POWER DEVELOPMENT AT CEDARS RAPIDS, QUEBEC.

As announced in these columns some time ago the Canadian Society of Civil Engineers, recognizing the extent and importance of the large development near Montreal of the Cedars Rapids Manufacturing and Power Company, arranged to have the subject dealt with in three papers, each dealing with a separate division of the work, by engineers connected with the development.

The first paper was presented on November 4th by Mr. Henry Holgate, M. Can. Soc. C.E., consulting engineer, Montreal. It had to do with the history and legal phases involved in the organization and the early stages of the work.

The second paper was presented by Mr. Julian C. Smith, M. Can. Soc. C.E., general manager of the Cedars Rapids Manufacturing and Power Company. It treated of the general hydraulic design, hydraulic machinery, auxiliary equipment and some phases of the construction work. This paper was presented on November 18th.

The third paper of the series was presented on December 2nd by Mr. R. M. Wilson, M. Can. Soc. C.E., chief engineer and general superintendent, Montreal Light, Heat and Power Company. It dealt with the electrical design and construction of the plant, electrical testing and the operation of the plant during the past year.

This large hydraulic development, one of the most extensive in Canada, has been dealt with in numerous articles that have appeared during the past two years in *The Canadian Engineer*. Many interesting and important details, previously unrecorded in the engineering press, have been brought to light, however, in the three papers referred to above. In our issue of November 18th we referred to some features of that division of the subject treated by Mr. Holgate; the following paragraphs have been extracted from Mr. Smith's exhaustive paper; and in an early issue we hope to similarly refer to the phase of the work dealt with by Mr. Wilson at the meeting on December 2nd.

According to Mr. Smith, the engineering problem involved was to design a plant which would utilize the 56,000 cu. ft. per sec. (which the company had acquired the right to use) from the St. Lawrence, with its total head of 32 ft., without affecting the navigation of the river, and to keep the cost of the development within such limits as would provide for a commercially successful future. An important finding in the early stages of investigation was that relating to the freedom of the tailrace level of the proposed plant from ice troubles in the river, and the design proceeded on the assumption that both the tailrace level and the headrace level fluctuated approximately the same amount, leaving the head acting on the plant approximately constant at all seasons.

The paper describes first the general scheme of development and the construction of the dyke and canal. The velocity of the water in the canal was chosen as 3 ft. per second for normal water conditions, for the final development of 160,000 h.p. Owing to a variation of velocity and to a fluctuation in the river above the power-house amounting to 6 ft., the south bank of the canal was constructed so that under worst conditions of high water and high wind waves would not overtop the embankment, high winds being apt to prevail in the locality at certain seasons of the year. The effect of waves was given careful consideration in the design of the plant. This is a rather unusual element in power plant design.

The velocity of the canal, stated above to be 3 ft. per second under normal conditions, increased, during low water and with ice coating, to 4 ft. per second, and creating a problem in which the canal had to be considered as an open channel in the summer and a closed conduit in the winter.

The probable effect of sudden load changes on the water level was also studied and provided for.

The south bank of the canal rests on solid rock throughout the lower section and has a concrete core wall, except at the upper end. The total excavation for the first development of 100,000 h.p. included 1,800,000 cu. yds. of earth and 650,000 cu. yds. of rock, this material being used in the sides of the canal.

The velocity of the river being high, about 7 or 8 ft. per second, and that of the water entering the canal comparatively low, about 2 ft. per second, a series of cribs was constructed to deflect the main current farther out into the river and minimize the probability of floating material entering the canal. Further precaution against ice involved two sets of openings through the south bank, each consisting of 17 openings, each of which has a free span of 15 ft. These are closed with stop-logs, which may be adjusted at will to provide an overflow of about 2 ft., creating a high surface velocity, which will remove the ice, assisted by properly located booms.

The power-house, which is really a dam at the end of the canal, will ultimately be 1,200 ft. long, but at present is approximately 700 ft. Openings are provided here also for the removal of ice and other material that may collect in the canal.

The substructure as now constructed has ten units, each of about 10,800 h.p., and three exciters, each of 1,500 h.p. An interesting study was presented in the selection of type of thrust bearing from the three types in common use, viz., the oil pressure bearing, the roller bearing and the Kingsbury bearing. The paper enters into a review of the advantages and disadvantages of each type, a study of which led to a decision in favor of the Kingsbury bearing, and a further decision to place the thrust bearing on the top of the machine in order to make it more accessible, and also to reduce the thickness of concrete required under the machine. A thrust bearing between the water-wheel and the generator would have necessitated a tunnel passage for accessibility. The design finally adopted involved cast-iron brackets to carry the thrust bearing on the generator, which provided a construction of satisfactory rigidity and little variation.

The paper deals also with the construction of the power-house superstructure, the features of which have already been fully covered in these columns. It will be remembered that the unit method of construction was used.

Proceeding onward to a discussion of the hydraulic equipment, Mr. Smith describes the governors, racks and gate hoists. The racks are specially rolled sections, made up of bars 2¾ in. deep by 5/16 in. thick and spaced 3 5/16 in. c. to c. They are made in two sections, upper and lower, and are located in slots in the concrete, providing easy removal, although the water may be over 35 ft. deep in front of them. Owing to this depth the facilities provided for cleaning the lower parts of the racks consisted of an emergency set of gates by