"The Main Intersecting Sewer of the City of Brooklyn, N. Y.," Scientific American, Volume LXVI, No. 5 (30 January 1892), cover, p. 69.
The main Interests of Sewer of the City of Brooklyn, N. Y.

The city of Brooklyn is on the verge of completing an immense sewer of large dimensions for the purpose of relieving what is known as the flooded district of Brooklyn from the effects of heavy rainfalls. The underground lines from which the water is derived comprise about 1,300 acres. During storms the first rush of water is intercepted by the local districts and finds the conduit, the sewer perhaps only by tides. The lead pipes used, thrown off the manholes covers in the lower streets and flood both streets and houses. To do away with this trouble, the present structure, known as the main relief sewer, has been built. It is carried across the drainage area, intercepting about two-thirds of the surface water falling on the district. Its course runs through the avenues, Fourth Avenue and Beaver Street, and meets the bored of the Gowanus canal. The regular street sewers are to be connected to it in such a way as to deliver storm water only to it. In this way the surface water during heavy rains from two-thirds of the area will be effectively provided for; and from their points of intersection with the relief sewer, only the normal amount of drainage will pass to the tunnels.

The principal portion of the sewer is circular in section, ranging with a diameter of 30 feet and 13 inches; and increasing successively to a diameter of 12, 14, and 16 feet with 18-inch walls, except where in some places a 28-inch side wall has been introduced. Of this circular portion, there are 11,400 feet, of which 3,000 feet were laid by tunneling, and as shown in our sectional drawing, part of it is in the ground. At the end however it is near the surface, and from the section to an approximate rectangle, whose bottom is an arch of long radius, and which is covered by regular 1 in 4, and brick arch construction. At the end it delivers into a still basin, and through twenty pipes of 36-inch diameter each into the canal. The basin is trapezoidal, although such would, it is stated, be necessary, as the pipes are 8 feet under the tidal level. The basin is 60 feet long and 40 feet wide. Its bottom is about 5 feet below the bottom of the sewer, and the pipe outlets are on the level of its bottom. Arrangements are provided for the use of screens, if desired, for separating solid material, and unquestionably if silk is used in the same manner, a large portion of it will be deposited by subsidence.

Our drawings refer more particularly to the tunnel portion, which was built by the use of the pilot tube, under the well-known Anderson method of construction, formerly employed on the (Hudson) River Tunnel. The pilot tubes of sheet iron, circular in section, and 5 feet 4 inches in diameter, and occupying the center of the tunnel area, was kept about 10 feet in advance of the completed excavation. From its exterior rollered bridges were employed to support the shell plates and wooden lagging.

The long tunnel was cut as nearly as possible to the true size desired, and for most of the sections two-inch planks were laid on the bottom of the circle, determining the extrados of a portion of the invert. On the bottom curves thus described the brick were laid; until ribs of 1 1/2 in. were placed horizontally less than that of the brickwork, were set up and supported by radial beams from the pilot tube, while over the top of the arch and against the earth a curved shell plating or shield of iron, which covered from one-third to one-half the extrados of the upper arch, was placed and bolted together and held in position by other radial braces from the pilot tube. The sections of the shell plating were twelve inches long in the direction of the axis of the tunnel. Narrow lagging boards were laid upon the iron ribs and were carried up at one time far enough to allow the casing to be conveyed by brick behind them. When had reached their top, more boards were put in place and more brick laid. In this way the brick tube was completed until a space of but two feet was left to be filled by the key bricks. To support the brick in this space, short boards two feet long, passing between the last lagging boards, which were rabbed to receive them, fitted like the siding lid of a box. They were inserted by the mason, who, after passing one of them in place, laid in the key bricks to cover it, during that of the arch. These would slide in a second board, lay the key brick corresponding to it, and thus would work, board by board, toward the face of the sewer. The iron plates were left in position, the false work of course was removed as the work progressed.

One of the interesting features of this work, which facilitated the rapid construction of the tunnel and the speed at which the work progressed, was the use of the Brooklyn system of tunneling-machine, which is clearly illustrated in one of our engravings. This system was patented June 8, 1969, No. 9,475, by Alfred W. Betch, of Scientific American, New York. It consists of a series of iron sheet bars or needles arranged to slide in juxtaposition upon the exterior of the front end of the constructed tunnel; each needle is moved forward independently from within the tunnel. The front end of each needle has a cutting edge. In operation the needles are driven forward separately into the earth, which forms a support for their front ends, while their rear ends are supported on the exterior of the completed tunnel, thus forming a temporary protecting roof or shield, which permits the safe removal of a sufficient width of the earth of the heading to allow the insertion of a new section of the iron plates that compose the outer wall of the tunnel. This system, substantially, was successfully used the year before last (1890) in boring the large 15-foot tunnel, 1,300 feet long, for the new double-truck railway line at King's Cross Station, London.

Our illustrations show how various interesting features of the work, the section of ground under which the tunnel passes, and its course near a church on the corner of Greene and Rivington Avenue, illustrating vividly the depth of the sewer and what the engineer has accomplished. The connections with the existing sewers which lie above its level is to be thus managed. Manholes are carried up from it to the street level. Swapping side connections are made from these manholes to the sewers. Where the connection is made a lagging is to be laid diagonally across the sewer on the lower side of the connection, so as to be approximately a tangent to the side connection. The bottom of this lagging will be, as nearly as possible, at the level of the ordinary surface of water maintained by the sewer in its act upon gravity. On the occasion of a rain storm, any water rising above this level will be deflected into the side outlet and thence to the manholes of the intersecting sewer. This will give it a fall in some places as great as one foot, as will be evident by inspection of the sectional drawings. After the tunnel was completed and in the ground, the encroachment of the sewer was built by a Bond. As yet the existing sewers are not connected to it, but before long the entire work will be completed and ready for the spring and summer storms of the present year.