was constantly an open cavity between the caisson and this perpendicular face of earth. This opening in some places was ten feet high and wide enough when a large boulder had been removed from under the shoe to allow a man to go entirely out of the caisson. Such cases were rather dangerous, since on two occasions the air had a chance to rush out above through crevices caused by slipping of earth. Such escape would then be followed by cartloads of clay and water, pouring in underneath the shoe.

**The Water Shafts and Buckets.**

All the material in the caisson was taken out through the water shaft by means of Morris & Cumming's "Grapnell bucket," an instrument which is analogous to the human hand in its action. It is lowered down the shaft by means of two ropes in an *open position*; arrived at the bottom it closes over the material, filling itself at the same time. It is then drawn up and emptied into a car run under for the purpose. For a cut and description I would refer to "Engineering" p. 50 vol. 7. Each bucket has a capacity of one and a half yards, a lift being accomplished every four minutes. The estimated efficiency, making all due allowances, was eight hundred yards per day. In regular harbor dredging one bucket alone will raise one thousand two hundred yards per day.

The total quantity of earth removed from the caisson was over 20,000 yards. Our buckets therefore should have removed the material quite comfortably in one month's time. In place of one month five were required, and these were five months of incessant toil and worry, everlasting breaking down and repairing, and constant study where to improve if possible. We had in fact a material which could not be dredged. The Osgood dredge which was used for leveling off before the caisson was floated in, could accomplish about ten yards a day, when not aided by submarine blasting, and the Morris & Cummings dredge fished all day without bringing up a handful.

The first disappointment lay in the fact that the buckets