REPORT

OF OPERATIONS IN BORING FOR COAL WITH THE DIAMOND-POINTED

STEAM DRILL

AT

NEWCASTLE BRIDGE, QUEEN'S COUNTY, NEW BRUNSWICK.

BY

MR. R. W. ELLS.

ADDRESSED TO

ALFRED R. C. SELWYN, ESQ., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

FREDERICTON, 26th April, 1873.

SIR,—In accordance with instructions received from you in November last, I proceeded to Grand Lake, New Brunswick, to take charge of the boring operations about to be carried on there with the Diamond Drill. The spot selected by the Directors of the Company, in whose hands the drill was placed by the Government of New Brunswick, was at Newcastle Bridge, on the slope of the hill rising southward from the Newcastle Creek, and about eighty rods from the stream. Owing to neglect on the part of the Drill Company in sending the drill, many parts were found to be wanting when it was set up, and much valuable time was lost in sending to New York for a core lifter and solid bit, and in obtaining from St. John other parts of the machinery that should have been sent with the drill at first. After some three weeks delay in waiting for the articles to arrive from New York, we received the core lifter, and at once determined to carry on our operations with the core bit until the solid bit might come to hand.

Instructions.

Selection of site.

Loss of time owing to deficiencies in the machinery.

From the broken nature of the rock at the place selected, we found on boring that the core lifter would not work; the cores being so shattered as to make it impossible to raise them from the hole. From the fact also that the core bit would not work in soft shale and fire-clay, we were compelled to suspend operations till the solid bit arrived from New York, which was not till the middle of December; and on the 19th of that month we again commenced boring, using the solid bit.

Broken nature of the rocks.

Delays incident to starting the machinery, rendered our average of boring for the first three days only eleven feet per day; but the difficulties being got over, on the fourth day we bored thirty-two feet five

Ninety-five feet bored in five days.

inches, thus making a depth of ninety-five feet for the first five days boring. At this depth we struck a fissure in the rock, and the water that should have come to the surface, to bring up the borings, passed off at a lower level, and necessitated the drawing of the rods, in order that the leak might be stopped. This we partly succeeded in doing, by pouring down sawdust, and the water again coming to the surface we again proceeded with the boring to the depth of 109½ feet, when the borings again failed us. Our farther attempts at stopping the fissure partially succeeded, and we obtained borings again to the depth of 124 feet. At this depth, owing probably to striking another fissure, the borings failed us again, and several days more were spent in efforts to stop the leak, in which we were again partially successful. On the 3rd January, we again obtained borings, and continued our operations to the depth of 140 feet, when we struck a band of dark oily shale—the intervening distance from forty feet comprising grey sandstone of different degrees of fineness. At the depth of 162 feet the borings failed us entirely; and we were compelled to lay aside the solid bit and resort to the hollow bit, for the purpose of obtaining cores. By the 11th January we had reached a depth of 170 feet 2 inches, when we again attempted to use the solid bit. From the carelessness again of the Drill Company in sending the solid bit, we found on using it that it was one eighth of an inch larger in diameter than the hollow bit, so that in resorting to its use again, it could not easily follow the hole previously made by the hollow bit, and, becoming jammed, two of the diamonds of the outer circle were knocked out and lost down the hole. In the attempts to recover the diamonds much of the packing that had been used to stop the leaks became loosed from the fissures by the frequent drawings of the rods, and falling on the bottom, it so covered the diamonds that it was impossible to recover them.

Leak carrying away the borings.

Dark oily shale struck at 104 feet.

Diamonds knocked out of the bit and lost down the bore-hole.

Doubt existing in the minds of some of the Directors of the Company as to the diamonds being in the hole, they instructed the Engineer to put in the hollow bit again, and resume boring. It was found, however, in attempting to bore again, that the diamonds were on the bottom, and on bringing up the bit a number of the diamonds in it were found to be destroyed by their action upon those in the bottom. This necessitated the abandoning of the hole.

Hole abandoned at 170 feet 2 inches.

Much of the difficulty and delay in this boring arose from an insufficient supply of water to keep the pump running, in order that the borings might be driven up to the surface of the hole, the spring which we used having become, from the depth of the snow and the severe cold, quite unequal to supply the demand. Delays were also caused by the want of materials to repair damages on the spot; and the impossibility of communicating with Fredericton, thirty-one miles distant, owing to the state of the roads, rendered it difficult to obtain them when wanted.

Causes of difficulties and delays met with.

On abandoning the hole, a meeting of the Directors was called, and it was again decided to commence operations, near the bank of the stream, about eighty rods north of the first location. The place selected by the Directors was very bad: by the side of a small pond where the rock was very much broken and leaks almost sure to occur; and though both the Engineer and myself pointed out this fact to them, it was decided to go on with the boring in that spot. The engine house and drill were moved down, and the borer set up again, ready for work by the 17th of February. Commencement of a second boring.

In our first day's boring, we struck a leak at fourteen feet from the surface. The next day was spent in packing the hole with fire-clay—cement not being obtainable—resulting in an apparent stoppage of the fissure, so that we resumed boring on the 19th. The borings again gradually failed us, till at the depth of forty-four feet we were again obliged to lay aside the solid bit from the entire absence of the borings. The hole was then rimed out, and an iron pipe inserted to the depth of seventeen feet; but owing to the want of proper riming apparatus, it was found impossible to get it farther down. Efforts were then made to stop the hole by filling it with cement and boring over again, but owing to the poor quality of the cement employed, this work was ineffectual. The Directors then resolved to finish the boring with the hollow or core bit. This process is necessarily slow; the jamming of the cores in the barrel of the rods preventing the easy passage of water down, for washing away the borings, necessitating the drawing of the rods every few feet, for the purpose of cleaning the bit. Pieces of core and pebbles from conglomerate remain in the hole after drawing the rods, and these, as soon as the bit begins to revolve on them, tear out or break off the diamonds, necessitating their frequent replacing or re-setting. Fissure struck, causing leakage. Difficulty in inserting pipes.

On the 25th of March we had reached a depth of 154 feet, and finding the wear of the bits from the loss of the diamonds to be so great, the Directors determined to again attempt to stop the leak by cementing the hole with the best quality of cement. Thinking the leak was near the top, the hole was cemented to the depth of only forty-five feet; but on boring out the cement again, the leak was still found to exist. The hollow bit was again resumed on the 11th of April—much time having been lost in sending for more diamonds—and the boring continued. At the depth of 160 feet, a large mineral spring was struck, which, when the rods were out of the hole, flowed over the top at the rate of about twenty gallons per minute; but when the rods were down, even with the additional water thrown over the hole by the full force of the pump, it could not be brought to the surface, showing that the fissure by which the water escaped must have been very large. By the sixteenth of April we had reached the depth of 190½ feet, and our supply of diamonds being again completely exhausted, work had to be suspended till more could be ordered. Depth reached. Large artesian spring struck at 160 feet. Work suspended at 190½ feet for want of diamonds.

The last core brought up was of a grey shale, very similar to that overlying the surface seam of coal in the vicinity.

Breaking up of the cores.

From the breaking up of the cores into short pieces, either from the vibration of the rods or the broken nature of the rock, and from the fact that the pieces of core, acting on one another, wear away very rapidly, it is impossible to obtain a full section of the different strata passed through; in boring with the solid bit, however, the boring coming at once to the surface, any change in the nature of the rock can be at once observed.

Much delay occurred in our boring from the want of suitable hoisting gear, thus rendering the drawing of rods a very slow process; also from the ordering of only sufficient diamonds to meet the actual requirements of the time, as on several occasions we had to suspend operations till they could be sent from New York.

Inappropriate location of the drill.

Had the drill been located at first in an appropriate place, much delay and expense would probably have been avoided, as the boring of a 500 feet hole under favorable circumstances ought to require but a short time.

Owing to the opening of regular communication again between Newcastle Bridge and Fredericton, and the fact that cores could be as well examined in one place as the other, it has been decided that, during the continuation of the boring, the cores should be sent to Fredericton for examination. The Engineer in charge of the drill will take care of, and label each piece as it is brought up, and will send the samples to Fredericton weekly; he will also keep a daily record of the progress made, and submit it from time to time with the borings.

I have the honor to be,

Sir,

(Signed,) Your obedient servant,

R. W. ELLS.

Description of the "Diamond Drill."

The drill in use in the Grand Lake boring is the so-styled "American diamond-pointed steam drill," driven by a steam engine of seven-horse power, and doing its work by means of a metal bit, set in its lower surface with black diamonds. The bits are of two kinds: hollow and solid. The first consists of a hollow cylinder of metal, the diameter of the bore being about one and one-quarter inches, with the diamonds set in the inner and outer edges, and distributed over the intervening surface, so as to cut a complete ring in the rock, the core passing up the inside of the rods. The bit screws in to a core lifter, or hollow cylinder of metal with two steel slides, working in dove-tailed shelving grooves, which when the bit is

Bits.

Core lifter.

boring remain flush with the inner surface of the cylinder ; but in drawing the rods, they slide down and grasp the core, breaking it off and lifting it with the rods.

Core barrel.

The core lifter is screwed to the end of a hollow rod called the core barrel, eight feet in length, and the boring rods are screwed on the upper end. The boring rods are in lengths of ten and twelve feet, and are connected by means of screw couplings. Owing to the rush of water forced down the rods for the purpose of washing away the borings, there is a tendency to drive the cores to the mouth of the bit where, when the rock is soft or broken, and the cores in pieces, they are ground up. The pieces of core also revolving on one another wear away, so that it is almost impossible to obtain a perfect section of the rock passed through. The jamming of the cores in the core barrel also prevents the easy passage of the water to wash away the borings, so that the drill cannot be driven at its full speed ; and also renders it necessary to draw the rods very frequently to clear the bit, thus making the rate of progress very slow.

The solid bit.

In the solid bit the entire lower surface is set with diamonds, so that every part of the metal is protected from the wear of the rock. The rock for the entire size of the hole is ground up fine, and the borings are washed up by the ascending current of water, which in its descent passes through the bottom of the bit by means of four small holes ; the borings being brought at once to the surface, any change in the rock passed through is instantly seen. As there is no occasion for drawing the rods, the progress is very rapid ; the fastest speed made by us in hard grey sandstone being three feet in twenty-five minutes, allowing for delays in screwing on rods, running back gear, &c. A speed of five or six feet per hour should be made under favorable circumstances. The solid bit, not requiring a core lifter, is screwed directly on the core barrel.

Rate of boring.

Rods.

The boring rods in which the bits are screwed are hollow, and a constant stream of water is forced down them by means of a steam pump of two-horse power. This is necessary in order to clear away the borings as fast as made, as well as to keep the bits cool. The rods are driven round at a speed of about 600 revolutions per minute ; but, of course, this speed can be regulated to suit the nature of the rock. The stream of water passing down the rods is driven up outside and out at the top of the hole ; any fissures passed through allow the water to escape, so that in boring with the solid bit, the sides of the hole must be perfectly tight. The hollow bit will not work in soft or very broken rock, since the core lifters cannot act upon the cores to lift them ; and neither of the bits will work in sand or clay, unless very stiff, owing to the body of the ascending water destroying the sides of the hole.

In running the drill, but two men are necessary—the engineer and fireman ; the engine consumes about three barrels of coal during the 24 hours.

A suitable house, 18 feet by 20, can be erected at a cost of $100 to $150 ; the cost of this will depend on the season. It should be placed near a large spring, or in some place where a plentiful supply of water can be obtained for the use of the pump.

The following is a record of the borings in the Grand Lake coal field at Newcastle Bridge, Queen's county, New Brunswick.

Record of boring No. 1. 170 feet 2 inches.

1872.		BORING No. 1.	Ft.	In.
December	19.	Fine-grained shaly sandstone	4.	0
		Coal shale, ½ inch coal	1.	0
		Do 2 inch do	2.	0
	20.	Do do	6.	0
		Do with pyrites (very hard)	3.	1
		Bituminous shale	0.	4
		Solid coal, surface seam	1.	10
		Bituminous shale and impure coal	0.	10
		Fine clay	4.	6
	21.	Fine shaly sandstone	4.	9
		Fine coal shale	3.	0
		Shale and fine clay, with iron pyrites	2.	9
	23.	Fine-grained greenish sandstone	1.	0
		Do Do with shale	2.	0
		Do Do Do and fire clay	1.	0
		Dark, brown, and greenish shale	2.	0
		Hard grey shale, with fine clay	3.	0
		Fine-grained sandstone, (grey micaceous)	6.	8
		Do Do	3.	0
		Olive-green sandstone	1.	0
		Fine-grained grey sandstone	6.	9
	24.	Do do (micaceous)	3.	0
	26.	Do do	10.	0
	27.	Do do (micaceous)	27.	0
		Do do	6.	0
	28.	Do do (micaceous)	2.	0
	29.	No borings	4.	8
	30.	Greenish-grey sandstone	9.	3
1873.	31.	do (coarse grit)	3.	0
January.	4.	Grey sandstone, micaceous, with coarse bands	9.	10
	6.	Do do with iron pyrites	6.	2
	8.	Hard, dark grey shale (oily), with thin seams of coaly matter	3.	8
		Grey coal shale	5.	4
	9.	Fine-grained grey sandstone, (micaceous)	5.	5
	10.	No borings	7.	9
		Fine-grained grey sandstone, (micaceous)	8.	0
			170	2

BORING No. 2.

Commenced in rock at seventy feet lower level than the first.

1873.		Ft.	In.
February 17.	Shelly grey sandstone	4.	0
	Fire-clay, grey shale and sandstone	2.	3
	Grey sandstone and fire clay	1.	0
	Yellowish grey sandstone, (micaceous)	3.	2
	Do do (fine grit)	2.	3
19.	Fine grey sandstone (micaceous)	1.	0
	Yellowish grey sandstone and fire clay	10.	8
	Grey conglomerate	1.	3
	Yellowish grey sandstone, (micaceous)	2.	0
	Dark grey sandstone, do	1.	3
20.	Grey conglomerate	1.	2
	Grey sandstone	1.	0
	Grey conglomerate	1.	0
March 14.	Fine grey sandstone	5.	5
15.	Coarse grey sandstone	20.	6
16.	Fine grey sandstone, the last two feet containing fossils and iron pyrites	18.	9
17.	Grey shale (slate of Matthew)	6.	4
	Grey sandstone, (micaceous)	1.	3
	Grey shale, do	3.	5
18.	Grey sandstone	1.	0
	Grey conglomerate	1.	3
19.	Fine grey sandstone	18.	9
20.	Coarse quartz grit	2.	5
21.	Grey shale	2.	0
	Grey sandstone	3.	6
22.	Dark grey shale	4.	0
	Fine-grained grey sandstone	6.	4
	Shaly grey sandstone	1.	8
	Fine shale	7.	7
24.	Fine grey sandstone, (micaceous and pyritous,) with seams of fire clay	5.	4
	Fine grey sandstone	9.	3
	Fine grey sandstone (fossils and iron pyrites)	4.	7
25.	Coarse grey sandstone	3.	3
	Coarse grey sandstone, with fossils and iron pyrites, band of conglomerate	1.	9
April 11.	Greenish grey sandstone, very fine	8.	4
12.	Do do do (micaceous)	9.	6
14.	Coarse grey grit	10.	5
15.	Fine dark-grey sandstone	5.	3
16.	Grey conglomerate	1.	0
	Grey shale	1.	8
		190.	6

Record of boring No. 2. 190 feet 6 inches.

R. W. ELLS.