of class A, and nine and three-eighths tons for bridges of classes B and C. For pins belonging wholly to the lateral systems in bridges of either class, the intensity of working bending stress may be taken equal to eleven and a quarter tons.

Where steel pins are employed the intensity of working bending stress must not be taken greater than twelve tons for bridges of class A, or fifteen tons for bridges of classes B and C, unless special experiments on the steel used show a greater ultimate resistance than sixty tons per square inch, in which case a factor of five may be used for class A and a factor of four for classes B and C.

Sizes of Upper Lateral Rods.—In many cases the stresses in the upper lateral systems in through bridges or the lower lateral system in deck bridges call for sections of rods which would be practically too small; the limits for the diameters of the end rods in such cases are to be taken from the following table:

Diameter of end rod.	Length of Span.	
	from	to
$\frac{3}{4}$ in.		60 in.
$\frac{7}{8}$ "	60 in.	80 "
1 "	80 "	100 "
$1\frac{1}{8}$ "	100 "	140 "
$1\frac{1}{4}$ "	140 "	170 "
$1\frac{3}{8}$ "	170 "	200 "

Hip Verticals.—Hip verticals in bridges of classes A and B are to be proportioned for a live load of one hundred pounds per square foot, and those of class C for a live load of eighty pounds per square foot, irrespective of the length of span.

Stiffened Hip Verticals in Pony Tresses, Trussing.—Hip verticals in pony tresses are to be stiffened so as to resist compression. In these members and in the posts of small pony truss bridges, where there is an excess of strength, trussing may be used, but in no other case.

Upset Rods.—Middle panel diagonals, counters, lateral rods, vibration rods, and all other adjustable rods are to have their ends enlarged for the screw-threads according to the table given on pages 126 and 127 of "Carnegir's Pocket Companion."

Minimum Dimensions of Chord and Batter Brace Plates.—The minimum dimensions for the top plate in top chords or batter braces are to be taken from the following table. Should the width employed exceed that given in the table by from forty to sixty per cent, the thickness must be increased by onesixteenth of an inch; if it exceed from sixty to eighty per cent., the thickness must be increased by one-eighth of an inch.

Depth of Chan.	Min. Thickness.	Min. Width.
5 in.	$\frac{1}{4}$	7 in.
6 "	$\frac{1}{4}$	8 "
7 "	$\frac{1}{4}$	9 "
8 "	$\frac{1}{4}$	10 "
9 "	[illegible]	$11\frac{1}{2}$ "
10 "	$\frac{5}{16}$	$12\frac{1}{2}$ "
12 "	$\frac{3}{8}$	15 "

(*To be continued.*)

ON THE SINKING OF TWO SHAFTS AT MARSDEN, FOR THE WHITBURN COAL COMPANY.*

BY JOHN DAGLISH, M. INST. C.E.

It has long been known that the North of England coal field extends under the sea on the coasts of *Northumberland and* Durham; but although the coal has been worked up to the coast line at several points many years ago, no operations had been carried on under the sea on the east coast of England until within the last few years.

Recently, however, leases of the under-sea coal have been negotiated by various large mining companies from the Crown, along nearly the whole coast line from Newbiggen on the north, to Castle Eden on the South (Page 228, Fig. 1). And at several places (Seaham and Ryhope to the South, and Monkwearmouth to the north of Sunderland, and North Seaton to the North of Blyth) where the existing pits were comparatively near the coast, the workings have now been extended to a considerable distance under the sea. At other points, however, the coal-field under the sea cannot be reached by any existing pits, and and special pits will be necessary for working these portions.

An important Geological feature of this district is the outcrop of the Permian rocks about midway on the coast line of this coal field, at the mouth of the River Tyne; the Coal-Measures, which appear on the surface between the River Coquet, at the northern extremity of the coal-fields, and this point, here dip under, and are overlaid by the Magnesian Limestone as far as the southern extremity of the field at Castle Eden, near which point the coal-field is again overlaid by the red marl of the Trias formation. The dip of the magnesian beds being southerly, they gradually increase in this direction, from a thickness of a few feet under the Priory at Tynemouth to upwards of 600 feet at Castle Eden (Page 228-9, Figs. 1, 2, and 3). Underlying the Magnesian Limestone and stratified conformably with it, and unconformably with the Coal-Measures, is a bed of sand varying in thickness from a few inches to 100 feet; and in quality from hard rock to almost incoherent sand. This bed is well developed under the Priory rock at Tynemouth (Fig. 2), and in the railway cutting at Ferryhill. Where this bed is of of great thickness and of incoherent character, it has been the cause of a large expenditure of capital and time, at many of the colliery sinkings in the south east part of the Durham coal-field, and notably at the Murton Colliery.[1]

A considerable area of submarine coal, extending for a distance about three miles along the coast, intermediate between the town of South Shields and Sunderland, was acquired by the Whitburn Coal Company in 1873, together with a portion of the land coal adjoining. To win this area it was decided to sink two or more shafts near Marsden, at a distance of 500 yards south of the Souter Point Lighthouse and 400 yards from the sea. As these shafts had to pass through a considerable and unknown thickness of Limestone, which always contains large quantities of water, and as the thickness and character of the underlying Yellow Sand were also unknown, it was from the outset anticipated that difficulty would be encountered in sinking them to the Coal-Measures, especially in passing through the Sand. A preliminary boring was made, by the ordinary process, which proved the thickness of the Limestone to be 340 feet, and fortunately the entire absence of the Yellow Sand at this point.

The same general arrangements which a few years before had been successfully carried out by the Author at a similar sinking at the adjacent Silksworth Colliery, *the property of the Marquis* of Londonderry, were followed at Marsden. In the first instance an engine (A. Fig. 5), with two cylinders each 48 inches in diameter, capable of being employed as a pumping engine during sinking, and afterwards to be used for winding or drawing coals, was erected at No. 1 pit. This engine is a duplicate of the one erected at the Silksworth Colliery,[2] and that erected more recently at the adjoining Boldon Colliery. A second engine B, having to two cylinders, each 44 inches in diameter, hereafter to be used for driving the ventilating machine, was also arranged for pumping out of No. 1 pit, and a third and smaller engine (C), with two cylinders each 26 inches in diameter, for pumping out of No. 2 pit. This was intended to be used as a temporary coal-drawing engine, and ultimately as an underground hauling engine.

* Reprinted for the Proceedings of the Institution of Civil Engineers.

1 North of England Institute of Mining Engineers. Transactions (1856-7), vol. v., p. 43.

2 North of England Institute of Mining and Mechanical Engineers. Transactions, vol. xxv., p. 201, and vol. xxix., p. 3. Bulletin de la Société de l'Industrie Minérale. 2e série. Tome vi. 1877, 2e partie, p. 411.