specially weak spot in the breakwater, about 200 feet from the commencement, an additional protection has been made by building on the top of the new rubble foreshore sixteen wave-breaker blocks, each weighing 30 tons. These are of interest in a general way as showing the size and shape of the blocks to be deposited as foreshore to the restored works.

5. *Concrete Blocks.*—All this time I regret to state that it is not possible to proceed with making blocks for the new work of restoration as there are at present only sufficient funds at my disposal to keep the foreshore work going on. There is no longer any doubt as to the section and shape of the blocks to be made, as during my visit to England, from 20th May to 18th September, I received from Mr. Parkes full instructions in a general way on this head.

6. The block yards on which the blocks are made need very considerable alterations, which will cost not less than Rs. 10,000, and these cannot well be proceeded with until more funds are available. It seems to me therefore to be better to go on with the useful and necessary work of depositing rubble foreshore rather than to make a new departure before it is quite settled where the funds for such a purpose are to come from.

7. *South Pier—Rubble Foreshore.*—After 11th October, the wind getting to the north of east, it became necessary to transfer stone trains and cargo boats to the south side of the south pier, since which date 2,691 tons of stone have been deposited as foreshore in accordance with Mr. Parkes's instructions received in Westminster.

As at the north pier, this foreshore so deposited, although the amount at present is insignificant, will form the foundation of the very substantial screens of wave-breaker blocks which are to protect the walls of the breakwaters.

8. *Plant and Machinery.*—I am able to report that the Titan cranes for setting blocks and one of the wave-breaker cranes are in hand in England, and I hope that by January next one may be delivered here. It is hardly necessary to point out that until one of these machines is erected it is impossible to deposit a single block in the breakwater.

9. Here on the spot extensive renewals and repairs have been going on (with very few workmen) to the cranes, locomotives and trucks for carrying blocks. I only recently discovered that the timber work of the 40-ton Goliath crane at the south block-yard was much decayed, and needed entire rebuilding. The block carrying trucks also, I find, are very unsafe, and all need new frames. All these works give full employment to the skilled hands reduced in number to a minimum.

10. *Divers and Diving.*—During October the diving staff were employed in making a species of submarine survey of the line of the foundation of the new work. This was carried on with much elaboration and care, and I have plotted the results on a plan of large size. The conclusion one is able to arrive at on inspecting the result is that the work of preparing the new foundation will not probably be so formidable as was at first anticipated.

11. *Encroachment to the North.*—The sea continues to encroach to the north but not to any very serious extent. Some bungalows are becoming of less value owing to the encroachment, and many cocoanut trees belonging to Government have been washed away. The charge of this property is now entirely in the hands of the Collector of Madras, with the single exception of Carlton House, the rent of which is paid into this office.

12. With reference to this matter I feel bound, in justice to myself and staff, to correct a wrong impression that may have been conveyed to His Excellency the Governor in Council regarding the cost of collecting the rents of this harbour works property. In his letter attached to G.O., No. 998, dated 9th September 1884, Revenue, the Collector states that, whereas the monthly salaries of the staff collecting rents while under my charge amounted to Rs. 294, his people can do the work for Rs. 79. It must be borne in mind that carpenters and masons for repairs, surveyors, chainmen and draughtsmen are included in the higher amount, and are not included in the Collector's list.

ORDER—dated 19th November 1884, No. 2893 W., Public Works.

The report will be recorded, with remark, as regards paragraph 5, that the revised budget providing for additional expenditure on the works this year, in accordance with the conclusions adopted in London, has been recommended for the sanction of the Government of India.

2. Adverting to paragraph 11, there seems no reason why the charge of the Carlton House property should be retained by the harbour works staff. The property will be dealt with in the same manner as other properties referred to in G.O., No. 200, dated 9th February 1884, Revenue Department.

(True Extract.)

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintendent, Madras Harbour Works.
" Examiner, Public Works Accounts.
" Revenue Department.

Exd. E. Fernandez.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1884} Madras.

PUBLIC WORKS.

Dated November, 19th.

Recd. *Encl.*

G.O., 19th Nov. 1884, No. 2893 W.

NOVEMBER.

Madras Harbour Works

Orders on report submitted by the Superintendent on the present state of the —.

1884

19th December 1884, No. 3128 W., Public Works.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

Read—the following papers :—

Despatch from the Right Honorable the Secretary of State for India, to His Excellency the Most Honorable the Governor-General of India in Council, dated India Office, London, 25th September 1884, No. 56, Public Works.

Your Excellency's Public Works letter, No. 32, dated 4th July 1884, on the subject of the Madras Harbour works, has received my consideration in Council.

2. Your Excellency forwards a communication addressed to you by the Government of Madras, together with a letter from the Chairman of the Madras Chamber of Commerce, reiterating objections to certain features in the plan of restoration of the harbour works as settled by the committee, to whom the matter had been specially referred in this country, and you state that you concur generally in the views held by the Madras Government.

3. It is recognized by every one that the chief objects which have to be kept in view in carrying out the works of restoration are (1) the structural stability of the pier walls, (2) the selection of the best position for the entrance, in view to providing a safe and easy ingress and egress for ships, and (3) the security and accommodation to be given to shipping, especially local craft, by obtaining stiller water within the harbour.

4. It is to the position of the entrance to the harbour advocated by the committee, and to its supposed unfavorable effect on the stillness of the water within, that the objections taken by local opinion appear to apply, and I have anxiously considered what course I should follow in consequence of this much to be regretted divergence of judgment.

5. The engineering questions discussed in the correspondence now forwarded to me have been so recently investigated a second time by Sir John Hawkshaw's committee, the engineer members of which are regarded as among the greatest living authorities on works of the description in question, and who were in possession of and carefully considered all the views before expressed by the authorities at Madras and of your own professional advisers, to which I cannot find that any argument or statement of fact have now been added, that, without underrating the value of local knowledge and opinions, I have felt that it would be useless again to ask the committee to reconsider their recommendations.

6. It appeared to me that, after consulting the best authorities available on the subject, no choice was left to me but to accept their decision on the questions raised, the whole of which are of an eminently technical nature, and trustworthy opinions on which can only be formed upon prolonged and extensive experience such as that possessed by Sir John Hawkshaw and Sir J. Coode, and in my despatch, No. 23, of 24th April last, I informed your Excellency that this was the conclusion at which I had arrived, and I am not now able to see any sufficient reason for changing it.

7. In the accompanying report * which Mr. Parkes, in communication with Mr. Thorowgood, has made on the subject of future operations, he expresses concurrence with the conclusions of the committee. He points out that the larger vessels should have no difficulty in getting out to sea when a severe storm is threatened, and

* Dated 21st August 1884.

that of the approach of such storms timely warning can be, and in fact always has been, given, while, as regards the smaller craft, he is of opinion that the provision of floating docks or basins, which he shows might be formed on the land reclaimed on the south side of the harbour, would protect them from danger. Nor is it anticipated that, in ordinary weather, the quietude of the water within the harbour would be better secured by a change in the entrance. These suggestions are in conformity with the views expressed in the report of Sir John Hawkshaw's committee, and, if acted upon judiciously, appear to offer a means by which to accomplish the object sought without changing the position of the entrance. Mr. Thorowgood, who is in full possession of Mr. Parkes' views, and of the reasons which have led him and the committee to adhere to the eastern entrance, has already started on his return to Madras, and will be able to furnish the authorities there with any additional particulars they may require; it is to be hoped that conflicting views may be reconciled by further discussion. Meanwhile, the plan of operations which Mr. Parkes has proposed will not preclude the further consideration of the position of the entrance of the harbour for several months at least, and possibly for another working season, and his plans should be followed generally, on the understanding that if any additional facts or arguments are adduced bearing on the question of the entrance which appear of sufficient weight to justifiy the step, a further reference to engineering authority in this country may become desirable.

Two Titan cranes.
One crane travelling wave-breaker.

8. In the meantime the machinery, noted in the margin, has been ordered and will be despatched to Madras.

9. With regard to the estimates which form the appendices to Mr. Parkes' letter, I beg that they may be examined, and that I may be duly informed whether they are such as may be accepted.

ENCLOSURES.

P.W. 1612/84.

MADRAS HARBOUR.

23, ABINGDON STREET,
21st August 1884.

In the concluding paragraph of my letter to you, dated 5th July last, I stated that I was preparing a report, in which I proposed to deal with the various questions which have accumulated in the last two years, and which would include a more detailed explanation and estimate of the proposed works of restoration, together with a classified statement of the operations carried on, and the expenditure incurred, during the period of the general suspension of work. I have now the honor to submit that report.

2. I will begin with the proposed works of restoration. The general character and extent of these works will be as laid down in the first joint report of the committee, consisting of Sir John Hawkshaw, Sir John Coode, and Professor Stokes, dated 23rd January 1883, which I accept as my implied instructions. But the proposals I am about to submit are the result of a careful reconsideration of the existing state of the works, based on records of later date than those laid before the committee above mentioned, and aided by personal conference with Mr. Thorowgood. The details of the new work have been independently designed, but where my conclusions differed from those of the committee I have carefully investigated the grounds of difference, and when I thought there was reason for doing so, I have not scrupled to increase the dimensions given by the committee, and to introduce some additional precautions.

3. There are on the other hand one or two features of the committee's plan, of which I think it only right to state that I am not myself satisfied of the necessity, but I have included these in my own design and estimate in deference to the opinion of the committee. They are works for the execution of which no immediate provision can be made, and if I feel it my duty at some future time to raise the question of their being carried into execution, it will be in consequence of some definite confirmation of my present doubts.

4. On the accompanying general plan of the harbour, to a scale of 200 feet to an inch, the new works are shown in red, and on the sheet of cross sections the character of the work at the different points is shown.

5. Commencing with the shore end of the north pier, and noting that the numbers represent the distance in feet from the point B, the first cross section from 200 to 250 shows the addition required to a special weak point. It is simply the continuation of a form of protection which was applied in 1877 as far as 200, and was so far very effective. There was at that time no occasion to carry it further, but the rubble foreshore has since been worn away by the action

of the sea, and requires feeding and protection. This is shown not only by the foreshore being rather bare in front of the wall, but also by the fact of the centre joint having latterly opened a little, which indicates a settlement. It will be seen by the section that the superstructure is only two blocks high at this part, so that it is founded at a depth at which the action of the sea is considerable, and a wide sloping foreshore is the only protection. Beyond the site of this special protection the superstructure is three blocks high, and founded at a lower level. The protective work consists of a rubble bank 50 feet long and 22 feet wide at the top, and tapered off at either end for a further length of 40 feet. On the top of this rubble 16 concrete blocks, each 9 feet × 9 feet × 6 feet and weighing 30 tons, will be built during the ensuing three months, when the wind and sea may be expected to be invariably from the southward. The northerly seas of the next north-east monsoon will wash down the rubble bank, and the concrete blocks will drop and form a facing for the submerged foreshore, as was the case with similar work in 1877. As this work can be done with appliances now on the ground, as it is of importance to carry it out during the present season, and as it may fairly be considered included in the sanction already given for the protection of existing works, Mr. Beardmore has been instructed to proceed with it; 2,500 tons of rubble and 288 cubic yards of concrete blocks will be required, and the cost will be about Rs. 7,500.

6. The above work will occupy the length from 160 to 290. In the remainder of the length, from 0 to 400, all that is required is to fill up the existing foreshore with a little additional rubble as may be required. This is in accordance with section I of the committee.

7. At 400 the line of continuous protection by random blocks will commence, but from 400 to 900 it will be of gradually increasing dimensions, from a single block laid against the foot of the wall at 400 to a mound 20 feet wide at the level of high water at 900. Within this length the depth of water is such that any waves of sufficient height to be formidable will have been broken outside, and a wave-breaker, as such, is not required. All that is required is a protection against the scour of the foreshore.

8. At 900, where the depth at high water is 25 feet, and from thence outwards, the dimensions of the wave-breaker are intended to be such as to prevent the blow of the wave from falling with its maximum force on the superstructure. What these dimensions should be are not determinable, so far as I am aware, by any recognised rule, whether based on theory or experience. It is a matter in which each engineer must use his own judgment, and mine, based on the best data I am acquainted with, would give rather greater dimensions than those shown by the committee. The difference so far as cost is concerned is not very great. If the additions were made by increasing the quantity of concrete blocks the increase of cost would be about a lakh and a half, but it might (as I think may be done without any infringement of the essential principles laid down by the committee) by forming the interior of the mound of large rubble, the increase of cost would be only half a lakh. I think I am justified in asking the Government to sanction this modification of the design, so that it may cover my own conceptions of the required conditions of stability, but I shall, of course, be prepared to submit my conclusions to further consideration if it is considered desirable to do so.

9. It will be understood then that the following dimensions for the wave-breaker are rather in excess of those shown by the committee, but the excess is obtained by forming a nucleus of large rubble against the face of the wall and covering it with blocks. This large rubble will be deposited immediately before the blocks, so that it may not be exposed to the wash of the sea before being covered with blocks.

10. At 900 feet, then, as before said, the width of wave-breaker at high water (taken as one foot above De Haviland's mean sea level) will be 20 feet, and the width will gradually increase to 28 feet at 2,200 (see sections at these points). The blocks will be allowed to form their own slope to seaward, each block being simply carried out by the wave-breaker crane to the required distance and dropped into the sea, till the mound has reached the required height. If future storms should draw the mound down to a flatter slope more blocks will have to be added to maintain the designed width at high water level. The slope of 1½ to 1 shown on the sections is that at which it is anticipated the mound will be ultimately permanent in form, but this, of course, cannot be guaranteed.

11. The point 2,200 is the limit to which the existing work can be utilized as a built structure. Since the storm of November 1881 the upper blocks have been tied together with pieces of bent railway bars cemented into them, and the top has been levelled with concrete. Nothing more will be done till, as a final operation, after the whole length of the piers shall have been completed, the capping of concrete in mass about six feet high recommended by the committee is placed upon it.

12. From this point forwards the system of construction will be in a certain sense reversed. Instead of placing a new wave-breaker in front of the old work, the old work will be treated as part of the wave-breaker, and a new wall constructed inside it. By this arrangement the old work will be utilized to the fullest extent, while in the execution of the new work the elements of uncertainty will be reduced to a minimum. It will be a continuance of the system of work hitherto carried on with much success as an executive operation, and of which the cost is well

known. Some modifications and some special works, however, will have to be introduced, which to a small extent will involve new conditions.

13. The mode of passing from one system to the other is shown upon the plan. The old building is standing complete to 2,200, and from that point the new building will commence as a complete section, but in order to form a continuous line along which the setting machines and the blocks and other materials can pass without interruption, it is proposed to build a wall 12 feet wide for a length of 160 feet back, starting at 2,040. This wall will curve away from the old wall (the space between the two being filled in with rubble and concrete) till sufficient space is gained to build the section to the full width of 24 feet.

14. The new building will be of the same general character and dimensions as its predecessor, but there will be some modifications of detail. The original building consisted of two independent walls placed in contact, but not tied together. It is recommended that for the future the blocks should be bonded together, so as to form one wall, and in this recommendation I concur. The unbonded system has great advantages in comparatively shallow water, in which the waves have little effect on the blocks themselves, but much on the foundations, while in deeper water the action of the sea on the foundations is less, but that on the blocks themselves is greater, and this fact turns the scale in favor of bond for the outer portions of the piers. At the same time the bond rather increases in some respects the difficulties inseparable from a compressible foundation, and new difficulties are introduced by the special circumstances of the case.

15. It will be seen from the sections that the new rubble base will be deposited over the inner slope of the old, and upon that slope some of the overthrown blocks are lying. All the blocks which lie under the line of the new building will have to be removed, either bodily or by blasting, for if they are allowed to remain they will cause inequalities in the settlement, which will be highly injurious to the superstructure above. In order to avoid these blocks as much as possible I have increased the distance at which the committee proposed to place the new pier from the old one by 9 feet, and this will also place the line of new building more clear of the old rubble.

16. But even with these precautions of removing the old blocks, and increasing the distance from the old work, there will still be a greater liability than there was in the original work to unequal settlement. The sea side of the new building will still partially rest on the old rubble, which has been consolidated by four or five years' exposure to the sea. The new rubble will be in the same position as the old was when first built upon, that is, it will be liable to be compressed to the extent of a foot or 18 inches within a few hours after the weight of the blocks is placed upon it, and to a slower settlement subsequently extending over months, and perhaps years. This latter slow process of settlement, however, is not injurious to the work. But the first is so, it subjects the blocks to great and irregular strains, and is, I think, the most fruitful cause of many of the original blocks having been broken. The evils would be materially aggravated by the fact of one side being more liable to settlement than the other.

17. It is, however, possible materially to reduce these evils, if not to prevent them altogether, and it is proposed to do this by subjecting each length of bed after it is prepared by the divers, and before the blocks are set, to a compression rather greater than that of the blocks themselves. This will be accomplished by placing in front of the work a pile of iron (old rails, with the interstices filled up with cheap cast-iron bars), covering the same area as a row of blocks, and having a weight rather greater than that of the blocks. This "compressor" will be moved forward in advance of the building by the Titan. If, after its removal, it is found to have compressed a bed unequally, the hollow parts will be fitted up with suitable flat pieces of stone before the blocks are set.

18. I propose to introduce another departure from the original design, which will also diminish the evils of settlement. In the original work the foundation blocks were 6 feet high, and above this there were three courses of blocks, each 8 feet high, the whole being 4½ feet wide. It is intended now to use blocks 6 feet high and 6 feet wide, of which there will be five courses, including the foundation course. These blocks will be stronger than those 4½ feet wide, and less liable to break. There is also the incidental advantage that the iron compressors would have to be advanced in stages of 6 feet instead of 4½ feet, and this would accord better with a fair rate of progress of one row per day.

19. It will be seen by the cross sections that the foundation course consists of two blocks of equal length (each 14 feet), the upper courses of blocks of 14 and 10 feet alternately breaking joint. Thus the foundation course will not be bonded. The reason for this is that there would be a practical difficulty in manipulating both the 16 feet and the 12 feet blocks in that situation. I pointed out these difficulties to the committee, and obtained their concurrence to this small departure from their recommendation. The importance of bonding is greatest in the top course, and diminishes in descending. In the bottom course it is practically *nil*.

20. The blocks will be further locked together by means of a projection on the top of one block fitting into a corresponding recess in the bottom of the block above. This principle was adopted in the original work, and was certainly successful in preventing the blocks from sliding on one another, as they had been found to do at Kurrachee and elsewhere. In the present case a

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connection of a similar kind will be made between the ends of the 14 feet blocks on one side with the ends of the 14 feet blocks in the courses above and below on the other side, which overlap them, and there will also be hollows and projections on a somewhat similar principle in the backs and faces of the two top courses, thus giving additional ties throughout the whole width. A further tie will be given by means of a bent rail cemented into the two blocks of the top course in every row, but the cramp which is shown in the committee's sections in the second course from the top may, I think, be dispensed with, in consideration of the additional ties provided by the projections and hollows in the blocks themselves. The cramp could be only very imperfectly fixed, as it would be constantly in the wash of the sea, and the necessity of fixing it before setting the top course would be a serious obstruction to the work.

21. There will be an interval of about 45 feet between the face of the new wall and the back of the old one, and in this space the great bulk of the overthrown blocks are lying. The remainder of the space will be filled up with random blocks to form the wave-breaker, of which the remains of the old work will form the sea slope. Any of the old blocks of the two upper courses that remain in place will be removed to the body of the wave-breaker so as to leave the sea face fairly uniform. The two lower courses, of the sea wall at any rate, are very nearly perfect and will form a continuous toe to the slope of the wave-breaker very much as shown in the average section from 2,600 to 3,800.

22. There are now in stock 800 blocks which will be available for use in the wave-breaker. They are not of the best form for the purpose, but they will be used in the under parts where this is not of consequence. About 6,000 additional blocks will be required to complete the wave-breakers, and there will be uniformly 9 feet × 9 feet × 6 feet, and weigh 30 tons each.

23. The same system of work will be continued to the pier head, but the new built work will be curved round as shown on the plan, so as to avoid a great mass of fallen blocks among which the "Titan" is lying embedded, and also to obtain an entirely new foundation for the additional 50 feet of length required to obtain the narrower entrance. The old pier head is standing with the lower courses almost perfect, the interval between the ends of the old and the new work will be built up with a solid wall of concrete blocks, and the enclosed space behind filled in with random blocks. The last 200 feet of the new pier, including the portion facing the entrance, will be made 38 feet wide, instead of 24 feet, and will be founded 12 feet lower than that within the harbour, or 34 feet below mean sea level. Its toe will be protected by an apron of concrete blocks laid on the foreshore.

24. The work at the south pier will be generally similar to that at the north, except that, in consequence of the advance of sand, the protection works need not be commenced so near the shore, and there is no place requiring special protection like that proposed for from 200 to 250 at the north pier. There has been some advance of the sand since the date of the latest survey (1882), and in execution rather less work will be required than is shown upon the accompanying plan and sections, but for the present I have thought it better to base my estimates on the latest complete survey.

25. According to this then the protection by concrete blocks will commence at 1,000, and will gradually increase up to a high-water width of 20 feet at 1,300, where the depth at high water is 25 feet. It then continues with the width gradually increasing to 28 feet at 2,550, up to which point the existing pier is perfect.

26. At 2,550 the new pier commences, being connected with the existing work in the same manner as at the north pier, and is carried on to the head with only such variations as the different circumstances require. The line shown on the plan passes between the overthrown blocks and can be removed by blasting if it should be necessary to do so. The Titan is not in this case encumbered with blocks connected with the old one in the same manner as at the north pier. The new head will be of the two heads is rendered necessary by the different positions of the fallen Titans, but the difference in the form it, as it will be scarcely noticeable from any accessible point of view.

27. I estimate that the above works will require 3½ years from the recommencement of blocksetting in June next, or till about the end of 1888. The estimated cost is Rs. 45,90,051, including 7½ per cent. for establishment, and 2½ for contingencies, but this estimate does not give a basis for determining the total cost of the harbour as completely restored, without taking into account the expenditure since the storm of November 1882, and the relation of that expenditure to the previous outlay on the one hand, and to the future outlay on the other, I shall show (in paragraph 42 *post*) that a sum of Rs. 2,96,334 has been already expended on works and materials included in this estimate. 082 including Rs. 1,53,945

28. The total expenditure up to 31st October 1881 was Rs. 58,7[illegible]e the subject of a different sanction from that of the harbour works proper. It also included the value of certain materials which had been acquired for the completion of the work and are still available. have been expended, and

29. Between 31st October 1881 and 30th April 1884 Rs. 9,08,088 is expenditure have been regular monthly statements purporting to account for the details of th

regularly submitted to Government, but as, in conformity with the inflexible rule of the Public Works Department system, all charges are referred to heads for which there is a corresponding sanctioned estimate, the accounts would show that expenditure has gone on increasing for works to which no addition has been made. It is obvious that the present form of the accounts can only be viewed as provisional, and that any real explanation of the expenditure must be based on an entire re-arrangement of the statement.

30. At my request Mr. Thorowgood has made such a re-arrangement, of which I append a copy (appendix A). From this it would appear that the total expenditure may be classed as follows:—

		Rs.
1.	Actual work, and purchase of materials for work	4,43,972
2.	Purchase of land threatened with erosion, and compensation for land washed away	2,58,075
3.	Establishment, and salaries of foremen under agreement ...	2,06,041
	Total ...	9,08,088

But as the first and second of these items were incurred under the superintendence of the harbour works' staff, they should bear their fair charge for the cost of such, which I place at 10 per cent. for the first, and the sum of Rs. 6,650 (the actual salaries of the persons employed) for the second. With these corrections the items would stand thus:—

		Rs.
1.	Actual work, &c.	4,88,369
2.	Purchase of land, &c.	2,64,725
3.	Establishment. Cost during suspension of work	1,54,994
	Total ...	9,08,088

31. Now I would submit that the last two of these items, although fairly debitable to the harbour *undertaking*, are not fairly chargeable to the *works*, and should be kept distinct in any statement of expenditure. I shall have occasion further on to explain the circumstances under which the outlay under the second head was incurred, and I will only now say that it ought to appear in a statement of gain and loss of land, in which there is a credit as well as a debit side. With regard to the third, I need only say that to add it to the item of "Establishment" in the accounts of either the old or the new works could only mislead. I submit that it should appear as an item by itself.

32. There remains to be accounted for the sum of Rs. 4,43,972, or, including cost of management, Rs. 4,88,369, little more than half the total of the official statement. This may be classed under four heads, as under:—

		Rs.
A.	Stone revetment for protection of shore north of harbour ...	1,13,618
B.	Expenditure debitable to the original design	1,17,769
C.	Expenditure consequent on the storm of November 1881 ...	39,509
D.	Expenditure in anticipation of the restoration works	1,73,076
	Total ...	4,43,972

33. The first o
and hitherto charged
gory as the purchase of
kept apart as an excepti
these items is part of a total of Rs. 2,04,627 expended on this object
to "Contingencies." I think it might fairly be placed in the same cate-
land, for which it is simply an alternative, but, at any rate, it should be

34. Item B consists
portions of the piers, and t
had not been damaged by
of November 1881 previo
Rs. 16,013 expended on an
the harbour, and chargeable
Rs. 11,399 for various small
nal item of expenditure.
of Rs. 75,029 expended on levelling and clamping the injured
his would have been done even if the remaining portions of the work
he storm; Rs. 15,328 is the expenditure on moorings in the month
s to the storm. The remainder of this item, Rs. 27,412, covers
extension of the town sewer at a spot more than half a mile from
to the harbour funds on rather questionable grounds. This leaves

35. Item C consists of
barges sunk in the storm, a
(the proceeds of a sale of th
easily separable); Rs. 17,
stowing away for future
damaged in the storm.
contingent expenses.
Rs. 16,485 expended in clearing away the wrecks of the two hopper
nd this has to be reduced by more than half of a sum of Rs. 12,835
e recovered materials of the barges and some other old materials not
03 expended on the recovery, removal, painting, and tarring and
use of mooring materials, and Rs. 5,221, repairs to private property

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36. Item D consists of Rs. 87,230 for new concrete blocks, Rs. 58,079 for various repairs and renewals of plant and machinery, and Rs. 27,767, the net increase in the value of unissued stores and materials since November 1881. The expenditure under this item (D) are charges against the estimate for the restoration works.

37. I have appended (appendix B) a statement of the total expenditure from the commencement of the works to 30th April last, classified under five principal heads, which I would submit for adoption in future accounts. The following is a summary:—

Sanctioned estimate. Rs.	Name of account.	Expenditure. Rs.
56,50,000	I. Original design	56,57,840
2,00,000	II. Moorings	1,90,589
	III. Cost of establishment during suspension of works	1,54,994
	IV. Gain and loss of land	4,82,114
	V. Restoration works	2,96,334
	Total as per official return ...	67,81,871

38. The first of these, I would suggest, may be considered a *closed account*. The official statement of expenditure up to 31st October 1881 has been amended by the addition of such subsequent works as are fairly debitable to the design, and by the removal from it of charges which must still be kept open, some being transferred, as shown in the appendix to account IV and some to account V.

39. The second (moorings) must be kept open, but no further expenditure will be incurred till the restoration works are further advanced. An amended estimate, though not a very large one, will then have to be submitted.

40. The third (cost of establishment during suspension of works) I would suggest should be treated as a *closed account*. A liberal allowance has been made for the legitimate cost of superintendence of such works as have been going on during the general suspension, and the sum of Rs. 1,54,994 is the remainder.

41. The fourth (gain and loss of land) I shall explain more fully further on, and show that it should be treated from henceforth as one side of a Dr. and Cr. account.

42. The fifth will be absorbed in the regular accounts of expenditure on the restoration works, and will appear under the proper heads. Sanction is asked for an estimate of Rs. 45,90,051, against which this amount of Rs. 2,96,334 will be the first charge. The estimate itself, in the form which I submit for adoption, is given in appendix C.

43. I beg now to return to the subject above named, the gain and loss of land. This subject has been treated in former reports as the "sand difficulty" and the "changes of the coast line," but the two latter descriptions are now imperfectly applicable to it, while the first represents the result which is now most prominent.

44. It will be remembered that from the commencement of the works it became manifest that there were movements of sand up and down the coast in opposite directions in the two monsoons, of which the movement from south to north during the south-west monsoon was the greater. This movement being obstructed by the harbour piers the result was an annual advance of the shore line on the south of the harbour, and an annual retreat of the same on the north. The plans show the former in its successive steps for the last seven years. Each blue line shows the most shoreward position of high-water mark for the year. It advances every year from about March to about October, and then retreats from October to March. The rate of increment decreases with fair regularity from year to year, as the length of shore to be covered and the depth of water to be filled increase. It is clear on the one hand that there is no indication of a limit to the advance, and on the other that, considering the decreasing ratio in the rate of advance, the time when it will be injurious to the harbour is still very remote. The area of land gained from the sea up to the present time is 70 acres.

45. Within the harbour there has also been an advance of the shore line, but this took place almost entirely during the years 1876 and 1877, when the north pier formed the only barrier to the northerly movement, the south pier not having then advanced sufficiently to arrest it. Since the latter year there have been some variations in the positions of the high-water line, due to local causes, but no persistent annual advance. The area of land gained within the harbour is 18 acres.

46. To the north of the harbour the result is as might be anticipated, the reverse of that to the south. The pre[illegible] northerly movement of sand causes an annual erosion instead of an accumulation. But the progress is [illegible] regular. This is due to two causes, the one natural, the other artificial. The natural cause is this. The sand within the influence of the waves is subject to two distinct movements, the alongshore movement due to the oblique stroke

of the wave (and this is greatest in moderate weather), the other a transverse movement which is *on* or *off* shore according as the wind is *off* or *on* shore. Thus the *off* shore wind in itself accumulative all along the coast acts with an accumulative alongshore movement to the south, and an erosive movement to the north, and the *on* shore wind of the remainder of the year, erosive all along the coast, acts with the erosive alongshore movement to the south, and the accumulative to the north. Hence the forces are in both seasons acting in concert to the south, and in opposition to the north, and the result is much greater irregularity in the annual changes where they are in opposition.

47. The artificial cause of irregularity is that whenever erosion is manifested protective measures are naturally at once taken, and counteract the local erosion, even if they drive it to some other locality. As a whole, however, the protective measures appear to have been efficient, for while the gain of land to the south of the harbour has been, as already stated, 70 acres, the loss to the north has been only 41 acres, and this, of course, entirely beyond the limit of the protective works.

48. For the above reasons the conclusions to be drawn from the records of erosion north of the harbour are much less definite than those drawn from the records of the accumulation to the south. We know that erosion is going on, but both the rate of it and the locality for the future are very uncertain. Nevertheless, I think a provisional settlement has now been made upon a tolerably satisfactory basis, and I would ask for a confirmation of it.

49. To explain the present state of the question I must go back to the early stages of the work. The part of the shore affected extends for about two miles northward from the north pier. For three quarters of a mile there was a made road along the shore, and on the landward side of this road stand in succession the Madras Railway Company's Ráyapuram terminus and offices, the Biden Seamen's Home (these are shown on the plan), some merchants' godowns, a first-class bungalow and compound belonging to the late Honorable J. G. Coleman (lately purchased by the Government), and a cluster of small brick-built native houses. Beyond this there was no regular road, but the shore was occupied by hut villages, with few permanent buildings, and timber yards. A little inland are five second-class bungalows standing in compounds having a depth of some 400 feet, beyond which is a good road parallel with the shore. To the northward of the last of these bungalows is a native village with a bazaar, but few permanent buildings, and beyond this agricultural land.

50. As the north pier advanced into the sea in 1876 the first effects of erosion were felt opposite the railway terminus. These were immediately met by the deposit of stone and [illegible] of concrete, and little inconvenience resulted. As the pier advanced further seaward the locality of erosion was thrown further to the northward, and the protective works assumed the form of a continuous stone revetment between the road and the sea, and upon this had been expended up to 31st October 1881 the sum of Rs. 91,009. It extended to a point 3,450 feet from the north pier and a little beyond Mr. Coleman's property.

51. The storm of November 1881 showed, as had been anticipated, that this revetment required an addition of stone, as the first was worked into the sand by the action of the sea. Some of the buildings close to the road were damaged, and were repaired at the expense of the harbour works, but, on the whole, the results of the storm were not serious so far as the revetment extended.

52. But the question was now prominently presented: How far is this protective revetment to be carried? It was effective as far as it went, but costly, and it became evident that it would be possible to spend more in protecting the land than the land itself was worth. In the early part of 1882, therefore, while at Madras, I investigated this question, and satisfied myself that though the revetment was fully justifiable as far as it had gone, for up to that point the evil of erosion would be even greater than the loss of the value of the land, this would not be the case much further on. I therefore recommended that the existing revetment should be strengthened, and that it should be extended northwards sufficiently to make a fair junction with the new line of shore, but that beyond that no further protection should be attempted. All the land abutting on the shore for some two miles northward should be purchased by the Government, so that no further questions of compensation to private owners should arise.

53. These recommendations have since been carried out. The revetment has been completed and extended at a cost of Rs. 1,13,618 and 140 acres of land have been purchased, or its loss compensated for, at a cost of Rs. 2,59,475, and these sums, together with the Rs. 91,009 spent on the original revetment, and the cost of management, make up the sum of Rs. 4,82,114, which I put forward in paragraph 37 as the *debit* side of the "Gain and Loss of Land Account."

54. I have now to show on what the credit side of this account will be based, and while I allow that the great bulk of this is still in the future, yet I submit that the longer the opening of the account is delayed the greater will be the difficulty in establishing it.

55. I have mentioned that 140 acres of land have been purchased; of these 41 have been washed away, so that 99 acres remain. The rents of these are collected, and under present orders are to be credited to the harbour works funds. These at any rate should be placed in the new account.

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56. Then there have been gained within the harbour limits, as stated in paragraph 45, 18 acres of land. A great part of this has been utilized, and two large godowns have been erected upon it by the Marine Department for port revenue purposes. The value of the accommodation thus given should be credited to the same account, either by the land being transferred to the Marine Department at its fair value, or by an annual payment proportioned to the use made of the land. This payment would no doubt increase from year to year.

57. To the south of the harbour 70 acres have been gained. The Commissariat Department have appropriated an advantageous site, which, five years ago, was in the surf, on which a building, 200 feet by 120 feet, has been erected. Another site has been appropriated in a similar manner by the Marine Department, on which was erected a shed for horses landed from ships. Other buildings of the same kind will no doubt follow, for the situation is a valuable one, and though it is no doubt gratifying to see it utilized, it is somewhat inconsistent that the outlay by which it has been acquired should be debited to one department, and the returns credited to another.

58. The above are Government appropriations, but private individuals are also profiting by the new site. The dealers whose timber yards orth of the harbour were purchased at a high price out of harbour works funds are occupying the new beach south of the harbour for the same purpose *rent free*, or if rent is paid it is not credited to the harbour works accounts.

59. I am well aware that if revenue were collected from the sources I have indicated it would make at present but a small show in comparison with the expenditure, but it is certain that it would increase, and it is also desirable that the new land should be recognized as a property which has been acquired by the Government, at a cost of nearly five lakhs of rupees, and that some control should be exercised over its occupation. I would add that I am about to point out a mode of utilization of a portion of a site which would ultimately add materially to the value of the whole.

60. I would now beg to submit some remarks on the future utilization of the harbour, which, although they can only be followed up by definite recommendations for immediate action to a small extent, are, I think, especially called for at the present time, because the subject has been lately under discussion from another point of view. A proposal had been made to alter the position of the entrance, with the view of obtaining stiller water in the harbour, but as this proposal was not approved by Sir John Hawkshaw, Sir John Coode, and Professor Stokes, on reference to them by the Secretary of State, it may now be considered at an end. It is only necessary for me to say that I concur in their conclusion, and I only refer to it now as giving a suitable occasion for pointing out what may be done for improving the accommodation of the harbour with the entrance in its present position.

61. The main points to be kept in view are—

I.—The safety of ships.

II.—The facility for loading and discharging cargo boats alongside the ships.

III.—The facility for loading and discharging cargo boats at the shore.

IV.—The safety of cargo boats and other local craft in bad weather.

62. With regard to the safety of ships, I think it is now generally understood, though it may be somewhat inconsistent with the popular ideas upon the subject, that a harbour may be very useful, even though it may not be a place of absolute safety in the heaviest storms. If Madras were a terminal port, such as London or Liverpool, or even Calcutta or Bombay, the want of absolute safety would be a serious drawback, but Madras is essentially a port of call, where ships only remain for a day or two, and are never dismantled. A steamer's fires are never let out during her stay in the port, and no sailing ship would ever be admitted, unless in very settled weather, without every facility being provided for her leaving at an hour's notice, and in any wind. To be caught in a cyclone at Madras, therefore, is no more than to be caught in a cyclone in mid ocean, provided always that the ship can get to sea. This then is the provision that is wanted, and not a safe mooring in the height of the storm.

Now, it must be remembered that the dangerous storms in the Bay of Bengal never come without notice, but occasionally, indeed frequently, the notice comes without the storm following. This is a source of inconvenience, because precautions have to be taken upon the *notice*, before the actual advent of the storm, when they would be too late. Hence it happens more often than not that when ships are sent to sea they return without having met with the expected storm.

63. But this is an inconvenience which may fairly be expected to be lessened as the indications of storms are better recorded, and the actual courses of existing storms are more perfectly traced. Even as it is, however, the inconvenience is not an intolerable one, and may be taken as an infinitesimally small deduction from the real value of the harbour. During the last two years there have not been more than four or five occasions on which ships have been warned to sea, and not one of which they would have been in actual danger if they had remained at their moorings in the harbour, mutilated [illegible]. Yet, during all this time, every single steamer has come into the harbour to load and discharge, and paid dues for doing so.

64. It must be admitted that, in one respect, a ship is worse off in the harbour than anchored in the roads outside. She must put to sea at an earlier stage of the warning for bad weather, as the confined space increases the difficulty of manœuvring the ship with a rising wind and sea, setting probably from different quarters. But this is an evil which will certainly diminish with more complete mooring and warping appliances, and more local experience on the part of the marine officers, and it does not touch the question of the ultimate safety of the ship. It has sometimes been asserted that the harbour is a trap from which escape would be impossible. It might perhaps be so once in 10 years if the commander of the ship, and the whole staff of the Marine Department and the Meteorological Observatory, were simultaneously to neglect the most ordinary and well known precautions, but, under existing conditions, such an idea is inconceivable.

65. I submit, then, that the demand for absolutely safe berthage for ships in the height of a cyclone is based rather on sentimental than on practical grounds. The harbour introduces no new element of danger. All that can be said is that, while it gives many new advantages and remedies many evils, it leaves one evil of very rare occurrence untouched. It is right to add that I do not think even this one evil is irremediable at some future time, but at present the circumstances of the port would not warrant the necessary outlay.

66. With regard to the second point, the facility for loading and discharging cargo boats alongside the ship, the advantages of the present over the old system are obvious. Under the old system the ship was anchored at a mile or upwards from the shore to a single anchor, so that she swung with her head to the wind or the current whichever might be the stronger, and rolled to the swell which generally comes from a third quarter. A more "uneasy" position for a ship, even in ordinary weather, it is difficult to imagine, and all around her, while subject to these conflicting disturbances, the cargo boats had to crowd. These boats again were subjected to yet another disturbance, the wind waves, which would scarcely affect the ship except indirectly by constantly driving the boats against her sides. Under these circumstances cargo had to be transferred to and from the boats. Then the boats had to be rowed out and back by manual labor (11 men to a boat carrying two tons) over this mile, and through the surf. The whole operation was one of little danger but of great cost, both in the labor employed, the damage done to goods, and the detention of the ships.

67. Now compare this with the present system. The ship is now brought to within a quarter of a mile of the shore; she is completely out of the current, and, being moored head and stern, is not affected by the wind; her head faces the swell. The wind waves which tossed the boats outside the harbour are much reduced, so that the latter are far more manageable. I mention these details to show that the advantages afforded by the harbour are by no means confined to a reduction of the on-shore swell. Even if this were disregarded altogether (and even those who are loudest in their disparagement admit *some* reduction), the advantages which remain are sufficient to explain the reason of the notorious fact that ships are eager to enter the harbour. Of course it is fully admitted that the more the swell can be reduced the better, but to make this one object paramount is altogether to misrepresent the case.

68. With regard to the loading and discharging cargo boats at the shore, the advantage gained so far is simply that due to the reduction of the waves, whatever that may be. In itself it is not much, but the stiller water enables improvements to be made which would have more effect. The existing screw-pile pier was made for open sea work, and it has inconveniences which are inseparable from such work. The principal one of these is its great height (about 18 feet) above water. With constant smooth water a height of 6 feet would be sufficient, and obviously much more convenient.

69. A few months before the storm of November 1881 two new low level jetties, were actually commenced, with the intention that they should for a time supersede the screw-pile pier, which was itself to be altered and adapted to the new circumstances, and again brought into action when required as an auxiliary to the new jetties. The storm put an entire stop to this scheme, at any rate till the harbour is restored, and if it is then revived it must be with considerable modifications. But this scheme was after all only the best under circumstances then existing. New circumstances have since arisen, and another scheme must be adapted to them.

70. Such a scheme may be found in the modification in the system of working the existing pier. The complaint first made was of the great height cargoes had to be lifted, but, in reply to the obvious suggestion that the employment of steam cranes would remedy this evil, the further complaint was started that, even if the goods were lifted more quickly, they could not be removed from the pier on the existing line of railway. Now the pier is 40 feet wide. It contains four lines of railway of 5 feet 6 inches gauge. Upon the same width six lines of metre gauge could be placed. These two additional lines of railway would relieve any conceivable amount of block. All that is wanted, therefore, to *treble* (I think I may safely say) the present accommodation of the pier is to expend fifty thousand rupees on three or four steam cranes with a quick motion, a sufficient stock of narrow gauge trucks, and materials for two extra lines of railway. It is no part of the present duty of the harbour staff to work out the details of such a scheme, but I have no hesitation in saying that some such would be a perfect solution of any existing or probable difficulty in the landing and shipping of goods at the shore.

71. The last point which I named in paragraph 61, the safety of cargo boats and other local craft in bad weather, is, in my opinion, the most important of all. As I have already shown ships have a refuge at sea, but this is not available for local craft. If they cannot safely ride at anchor they must be hauled up on the beach. This necessity obviously limits the size of the craft to be employed. Masula boats carrying two tons can be beached even when loaded. The cargo boats carrying 12 tons, which were introduced after the screw-pile pier was built, can be beached empty, and were formerly so placed in safety during the two bad weather seasons of the year; but for lighters of 60 to 100 tons, which are essential to an economical system of landing and shipping cargo, for a steam tug, for a floating derrick for lifting heavy articles, and for other craft for which a demand is sure to arise, beaching for purposes of safety is not practicable; safe floating berths must be provided.

72. I had certainly formerly anticipated that craft of this description might have safely lain at anchor within the harbour even in the worst weather, but I am not prepared to resist the impression to the contrary which was produced by the effects of the late storm. It may be that that impression will be removed or modified by further experience of future storms, when the breakwaters are more efficient and the opening for the entrance of the waves reduced; but for the present I will assume that, on the threatening of a cyclone, the present area of the harbour must be cleared by the sea-going ships going to sea, and the local craft in another direction. What is this direction to be?

73. The 70 acres of land gained to the south of the harbour and described in paragraph 44 of this report seem to suggest an answer to the question. It will be seen from the plan that, in March of this year, the high-water line outside the harbour was nearly continuous with the two-fathom contour inside. Two years hence it may be safely predicted that it will be something like 100 feet further out. Now, a dock or basin 1,000 feet long, 300 feet wide, and 10 feet deep at low water, with an opening through the pier into the harbour 60 feet wide, covered by a jetty of concrete blocks running northwards from the pier for 300 feet, would provide accommodation for the whole of the local craft, and would cost, including a stream dredger for the excavation, about 1½ lakh of rupees, and for an additional half lakh the area of the basin could be doubled.

74. I do not suggest this for immediate execution. Craft too large for hauling up on the beach should not be introduced till the harbour is somewhat more complete, but I point it out in general terms as the direction in which the harbour may be extended, and developed to a great extent. The basin would be, in the first instance, a mere place of shelter, but a boat wharf would soon be established on its landward side, and the frontage would become valuable. As the high-water mark advances seaward the basin would be widened, and in course of years its seaward margin would be so near the deep water in the harbour as to suggest the possibility of a ship entrance. With such capabilities in the site which has been added to the harbour property I submit that I am justified in anticipating advantages which will go far to compensate for some disappointment in the degree of stillness obtainable in the area of the harbour itself, and an equivalent for the five lakhs expended in protecting and purchasing land to the north.

75. It is right to state that the idea of the necessity of boat shelter is by no means new. It was urged years ago, and among others by the present Master Attendant, Captain Taylor, as the real want of Madras, and, in the visits I have paid to several other ports of India, I have found that the cost of landing and shipping cargoes is less dependent on the condition of the ship's anchorage, as to exposure or distance from shore, than upon the power of employing larger or smaller cargo boats, and this in its turn depends on the facilities for giving them shelter. But it must be remembered that at Madras a boat harbour would have been impracticable on account of the movement of sand along the shore until works had been carried out far enough into deep water to stop the sand and at the same time to form a ship harbour.

76. I may further suggest that this boat harbour would form the most convenient access to a line of water communication with the Buckingham Canal, and the extensive system of inland navigation in connection with it. The distance is about a mile, and the intermediate ground is almost entirely unoccupied.

77. As the foregoing report has dealt with a variety of subjects, it may be convenient if I conclude by a concise *resumé* of its contents.

Paragraphs 1 to 26 are devoted to a description of the proposed works of restoration.

Paragraphs 27 to 42 contain an analysis of the expenditure especially since the storm of November 1881, and paragraph 37 contains my recommendation as to the apportionment of the items of expenditure to five several heads.

Paragraphs 43 to 59 deal with the question of gain and loss of land by the accumulation and erosion of the sand on the coast.

Paragraphs 60 to 75 deal with the utilization of the harbour, 62 to 65 having reference to the means for ensuring the safety of ships, 66 and 67 to the transfer of cargo between the ships and the boats, 68 to 70 to the [illegible] at the shore, with a suggestion in paragraph 70 for an immediate improvement of the system of working on the screw-pile pier, 71 to 75 to the safety of cargo boats and other local craft in bad weather, with a suggestion in

73 and 74 for the future utilization of the land gained to the south of the harbour by the formation of a boat harbour.

Paragraph 76 suggests that a communication may ultimately be established between this harbour and the inland canals.

78. In the appendices will be found the following :—

A. Mr. Thorowgood's re-arrangement of the accounts of expenditure from October 1881 to April 1884.

B. Abstract of expenditure from commencement of works to 30th April 1884.

C. Estimate of restoration works as recommended, with statement of expenditure in respect thereof to 30th April 1884.

I have, &c.,

(Signed) W. PARKES.

APPENDIX A.

Madras Harbour.

Analysis of Expenditure between 31st October 1881 and 30th April 1884 by Mr. Thorowgood.

		Rs.
Total expenditure shown in accounts, 30th April 1884		67,69,036
Add recovery on sale of plant and materials		12,835
Total expenditure, as shown 31st October 1881 ...	Total ...	67,81,871
Add for work done in November 1881, south pier rubble	1,200	
	58,72,083	
Add further for recoveries on "concrete blocks" in north and south piers (of which Rs. 296 is accounted for)	300	
		58,73,583
Total difference to be accounted for ...		9,08,288

Expenditure.

1. Additions to existing pier works :—		
Concrete topping, clamping, and railways—		
North pier	44,088	
South pier	27,080	
Rubble foreshore and repairs to surf banks—		
North pier	3,861	
South pier	...	75,029
2. Recovery and destruction of hopper barges		16,485
3. Recovery and painting mooring gear, exclusive of cost of four pontoon boats (Rs. 8,465)		18,003
4. Rubble stone revetment, north beach		1,13,618
5. Repairs to buildings, damages by sea		5,221
6. New concrete blocks		87,230
7. Repairs and renewals to machinery and plant, transferred from other heads as below :—		
Concrete blocks	19,082	
Setting blocks	8,819	
Revetment, north beach	1,859	
Moorings	2,000	
North pier, repairs	2,459	
South pier, do.	1,933	
North pier, foreshore	1,766	
South pier, do.	4,552	
Pontoons (item 3)	8,465	70,935

		Rs.
7a. Actual charges under "General Tools" between November 1881 and 30th April 1884, as shown in accounts		7,144
Total to this point ...		3,73,665
8. Establishment taken at 7½ per cent. on the above total ...		28,010
9. Contingencies (including intercepting drain)		27,250
9a. Police, conservancy, and lighting		3,307
10. Compensation paid for land washed away		52,181
11. Purchase of land north of harbour		2,05,894
12. Establishment on items 10 and 11, estimate at Rs. 350 a month for 19 months (nearly 2¾ per cent.)		6,650
13. Taking total establishment charges, as shown in accounts, and adding charge for establishment during suspense, transferred as below, deduct from this total, items 8 and 12 and there remains establishment during suspense		1,68,074
Total charge to 30th April 1884	5,10,809	
31st October 1881	3,51,004	
	1,59,805	
Add from—		
North pier rubble	1,766	
Setting blocks	8,819	
North pier, sea damage	4,918	
South pier, rubble	4,552	
South pier, sea damage	1,932	
Concrete blocks	19,082	
Revetment	1,860	
	42,929	
	2,02,734	
Add to this—	Total ...	8,64,831
Stone lying at quarry	4,659	
Stores on hand	23,108	
Payments for moorings in accounts of November and December	15,328	
Item No. 34 in account sheet	162	
	43,257	
	9,08,288	

Note.—The above is the basis of the statement forming appendix B, but the items have been further re-arranged to some extent, which accounts for some differences in the figures, though the total amounts will be found to agree.

W. PARKES.

APPENDIX B.

Madras Harbour Works.

Abstract of Expenditure from Commencement of Work to 30th April 1884.

Estimates.	Description of Work.	Expenditure.
		Rs.
	(I) *Original Design.*	
	Expenditure to 31st October 1881	57,18,137
	Do. in November ,, ...	1,500
	Supplementary protection works	75,029
	Contingencies	27,412
	Recovery of wrecks and repairs of storm damage	21,706
	Establishment, 10 per cent. on Rs. 1,24,147 ...	12,415

Abstract of Expenditure from Commencement of Work to 30th April 1884—*cont.*

Estimates.	Description of Work.			Expenditure.
				Rs.
	Deduct (transferred to IV and V)—			
	To IV, Revetment	91,009		
	„ IV, Purchase of land	1,400		
	„ V, Concrete blocks	40,281		
	„ V, Stores	65,669	1,98,359	
Sanctioned, Rs. 56,50,000	Net expenditure on original design			56,57,840
	(II) *Moorings.*			
	Expenditure to 31st October 1881		1,53,945	
	Do. in November 1881		15,328	
	Subsequent expenditure		18,003	
	Establishment, 10 per cent. on Rs. 33,133 ...		3,313	
Sanctioned, Rs. 2,00,000	Expenditure to 30th April 1884			1,90,589
Submitted for sanction, Rs. 1,54,994	(III) *Cost of Establishment.*			
	During suspension of works			1,54,994
	(IV) *Gain and Loss of Land.*			
	Gained, 88 acres; lost, 41 acres.			
Submitted for immediate sanction, Rs. 5,00,000 to be subject to recovery by rents and value of land utilized.	Protection: Revetment previous to October 1881		91,009	
	Do. do. subsequent to do.		1,13,618	
	Establishment, 10 per cent. on Rs. 1,13,618 ...		11,362	
	Purchase of land and compensation		2,58,075	
	Do., transferred from I		1,400	
	Establishment expenses		6,650	
	Total to be carried to debit of account			4,82,114
	(V) *Expenditure to be charged against Restoration Works.*			
	Concrete blocks, transferred from I		40,281	
	New do. made since October 1881 ...		87,230	
	Repairs and renewals of plant and machinery.		58,079	
	Consumable stores on hand October 1881, transferred from I		65,669	
	Do., balance of additions and issues since October 1881		27,767	
	Establishment, 10 per cent. on Rs. 1,73,076 ...		17,308	
	Total to be carried to debit of account			2,96,334
	Total expenditure to 30th April 1884, as per official return.			67,81,871

21st August 1884.

W. PARKES.

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APPENDIX C.

Madras Harbour.

Estimate of Restoration Works.

	Amount.	Amount.	Expenditure to 30th April 1884.
Preliminaries.	Rs.	Rs.	Rs.
New machinery from England	1,74,050		
Repairs and renewals of old machinery	72,479	...	58,079
Alteration and extension of block grounds	10,000		
Railway materials	71,000		
Total preliminaries ...	...	3,27,529	
North Pier.			
Rubble stone in foreshores and base—			
Ordinary deposited from breakwater, 5,532 tons at Rs. 1-8-0	8,297		
Do. from boats, 182,260 tons at Rs. 2	3,64,520		
Large do. under wave-breaker from breakwater, 14,757 tons at Rs. 1-12-0	25,812		
Concrete blocks for building—	Rs. A. P.		
Making 58,116 cubic yards at	9 0 0	5,23,044	
Setting 2,062 „ „	2 0 0	4,124	
Do. 35,245 „ „	2 8 0	88,112	
Do. 20,809 „ „	3 0 0	62,427	
Concrete in mass for filling 500 cubic yards at	10 0 0	5,000	
Wave-breaker—			
Built blocks, 288 cubic yards at... ...	10 0 0	2,880	
Ordinary do. 70,849 cubic yards at ...	9 0 0	6,37,641	
Depositing do. 70,849 cubic yards at ...	1 0 0	70,849	... 63,756
Apron blocks, 1,667 do. ...	9 0 0	15,003	
Setting do. 1,667 cubic yards at ...	4 0 0	6,668	
Concrete in bags, 742 cubic yards at ...	12 0 0	8,904	
Cramps, 330 each	10 0 0	3,300	
Concrete capping, 22,400 cubic yards at ...	10 0 0	2,24,000	
Total for north pier ...	...	20,50,581	
South Pier.			
Rubble stone in foreshores and base—			
Ordinary deposited from breakwater, 675 tons at Rs. 1-8-0	1,013		
Do. deposited from boats, 169,517 tons at Rs. 2 ...	3,39,034		
Large do. deposited from breakwater, 15,038 tons at Rs. 1-12-0	26,317		
Concrete blocks for building—	Rs. A. P.		
Making 52,113 cubic yards at	9 0 0	4,69,377	
Setting 2,062 „	2 0 0	4,124	
Do. 29,282 „	2 8 0	73,205	
Do. 20,809 „	3 0 0	62,427	
Concrete in mass for filling, 500 cubic yards at Rs. 10	5,000		
Wave-breaker—			
Blocks, making 57,066 cubic yards at ...	9 0 0	5,13,594	
Depositing do. 57,066 do. at ...	1 0 0	57,066	... 63,755
Apron blocks, 1,667 do. at ...	9 0 0	15,003	
Setting do. 1,667 do. at ...	4 0 0	6,668	
Concrete in bags, 742 cubic yards at ...	12 0 0	8,904	
Cramps, 275 each	10 0 0	2,750	
Concrete capping, 19,200 cubic yards at ...	10 0 0	1,92,000	
Total for south pier ...	...	17,76,482	

Estimate of Restoration Works—*cont.*

	Amount.	Amount.	Expenditure to 30th April 1884.
	Rs.	Rs.	Rs.
Materials in store to be debited to works during progress.	...	...	93,436
Establishment, 7½ per cent.	...	3,11,594	17,308
Contingencies, 2½ „	...	1,03,865	...
Lighting entrance	...	20,000	...
Total ...	...	45,90,051	2,96,334

21st August 1884. W. PARKES.

From the Officiating Under Secretary to the Government of India, dated Simla, 28th October 1884, No. 415 M.

Forwarded to the Government of Madras in the Public Works Department for report on the proposals and estimates.

(By Order.)

(Signed) R. B. BUCKLEY,
Offg. Under Secy. to the Govt. of India.

From JULAND DANVERS, Esq., Secretary, Public Works Department, to the Secretary to the Government of Madras, Public Works Department, dated India Office, S.W., 25th September 1884, No. 1433-P.W..

I am directed to transmit herewith, for the information of the Government of Madras, copies of a despatch, No. 56 (together with its enclosures), which the Secretary of State for India has this day addressed to the Government of India relative to the Madras Harbour Works.

From JULAND DANVERS, Esq., Secretary, Public Works Department, to the Secretary to the Government of Madras, Public Works Department, dated India Office, S.W., 10th October 1884, No. 1433/2 P.W.

With reference to my letter of 25th ultimo, No. 1433/1 P.W., I forward herewith the plans (2) referred to by Mr. Parkes in his report on the restoration of the Madras Harbour Works, dated 21st August last.

Office Note from the Examiner of Public Works Accounts, to the Secretary to Government, Public Works Department, dated Madras, 13th November 1884, No. 589.

Your office note No. 1999 D, dated 10th November 1884.

I do not see any objection to the proposed recasting of the heads of account under which the expenditure on the Madras Harbour Works has been recorded. If the re-arrangement be ordered the details can be settled by Mr. Thorowgood in communication with this office.

From J. H. TAYLOR, Esq., Lieut., R.N.R., Master Attendant, Administrative Department, Madras, to the Chief Secretary to Government, dated Madras, 17th November 1884, No. 10562.

With reference to your endorsement, No. 2532, dated 13th November 1884, I have the honor to state that, under the provisions of the Indian Ports Act XII of

1875, the beach is vested in the Marine Department and not the Harbour Works, and accordingly rent is being levied for the same, at the rate of Rs. 6 per ground per month for the storage of timber, the amount being credited to the harbour dues account in order to assist in meeting the interest on the construction of the harbour. The Railway Company alone pay Rs. 3 per ground per month for the ground held by them, as it is at a long distance from the landing place. Mr. Parkes is in error with regard to the value of the sand reclaimed. The principal portion of it is now a lake, and no building could be erected on it, even if other objections did not exist from a military point of view. The horse stockade has no sure existence. It is liable to be washed away in any storm, and the mule stables, which occupy a slightly higher ground, are erected by Government, and the Marine Department has not taken any rent or claimed any jurisdiction over it.

From A. T. ARUNDEL, Esq., President of the Municipal Commission Madras, to the Chief Secretary to Government, dated Madras, 27th November 1884, No. 1595.

In reply to endorsement, No. 2593, Financial, dated 20th November 1884, I have the honor to report that the municipality does not occupy any part of the new foreshore gained by the harbour, nor does it collect rents from any of the timber merchants or other occupants. The collection of such ground rents by the municipality ceased in 1881 and was left to the proper officers of Government (G.O., No. 234 W., dated 28th January 1881).

No. 2704, Financial.

Transferred to the Public Works Department.

(By Order.)

Fort St. George, 5th December 1884. (Signed) J. D. REES, Ag. Under Secy. to Govt.

No. 2612, Marine.

Transferred to the Public Works Department.

22nd November 1884. (Signed) E. F. WEBSTER, Chief Secretary.

From R. B. BUCKLEY, Esq., Officiating Under Secretary to the Government of India, Public Works Department (Civil Works—Miscellaneous), to the Secretary to the Government of Madras, Public Works Department, dated Fort William, 28th November 1884, No. 450 M.

In compliance with the request contained in your letter, No. 2815 W., dated 10th November 1884, I am directed to forward the accompanying copy of a despatch to the Secretary of State, No. 32 P.W., dated 4th July 1884, regarding the restoration of the Madras Harbour.

Enclosure.

Despatch from the Government of India, Public Works Department (Civil Works—Miscellaneous), to the Right Honorable Her Majesty's Secretary of State for India, dated Simla, 4th July 1884, No. 32 Public Works.

In continuation of our despatch, No. 59 P.W., dated 13th November 1883, and with reference to your Lordship's despatches, Nos. 23 and 28 P.W., dated 24th April and 15th May 1884, respectively, in connection with the Madras Harbour Works, we have the honor to forward,

for the information of Her Majesty's Government, copy of a further communication from the Government of Madras, and to state that we concur generally in the opinions therein expressed concerning the restoration of the harbour.

G.O., dated 6th December 1884, No. 6093, Military.

From the Controller of Military Accounts, to the Secretary to Government, Military Department, dated Fort St. George, 1st December 1884, A.

In forwarding the accompanying letter * from the Commissary-General, I have the honor to express my concurrence with the views held by him, and to attach a letter † from the Examiner of Public Works Accounts, to whose department the charge appertains.

* No. 2124 T.B., of 22nd November 1884, stating that the Harbour authorities have no claim to rent for mule lines if it is not within their limits.

† No. 57 C.M.A., of 28th November 1884.

Enclosures.

From the Commissary-General, to the Secretary to Government, Military Department, dated Madras, 22nd November 1884, No. 2124 T.B.

I have the honor to acknowledge the receipt of Proceedings of Government in the Public Works Department, No. 2817 W., of the 10th instant, forwarded for report under your docket, No. 5627, of the 13th idem, and herewith returned as requested.

2. Mr. Parkes, Chief Engineer of the Madras Harbour Works, in paragraph 57 of his report claims rent for the site on which the commissariat mule stables now stand on the plea that five years ago this site was in the surf and that the beach on which the stables stand has been reclaimed in consequence of the construction of the harbour works.

3. It seems open to question whether the reclaiming of this beach was a portion of the original harbour scheme, or whether this [illegible] which gives the authorities considerable anxiety for the future of the harbour.

4. If this reclamation was not a portion of the original scheme, it appears doubtful whether the harbour authorities can claim rent for a site which they had no direct intention of forming.

5. A question of fact also arises, viz., whether the site of the commissariat mule lines was five years ago in the surf as stated by Mr. Parkes. That officer may not be aware that to prevent the encroachment of the sea a number of stone groynes were many years ago thrown out by the Engineer Department of Government, the first being constructed opposite the office of Messrs. Parry and Company as far back as 1853.

6. These groynes reclaimed a considerable beach, and in default of accurate measurements of the foreshore for many years past I think some further proof is needed of Mr. Parkes' statement that the site on which the mule stables stand has been reclaimed since the harbour works commenced.

7. Moreover if, as I suppose, the commissariat mule sheds are beyond harbour limits the harbour authorities can, I imagine, have no claim to rent.

From the Examiner, Public Works Accounts, to the Controller of Military Accounts, Fort St. George, dated Madras, 28th November 1884, No. 57 C.M.A.

In returning the papers received with your memorandum, No. 2641, dated 25th November 1884, I have the honor to state that this office has no remarks to offer on the question raised.

Order—dated 6th December 1884, No. 6093, Military.

The replies of the Commissary-General and Controller of Military Accounts communicated to the Public Works Department.

(True Extract.)

(Signed) A. KENNEY-HERBERT, Lt.-Col.,
Offg. Secy. to Govt., Mily. Dept.

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From F. N. THOROWGOOD, Esq., M. Inst. C.E., Superintendent, Madras Harbour Works, to the Secretary to Government, Public Works Department, dated Madras, 6th December 1884, No. 27 W.

I have the honor to acknowledge the receipt of your memorandum, No. 1996 C., of the 4th, asking my opinion as to the sufficiency of the estimates made by Mr. Parkes for the restoration of the Madras Harbour and forwarded with the Secretary of State's despatch, No. 56, of September 25, 1884.

2. I have carefully examined all the details of the estimates, and indeed was in consultation with Mr. Parkes at Westminster when they were made, and I believe that they are perfectly sufficient for the work to be done.

3. I beg to be permitted to add that I hope the arrangement suggested in paragraph 37 of Mr. Parkes' report may be carried out, substituting for the date April 30, 1884, the date at which the *bonâ fide* work of restoration on the new design shall commence, and correcting the figures accordingly. An infinite deal of trouble and numerous petty disputes will be avoided if we can start fair on a new estimate, the detailed arrangements of which can be made between the Examiner of Public Works Accounts and myself.

1 Despatch.
2 Plans.

4. I return the papers marginally noted, as I imagine you intend that I should do.

Order—dated 19th December 1884, No. 3127 W., Public Works.

In his despatch of the 25th September 1884, No. 56 P.W., the Secretary of State communicates to the Government of India the conclusions at which he has arrived in respect to the restoration of the Madras Harbour Works. It is intimated that the plan of future operations proposed by Mr. Parkes should be followed generally; the eastern entrance being maintained, in the absence of any additional facts or arguments of sufficient weight to justify a further reference to engineering authority in England. The revised estimates framed by Mr. Parkes should, it is stated, be examined and reported on.

2. His Excellency the Governor in Council observes that a decision having been come to in favor of the eastern entrance, there seems nothing to prevent the immediate prosecution of the work of restoration on the estimates framed by Mr. Parkes, the sufficiency of which for the object in view there seems no reason to doubt.

3. The Examiner, Public Works Accounts, reports that he sees no objection to the proposed recasting of the heads of account under which the expenditure on the works has been recorded. The details of the re-arrangement can now be undertaken on the lines suggested by the Superintendent in his letter, No. 27 W., dated 6th December 1884.

4. It is observed that the accretion to the south of the harbour is vested in the Marine Department under the provisions of the Indian Ports Act XII of 1875, and that the rents collected for occupation of the land are carried to the credit of the harbour dues account, to assist in meeting the interest on the capital cost of the harbour works.

5. A copy of these Proceedings will be forwarded to the Government of India in reply to their endorsement, No. 415 M., dated 28th October 1884.

(Here enter No. 3128 W., dated 19th December 1884.)

(True Extract.)

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintendent, Madras Harbour Works.
" Examiner, Public Works Accounts.
" Marine Department.

20 19TH DECEMBER 1884 No. 3128 W., PUBLIC WORKS.

ENDORSEMENT—dated 19th December 1884, No. 3128 W., Public Works.

Copy of the above forwarded to the Government of India.

(Signed) J. SHAW-STEWART, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. C. Howarth.
Spare Copies

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BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of {1884} Madras.

PUBLIC WORKS.

Dated December, 19th.

Read. *Encl.*

G.O., 19th Dec. 1884, No. 3128 W.

DECEMBER.

Madras Harbour Works

Forwarding copy of Proceedings on the subject of the reconstruction of the —.

1888/76

15TH AUGUST 1885, No. $\frac{10}{1889\ W.}$ PUBLIC WORKS.

PUBLIC WORKS DEPARTMENT.

LETTER—to

THE RIGHT HONORABLE THE SECRETARY OF STATE FOR INDIA.

MY LORD,

We have the honor to acknowledge the receipt of your Lordship's despatch No. 4, Public Works, dated 30th June 1885, forwarding copy of a report by Mr. W. Parkes, C.E., on the operations in connection with the Madras Harbour Works, and calling for an expression of our opinion on the point raised by Mr. Parkes in the 16th paragraph of his report, as to the best manner of administering and utilising the funds derived from the rent of buildings on the land lying to the immediate north and south of the harbour.

2. In reply, we have the honor to state that the land purchased at the cost of the harbour works to the north of the harbour is in charge of our Revenue officers, who collect the rents and credit them to the harbour works account. The control of the accretion to the south of the harbour is vested, under the provisions of the Indian Ports Act XII of 1875, in the Marine Department, which levies rent for the occupancy of the same. When the proposed Act to provide trustees for the harbour of Madras is brought into force, all sums advanced by Government for the construction of the harbour from 1st April 1883 will, in accordance with your Lordship's Financial despatch to the Government of India, No. 300, dated 18th October 1883, be taken over as a debt due by the trustees, and the interest on that debt will be provided from local funds raised under the Harbour Dues Act VI of 1882. The rents collected by the Marine Department for occupation of the land to the south of the harbour are carried to the credit of the harbour dues account, and will therefore eventually assist in meeting the interest on the capital cost of the works. The revenues derived from the lands both to the north and south of the harbour are therefore utilised to the direct advantage of the works; and as the existing system of controlling the lands is convenient and efficient, we do not consider that any change is called for for the present.

3. In this connection we forward, for your Lordship's information, copy of a letter from the Master Attendant, Madras, No. 10562, dated 17th November 1884, which shows that Mr. Parkes overestimates the value of the sand reclaimed to the south of the harbour.

We have the honor to be,

My Lord,

Your Lordship's most obedient, humble servants,

(Signed) M. E. GRANT DUFF.

(") H. E. SULLIVAN.

(") C. G. MASTER.

OOTACAMUND,
15th August 1885.

Exd. J. Henricus.

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GOVT. OF MADRAS.

PUBLIC WORKS DEPARTMENT.

LETTER to the Right Honorable the Secretary of State for India.

No. 10/1889 W.[1] dated 15th Aug. 1885.

Affording information as to utilisation of the funds derived from the rent of buildings on the land lying to the north and south of the Madras Harbour Works.

India Office.
London, 30th June 1885.

Public Works.
No. 4.

dated 23rd May 1885

Sir,

1 Herewith is transmitted for the information of your Government, copy of a report which has been submitted to me by Mr. W. Parkes C.E. on the operations in connection with the Madras Harbour works which have been carried on since the severe storm of 1881 up to the 31st of March last.

2 The point raised by Mr. Parkes, in the 16th paragraph of his report, as to the best manner of administering and utilizing the

His Excellency,
The Right Honorable,
The Governor in Council,
Fort St George.

1883
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the funds derived from the
rent of buildings on the land
lying to the immediate north
and south of the Harbour will
call for your consideration and
I shall be glad to be furnished
with an expression of the
opinion of your Excellency's
Government on the subject.

I have the honor to be,

Sir,

Your most obedient

humble servant,

J Randolph S Churchill

№5
Rec'd 7/90

Public Works
30 June 1885

Go 4 hs 28 h 4 d 6-1-82
" 601 h 4 d 8-3-82
" 2837 h 4 d 9-10-83
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" 2893 h 4 d 19-11-84
" 3128 h 4 d 19-12-84
Ins 102 4 d 17-6-85 Legislation
No 15 of 30 July 1885

The
Letter to Fort St George
№4
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1880/90

Madras Harbour.

Report of Progress up to 31st March 1885.

23 Abingdon Street
23rd May 1885.

Sir.

In resuming the series of quarterly reports of the progress of the Madras Harbour Works which has been suspended since the severe storm of November 1881, it may be convenient if I commence by a short resumé of the works which have been executed in the interval, distinguishing those which were in pursuance of, or contingent on, the original design and those which are a portion of the subsequently designed for restoration and completion, now in course of execution.

2. North Pier, Surf Bank. 655 tons of rubble were deposited immediately after the storm of 1881, and 300 tons in the latter part of 1883, to maintain the sea slope. The cost of this is the only charge which has been entered against this Debit of the works since 1876, but it is probable that similar small expenditure may from time to time be required as the rubble is wasted

The Under Secretary
of State for India

by

by the sea. No similar maintenance is required for the South Pier Surface Bank as it is completely buried in sand.

3. North Pier, Rubble Base. In 1882 4.782 tons of rubble were deposited on the outer foreshore where it had been scoured out by the heavy sea. No similar maintenance was required for the South Pier rubble base.

4. North Pier Superstructure. The 2200 feet of work left unfinished was strengthened by iron clamps connecting the blocks at the top. The top of the breakwater was re-levelled with a bed of concrete, and a line of broad guage railway bedded in concrete laid nearly to the end. These works were completed in 1882.

5. South Pier Superstructure. This was treated in the same way as the North Pier by clamping the blocks and levelling the top with concrete, but only a portion of the railway (1780 feet out of 2500) has been made and that on the narrow gauge, being in immediate connection with the South Indian railway, by which the rubble stone is conveyed. The total cost

of

of the foregoing works was R 75.029.

6. Protective works for the shore north of the Harbour. This is a work which was incomplete at the time of the storm, and was not materially affected by it. — Between Nov.r 1881 and February 1883, 59,726 tons of rubble stone were deposited to form a revetment in addition to the 44.180 tons previously deposited, and it may now be considered complete. It will probably require some occasional feeding as the sea washes it down, but up to the present time only 65 tons have been so added to it, which was in Nov.r 1884.

7. In pursuance of the design now under execution 43.357 tons of rubble have been deposited at the North Pier and 19.538 tons at the South Pier to widen the foreshore on the sea side to receive the Wavebreakers of Concrete blocks, the deposition of which will be commenced at the North Pier as soon as the Crane specially designed for the operation and now nearly completed by the Manufacturers Messrs. Ransomes & Rapier of Ipswich, has been erected. The positions in

which

which this stone 1888/23 has been deposited at the two piers are shewn on the accompanying plan.

8. In addition to this deposit of stone below water, the special protection referred to in para 5 of my report of 21st August 1884, near the commencement of the North Pier, has been completed. A bank of rubble was made for a length of about 140 feet to the level of the top of the Breakwater, and on this 16 thirty ton Concrete blocks were built. The rubble was partially washed down in a heavy sea in November, and 12 out of the 16 blocks fell over upon the flattened slope, as was anticipated. The next heavy sea will probably bring down the remainder, and the whole of the rubble and the superincumbent blocks will ultimately be lost to sight but will remain an efficient protection to the foundation at that point.

9. As regards concrete block work 313 blocks which were remaining in stock at the time of the destructive storm will now be utilized and 487 more were made in the course of the year 1882. Since then no blocks have been made, but the manufacture

of them is about to be resumed.

10. The plant and machinery throughout the works has been thoroughly repaired and renewed where necessary and the two Titan Cranes lost in the storm are being replaced by two new Titans of a design somewhat modified to suit the new requirements. Of these one is now ordered for shipment, and the other is nearly completed. A special crane for depositing blocks in the breakwater is also nearly complete. The first of these machines may be expected to be in working order in about 3 months from the present date and the other two in about 4 months, after which everything will be in readiness for carrying on the actual works in the sea with rapidity

11. Mr. Thorneycroft informs me that he has made contracts for several of the Departments of the works on rather lower terms than previously but the saving on the estimate thus effected will I fear be more than alleged if the South Indian Railway Company substantiate their claim to a higher rate for the conveyance of stone from Pallavaram

C.

to Marras. 1888/5

12. I alluded in para 8 to the effect of a heavy sea in November 1884, in washing down the bank of rubble on the outer side of the North Pier. This was the only effect produced upon any part of the work, except that three cargo boats belonging to the Harbour works which were moored to the South of the South Pier broke adrift, and two of them were carried into the Harbour and wrecked; the third was saved. The sea was not of extreme force, but the circumstances were remarkable from the rapid change in the direction of the sea from North to South, the rubble bank being washed down in the early part of the night, and the boats which were then in comparative shelter being attacked in the early morning from the opposite direction. The latter disturbance was of very exceptional character, the wind blowing from a very unusual quarter, (S.S.W.) with a force greater than any that has been registered since 1872. Its velocity was 49 miles per hour as compared with 33 miles in the destructive storm of 1881.

13.

1887/28

13. I would now beg to direct attention to the changes in the Coast line both South & North of the Harbour. These changes have of course been proceeding quite independently of the existence of the works, and they become more important as time goes on. On the accompanying lithographed plan I have shown the positions of the High water mark when the accumulation was at its minimum each year (which is about the end of February) since the commencement of the works. This shows clearly the constantly diminishing rate of advance year by year which was originally anticipated, and it is worthy of remark that the advance of 450 ft in 8 years is almost exactly that which I calculated upon on very slender data in 1876, and which will result if it continues in the future as it has done in the past in the 4 fathom line reaching the head of the pier and permitting the sand to work towards the entrance, in about 100 years from the commencement of the works in 1876.

14. On another plan also attached I have shown the annual waste to

1883/27

to the north of the Harbour since 1890, also the position of the High water line in 1876, before the Harbour works could have had any effect upon it, and in 1862. In this case the most shoreward position is in September each year. There is evidence of the coast line having been still further out at various earlier dates during the present century and there have been considerable fluctuations, sometimes erosion and sometimes accumulation, so that it is no new thing for property abutting on the sea to be washed away and afterwards recovered, though of course the recovered areas are for sometime comparatively valueless.

15. It is, however clear that at the present time a process of erosion is going on which must be attributed to the Harbour Works; and, though the loss last year was not large it cannot be assumed that erosion has reached its limits. It is uncertain whether it will in future years take the form of deepening the indentation of the Bay, or whether the coast to the north will continue to retreat by parallel steps of.

Document

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decrement. The area coloured green has been purchased by the Government to anticipate either result and this having been done, will evidently avoid for many years to come any question arising from the encroachment of the sea on Howth property.

16. The rents of the purchased land are collected and credited to the Harbour Works. Some of parts of the reclaimed land to the South of the Harbour are let at high rents by the Estate Dept. and the proceeds credited to the Harbour Dues account in order to assist in meeting the interest on the construction of the Harbour. The two revenues (of which I have no particulars, but which must now amount to an annual income worth consideration) being thus in the hands of different Depts, while other Departments and authorities claim the right to establish themselves on the land at their discretion. I would therefore beg to represent the increasing urgency for the recognition of these inevitable changes

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1888 28

of the shore line and the expenditure
and revenues connected with them
as a ground for the establishment
of some special suitable
administration under which they
should be placed, with a view
to the land being utilized for
the public service to the
greatest possible extent.

17. I observe in future returns
to receive my Commissioners
the expenditure as compared
with the estimate up to date,
but on the present occasion it
would be difficult to present
such a statement in a form
that it could be combined with
with the special statements, as
the latter are not yet made out
according to the new form which
I suggested in August 1884 but
which will be adopted as from
the 1st April last.

I have &c.

(Sd.) G. Par Rees

Company

No: 6

Copy Report by Mr Parker
Dated 23rd May 1865.

Rec'd 7/9/15

Referred to in Public Works Letter
Madras No 41 dated 20th January
Para 1

1885/33

Letter from the Master Attendant, Administration Department, Madras, to the Chief Secy: to Govt:, No: 10562 of 17th November 1884.

With reference to your endorsement, No: 2532, dated 13th November 1884, I have the honor to state that, under the provisions of the Indian Ports Act XII of 1875, the beach is vested in the marine Department and not the Harbour Works, and accordingly, rents is being levied for the same, at the rate of Rs 6 per ground per month for the storage of timber, the amount being credited to the harbour dues account in order to assist in meeting the interest on the construction of the harbour. The Railway Company

alone pay Rs 3 per ground per month for the ground held by them, as it is at a long distance from the landing place. Mr. Parkes is in error with regard to the value of the sand reclaimed. The principal portion of it is now a lake, and no building could be erected on it, even if other objections did not exist from a military point of view. The horse stockade has no sure existence. It is liable to be washed away in any storm, and the mule stables, which occupy a slightly higher ground, are erected by Government, and the Marine Department has not taken any rent or claimed any jurisdiction over it.

Buildings & Roads
Civil Works

1885/37

No. 1898

PUBLIC WORKS DEPARTMENT.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the 15th August 1885

READ the following

Despatch from the Right Honble the Secretary of State for India. (No. 4 P.W. dated June 30th 1885)

Communicated to the Superintendent Madras Harbour Works & Chief Engineer Marine Department.

2. The Secretary of State for India will be addressed on the subject of para. 2 of the foregoing despatch.

(H.E. No. 10—1889 W dated 15-8-85)

To The Supt. Mr. H. Works ✓
" Marine Dept ✓
" Rev. Dept ✓

Dgd 28/8/85

To,
The Right Hon'ble the Secy of State for India

My Lord,

We have the honour to acknowledge the receipt of your Lordship's despatch No. 4 Public Works dated 30th June 1885, forwarding copy of a report by Mr. W. Parkes, C.E., on the operations in connection with the Madras Harbour Works, and calling for an expression of our opinion on the point raised by Mr. Parkes in the 16th paragraph of his report, as to the best manner of administering and utilising the funds derived from the rent of buildings on the land lying to the immediate north of the harbour.

1885/37

2. In reply, we have the honour to state that the land purchased at the cost of the harbour works to the north of the harbour is in charge of our Revenue officers, who collect the rents, and credit them to the harbour works account. The control of the accretion to the south of the harbour is vested under the provisions of the Indian Ports Act XII of 1875, in the Marine Department, which leases out for the occupancy of the same. When the proposed Act to provide trustees for the harbour

of Madras is brought into force, all sums advanced by Government for the construction of the harbour from 1st April 1883 will, in accordance with your Lordship's Financial despatch to the Govt of India No. 300 dated 18th October 1883, be taken over as a debt due by the trustees, and the interest on that debt will be provided from local funds raised under the Harbour Procedure Act VI of 1882. The rents collected by the Marine Dept for occupation of the land to the south of the

1885
1883

harbour are carried to the credit of the harbour dues account, and will therefore eventually assist in meeting the interest on the capital cost of the works. The revenues derived from the lands both to the north and south of the harbour are therefore attributed to the direct charges of the works; and as the existing system of controlling the lands is convenient and efficient, we do not consider that any change is called for for the present.

5 In this connection

we forward for your Lordship's information, copy of a letter from the Master Attendant, Madras, No. 1056 dated 17th Nov. 1884, which shows that Mr. Parkes over estimates the value of the sand reclaimed to the south of the harbour.

31-7-85

X Rec'd 3125 Pol/11/84

JW 31/7/

Noted
Minute of Council
Covered

Shown in Council.
draft approved.
12-6-85

To the Chief Secretary
favour of initials. 8/

Cir. 7617 Cir. 1/8.

7198

Govt. of Madras, 1885.

PUBLIC WORKS.

Dated 15 Aug 1885.

G.O. 15 Aug 1885. No. 1659.

Despatch from the Secy. of State for India forwarding Copy of report by Mr. Price on the operations for the year 1884-85 with the Govt's observations thereon.

Ordered

Affording information as to obligations of the funds derived from the Railway Branch Ship on the Railways to the North & South of the N. A. works