ON THE SYSTEM OF WORKING IRONSTONE AT LUMPSEY MINES BY HYDRAULIC DRILLS.

By A. L. STEAVENSON.

The members of the Institute have twice honoured the works at Lumpsey with a visit, first in September, 1881, when the younger members had an opportunity of seeing the process of sinking the shafts, and afterwards in July, 1886, when they were shown the process of getting the ironstone by means of a hydraulic drill, but as this drill was not described in the Transactions, it has been thought that a detailed account of it would be acceptable to the members.

The ironstone at Lumpsey was reached on the 3rd of November, 1881, after tubbing off feeders amounting to 1,700 gallons per minute; since that date the winding engines, two 42 inch cylinders with scroll drum, by Messrs. Fowler, have been erected and put to work, other surface arrangements have also been completed, and the mine has steadily but slowly progressed, slowly because trade has never allowed the amount of work to be carried on that the arrangements are equal to.

On the occasion of the previous visit the members were shown the Walker drills working by compressed air at Park pit, and drawings of this excellent drill will be found in Vol. XXXI., p. 114; so that on opening this mine the question of mechanical drilling was approached with some amount of experience, and careful estimates were made for applying the Walker system to Lumpsey. This of course necessitated the erection of compressing machinery, which, on a permanent scale suited to a large mine such as this, involved a serious expenditure, so that in September, 1883, the writer reported to Messrs. Bell Bros. that it had occurred to him to utilise the water behind the tubbing; first, because it would save all the outlay for compressing machinery, throw but small additional work on a pumping engine which was only employed three or four hours every day, and at the same time allow of the application of hydraulic power, which is much more economical than compressed air. In this mine it is particularly applicable, because, as the great bulk of the ironstone is to the rise of the pit bottom, in working to the dip, the water could be run back to the shaft through exhaust or delivery pipes, if necessary. Being aware that a very excellent turbine was made by Messrs. Gilkes & Co., of Kendal, plans and specifications were prepared by Mr. Clough, of Page Bank Colliery, and the writer, and Messrs. Gilkes were asked to tender for the whole machine, with results which have been in every way satisfactory to the present day.

A range of 6 inch pipes is connected with the tubbing at the depth of 50 fathoms, and carried to the bottom of the upcast shaft, and from there into the working face; the size of pipes being, of course, diminished when they branch off from the main, so that the final lengths are only 3 inches, and to these are connected hose pipes of special strength.

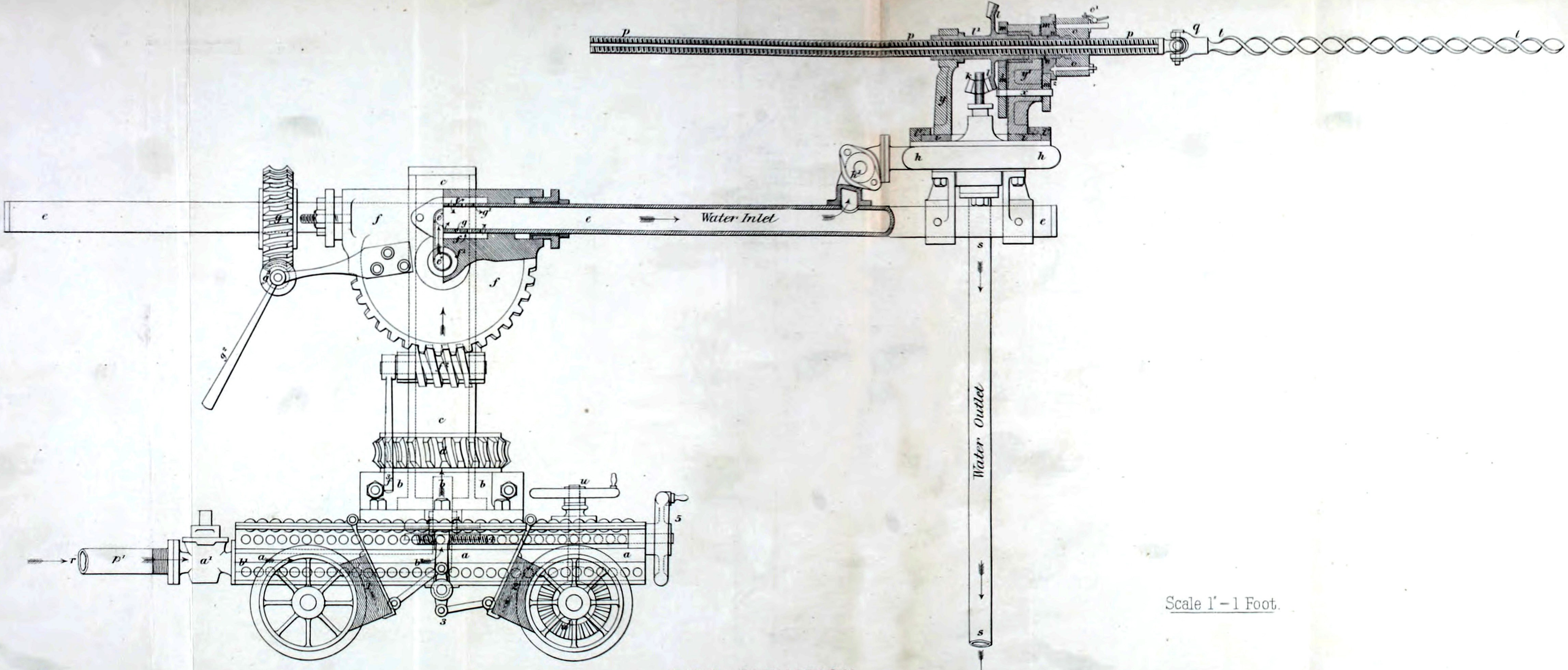
The pressure of water at the pit bottom is 215 lbs. per square inch, showing that the full head of 500 feet is made available, and this corresponds with the point in the strata 13 fathoms from the surface, where water was first met with (see strata account, Vol. XXXI., page 113).

DESCRIPTION.

Views of the machine are given in Plates IX., X., and XI., and the same letters correspond to the same parts on all, viz. :—*a a* is a wrought iron bogey, the wheels of which can be secured by brakes 1, 2, worked by a wheel and handle 5, a screw 4, and a lever 3. The water is let in to the back part of the bogey, through the flexible pipe p^1 and the shut-off cock a^1, it is then carried into the centre of the bogey through the pipe b^1, and turning upwards it is secured by a stuffing box and hydraulic leathers c^1 attached to the bottom of a cast-iron cylindrical upright *c* of considerable strength ; this upright is firmly secured to the bogey by a clamp *b b*, while at the same time it allows it to have a rotating motion round its axis, which is communicated to it by the attendant, by means of the ratchet brace *d*, the small worm d^1, and the worm wheel d^2, which latter is firmly keyed on to the upright *c* ; *f* is a cast-iron semi-circular worm wheel working on a pin f^1 made hollow, so as to allow of a connection being made by means of the small pipe e^1 provided with suitable stuffing boxes to allow of its free motion round the axle f^1. The upper portion of the semi-circular wheel is hollow and allows a wrought iron tube *e* to pass through it ; the portion of this tube which is enclosed within the semi-circular wheel has a number of small holes which allow the water coming through e^1 into the hollow portion of the semi-circular wheel to pass through into the tube.

The semi-circular worm wheel *f* is moved round its axis f^1 by means of a worm f^2 and the ratchet brace f^3.

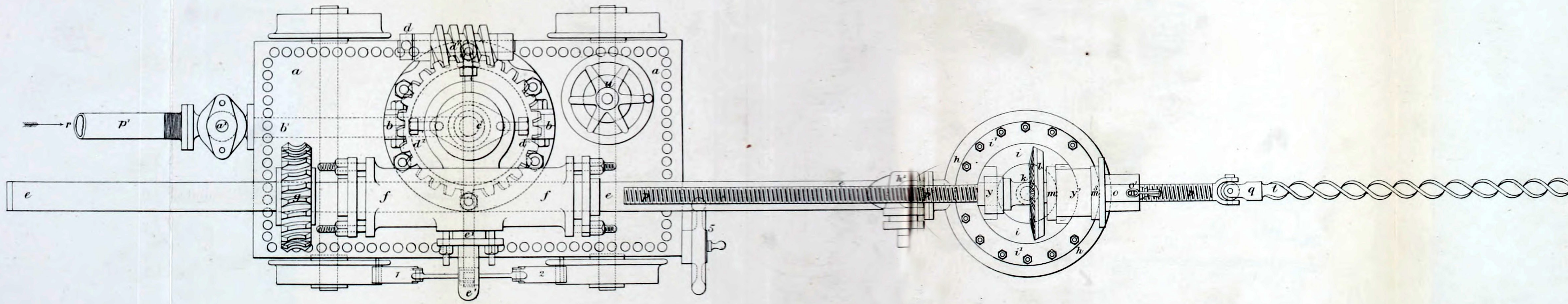
To illustrate M^r. A. L. Steavenson's paper "On the system of working Iron Stone at Lumpsey Mines by Hydraulic Drills."



Scale 1" – 1 Foot.

SIDE ELEVATION.

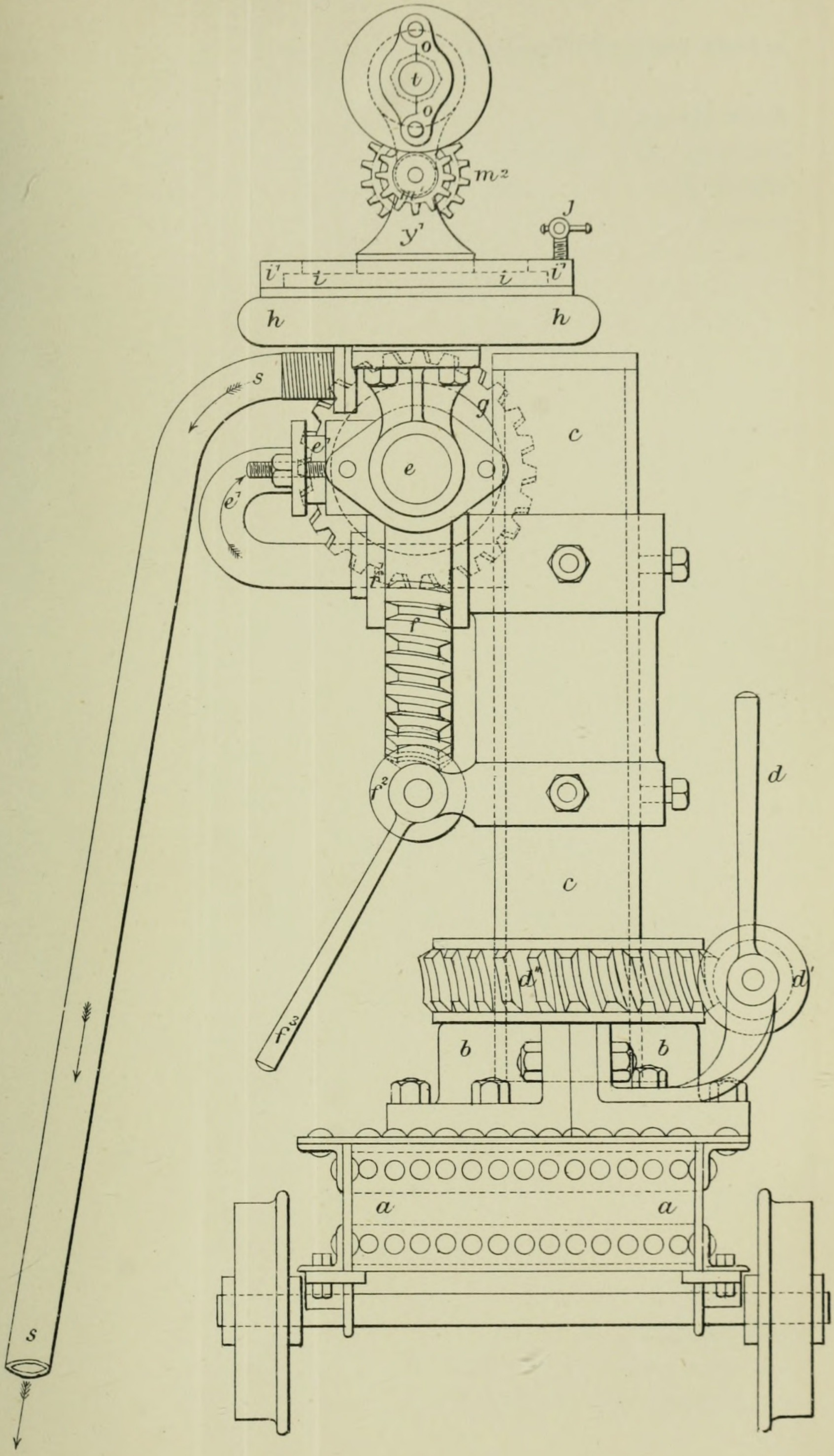
To illustrate Mr. A. L. Steavenson's paper "On the system of working Ironstone at Lumpsey Mines by Hydraulic Drills."



PLAN.

Scale 1" = 1 Foot.

To illustrate Mr. A. L. Steavenson's paper "On the system of working Iron Stone at Lumpsey Mines by Hydraulic Drills."



END ELEVATION

Scale 1" = 1 Foot.

The tube *e* can also be made to rotate by means of the worm wheel *g*, the worm g^1, and the ratchet brace g^2.

There is a stop-cock h^1 at one extremity of the pipe through which the water is admitted into the turbine *h h*, where, after it has performed its work, it is allowed to escape through the pipe *s*. The whole length of boring bar proper *p* is screwed and cut with a key way, which allows it to slide backwards and forwards on a key inserted in the socket l^1, which is cast on to the bevelled wheel *l*; this socket is not screwed but rides on the tops of the threads on the bar *p*, and rotates freely with the bar *p* in two uprights *y* y^1 attached to the top of the turbine *h h*. The upright y^1 has inserted into it a small bush *n*, made with a small groove in it at one end so formed as to keep a nut *o* in its place; this nut *o* allows the screw on *p* to work in it, and is split so that it can be opened out by a simple contrivance o^1, and allow the bar *p* to be pushed freely backwards and forwards when adjusting the drill *t* to its work, or to enable the attendant to pull it back quickly after the hole has been drilled. Motion is given to the nut *o* so that a suitable speed may be given to the drill by means of a train of small wheels m^1 to m^3; *m* is keyed on to the socket coat on the bevelled wheel *l*, and m^1 and m^2 are fixed on to a small spindle *x*, working in the upright y^1, m^3 being keyed to bush *n* and nut *o* bolted to m^3 with one fixed bolt for a hinge and the other pin o^1 for drawing out to open the nut with the hand; *q* is a universal joint connecting the drill *t* to the bar *p*. The whole of the bar *p* and its driving apparatus can be made to turn round to any position by slackening the bolt *j* which secures the ring *i* to the ring i^1, to which latter are attached the two uprights *y* y^1, and then tightening it when the requisite position is obtained; *u* is a wheel attached to a spindle passing through the bogey *a*, carrying at its lower end a small bevelled pinion geared into the bevelled wheel u^1, which allows the position of the bogey to be readily adjusted by the attendant.

From this description it will be seen that the position of the drill with reference to the part of the stone it is desired to pierce may be adjusted by four different movements.

First, round a vertical axis by the worm wheel *d*, fixed on the main upright *c*.

Secondly, round a horizontal axis by the sector *f*.

Thirdly, round the axis of the hollow arm *e* by the worm wheel *g*.

And fourthly, by the adjustment *j* on the top of the turbine *h*, which allows the drill to assume any desirable angle with the bar *e*; and it will be seen that the machine has been specially designed so as to enable one drill to be quickly set to any position either at the top or bottom of the seam by means of one attendant, who has all the handles necessary to enable him to do so within his reach without his having to move, and to fix and hold the drill rigidly when once set, by means of a system of worm wheels, instead of trusting to clamping smooth plates or surfaces as is commonly practised, which surfaces, by slipping constantly, allow the drill to get out of line and work to a great disadvantage, frequent stoppages being the result. All these objects have been most successfully accomplished.

The work it has done may be thus described: the first machine commenced on the 9th October, 1884; during the first quarter it averaged 55·4 holes per shift of eight hours, producing 125·3 tons each shift and 2·26 tons per hole, the cost for powder being 2·66d. per ton of ironstone, compared with 1·83 per ton by hand. Since that time the work done has materially improved, so that during the quarter ending 9th October, 1886, it averaged over 152 tons per shift.

On various occasions special tests have been made with the machine, but for the purposes of this paper Mr. Dixon has been kind enough to make the following observations:—"I have to-day carefully timed the No. 2 Drilling Machine and measured the water, and find it drilling at the rate of 2 feet 5 inches per minute. The water consumed is 31 gallons in 28 seconds, equal to 66·4 gallons per minute when running. The machine took 79 minutes to drill 17 holes, measuring in all 76 feet 3 inches in one bord, or nearly one foot per minute, including setting the machine and changing the drills. Supposing that 55 holes are drilled about 7,000 gallons of water are used per day, which we can pump easily in twenty minutes." This equals 5 gallons per minute, day and night.

The repairs to the machine have been practically nothing, but frequent alterations and improvements have suggested themselves during the experience gained in nine months; three hoses had cost about £9, when the members visited Lumpsey, but one was then as good as new and the two others not worn out; the total stores used during nine months amounted to a few shillings over £20.

Of the value of mechanical drilling, as compared with hand mining, there remains no longer any dispute: one skilled man and an assistant work the machine eight hours per day, and following them is a shot firer, but he cannot charge and fire the holes fast enough to keep up with the machine without assistance, and then a gang of unskilled men break and fill the stone into waggons.

The cost of drilling the holes being small, the system of blasting is entirely altered so that forty tons of loose stones are often left in a single place. The cost of powder per ton of stone is higher, but this is amply covered by the saving in labour.

The writer has been often asked about the suitability of the drill for other districts and harder stone; but the rotary drill will not face a harder stone than that of Cleveland, although by the adoption of a small crown similar to what is used for the diamond boring machines no doubt this could be got over, and by modifying the mechanical arrangements a reciprocating or jumping action could be imparted.

Another point which should not be lost sight of is that although the water pressure in this case is got from a natural supply, nothing could be more simple or cheap than a force-pump to supply water at any pressure thought desirable, which arrangement would certainly possess many advantages over any system actuated by compressed air; for the loss incidental to the heating of air when under compression and the large size of pipes requisite, as well as the large and unavoidable leakage form very formidable drawbacks (as the writer has had ample means of ascertaining) which do not accompany the use of water.

Perhaps, in these days of anxiety as to the future of powder in dusty collieries, the writer may be allowed to say that he has not yet seen any means of mechanical drilling likely to supersede hand labour either for coal or stone; the holes in coal are so few and far between, that no margin is left to cover the outlay and loss of time incidental to moving about from place to place, although whether for water-cartridges, or wedges, the size of the holes in future is likely to be much greater than in the past.

The CHAIRMAN said they would be glad to hear any remarks upon the paper.

Professor MERIVALE said, he would like to ask one or two questions, but he did not propose to make any remarks upon the paper. How did Mr. Steavenson get the water back when working to the dip? How many pounds of powder did he use to the ton of ironstone? Was it of very great importance to get large pieces of ironstone as in the case of coal? And how did Mr. Steavenson measure the water used?

Mr. STEAVENSON said, that with respect to getting the water from the dip, he would simply run the water back to the bottom of the pit in a pipe. He thought he had already stated that about 6 ozs. of powder were used to one ton of ironstone on an average in Cleveland. In Bell

Brothers' mines alone somewhere about a ton of powder was used every day when in full work. Large blocks were no benefit, but rather a drawback; for these had to be reduced to the size suitable for calcining. He had tested the mode of measuring water over a weir or notch, and with a box, and his experience certainly was that, in measuring water over a notch, a less quantity was given than was obtained by actual measurement with a cistern.

Mr. T. W. Benson asked whether this mode of working a drill would be any advantage in driving a stone drift in hard rock; or whether Mr. Steavenson considered it would be necessary to use a percussive drill for this class of rock?

Mr. Steavenson said he had already stated that rotatory drills were not suited for any hard stone; but it would not be a difficult matter to alter the movement from the rotative to the percussive action, or a small diamond drill could be substituted for the auger. He believed a percussive action was absolutely necessary for a hard stone.

Mr. C. Z. Bunning asked Mr. Steavenson if he had had any experience with the Brandt drill? It is a rotatory hydraulic drill, and was used in boring the Arlberg tunnel in Germany, and did exceedingly good work.

Mr. Steavenson stated that although he had used a great many drills, both revolving and jumping, he had not to his knowledge had any experience with the German one spoken of. His experience conclusively pointed out that a jumping drill was absolutely necessary for hard stone, except with the Diamond drill.

The Chairman said he had not only the duty, but the great pleasure of proposing a vote of thanks to Mr. Steavenson for his paper.

Mr. J. B. Simpson seconded the vote of thanks, and it was unanimously agreed to.

The following paper on "A Fire-damp Indicator," by Sir William Thomas Lewis and Mr. A. H. Maurice, was read:—