culty was experienced in this, owing to the mud being so soft that sometimes tipping from wagons would go on for days without making the slightest difference, and then the ground would probably spue up and disgorge the material 100 yards away. This trouble was overcome by placing in the embankment great quantities of brushwood made into bundles. Two 3 feet diameter C.I. pipes, with sluices, were laid through this embankment, to drain off the water, and at low tide the sluices were closed and the sea shut out.

A large drainage well, about 20 feet square, was then sunk about 80 feet to the rock, and any surface leakage water was led to it in open channels about 18 inches broad.

Later, a second embankment dam was constructed in a similar manner, farther out, as indicated on the plan, and last of all a concrete monolith dam was constructed across the extreme outer end of the lock, as described later.

*Excavation.*—The scheme of construction was to excavate the whole site of the dock in the dry, down to a level of +14 O.C.B. = about 24 feet below cope, at which level the trenches for the dock walls were commenced, the "dumpling," about 20 feet deep, being left in until the walls were completed. Some 4,000,000 cubic yards had to be excavated, mostly silty mud, yet of sufficient consistency to bear the steam excavators on rails on a close-tied bed. The whole of the excavation was done by mechanical means, excepting the heavily timbered trenches of the walls, which were excavated by hand. The material excavated was hauled in wagons partly by two standing engines, but mostly by locomotives (of which there were 37 employed during the work), and tipped towards the north. The land thus reclaimed from the sea was afterwards used for terminal facilities.

Rock Breakers .-- In this instance practically all the excavation was of soft material, but where excavation is in rock below water, instead of using explosives to break up the rock before dredging, what is known as a Lobnitz rock breaker, which does the work without explosives, is used. It consists of a heavy chisel of compressed steel, of which the weight is from 10 to 15 tons. This chisel is fitted with a hard-cutting point, and is allowed to fall by its own weight through 6 to 10 feet from a suitable height on to the clean surface of the rock. The cutter breaks its way into the surface rock, partly pulverising it and partly breaking it. The whole force of impact thus concentrated on a very small surface, and has been proved to crush or disintegrate the hardest rock. If the depth of rock to be broken up is more than 3 feet, it is best to break it in horizontal layers. A single cutter machine will break up 100 cubic yards per day in average rock at an expenditure of one ton of coal, wages of four men, and the cost of oil, stores, and repairs, which does not exceed the outlay for coal and wages.

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