in the brick work, and, as the work was laid with a shove joint with one to three cement mortar, it is practically watertight, the leakage through the seams in the rock passing into the hollow brick and down openings left in the hollow brick lining to cast-iron weeper boxes at the rack deck level, the water falling from them freely into the wheelpit just above tail race level.

During the placing of the brick lining a great number of castings were placed in position. These consisted of the main and auxiliary draft tubes, which were buried in the brick walls (the bracket casting section alone of each draft tube weighing about 25 tons) and castings for supporting the lower penstock elbows, guide girders, thrust girders, and the various floors placed in the pit for purposes of operation.

These castings varied in weight from ½ ton to 6 tons, and extended back from the face of the wall from 3 to 5 feet depending on the loads to be carried, while the lip or shoulder carrying the loads extended only a few inches beyond the face of the walls. These castings were, of course, hollow and were filled with concrete before being placed in position.

Accuracy being necessary, great care was taken as to height and longitudinal position. In placing all castings, piano wires on a reel carried heavy plumbobs immersed in water, and elevations were transferred from one level to another by a steel tape, which had been standardized at Washington, D.C. All work was carried to 1-1000ths. of a foot, and, with very few exceptions, the results obtained were found very satisfactory during the period of machinery setting.

On the east side three chambers, averaging about $40' \times 16' \times 30'$ high, were built at right angles to the wheelpit and just above the level of the rack deck, which is the first floor above the water in the tailrace part of the wheelpit.

They were excavated as tunnels by top headings and benches, but being in limestone did not need timbering. The lining was the same as that of the wheelpit, and they were divided up into various levels by steel floors carried on brick ledges on the lining walls.

In the extension of the wheelpit two more similar ones are being built.

These chambers contain the exciter units, the pumps for forcing water to the transformer station, an air compressor (Pelton driven) and a system of oil tanks, filters and pumps for supplying oil to the high and low pressure bearings. The machinery in these chambers will be referred to later on.

Tailrace Tunnel.

The original design for this tunnel was of a section 21 feet high, with brick lining 16½ inches thick, but this was finally modified to the present section, which is 25 feet high, and has a composite lining, the bottom and sides being of concrete, faced with 4 inches of highly burnt brick, while in the arch a brick ring with dry packing was adhered to on account of the difficulty which would have attended the building of a concrete arch (see Fig. 4).

When the discharge tunnel was built for the Niagara Falls Power Company there was no exact information as to the value of the friction coefficient for a brick lined channel of such large dimensions carrying water at a high speed, and even when the present tunnel was commenced, the United States tunnel had not yet been tested to its full capacity, nor properly calibrated, but an examination in the winter of 1902 showed the brick lining, although of a very ordinary quality, to be absolutely intact, unworn, and slimed over after seven years' use, with water flowing at about 27 feet per second. Still, to make assurance doubly sure, the brick facing of the present tunnel was made of a superior burnt smooth brick, and the section made about 20 per cent. larger than the earlier one, so that the velocity will be slightly increased as the grade of seven feet per 1,000 is continuous, and the alignment of the tunnel very favorable, consisting of two curves of long radius with direct outlet in line of wheelpit.

This tunnel is 2,200 feet long, including the headworks at portal, which consist of a square headwall 60 feet wide. 12 feet thick, and 55 feet high, extending to a depth of 35 feet below water level resting on a foundation well into the Medina sandstone; from this headwall the tunnel rises in an ogee curve for some 80 feet to the tunnel proper, and this portion is lined with 2 feet of granite, which it was considered advisable to use in place of brick, owing to the excessive speed of the water when dropping to the river level, it being understood that the invert of the tunnel at the top of the ogee curve is at the low water river level.

The excavation was carried both ways from a shaft sunk midway between the portal and wheelpit and was also carried in several hundred feet from the portal, and although the alignment was fixed from two piano wires 12 feet apart, suspended in the shaft, the instrument work at point of meeting of headings was found to be almost perfect, which must be looked on as a result of extreme care in the use of plumbobs, and taking the average of a large number of observations in this and surface instrument work.

Owing to the upper portion of the tunnel being in shale, it was necessary to carry a full timber roof consisting of 5 centred 12"x12" rings four feet apart and three inches lagging, and these were put in place, along with the wall plates, as fast as the headings were driven, while the plumb posts, carried down to limestone, were inserted at the time the two benches were being taken up.

The original idea was to use yellow pine timber, but this was modified by substituting hemlock for centres and plumb posts, where the stresses would be compressive, and, although they were much abused by blasting, the result was satisfactory, owing to the absence of much water to soften and swell up the shale roof; the portion of roof adjacent to the wheelpit was subject to leakage when the pit excavation was being done just above the tunnel level, and at this point the roof timbers were badly crushed, and the centres settled several inches, the fibres of the hemlock segments being forced into one another.

The process of lining the tunnel was as follows:—The concrete invert (1:3:5:) being laid, the vitrified brick invert was placed as far as the corner specials, side forms were then put up and lagging, wedged back 4½ inches, was placed as high as the first course of brick headers. After the concrete side walls were built up to this height, the lagging was removed, and the brick facing carried up to and including a header course, after which the process was repeated to the springing, the only variation being that dry packing was used between and behind the plumb posts, in place of concrete shown on plans.

The brick arch was built in the ordinary way on full centres, and 4"x4" lagging, a night man building in the key of the arch work done during the day, and laborers placing dry packing above the haunches and driving it home against the roof timbers, also removing centres after being in position two or three days, and bringing them forward to a new position.

After side forms and arch centres were removed, the whole tunnel was scraped clear of all mortar with sharp iron tools, leaving the surface smooth and clean. It is believed that a very low friction coefficient will exist in this tunnel, especially when the walls become slimed over with deposits from water such as have formed on the walls of the Niagara Falls Power Company's tunnel. The shaft for this tunnel was sunk from May to September, 1901. Excavation was completed December, 1902, and lining and headwall in May, 1904, after which the shaft was bricked up, and outlet excavation at portal completed during the summer of 1904.

No attempt was made to hasten the completion of this portion of the plant before the machinery installation demanded it, otherwise much greater speed could have been made.

(To be Continued).

The Manitoba Peat Co., of Winnipeg, has secured valuable tracts of peat lands, and will immediately proceed to erect its first plant, which is expected to be in full operation by August next.