

spring of 1839. The result has justified the most favourable anticipations, for there have been no serious difficulties to contend with, and all parts of the work stand well.

The tide work, in founding the outer wall, was at first found to be very tedious, and expensive, owing to the great leakage, as the foundation was considerably below low water, until Mr. Smith, of Montrose, the contractor, had a steam-engine erected to work the chain-pumps. This was done by common ropes passing over sheaves, and so conveying the motion in a very simple manner, sometimes above 600 feet from the engine-house to the coffer-dams; the work then proceeded rapidly.

The coffer-dams were wooden boxes, about 25 feet long by 15 feet broad, sunk as far as they could be got down, and afterwards piled inside, with thin sheeting piles, to keep the sand from running in below.

The gates were contracted for, and made by Mr. Stirling, of the Dundee foundry (Dundee).

The dock was commenced in June 1839; the gates were completed, and the water was admitted in July, 1843. The whole expense of the dock and the gates, but exclusive of the Act of Parliament and the purchase of property, was about £40,000.

The dock enters from the river South Esk, which forms the harbour, and is kept open to the depth of 7 feet at low water, and 22 feet at high water, of ordinary spring tides, by a strong scour into and out of the basin of Montrose, an estuary of nearly four square miles in extent, immediately behind the town. The dock has a depth of 20 feet at high water of spring tides, and 16 feet at neap tides, and the entrance being as before stated, 55 feet in width, it can always receive at high water the largest steamers navigating the east coast of England and Scotland.

The paper is accompanied by three drawings and an engraved plan, (Nos. 3624 to 3627,) giving a general plan and sections of the entrance, and of the river and dock walls, with the line of the coffer-dam, of which the inner row of piles was cut off, while those of the outer row were drawn. A general plan and elevation of the gates, details of all parts of the iron-work and the construction, and a plan of the harbour and basin of Montrose.

The President observed, that the introduction of cast-iron for lock gates, was, in a great degree, owing to the difficulty of procuring timber fit for large gates. He had recently experienced this difficulty, for the gates of the new graving dock at H. M. Dockyard, Woolwich, and was ultimately obliged to use cast-iron. The clear opening was 65 feet, and the weight of each gate was about 70 tons; this weight was in some degree compensated, by planking them on both

The President.

sides, so as to be water-tight and render them buoyant; they were also so well made and hung, that before the water was admitted into the basin, two men could open or close either gate, by merely pushing steadily against it. They were constructed and fixed by Messrs. Hunter and English (Bow.)

Mr. Vignoles.

Mr. Vignoles remarked, that at Liverpool, there was generally such an assortment of foreign timber, of large dimensions, that he was surprised, at any difficulty existing in procuring timber for the Woolwich gates.

The President.

The President was aware of what Mr. Vignoles had mentioned, but in general, foreign timber was not approved for very heavy works; the large dock-gates at Liverpool, were all made of English oak, which Mr. Hartley had taken infinite pains to procure.

Mr. J. Oldham.

Mr. Oldham said, that Mr. Leather (Leeds,) had built similar gates, of cast and wrought-iron, at the Goole Docks, and had made the heel-posts sufficiently large, to enable a man to descend within them, in order to examine the state of the interior of the sheathing. He considered this of importance, particularly with wrought-iron sheathing.

Mr. J. Samuda.

Mr. Samuda suggested the employment of wrought-iron instead of cast-iron, for the framing of lock gates, in order to reduce their weight. He thought, that by a judicious combination of angle-iron, and boiler plates, very strong, and yet light, gates might be produced.

The President.

The President said, that when he was considering the question of the gates for the Caledonian Canal, he examined the relative prices and qualities of timber, cast-iron, and wrought-iron, and he found, that sufficient advantages were not offered by the latter, to induce him to try it. He had before mentioned, how easily large gates of cast-iron could be moved, when they were well constructed, and he was of opinion, that cast-iron being stiffer than wrought-iron, bars of gates constructed of the former material, would better bear heavy blows without being strained: this quality was of great importance in lock-gates, where leakage was fatal, and it would be produced whenever any distortion in the form occurred.

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May 14, 1844.

WILLIAM CUBITT, V.P., in the Chair.

No. 681. "The Atmospheric Railway." By Jacob Samuda, Assoc. Inst. C. E.

The Atmospheric Railway.

So much has already been printed, in various publications, descriptive of the Atmospheric Railway, that a minute detail of its operations would, the author feels, be superfluous. He therefore first