THE NEW CROTON AQUEDUCT—THE HARLEM RIVER SIPHON AND PUMPING APPARATUS.

As our readers know, the new Croton aqueduct will soon be in use. It is now practically completed. One of the most interesting features of its construction is the siphon by which it passes under the Harlem River. The old aqueduct was carried above the river on the High Bridge, and up to the present time all of the Croton water supplied to the city of New York has passed over this structure. In constructing the new aqueduct, it was determined to carry the conduit under the bed of the Harlem River, forming an inverted siphon. The conduit, coming from Croton Lake in a practically straight line, reaches the banks of the Harlem River at a point north of High Bridge at shaft 24. The general course of the aqueduct up to this point may be summarized in a few lines. Its grade for the majority of the distance is seven-tenths of a foot to the mile. This average it maintains for a distance of about 23 miles from the Croton Dam to South Yonkers. In the neighborhood of Van Courtland a ten per cent grade exists for about a quarter of a mile. For the next four miles it resumes the original rate of descent of seven-tenths of a foot to the mile until within two miles of the Harlem River. Here the descent is very steep, being 15 per cent, and it ends at shaft 24.

Shaft 24 marks the eastern extremity of the siphon with which we are now particularly concerned. The shaft is 341 feet deep. In its center there is a break indicating the level originally contemplated for the tunnel under the river. At its bottom it forms a sump 6 feet deep. On attempting to prosecute the work on this level, it was found that a large fissure in the bed near the western bank interfered with the progress of the work. It was accordingly abandoned and a further descent of about 150 feet was made, and a new tunnel started. This is the reason why this shaft is so deep. Starting six feet above the bottom of this shaft, the tunnel runs across the river with a uniform grade of 1 per cent, descending toward the western extremity. The tunnel runs 1,500 feet under the river, falling in that distance 15 feet, to shaft 25, on the western extremity. The shafts and tunnels are all circular and 12 feet 3 inches in diameter. They are constructed of brick, and the tunnel in places is lined with cast iron plates bolted together by flange joints. The tunnel ends at shaft 25, on the west bank of the Harlem River.

Shaft 25 is a double shaft, 413 feet 6 inches deep from the original level of the ground. From the floor of the engine house above it, its depth is 424 feet 6 inches. The original excavation was in general terms a rectangular one, but is now divided into two circular shafts of identical size, one the aqueduct shaft, which is brick lined, the other one the pump shaft, also brick lined, but lined in addition with cast iron plates. The rest of the rectangle is filled in solid with rubble masonry. At its bottom the pump shaft has a sump, which descends 21 feet 6 inches below the floor of the conduit.

On both sides of the Harlem blow-offs are constructed, connecting respectively with shafts 24 and 25. Shaft 24 has a single line of pipe connected with it for the blow-off, partly of 30 and partly of 36 inches diameter. The blow-off on the western bank connecting with the pump shaft of shaft 25 is naturally larger, and includes two lines of 48 inch pipe. Both lines of blow-offs are provided with gates, in order to keep them closed during the working of the aqueduct.

Owing to its great depth, there is no means of draining the siphon. The establishment of pumps for pumping it was not approved of, not only on account of its great depth, but also because it will have to be emptied very seldom, and an installation of pumps would be exposed to deterioration for want of use. Accordingly a system of buckets have been applied to its emptying, and for some days they have been in use discharging water. For many months the siphon has been full of water that has drained into it from the long line of aqueduct. Before pronouncing it acceptable, it has to be emptied and examined by the authorities.

The pump and aqueduct shafts, it will be remembered, are side by side. Near their bottoms they are connected by a rectangular conduit, two feet six inches by one foot eight inches. This conduit is provided with a gate. In the normal working of the aqueduct this gate is kept open. To empty the siphon, the valve or gate is opened, admitting water to the pump shaft. In the latter two buckets are suspended by steel wire cables. The buckets are made of sheet iron, and are of 1,390 gallons capacity each. The cables by which they are suspended are carried over pulleys to the drums of a pair of hoisting engines. The whole is so connected that as one bucket rises, the other descends. At the bottom of each bucket is a butterfly valve, opening upward. When such a bucket is lowered into the water, the butterfly valve opens upward and water enters. In addition to the valve in its bottom, each bucket has a valve or gate in its side. This is normally closed. As a bucket rises filled with water it comes in front of a discharge spout near the top of the shaft which connects with the blow-off. The rear of this discharge piece is curved to correspond in shape with the contour of the bucket. A handle is connected to the side gate of the bucket, which, as the bucket rises opposite the discharge spout, strikes a cam so as to open the gate. The water from the bucket then enters the discharge spout and escapes through the blow-off into the Harlem River.

The buckets are worked by a pair of engines built by the Franklin Iron Works, of Fort Carbon, Pennsylvania. They are provided with a steam reversing gear, so that the links are thrown one way or the other by reversing a lever controlling the admission of steam into a cylinder which actuates the reversing mechanism. An attendant at the entrance does the reversing. Turning the engines one way, one bucket descends and the other rises. As the proper height is reached a bell rings and an indicator also shows the fact to the attendant. The engines are stopped until the bucket has emptied itself. By motion of the lever they are next reversed; the empty bucket descends and the full one rises, until the alarm is again given, notifying the attendant to stop the engine. In this way the water is rapidly withdrawn. It will be seen that several peculiar features are involved in the process. While the buckets always rise to a standard height, they have continually to be given a little more descent. This is effected by having one of the drums fixed upon the shaft, while the other is loose and attached to the first by eight bolts. By releasing these bolts, while holding the loose drum with the brake, the engine is driven in one or the other direction until the proper amount of rope has been fed out. The bolts are refastened again. The operation takes about three minutes. The contract requires each bucket to be hoisted in an average of 40 seconds. So far this time has been exceeded. While it would seem that at greater depths the operation would be slower, it is found that the reversing and emptying takes most time, and that the actual hoisting operation will be of short duration for the maximum depth.

Both aqueduct and pump shaft are provided with heavy brick diaphragms, each embodying an inverted arch. These, when the aqueduct is in use, have the manholes closed, and resist the pressure of the water. As some water will percolate through the pores of the brick, a small overflow of 12 inch pipe is provided to discharge this leakage into the Harlem River.

Carbon.

BY GEORGE L. BURDITT.

In looking over Mendelejeff's table, we find at the head of the fourth series the element carbon. It is one of the most abundant elements, and one of the most important in nature. It is the characteristic element of organic chemistry, where it forms a sort of framework upon which the organic compounds are grouped. Indeed, inorganic chemistry is called by some the study of the carbon compounds. Carbon occurs in all vegetables and in some minerals. It also exists in three allotropic forms, as the diamond, graphite, and charcoal.

The diamond is the purest form of carbon, occurring in nature usually in the conglomerate formations. India, Brazil, and the Cape of Good Hope furnish most of the diamonds in use, the Cape of Good Hope mines being more recently discovered. The diamond has probably never been made artificially, although many attempts have been made. In order to make one, the carbon would have to be liquefied and crystallized. But carbon is only soluble in melted cast iron, and is infusible; and so diamonds could not be got in this way. Making diamonds from benzole was at one time tried by a Scotch chemist, but with questionable success. In nature they are probably made from some liquid form of carbon, but little or nothing is known of the process. Although they may be of almost any color, they are usually white, and when entirely free from all color are said to be of the first water, and these are the most valued. However, owing to impurities, they may be gray, yellow, brown, green, red, blue, or black. The rose diamonds are valued highly, and next to them the green.

To heighten the effect of a diamond it must be cut. This is a very slow and tiresome job, sometimes taking many weeks or months to finish. The stone is first clipped off, piece by piece, until it is nearly the required size. It is then fixed upon a steel spring, by means of melted lead, and the lead allowed to soldify. This spring is then pressed down until the stone reaches a swiftly revolving steel wheel, upon which there is a quantity of diamond dust, called "bort." By the constant grinding of the stone against the bort, a smooth plane or face is formed. And this is what is meant by diamond cutting. The operation must be repeated for each face. The commonest forms after cutting are the rose and brilliant. The diamond is the hardest substance known, but is quite brittle. Besides its extensive use as a gem, it is used for cutting glass and in making diamond drills for boring rock. Quartz is hard enough to scratch glass, but the diamond point is more curved than that of quartz, by virtue of which it gives a cleaner scratch, and so is always used. Diamonds do not occur to any extent in the United States, although small ones have been found in North Carolina.

The second allotropic form of carbon is graphite, sometimes—but wrongly—called blacklead. It is found principally in Siberia, Cumberland, and at Ticonderoga, where it occurs as lumps between layers of slate. It is of a grayish-black color; soft, greasy, and has a metallic luster. It can be made artificially by dissolving carbon in melted cast iron, and treating the product with dilute hydrochloric or nitric acid to remove the iron. Owing to its high fusibility, it is used in making crucibles for melting substances which require great heat. It is also used with oil as a lubricator; also in electrotyping. Its most important use is in making pencils. The graphite is crushed fine under water, on top of which it floats off through a series of tubs, each a little lower than the one before; and in this way the fine powder is separated from the coarser. Pipe clay is then added to it, and enough water to make a paste about as thick as cream, and this is ground until the substances are perfectly mixed. For hard pencils, more clay is added; for soft ones, less; medium hard pencils contain about seven parts of clay to ten of graphite. After grinding, the paste is put into canvas bags and pressed until all the water runs out, leaving a thick dough. This dough is then put into an iron cylinder with a tight-fitting piston. In the bottom of the cylinder are holes the size and shape of the lead desired, and through these the dough is slowly forced by the descending piston, coming out in long strips. These strips are then cut into the proper lengths, baked, and put into their wooden cases.

The third or amorphous form is represented by charcoal. Charcoal is made by burning wood in a limited supply of air. Sticks of wood are piled up into a round heap, with a small hole in the center for a chimney. Another hole runs from the chimney to the outside of the pile, so as to give a draught. The whole pile is then covered with sod and earth. The wood is lighted through the chimney, and chars slowly until it is all converted to charcoal. The time required varies from one to three weeks, according to the size of the pile. The best quality of charcoal is made by heating wood in iron cylinders. When made in this way, some other valuable substances—such as wood alcohol, etc.—are also formed, which run off as liquids and are collected. This kind of charcoal is used for gunpowder. Charcoal is black, lusterless, soft and smutty. It has no crystalline form, but retains the internal and external forms of the tree from which it is made. While the wood in the pits is charring, the walls of the wood cells become charcoal, but the matter within the cells is driven off. This makes the charcoal very porous, and it absorbs air to such an extent as to float on water. Charcoal has a strong tendency to condense gases on its surface. It acts on different gases to different degrees, but most readily on ammonia and sulphureted hydrogen. It is also used to absorb coloring matter in bleaching colored solutions; but boneblack—a sort of charcoal made by burning animal bones—is better for this purpose. Brown sugar is turned into white sugar by running it through a layer of boneblack from twenty to thirty feet high.

Lampblack is made in much the same way as charcoal, only no wood is used. Heavy oil of tar or natural gas is burned in a close chamber, at the top of which is a tight-fitting iron dome. The oil is lighted and burns with a smoky flame, giving off small particles of carbon, which are condensed on the sides of the chamber into lampblack. When the process is finished, the dome descends and scrapes the lampblack off. It is tolerably pure, is very black and permanent, and can be advantageously used in making paint, blacking, etc.

The question may sometimes arise: How do we know that these allotropic forms are really carbon? The proof is, if we burn twelve parts of carbon, it will give forty-four parts of carbonic acid gas—and this is the case with each of the three forms.—*Pop. Sci. News.*

The Infrequency of Deaths by Lightning.

It is probably idle to tell people that there is a thousand times the danger in the sewer pipes that there is in the thunder clouds, but it is true all the same. The deaths by lightning are few indeed. Who of the readers of this paragraph, says the Hartford *Courant*, ever lost a friend that way? Who of them hasn't lost a score of friends by the less brilliant and less noisy destruction that comes up out of the drains? The trouble with the lightning, or the trouble that it gives the people, is in its indescribable suddenness and its absolute uncertainty. You know neither when it is coming nor where it is going, all you feel certain about is that some storms leave a number of catastrophes to mark their course. The caprice of the lightning defies the explanations of science, and there is no predicting beyond a few generalities. This much it does seem safe to repeat, even in a lively lightning season, that the increased use of electricity, with the multiplicity of wires, has tended to fewer fatal strokes of lightning in cities.

To Remove Thirst.

Paint the tongues of your fever patients with glycerine, says a physician; it will remove the sensation of thirst and discomfort felt when the organ is dry and foul.