posited the water was pumped out and the space between the caissons was then bridged by six old steel girders, 6 ft. deep, resting in pockets left in the concrete in the adjacent ends of the caisson, the wooden walls of the caisson having been cut away to allow this to be done. Afterwards the concrete was deposited in a continuous mass in and between both coffer dams and caisson, thus forming a monolith upon which the masonry shaft of the pier could be carried. The masonry of the pier was then built up inside of the crib work, which was kept in place until the mason work had extended above high water.

The sinking of the large caisson for the south main pier was started July 28, 1912, and was completed October 24, 1912, or at the rate of 0.75 ft. per day during the entire period. The material encountered at this point was, as indicated by the borings, chiefly sand, and required that the pier be carried down to rock, which was reached at El. 0.0, 101 ft. below high water, and 86 ft. below the bed of the river. The difficulty experienced on the north side in keeping the cutting edge intact, and also on account of the fact that the caisson had previously been overstrained, and the fear that it might yet be weak, led the contractors to take unusual precautions to prevent the possibility of any accident happening to the caisson during the sinking operations. For this reason, special appliances were devised for relieving the cutting edge from carrying all the load, and by the use of sand-jacks the total weight of the caisson was distributed over the entire bottom area. The manner of using these sand-jacks was one of the most interesting features connected with the sinking of this caisson, and possibly merits especial description.

The jacks themselves were of very simple construction. The cylinders of the sand jacks had an internal diameter of 31 in., and were 36 in. long, constructed of ¼-in. steel plate with 4-in. lap joint; two angles 1½ x 1½ x ¼-in. reinforced the cylinder at top and bottom. The piston was a block of yellow pine 2½ ft. square and 5 ft. long. Four feet at one end was round with a diameter of 29 in., thereby allowing 1 in. play in the cylinder. The lower end of the piston was reinforced by a 2½ x ⅜-in. welded iron band. During operation the piston was attached rigidly to the roof of the working chamber by long screw bolts, and remained there permanently during the entire period of sinking.

In preparing for a drop, the first step was to excavate a hole under the piston. The cylinder was filled about ⅔ full of sand, placed in position under the piston, and blocked up hard against it by means of timbers. While this was being done the caisson was supported on timber blocking under the bulkheads and other points. At the bottom of the sand-jack was a 2-in. iron pipe extending entirely across the cylinder, the centre of which was split and opened up to allow the sand to escape. This type had no bottom to the cylinder, the timbers acting as a support for the sand. Another type used had a steel bottom and two 3-in. holes with sliding cover at each side at the foot of the cylinder. The operation in both cases was the same.

When everything was ready for a drop, the timber blocking supporting the caisson was undermined by a water jet and the full load taken by the sand jacks. A man was stationed at every jack, and at a given signal, afforded by the flashing of electric lights, each man turned a hydraulic jet with 60 lbs. pressure into the hole at the bottom of the cylinder, thus washing the sand out. The sand was caught in canvas bags of uniform size. When the canvas bag was full the lights flashed again and the water jet was turned off. Another bag was then obtained, and at the signal the jet was again turned on and the bags filled. Each cylinder contained in the neighborhood of 16 bags of sand. This operation was continued until the required settlement was obtained. By adopting the signal system and emptying the sand into bags, it was possible to guarantee that the whole caisson was being sunk at a uniform rate, and that there was no reasonable possibility of any part of the caisson being strained by being sunk more rapidly than another portion. As a rule, a drop of from 1½ to 2 ft. could be effected at each operation, the recurrence of the operations depending entirely on the nature of the material to be removed. When the drop had been finished the blocking was again placed under the bulkheads to take the load of the caisson, and the holes under the sand-jacks deepened in order that the operation might be repeated. The greater part of the material excavated in this caisson, being sand, was forced out through blow pipes.

Practically no problems were encountered in the construction of the north and south anchor piers and the north intermediate pier. Both anchor piers were constructed on a location south of the existing anchor piers. For the north anchor pier a coffer dam had to be constructed around the foundations since the foot of the pier was below high-water mark. The south anchor pier was well above high-water mark, so that all excavation was in the dry.

The anchorage girders were embedded in concrete and the first length of anchorage eyebars set in place, two shafts being left in each anchor pier for connecting up the anchor eyebars of the main anchorage. It is the intention ultimately to embed the bottom section of eyebars in concrete, but this will be deferred until they receive the full dead load stress.

The concrete used in the caisson and backing of the piers was 1:2½:5 by volume, except the concrete in the working chamber, which was 1:2½:4. The cement was required to pass a tensile test for neat cement of 450 and 540 lbs., for 7 and 28 days respectively; and for 1 part of cement and 3 parts of sand, 140 and 220 lbs. respectively. For the main piers entirely new quarry cut stone was used. For the anchor and intermediate pier the specification allowed the use of stone from the old masonry. The greater portion of the old stone demolished from the old masonry was consequently used in the construction of these piers. The abutments were not radically changed, it being only necessary to raise the ballast walls and make minor alterations to suit the new design.

The masonry in the pier shafts consists of grey granite rock faced ashlar, laid with alternate headers and stretchers and backed with concrete, in which were embedded displacer stones usually about 1 cu. yd. in size. Headers were required to have a length of at least 2½ times their build, with a minimum length of 7 ft. Bed joints were ½ in. throughout and vertical joints ⅜ in. for 12 in. back from the face and not exceeding 4 in. wide at any point.

All stones in rounded ends of main piers were clamped together and connected vertically by dowels. The upper 18 ft. of these piers were built with cut granite backing. About 40% of the stones in these backing courses were made to project up through the course above, in this way giving a very strong vertical bond. The bridge seats proper are built 2 ft. higher than the surrounding upper coping course, and are 4 ft. deep, extending to the bottom of this coping, thus providing heavy stones under the main bearings.

The anchor piers are in plan about 136 ft. long by 29 ft. wide at the bottom, with a batter of 1 in 24, and re-