Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

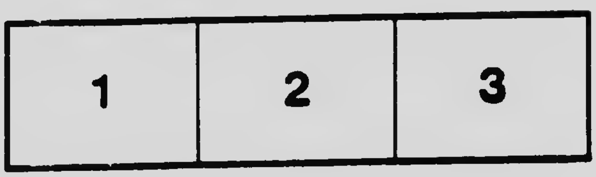
- [ ] Coloured covers / Couverture de couleur
- [ ] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [ ] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [ ] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments / Commentaires supplémentaires:

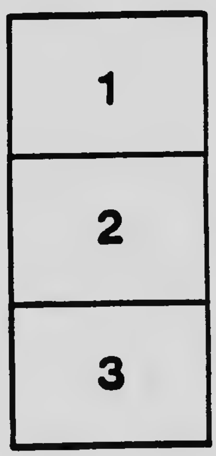
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

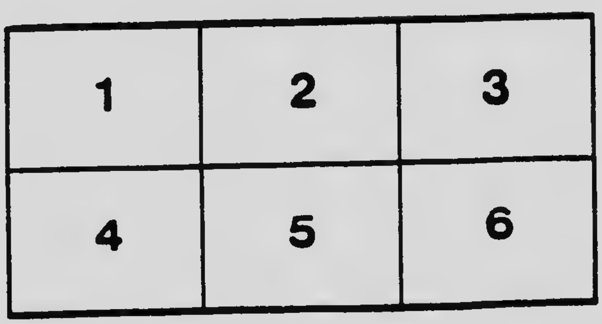
- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [x] Showthrough / Transparence
- [ ] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary material / Comprend du matériel supplémentaire
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- [ ] Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below /
Ce document est filmé au taux de réduction indiqué ci-dessous.

10x	12x	14x	16x	18x	20x	22x	24x	26x	28x	30x	32x
						✓					

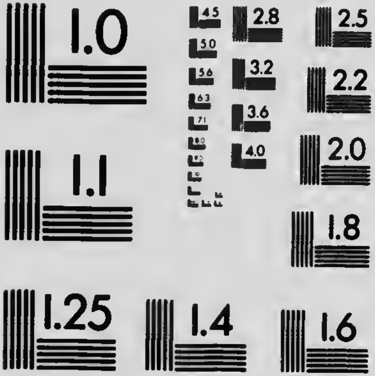

1
2
3


1
2
3


1
2
3
4
5
6

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



REPORT
ON
Coal Boring Operations at the Head of the Grand Lake

By JAMES P. HOWLEY, F.G.S.
for the Year 1893

ST. JOHN'S, N.F.
Robinson & Company, Limited, Press
1917

REPORT

ON

Coal Boring Operations at the Head of the Grand Lake

By JAMES P. HOWLEY, F.G.S.

for the Year 1893

ST. JOHN'S, N.F.
Robinson & Company, Limited, Press
1917

REPORT

ON

Coal Boring Operations at the Head of the Grand Lake, by James P. Howley, F G.S., for the Year 1893

Geological Survey Office,
St. John's.

Honourable Surveyor General,—

SIR,—The following report upon the coal-boring operations at the head of the Grand Lake is respectfully submitted.

The necessity for the application of the boring rod to further test the carboniferous area at the head of the Grand Lake having been strongly urged in the two preceding years' reports, the Government were pleased to authorize the purchase of a diamond boring machine for the purpose. Negotiations were accordingly entered into in the early part of last season with the Sullivan Machinery Company, of Chicago, for the purchase of one of their "S" core-drills and the services of a competent engineer to work the same.

Owing to a series of unavoidable delays in the shipping of the apparatus, and the unfortunate circumstance of having the boilers requisite for obtaining the necessary steam power smashed up in a railway collision while in transit, the season was far advanced before we arrived at the scene of operations.

Finding that it would facilitate the work by sending on the crew and outfit under Mr. Bayly's charge, to the Humber while awaiting the arrival of the machine, they were despatched west by the boat leaving here on June 17th. Mr. Bayly was instructed to proceed up the river, make a portage of all the provisions, etc., to Grand Lake, there to store them at a convenient point on Kelvin Brook, where the first trial was to be made. In the meantime, the long delay caused by the accident above referred to, and the detention by the railway authorities in Halifax of such portions of the machine as had been sent on, necessitated my visiting the latter city and personally attending to the further transportation. I left here on June 30th in the S.S. Bonavista for Cow Bay, Cape Breton, where we arrived on Sunday, July 2nd. The same afternoon I proceeded overland to Sydney, and spent two days closely inspecting the coal measures there, in order to institute a comparison between them and our own deposits at St. George's Bay and Grand Lake. I then proceeded on to Halifax by rail. Matters were soon satisfactorily arranged there, and the apparatus, consisting of the drilling machine, pump, rods, stand-pipe, forge, tool-chest and drive-block, were all removed to Messrs. Pickford & Black's wharf for transhipment per S. S. *Harlaw* to Bay of Islands. I cannot but express my thanks to the members of the above firm for their uniform kindness, and the obliging manner in which they undertook the labor and responsibility of removing all the heavy material and putting it safely on board the steamer. The *Harlaw* was ready to sail on July 11th but still neither the drill-man nor boilers had turned up, and in reply to a telegram sent the firm the Sullivan Machinery Company the ycould only inform me that both were on their way to Halifax and should be there by that time. They did not, however, arrive up to the time of sailing; consequently I was obliged to go on without them, leaving orders with Messers. Pickford & Black to forward them by next boat.

We arrived at Bay of Islands on July 15th, and made all possible haste in getting up the river. At the portage we were met by some of the crew sent over by Mr. Bayly to assist in landing the machinery. Seeing that it would take the entire crew, together with a horse and dray, to drag such heavy material across to Grand Lake, I proceeded on to Mr. Bayly's camp at Kelvin Brook and made arrangements for getting them all back to the portage. They had been employed up to this time in clearing away the surface preparatory to boring, building a store-house, and quarrying out coal for the furnaces from No. 4 seam, Coal Brook. They had about three tons mined, and most of it brought to the bank of Kelvin Brook to a convenient point, where it could be easily reached by boat. The coal had to be carried in bags on the backs of the men over a mile, which was pretty laborious work.

Having moved back to the Grand Lake end of the portage, several days were spent in improving the trail. The softer portions were corduroyed, rocks and stumps removed, and the road-bed raised and levelled in some of the worst places. Several of the larger boulders had to be blasted before it was possible to move them. It would have been next to impossible to transport the heavy machinery over without undertaking this necessary work. The machine proper, which is estimated to weigh 880 lbs., took two whole days with the horse and dray and all the men to drag it across. While still engaged in this work, the *Harlaw* again became due at Bay of Islands. I went down to meet the drill-man, Henry Cossette by name, and see to getting the boilers up stream. It was with no little dismay that I found each case containing a single boiler marked 1,750 lbs. gross weight. How to transport such cumbersome articles as these to Grand Lake in the present condition of the portage, and with the means at our disposal, caused me no little anxiety. Still an effort had to be made, or otherwise the work of the season abandoned. With great difficulty they were shipped on board a large boat in charge of Watson, an experienced river man, and after two days hard rowing and polling, the portage was reached and the boilers safely landed. To attempt portaging these heavy cases as they were would have been quite beyond our resources. It was therefore found necessary to divest them of all superfluous weight by separating the body of the boilers from the cast-iron base and top and removing the outer shells, thereby reducing the weight of the cast-iron internal rings to about half a ton each. After several days desperate drag, these were successfully landed at the Grand Lake side. It was 11th of August before we had the whole apparatus boated across the lake and in position at Kelvin Brook. Mr. Bayly had purchased a good, stout boat at Bay of Islands on his arrival there, which he had carried up the river and over to the lake when he came up first. Had it not been for this boat, we could not have succeeded in getting the machinery across the lake at all.

By August 14th we were ready to commence operations, having the boilers and drill set in position, and all necessary connections made and tested for working.

When fully equipped, the whole arrangement presents a striking and picturesque appearance. The two vertical boilers, consisting of a series of hollow cast-iron rings, surrounded by wrought iron shells, are bolted together by long iron rods passing through bosses, where the rings come in contact with each other. A space of a couple of inches intervenes between the rings through which the smoke and flame from the fires pass, thus effectually reaching all the surface required to be heated. The rings rest upon a cast-iron base fitted with a circular grating to receive the fuel, which is passed in through a door in the front of the metal shell. Another cast-iron cap, with a hole in the centre to give egress to the smoke, rests on the top of the boilers, to which again the smoke-stacks are fitted. The steam from the boilers circulates through the hollow rings, passes upwards through the pipes at the top, which connect with a horizontal pipe over the boilers. This latter projects a little on either end, where it is turned off and upward, terminating in two safety valves. A large metal T-shaped piece forms the central portion of this pipe, from the top of which another short piece rises upwards and then turns off, connecting with the main steam conduit. This is a long pipe passing over the boilers in a horizontal position, and stretching towards the pump and boring machine. It is connected with the former by a vertical pipe let down to the pump, and to the latter by a piece of stout rubber hose. From the bottom of the metal T above mentioned, a short piece of pipe leads downward between the two boilers, to which is attached the inspirator, an ingenious contrivance which acts as a feeder to the boilers. A short pipe leads from this to the rear and into a barrel which is kept filled with water, from which the boilers are supplied. When steam is let on to the inspirator it has a syphon action drawing the water from the barrel, which then passes downward through another small pipe and into a larger one at the base, which is in turn connected with the boilers. A steam gauge is screwed on at the top of each boiler, and water gauges at the sides. There are also taps to determine the quantity of water therein at any time.

To the left of the boilers, some three or four feet distant, a platform of hewn sticks of about twelve feet square, rests upon four stout logs partly imbedded in the soil. Upon this platform stand the pump and machine proper, the former nearest the boilers. Steam is let on to the pump by turning a valve in the pipe leading from the main steam pipe above. A long suction pipe extends from the pump towards the water supply passing behind the boilers, to the outer end of which is attached a stout rubber hose with a copper strainer, which is let down into the water Another small pipe rises vertically from the pump, and has a small rubber hose attachment connected with the top of the drill rods; when in use, by a swivel-headed joint. By this means the water is driven from the pump to the rods, which are hollow, and thence down inside to the bottom of the bore hole, for the purpose of washing up the loose material, and also to act as a lubricant to ease the friction and keep the rods and diamonds cool. A long exhaust pipe stretches away from the rear of the pump to carry off the superfluous steam.

The drilling machine stands on the centre of the platform, and consists of a stout wooden frame upon which rests the metal work. At the rear is a small vertical piston, which turns a horizontal bar extending to the front of the machine. This bar carries a drum, around which is wound the wire hoisting rope. The horizontal bar terminates in front with a crown-wheel. The swivel head which contains the feed piston, into which the drill rods fit, is secured to the front of the machine with clamp screws in such a manner that it can be set in any position, so as to bore vertical, horizontal, or angular holes—the whole arrangement being set in motion when the steam is turned on, and the rods revolved by means of the above mentioned crown-wheel. Both the drum and swivel head can, however, be disconnected at will by means of levers, so that either can be revolved irrespective of the other. When not required for boring, or when in the act of driving the stand pipe, the swivel head is unshipped and laid aside, and the machine slid back on its frame to make room for the pipes and drive block. A square hole of about two feet is cut through the platform in front of the machine, to allow for putting down the pipes. Over all is erected a tripod of stout sticks, about thirty-two feet long, bolted together at top, upon which two platforms are fastened, where a man stands to aid in hoisting and lowering the rods, screw the joints together, and attach the blocks or water swivel, &c. A large sheave wheel hangs from the apex of the tripod to receive the wire rope from the drum. A hook attached to the end of the rope hangs down immediately over the hole used in hoisting the rods and driving block. Another long exhaust pipe extends from the back part of the machine similar to that from the pump.

When fully equipped ready for work, steam is let on, the pump set in motion, and all the various connections, etc., tested until everything is found to work satisfactorily, precautions being taken to see that each part performs its functions properly. Then commences the first operation of driving the stand pipe through the surface deposits. This pipe is three inches in diameter and in ten feet lengths, each pipe fitting the other with a screw joint. Before placing the first pipe in position, a hole is made for a short distance through the gravel with one of the drill rods having a chopping bit attached to the lower end. This is revolved by placing the drill rod in the feed piston of the swivel head, while water from the pump is kept circulating all the time through the hollow rod, which gushes out at the bottom, thereby washing away the loose material dislodged by the bit. The swivel head and rod are now removed, the machine slid back on its frame, and the first, or drive pipe placed in position. A thick steel drive shoe having a bevelled cutting edge is screwed on to the lower end of the pipe and let down in the hole, while another stout steel ring, the drive head, is screwed on at the top. The pipe is now set up vertically and securely wedged in place. A couple of drill rods, with chopping bit attached, are let down inside, the heavy metal driving block is hoisted up so as to rest on the top of the pipe. A groove in one side of this block fits over the rods and keeps the block in position. It is now hoisted by means of the wire rope and let drop on the pipe head. By alternate hoisting and dropping, the pipe is forced downward as in pile-driving. All this time a plentiful force of water is kept flowing through the hollow drill rods to the bottom of the hole, effectually washing up all the loose material which flows over from the top of the pipe. After driving a few feet, or when an obstruction is met with, the drill rods are kept constantly in motion by hoisting and dropping, so as to chop away the material or break up the gravel in advance of the drive shoe, and cut a way for the pipe to pass downward. When one length of pipe is down, the drive head is removed, another length screwed on, and the driving continued till the solid rock formation is reached. When this is accomplished, the rock is cut into a few inches, the pipe driven well home, then a smaller, two-inch casing pipe is let down inside, joint by joint, till the bottom is reached, when the hole is thoroughly washed out and all loose gravel or sand removed therefrom. All this must be accomplished before the diamond bit can be brought into requisition, as it is only when the bed-rock is reached that the diamonds can be used. Were any attempt made to bore through the gravel or coarse sand, they would soon be destroyed or torn out of the bits and lost.

Having once reached the solid rock strata, the swivel head is again replaced, the machine pushed forward so as to bring the feed gear immediately over the pipe. Now the drill rods, with the diamond bit and core-barrel screwed on, are lowered down to the bottom, the uppermost being firmly clamped in the feed piston by means of a chuck at its lower end. Next, the water swivel is screwed on to the top of the rod, and all is in readiness for actual boring. Steam is let on, the drill rods rapidly revolved, water poured in copiously from the top, and the work of boring continued until the core-barrel is filled. The rods are then hoisted up, taken apart joint for joint, and when the last one is brought to the surface, the core-barrel is unscrewed and the core removed and examined. The same process of lowering the rods, boring and hoisting out, is continued so long as no obstruction is met with, or until the required depth is reached. It occasionally happens, however, when cutting through soft-shaly rocks, that the force of the water so loosens them as to cause a cave in of the broken material, which jams the rods and endangers breaking the bit. When this occurs, the rods are all hoisted out, and the hole has to be reamed with a larger bit set with diamonds to a size sufficient to allow of the casing pipe being let down below the interruption.

By far the most serious difficulties in getting down a bore hole are those encountered while driving through the surface deposits, especially when these latter accumulations are of great depth, and composed of coarse sand and gravel; but when boulders of large size and of hard, intractable trapean or granite materials are met with, the difficulties are increased tenfold.

These cannot be chopped through or broken up, and the only resource left is to try and remove them aside by continuous washing and driving. Should the drive shoe take them near the edge, and they be surrounded by sand or gravel that will wash away, it is quite possible to move or pass them. When, however, they are of extra large size, firmly embedded—or worse still, resting on the rock-bed—there is no dislodging them, especially should the shoe strike on the top of the boulder. As will appear in the sequel, we were met almost everywhere with such difficulties, and completely baffled, except in one instance, in our endeavours to reach the subjacent rock formation.

Our first trial was at a point on the right bank of Kelvin Brook, about three-quarters of a mile from the mouth, where bore A, of 1879, is situated. We commenced driving the standpipe on

August 14th, making nine or ten feet, and on the 15th seven feet, when we met with some tough, hard gravel, which delayed us considerably trying to chop and drive through it. We were delayed again all the forenoon of the 16th repairing one of our grates, which had given out: but by the afternoon we had reached a depth of twenty-seven feet. We drove twenty-one feet on the 17th, making forty-eight feet in all. On the 18th we made twenty-one feet again—sixty-nine in all—and by the evening of the 19th we had reached ninety-eight feet, having driven twenty-nine feet on that day. Our stand pipe, of which we were only provided with one hundred feet, was now all down, and still we had not reached the bed rock. Here we were met with an entirely unlooked for and unforseen difficulty. It was never contemplated we should find over one hundred feet of superficial drift in this region. On the 21st we made an attempt to drive the smaller casing pipe inside the stand pipe, and succeeded in reaching to a depth of one hundred and thirty feet in all. Here we struck some very hard gravel, and after three days chopping and driving only made two feet more, or one hundred and thirty-two feet in all. Finally we struck a boulder, apparently resting upon the solid rock below. After a vain attempt to chop or move the boulder, we only succeeded in smashing up our pipes, which telescoped at one of the joints some twenty feet from the bottom, causing the loss of two lengths, which remained in the hole. The smaller pipe is not provided with a drive-shoe or head, and is not at all calculated for such work, being too weak at the joints to withstand the force of the blows from the heavy drive block. It was useless to make any further attempt at this particular point, so another was selected about a mile farther up the stream to the southward, where it was hoped the drift deposits would not be so great. We began to withdraw our pipes, and had all removed, set in place, and ready for work again by the 25th. The following day, after erecting our tripod, etc., we commenced to drive again, and got down seven feet. On the 29th, at a depth of ninety-two feet, we struck a boulder. Tried hard to remove it by chopping and pumping, but could not succeed. We broke our rods and lost the chopping bit, and had to withdraw our stand-pipe again. It was so difficult to start it this time, we were two days getting it all up. The machine, platform and all, was now moved some three feet, and driving begun again. On September 1st we drove seventy-nine feet, and on the 2nd we got down one hundred, using all the stand-pipe without reaching the rock formation, but the deposits of tough, marly clay at the bottom seemed to indicate we were not far from it. The casing pipe was again resorted to, and by careful handling we succeeded in reaching the rock surface at a depth of one hundred and six feet. The uppermost strata consited chiefly of a fine, bluish, arenaceous shale, with thin layers of fine-grained very micaceous sandstone. Boring with the diamond bit was at once commenced, and by the 5th a depth of one hundred and twenty-one feet was reached, and several cores taken up. Owing to the soft, shaly nature of the rock pierced, much of it was ground to a fine powder and washed away. We continued boring till the 28th, with occasional interruptions to effect repairs, re-set diamonds, ream the hole when caves in occurred, etc.

We had now reached a depth of three hundred and thirty-five feet, three hundred of which was through the solid rock, the general character of which clearly indicated that we were below the true coal-bearing part of the formation, and that it was useless to penetrate further at this particular point. The angle of inclination, as ascertained from the cores taken up, averaged 50°, but the direction of the dip remained an uncertainty, though there is reason to believe it corresponds prettly nearly with that ascertained previously in the section exposed on Coal Brook, a mile further south, which is S. 10° E. magnetic.

The following is a detailed section of this bore-hole, distinguished by the letter F from those already reported upon, which range from A to E:—

SECTION OF BORE F, KELVIN BROOK.

From.	*To*	*Strata*	*Formation.*
....	8	8	Sand and gravel.
8	70	62	Sand.
70	94	24	Gravel
94	100	6	Clay.
100	106	6	Clay.
106	115	9	Clay and shale.
115	120	5	Sandstone.
120	130	10	Arenaceous shale.
130	151	21	Arenaceous shale.

151	155	4	Arenaceous shale.
155	156	1	Shale
156	158	2	Arenaceous shale.
158	160	2	Arenaceous shale.
160	162	2	Shale.
162	171	9	Arenaceous shale.
171	174	3	Arenaceous shale .
174	178	4	Arenaceous shale.
178	188	10	Arenaceous shale.
188	190	2	Arenaceous shale.
190	194	4	Arenaceous shale.
194	206	12	Arenaceous shale.
206	217	11	Sandstone.
217	219	2	Black carb. shale with thin coal streaks.
219	225	6	Shale.
225	235	10	Sandstone.
235	241	6	Arenaceous shale.
241	247	6	Sandstone.
247	249	2	Red shale.
249	253	4	Red shale.
253	264	11	Red shale.
264	267	3	Arenaceous shale.
267	273	6	Arenaceous shale.
273	281	8	Sandstone and shale.
281	293	12	Arenaceous shale.
293	300	7	Sandstone.
300	305	5	Sandstone.
305	314	9	Red shale.
314	320	6	Red shale.
320	328	8	Sandstone.
328	335	7	Arenaceous shale.
		335	

It was now decided to move back again towards the mouth of the Brook, to within a quarter of a mile of bore A, where it was hoped the same coal seams ascertained to exist there might be struck, with possibly some in a higher position, but with a view more particularly of ascertaining the true direction of the inclination of the underlying strata. Great difficulty was experienced in drawing the stand-pipe this time. It appeared to have been nipped at the bottom and held fast by boulders, which must have slid down against the pipe and caught it just above the projecting drive-shoe. Two jack-screws and four powerful levers of long sticks, two on either side, were fixed under the clamps at top, and the combined weight of all the crew brought to bear thereon; nevertheless, for two whole days we could not start the pipes. We had almost despaired of doing so, when at length the obstruction at bottom gave way, and the pipes started with a jerk several inches. After that they soon began to draw with comparative ease. On the 2nd of October we had all up and removed down stream, and by the 4th were again under weigh driving the stand-pipe at bore G. At a depth of forty feet we struck a boulder, but succeeded in moving it aside. At sixty-five feet we met with very coarse, hard gravel, which caused much delay. On the 6th, at a depth of seventy-one feet, we struck boulders again, which could not be moved or broken up. We had to withdraw, move a few feet, and make a fresh trial. This time we struck boulders again in about the same position, and in an attempt to drive through them, our pipe became so badly bent at bottom as to prevent the rods passing through. We withdrew a second time and moved several feet further in, but with no better result. On the 13th, between forty and fifty feet down, we struck a boulder, which we passed; but the next day, at sixty-five feet, we met others, and for the second time bent up our pipe, which necessitated withdrawing. The pipes were straightened as well as could be effected with the means at hand, and let down again in the same hole. When the boulders were reached, the small casing-pipe was put down inside, with which we succeeded in reaching a depth of sixty-nine feet, when another lot of boulders were struck and our pipe badly broken, compelling us to abandon the attempt. It would appear as if an extra number of boulders had been accumulated at this particular point. Most probably it formed the edge of an ancient glacial moraine, where the erratics, carried or pushed along by the ice-stream, had been shoved on one side and left behind—arranged, as is usual in such instances, in long lines closely packed together and piled on each other. It was now too late in the season to move to a new locality, where the prospects of finding a lesser accumulation of drift material were more favourable. Judging from our previous experience, we could only hope to find such a place further back from the Lake shore. But in order to reach such a point and remove all the heavy machinery thither, it would be necessary to clear a roadway, lay rails, and construct trolleys for transportation. We were not provided with any means of doing so, even did time permit. The weather also had set in cold and stormy, with frequent hard frosts at night, greatly endangering the steam pipes; it was therefore deemed advisable to abandon any further attempt for this season.

The machine was taken to pieces, well cleaned and oiled, and carefully stored in a good log-house erected for the purpose. When all was made secure to stand the winter weather, we began our homeward journey, and arrived at Bay of Islands on October 27th, where we were detained several days awaiting the steamer, and did not reach St. John's till the 8th of November.

During the progress of the boring operations, two expeditions were undertaken by myself in person. One up the Birchy Pond stream beyond Sandy Lake, to ascertain how far the carboniferous series might extend to the eastward up the river valley. The second expedition was up the Grand Lake as far as the Narrows on the southern reach between Sir John Hawley Glover's Island and the mainland, to make a further and more minute investigation of the lower members of the formation extending in that direction. In the former instance, no rock exposures were met with till the Laurentian gneiss was come across on the first Birchy Pond near Mount Seemore, but the debris scattered along the river bed above Sandy Lake indicated that the carboniferous formation does not extend much more than about one mile beyond the latter lake. Outcrops of grayish slate, probably of Silurian origin, are seen on the eastern shore of Sandy Lake towards its northern angle, and it appears quite evident that the overlying carboniferous strata, after crossing Kitty's Brook below the falls, sweep around the head of the lake a short distance inland, striking out again in a great bay on the eastern side. They continue across the lake into the country on the western side till they butt up against a tongue of Laurentian forming the hill range between the two branches of the Humber River.

On the north side of Grand Lake and eastern end of the great island, the lower members of the formation are well displayed, forming extensive cliffs for a considerable distance along shore. These comprise the basic conglomerate pyrochists or Horton series and carboniferous limestone series. The latter are chiefly made up of bright red marly sandstones, thin limestones, and occasional pretty coarse conglomerate. The absence of gypsum is remarkable, considering the vast display of this rock in the Bay St. George and Codroy troughs to the southwestward. Not one particle of gypsum was come across anywhere in the region of the Grand Lake. The pyrochists or bituminous shales occupy a considerable strip of the shore on the north side of the lake, and extend back a mile or so. They are arranged in the form of a long, narrow trough much broken and disturbed. On one small brook flowing into the lake, a mile above Whetstone Point, a considerable body of these shales are exposed in the bed of the brook, tilted up at a high angle and folded over several times. Amongst these, several bands of very black carbonaceous shale, with impure coaly streaks, are seen crossing the brook. It is not improbable that some of these shales may prove to be sufficiently bituminous to produce mineral oil in more or less available quantities if treated in the proper manner by distillation. So closely do these pyrochists, with their inter-stratified, finely-micaceous, thin-bedded, greyish sandstones resemble the core taken up from bore hole F this season, that I am strongly impressed with the idea that the latter are belonging to the same horizon. Should this prove to be the case, then it follows that we hit upon a portion of the formation several hundred feet below the true coal measures. Their occurrence in the position found can only be accounted for either by supposing a fault to bring up the lower members, or what is more probable, a sharp anticlinal fold striking up and down the lake, which is borne out by the high angle of inclination. The coal found at bore A in 1879 would then, of necessity, lie in a separate trough from that occurring on Coal and Aldery Brooks. This view of the structure lying beneath the waters of the lake, and great superficial mantle spreading over the country to the eastward, has already been foreshadowed in my report for 1891, as the following quotation will indicate:—

"I am at present inclined to the belief that between the two points (viz.: bore A and Coal Brook Section) there is an anticlinal fold bringing some of the lower measures again near the surface, and that Coal Brook section is but a repetition of that underlying the head of the lake."

Where this anticlinal fold would be situated beneath the drift deposits could never be accurately determined without the aid of the boring rod. Now that it has actually been struck in the only successful attempt to pierce the rock formation this season the difficulty of determining the true position of the more northern trough is removed. Had we succeeded in reaching the rock-bed in our first and last attempts, I doubt not the whole problem would have been solved. In all the holes put down, but especially in the two latter mentioned places, numerous small fragments of coal were brought up from the gravel in the washings. The sharp, clean, angular appearance of these fragments would sufficiently indicate that they had not been far removed from their parent beds. They had apparently not undergone such attrition as would result had they been transported from a distance.

From all the facts gathered during this and the two preceding seasons, it seems pretty clearly manifest that the entire carboniferous basin of the Humber Valley has undergone a series of wave-like foldings, the outcome of some great earth movements of a subsequent period—the chief agent in bringing about which was, there can be little room for doubt, the irruption of the trappean hill range to the south, which intervenes between the carboniferous and Laurentian systems. As stated in previous reports, this igneous mass has produced the effect of doubling up the strata and folding them over upon themselves where the contact is observed, while in a few instances, as at Hind's Brook, the two are so intermixed, and the reddish carboniferous sandstone so altered, it is difficult to distinguish the one from the other. What lends much further force to this view of the structure is the fact that upon the north side of the Humber Valley, the lower carboniferous strata are comparatively undisturbed, and lie so flat, or with such gentle undulations, that these members hold the surface over a very extensive area. On approaching Grand Lake, the undulations become more frequent and the strata more highly tilted; while up and down both sides of the lake wherever any exposures occur, they are sharper still, but seem to have attained their greatest intensity as the trap range is approached. Of course it follows that the deeper the undulations are, the greater the thickness of strata to be looked for. It is for this reason we now find in the long, narrow troughs on Grand Lake a sufficient accumulation of higher strata to admit of a certain portion of the true coal measures being brought in with their included beds of coal. Whether more than two of these troughs exist will be a matter for the future to determine. That there are at least two, there is no reason to doubt. The first having been struck in 1879 near the mouth of Sandy Lake stream, by the boring operations then carried out, while the numerous fragments of coal constantly being washed up on the shores of the lake near this point are further evidence of its extending out under the waters of the lake. The second or more southerly trough, is that examined and reported upon within the last two years as occupying a strip of the shore on the south side, and extending easterly towards Sandy Lake. It is the dividing ridge between these, where, as has been shown, an anticlinal fold brings lower and unproductive members of the formation to the surface, which was struck in the present year's operations. It will be absolutely necessary to continue the boring over an extensive area to fully determine the extent and character of these two troughs. Now that the apparatus is on the ground, the heavy cost of purchasing and transporting it thither will not require to be met again. The few extras in the way of piping and outfit required in future operations should not deter us from giving the place a thorough trial. The experience of the past season will also enable us to avoid, to a great extent, many of the difficulties met with, and be the means of ensuring a greater measure of success another time.

In conclusion, I would add that the machine is admirably adapted for such work, and is a most ingenious contrivance. Our drill-man, Henry Cossette, who has had eleven years' experience in the employ of the Sullivan Machinery Company, and has bored for various purposes all over the United States, proved himself a thoroughly competent drilling engineer, and gave the utmost satisfaction. None but a practical man with such an experience as he has had could successfully cope with the many difficulties encountered. An ordinary engineer without such experience would be c[illegible]y nonplussed on many occasions. The act of setting the [illegible]ds in the bit alone is not easily accomplished, requiring such delicate handling that the utmost care has to be exercised to avoid breaking them, while at the same time they must be very securely embedded in the soft steel to prevent their being dislodged. All our crew worked well, and some of them soon became quite expert in the manipulation of such portions of the work as were allotted to them. Mr. Bayly has paid special attention to the whole process of drilling, and has acquired a knowledge of the machine and its working which will be of much value in the future.

The Museum.

The occupancy of the Museum by the Customs Department since the great fire of last year necessitated closing it to the general public for a time. The cases containing the specimens had to be moved aside to make room, and consequently they could not be kept in proper order. Since the transfer of the Customs Department to their present quarters, and our own return home last fall, Mr. Bayly and I have been busily engaged in re-arranging the collection, and have succeeded in putting it in fairly good order again. Unfortunately, owing to the accumulation of dust and increase of moths, which could not be kept under during that interval, many of the natural history specimens were so far destroyed that they had to be condemned and thrown out.

So far as the collection goes, it is now in good condition and rapidly increasing, so much so that the room at our disposal is fast becoming overcrowded. Many additions have been made recently, greatly enhancing the value of the collection. An effort is being made to complete the ichthyological section by obtaining all possible specimens of our fish and fish products. So far we have been kindly favored with specimens from the following mercantile firms, namely: cod and cod-liver oils from Messrs. Thorburn & Tessier and Messrs. John Munn & Co.; whale and porpoise oils from the firm of Edwin Duder; seal oils from Job Brothers & Co.; fish glue, mucilage, and fertilizer, from John Munn & Co. Other specimens have been promised by the same and other firms later on. A few natural history specimens have been procured, either as donations or by purchase. Mr. Wm. Sclater presented a blue heron (Ardea Herodias); Mr. McNamara, an osprey or fishing eagle (Pandion Haliaetus); Mr. John Messer, a Labrador porcupine

(Erethizon dorsatus). There were purchased one bald eagle, young (Haliaetus leucocephalus): three Greenland gyr-falcons Falco Islandicus); one Fulmar petrel (Fulmaris glacialis): one horned owl (Bubo Virginianus).

Several mineral and rock specimens have also been added to the collection from various sources.

I have the honor to be, Sir,

Your obedient servant,

JAMES P. HOWLEY.