

it became a matter of primary importance to dislodge all boulders in advance, before the shoe or the frames came to a bearing upon them.

All this work had to be done under water, because there was usually along the shoe a trench filled with water communicated with the water outside, and this trench was connected with cross-trenches under the frames, which in time supplied the large pools around the water shafts.

The finding of these boulders in advance was a laborious, disagreeable, never-ending task. Its performance fell entirely upon the engineering staff in the caisson, Col. Paine and Mr. Clark. The perimeter of the shoe or cutting edge measures about five hundred and forty feet, adding to this the five frames of one hundred and two feet each, gives a total length of one thousand and fifty lineal feet of bearing surface, every inch of which had to be carefully probed under water twice a day with a steel sounding bar, and the proper conclusions drawn as to the best means of moving the rocks, hard-pan, and other material found. Each shifting gang of laborers had to be informed anew whenever their turn of work came on. Being under water, this beside became a matter of memory and not of mere eyesight. Moreover, a settling of the caisson of six inches or a foot, would bring to light an entirely fresh crop of boulders in new positions, and very often half without and half within the caisson.

The shoe being of necessity unsupported, it was left for the frames to support so much of the weight of the caisson as was not balanced by the air-pressure.

The first attempt in the operation of lowering was to leave small pillars of earth under the frames, about three feet square, and from six to eight feet apart, the intervening earth being taken away, and forming part of the trench. These pillars were to be then uniformly undermined, and the caisson lowered in that manner. It was soon found that the pillars usually concealed the head of a large boulder, which required their premature removal. Again, the water would wash them down, and still oftener the laborers in adjacent