or lowering what is called a double gab. The lever on the rock shaft being double-ended, the lowering of the gab caused the lips of the lever to thrust the pin into the gab, and thus the forward movement was produced. The backward movement was produced by raising the gab, which caused the upper lips to strike the upper pin, and this shifted it to go backwards.

The smoke-stack was funnel-shaped with a heavy wire screen, having a piece of boiler plate about 12 inches diameter in the centre, stretched across the opening. The frame was made of boiler iron filled in with oak. The protection of the driver seems not to have been thought of, for the "Dorchester" had no cab. A frame of iron was bent over the steam chest, and by stretching canvas over this some protection was obtained. The "Dorchester" was considered a grand engine in her day, but she was no light undertaking for her driver. For instance, the heat of the boiler at the bottom of the smoke-stack was often so intense as to burn up the packing in the cylinders, and he had to pack the bottom of the smoke-box with clay.

The rails were of wood, with an iron strip running along the top about ⅝ inch thick and 2¾ inches wide. These served every purpose until the "Jason C. Pierce" appeared on the scene in 1837. This engine was built at the Norris works, Philadelphia, and was gigantic for her time. She had outside connections, a rather high boiler, cylinder on the incline, and four driving wheels—one set fore and the other aft of the fire-box. "She had the oddest rig I ever saw for valve motion," says Mr. Ostrout. "She had four eccentrics, four hooks or gabs, all disengaged at once, and tripped by small rock shaft with four short levers with friction rollers. To move ahead, two of the rollers were lowered to drop on pins; but the pins would not engage with hooks until the valve rods were manipulated by the engineer, who shifted the valve rods by levers on a slewed rocking shaft connected with the valves, and put the pins under the hooks. To back, it was necessary to reverse the small rock shaft to its full extent. This engine was much too heavy for the primitive wooden track, and would twist the iron strap into all imaginable shapes. On one occasion the strap rail curled up just behind the driving wheel, struck under the tender forward of the flange connection of the feed hose, running up through the bottom and top sheet of the tender and through the tool chest."

Mr. Ostrout remembers with amusement the first cut-off. It was a common throttle on which they set a band shaft with the lugs of two half hoops. As each lug revolved it would thrust a valve connected to a hinged post by an iron rod, rubbing on the shaft valve and closed or bumped out the opening valve. Some steam, he says, was saved, but the later introduction of the drop valve with dash pots was a great improvement. Mr. Ostrout is continually recalling, while he talks, little events which mark advances in both railway and marine engineering, and was recently engaged in writing his experiences when a calamity befel him like that which happened to Sir Isaac Newton—a little dog captured and tore into fragments his technical, though lucid descriptions.

OF MUCH INTEREST—TO US.

For THE CANADIAN ENGINEER.

CRIBWORK RETAINING-WALLS.

BY WILLIAM B. MACKENZIE, ASST. ENG. I.C.R., MONCTON.

Mr. P. E. Nostrand's description of the present state of the Riker's Island cribwork, near New York, published in *The Engineering News* of January 6, 1896, is very interesting and valuable. This crib has turned over backwards and slid out on the soft mud from 25 to 35 feet.

Mr. Nostrand was employed to make an expert examination, and his excellent suggestions for the building of cribwork are as follows:—

1st. Dredge for a level and firm foundation.

2nd. Build returns or anchors as part of the cribwork, at frequent intervals.

3rd. Begin to fill at the crib, so as to drive the mud wave towards the shore.

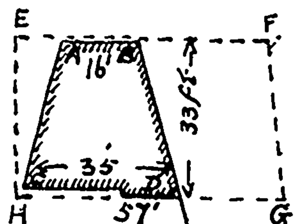

Fig. 2

Referring to Fig. 2 for the actual cross-section of the Riker's Island cribwork *A B C D* as built, it is doubtful whether it could have been made to stand and retain earth level with its top, on any but a hard and level foundation.

For a quick method of finding the approximate pressure against a retaining-wall of any kind, when the natural slope of the backing is 1½ to 1, I have constructed and used diagram 1, and for finding the proper width of cribwork filled with stone, acting as retaining-walls on soft bottom, I have constructed diagram 2.

These diagrams will explain themselves.

It will be seen that for a factor of safety of 1½, diagram 2 calls for a bottom width of 57 feet for the Riker's Island cribwork, instead of 35 feet as built; see dotted lines *E*, *F*, *G*, *H*, Fig. 2: the character of the bottom, etc., being assumed the same in both cases.

Diagram 1 is intended to save the trouble of calculating the pressure against any wall, and diagram 2 is simply a straight line drawn between two points, one corresponding to the width for a low crib, and the other that for a high crib, intermediate widths varying directly as the heights.

After finding the earth pressure against the crib by diagrams, the estimated weight of the crib in sea-water, multiplied by a co-efficient of friction of 0.20, for wood on soft mud, was used to find the width of the crib, which width was increased or diminished until a factor of safety of 1½ was reached.

The part of the crib above high water was taken as weighing 84.98 lbs. per cubic foot, the part between high and low water at 90.74 lbs. per cubic foot *in air*, and 48·97 lbs. per cubic foot *in water*, and the part below low water at 41 lbs. per cubic foot *in the water.* For the filling of earth at the back, the part above high water was taken as weighing 117 lbs. per cubic foot, the part between high and low water at 65 lbs. per cubic foot at high tide, and 123 lbs. per cubic foot at low tide, and the part below low water at 65 lbs. per cubic foot. No assistance was counted on from the mud in front.

In the summer of 1895 a crib 800 feet long was built at Halifax, Nova Scotia, having widths as per diagram No. 2, the heights varying from 24 feet to 32½ feet from mud line to top of crib. It was filled with stones, and built on a bottom so soft that it has sunk from 4 to 15 feet down into the mud. The ballast-floor was