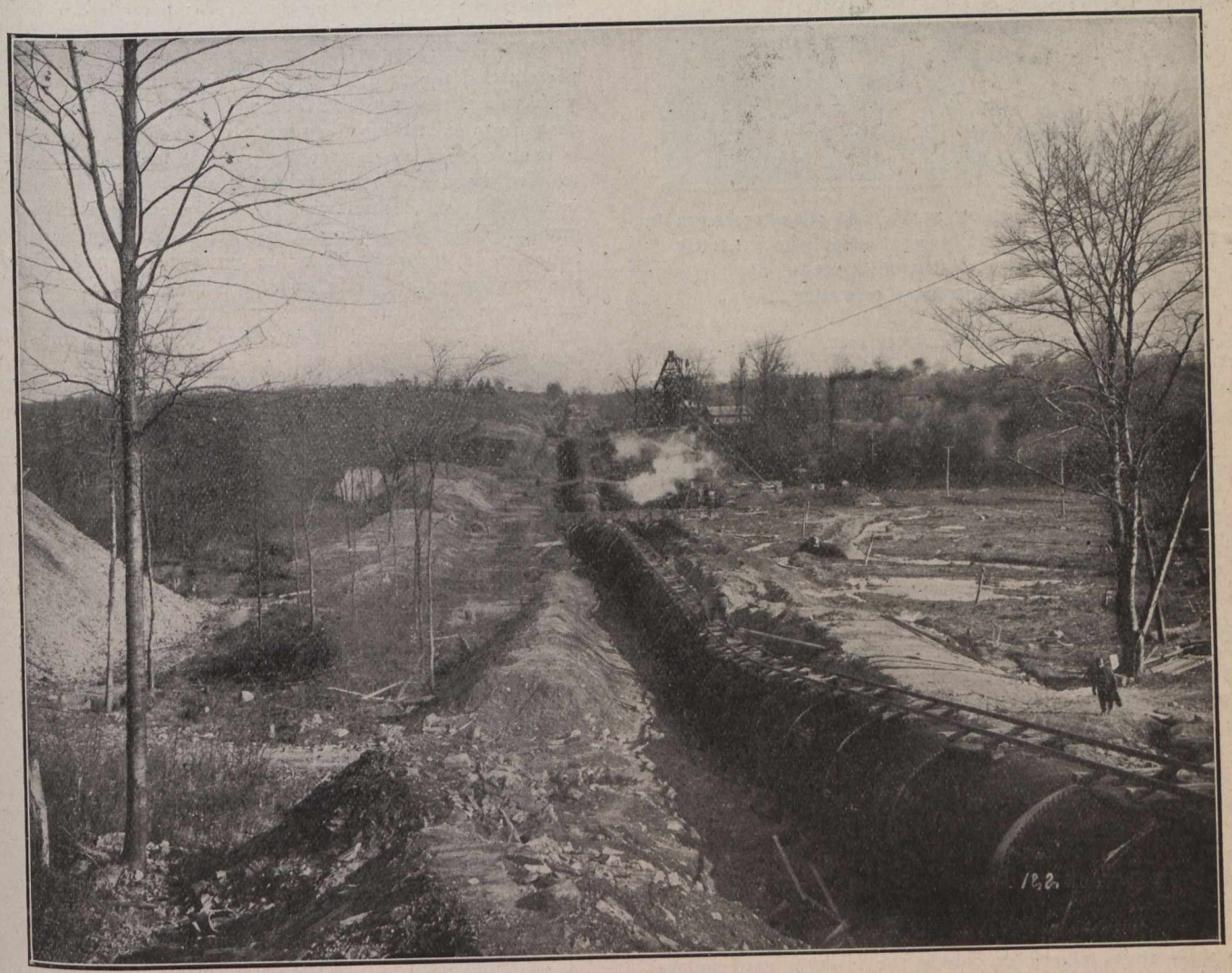
total of 2,900 bags of Portland cement was consumed. When the grout had hardened in the crevices a few more holes were drilled. Water having a head of 65 pounds was found 14 feet below. These holes were soon grouted up, only 60 bags of cement being required.

But sinking was not at once resumed. It was deemed advisable to deal further with the question of the water. The grit was now about 100 feet farther down. It was proposed to grout up the intervening water-bearing strata with more grout. Accordingly, six diamond drill-holes were put down to the grit. Half were of the size corresponding to a 1-inch core and half to a 2-inch core. With a pressure of 275 pounds per square inch, these holes were grouted up with 175 bags of cement. Nobody knew whether this small quantity of cement meant that the problem was a small one, or whether it had been only partially solved. It would seem that the thorough application of the method of grouting aheead of the excavation should have been employed sooner; that is, before the water-bearing strata had been penetrated. Sinking was now begun again, and prosecuted until a depth of 320 feet was reached. A couple of collecting rings had been arranged, and many sinking pumps installed in the shaft. The working space was much impeded. Besides, it was difficullt to secure easy, certain and adequate pumping capacity by the use of sinking pumps alone. It was determined to construct a pumping chamber off to one side at the 309-foot level. This chamber was quite large, being 10 feet high and having horizontal dimensions of 17 and 24 feet. Beneath its floor a sump, 5½ feet deep and 16 x 22 feet in area, was arranged. It had a capacity of 14,500 gallons. In the special chamber were installed three Cameron horizontal condensing pumps furnished by the Cameron Pump Works, New York City. These were all the 24 x 10 x 20-inch size, and had a combined capacity of 1,050 gallons per minute. They were run by steam supplied by three 100 horse-power boilers set up at the mouth of the shaft. As the pumps were of the condensing type, this whole arrangement was a possible one. Before the installation of this powerful pumping plant the sixth flooding of the shaft took place. Subsequently no especial difficulty was encountered from the water. More grouting was done, but none of the seams required more than 100 bags of cement, with one exception. When the grit was reached a hole gave trouble, and required 348 bags of cement. The amount of water pumped from this one shaft was 86,181,000,000 foot gallons. The total amount of Portland cement consumed in the grouting operations was 971 barrels.



Bryn Mawr Siphon—Southern End.

The Steel Siphons—Grout Inside, Concrete Outside.—Where the Catskill Aqueduct crosses a very broad valley a permanent vertical shaft is put down on each side, and the two bottoms connected by a more or less horizontal tunnel through the solid rock; but where the valleys are quite narrow, the practice is to make the crossings by means by steel tubes. These are of enormous dimensions. Three parallel tubes are required for each crossing in order to furnish full capacity. Only one is being put in at present—the middle one. There are to be, in all, fourteen steel siphon crossings of an average width of 0.455 mile. This work is divided