

for working the crab and the air-pump ; and it was moved along the transverse balks by means of bevel gear connected with its wheels. A similar travelling frame, and having a carriage with a crab winch upon it, was also placed upon the longitudinal framing, for lowering the stones into the sea, which was done in the following manner. The stone, after being cut to the proper dimensions, was fitted with a common "Lewis," and as soon as it was lowered to the bottom of the sea, the hook of the crab chain was detached from the Lewis, by the use of what was termed a "tripping line," which, being pulled, drew the hook out of the ring. The frame was then removed to procure and lower another stone. The bell frame was then brought over the place, where the stone had been sunk, and being lowered, the men in it having found the stone, hooked it on to a chain slung from the interior of the bell, and by this means the stone was carried to its destination. It was then set; its bed being previously levelled by turning up the ground with crowbars and picks, when necessary, and this being done, the bell was removed to fetch another stone. The adoption of these two frames was a great saving both of time and expense to the contractor. The air-pump was constantly worked by three men whilst the bell was under water; but when it was ascending, and had arrived within 15 feet of the water's surface, the pump was generally stopped. In addition to the three men who worked the air-pump, there were two men at the handles of the crab winch, two at the driving wheels of the travelling frame, one signal man, and two in the bell, which were all that could conveniently work in it; but five persons have descended in the bell, and have remained down for a considerable time, when it was high water. The signals were made in the usual manner, by striking the inside of the bell with a hammer. The bell was of cast iron, and weighed about 7 tons; the weight of water displaced by it was about 5 tons, which left a strain of 2 tons upon the frame which carried it. The works of the pier were commenced in 1841, and were completed in the latter part of 1843.

The paper is illustrated by two drawings, Nos. 3739 and 3740, showing the diving-bell, carriage frames, crab winches, and machinery, with all the details of their construction.

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Lieut.-Colonel H. D. JONES corroborated the accuracy of the account of the machinery used in working the diving-bell, which was chiefly employed in placing the stones for the foundations. The peculiarity consisted, in the stones being laid at an angle of about 60°, as had been practised in several instances by Mr. Telford: this

foundation was so brought up to the low-water line, and upon it the vertical pier wall of well-bonded horizontal courses was constructed. It was exposed to a heavy sea, but hitherto it had stood extremely well.

SIR JOHN RENNIE, President, said, that the late Mr. Rennie had used the diving-bell extensively, when worked from platforms travelling upon frames, at Ramsgate, at Howth, and other similar works. Smeaton had used the stones set on their edges at a considerable angle, in the foundations of the sea walls at Portpatrick. It admitted of doubt, whether it was preferable, as a mode of construction, to setting the stones upon their beds horizontally.

MR. WALKER believed, that the mode of laying the stones at an angle, or *en échelon*, was introduced, under the impression, that they were enabled better to find their bearing, and that if any subsidence took place, during the course of construction, the stones would slide upon each other, without cracking the wall.

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March 3, 1846.

SIR JOHN RENNIE, President, in the Chair.

The following candidates were balloted for and duly elected:—

Alfred Giles, as a Member; Frederick Pollock, Wyndham Harding, Charles Knowsley Sibley, John Van Norden Bazalgette, Thomas Russell Crampton, John Gastineau, and James Allen Ransome, as Associates.

The discussions upon the Papers No. 732, "On Water for Locomotive Engines," by Mr. West; No. 723, "The Dinting Vale Viaduct," by Mr. Jee; No. 726, "The Dublin and Drogheda Railway," by Mr. Hemans; and No. 718, "The Diving Bell used on the Shannon Works," by Mr. Vanderkiste, were continued at the meeting, and precluded the reading of any original communications.

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March 10, 1847.

SIR JOHN RENNIE, President, in the Chair.

No. 733. "Account of the Drops used for the shipment of Coals at Middlesbro' on Tees, with a short description of the Town and Port of Middlesbro'." By George Turnbull, M. Inst. C. E.

The town of Middlesbro' has risen so rapidly into commercial importance, and the circumstances attending its progress are probably so little known, that a short account of its origin and advancement