not recommend completion of the project, even after radical modifications.

Solution of the Problem.

The City—States that aqueduct power is the cheapest and best, and recommends completion of project.

The Ratepaying Engineers — Demonstrated the economy of abandoning the project as designed, making the most advantageous use of the work done and purchasing the balance of power or generating it by steam power.

The Board—Does not make any definite recommendation for the solution of the problem, except that firm bids on electric power be asked for,

Possibility of Lighting from Aqueduct.

The City—Stated that power from the aqueduct would be available for lighting the streets, with a surplus of power for sale.

The Ratepaying Engineers—Showed that lighting the streets with power from the aqueduct is impracticable

The Board—Shows that no aqueduct power would be available for lighting streets.

The above comparison shows a general concurrence by the Board of Engineers with the conclusions of the Ratepaying Engineers.

It is important to note that :--

(a) It was only after the protest by the Ratepaying Engineers in April, 1916, that the city began serious studies of the whole project.

(b) After the report by the Ratepaying Engineers in November, 1916, the City proposed radical changes in design at additional cost, to meet some of the objections raised. The Board's investigation and report shows that further changes in design must be made involving over a million dollars additional cost before the amount of water power claimed by the city could be approximated.

(c) The project as proposed by the city is strongly condemned by the board.

(d) The whole project has become so badly muddled that, after a long investigation, the board is unable to recommend a definite course of action, but merely recommends asking tenders for electric power and making further studies.

The resolution of February 6th, 1917, appointing the board, called for a comparison between the report of the ratepaying engineers made in November, 1916, at the request of the city council, and the different reports of the city engineer. This comparison has not been made.

This resolution stipulated that a complete study of the proposed development was to have been undertaken, and a report made "as to whether the development is feasible, practical and advantageous, and to advise the city on its advantages and disadvantages, with every recommendation which they (the Board of Engineers) will judge proper to make to the city." It cannot be said that this has been done.

Commissioner Ross' letter to the Board of Engineers dated February 16, 1917, apparently advised the board to disregard the reports referred to in the resolution of February 6th, 1917, but suggested that the board advise the city as to the right and wisest course for the city now to follow from a business point of view. The board apparently accepted this letter from one of the commissioners as instructions over-riding a resolution of the city, but failed to make definite recommendations as to the right and wisest course for the city to follow.

In the report and the detail figures sent to the city by the board certain items are omitted which are clearly chargeable to the capital cost of the aqueduct enlargement. The excess costs of the present steam pumping over that formerly done by the old aqueduct from 1907 until the completion of construction work, the repairs to the lateral conduit after the break in 1913 which was due to the construction work on the aqueduct, the emergency water supply from the Lachine Canal in this connection, the cost of ten bridges, and certain interest charges during construction, in all amounting to about \$1,400,000, are omitted. This makes the total cost \$12,000,000. This figure might easily reach \$14,000,000 if the cost of all work on the boulevards be included and if any substantial portion of the claims of the Cook Construction Company be allowed.

In comparing the annual unit costs of power purchased with the unit cost of power developed, the board does not place them on the same basis for comparison. The only proper basis for comparison is for power available as "electrical horse-power" delivered on the switchboard at the Atwater plant, whether produced by the water in the aqueduct, or purchased in the ordinary commercial way as electrical power, or produced from a steamelectric plant.

As shown in the board's report, only three-quarters of the theoretical water power is available as electric power at the switchboard after deducting the various losses through the water-wheels and generators, and therefore in making a comparison with purchased power on a unit basis only three-quarters of the theoretical water horse-power should be considered. In the table of unit costs, the cost under Scheme 2 is given as \$56.90 per theoretical water horse-power per year. This is equivalent to about \$76 per electrical horse-power per year. In the same table purchased electrical horse-power at \$25 gives a total annual unit cost of \$62.47 per electrical horse-power, or, on a proper basis of comparison, a difference of nearly \$14 per horse-power per year in favor of purchased power. This practically agrees with the relation of the total figures, where the total costs of developed aqueduct power under Scheme 2 are given as \$740,000 per year and the total costs of purchased power are less and are given as \$656,000 per year.

In the board's calculations of annual costs of power there is no provision made for sinking fund nor for depreciation. Based on the capital expenditure of \$12,-000,000 and with proper allowances for sinking fund and depreciation the total annual operating costs and fixed charges would amount to at least \$1,000,000, equivalent to over \$100 per electrical horse-power.

In view of the foregoing, there appears to be no justification for the statement: "Under ordinary circumstances and with the figures now before us, we would have no hesitation in recommending the adoption of Scheme 2 with provision for boulevards, as its cost of operation per horse-power per year is the lowest." If all cost items are included, either purchased power or steam-generated power is much cheaper than water power developed under Scheme 2.

A supplementary resolution of the city dated 26th February, 1917, voted an additional credit to the board on the understanding that the board was to answer questions submitted in writing by commissioners or aldermen. Commissioner Villeneuve, whose various published commentaries on the aqueduct question during the past year have shown his great interest in this important matter, submitted seven questions on April 30th, 1917, with a definite request for specific replies. In a letter dated May 10th, 1917, submitting their report to the city, the board

(Concluded on page 44.)