

THE SHEFFIELD STEEL MANUFACTURES.

Most of our workers in iron are familiar with the name of Thomas Firth & Sons, of Sheffield, England, whose tool steel bears such a high reputation in this country. Mr. Mark Firth, the head of the firm, is this year Mayor of Sheffield, and has signalized his term of office by presenting the people with a magnificent park, paying the whole expenses (over \$500,000) from his own pocket. The park was recently opened, with great rejoicing, by the Prince and Princess of Wales, who took an opportunity of inspecting several of the most remarkable of the steel works of the very grimy and very prosperous city.

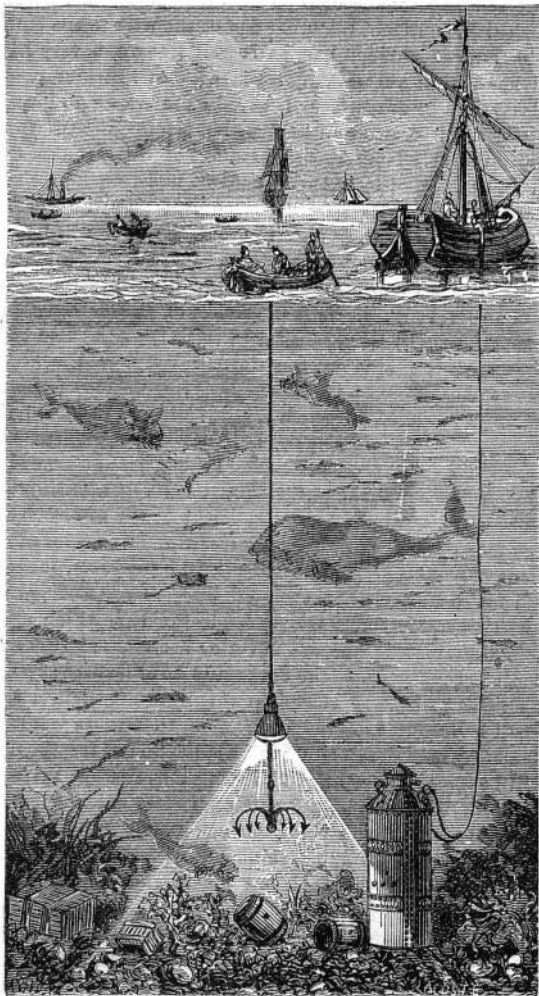
Our first engraving represents a scene in Messrs. Firth's works. An ingot for making the interior tube of an eighty tun gun is being cast, the gun, as we have already explained, consisting of a tube of fine steel surmounted by welded coils of wrought iron. The steel is melted in crucibles, which are brought to the founding pit on wheeled trucks, as shown in our engraving. By this means, ingots of nearly any weight and of the highest purity can be readily cast; and they are then forged into shape by immense steam hammers. We have frequently spoken of the large hammer, erected at Woolwich for welding the iron coils on these large cannon. This implement cost about \$250,000, and the falling portion weighs 40 tons, its force being increased by the use of steam to give it additional velocity. Messrs. Firth have recently erected a similar hammer in their works at Sheffield. But the greatest of all is being built at Krupp's works at Essen, where \$1,000,000 is being expended in building the largest hammer yet conceived, even in this age of Cyclopean wonders.

It is found that tubes for ordnance must be of pure steel, but softness of the metal is a requisite, a hard metal being too brittle to sustain the concussion of the large charges of powder used in these guns. The milder steel is tenacious, and has been proved to be almost indestructible by wear.

The Bessemer steel process is very largely carried on in Sheffield, the works of Sir John Brown & Co., Vickers & Co., and many others being largely in this manufacture. The second engraving on the opposite page represents the emptying of a Bessemer converter of its charge, after the metal has been brought to the required condition by the injection of the air blast. The proportion of carbon present in the metal is ascertained by the spectroscope, the moment for stopping the blast being ascertained by the use of that instrument with marvelous nicety.

DIVING BELL AND GRAPNEL.

We have already described M. Toselli's grapnel for raising heavy and valuable articles from the bed of the sea; and we now publish an engraving showing some recent improvements and new uses for this very ingenious apparatus. A diving bell, constructed of iron and bronze and weighing 3½ tons, is used; it is about 4 feet in diameter and 14 feet in height. The diver enters at the top, the lid on the dome being raised for the purpose, and the upper part is wholly out of the water when the bell floats, which gives an easy entrance to and exit from the apparatus, the bell not needing to be suspended by a crane. When the diver has entered the



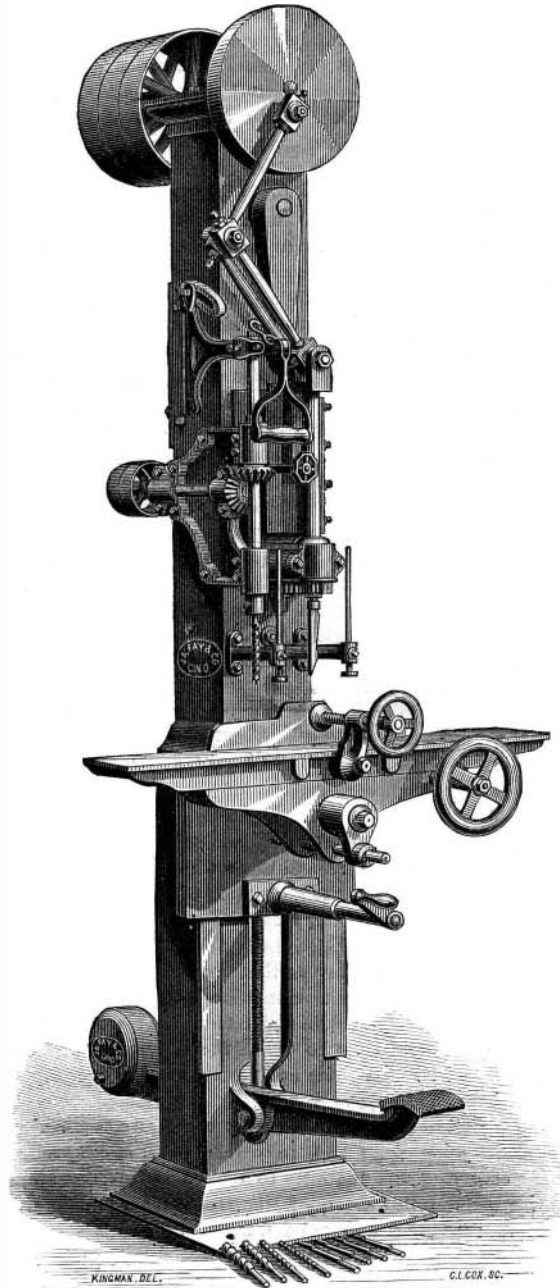
bell and closed the lid, he descends by allowing the water to enter the lower part of the cylinder, and he can come to the surface by ejecting the water by means of a pump placed inside the bell. Thus no rope or tackle is used, and the only necessary connection between the bell and the attendant boat is a telegraphic wire, shown in our engraving

At a distance of 5 feet from the bottom of the bell are placed bullseye glasses, guaranteed to resist a pressure of 60 atmospheres, equivalent to over 300 fathoms of water. At a depth of over 55 fathoms, the darkness is such that artificial light is necessary, both for taking observations and for directing the operations of the grapnel, which is provided with a submarine lamp. The bell is made double, the space between the circular walls being a magazine for fresh air; and two men can remain all day in the bell without further supply from above. Ample arrangements are made for absorbing the products of respiration.

The whole system seems to be complete and efficient, and in employment for coral, pearl, and sponge fishing, as well as for wrecking and salvage purposes, it will probably be found very valuable

J. A. FAY & CO.'S MORTISING AND BORING MACHINE.

The operation of mortising is one which has, to a large extent, engaged the attention of producers of woodworking machinery, and the numerous difficult problems in connection therewith have been solved only by actual experiment. Of the various systems in use for mortising in wood, the verti-



cally reciprocated chisel has obtained a preference. Other systems, such as rotating tools of various designs, are in use for special purposes where the same results could not be produced, or the stuff be conveniently handled, with the reciprocating mortising machine.

The class of work for which a machine of the abovementioned nature is wanted has a governing influence upon its construction. In one case the bed may have a vertical adjustment to receive the thrust of the chisel, which has a fixed distance to travel without any variation in its terminal points; and in another the bed may be in a fixed position, and the chisel be brought down from its highest position, where it has no reciprocating motion, to the depth of the mortise and full length of the stroke. An excellent example of the latter method, or variable stroke mortiser, is given in the accompanying illustration of a mortising and boring machine for agricultural, wagon, and cabinet work, recently brought out by the well known wood tool builders, J. A. Fay & Co., of Cincinnati, Ohio, who call it their No. 3½ mortising and boring machine.

This machine has for its support a cast iron column of strong section and substantial base. The driving shaft, carrying the pulleys and crank wheel, is placed at the top of the column, and revolves in self-oiling bearings with heavily bolted caps to receive the impact produced by the chisel blow. The treadle is connected by a rod to a short crank on the back end of the shaft to which the radial arm in front is keyed. This radial arm is connected with the central joint of the intersecting rods which connect the chisel stock with the pin in the crank wheel. By depressing the treadle, the radial arm is thrown out, which draws the central joint nearly into the vertical line drawn through the center of the dri-

ving shaft, and this produces the full stroke of the chisel with all the variations from a stationary position. There is attached to the short crank on the radial arm shaft a frictional slide, which receives the force of the stroke of the chisel, thus entirely relieving the foot of the operator from its effects.

The attached boring apparatus is set to the center line of the chisel, and will bore to the full depth of the mortise. It is driven from a pulley on the shaft at the top of the column, and has tight and loose pulleys so that it can be stopped while the chisel is operating. The bed is of a compound character; the timber can be moved upon it the length of the mortise, or the bed can be moved with the timber clamped to it, by means of a rack and pinion and hand wheel in front. There are stops for holding down the stuff, and necessary arrangements for adjusting to different sized mortises. The bed can be adjusted to any desired angle and mortises with the same facility as to a right angle.

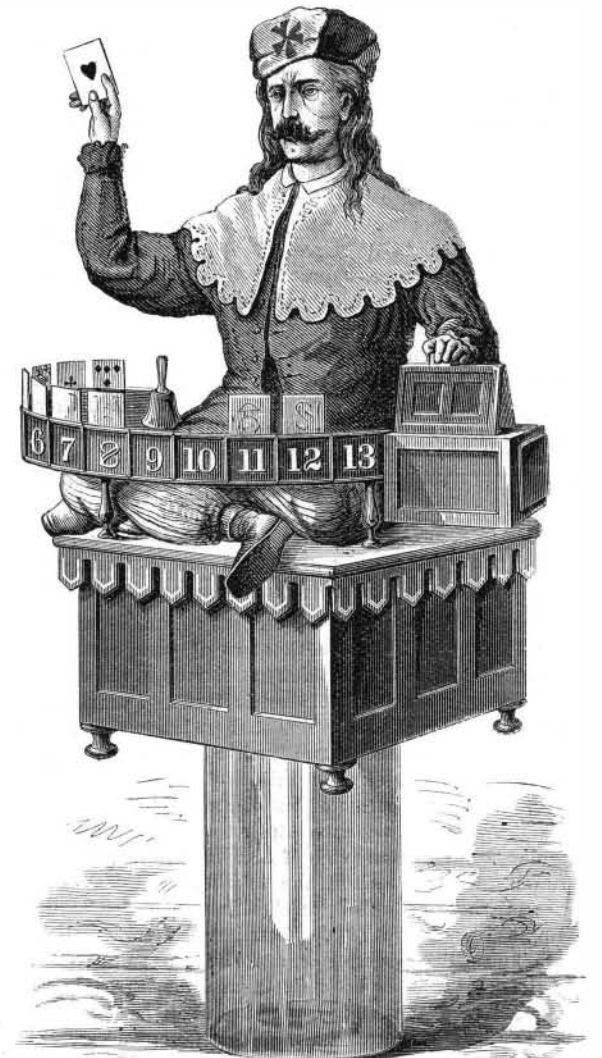
An important feature in this machine is the positive automatic reverser for the chisel, which is operated simultaneously with the raising of the chisel from the mortise. This being done at the end of the mortise, the chisel is thereby placed in position for finishing.

Further particulars can be obtained by addressing the manufacturers, J. A. Fay & Co., Cincinnati, Ohio.

THE PSYCHO MYSTERY.

We make the following extract from a letter to a gentleman in Boston, from Mr. J. A. Clarke, one of the inventors of the curious automaton Psycho, which of late has attracted much attention in London. Some time ago we mentioned this subject and noted the apparent discovery of the trick by an American gentleman, who suggested that the figure was worked by an air blast through the hollow glass pedestal. This suspicion was confirmed by one of the exhibitors declining to close the aperture previous to the operation of the automaton. It now appears that this test is freely permitted, so that the mystery of how the figure works remains as great as ever. We leave the (of course *ex parte*) statement of Mr. Clarke to the consideration of our readers without further comment, only reserving to ourselves the opinion that a solution to the puzzle certainly exists, and that that solution will be forthcoming should Messrs. Maskelyne and Cooke see fit to submit their trick, on this side of the Atlantic, to the crucial test of proverbial Yankee 'cuteness.

"Several years ago," says the writer, in substance, "it occurred to me that there was a good opening for a conjuring invention which should be really original and should baffle the profession as well as the public. After very many designs, I finally adopted the principle now embodied in Psycho, and I believe it is a completely new application. I made a rough model of the mode of working, and by accident was brought into communication with Mr. J. Neville Maskelyne. Mr. Maskelyne, possessing extraordinary ability in designing and constructing mechanical subtleties, has marvelously worked out my ideas; and Psycho is so much the fruit of mutual contrivance that all the parts may be said to be the



joint invention of us both. We designed an isolated figure, perfectly removed from any possible connection with anything or anybody outside, with no communication (mechanical, electrical, magnetic, pneumatic, hydraulic, or otherwise) conceivable from the stage, back, sides, roof, or elsewhere,