

the work, on which construction is to be commenced without delay, namely the 9-mile section between Peterboro' and Lakefield, and the 14-mile section between Aros, on Balsam lake, and Game bridge on Lake Simcoe. Tenders will shortly be asked by the Department of Public Works for the construction of the bridge over Pond Creek between Gatineau Point and Hull, and construction is expected to commence in a couple of weeks.—Tenders will be received until the 22nd inst. for heating the St. Lawrence hall with steam. The proprietors of the hotel are Messrs. Lebarge & Co.—The erection of a fire station in the south-west end of the city has been petitioned for.

TORONTO, ONT.—The Separate School Board has decided to purchase a site on Bolton avenue and erect thereon a two-roomed brick school house.—In a report presented to the Board of Works on Monday last, the City Engineer again recommends the construction of a 24-inch main on Front street, from Simcoe to Sherbourne, and a 36-inch force main from the intersection of Bathurst and College streets to Rose Hill reservoir. The former is estimated to cost \$36,000 and the latter \$135,000. The sum of \$3,000 is also asked by the City Engineer to place the Lake Shore road in proper condition, and a cedar block pavement is recommended outside of track allowances on Bloor street, from Dufferin street to Lansdowne avenue.—Hon. Wm. Harty, Commissioner of Public Works, has entered into negotiations with the City Council for the purpose of placing under Government control the whole of that portion of Queen's Park extending from Park road to Parliament buildings, with a view to improving the grounds. It is proposed to construct a granolithic pavement running through the centre of the park up to the main entrance of the buildings.—The by-law providing for the issue of debentures to cover the cost of widening the Queen street subway will be submitted to the ratepayers on the 20th of October.—A building permit has been granted to Mrs. R. C. Dancy, for alterations and additions to dwelling, 127 and 129 D'Arcy st., cost \$2,500.

MONTREAL, QUE.—Contracts will be awarded this week by the Road Department for the construction of a number of sewers and for the paving of several streets with asphalt. A. Davis, Superintendent of Waterworks, will receive tenders until noon on Monday, the 24th inst., for the supplying of cast iron water pipes and special castings for the city, in quantities and at dates specified.—The Road Committee has given notice that permanent pavements will be constructed on the following streets: Ernest street from St. Denis street to Laval avenue; Laval avenue, from Albina street to Ernest street; St. Peter street from Commissioners street to Notre Dame street; St. James street from Windsor to Mountain sts. Messrs. Perrault & Mann, architects, have prepared plans for the proposed Isolation hospital, but a definite site has not as yet been decided upon. It has been decided to pave the Brock street tunnel with block stone, at a cost of \$10,000.—The Finance and Road committees have concurred in favor of spending \$15,000 for the paving of St. Peter street from St. James to Commissioners street.—The new building of the Merchants Bank of Halifax, to be erected at the corner of Notre Dame and Seigneurs streets, will have a frontage of 36 x 87 feet, and will cost in the neighborhood of \$50,000. The plans were prepared by Mr. Edward Maxwell.—Mr. C. St. Jean, architect, is calling for tenders for a three story stone front tenement building on Amherst street for Mr. Desforges.—Messrs. J. B. Resther & Son, architects, have prepared plans and specifications for a three story stone front building on Notre Dame street west for Louis Barr, and also for a three story stone front residence for Mrs. J. C. Robert.—Mr. Theo. Daoust, architect, has prepared plans for an extension to the "Fabrique de Notre Dame" for the Seminary of Montreal.

FIRES.

The creamery building at Marsh Hill, Ont., was destroyed by fire on the 15th inst. Loss, \$3,000; insurance, \$1,700.—John Riley's grain elevator at Cypress River, Man., was burned to the ground last week.—The residence of Capt. W. Smyth, at Elginburg, Ont., was consumed by fire last week. Loss, \$2,000; no insurance.—The livery stables of Taylor & Bradshaw, at Brantford, Ont., were destroyed by fire on the 13th inst. Second & Perley's implement warehouse adjoining was damaged to the extent of \$4,000.—The saw and grist mills and two dwellings at Dartford, Ont., were burned recently. Loss, \$5,000.—A brick livery stable at St. Catharines, Ont., owned by Walter Haynes, has been destroyed by fire.

CONTRACTS AWARDED.

PRESTON, ONT.—The Galt and Preston Railway Company have awarded the contract to A. McAuslan, of Galt, for the construction of a bridge over the Speed river at this place.

OTTAWA, ONT.—The contract for one thousand barrels of Portland cement, to be used on the Lachine canal, has been let to Mr. Desota, of Montreal, agent for a Belgian firm.—The Public Works Department have awarded the contract for building the steam dredge for salt water operations, to be delivered at Halifax, to Messrs. Carrier, Laine & Co., of Quebec.

TORONTO, ONT.—Messrs. Bennett & Wright, of this city, have been awarded contracts for the plumbing and heating of the large store and office building of McLaughlin & Co., at Postage La Prairie, Man., and the business block of the Canada Permanent Loan & Savings Co., at Winnipeg.—The Toronto Radiator Mfg. Co., of this city, have been awarded the contract for supplying the new Parliament buildings at Victoria, B. C., with Safford radiators.

MONTREAL, QUE.—Messrs. J. B. Resther & Son, architects, have awarded the masonry contract for a three story stone front residence, corner Rachael and Panet streets for M. Thibodeau, to C. Lemay; also the contract for the fixtures and furnishing of the premises of Messrs. Hudon Hebert & Co. to Grothe Freres.—The Government contract for the deepening of the Lachine canal from the St. Gabriel locks to Lachine has been awarded to Messrs. F. B. McNamee and William Mann, of this city. The contract price is said to be in the neighborhood of half a million dollars. The work, which is to be completed in three years, will be commenced in a few weeks.—Mr. Charles Bernier, architect, has awarded contracts as follows: the carpenter and joiners' work of two three story tenement buildings on Notre Dame street west for A. L'Allemand to H. Plante, the carpenter and joiners' work of a three story tenement and stone building on St. Catharine street west for A. L'Allemand to H. Plante; the carpenter and joiners' work of a three storey stone front store and tenement building on Notre Dame st. west for A. L'Allemand to H. Plante, the carpenter and joiners' work of a 2½ story cottage at Beauport, Que., for J. Giroux, to G. Parent.

BIDS.

TORONTO, ONT.—At a meeting of the Fire and Light Committee, held on Monday last, the tenders for an electric light plant and for electric and gas lighting were opened. Seventeen tenders were sent in for the supply of an electric light plant, the lowest tender for dynamos being from the Siemens Co., of Chicago, which was \$24,500. Tender No. 6 quoted the price at \$54,968 for engines, boilers, economizers, condensers and pumps, piping and valves. For street lighting the Toronto Railway Company tendered to supply 2,000 candle power arc lights at 23 cents per night for five years, 22½ cents for 10 years, 22 cents for 15 years, 21½ cents for twenty years, and 21 cents for 25 years, and the Toronto Electric Light Co. offered to supply 1,500 lights at 20½

cents per night. The only tender for gas lighting was from the Consumer's Gas Co., who tendered at \$22 per lamp yearly on old mains, and \$23 on new. The tenders were all referred to the City Engineer and the Secretary of the Fire and Light Committee for a report.

PORTLAND CEMENT TESTING.

Engineering for July 13th, after discussing some of the present methods of testing cements, arrives at the following conclusions:

1. That the strength of a mixture of cement and sand is the most reliable of the present tests.
2. That the tensile strength of neat cement may be omitted altogether as a test of good quality.
3. That the weight per bushel is misleading, and should be omitted altogether.
4. That colour is not of sufficient importance to be considered as a test.
5. That extreme fineness of grinding is so absolutely essential that a sieve of not less than 175 to 180 meshes to the lineal inch should be used for testing purposes.

MUNICIPAL DEPARTMENT.

BOREHOLE WELLS FOR TOWN WATER SUPPLY.*

BY HENRY DAVEY, M. I. C. E.

At the Cardiff meeting of this association the author proposed a new system of borehole wells for town water supply. Since that time the system has been carried into effect at several places, and he describes one of the most important examples of executed work—viz., that of the Netherly pumping station of the Widnes Waterworks. The subject was dealt with under two heads—(1) the system of boreholes, (2) the application of the pumping power.

The system of boreholes.—In procuring water for town water supply it is the usual and necessary practice to provide duplicate pumping engines, and where two engines are made to pump from the same well, the well must be very large that it may accommodate two sets of pumps. Such wells are usually 12ft to 14ft. in diameter. To sink such a well in the ordinary way is a very long and costly undertaking, especially if soft strata are met with, where lining becomes necessary. On the completion of the well it may be necessary to drive adits to increase the water supply. A simple borehole is made very cheaply and very expeditiously. Four 30in. boreholes can be put down in a very small fraction of the time required to sink a 12ft. well. Instead of making a large well, the author puts down four boreholes to accommodate the pumps for duplicate pumping engines—a pair of pumps to each engine. The boreholes being completed, the pumps are lowered into them and coupled up to the permanent engines. Immediately that is done the water found in the boreholes can be pumped and supplied to the town. Should it be insufficient then a small well would be sunk in the dry to the bottom of the borehole pumps. The water being kept down by the pumps the boreholes at the level of the pumps would be connected to the center well, and adits driven to collect more water. Should the boreholes yield sufficient water it would not be necessary to sink the well. It would be absurd to advocate any particular system of well-sinking as being universally applicable; this system, however, of making wells offers advantages under favorable conditions, but the advisability of its adoption in any particular case must be a matter of judgment with the engineer planning the work. The boreholes at the Netherly, two in number, are sunk in red sandstone rock, and are placed 20ft. apart, each bored to a diameter of 30in. for a depth of 200ft., and to a reduced diameter of 18in. for a further depth of 200ft. and 300 ft. respectively, thus making the first hole 400ft. deep, and the second 500

ft. deep. On the completion of the boring the water stood 70ft. to 80 ft. from the surface of the ground, when the quantity pumped by the old engine on the same site was 1¼ million gallons per day. The main pumps were then lowered into the boreholes, each pump extending to the bottom of the large part of the hole, 200ft. from the ground-level. In that position the pumps were suspended from a cast-iron bed-plate supported on a concrete foundation formed round the top of the hole, a block of oak being inserted between the head of the pump and the bed-plate. In this suspended position the pumps worked without the slightest unsteadiness. The engines were made for the purpose of pumping 2¼ million gallons per day, but it was found that working up to their full capacity of 2¾ millions the yield of the boreholes was not reached. On starting the new pumps it was found that when pumping 2¾ million gallons per day the water level was lowered to 100ft. from the surface of the ground.

The application of the pumping power.—The motive power consists of a 230 H.P. compound surface-condensing engine, employed to pump from the boreholes into a masonry tank by the engine foundations, from which tank the water is forced by the same engine to a reservoir at an elevation of 260ft. The engine is made to work the force pump by means of a tail rod from the low-pressure cylinder, the borehole pumps being worked by means of rocking levers actuated by a connecting rod from the cross-head of the engine. There is no flywheel or rotary motion, but a very simple expedient is resorted to to enable the engine to work expansively. This steam distribution is effected by giving a peculiar bell-crank form to the levers which convey motion to the well pumps. The effect of this mode of coupling the pump piston or plunger to the engine piston is to make the pump-resistance diagram so nearly approach the shape of the combined engine diagram that the weight of the moving parts of engine is of itself, by its inertia, sufficient to equate the two diagrams.

Steam distribution.—The engine is of the receiver type, having separate expansion valves on both high and low pressure cylinders, adjustable by hand whilst the engine is in motion.

A careful trial of the engine has been made, and as it is provided with a surface condenser, it was quite easy to ascertain the exact quantity of steam used by the engine by measuring the air-pump discharge, and adding that discharged from the steam jackets. The efficiencies are as follows: (1) engine efficiency, the proportion which the area of the actual indicator diagrams bears to the area of the theoretical diagram for the steam admitted to the engine = .644; (2) mechanical efficiency, or the portion of the indicated power utilized by the pumps = 87 per cent.; (3) thermal efficiency, or the proportion of the energy due to the fall in temperature of the steam which has been utilized by the engine = .433. Units of work per unit of heat = 110.8. The steam cylinders are both steam jacketed completely—bodies and ends—with steam at boiler pressure. The following summary gives the general particulars and cost of the installation:

Steam pressure	70lb. per square inch.
Diameter of cylinders	32in. and 60in.
Length of stroke	6ft. 3in.
Diameter of force pump	18½in.
Height of lift	260ft.
Length of stroke	6ft. 3in.
Diameter of borehole pumps	18½in.
Height of lift	100ft.
Length of stroke	6ft. 6in.
Number of strokes per min.	1 ½
Depth of boreholes	400ft. and 500ft.
Diameter of boreholes	30in. for 200ft. and then 18in.
Tube surface of condenser	420 square feet.
“ “ feed heater	140 square feet.
Water pumped in 24 hours	2¼ million gallons.
Duty of engine on an evaporation of 10lb. water per lb. coal	124 millions.
Pounds of steam per i.h.p. per hour	15.6.
Pounds of steam per p.h.p. per hour	18.0
Indicated horse-power	230.
Pump horse-power	200.
Mechanical efficiency	87 per cent.
Cost of engines and pumps	£6,000 = £30 per p.h.p.
Total cost of engine, pumps, boreholes and buildings	£9,700 = £48½ per p.h.p.

*Abstract of paper read before the Mechanical Science Section of the British Association.