

the rock, and in some instances to the rock itself. But the immediate rock surface was covered with a compact layer of material through which it was impossible to drive a six-inch pipe without shattering it. To drive the pipe one inch only, required thirty blows of a five hundred-pound hammer, falling from a height of twenty feet. But even in such material the quicksand would run into the pipe from below and fill it up for several feet.

When the sinking of the caisson commenced, this question still remained undecided, whether to go to rock or remain above it.

In case of the former alternative, we had the means at hand for blasting the entire rock to a level surface if necessary, and of removing the blasted material, at an additional expense, it is true, of several hundred thousand dollars and six months' more time.

Or, in case the material on the rock proved water-tight, it would be feasible to sink a requisite number of smaller foundations to the bed rock, sufficient to hold the immediate weight above, and then, by a series of smaller coffer-dams or cylinders, remove the remainder of the material and thus get a uniform mass of material between the rock and the roof of the air-chamber.

The only course, therefore, left open under the circumstances was to proceed with the work, and when the caisson had arrived within a short distance of the rock, make a sufficient number of soundings, and then determine upon a course of action when we were face to face with the material.

The character of these bore-holes had also made it apparent that any single plan of operations would not be adequate for removing all the material we would encounter. The immediate river bed consisted of logs and loose dock stones, followed by a sticky, black clay.

These materials could evidently be best removed by dredges working in water shafts.

The river sand and firm gravel beneath would be easier removed through pipes, either by pumps or the air pressure direct.