(Paper No. 4245.)

"The Development of the Port of Aden."

By Harold Berridge, M. Inst. C.E.

A paper on "Aden Harbour," by Mr. W. S. Child, records a stage in the development of the Port, and the present communication is intended to amplify that paper and bring the record up to date.

Early History.

The original anchorage for Aden was on the South side of the peninsula at Holkat Bay, which afforded easier access to the trading community than the inlet on the North, where the present harbour is situated. When the peninsula was taken by the British in 1839, the town of Aden was in a miserable condition, with only 500 to 600 inhabitants. Its population now numbers 45,000, and the total trade of the port was, in 1912-13, Rs. 13$\frac{3}{4}$ lakhs (£91,000).

With the advent of steam navigation, coaling became a consideration, and between 1850 and 1880 many grants were made for coal wharves on the foreshore of the present inner harbour, where greater facilities existed than at Holkat Bay. The outlet harbour is deep and commodious, but exposed to the rollers of the south-west monsoon between May and September. The inner harbour, though protected from this swell, had originally a depth of 19 feet only, over a comparatively small area (Fig. 1, Plate 9).

Between 1870 and 1877 reports were presented by Mr. Price and by Mr. Parkes with respect to dredging operations contemplated, and in 1885, in response to an appeal addressed to the Secretary of

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State for India by steamship owners, a scheme by General Hogg, C.B., Political Resident, was put forward, and Mr. Price again reported in 1888. He stated that the harbour was favourable and sheltered, that the tides were weak, and that there was no silting. He did not recommend reclamation as a means of disposing of spoil, as had been suggested previously. Dredging to 25 feet would, he thought, be best carried out departmentally, and he estimated the cost at—

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of dredger</td>
<td>Rs.4,77,856</td>
</tr>
<tr>
<td>Dredging 2,063,278 tons @ 3 As.</td>
<td>Rs.3,86,864</td>
</tr>
<tr>
<td></td>
<td>Rs.8,64,719</td>
</tr>
</tbody>
</table>

The Government of Bombay adopted Mr. Price's proposals, modified to give 26 feet of depth, but as the formation of a Port Trust was then in contemplation, it left the matter to be dealt with by the new body when formed, and, regarding the work as of national importance, asked the Government of India to give a grant-in-aid of 5 lakhs of rupees. This grant was not made, though a 12-lakh loan was sanctioned.

**Later History.**

The first act of the new Port Trust, formed in 1889, was to purchase the 1,000-ton hopper dredger "Mermaid," built by Messrs. Simons & Co., of Renfrew, when the dredging scheme to secure 25 to 26 feet over an area of some 163 acres, with six berths, was carried out in three stages of 20, 24, and 26 feet. Difficulties connected with establishment and direction of operations arose. The members of the Board constantly changed, none was acquainted with dredging operations, while the engineer had but limited executive power, facilities for heavy repairs were wanting, and the climate and conditions were trying to the European establishment. For a long time it was not thought necessary to dry-dock the dredger, even at 3-year intervals, and beaching every 4 months was conceded as a compromise. It was of course difficult to keep the hull and hopper doors in proper condition under these circumstances. The 26-feet scheme was reported complete in 1901. There had been dredged 3,852,800 tons in 11 years, at a cost of Rs.6,03,510, as against 2,348,510 tons in 5 years and Rs.5,16,960, as estimated.

As the dredging approached completion, conflict of interests arising between members of the local Chamber of Commerce, formed in 1886, and merchants outside that body, during which a claim for the construction of public wharves was urged, resulted in a draft
proposal for such accommodation being put forward by the Port Trust. There was also a strongly supported scheme to deepen to 30 feet with the formation of three new berths, accompanied by opposition to the raising of any loan for reclamation works, on the ground that port dues would become more burdensome. In the result the Port of Bombay in 1901 appointed a Commission of Enquiry, to sit at Aden, with Mr. (now Sir) W. C. Hughes, C.I.E., M. Inst. C.E., then Chairman of the Bombay Port Trust, as President. The terms of reference, broadly stated, covered the question of shipping needs, probable revenue, and relative desirability of public wharves, and of deeper anchorage. The Committee reported against any considerable expenditure which did not secure the abolition of lighterage, and advised that any improvement of wharf accommodation should aim at its total elimination for ordinary cargo. They recommended reclaiming 100,000 square yards of Tawahi Bay by spoil from dredging, and the construction of deep-water piers for ocean-going steamers, and short jetties for coasters. The cost was estimated at 18 lakhs of rupees. They also recommended that the existing channel and mooring-basin should be dredged to 30 feet, and the latter extended eastward at 26 feet. This was estimated to cost 12 lakhs, and to take 10 years in execution, assuming another dredger to be provided. The Committee further estimated the revenue from the wharf scheme at Rs.97,000, against existing lighterage charges of Rs.1,74,000, and that after 7 years spent in construction a surplus revenue would accrue to the Trust. While in favour of deepening the harbour as part of a general scheme benefiting the whole trade of the port, they were also of opinion that the Port Trust should not incur further expenditure under this head, at the cost of a section of the trade. Lastly, Government was urged to make an advance for the purchase of plant. Government did not act on the Commissioners' report, but sanctioned the purchase of a tug, and four 50-ton deck barges, and the reclamation of Tawahi Bay, on sanitary grounds. The shipping and lighterage interests opposed these proposals, and questioned the accuracy of the Port Commissioners' figures, while insisting on the utility and moderation of the existing private system of landing, shipping and wharfage.

Dredging meanwhile was carried on as directed by the Board, extending the basin eastward to a nominal depth of 30 feet. As, however, the dredger could only work to 35 feet, and spring tides rise 7 feet, this was about 3 feet too little for economical results. Pressure was exercised by the Board to keep the number of loads up to the maximum, almost irrespective of the depth obtained or the
hardness of the material, with the natural result that hard places and shallow patches were left, as taking too long a dredge. The portion of Tawahi Bay allotted to reclamation was shallow, and the least well adapted to deposition from barges. The only practicable method was to float them as far as possible at high water, and rake the sand off, the barge taking the ground and floating off at the next tide. The varying height of tides from day to day regulated the distance to which the barges could go in, and the whole area soon became covered with irregular banks of sand up to about half-tide level.

RECENT PARTICULARS.

In 1904 the Author was appointed to act as Engineer to the Port Trust, and in 1905 he was confirmed in the appointment. Being desired by the Board to suggest methods of improving the dredging he first applied for a complete hydrographic survey of the harbour, which had only been partially made since 1839. This was conceded by Government and carried out by Captain Heming, R.N., in 1906, it being understood that the Port Trust would keep the survey up to date in the future. The survey showed that the dredged basin was very irregular in shape, with depths ranging from 25 to 30 feet at Indian spring low water.

The Author, when reporting in December, 1905, had in view the following facts:—

The dredger was 16 years old and limited as to depths. Expenditure on repairs was increasing. The engineer's control was limited. The basin and channel were irregular and inconvenient. The capital sum in hand was small, and the amount available for dredging was but 1 lakh of rupees yearly.

As regards the depth to be attained, the shipping interests in 1899 had asked for 30 feet; it appeared that the Suez Canal was being dredged to 29·5 feet; Bombay and Colombo were both proposing a depth of 30 feet, and this minimum depth the Author recommended for Aden, as lying on the route between these ports. This necessitated the extension of the approach channel to the 5-fathom line in the outer harbour, and this extension was to be connected by a curve of 3,696 yards radius, to which both the extension itself, and a straight line rectifying the north bank of the mooring-basin, were to be tangential (Fig. 2, Plate 9).

The quantity to be dredged was estimated to be 2,730,000 tons, which, at 8 annas per ton, and allowing for sale of the "Mermaid," gave a total capital of Rs.12,00,000, equivalent to an annual
sinking-fund charge of Rs.88,000, reckoning 4 per cent. interest on capital.

This scheme was adopted by the Trustees, who sent it to the Chamber of Commerce, whose approval it received; it was then forwarded to the Government of Bombay, with the result that Sir Walter Hughes was asked to report. He was not altogether favourable, and reverted to the Port Commission's earlier recommendations. In September, 1908, while the matter was still under discussion, Messrs. C. J. Wills and Company offered to carry out the work at the estimated rate, in 3 years, and Lieut.-Col. W. Merewether, I.A., then Chairman of the Port Trust, went to India, and, urging on the authorities that a favourable opportunity presented itself, succeeded in obtaining not only Government's approval of the scheme and contract, but also their consent to make a 20-year loan of 12 lakhs of rupees. A contract was accordingly made with Messrs. Wills and Company, who took over the dredger "Mermaid," and shortly brought into work other dredgers of 500 and 556 cubic yards capacity respectively, and two hopper barges of 270 cubic yards capacity each. The contract was completed in October, 1910, 1,976,000 cubic yards having been dredged, including two deep berths at 33 feet and 34 feet, and an equivalent quantity of soft dredging for a rocky patch found on the south side of the bell-mouth. The work was constantly sounded by inspectors, and finally passed on a complete survey; soundings were taken subsequently every 6 months, and the depths are now considered stable. Dredging was delayed but not stopped by the south-west monsoon, as it is generally calm enough at night and in the early morning to go out and tip. There is usually some swell in the outer harbour all the year round. The total cost of the dredging has been as under:

<table>
<thead>
<tr>
<th>Time</th>
<th>Tons of 20 Cubic Feet</th>
<th>Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Mermaid&quot;</td>
<td>18 years</td>
<td>7,185,150</td>
</tr>
<tr>
<td>&quot;Mermaid&quot; and Contract</td>
<td>3 years</td>
<td>2,962,400</td>
</tr>
</tbody>
</table>

The loan of Rs.12,00,000 from Government is being repaid by twenty yearly instalments of Rs.88,298. The harbour has now a 30-feet mooring-basin with berths for nine ships, and seven berths with depths of 24 feet to 26 feet, and anchorage for an indefinite number of smaller craft. It is considered that this accommodation
will be ample until the loan is paid off, though undoubtedly the Port of Aden will have to respond to any greater depths obtained in the Suez Canal.

The Tawahi Bay wharf scheme having been shelved, the reclamation of 15 acres was completed in 1909 by hill filling brought in camel carts. A sea-wall with balustrade has been built, and the area has been laid out in building sites, and has a recreation ground of some 3 acres. A central front site has been utilized for the erection of Port Trust offices. About 22,000 square yards of building sites remain, for which the lowest price yet paid is Rs.10 per square yard.

Public and Private Wharves.

The wharves are generally rough banks of stone pushed out to low-water mark, and faced with more or less vertical boulder walls. Maala Wharf, of this type, was bought by Government and handed over to the Port Trust in 1889, and small extensions, of similar construction, were made from time to time. In 1911–12 the pier heads were rebuilt in block work, and four galvanized sheds erected 150 feet by 30 feet by 15 feet to eaves.

In 1912, Mr. Barclay Robertson, then Chairman of the Port Trust, obtained the sanction of Government to a scheme for an extension westward (Fig. 3, Plate 9).

The wall for this is constructed of blocks 5 feet by 3 feet 6 inches by 3 feet, built in ordinary frames by a travelling mixer, and handled by a 5-ton crane. The foundations were dredged by a grab, worked on a 3-ton crane barge, filled with rubble and screeded to level by a diver (Fig. 3a, Plate 9). The blocks were brought on the site by the old reclamation barges, one of which was turned into a hand shear-legs for setting purposes. The wall was loaded by surcharge blocks to take out all settlement, and then built up from half-tide level to the underside of coping, in rubble masonry, with 1:4 Portland-cement mortar. The coping was of 1:2:4 Portland-cement concrete in situ. The shed provided was of steel and galvanized iron 750 feet by 100 feet by 15 feet to the eaves, in 30-foot bays. The floor was 5 inches thick, of concrete, of three parts of mortar to five parts of hill metal, the mortar being of lime, pumice, and sand, in equal parts, ground in a mortar mill 10 minutes, and passed through a concrete mixer. Great care was taken to keep it wet, when laid, and covered with sand to protect it from the sun. The wearing surface is 1:2 Portland-cement mortar, screeded with wooden screeds and floats to 1-inch thickness.
The filling and rubble backing was brought from the foot-hills in 1 cubic yard tipping-wagons, hauled by a small locomotive. The rails were of 2-foot gauge, 14 lbs. per yard, with seven sleepers to each 5-yard length.

The sorting platform on the quay-side is 24 feet wide, and there are provided for handling cargo, one 5-ton, one 3-ton, and three 1½-ton cranes.

The Port Trust has decided as soon as convenient to exercise their powers of closing the private wharves to cargo, and to handle it all at Maala. The private wharf-owners have never made a separate charge for wharfage in their charges for landing and shipping, so that these latter will probably remain the same, but the Port Trust makes a charge for wharfage, as it does not land and ship, so that it seems that the merchants will save by the proposed change, unless the charges for landing and shipping are reduced. The wharf is lighted by electricity furnished by a 22-kilowatt dynamo at 220 volts, to twenty-five 300 candle-power clusters for external lighting, and two hundred 25 candle-power lamps for internal lighting. The conductors are bare, and are carried overhead on steel poles. The dynamo is driven by a Gardner 40-HP. oil-engine. The wharf is the best-lighted place in Aden, where there still is no public system of supply. It will be seen that the shipping companies have got their 30-feet mooring-basin, and the Chamber of Commerce has secured the extension of the wharf at Maala, but that little difference has been made in the monopoly of the lighterage firms handling cargo. Possibly an amendment of the Port Trust Act may enable this to be achieved, and some control over lighterage secured as at Karachi and elsewhere, where a public lighterage contract is let by tender—probably this would be the best solution.

MINOR WORKS.

The Prince of Wales pier was constructed in 1905–6. It is 100 feet long and has 10 feet of water at Indian spring low water. It was built entirely by manual labour. Frames were set in position and filled with concrete deposited under water. The system is not satisfactory on this small scale. The pier is only used for launches and tugs. The Post Office pier was originally a steel structure with screw piles 5 inches in diameter, and timber decking. These piles lasted fairly well from 1876 to 1911, but the bracing deteriorated badly, and as the whole pier was thoroughly shaken, it was rebuilt with reinforced-concrete piles. The monsoon swell, however,
carries the mail-barges with such force against the pier that a
masonry head outside the framed structure had to be provided.
The method of construction was similar to that at Maala: jarrah
fenders, 12 inches by 12 inches, are provided, but the berth is a
bad one in the south-west monsoon, and during that period mails
often have to be landed at the Prince of Wales pier.

**General.**

The execution of engineering works in Aden involves some
difficulties. Engine-drivers, mechanics and other tradesmen are
limited in number, and not of the best class. There is good
building-stone of volcanic origin in the hills, but it is suitable for
plain work only, and obtainable only in small sizes. Masons are
fairly good. The Arab will do all the hard rough work, and is
efficient if means can be adopted of utilizing his methods of
working. On the Maala works, French, Greek, Arabic and
Hindustani were spoken. Europeans and Indians specially qualified
have to be brought into the station on agreements at enhanced
rates of pay, while the climate often deteriorates their efficiency. It
is practically impossible to effect improvements in working
methods with such a transitory population. Housing accommodation
is scarce and expensive, except where provided to meet
public requirements.

**Port Lighting and Signalling.**

A masonry lighthouse, 85 feet high, was built on the top of Ras
Marshag in 1886, the focal plane being 244 feet above sea-level.
The original lantern was a first-order light with a multiple-wick
lamp of 4,500 candle-power. On the recommendation of the late
Mr. W. T. Douglass, M. Inst. C.E., it was converted into an occult-
ing light of 15,500 candle-power, the apparatus being of Mr.
Douglass's design, with a Chance incandescent oil burner. This was
installed by the Author in 1905. The new light has a period of
5 seconds—3 seconds light, and 2 seconds dark—and has worked
satisfactorily. It is visible at 22 miles. On the west side, at the
entrance to the inner harbour, the lightship "Euphrates," which
had been an old H.E.I.C.S. brig, built in 1828, did duty from
1862 to 1911, and was then reported unrepairable. She was
provided with a catoptric light revolving round the mast, and this
was erected on Elephant's Back temporarily.

In 1912 the Author erected, to the design of Mr. W. T. Douglass,
a lighthouse (Figs. 4, Plate 9), which has worked successfully, the flash being visible 22½ miles, with the following characteristics:

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<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eclipse</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The intensity of the light is 50,000 standard candles, and over two red sectors 18,000 candles, the height of the focal plane being 192 feet above high water. The apparatus was made by Messrs. Chance Brothers.

To mark the entrance of the fairway channel an acetylene buoy has been provided. This burns 6 months without attention and is quite distinctive and successful. The other twelve channel buoys are lighted with lamps of the Cera Wax Company and are filled and lighted daily. The system is cheap and answers well on the small scale suited to Aden. The principal signal station is at Steamer Point, where vessels are signalled by flags from the main flagstaff, the truck of which is some 350 feet above sea-level, and very conspicuous. These signals are repeated from and to Shum Shum and Marshag, all stations being connected by telephone. Until the war broke out the principal liners were also signalled by gun. In 1912 the late Captain Sinclair, R.I.M., the Port Officer, suggested that the signalling would be more efficiently carried out at night by electric lamps, and a 5-B.H.P. Crompton petrol-paraffin engine, with sixty accumulator cells working at 120 volts was installed, and is used for signalling, by an arrangement of nine coloured lights, the clearing of the channel outward and inward—a Morse lamp is used for other signals.

**Workshop and Launches.**

Up till 1913 the Port Officer was in entire charge of all Port Trust launches and floating craft, both executively and also as to repairs, and he had a workshop in direct charge of the harbour-master. The engineering department had also a small workshop for repair work, which in 1912 it was decided to enlarge and place in charge of the Chief Engineer. There was installed a 25-B.H.P. Gardner oil-engine, a 20-feet gap lathe, a drilling-machine, and pneumatic tool plant. A superintendent of machinery (Mr. A. F. Ford) was appointed and placed in charge of the workshop and all mechanical plant of the Trust. It was also ordered that all consumable stores should be purchased and issued by the engineering department,
Considerable savings have resulted; work of repair to launches and other work has been more satisfactorily carried out, and "lay bys" of craft have been largely reduced.

Up to 1913 pilots boarded vessels from rowing boats, and in monsoon weather extra lascars had to be employed. In 1911 a small 12-HP. motor launch had been purchased, and in 1913 two more launches were acquired, driven by 50-HP. oil-engines. These provide a much more efficient service. This kind of motor is satisfactory with proper supervision, but suffers more from neglect than a steam-engine.

**Administration of Fortress Settlement and Port.**

Aden includes administratively Sheikh Othman, a village 7 miles distant, as well as Perim, an island at the southern entrance of the Red Sea. The representative of Government is styled Political Resident, and he is also General Officer commanding the Garrison. The civil administration is carried out, under the Political Resident, by Officers of the Bombay Political Department, the chief of whom, called the First Assistant Resident, was, ex-officio, Chairman of the Port Trust up to 1911.

Besides the Port Trust, there is a Settlement Committee charged with the administration of municipal affairs within civil limits; its powers are, however, advisory only, except in matters of routine. Conservancy, lighting and roads in cantonments are looked after by the Assistant Commanding Royal Engineer and by a Cantonment Committee. It will be seen there are practically four authorities controlling public facilities in this small area, and curious anomalies sometimes result. Simplification of administration is a matter of urgency. In 1906 Mr. J. Sladen, I.C.S., visited the fortress and discussed local administration with the various authorities. Following this a new appointment of Joint Chairman for the Port Trust and the Settlement was created in 1911, the first incumbent being an engineer of the Bombay Public Works Department—the late Mr. T. Barclay Robertson, who was succeeded in 1912 by Mr. J. B. S. Thubron of the same department.

It may be of interest to note that in India, until recently, the Chairmen of the Port Trusts at Aden, Bombay, Madras and Rangoon, were all engineers, though at Bombay the office has been taken by the Indian Civil Service. Indian Port Trusts are in general "Excluded Local Funds," having no financial or administrative connection with each other. The Author ventures to suggest that the creation of a separate Port Trust Service for
India would be of great benefit, favouring co-operation as to depths and accommodation to be provided. Establishments would be trained, and similar matters carried out in a systematic way. This would be a first step in co-ordinating the steamer routes in the East, on which the Author believes Aden will remain a highly important junction.

The Paper is accompanied by seven drawings from which Plate 9 has been prepared.

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**APPENDIX.**

Summary of Expenditure on Harbour Improvements and Wharfage Works from the commencement, i.e., from 1st April, 1889, up to 31st March, 1916:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredging</td>
<td>Rs. 35,10,571</td>
</tr>
<tr>
<td>Lighthouses, moorings, buoys</td>
<td>Rs. 1,52,652</td>
</tr>
<tr>
<td>Offices, workshops and quarters</td>
<td>Rs. 2,50,112</td>
</tr>
<tr>
<td>Wharves and piers</td>
<td>Rs. 10,77,926</td>
</tr>
<tr>
<td>Tugs, launches and barges</td>
<td>Rs. 2,87,080</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Rs. 52,87,080</strong></td>
</tr>
</tbody>
</table>