Once it has stood this ordeal we may consider it safe from all damage except by weathering and frost.

The author has also placed on Plate X the section of an abutment built in Canada, in 1888, under his supervision, which is of much heavier design, and as it had very good opportunity to get fully set before the embankment was made in layers by train, it would seem very heavy for its duties, unless the greater severity of climate of Ontario over that of Pennsylvania, which is very small in amount, be counted against it.

The author would very much desire opinions from members of the Society, engaged in such work, on this much vexed question.

Plate XI shows some details in constructing the river piers.

The dredging lines were marked by 4 flags for each excavation, 2 in the line of each side of a pit, one being 20 feet distant from the up stream end of the pit to measure from, the other some 200 feet further up stream to give line.

These flags were very large quarry stones, with a 20-foot scantling dowelled on to one side in an upright position, a rope attached to the stone and slipped over the top of the flag served to raise the stone for removal or setting. The dredges were worked backward down stream, and did not interfere with the flags.

The pits were dredged 5 feet all around larger than the timber cribs, to allow for variation in sinking the latter, this being sufficient, as the dredging was only about 1 to 2 feet deep, and chiefly consisted of gravel and soft shale. After dredging a pit to a fairly even surface, the dredge was drawn up alongside and anchored (with spuds).

The side was then graduated every 3 feet, and a small coal barge, placed at right angles, done in the same way.

Soundings were then taken every 3 feet each way, and after being recorded on a diagram (See Plate XI.) the high spots were found by inspection. A diver was then sent down to these spots, which he levelled off by hand or with a bar; by this means a good surface for the foundation of the cribs was obtained, but further uniformity was secured by a thin layer of broken stone carefully shovelled from a barge into the low places, by aid of sounding poles, with large iron shoes, to prevent their entrance into the smallest interstices.

The timber cribs, with caissons properly attached and caulked, were then floated into place, and after being roughly located were anchored by guy lines attached to shore or to sunken boxes of stone, which were used because ordinary anchors were not on hand, and would probably have dragged on the rock bottom if they had been.

Masonry was then built into them until bottom was nearly reached, when they were carefully located by transit and wires from the shore, and sunk.

The wire used was No. 15 German Piano wire, stretched to about 30 lbs. tension, tagged every 5 feet, where needed, with pieces of wire, attached by solder. To make the solder firm it was found necessary to remove the exterior coating of the wire by muriatic acid.

During the sinking of one of the cribs, the foreman, with it within 2 or 3 feet of bottom, found one corner high, and, before getting carefully located, thought it better to get the crib levelled up, after which the practice was to put the crib in exact position, about 1 foot above bottom, and then by piling on large stones at one end that end was lodged and the position fixed. But alas! for him, in this case, being *out* of position, it had lodged on a high undredged corner; and after putting 10 or 15 of the largest stones he could find on this obdurate corner, it was still high, and the theory of hydraulics put to confusion. On discovering the true state of affairs, he, painfully but wrathfully, removed the stones in order to move his crib at all, all of which has a moral attached.

Of course a crib cannot be landed perfectly exact in position, but all that is necessary is to get it so nearly so that the neat work,