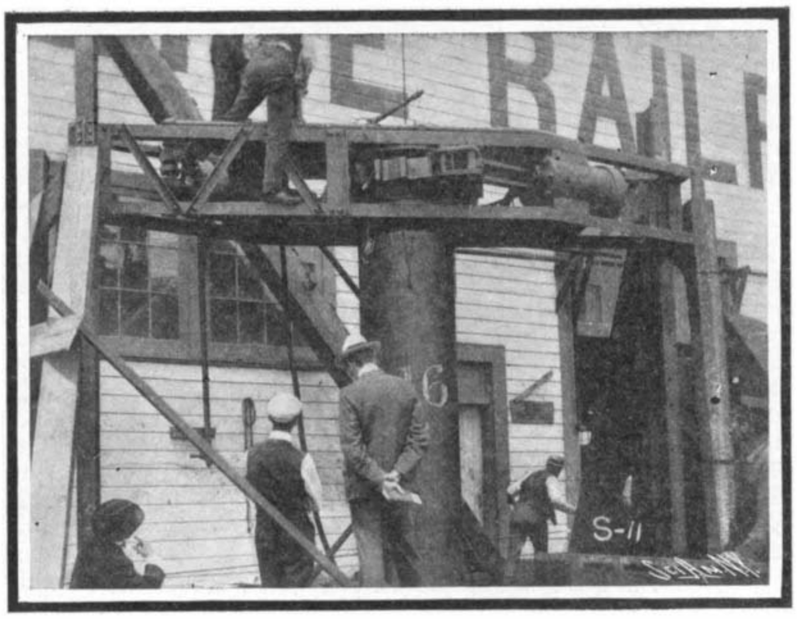
DRIVING A TEST PILE FOR THE HUDSON RIVER TUNNEL.

The Pennsylvania Railroad tunnel beneath the Hudson River will be driven through a stratum of silt whose consistency is so uncertain as to necessitate making special provision to support the tunnel and prevent any displacement, either in a vertical or lateral direction. The problem has been carefully studied by the chief engineer of the tunnel, Mr. Charles M. Jacobs, who decided to treat the tunnel as a trestle bridge, driving cast-iron piles, at 15-foot intervals, to the rock underlying the bed of the river, and supporting the track system upon them, the shell of the tunnel serving as a protecting envelope for the trains.

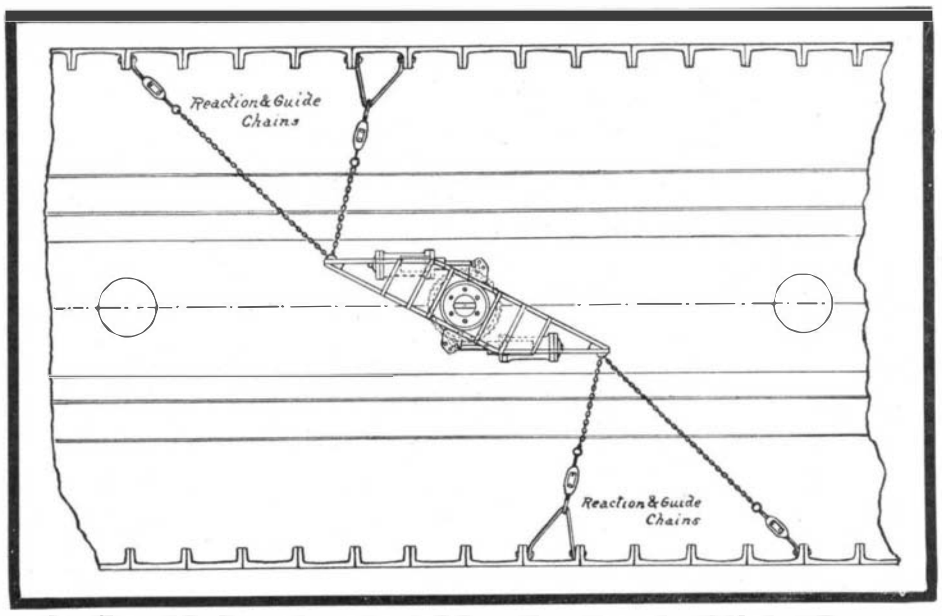
The piles are to be hollow, 27 inches in outside diameter with 1½ inches thickness of shell, and they will be made in 7-foot sections. At the foot the piles will be provided with one turn of a wide screw of 12-inch pitch, whose outside diameter will be about 5 feet. They will be screwed down through a hole in the base of the tunnel shell, a fresh length being bolted on, as each length is screwed down, until the underlying rock is reached.



View of Top of Pile, Showing the Hydraulic Screwing Machine.

With a view to testing the proposed method of driving the piles, and the bearing power of the piles themselves, a test pile was driven in a caisson sunk at the outer end of the Erie Railroad dock "C" in Weehawken, at a point 102 feet south of the center line of the proposed tunnel.

In order to screw the pile down, a hydraulic screwing machine was constructed, as shown on the accompanying line drawing. It consisted of two cylinders attached to a frame and furnished with differential plungers, 11½ and 10 inches diameter by 18 inches stroke. The cylinders were tested to 1,500 pounds water pressure per square inch. The frame was pivoted on a center casting to which a ratchet wheel was keyed; the center casting was bolted to the top of the pile when the machine was in operation. The thrust of the plungers was transmitted by means of connecting rods to pawls, which engaged the teeth of the ratchet wheel, and was guided by the rim of the latter. The screwing machine had ten strokes per revolution of pile.



Plan View of Section of Pennsylvania Railroad Tunnel, Showing Method of Staying and Operating the Pile-Screwing Machine.

It was anticipated the weight of the pile might not be sufficient to force the pile down the full pitch of the screw blade, and a hydraulic jack was built for this purpose. It consisted of a cylinder with a simple plunger, 18 inches diameter by 25 inches stroke. The reaction from this plunger was taken up by weights (pig iron, etc.) on two platforms, which were suspended from cross-beams attached to the plunger of the vertical jack. The whole arrangement is shown on the various cuts.

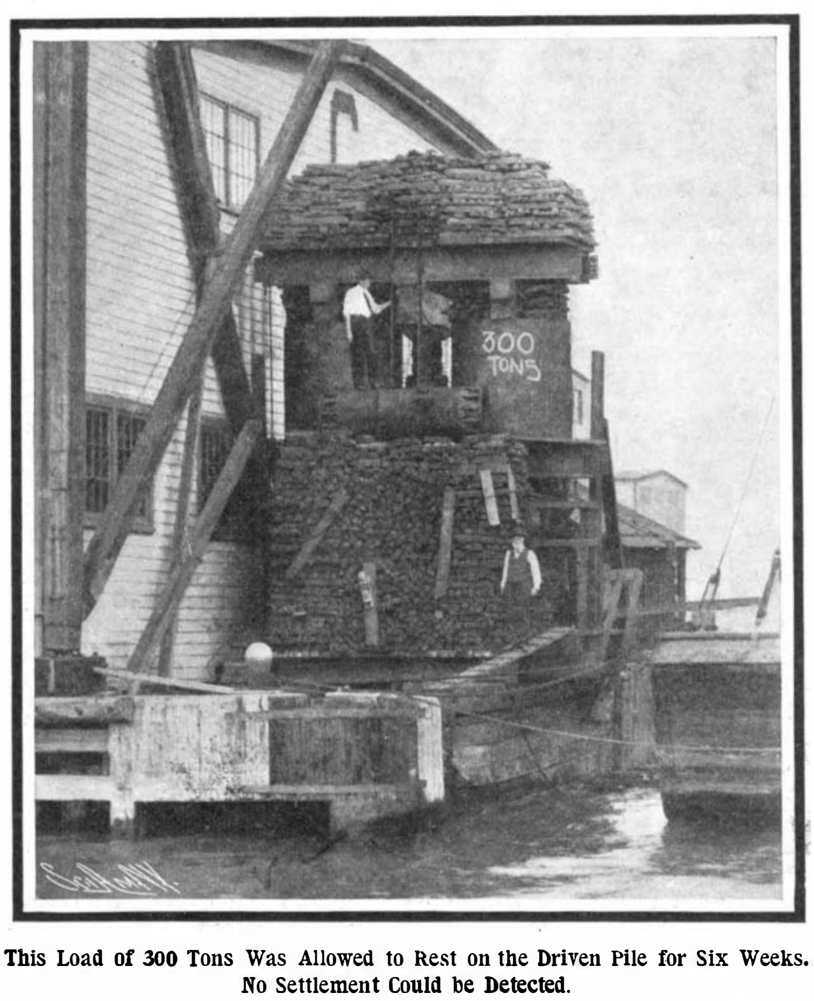
The point of the screw pile was first bolted to eight sections and lowered in the caisson, and afterward seven more sections were added, making fifteen in all before the screw pile came to rest at El. 193.47. The total weight of the pile was now 63,353 pounds.

The screwing machine was then started, and for each turn the pile was driven from a maximum of 1.2 feet to a minimum of 0.21 foot. At the thirty-sixth turn, when the dead load, including the weight of the pile, was 96,140 pounds, the penetration for one turn of the pile was 0.8 foot. The load was then gradually increased until under a load of 383,330 pounds under the operation of the hydraulic jack, the penetration for one revolution was 0.75 foot; and at the fortieth turn it decreased to 0.21 foot. The total penetration for forty revolutions was 35 feet.

The fortieth revolution was not completed, the pile refusing to revolve under a turning moment of 439,800 foot-pounds. The screwing operation was now stopped and arrangements made for the dead-load test.

The actual time occupied (exclusive of all other work, such as placing of fresh sections, etc.) in screwing down 34 feet 10 1-32 inches in thirty-eight and three-quarter turns was 9 hours 5 minutes = 14 minutes per turn, with an average penetration of 10 25-32 inches per turn, and about two-fifths of this time was occupied in making the return stroke of the screwing machine; as previously noted, the machine worked ten strokes to each revolution of the pile.

The test-pile was subjected to dead-load tests, which occupied a period of 5½ months. The load, including the pile itself, was gradually increased from 400,000 pounds to 500,000 pounds by increments of 20,000 pounds. During the first five days of the dead-load test the pile subsided about ¼ inch, and for every 20,000 pounds added thereafter the pile apparently subsided about 0.025 inch, but this was compression in the pile itself, which now measured 148 feet between the screw point and the micrometer attachment. The 500,000 pounds was kept on for about one and a half months, when the load was increased to 600,000 pounds for another month and a half without subsiding. The test was now discontinued and the pile removed. A series of drop tests was previously made on the pile with the point closed under Test No. 2, as follows: A hammer, 3,750 pounds, with a fall of 1 foot, was applied in 132 series of 250 drops each, while the dead load at the same time was increased from 200,000 to 330,000 pounds. Altogether, 33,000 blows were applied at a rate averaging thirty blows per minute.



This Load of 300 Tons Was Allowed to Rest on the Driven Pile for Six Weeks. No Settlement Could be Detected.

DRIVING A TEST PILE FOR THE PENNSYLVANIA RAILROAD HUDSON RIVER TUNNEL.

Artificial Fuels.

Everybody who has spent any time on the continent of Europe has noticed the economy practised by Europeans in the consumption of coal and marveled that the results should be so satisfactory. To be sure, the lofty, tombstone-like porcelain stove of the Germans has a chilly look at first, and the cooler atmosphere of German houses may give one a homesick longing for the furnace-heated rooms of America, but gradually the open-minded stranger comes to look with approval on the European arrangements for keeping warm, and to wonder why his own people have not perceived the beauty, the cleanliness, the economy, and satisfactory results that some patent fuels have to recommend them. That many a Yankee has turned the matter over in his busy brain is attested by a chapter on artificial fuels in Edward W. Parker's report on "The Production of Coal in 1902," which is about to be published by the United States Geological Survey as an extract from the annual volume of Mineral Resources.

Prior to 1902, about 400 patents had been issued in the United States on artificial fuels, but up to the close of 1901 none had proved a commercial success. Mr. Parker gives a list of United States patents granted since January 1, 1902. It remains to be seen whether any of them will be successfully developed. The list includes thirty-seven patents, but contains no mention of fuels made from petroleum or petroleum residue unless used in connection with coal, lignite, or peat. Neither does it include any compounds that have for their object the increase of fuel efficiency unless they are used in the manufacture of the fuel itself. Three patents were used on briquetting machinery.

The steady advance in the price of coal —no less than 40 per cent—which has taken place since 1898 has stimulated experiments looking to the invention of artificial fuels. Results obtained in foreign countries from the use of lignite and peat in briquetted form should encourage producers in the United States to try similar methods of manufacture. Small sizes of anthracite coal formerly wasted are indeed recovered now by washeries from the old culm banks and utilized. A large amount of coal lost in the form of dust or finely pulverized material might also be put into convenient shape for domestic consumption and slack now wasted at many of the bituminous mines in the United States might be used to advantage if compressed into briquettes. There are many indications that the time is not far distant when these neglected fuel resources will all be utilized.

In the report for the year 1902 on the railways in the Straits Settlements it is pointed out that in Perak an addition of 30 miles 3 chains was made to the open line during the year, bringing up the total mileage open for traffic to 274 miles 40 chains. These established through communication between Penang and Taiping, thence the line is open to Bukit Gantang, where there is a break for 7½ miles—which will be completed this year—communication being resumed at Padang Rengas *via* Kuala Kangsar to Ipoh and Bidor. The total mileage of open line from Penang to Bidor is 146 miles.