it receives the weight of the pump. A cotter, which keeps the clack in its place, is then knocked out, and the table screwed down. The bottom clack and the frame descending with it, the contents of the pump are washed out by the rush of water contained in the pump-cylinder. The table is again raised by the screw, and the clack resumes its proper position; the cotter is then driven into the slot, and the pump is again ready to be lowered into the hole as before. It is generally necessary for the pump to descend three times in order to remove all the *débris* broken up by the boring-head at one operation.

The following facts obtained from the use of the machine in boring in the new red sandstone at Manchester will show its actual performance, and enable us to compare it with the other systems mentioned in this paper. The boring-head is lowered at the rate of 500 feet a minute; the percussive motion is performed at the rate of 24 blows a minute, and being continued for 10 minutes, the cutters in that time penetrate from 5 to 6 inches; it is then wound up at 300 feet a minute. The shell-pump is then lowered at the rate of 500 feet a minute, the pumping continued for one minute and a half, and being charged, the pump is wound up at 300 feet a minute. It is then emptied, and the operation repeated, which can be accomplished three times in 10 minutes, at a depth of 200 feet. The whole of one operation, resulting in the deepening of the hole 5 to 6 inches, and cleaning it of *débris* ready for the cutters or boring-head being again introduced, is seen to occupy an interval of 20 minutes only. The value of these facts will be best shown by comparing them with the results by the old method.

At Highgate the boring has occupied two years in attaining a depth of 680 feet from the bottom of a well 500 feet deep from the surface. Their progress at present is at the rate of 6 inches per week, working night and day. At Warwick, 13 months were occupied in boring 400 feet through red marl; at Saltaire, two years in going 80 yards.

One well-known defect of the old method of boring consists in the "buckling" and dangling of the rods, which has the effect of enlarging the hole in some instance to a diameter of four feet where soft strata intervene. This arises from the buckling and dangling of the rods causing them to strike against the sides of the hole, and breaking off portions of earth which fall to the bottom, thus considerably increasing the quantity of *débris* to be brought up by the shell, and occupying an immense time in getting out the *débris* which has merely fallen from the side, without increasing the depth of the hole. This is a serious defect where geological purposes are to be served by the boring, because the earth from the side falling to the bottom of the hole mixes with that which is cut up by the chisel, and thus prevents an accurate knowledge being obtained of the strata which the boring has penetrated. It must be remarked also that the defect of buckling is to crystallise the iron, deteriorating its quality, and thereby causing those frequent breakages which retard progress, and add so materially to the expense of this system of boring. The process of crystallisation being beyond the observation of the workmen, the result is scarcely, if ever, known till the breaking of the rods reveals it. To remedy this difficulty, and obviate the effects of buckling, it has been found necessary to put down iron tubes into the bore-hole. As the first length of these tubes can scarcely be got to a depth of more than 200 feet, on account of the great external friction, it is necessary, when the tube has to be carried to a further depth, to put down a second and a third length of tube; and as each length must come to the surface, the diameter of the bore-hole is very materially diminished. It will easily be seen that when the bore-hole is required to be of considerable depth, this diminution of its diameter will at length so contract the hole as to render the supply of water comparatively limited, and, in fact, to threaten the design with actual failure, after a vast outlay has been incurred. These inconveniences, so serious in character, are all obviated by the new method of boring. No rods are used; and as the rope which is substituted for them seldom comes in contact with the sides of the hole so as to disturb the strata, tubing will rarely be required. Indeed, it will only be necessary when the particular strata through which the hole passes happens to be very fluid; and even then it will not always be wanted. The great power of pumping and the facility of winding possessed by this new machine would enable it to exhaust any ordinary quicksand which might find its way into the hole. The pumping process could be carried on at a depth of 500 feet, at the rate of a cart-load per hour. It is possible with the improved machine to cleanse the hole so effectually that not a loose particle remains at the bottom. This will at once be seen from the fact that the pump has sufficient power to draw in masses of rock or other substances of from three to four pounds weight. This circumstance renders the machine particularly useful in geological researches, inasmuch as the lowest strata are brought up in a state of the greatest possible compactness and purity, notwithstanding any admixture of earth from the sides, or of that which the shell has been unable to bring up in the previous operation.

Notice of the Application of the Thistle to the Manufacture of Paper.

PATENTED BY LORD BERRIEDALE, LONDON, JULY 8, 1854.*

Whilst India and other tropical regions have been traversed in search of a plant to be used in place of rags in the paper manufacture, Lord Berriedale has turned his attention nearer home, and has selected the common thistle as the most suitable plant for his purpose. His invention relates to the application and use of the common thistle, or *Carduus*, as it is termed, according to the botanical classification of Linnæus, in the manufacture or production of pulpy material from which paper is to be made, as well as in the manufacture of a fibrous material for textile purposes. All the varieties of the thistle plant are applicable for the purposes of this invention, but more particularly the large Scottish thistle, which grows luxuriantly in many parts of the British Islands, attaining a great height and thickness of stem. Such thistles furnish, in each plant, a large amount of long fibre of great tenacity, and which, when duly prepared, is most excellently suited for the preparation of a powerfully cohering paper pulp, as well as for use in textile manufactures.

In adapting the thistle to the manufacture of paper pulp, the plant is used either in a green or dried state. If employed in its natural green condition, it is cut or gathered, and at once beaten or broken up by any suitable mechanism, such as is used in the primary treatment of the flax plant, so as to disintegrate the fibrous or ligneous matter. During this breaking treatment, the mucilaginous and aqueous matter present is washed clear away, either by pure water, or by an acidulous solution, or by any other economical and effective cleansing agent. When the thistle stems are thus fully reduced or distintegrated,

* From the Lond. Pract. Mechanics' Journ., March, 1855.