Two years ago extensive pile-driving was done by the Department of Public Works of Canada as protection work, when widening the River Sydenham, at Owen Sound, to increase the harbor area. Previous work at this place had shown the difficulty of driving piles through the sand and other compact material found at this place, sufficiently long to allow the lower ends to be below the depth required to be dredged in the harbor. A very clever mechanic, a partner of the firm of contractors for the protection work—Captain James Canan—consulted with Major Gray and conceived the idea that he could improve upon the method of using a jet alongside the pile, while being driven, to displace the material through which the pile had to pass, and, in fact, construct a machine which would *bore the hole* for the pile, and before the hole thus bored could fill in, insert the pile in place and to its required depth. After several trials Captain Canan succeeded beyond all expectations, and, as a result, the following facts will be of interest:

Fender piles of rock elm, 40 feet long, 12 x 12 inches square, with ordinary pile-driving machine—*i.e.*, ram 2,000 pounds weight, fall 20 feet, pile pointed and iron ring placed around head—after 200 blows, given in from 35 to 40 minutes, split below the ring, and a piece one foot in length had to be cut off the top of the pile and the ring replaced; after fifteen more blows the pile could not be driven any further, and three feet three inches still remaining above the proper height of the pile work had to be cut off.

With the use of the boring machine the same sized pile, viz., 40 feet long, 12 x 12 inches square, passing through the same material, was put down its *full length*, without use of ring, in three minutes, perfectly perpendicular, in line, and close up against the other work, and to exactly the required height, with nothing to cut off top; only the weight of the hammer resting on the head of the pile, at first, and then settling into its full depth, a few blows given, the hammer not being hoisted more than 2 feet in the leaders, completing the work. Eighty to one hundred piles, penetrating 20 feet in depth, have been driven by this method in one working day of 10 hours.

It may be remarked here, for comparison, that the U. S. Army Engineers (Vol. 1889, part 4) give a day's work of pile-driving, with use of jet, material, sand, with pockets of gravel, average penetration 18.9 feet, as from 20 to 34 piles.

With respect to that portion of Mr. Perley's paper in which he gives the power of ice adhering to and surrounding a pile to raise it by the influx of water underneath—acting as a platform—Major Gray states that having had considerable difficulty to keep a level railway track on a pile-bent structure at Catalone Lake, Cape Breton, from the same cause, he inverted the piles and by this means reduced the friction upwards (or adhesion), and the ice becoming free, thus prevented the piles from being disturbed.

Mr. Canan describes his machine as follows:—

The object of the invention is to design a simple machine which will rapidly bore into soil under water; and it consists essentially of a shaft to which a turbine and an archimedian screw are fixed and contained in a casing supplied with water under pressure, and having openings arranged in such a manner that the water forced into the said casing will, in escaping, act upwardly against the soil loosened by cutting blades fixed near the end of the shaft, substantially as hereinafter more particularly explained.

Figure 1 is an outside view of my improved boring machine, partially broken away.

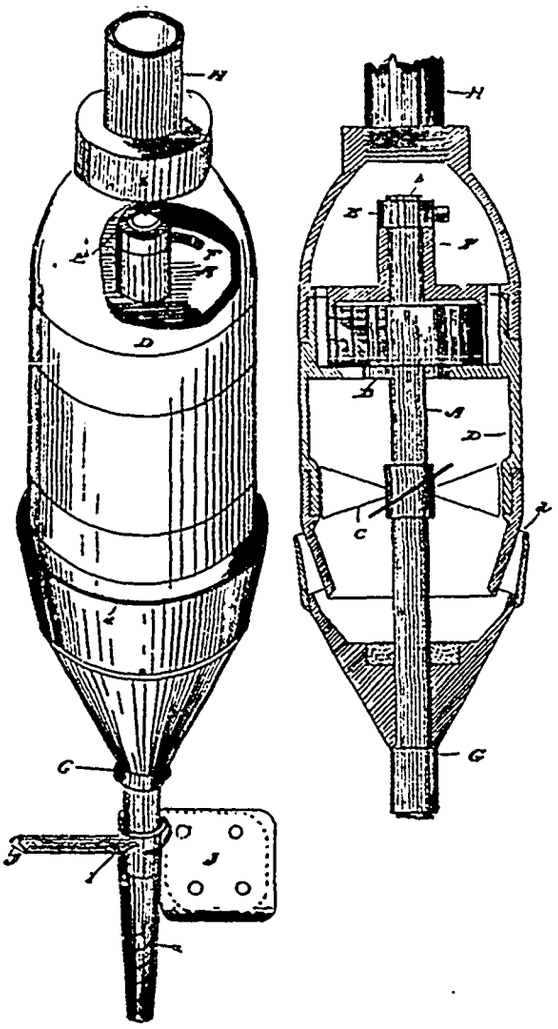

FIG. 1. FIG. 2.

Figure 2 is a sectional elevation of the same.

A represents a shaft, to which a turbine, *B*, and a propeller or archimedian screw, *C*, are fixed. A casing, *D*, is arranged, as indicated, to contain the turbine, *B*, and propeller, *C*. A collar, *E*, clamped on the shaft, *A*, rests upon the step, *F*, formed within the casing, *D*, as indicated. Suitable bearings are otherwise provided for the shaft, *A*, so that it can be made to revolve freely. A collar, *G*, clamped to the shaft, *A*, butts against the end of the casing, *D*, so that with the collar, *E*, the shaft, *A*, is securely held, so that it cannot move vertically within its casing, *D*. *H* represents a piece of gas pipe, by which the casing, *D*, is connected to a powerful pump. I cut or form a coarse screw, *a*, on the end of the shaft, *A*, and a little above the said coarse screw I fix to th. said shaft, *A*, a two-blade cutter, *I*, the blades being set at such an angle that they will not only cut into the soil against which they are pressed, but will elevate the loosened soil so cut. I provide steel plates, *J*, which are detachably connected to the blades of the cutter. These plates are sharpened, and in fact form the cutting edges of the cutter, *I*. They are made detachable, so that they can readily be removed to be replaced by new ones when they are worn out, or when they require sharpening. The water which is forced into the casing, *D*, under a high pressure, passes into the hollow shaft, *A*, through its open end, *b*, and thence through the hole at its bottom end,