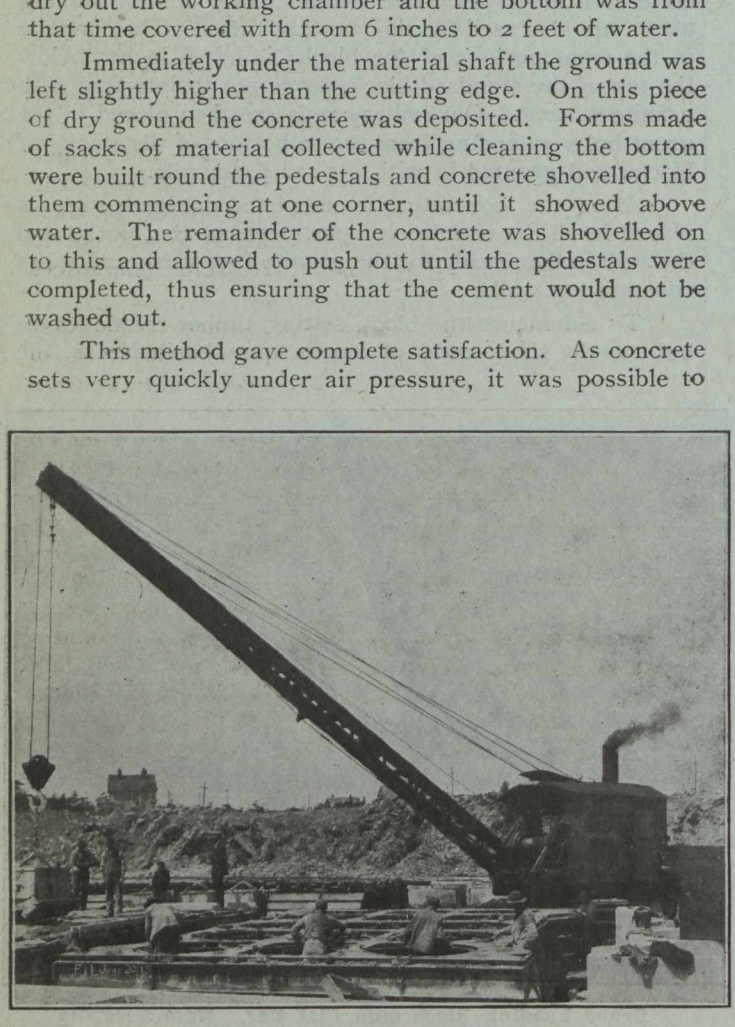
a ½ cubic yard concreting mixer and a steel frame derrick of 20-ton capacity.

For the first few months clay was packed around the cutting edge of the bell, all the water pumped out and the concrete pedestals constructed in the dry. This mode of procedure, however, took considerable time, and there was always the danger of the clay bank breaking and allowing the water to rush in. It was, therefore, decided not to dry out the working chamber and the bottom was from that time covered with from 6 inches to 2 feet of water.

Immediately under the material shaft the ground was left slightly higher than the cutting edge. On this piece of dry ground the concrete was deposited. Forms made of sacks of material collected while cleaning the bottom were built round the pedestals and concrete shovelled into them commencing at one corner, until it showed above water. The remainder of the concrete was shovelled on to this and allowed to push out until the pedestals were completed, thus ensuring that the cement would not be washed out.

This method gave complete satisfaction. As concrete sets very quickly under air pressure, it was possible to



Blocks Before Leaving Yard.

strip the forms off the pedestals in six hours even with a pedestal 3 or 4 feet high. The water was then allowed to rise slowly in the bell and the bell moved.

There was only one foundation which caused any trouble and calls for special mention, and that was for the first stack of blocks on north quay basin No. 1, where it was found that the rock at the front of the wall slipped down suddenly for a depth of 7 feet below foundation level.

In order to set the bell on this foundation the hole was filled with granite boulders, and the bell then set with its front edge resting on them, and its back edge on the solid rock. The water was then expelled from the working chamber and the bell tilted forward by removing pieces of granite until it was 3 feet out of level. Fortunately the front edge of the bell just rested upon two large granite boulders, so all the granite inside the line of the wall could be removed. When this had been done a clay bank 4 feet high was built from the bottom of the hole to the cutting edge and all the water expelled.

By this means it was possible to excavate the rock along the front of the wall forming a level strip 7 feet wide at the bottom of the hole to ensure a good footing. This was a somewhat interesting and delicate operation, as the men were working 4 feet below the cutting edge with only a light clay bank to keep the water out.

Wooden forms were then placed along the front of the bell and a concrete wall 8 feet thick constructed up to the level of the remainder of the foundation, and on this wall the front pedestals were made. It was found in connection with the bell work that if the rock had been properly dredged to grade by the dipper dredge 22 lineal feet of foundation could be prepared with the bell per day.

Materials of Construction.—Cement: All the cement used on the works is manufactured in Canada, at Montreal and Belleville. The Belleville cement, which contains a low percentage of magnesia, was used in concrete which would come in contact with the salt water.

Aggregate for Concrete: Beach sand and gravel is used in all concrete work. This material is obtained from a beach purchased by the contractors at Lawrencetown, about 16 miles east of Halifax. With careful inspection it was found possible to use run of beach material for all the mass concrete work.

Reinforcing Steel: The reinforcing steel is manufactured at New Glasgow and Sydney, Nova Scotia.

Granite: All the granite is obtained from Purcell's Cove Quarry.

Cast Iron: The castings for the mooring hooks are all made locally.

Features of Design.—The smoothness and facility with which the harbor works have been carried out and the general standard of excellence attained have so far amply justified the main features of the design of the quay walls and breakwater and the location. The principle of using the largest possible blocks for quay wall construction, providing the weight does not exceed the capacity of reasonable and, if possible, standard equipment, has been further illustrated and the results have even exceeded expectations. It would be impossible to set smaller blocks with greater accuracy and at a faster rate. Experience has shown that the large reinforced concrete blocks can be set as quickly as the small granite corbel course blocks.

The cellular construction of the blocks has made it possible to manufacture a block about three times as large as a mass concrete one of the same weight, and has thus cut the amount of block setting to one-third.

The width of the wall, namely, 31 feet, has eliminated the use of expensive temporary staging for carrying the block setting cranes and at the same time has provided foundations for the front row of freight shed columns, which otherwise would have to be provided independently at considerable cost. Perhaps the most interesting and certainly the most important feature of the design of the blocks is that an enormous saving in foundation work has been effected. Whereas it is usually necessary to carefully construct a level foundation for the full width and length of the wall, by means of concrete in bags or mass concrete carefully levelled, all that is necessary with the cellular blocks is to level the small areas on which the corners of the bottom blocks rest, that is, a pedestal 5 ft. x 6 ft. back and front of the wall is constructed every 22 feet, and the remainder of the foundation allowed to remain as left by the dredges, with the exception of a little cleaning, as previously described.

The harbor works are also sufficiently advanced for it to be safely recorded that the main features of the design are even better suited to conditions found at the site of the terminals than was anticipated.