FIGURE 5.—CAISSON FOR PIER 4 BEING ROLLED OVER.

was necessary, as we not only had the racking of the machinery, but the sandbars were so changeable that, generally, at low water, the barges would be on the bottom and very unevenly landed. Our machinery consisted of an ordinary pneumatic plant, viz.: compressors, pumps, boilers, electric lighting machinery, etc. We also had in the hold of the machinery barge a large number of barrels connected with pipe, which we used for water storage, the plant being very compact. Our derrick barge was a duplicate of the machinery barge; it was surmounted with a very strong derrick and carried an 8¼ by 10 in. double winding engine. The coping stones for those piers were quite heavy, four on each pier weighing over 8 tons each. Setting those stones with a long boom was no child's play, with the strong running water that was there. We also had several derricks along the wharf on shore, also at the shipyard where we built the caissons and one up the river at Stewiacke. This work called for more machinery than ordinary work does, due to the time of still water being so limited for loading or unloading supplies.

Our caissons were built of 12 by 12 in. white hemlock and were 62 ft. long, 26 ft. wide, and had 8 ft. of working chamber. The sides were 3 ft. thick, all drift and through bolted, lined on the inside with 3-in. spruce and calked, also braced across and through with 1½-in. rods put in from side to side. A hemlock roof 3 ft. thick was planked over and the seams calked. From this point we started our crib work, this also being calked on the outside. They were built sharp on each end, and each of the ends was faced with hardwood 6 in. thick, which was fastened on with ⅝-in. steel drift bolts; then the nose and shoulders were faced with ⅜-in. steel plates, fastened on with ¾-in. iron rag bolts. The cribbing was 12 by 12 in. bay shore spruce. We did not use any timber ties, but in place used 1¼-in. through rods with turn-buckles. There were four of these put in every third course of timber.

Our concrete was of two classes, viz., hearting and facing; this was mixed on a platform on the west side of the river under the cable way and transferred out to the various piers. In all cases Portland cement was used. We also built into the concrete hook rods made of ¾-in. round iron, which overlapped each other, thus making a continuous bond. These were put in vertically and horizontally. This work was designed by the Chief Engineer of the Midland Ry., Z. I. Fowler, of Ottawa, Ont. He is a very able engineer, and of whom I cannot speak too highly. I found in Nova Scotia a warm-hearted and energetic people, ever ready to extend the hospitality of their homes and hearts to us. The work was done under the supervision of Dr. M. Murphy, the Nova Scotia Government Engineer, whom I found a very able and competent engineer. Mention should also be made of Mr. Douglas, assistant to the Dominion Government Engineer, and J. J. Taylor, resident engineer, Truro, who were concerned in the work and to whom due credit should be accorded.

The foregoing paper was read before the Western Society of Engineers at Chicago, the reading being followed by the discussion given below:

MR. FINLEY—In describing the foundations for one of the piers Mr. Thomas mentions that there was a hard material that was very difficult to remove. Why was it necessary to remove it?

MR. THOMAS—I will simply say that what has been might occur again, and it was very evident that at some time the river bed was down at bed rock, and at some time in the future the water might go down again to the bed rock. I can never do my work too well, for I realize that human life is concerned in the integrity of the foundations of these piers.

GEN. W. SOOY SMITH—What appears to me most singular, in Mr. Thomas' talk this evening, and what might perhaps invite criticism (which would not be in good taste in the absence of those who designed the work), in the light of American engineering, is the fact that the bridge should have been planned as it was, and that there should have been such a lack of knowledge of the conditions under which these foundations have been built, and even the material itself upon which they were to rest was not well known. The soundings also proved deceptive. It would certainly appear that that, of all situations, was one in which a long span would have been advisable, first, on account of the extreme difficulty of putting in the piers, and, second, because of the obstruction of the piers themselves. Great ingenuity was called for on the part of those conducting this work, as has been made evident to us. The greatest difficulty was imposed upon them, and it seems to me to have been, to some extent, unnecessary, if a thorough knowledge of the work had been obtained in the first place. If a plan of substructure had been made, adapted to the superstructure and adapting itself to the existing conditions, the difficulties would have been very largely reduced, and the final result, it seems to me, very much better.

MR. THOMAS—With regard to the proper soundings being taken, it was what we have all met with and will meet with again, namely, they did not allow the engineer, in the first place, sufficient money to make the necessary examination, and more than that, the man who did make it had evidently never done any of that class of work before, as in place of making "borings" he made "drivings." He drove a rod down; he said he could not turn his pipe down. I made some surveys for the Roberts-Corbin syndicate when I was in the employ of Sooy Smith & Co. It is not generally known, but I made all the borings and all the surveys in New York harbour, from Cortlandt street to Ft. Tompkins, and up the Kill von Kull for the proposed tunneling, etc., which is to be done under New York city. I went down over 266 ft. to rock, using only a 1¼-in. pipe. I went down 104 ft. through boulders and very hard material, and there is no use telling me a man cannot put a pipe down where he wants to, if he understands his business.

MR. STROBEL—I would like to ask what are the dimensions of these piers?

MR. THOMAS—Size under coping, 24 ft. long by 8 ft. wide; coping, 2 ft. thick, of granite.

MR. STROBEL—What batter?

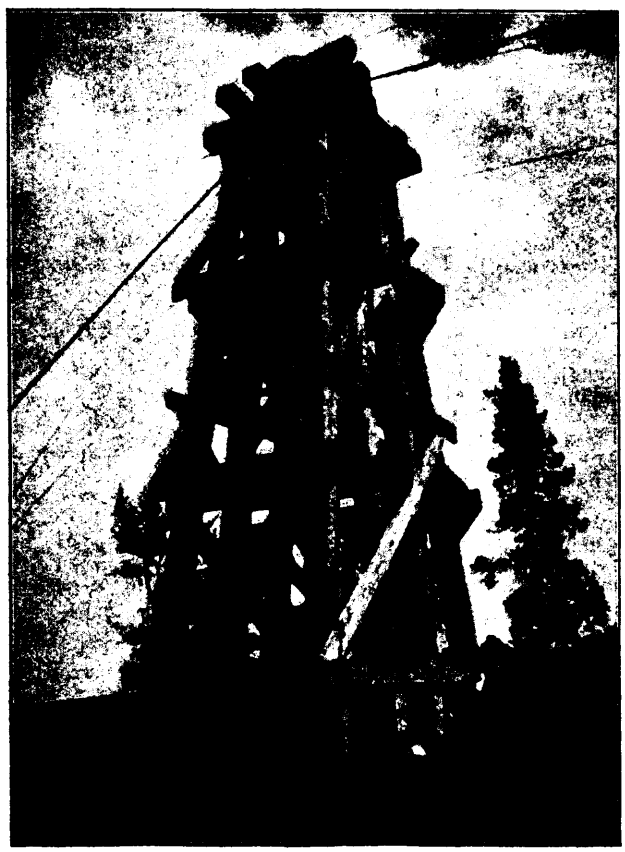

FIGURE 6.—TOWER SUPPORTING CABLE RAILWAY.