SINKING THE FOUNDATION FOR THE NEW HARLEM RIVER BRIDGE.

The foundation for the center pier of the bridge now being erected over the Harlem River at 181st Street, this city, is rapidly nearing completion. The bottom of the caisson now rests upon solid rock at a depth of forty-five feet below the surface of the river, and the air-chamber is being filled with concrete; the masonry of the pier is now being rapidly carried up. The bridge consists of two metallic arches, each 510 feet clear span, one of which spans the entire width of the river, and the other the whole distance from the easterly bank of the river to Sedgwick Avenue. Each span consists of six separate steel-plate arches, spaced 14 feet between centers and connected by bracing. The floor system is carried on vertical columns supported by the arches. The floor is 80 feet wide, and consists of a roadway of 50 feet and two footwalks of 15 feet each. The grade of the roadway is 150 feet above mean high tide. The arched masonry approaches are as nearly symmetrical at both ends as practicable.

The work of sinking the foundation for the center pier of the bridge is of particular interest, owing to the nature of the material to be passed through and its peculiar disposition. Borings showed that about fifteen feet from the surface of the water the eastern edge of the foundation would encounter rock, sloping downward at a sharp angle toward the center of the river; on this rock lie the soft mud and sand of the river bed. During the greater part of its downward journey the caisson rested both upon rock and mud and sand, and the work of sinking it vertically was, therefore, rendered extremely difficult, since there was a constant tendency to shift or move sidewise toward the river. This formation of the rock made necessary the extensive use of explosives, and it is most probable that in this instance more rock was removed by blasting than in any other similar work ever undertaken. The size of the drill holes and the quantity of explosive used were not influenced by the fact that the discharge took place in compressed air confined in a comparatively small chamber in which the men were. There was a possibility of the caisson being injured by flying fragments of rock if too large charges were used, and this consideration alone controlled the quantity of explosive of each blast.

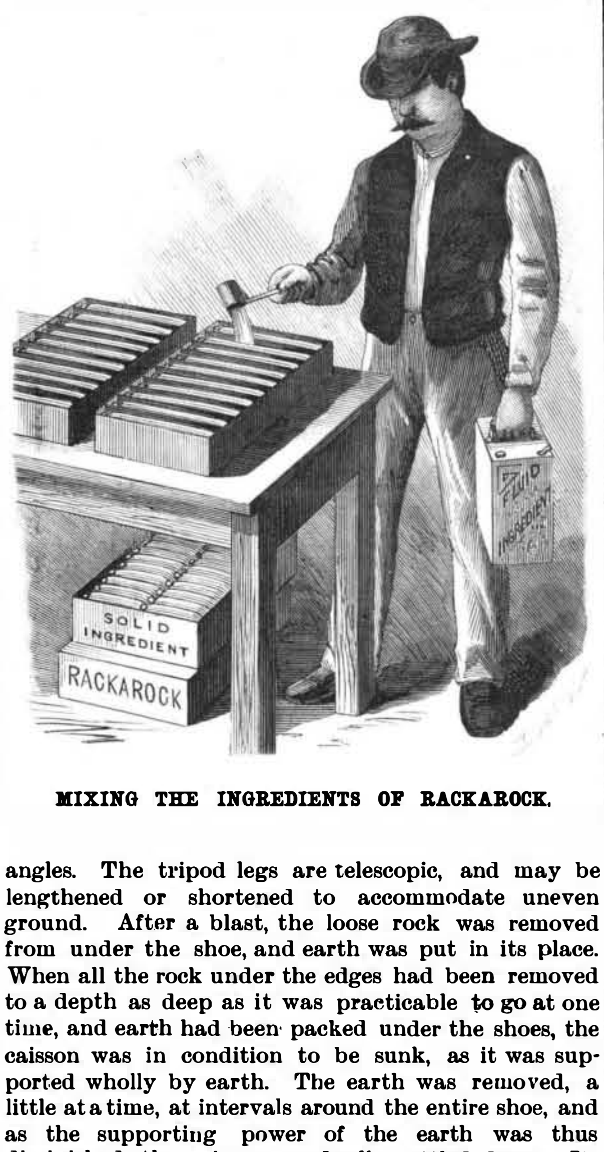
In a closed chamber like a caisson, the replacing of foul by pure air is a very slow operation; and as the condition of the men depends directly upon the purity of the air they breathe, it is of vital importance to preserve it in its normal state by preventing pollution. Such being the case, it naturally follows that of different explosives of equal power, the one producing the least hurtful gases is best adapted for all work which cannot be quickly and thoroughly ventilated. In this caisson both dynamite and rackarock were tried, and the experience gained concerning the effects produced upon the men by breathing the gases resulting from the explosion of each is of great value.

The caisson was designed, and the foundation built, by Messrs. Anderson & Barr, of this city. The bottom of the caisson measures 54 by 104 feet, the dimensions of the top being one foot less. The roof is six feet thick, and is built up of pine timbers one foot square laid in courses running in different directions. The side walls are three feet thick, and are also made of timbers one foot square; the outside and inside courses are horizontal, while the intervening course is vertical. The inner lower portion of each wall is beveled off to form a shoe or cutting edge, which is 9 inches wide and is protected by an oak strip. The outside of the walls is covered with a three inch sheathing, and the entire interior is sheathed. From the bottom of the shoe to the top of the caisson is 13 feet, and the interior is 7 feet in height from shoe to ceiling. The chamber is divided into three compartments by two longitudinal partitions, which are two feet thick by five feet high and in which are formed suitable openings that serve as passage ways. The bottoms of the partitions and of the side walls are connected by heavy timber struts and iron tie rods.

In the center of the roof is placed the supply lock, through which all excavated material is passed and all supplies received. The shaft of the lock is 5 feet in diameter, and extends up above the surface of the water. To the bottom of the shaft, which just enters the chamber of the caisson, is attached a rectangular air lock provided with doors at two opposite sides, so that the loading and unloading of the lock can be carried on simultaneously from two points, the work being thereby expedited. At the bottom of the shaft is a third door, opening downward or toward the interior, as do the other two. It is evident that when the shaft door is closed, the others may be opened without permitting the escape of air; and when the two inner doors are closed and the air admitted to the lock to make the pressure equal to that in the caisson, the shaft door may be opened. The excavated material is placed in buckets in the lock and then raised by hoisting machinery and dumped into cars at the top.

The lock for the men is placed at the top of a shaft extending through the roof, a ladder furnishing the means for ascent and descent. This lock is 12 feet long by 4 in diameter, and is provided at each end with a chamber closed by two doors opening inwardly. As this forms two independent locks, no time is lost in waiting, as one lock may be always entered from the interior, and the other from the exterior. Although eight or ten men can crowd into one of these locks, their small size is a decided advantage, since one man can pass without the loss of much air.

On account of the rock, the method of sinking the caisson was somewhat different from that usually followed. In the solid rock under the shoe, and in the large fragments, the holes were drilled by hand; but in the center of the chambers the drilling was done by a Little Giant drill* No. 3, of the Rand Drill Company, which was supplied with air at 80 pounds pressure, and as the greatest pressure in the caisson was about 18 pounds—the depth sunk below high water being about 45 feet—there was ample power to run the drill effectively. The pure air thus supplied was also an advantage. This drill was well adapted for the work, as it could be easily moved from place to place, could be quickly set up so as to drill at any required angle, and required no particular attention. The adjustable tripod upon which this drill is mounted renders the tool of special service in work where there is not much room, and where it is necessary to drill the holes at almost all conceivable



MIXING THE INGREDIENTS OF RACKAROCK.

angles. The tripod legs are telescopic, and may be lengthened or shortened to accommodate uneven ground. After a blast, the loose rock was removed from under the shoe, and earth was put in its place. When all the rock under the edges had been removed to a depth as deep as it was practicable to go at one time, and earth had been packed under the shoes, the caisson was in condition to be sunk, as it was supported wholly by earth. The earth was removed, a little at a time, at intervals around the entire shoe, and as the supporting power of the earth was thus diminished, the caisson gradually settled down. Its downward progress was closely watched, four stakes, one in each corner, forming guides that indicated the settlement; and if one side advanced more rapidly than the other, the earth was repacked under its shoe, so as to offer more resistance and retard that side. In this way the caisson was sunk vertically, and so truly and evenly that, when it finally rested upon its bed, the four corners and the center did not vary an inch from being in the same horizontal plane.

As the caisson descended, the masonry of the pier was added on the top. This furnished the weight necessary for overcoming the friction upon the outside.

In an engine house located just across the railroad tracks are the compressors for supplying air to the caisson, and a separate compressor for the drill. The electric light plant consists of a dynamo capable of running seventy-five 16 candle power incandescent lamps. The experience of Messrs. Anderson & Barr has shown that in interior work such as this many lights of small power distributed through the chambers afford a much better illumination than a few arc lights arranged at long distances apart, and their use does away with the annoyance caused by the carbon dust of the arc lights.

At the time of blasting, the men pass into the furthest chamber, so that the intervening partitions, or partition, if the blasting takes place in the center chamber, will prevent the passage of flying rocks. Care is also exercised to keep out of line with the openings in the partitions; and in order to raise the feet, so they may not be struck by rocks passing underthe partitions, which are but five feet in height, the men generally climb upon some of the cross braces. The effects produced by the discharge are very different from those caused by the same quantity of a like explosive fired in the open air. The sound is decidedly duller, and although its source is apparently very close, there is no sharp and sudden concussion. Even the simultaneous explosion of five 1¼ inch cartridges of rackarock produces no unpleasant sensation whatever upon the ear. But the effect upon the caisson was certainly startling. The waves of air seemed to bound from one wall to the other, causing heavy vibrations of all parts of the structure. This disturbance continued several seconds, and the motion could be distinctly perceived some time after all sound had ceased. The sound did not die away in the distance, but even when last heard appeared to be in the chamber.

During the first part of the sinking, dynamite was exclusively used, and after each firing the men complained of severe headache, and suffered from nausea. These troubles were caused entirely by the gases generated by the dynamite, and their severity depended directly upon the quantity used at one time—a small charge not vitiating the air to such an extent as a large one, and consequently not creating such disagreeable results. The pains continued until the constant inflow of fresh air either displaced the hurtful gases or so reduced them as to render them harmless. The danger always attending the handling of dynamite cartridges was another great disadvantage, especially in work of this character, where, during the charging, the holes were surrounded by workmen.

Rackarock was then tried, and its better adaptability for all operations in closed chambers was conclusively demonstrated. The fumes generated by it were comparatively harmless; nausea disappeared completely, and there were but few and slight cases of headache, while the immunity from risk in handling it lessened the anxiety of all connected with the work. This explosive, as is well known, consists of two ingredients, a fluid and a solid, which are shipped and delivered to the consumer in separate packages, and each of which is absolutely non-explosive. When needed, the two ingredients are combined by pouring a certain proportion of the fluid over the solid, which is contained in a bag of the usual cartridge form, as illustrated by the engraving upon this page. In a few seconds the oil has thoroughly saturated the cartridges, one of the tied ends of which is then cut, the cloth case opened, and the fuse inserted, when the end is retied and the cartridge is ready for use in the ordinary way. Enough of the ingredients may be mixed to produce charges for a single blast, a shift, or a week's work. This explosive is as powerful as dynamite, is safer to handle after the ingredients have been mixed, and for all tunnel and mining work, where it is difficult to quickly change the air, it is decidedly superior.

After the caisson had been carried down so that almost the entire shoe rested upon solid rock, the rock was cleaned of all debris and the three chambers completely filled with concrete, the filling being commenced at the corners and carried toward the shafts. Sand and Portland cement, in the proportion of 1 cement to 2 sand, were mixed and moistened outside and introduced through a long lock, consisting of a tube 18 inches in diameter, extending from the caisson to the surface, and provided at each end with a door. Upon the lower door being closed, this shaft was filled with sand and cement, when the upper door was closed, the compressed air admitted, and the load allowed to fall into the caisson.

The two main shafts were extended from time to time, as the caisson descended, by additions secured to their outer ends. As the lock for the men was at the upper end of the shaft, it was necessary to close the lower end while the air lock was removed and an additional length of shaft put on. The inner end of the shaft was closed by a heavy timber piece, fitted airtight on it. Upon the escape of the compressed air from the shaft, the pressure in the caisson served to hold this cap firmly in place.

* This is the first instance of a power drill being used in any work subjected to compressed air.

New Process for Making Steel Pipes.

The new method of making steel pipe at Barbach, Germany, is said to be very successful, and the process of manufacture is briefly as follows:

As soon as the steel is cast into the round mould, a core is thrust into the steel, so that the tube is formed between it and the sides of the mould. In order to prevent cracking of this annular casting during cooling, the core is made up in such a manner that it follows up the shrinkage of the steel. The steel cup thus obtained may then be rolled in an ordinary train. It is stated that a large firm in Paris proposes to apply the method to the manufacture of copper tubing.