EFFECTING THE BLAST.

General Newton finally suggested his own plan for blowing up the reef at Hallett's Point, which was to perforate each pier with drill holes entirely or partly through its mass, a sufficient number of those being provided to complete the destruction of the pier when fully charged. The charges in the different holes of the same pier were to be connected together, and a fuse composed of a quick explosive, would connect the system of charge in each pier with those of the neighboring piers. By this mode the communication of heat or the electric spark to a few centres of explosion would suffice to propagate it through the whole system, because the explosion of the connecting fuse would advance more rapidly than the demolition of the rock. General Newton's plan is the one that has been adopted, although a few slight changes, principally suggested by himself, have been made. Instead of depending on explosives to convey the fire from pier to pier throughout the mine, an electric spark will be sent directly to every centre, insuring the simultaneous explosion of the whole mine, unless some unexpected difficulty shall intervene to prevent it. General Newton decided that the minimum amount of explosives could be determined by placing one charge in each square pier and two in each oblong pier, but this mode would make the lines of least resistance the maximum, and thus increase the shock, which would be propagated through the reef to the dwellings upon the land. It was therefore determined to decrease the lines of least resistance, which will multiply the number of blasts and increase the quantity of explosives, but will, at the same time, reduce to a minimum the vibrating influence through the reef. It is hence calculated that the exterior effect, except an agitation of the water, will be small.

THE FORM OF THE REEF.

Hallett's Point reef is in the shape of an irregular semi-eclipse, the major axis, which lies next to the shore, being 770 feet in length, and the minor axis, projecting straight into the channel, about 300 feet. The cubic contents, above the depth of twenty-six feet at mean low water, amount to 51,000 yards. Besides the risk of striking the reef, it produces eddies on both sides of it according to the directions of the tidal currents, and is as much in the way of vessels coming down in the ebb in the effort to hug the shore and thus avoid being drawn on the Middle Reef.

THE EXPLOSIVES.

The explosives used in tunnelling at Hallett's Point have been nitro-glycerine and its compounds, and gunpowder, the latter being used only when the rock was weak and seamy. Nitro-glycerine was always used for driving the headings of the tunnels. To drive a heading, the drill holes are made at an angle with the face, so that the charge lifts out the rock by its explosion. A cavity being made in the middle of the heading, holes are drilled around it and the surrounding rock blown into it. Only one blast is exploded at a time, and great care has to be taken not to shake the structure overhead by too heavy vibrations. There is consequently no volley firing, and the galvanic battery is not used for discharging the blasts.

THE DRILLING.

The average of twelve month's work with six Burleigh drills was the excavation of 225 lineal feet of heading per month. Up to June, 1872, the work had been prosecuted by hand drillings, with the exception of 20,160 lineal feet of drilling by the Burleigh drill, and 7,000 feet by the diamond drill. That by the Burleigh drills was done by contract so much a foot; and the diamond drill, purchased for the purpose of exploring the rock ahead, was put in competition with it. The cost of drilling, after a long trial with the Burleigh drill, is found to be between 36 and 37 cents per foot. The number of feet of holes, drilled by each machine per shift of eight hours, was thirty feet. The diamond drill, owing to the encounter of frequent veins of pure quartz in the rock, often gives out and has to be repaired. Owing to the restricted area of the tunnels and galleries, the work of excavation was almost exclusively that denominated heading, without the advantage of enlargement. The rock, after being blasted, was lifted by hand into a box resting on a truck car, which was run down to the place upon a railtrack, and thence drawn by a mule to the shaft, where the box was hoisted by a derrick and its contents emptied into the dump cars, to be rolled away and deposited in the pile. Calling the cost of blasting and removing one cubic yard $1.00, the following gives the proportion of each item of expenditure:

Blasting	0.46
Transporting rock to shaft	0.17
Hoisting	0.0328
Dumping	0.0203
Pumping	0.1037
Incidental	0.2132
	$1.00

The work of excavation having been finished, the drills were set to work perforating the roof and piers with holes to receive the final charges which are to explode the mine. These holes were made from two to three inches in diameter, and from six to ten feet apart, and their average depth was about nine feet. The size of the holes and their direction and distances apart were made to vary according to the character of the rock to be broken. The drilling of these holes up into the roof of the mine soon increased the leakage of water into the works from 300 gallons per minute to 500, it being impossible to avoid tapping a seam occasionally. Many of the holes that were found to be leaking were plugged up temporarily, and the leakage thus reduced. The outside gallery and No. 4 heading were deepened so as to concentrate all the leakage, and cause it to flow to the shaft end of that heading, where the pumps are placed.

THE COST OF THE WORK.

The following shows the amount of the appropriations made by Congress each year for the Hell Gate and East River improvements, and the whole amount expended up to the date of the last report of General Newton to the chief engineer:

1868	$ 35,000	1873	$225,000
1869	180,000	1874	250,000
1870	250,000	1875	250,000
1871	225,000		
1872	225,000	Total	$1,690,000

Amount expended, $1,434,129.99

Since this report was made Congress has appropriated $250,000.

Total amount of appropriations to date	$1,940,000.00
Total amount expended to August 1, 1876	1,686,841.45
Estimated cost of of completing the entire work of improving Hell Gate and the East River	$5,139,120.00

Care has been taken to test the various kinds of explosives. Up to the middle of 1874, nitro-glycerine had been principally used for blasting purposes. Several hundred lbs of mica powder were then tried, some giant powder, several thousand lbs. of rendrock, and later considerable vulcan powder was used. All of them are nitro-glycerine compounds. Neither of them was found to be as powerful as the glycerine itself; but it was repeatedly demonstrated that, with 10 ozs. of rendrock or vulcan powder, they could break as much rock as they formerly did with 8 ozs. of nitro-glycerine, while the cost per lb. was less than one half that of the glycerine.

THE FINAL EXPLOSION.

The blast is to be effected by 96 batteries of 10 cells each, which are to be placed in a bombproof structure. The cells are charged with the fluid known as electropoin and bichromate of potash in dilute sulphuric adid. The zinc and carbon plates are 4x6 inches, and oppose an area when lowered into the fluid of 40 square inches each. The cells are connected for intensity, about forty two of them forming one battery, the intensity of which is sufficient to ignite simultaneously one set, consisting of eight groups of 20 fuses in continuous circuit, equivalent to 160 fuses. There are, in all, 23 sets to be exploded by 23 such batteries. In order to ensure the simultaneous explosion of these 23 times 160 fuses, a novel apparatus will be interposed into the circuit of each of these independent sets. The apparatus consists of a gravity circuit closer, a brass pin closing the open circuit when the batteries are lowered down, after the charging of the mines are finished, by dropping into a cup filled with mercury, both brass cup and pin being part of the circuit. It is understood that there are 23 brass pins and as many mrecury caps in the instrument forming the circuit closer. The simultaneous explosion of all the mines will hence, if no accident changes the programme, be accomplished in the following way: After the wires are connected with the pole of the battery and the brass pin and cup respectively, the plate containing the brass pin is to lifted and held by a cord containing the fuse, the destruction of which, by a separate battery, will cause the closing of the circuit by the contact of the brass pins with the mrecury in the cups, and the explosion must follow.