

SOME METHODS OF CONSTRUCTION OF THE RAPID TRANSIT SUBWAY.

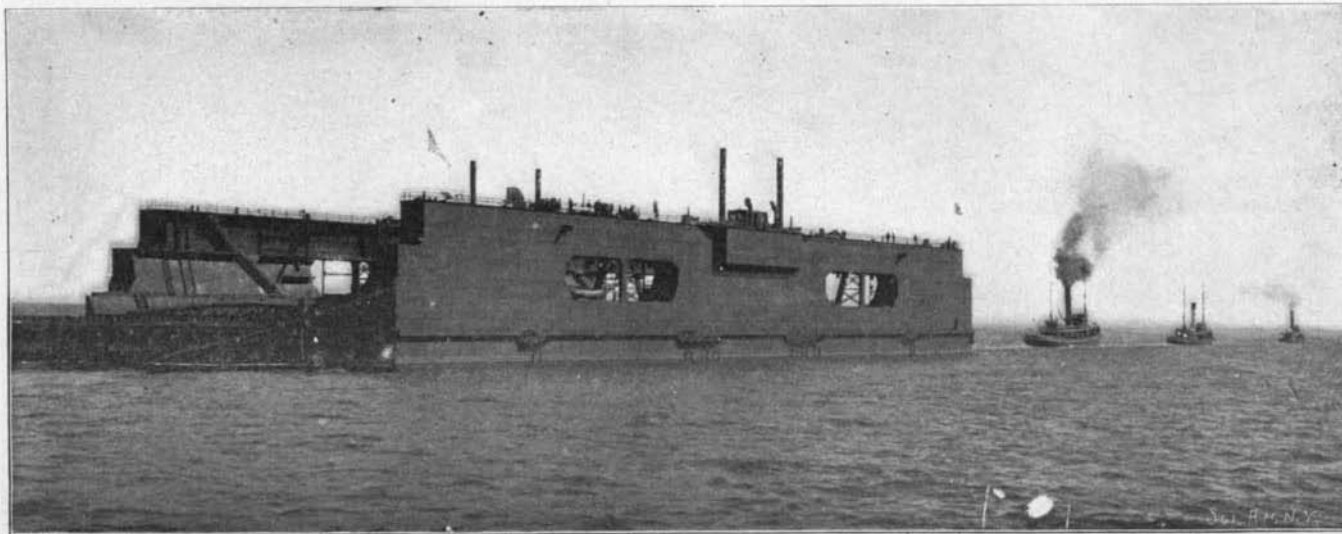
In our last issue we showed by diagram and description what remarkable progress was being made in the construction of the Rapid Transit Subway, and we now supplement that article with a series of views, taken at various points along the route of the work, which illustrate the methods by which the construction is being carried on, and serve to show, incidentally, how fully completed certain portions of the work are at the present writing. Commencing at the northern extremity of the line, the first important piece of construction is found at 181st Street and 168th Street and Broadway, at each of which places a shaft has been sunk and tunnel excavation has been carried on north and south under Broadway for a distance of about an eighth of a mile. One of our illustrations shows the head works above the shaft at 168th Street. Two hoisting cables are used, an empty truck being lowered while the loaded truck is being hoisted to the surface. In the tunnel the rock as it is blasted away is loaded onto trucks which are hauled to the foot of the shaft, run onto the hoisting cages, and brought up to the unloading platform shown in our illustration. Here the load is dumped into trucks, in which it is hauled by mule power down one of the cross streets, leading to the bluffs of the Hudson River, where the material is being used for making new ground. At each of the places mentioned a pair of elevators and a stairway will carry passengers to the level of the Subway tracks, and separate passageways will lead at two different levels to the north-bound and south-bound trains. The next point of interest illustrated is the entrance to the tunnel at 157th Street and Broadway. The view shows clearly the concrete arched lining of the tunnel with its back-filling of rock. Although there are long stretches of tunnel excavation where the rock would probably be sufficiently solid to prevent any cave-in, no risk will be taken, and the whole interior of that portion of the tunnel which is being excavated too deep below the surface of the ground for open-cut work will be lined and finished off with a concrete arch. At 157th Street, owing to a natural depression in the ground, the tunnel reaches the surface, and here a station will be built.

Another important stretch of tunnel excavation occurs beneath the northwestern corner of Central Park between 104th Street and Central Park West and Lenox Avenue. A shaft has been sunk to grade at the former point and the tunnel is being driven in both directions. We present an illustration taken at the intersection of 110th Street and Lenox Avenue looking toward the point of exit of the tunnel from the face of the high ground at the northwest corner of the Park. Here a deep cutting, several hundred feet in length, has been made into the face of the cliff, the poor nature of the rock rendering it necessary to make a long open cut before the heading could be driven. The view shows the heading and also the commencement of the concrete arch, which extends at this point beneath the northerly driveway of the Park. It should be explained here that not merely will the tunnel excavation be lined with concrete arches, but at several other points, such as the one last mentioned, and the loop beneath the City Hall Park, the same concrete arch finish will be used.

The bulk of the Subway, as our readers are well aware, is being built by open excavation, and several of our views show the method adopted in carrying temporarily the heavy double tracks of the Metropolitan Street Railway Company's lines, upon which traffic has to be maintained without interruption. In order to support these tracks until after the underpinning can be placed beneath them, the contractors make use of a pair of steel or wooden trusses, or deep I-beams, one on each side of the tracks, these trusses being of sufficient length to cover a stretch of from 30 to 40 feet. The ends of the two trusses are given a firm footing on the natural soil, and transverse trenches are then cut beneath each of the cast-iron yokes that support the trolley tracks. Into these trenches are inserted 12 by 12 timbers, which are hung from the bottom chords of the trusses by stirrups of 1-inch wrought-iron. The excavation is then com-

pleted, leaving the track entirely supported by the trusses. As soon as the excavation is down to grade 12 by 12 posts are placed beneath the transverse sills, leaving the trusses free to be moved forward from 40 to 50 feet, as the case may be, and the operation repeated.

After the excavation has been carried down to sub-grade the square blocks of stone which form the footing for the columns that support the roof are put in place, the steel columns are erected, the overhead and sidewall girders put in place, and the whole riveted together. The bents thus formed are spaced 5 feet apart and extend continuously throughout every part of the tunnel that is not finished with a concrete arch, as above described. One of our views, taken in the interior of the station at 59th Street and Broadway, gives an excellent idea of the appearance of these columns. They perform the important work, not merely of supporting the roof, but of carrying the extremely heavy loads of the street traffic overhead. They and the girders which span them have been made sufficiently heavy to stand the concentrated loads which result from the passage of traction engines, or of trucks loaded with structural iron or heavy cables. After the steel work is all riveted up the spaces between the I-beams at the side walls and in the roof are filled in with concrete which is rounded off with a smooth finish. One of the accompanying illustrations, which was taken looking north on Elm Street from Houston to Bleecker, shows a portion of the four-track Subway with the steel in place, and the process of finishing in the roof and sides with concrete going on. The Subway, in sections such as this, is a continuous steel-and-concrete rectangular tube and an important feature, which is absolutely necessary to the success of the tunnel, is the extremely careful system of waterproofing which is worked into the concrete covering of the shell. After half the total



Length, 525 feet; breadth, 126 feet 2 1/2 inches; depth, 51 feet 9 1/4 inches.

TOWING THE NEW UNITED STATES FLOATING DOCK TO ALGIERS, LA.

thickness of concrete has been put in place, six layers of tar and felt are applied, both in the floor, the walls and the roof, thus shutting in the whole Subway with an absolutely impermeable sheathing.

Between the stations the interior surface of the Subway will be left as finished by the steel men and the concreters, but at the stations themselves the surface will be lined with enameled tiling; and experiments are now being carried out at the 59th Street station with various colors and patterns of tiling to determine which will be the most suitable. The accompanying illustration shows a section of the wall finish of the station which has been put up to test its qualities and judge of its effect. The center panel is pure white and the trim and frieze are dark green.

One of the most important stretches of rock excavation by open cut is that which is being made along the eastern side of Union Square, from 14th to 17th Street. To facilitate blasting operations the Metropolitan Street Railway tracks were diverted, a new line being built close against the eastern curb of the street. The rock has been taken out pretty well back to the eastern line throughout most of the three blocks, and the floor over the greater portion of it has been concreted, the foundations of the columns laid, and the steel work erected. A photograph taken at this point shows with great clearness the whole construction. It will be noted that after the footings of the columns are in place the concreting is carried up flush with the top surface of the footings. Not far from the massive steel work shown will be located the 14th Street station, one of the most important stations.

The Russian Imperial Geographical Society has received news from the Kozloff expedition, sent out to explore the headwaters of the Hoang River, that this expedition has obtained valuable collections which are now under the military guard.

TOWING THE NEW NAVAL DRYDOCK TO ALGIERS, LA.

The floating steel drydock intended for the naval station at Algiers, La., which has already been described in the SCIENTIFIC AMERICAN, was towed from the works of the Maryland Steel Company at Sparrows Point to Algiers by the steamer "Orion," one of the largest towboats on the Atlantic coast, assisted by the steamer "Taurus." The route down Chesapeake Bay around Cape Hatteras and the Florida peninsula, thence through the Gulf of Mexico and up the Mississippi River, comprised about 1,800 miles. As the dock weighed nearly 7,000 tons, and when in its ordinary position opposed a surface nearly 50 feet high to the wind and seas, the task of bringing it safely to its destination was one of unusual magnitude. In carrying out the work two 5-inch hawsers twisted together were used as the towing cable, the dock end being connected to the anchor chains of the dock, forming a bridle. On the towing craft the cable was connected to a steam towing machine which automatically kept the line taut, reeling it in when necessary and running it out to relieve any strain caused by current or waves. The auxiliary wedge-shaped ends were used in front and back of the dock principally to steady the great bulk, and keep it as much as possible from drifting broadside to the sea. The average speed ranged between four and six knots an hour. The illustration shows the dock just after starting, with a third steamer to assist in taking it through the channel at the entrance to Baltimore Harbor.

A Rival of the Clyde and the Thames.

Attempts are being made to convert the River Tyne, on the northeast coast of England, into a river shipbuilding rival with the Clyde and the Thames. For this purpose the great shipbuilding and boiler-making yards of Messrs. Robert Stephenson & Co. have been acquired and are being converted into a huge dockyard.

An immense graving dock 700 feet in length sufficiently large to accommodate the largest battleship afloat, is in course of construction. Four machine sheds, each 285 feet by 75 feet, have been built, and are being equipped with the latest and most up-to-date shipbuilding, boiler-making, and bending machinery. An American plate-stacking electric crane with arms each 142 feet in length has been erected. Four berths are

also being prepared on which vessels 700 feet in length can be built, while four additional berths capable of accommodating vessels varying from 350 to 500 feet are to be constructed. The river at the end of these launching ways is to be considerably deepened to facilitate launching. The object of these elaborate reconstruction works is to enable the largest types of ocean-going steamers to be built, and also to provide extra facilities for the construction of battleships for the Admiralty, extensive orders for which are expected to be given out in the near future. There is remarkable activity in all the shipbuilding yards of Great Britain at the present moment, several of the leading ocean steamship companies having placed large orders for additional vessels.

600-Foot Waterfall in Hawaii.

The Bishop Museum has an exploring party in the field surveying and measuring the rainfall and water supply of the Honolulu region, in order to determine whether it is practicable to store water in the mountains and carry it to sugar plantations in flumes. The endowment of the museum includes lands in Kohala and Hamakua, on the Island of Hawaii, in which are Waipio and other gulches that extend from the sea to the highest points of the Kethala Mountains. The party has made a number of important geographical discoveries. The source of Waipio River has been found to be several miles further up the mountain than was supposed and in a waterfall that has one sheer fall of 600 feet, and in this exceptionally dry season runs 8,000,000 gallons per day. The party reached this waterfall only because of the low water, which permitted the explorers to ascend the bed of the stream. The forest growth was nearly impenetrable and the trail had to be cut through the tropical jungles. They were probably the first white men to see this magnificent waterfall.