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“Development of the Port of Swansea and Dredging a Deep Entrance Channel to Swansea Harbour.”

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THE history and condition of the Port of Swansea, up to the end of 1861, has been already fully described by Mr. James Abernethy, Past-President Inst. C.E., in his Paper on the “Ports of Swansea, Blyth, and Silloth,”¹ in 1862. At that period the South Dock had been recently opened on the right bank of the River Tarve, in front of the town; but since then the port has been largely developed by the construction of the Prince of Wales’ Dock on the opposite bank of the river, opened for traffic in 1882, and the deepening of the approach channel. Swansea is the seat of the copper industry, and four-fifths of the metal trade of the country is manipulated there. Of the three principal mineral importing ports, Swansea stands first, with 417,834 tons in 1884; the mineral imports of Liverpool having only reached 213,626 tons, and of London 152,095 tons in the same year. There are also five hundred and sixty coal-pits within a radius of 40 miles. The development of the trade of Swansea since 1862 has been considerable, especially subsequent to about 1878; for the exports and imports, which amounted to 1,283,700 tons in 1862, reached 1,502,040 tons in 1878, and rose to 2,484,704 tons in 1885. The gross receipts, which were £38,892 in 1863, reached £58,356 in 1879, and attained £100,494 in 1885; whilst the ordinary expenditure was £15,097 in 1863, £23,199 in 1879, and £40,926 in 1885. At Swansea, as at other ports, the number and size of the steamers have notably augmented; the net tonnage having risen from 104,025 tons in 1865, to 305,780 tons in 1878, and 845,684 tons in 1885. The increase in the average size of the vessels leaving the port, and the decrease in the payment per ton, are given in the following Table :—

¹ Minutes of Proceedings Inst. C.E., vol. xxi. p. 309. A few additional details are given in the present Paper.

	Registered Tons.		Average Payment per Ton.	
	1877.	1885.	1877.	1885.
	Tons.	Tons.	d.	d.
Coasting trade	89·75	111·97	4·59	4·06
Trade with Europe.	201·05	362·65	7·22	6·22
Trade beyond Europe	385·56	704·31	13·64	9·15

An Act was obtained in 1874 for the construction of the Prince of Wales' Dock, designed by Mr. Abernethy; and the works were commenced in 1879, under a contract with the late Mr. T. A. Walker. They comprised a dock of 23 acres, 2,300 feet long and 500 feet broad, with a minimum depth of water of 26 feet; a lock 500 feet long, with an intermediate pair of gates, 60 feet wide and having a depth of 32 feet of water over its sills at high water of ordinary spring tides and $24\frac{1}{2}$ feet at neap tides; a tidal basin of $6\frac{1}{4}$ acres, 8 feet deeper than the lock sills, protected at its approach by an extension of the west pier, and by an east pier 1,210 feet long; and an embankment, sidings, hydraulic machinery, and electric lighting. The works generally are similar to those of the South Dock, described by Mr. Abernethy, and they cost £545,313, details of which are given in Appendix I. The piers are formed of timber encasing a hearting of rubble stone laid in courses; and the west pier, which is the most exposed, has piles 48 feet in length, and cost £30 per lineal foot. The coal-tips at the Prince of Wales' Dock, erected by Sir W. G. Armstrong and Co., are of the most improved type, and have occasionally loaded vessels at the rate of a truck of 10 tons per minute. The greatest shipments of coal in six consecutive days, at the three Great Western staithes, amounted to 11,630 tons 6 cwt. in 1885, and 11,886 tons 7 cwt. in 1886.

In constructing the docks of the Port of Swansea, the outer sills of their entrances have always been placed lower than the entrance channel to the port, in order that, as soon as the channel could be adequately deepened, they might be capable of admitting the trading vessels of largest draught at the periods when they were respectively constructed. Accordingly, the sills of the Prince of Wales' Dock lock, completed in 1881, were placed 6 feet lower than the bed of the entrance channel, and of Swansea Bay for $1\frac{1}{4}$ mile out to sea, which was then level with the deepest sill of the previous entrances. In order to render this depth on the lock sill

available for vessels, the approach channel required to be dredged for about 7,000 feet into the bay, to a depth of 14 feet, with a width of 200 feet at the top, and 150 feet at the bottom; and the material brought up had to be conveyed to a distance of 7 miles.

The dredging-plant of this port in 1881 consisted of an old single-ladder stationary dredger, a Priestman grab, and a self-propelling single-ladder hopper-dredger, which was quite inadequate to execute the extensive deepening works proposed. The hopper of the latter dredger was eventually removed, as the trips to sea of this dredger occupied too much of the available time. The formation of an entrance channel through the shoals in the estuary was commenced in 1881, with a dredger and five hoppers hired from the Tyne Commissioners, at the rate of £100 a week for the dredger and £9 a week for each hopper, the Swansea Harbour Trustees having to insure the whole plant, and the dredger not being allowed to ground. The voyage from the Tyne to Swansea, of 800 miles, was accomplished in seven days, the hoppers being each covered with a platform; and on the return journey, the well of the dredger was also closed at the top and bottom with planks. Work was commenced in Swansea Bay in May, 1881, twelve days after its arrival. Towards the end of July, it was removed to the old entrance channel; and left off dredging in October, one hundred and forty-nine days from its commencement, on the expiry of the six months of hire, during which period ten days were lost by the weather being too rough for the barges to remain alongside. The amount of material lifted and removed by this plant was 336,768 tons, at a total average cost of $10\frac{1}{2}d.$ per ton (see Appendix II). About 1,200 feet of channel had been cut in the bay when the work had to be stopped; and the trustees were only able to set to work again, with a dredger built expressly for them, in May, 1882, which completed the channel in May, 1885.

Details of the Swansea dredger No. 1 are given in Appendix III. It has double ladders, and dredges its own channel in advance; but in other respects resembles the largest of those used on the Tyne. Though in theory it could raise 944 tons an hour, the average performance in actual work was only 322 tons per hour. The greatest quantity raised by it in one day was 6,005 tons, and in a week 28,348 tons. The cost per ton lifted was from $3\cdot525d.$ to $3\cdot394d.$, exclusive of interest on capital and depreciation, which would be about as much again (see Appendix IV). This is half the cost of dredging with a single-ladder hopper-dredger, and about $1\frac{1}{2}d.$ less than the dredging in the Tyne, which averages $4\cdot94d.$ per ton. The consumption of fuel averaged 45 tons per week, and

22·23 lbs. per ton lifted. The material removed consisted of a mixture of mud, clay, and gravel, interspersed with boulders. The sides of the channel stand up like a wall in most places, though the material dredged varied in hardness, sometimes tearing off the backs of the buckets, whilst sometimes a sort of sandy silt ground away the working parts of the dredger. No rock was excavated, but buffalo horns and submerged oaks were often brought up; and, on one occasion, part of a vessel was lifted from a depth of 8 feet below the river-bed. Force pumps were provided for raising water to facilitate the passage of the dredged material down the shoots. The buckets were made of iron, with steel lips, semicircular in form, to avoid sticking in the ground, and with numerous holes for draining off the water carried up with them. Saddle-back hoppers were used for the conveyance away of the dredged material, having eight compartments carrying 40 tons apiece, or altogether 320 tons, fitted with side doors, so that on depositing the material on the beach, the hoppers rise and float off at once. The total amount of material lifted by the Swansea dredger and the other dredgers employed, between 1877 and 1885, is given in Appendix V.

The new channel formed by dredging affords a depth of $24\frac{1}{2}$ feet at high water of the lowest neap tides, up to the docks, and an additional depth of 8 feet alongside the piers; so that ocean-going steamers can leave the port at fixed times, morning and evening, throughout the year. Moreover, the new channel maintains itself; and the increased scour which has resulted from its formation has deepened the river-bed about 4 feet; and the flood tide comes up an hour earlier than formerly. In 1875, vessels drawing 23 feet of water could only reach the port at extraordinary spring tides; whereas now vessels drawing $25\frac{1}{2}$ feet, can come in at ordinary high water. The depth in the entrance channel is at present 42 feet at springs, and 35 feet at neaps. The volume of water inside the piers at high water, which amounted to 23 million cubic feet at springs, and 16 million cubic feet at neaps in 1866, attained 35 million, and 27 million cubic feet, respectively, in 1886. As a result of the deepening of the entrance channel, the shipping trade of the port increased 59·82 per cent. between 1880 and 1886, as compared with a general increase in British ports of 26 per cent. during this period. Moreover, whereas in 1880, no vessels went direct from the port to America, and only seven in 1881—as many as fifty-two went to America in 1886.

APPENDIXES.

APPENDIX I.—COST OF PRINCE OF WALES' DOCK, AND OTHER WORKS UNDERTAKEN IN 1879.

	£
Dock, lock, basin, entrance channel and embankment	247,958
Engineering and expenses of Act	22,129
Land and compensation	59,365
Railways	51,249
Transit sheds	6,665
West pier extension	29,443
East pier	34,769
Hydraulic machinery, cranes, &c.	38,048
Electric light	1,731
Canal, lock and basin	7,690
Fresh water for shipping and boilers, culverts, roads, and water-pipes }	6,283
Dredging new entrance channel	61,159
Commission on loans	3,860
Interest during construction	39,974
Printing, advertising, debenture stamping, and sundry disbursements }	5,039
Total cost of dock, piers, and new entrance channel	615,371

APPENDIX II.—TOTAL COST OF WORK DONE BY THE SELF-PROPELLING TYNE DREDGER, No. 5, VALUED AT £25,000, BUILT IN 1864, AND FIVE HOPPERS, VALUED AT £1,500 EACH, INCLUDING A GRATUITY TO THE CAPTAIN OF A HUNDRED GUINEAS.

							Percentage of Cost per Ton lifted.
	£	s.	d.	£	s.	d.	
Cost of bringing dredger and barges round to Swansea, and taking back to Newcastle-on-Tyne, viz., 800 miles each way; towage, £800 and £1,200 .)	2,000	0	0				
Insurance, £886 16s. 9d. and £667 4s. 1d.; 60 per cent.)	1,554	0	10				
Wages, victualling boat, ropes, flooring, wells, &c.)	1,664	2	3				
				5,218	3	1	3·71
Cost of dredger and barges while working, viz. :—							
Working expenses, weekly wages of crew; coal, 605 tons (or say, 29 tons a week), stores, &c.)	2,700	1	1				1·93
Rent of dredger and barges	4,487	0	0				3·20
Towing barges and attending upon dredger	1,308	19	8				0·93
				8,496	0	9	
Maintenance, &c., viz. :—							
Repairs to chains, &c., for dredger . .	266	13	2				
„ „ „ barges . . .	215	19	2				
				482	12	4	0·35
Paid River Tyne Improvement Commis- sioners' claim for balance of standard cost of repairs over three years, aver- aging £4,000 per annum.)				469	0	0	0·33
				14,665	16	2	10·45

APPENDIX IV.—COST OF WORKING SWANSEA DREDGER NO. 1 DURING 1885.

	£	s.	d.	£	s.	d.
Wages				2,645	18	6
Towage				2,617	0	11
Fuel				895	18	8
Stores				161	14	9
Maintenance as per Stores Journal	320	9	8			
Bills	1,251	3	0			
Smiths and Fitters	380	12	9			
Pattern Makers	27	14	1			
Carpenters	58	13	10			
Joiners	7	1	3			
Masons	0	10	7			
Painter and Diver	0	18	1			
Labourers	67	12	9			
Haulage	19	17	6			
Timber, as per Carpenter's account	23	17	11			
				2,158	11	5
Hoppers	611	11	11	611	11	11
				9,090	16	2

APPENDIX V.—MATERIAL DREDGED EACH YEAR, AND ALSO BY EACH DREDGER AT SWANSEA.

Year.	<i>Material Dredged Annually.</i>	Tons.
1877		130,734
1878		96,052
1879		106,947
1880		107,689
1881		516,891
1882		309,672
1883		279,099
1884		709,103
1885		1,065,054
		3,411,241

	<i>Material raised by each Dredger.</i>	Tons.
Old dredger		578,845
Abertawe (Simons Builder)		1,042,048
Grab		70,492
"Number One"		1,151,470
Tyne dredger No. 5		336,768
Public Works Commissioners' "Briton"		192,903
Great Western Railway dredger.		41,715
		3,411,241