PAGES

MISSING

Volume 29. Toronto, November 4, 1915. Contents of this issue on page 5.

# The Canadian Engineer

*A weekly paper for engineers and engineering-contractors*

## REPAIRING A SUBMERGED WATER MAIN

SOME NOTES ON THE EDMONTON WATER SUPPLY SYSTEM AND ON THE REPAIR OF A SUBMERGED PIPE SECTION BY A UNIQUE AND EXPEDITIOUS METHOD.

By **JAMES HAMILTON,**
Assistant Engineer, Sewer Department, Edmonton.

THE present domestic water supply for Edmonton is taken from the North Saskatchewan River, which flows through the city. It is subjected to sedimentation, mechanical filtration and sterilization before being pumped into the distributing mains. Prior to 1912 the portion of the city lying to the south of the river was known as Strathcona, and that to the north as Edmonton, but in that year both municipalities amalgamated, assuming the name of the latter city. Before the amalgamation, each municipality had its own pumping plant. Subsequently, the one on the south side was discontinued, and that on the north, being the larger and better equipped, was extended. It, in conjunction with increased filtration capacity, now supplies the entire city. The fact of the pumping and filtration plants being situated on the north side necessitates the supply for the south side being conveyed across the river, this being accomplished by means of two parallel, 20-inch diameter, cast-iron, submerged mains. These mains were laid following the amalgamation, and the execution of the work presented no unusual engineering features. Similar submerged mains are to be found at many points on the North American continent, and engineers are familiar with the recognized methods of construction from articles which have appeared from time to time in the technical journals.

It has already been observed in these columns that the Saskatchewan River flows through a deep ravine,* the bed of which is approximately 200 feet below the tableland on which the principal parts of the city stand. The pumping plant is situated on flats on the north bank, at a level intermediate between the river bed and the tableland. While the normal pressure in the mains on the tableland is about 45 lbs.; in those on the flats it is much higher, and particularly in the submerged mains above referred to, where it is as high as 135 lbs. If necessary, these pressures can be raised to 75 lbs. and 165 lbs. respectively to cope with an exceptional fire, but as a rule any pressure above the normal required for fire purposes is supplied by the movable equipment of the fire brigade.

Strictly speaking, one line of 20-inch diameter pipe would have been ample for all the needs of the south side district, but the city commissioners, on the advice of their engineers, sanctioned the construction of the double line, it being their opinion that, with such a provision, the possibility of any prolonged interruption to the supply would be practically eliminated. Subsequent events proved that such a margin of safety was not only advisable but necessary.

At various stages in the progress of the work, tests were applied to the mains and satisfactory results secured,

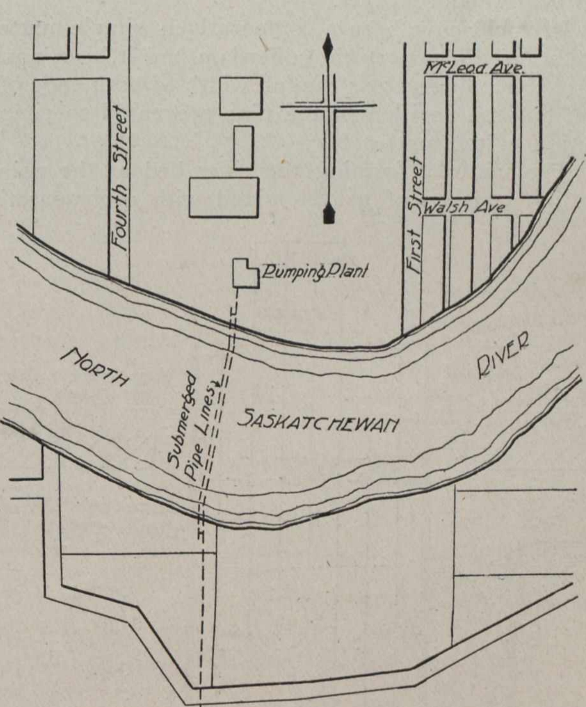


**Fig. 1.—Section of Edmonton System of Water Supply, Showing Location of Two 20-inch C.I. Submerged Mains.**

but after they were lowered into position and all contingent works completed, the final test under a pressure of 180 lbs. was applied, when the gauge unexpectedly dropped, and it became apparent that a serious leakage had developed in one of the lines. Investigation revealed the fact that one 12-foot length of pipe had burst during the application of the test, the fracture being about 4 feet long and extending from a point within a few inches of one flange, in a direction parallel to the longitudinal axis of the pipe. The location of the failure on the submerged line was about 120 feet from the south bank.

*The reader is referred to an article descriptive of the Edmonton Viaduct of the Canadian Pacific Railway, published in *The Canadian Engineer* for September 9th, 1915.

The purpose of this article is to describe briefly how the repairs were carried out, the broken 12-foot length of pipe being removed and a sound one substituted. Fortunately it was possible to undertake the repairs before the end of winter, while the water level in the river remained at its minimum, and the ice was in good condition.

Fig. 1 shows the location of the two submerged water pipe lines. Fig. 2 shows the trench dredged in the

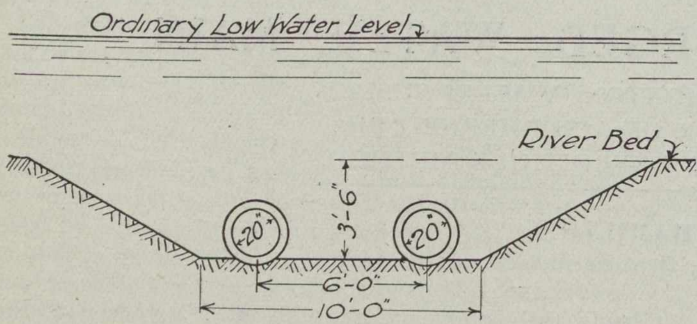


**Fig. 2.—Trench Dredged in River Bed, for the Pipe Lines.**

bed of the river with the two lines of 20-inch diameter cast iron pipes in position. Fig. 3 shows a cross-section of the cofferdam constructed around the broken pipe. Lock Joint steel sheet piling was used, the length of the dam being about 24 feet.

It would have been a comparatively simple matter to have secured a watertight cofferdam had it been possible to use this piling across the full width of both ends of the dam, but the position of the pipe prevented so simple a solution of the matter.

The material forming the river bed at the point in question consists of gravel mixed with a comparatively

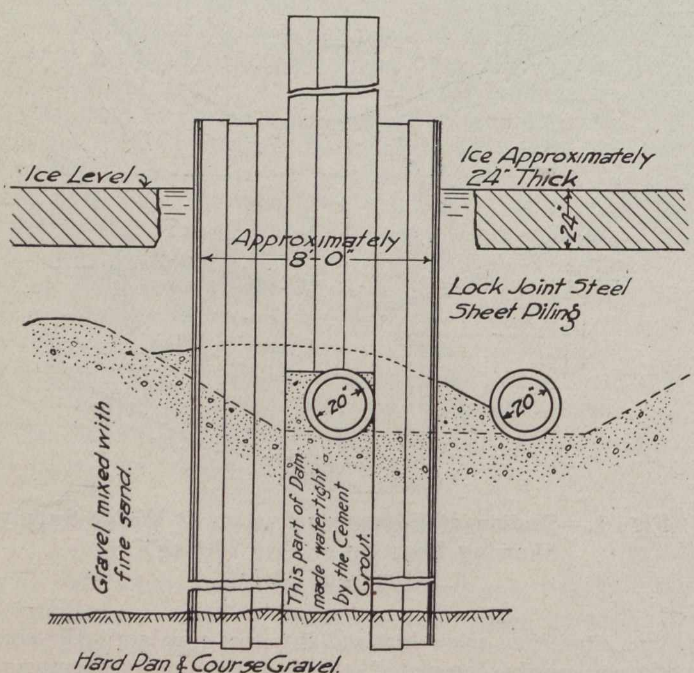


**Fig. 3.—Sketch of Cofferdam Constructed Around the Section of Broken Pipe.**

large proportion of fine sand, which overlies for a depth of several feet a firm stratum of coarse gravel and hardpan firmly cemented together, into which the sheet piling was driven.

Several attempts were made to complete the ends of the cofferdam above and below the pipe, but without success, and much delay and expense might have been entailed had not the superintendent in charge of the work conceived the idea of forcing cement grout into the gravel and sand at these points by means of a hand pump—an idea which was put into operation with immediate and complete success. The cement was mixed in deep steel wheelbarrows, and reduced to the consistency of cream with water in which had been dissolved soda crystals, the latter being used to hasten the setting of the cement. The pump was operated by four laborers, and was found capable of exerting a pressure of 40 lbs. when previously tested with water against a pressure gauge.

The work of pumping the grout had to be carried out with the utmost despatch in order to prevent the pump from becoming choked, each batch of grout being handled quickly, and the pump thoroughly washed out after dealing with each batch. In all, twenty-two bags of cement were used, and within a period of 60 hours the cofferdam had been pumped dry.

The subsequent work of removing the broken pipe, and replacing it with a sound one was successfully and expeditiously performed.

The work of laying the double line of submerged mains, and the execution of the repairs above explained, were carried out under the direction of Mr. J. Ryan, superintendent of works for the city.

---

## COST OF ROAD REPAIR AND MAINTENANCE, NIAGARA FALLS PARK.

In our issue for October 1st, 1914, were given some road surfacing costs relating to work executed during 1913, in Queen Victoria Niagara Falls Park, under the direction of Mr. John H. Jackson, superintendent. The data related in particular to both heavy and light resurfacing of waterbound macadam roadways, and to carpet treatment with refined tar. Costs were also given for resurfacing a stretch of driveway with Rocmac.

The value of the figures is considerably enhanced by the recently issued report of 1914 operations. In the following data the costs have all been reduced to a square yard basis and the corresponding cost per mile is deduced for a stated width of surface.

### Oiling Boulevard and Park Driveways.

Time—June and July.

Location—Between Park and Chippewa and south end of main driveway.

Average haul—.95 mile.

Surface treated—Length 8,265 ft. (1.56 miles), 19,240 square yards.

| | Total. | Per sq. yd. |
|---|---|---|
| *Labor.* | | |
| Loading and placing ½-in. stone | $ 270.00 | 1.40 cts. |
| Hauling ½-in. stone and oil .... | 234.00 | 1.23 |
| Rolling and heating ............ | 150.00 | .77 |
| | $ 654.00 | 3.40 cts. |
| *Materials.* | | |
| ½-in. stone, 260 tons .........; Screenings, 83 tons .......... | $ 358.00 | 1.86 cts. |
| Vulcan asphaltic oil ........... (80%) 6,500 gals. .........; Demurrage, etc. ............. | 469.00 | 2.44 |
| Coal for heating and rolling, 9.05 tons ................... | 48.00 | .25 |
| | $ 875.00 | 4 55 cts. |

*Summary.*

| | | |
|---|---|---|
| Labor | $ 654.00 | 3.40 cts. |
| Materials | 875.00 | 4.55 |
| | $1,529.00 | 7.95 cts. |

Distribution of oil =.388 gal. per sq. yd.
Distribution of grit = 1 cu. yd. on 67.3 sq. yds. surface.
Cost per square yard, about 8c.
Cost per mile (22 ft. wide), $1,036.00.
Wage rates:—

| | | |
|---|---|---|
| Teams | 55c. | per hour |
| Laborers | 22c. | " " |
| Foremen | 35c. | " " |

### Niagara River Boulevard—Tarvia "A" Treatment.

Time—July, August, September and October.
Location—Boulevard, Station 293 south to Station 545.
Average haul—2.62 miles.
Surface treated—25,200 ft. × 18 ft. = 54,400 sq. yds.

*Labor.*

| | Total. | Per sq. yd. |
|---|---|---|
| Spreading ½-in. stone | $ 318.00 | .63 cts. |
| Loading materials | 313.00 | .62 |
| Hauling materials | 740.00 | 1.47 |
| Heating Tarvia | 382.00 | .76 |
| | $1,753.00 | 3.48 cts. |

*Materials.*

| | | |
|---|---|---|
| ½-in. stone, 724 tons at $1.10 | $ 796.00 | 1.58 cts. |
| Tarvia, 25,000 gals. at 10c. | 2,500.00 | 5.72 |
| Freight, $342; demurrage, $39 | 381.00 | 5.72 |
| Coal for roller and heating, 28.2 tons at $5.42 | 153.00 | .30 |
| | $3,830.00 | 7.60 cts. |

*Summary.*

| | | |
|---|---|---|
| Labor | $1,753.00 | 3.48 cts. |
| Materials | 3,830.00 | 7.60 |
| | $5,583.00 | 11.08 cts. |

Distribution of Tarvia, .46 gal. per sq. yd.
Distribution of grit, 1 cu. yd. on 90 sq. yds. surface.
Cost per square yard, $11.08.
Cost per mile (18 ft. wide), $1,162.00.
Wage rates:—

| | | |
|---|---|---|
| Teams | 45c. | per hour |
| Laborers | 20c. | " " |
| Foremen | 30c. | " " |

### Rocmac Resurfacing—Section No. 4.

Time—August to November, 1914.
Location—Boulevard, from Shipyard south, 1.286 miles.
Average haul—2.07 miles.
Surface treated—6,790 ft. × 18 ft. = 13,580 sq. yds.

*Labor.*

| | Total. | Per sq. yd. |
|---|---|---|
| Resurfacing (Rocmac) | $1,406.00 | 10.36 cts. |
| Loading materials | 650.00 | 4.78 |
| Hauling materials | 1,394.00 | 10.27 |
| Rolling | 246.00 | 1.81 |
| | $3,696.00 | 27.22 cts. |

*Materials.*

| | | |
|---|---|---|
| 2″ stone (trap), 514 tons at $1.80 | $ 925.00 | 6.81 cts. |
| Screenings, 560 tons at 90c. | 505.00 | 3.72 |
| Rocmac, 10,473 gals. at 45c. | 4,713.00 | 34.70 |
| Coal for roller, 17.46 tons at $6.35 | 111.00 | .80 |
| | $6,254.00 | 46.03 cts. |

*Summary.*

| | | |
|---|---|---|
| Labor | $3,696.00 | 27.22 cts. |
| Materials | 6,254.00 | 46.03 |
| | $9,950.00 | 73.25 cts. |

Cost per square yard ....................$ 73.25
Cost per mile (18 ft. wide) ....................$7,736.00
Wage rates:—

| | | |
|---|---|---|
| Teams | 45c. | per hour |
| Laborers | 20c. | " " |
| Foremen | 30c. | " " |

### Queen Victoria Park—Repairing Main Driveway.

Time—Summer, 1914.
Location—Main driveway.
Average haul—
Surface treated—22,000 square yards.

*Labor.*

| | Total. | Per sq. yd. |
|---|---|---|
| Repairing | $ 403.00 | 1.83 cts. |
| Loading | 185.00 | .84 |
| Hauling | 317.00 | 1.44 |
| Rolling | 175.00 | .80 |
| | $1,080.00 | 4.91 cts. |

*Materials.*

| | | |
|---|---|---|
| 2-in. stone, 253 tons | $ 298.00 | 1.35 cts. |
| Screenings, 238 tons | 278.00 | 1.26 |
| Coal, 15 tons | 77.00 | .35 |
| | $ 635.00 | 2.96 cts. |

*Summary.*

| | | |
|---|---|---|
| Labor | $1,080.00 | 4.91 cts. |
| Materials | 653.00 | 2.96 |
| | $1,733.00 | 7.87 cts. |

Cost per square yard, about 8c.
Cost per mile, 22-ft. roadway, $1,036.00.
Wage rates:—

| | | |
|---|---|---|
| Teams | 55c. | per hour |
| Laborers | 22c. | " " |
| Foremen | 35c. | " " |

## LONG LINES IN TRIANGULATION.

The longest line in the United States Coast and Geodetic Survey triangulation is that from Toiyabe Dome, Nev., to Ragged Peak, Nev., about 227 miles. This was observed only in one direction. The line from Mount Shasta, Cal., to Mount Helena, Cal., is 192 miles in length, and that from Mount Ellen, Utah, to Mount Uncompahgre, Col., is 183 miles. The triangle formed by Wheeler Peak, Nev., Mount Nebo, Utah, and Pilot Peak, Nev., has sides of 148, 148 and 141 miles respectively.—August "Bulletin" of the U.S. Coast and Geodetic Survey.

## FINENESS OF CEMENT DETERMINED BY AN AIR ANALYZER.

THE fineness of cement is one of its most important and at the same time one of its most indefinite characteristics. Its importance is recognized in the tendency toward higher fineness requirements in cement specifications and in the general belief that the finer a cement is ground the greater its cementing value. Its indefiniteness is due to the almost universal method of determining fineness by means of the No. 100 and No. 200 sieves. The inadequacy of these sieves is evident when one considers that at least 75 per cent. of the total cement is required to pass the No. 200 sieve. It is also well known that a considerable portion of the cement passing the No. 200 sieve is comparatively inert because the larger particles in this portion are still too coarse to be readily acted upon by water.

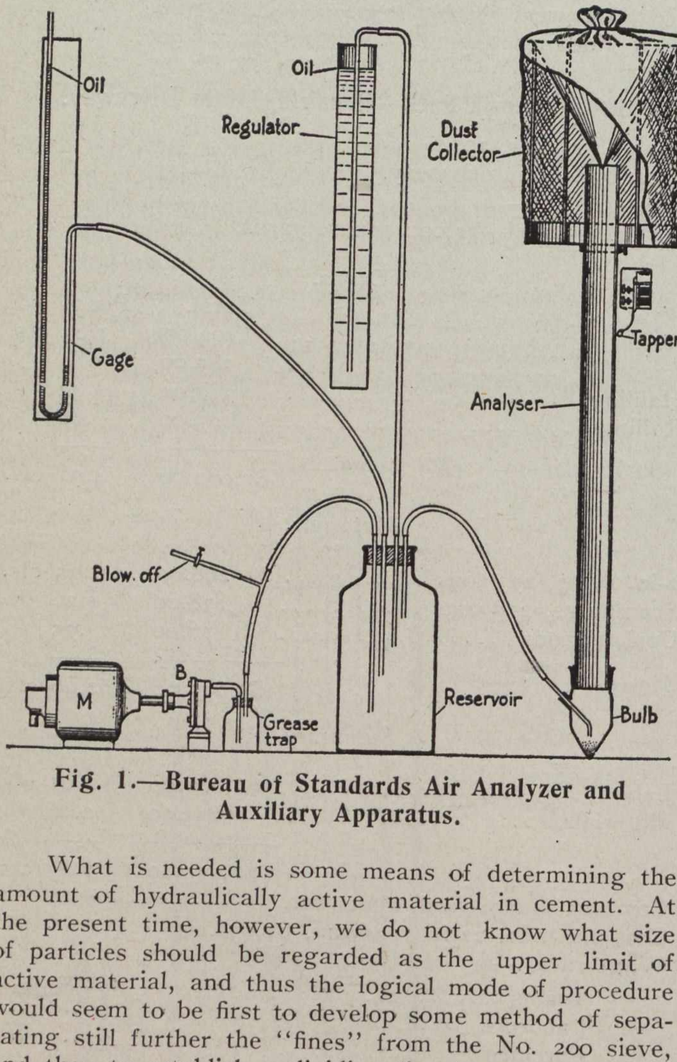


**Fig. 1.—Bureau of Standards Air Analyzer and Auxiliary Apparatus.**

What is needed is some means of determining the amount of hydraulically active material in cement. At the present time, however, we do not know what size of particles should be regarded as the upper limit of active material, and thus the logical mode of procedure would seem to be first to develop some method of separating still further the "fines" from the No. 200 sieve, and then to establish a dividing line between inert and active particles.

The terms flour and impalpable powder are frequently used to designate the hydraulically active material. It is believed preferable to limit these terms to that very fine portion of cement beyond the finest perceptible grit, which probably does not constitute all of the hydraulically active material.

In order to find some better means for the mechanical analysis of that portion of cement passing through the No. 200 sieve, Messrs. J. C. Pearson and W. H. Sligh, of the United States Bureau of Standards, went into the subject with great care and detail, spending over two years in their researches. Their experience in the design of a suitable device, as outlined in Technologic Paper No. 48 of the Bureau, leads to the conclusions that:—

1. The apparatus should insure as far as possible a constant velocity and uniform stream lines in the fluid as it passes through the separating chamber.

2. The fluid should not be appreciably retarded by the resistence of the material under examination or by constrictions or obstructions in that part of the apparatus beyond the separating chamber unless the amount of such retardation can be determined by pressure gauges or compensated by special devices.

3. All particles of the material should be completely and continuously exposed to the action of the fluid, so that any which are capable of passing through the separating chamber may have every opportunity to do so.

4. The separating chamber should have no places of lodgment for material.

5. The apparatus should be capable of separating fair-sized samples, preferably 25 g. or more. Thus, representative samples are more nearly insured and the percentage error in the separations is reduced.

More difficult than the mere design and construction of a satisfactory elutriator is its calibration or standardization. The mechanical analysis involves separations in terms not only of percentages, but also of sizes, and the determination of the size of very small and irregularly-shaped particles can be most readily accomplished by averaging microscopic measurements on a large number. Herein lies the one great obstacle to the furtherance of elutriation methods, for if the fineness curves of different cements are to be at all comparable, the sizes of separation must be determined with considerable accuracy. It is not sufficient simply to state that the average diameter of a lot of particles which lie on the dividing line between two fractions is so many thousandths of an inch, or so many hundredths of a millimeter, but it is necessary to define what is meant by the diameter of an irregular particle, and to state explicitly how the diameters are measured. For example, if the diameters of a number of particles as seen in the microscope are measured in one direction without regard to their orientation (which is, perhaps, the easiest and most direct method) the average diameter so determined will be very approximately the mean of the average length and breadth of the particles as seen in the microscope. This average diameter, however, is greater than the cube root of the product of the average length, breadth, and thickness of the particles, which is generally taken to be the true mean diameter and the true index of "size" in the sense of volume. But the measurement of three diameters of microscopic particles is exceedingly laborious, and the most one can expect for practical purposes is to establish some reduction factor which will give the true mean diameter when applied to the simpler measurements.

Still another condition enters which magnifies the differences in these systems of measurement: The separation of powders by flotation methods obviously depends on the "floating power" of the particles, a property which presumably bears as close a relation to shape and surface condition of the particles as to their actual size and weight, and we may, therefore, anticipate a greater range in diameters of particles so separated than, for example, in uniform sieve separations.

Descriptions of existing apparatus are given by the authors. These relate to Goreham's flourometer, the

Gory-Lindner elutriator, Cushman and Hubbard's air elutriator, the Petersen apparatus, the Griffin-Goreham standard flourometer, the Thompson classifier, Feret's air sifter, and Mackey's apparatus. Then the authors describe the new Bureau of Standards air analyzer, the essential features of which are as follows:—

The analyzer proper consists of a bulb with a set of three interchangeable nozzles, a stack or separating chamber, a tapper, electrically operated, and a dust collector, which retains all material carried off through the vertical separating chamber. The auxiliary apparatus consists of a motor-driven blower, and a grease-trap to prevent oil and grease from getting into the air tube leading to the reservoir. This auxiliary apparatus is designed entirely for the purpose of automatically supplying air at constant pressure to the analyzer. The complete equipment is shown in Fig. 1.

The process of making a separation with the analyzer is described as follows:—

The motor and blower are first started at slow speed, and the air tube leading from the reservoir to the analyzer is connected to the nozzle to be used. This causes a rise in pressure in the reservoir, indicated on the gauge, which is to be raised to the working pressure of 1 pound per square inch. The pressure is further raised by gradually closing the blow-off, and if not high enough when the latter is completely closed, the blower speed is increased. It is desirable always to have an excess of air supplied by the blower, and to have the blow-off so adjusted as to allow a slightly greater quantity of air to pass into the reservoir than is required for the analyzer. Further regulation of pressure is automatically provided by the regulator, which consists of a vertical pipe about 5 ft. long and 4 in. in diam., closed at the bottom and nearly filled with kerosene. Into this a long glass tube connected to the reservoir and open at the lower end projects to a depth which can be adjusted and is approximately the same as the difference in level of the kerosene in the two arms of the gauge at working pressure. This adjustment is always made by trial, and when the proper depth is attained, the regulator functions perfectly for an indefinite time without further attention.

It is obvious that if the pressure in the reservoir is below the required working pressure, air can escape from the reservoir only through the analyzer nozzle, but by further closing the blow-off, the pressure rises and the kerosene is driven down the regulator tube until finally the seal is broken and air bubbles off. The pressure in the reservoir will thereafter remain sensibly constant, unless the speed of the blower varies considerably. In normal operation, therefore, the oil in the pressure gauge mounts quickly to its prescribed height and remains there while the regulator disposes of the slight excess of air supplied to the reservoir. Unavoidable irregularities in the speed of the blower are thus automatically compensated and the gauge indicates the constant pressure of the air supplied to the nozzle. Variations in the reservoir pressure as large as 1 per cent. are rare, and of this magnitude are entirely negligible in their effect on the separations.

Having adjusted the blow-off, the nozzle is removed from the air tube and inserted in the bulb, which is detached from the stack. The weight of nozzle and bulb should be known to the nearest 0.01 g. If the 0.001-inch separation is to be made, a 33⅓ g. sample of cement is placed in the bulb; if the coarser separations are desired, 50 g. are ordinarily used. The bulb containing the cement is then attached to the stack, the air tube is connected to the nozzle, the tapper is started, and the analysis proceeds without further attention on the part of the operator. The residue in the bulb gradually darkens as the fine material is removed, and in the course of half an hour or less appears to become distinctly granular, especially in the coarser separations. It has been found by experiment that greater uniformity in the fractions is obtained if the separations are regarded as completed when a certain rate of loss is reached, as in the case of the No. 200 sieve fineness determination. The air separations require a considerably longer time, however, as the diminuation of the quantity of material removed is much less rapid toward the end of the process than in the sieve separations.

One of the practical uses of the analyzer is its adaptation to the study of the products of different types of grinding machinery. Comparative examinations of this sort can be made without calibration of the analyzer, and from examination of a large number of cements a fairly correct notion may be obtained of the characteristics of different mills. For the most reliable comparisons, however, the tests should be made on cements ground from the same clinker. Similarly, the degree of pulverization of different clinkers in a given mill can be determined, and the effects of hardness and other variables can be studied with the aid of the analyzer more satisfactorily than with the aid of sieves alone.

Experience has shown that the analyzer is equally well adapted to separations of other materials than cement, and in many cases may give more consistent results on other materials. For example, excellent separations have been made of ground quartz, emery, alumina, and other hard-grained materials. A new field of usefulness has recently been found in the testing of molding sands, in which the ordinary clay and silt determinations are especially important, but ordinarily made by crude washing and settling methods. On the other hand, the present form of analyzer has failed in attempts to separate hydrated lime and certain paint pigments, in which the coarse material appears to consist of compact agglomerates of fine particles, or of soft grains.

---

## NIAGARA FALLS PARK ROADWAYS.

Last year the roadways of the Queen Victoria Niagara Falls Park were treated with heavy asphaltic material applied hot and under pressure, after which a liberal covering of pea stone was placed. According to the latest annual report of John H. Jackson, park superintendent, this carpet treatment has provided an excellent wearing surface impervious to water and capable of taking the wear which would otherwise come upon the road metal itself. It is found that prompt attention to small depressions and ruts proves more economical than allowing the roadway to deteriorate to such a degree that large resurfacing operations have to be undertaken to restore it.

---

The percentage of all-steel passenger cars built in the United States during the past six years has increased from 26 to 74.6, while the percentage of steel underframe cars built has increased from 14.8 to 20.9. The older wooden cars are being steadily withdrawn from service, so that the percentage of steel and steel underframe cars will increase rapidly within the next few years. Wooden cars to the number of 1,048 were withdrawn during the calendar year 1914. It is estimated that to replace the present wooden cars will cost approximately $560,000,000.

## TIMBER IN CANADA.*

By R. H. Campbell,
Director of Forestry, Ottawa, Canada.

CANADA'S present supply of commercial timber has been variously estimated at lying between five and seven hundred billion feet, board measure, and covering an area of approximately 170,000,000 acres. This estimate refers only to timber of commercial value as saw timber. It does not include pulpwood, firewood, tie and pole material or small timber of any description, although this may have considerable commercial value.

Even pulpwood values are difficult to estimate as so much depends on accessibility to market. Firewood may be worth four dollars a cord in the settled parts of the country, and may have absolutely no value whatever in more remote districts. Ties may be worth forty cents at the railway, but the cost of transporting them may exceed this value, and they then become valueless for the present at least.

A complete estimate of available forest products could not even be attempted with the information existing, and this estimate is therefore largely confined to commercial saw timber (including all material ten inches and over in diameter at the stump).

British Columbia contains a land area of approximately 226,186,240 acres (353,416 square miles), of which about twenty-one per cent. is covered with commercial saw timber. This area of about 50 million acres has been estimated to contain 300 billion feet board measure.

The coast type is made up largely of Douglas fir, hemlock, Sitka spruce, western red cedar, western tamarack, western white pine and others of less commercial importance, and contains the bulk of British Columbia's best saw timber (about 225 million feet). The interior is divided into two distinct types. The Dry Belt country is characterized by light precipitation and the tree growth is light in consequence. It consists largely of Douglas fir and western yellow pine. The Kootenay country has a high annual precipitation and is practically a modified repetition of the coast type, characterized by the addition of such species as mountain fir and Engelmann spruce, and a lack of Sitka spruce. This type grades into the Southern Rocky Mountain type of mountain fir, Englemann spruce and lodgepole pine, which crosses the summit and clothes the eastern slope of the Rockies down to the prairie line.

British Columbia cut in 1913: 1,173,647,000 feet, board measure, of lumber in her mills. Over two-thirds of this was Douglas fir, about 7% was tamarack and 7% red cedar, and of the remainder, 5% was spruce, 5% western yellow pine, 3% hemlock, 2% western white pine, and 1% each, mountain fir and jack pine. With the exception of unimportant qualities of cottonwood, maple and birch, no hardwoods are found in this province. Twelve kinds of wood were reported.

The province of Alberta has a total land area of 161,000,000 acres (252,925 square miles), of which 5,416,000 acres are said to contain saw timber to the extent of twenty-one billion board feet. Four reserves exist in Alberta at the present time, and these contain 16,-711,776 acres. This province sawed in 1913, 44,662,000 feet of lumber of the following composition: Spruce, 93.8%; jack pine, 5%, and small quantities of Douglas fir, tamarack, poplar, balsam fir and birch. With the exception of birch and poplar the forests of Alberta are entirely coniferous. The Douglas fir, Engelmann spruce, mountain fir and lodgepole pine, extend from British Columbia down the eastern slope and mix with the typically northern forest type.

In the northwest territories and the Yukon the forest at the present time has practically no commercial value. Forest cover exists but the trees are not found in commercial sizes or quantities. Wood is used locally for fuel, fencing and rough construction, but none is sawn and brought to the lumber markets. The country is sparsely settled; much of it has never been explored.

Saskatchewan's land area is 155,764,080 acres (243,382 square miles) and the province's timber area covers 3,584,000 acres and contains about fourteen billion board feet. The province in 1913 cut 114,800,000 board feet of lumber. The lumber was made up of spruce (98.2%) almost entirely, with small unimportant quantities of tamarack, jack pine and poplar. The forest reserves in Saskatchewan cover an area of 1,152,889 acres and consist of eight different reserves.

Manitoba contains a land area of 148,432,640 acres (231,926 square miles), of which 1,920,000 acres are saw timber land with a stand of some 6,850,000,000 feet of timber. The northern part of this province is covered with the same northern forest type found in Saskatchewan and eastern Alberta, but another type is found in the southeastern part, sometimes called the southern Laurentian type. It is characterized by white and red pine, cedar and hemlock among the conifers and such eastern hardwoods as maple, yellow birch, elm, ash, basswood, beech, etc. The white and red pine reach Manitoba as do also the cedar, black ash, white elm and basswood; the other trees of this type are usually confined to Ontario and the provinces farther east.

Manitoba in 1913 cut a total of 71,961,000 feet of lumber in her saw mills. Spruce formed about 90% of this quantity as in the other prairie provinces. Smaller quantities of poplar, tamarack, jack pine, birch and balsam fir are also produced. Five forest reserves have been set aside, containing an area of 2,629,440 acres.

Ontario is Canada's largest lumber producing province and probably contains more mature standing timber than any other province excepting, perhaps, British Columbia. The land area of Ontario has been estimated at 234,163,200 acres (365,880 square miles). The greater part of this area is covered with the northern forest type of spruce, jack pine, poplar, balsam fir and tamarack, and parts of the northwestern portion of the province are treeless or covered with timber of no commercial value. This northern type in Ontario covers at least 180 million acres. South of this in Ontario and, generally speaking, south of the height of land between the St. Lawrence and Hudson Bay basins, we find the southern Laurentian type of forest which covers the southern rim of the Laurentian shield of rock formation. This type covers some hundred million acres in Ontario and Quebec, and has been estimated to contain 200 billion feet of saw timber. In this area are situated the principal forest reserves of both these provinces. Ontario has a forest reserve area of 11,539,200 acres (18,030 square miles) and Quebec has 111,400,320 acres (174,062 square miles). Ontario is Canada's premier white pine province

*From a paper presented at a meeting of the International Engineering Congress, 1915, in San Francisco, Cal., September 20-25, 1915.

and the stand of this species has been estimated at about 40 billion feet. The productive forest area in Ontario probably consists of from 70 to 90 million acres.

South of the southern Laurentian type we find the northern fringe of the great central hardwood type of the United States. This type of forest covers the middle west and eastern states of the Union and extends across the boundary to Southern Quebec and Ontario.

Ontario in 1913 cut 1,101,066,000 board feet of lumber, of which white pine formed about half of the total. The cut was made up as follows: White pine, 46.9%; hemlock, 13%; red pine, 12.0%; spruce, 9.5%; maple (the most important hardwood), 5.6%, and twenty-two other kinds of wood, making a total of twenty-seven kinds.

Quebec, with its recently added territory, now contains a land area of 442,153,600 acres (690,865 square miles). Of this, about 367 million acres belong to the Northern Forest type of pure conifers, 50 million to the southern Laurentian type of conifers with mixed hardwoods and about 5 million acres to the hardwood type. The eastern counties of Quebec, south of the St. Lawrence, belong to another type which is characteristic of the Maritime provinces, and is similar to the southern Laurentian. This type in Quebec covers about twenty million acres.

The Quebec government has reserved 111,400,320 acres (114,063 square miles) of forest land. The greater part of this lies in the northern portion of the province, either in southern Laurentian or Northern Forest type and most of it is not heavily timbered.

Quebec in 1913 cut 630,346,000 feet of lumber. Spruce here forms 65.4% of the total, white pine only 11.4% and hemlock 6.1%; birch comes fourth on the list with 5.4%, and is the most important hardwood. Generally speaking, the rest of the lumber output is similar in composition to that of Ontario.

The provinces of New Brunswick and Nova Scotia and the eastern counties of Quebec, or in short that part of Canada lying south of the St. Lawrence River, is covered by a forest type often called the Acadian. This consists chiefly of birch, maple and beech, with smaller quantities of basswood, ash, elm, oak and butternut. Red spruce is the most important conifer as compared to white pine in the southern Laurentian, and white spruce in the northern forest type. White and red pine are found in the Acadian type often in great abundance, but pure stands are scarce and most of the best material has been removed. The forest area might make up a total of 14 million acres, and is supposed to contain in round figures 100 billion feet of lumber. There are no forest reserves in the Maritime Provinces.

New Brunswick has a land area of 17,863,040 acres (27,911 square miles). The forest area has been estimated at 12 million acres, but this, of course, includes more than commercial saw timber land. The standing timber has been estimated at 22 billion feet of the following composition: Spruce, 60%; pine, 10%, hemlock, 5%; cedar, 5%, and hardwoods, 20%. With the spruce in this estimate would be included balsam fir which is often sold mixed with spruce. New Brunswick in 1913 cut 399,247,000 feet of lumber of the following kinds: Spruce, 79.3%; white pine, 7.8%; hemlock, 5.5%; balsam fir, 4.3%, and birch (the most important hardwood), 1.4%.

Nova Scotia's land area is 13,483,520 acres (21,068 square miles). The forest area has been estimated at 5,744,000 acres, and the coniferous saw timber at ten billion feet board measure. The hardwoods might provide five billion feet. The standing timber (conifers) would have the following composition: Red spruce, five billion feet; hemlock, three billion; white pine, one billion, and the remainder, balsam fir, tamarack, red and jack pine, and white and black spruce. The hardwoods would be: Beech, 40%; sugar maple, 30%; yellor birch, 20%, and white and wire birch, soft maple, red oak, white ash and black ash, the remaining 10%. Nova Scotia cut about 274,722,000 board feet of lumber in 1913. Spruce formed 56.9% and hemlock 23.2% of this total. Seventeen kinds of wood in all have been reported from this province.

The forest area of Prince Edward Island is too small to be considered in a general estimate of this sort as the entire area of the province is only 1,397,760 acres (2,184 square miles). The annual production is 6,771,000 board feet, of which spruce forms a half and balsam fir a quarter. Fifteen kinds of wood in all were reported in 1912.

## WOLFE ISLAND MACADAM ROAD.

Some figures pertaining to macadam road construction appear in the recently issued 1914 report on highway improvement in Ontario. The publication prepared by the Ontario Office of Public Roads, under the direction of Mr. W. A. McLean, provincial engineer of highways, describes the construction of a model macadam road, on Wolfe Island, adjacent to the city of Kingston. The road selected for construction is one which receives a large part of the traffic of the Island in reaching Marysville, from which a municipal ferry runs to Kingston, to which market the produce of the island is carried.

The road is constructed of broken limestone, quarried on the island and adjacent to the road. The width of grade is 26 feet between ditches, with stone spread from 12 to 14 feet wide, and uniformly 9 inches in thickness. The distance macadamized was 1.41 miles, the work being carried out in accordance with the specifications of the Highways Department.

Before improvement, the road had only a clay surface, was badly cut up, without drainage, and almost impassable during spring and fall months.

In constructing this road, suitable drainage was provided and the following concrete pipe culverts were laid: One 15-inch, three 18-inch, and one 24-inch; also one 36-inch corrugated metal pipe culvert; all bedded in concrete and having concrete head-walls. There are also two 4 ft. x 4 ft. reinforced concrete culverts 24 feet in length.

The unit cost per square yard of stone surface was not quite 73 cents, as follows: Culverts and tiling at farm entrances, $0.157; grading, $0.060; ditching, $0.023; crushing, $0.130; macadamizing, $0.106; rolling and sprinkling, $0.068; coal and oil, $0.042; supervision, $0.094; tools and repairs, $0.014; plans and surveys, $0.008; sundries, $0.022. Unit cost per square yard, $0.724.

---

The first central-station system for supplying electrical energy for light and power purposes was put into operation at Holborn Viaduct, London, on January 12, 1882. This plant, however, was for purely exhibition purposes and could hardly be called a commercial installation. Appleton, Wisconsin, can probably claim credit for starting the first commercial central station installation in the world, on April 20, 1882. This plant was necessarily small. The first large installation erected anywhere in the world was that of the Edison Electric Illuminating Company of New York, which commenced operation in the fall of the same year.

## TOPOGRAPHICAL RAILWAY TRAVERSING.

By J. A. MacDonald.

In running a preliminary line, except in old and settled localities, it is usually necessary to traverse the lakes and other larger bodies of water contiguous to the line. On the Grand Trunk Pacific, for instance, it was necessary, in many parts of the country, to traverse the lakes and map the country, for much of the region through which the railway ran had never been mapped. On striking a large body of water, it is necessary for the surveyor to learn from topographical investigations, which side of the water or lake is most suitable for the line, and in order to determine this a traverse of the lake

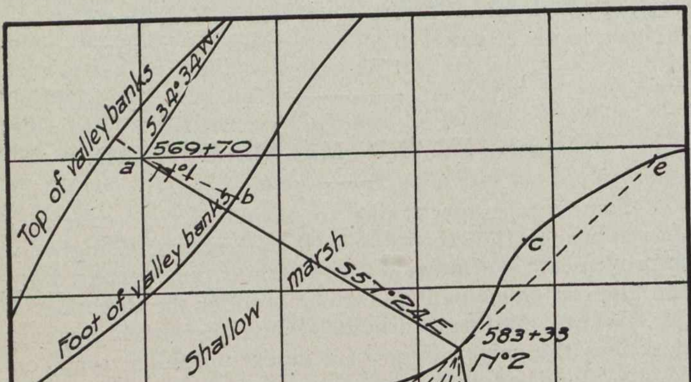


**Fig. 1.**

is absolutely necessary. While making this traverse, a large amount of topography can also be taken.

In these traverses the stadia is used for measuring distance, for rise and fall of the ground, and for obtaining the necessary topographical features of the country. By the use of the stadia, surveys of rivers, lakes and other bodies of water, etc., are made quickly and at a moderate cost. The stadia party consists of the surveyor, assistant, two rodmen, a couple of axemen and, where bodies of water are met with, a small boat or canoe, which may also require another man. A folding boat will be found the most convenient.

The traverse of a lake is made from one or more instrumental stations or hubs, at or near the shore, the rodmen following the bank and giving side shots at suitable distances apart. For rivers and narrow lakes there is an advantage in keeping one rodman on each side and surveying both sides at the same time. Under normal conditions the survey will be made on one side only, the front rodman travelling away from, and the rear rodman travelling towards, the surveyor. The latter having reached the surveyor, or transit man, and the former the next instrumental station, the surveyor moves his instrument to the next station while the rodmen are waiting in their places. Upon the arrival of the instrumentman or surveyor, the front rodman shows him the point of the new station, and the instrument is set up. The rear rodman places his rod upon the last station for orienting the transit, and the other can take charge of the folding boat and get a few soundings. He also gives side shots for stations at islands.

The procedure is better understood from the accompanying example: Commence the survey at a hub or instrument station, as, for example, at 569 + 70, in Fig. 1. Explain to the rodmen, if they are inexperienced, how to

| Point | Distance | Bearing | Vertical Angle | Corrected Distance | Remarks |
|---|---|---|---|---|---|
| Station 1; oh 569+70. Line south 34°34′ west. | | | | | |
| a | 1.50 | 307°00′ | 6°40′ | 1.52 | Top of valley bank |
| b | 3.50 | 115°30′ | 2°45′ | 3.53 | Foot of valley bank |
| (2) | 13.43 | 122°36′ | 5°50′ | 13.63 | |
| Station 2; marshy shore 6 chains wide. No perceptible rise. Water 5′ deep, 15 chains from shore. | | | | | |
| c | 4.57 | 31°25′ | | 4.68 | |
| d | 5.15 | 252°47′ | | 5.28 | |
| e | 9.18 | 46°40′ | | 9.40 | |
| f | 9.87 | 238°12′ | | 10.04 | |
| g | 14.23 | 224°51′ | | 14.56 | Creek 10′ wide 2′ deep |
| h | 16.41 | 212°38′ | | 16.78 | |
| k | 16.75 | 198°09′ | | 17.14 | |
| l | 17.10 | 180°53′ | | 17.49 | |
| (3) | 19.31 | 171°07′ | | 19.74 | |
| Station 3; sandy beach 30′ wide. Ground rising 6″ per 100′ to foot of valley banks. Water 11″ deep, 3 chains from shore. | | | | | |
| m | 20. | 2°80′ | | estimated | To foot of valley bank |
| n | 10. | 2°40′ | | estimated | |
| o | 5.52 | 191°31′ | | 5.65 | |
| p | 15. | 250°00′ | | | Distance estimated |

**Fig. 2.**

hold the rod vertical, how to ascertain it is not hidden, and how to select a new instrument station. Arrange also a system of signals with the rodmen for directing them to stop or start again, as to indicate that the rod is hidden. Some signals can be made with the arms or a flag may be necessary at a great distance. Before the front rodman leaves the instrument, show him where the next instrumental station is to be.

For distances greater than 1,300 feet use only half the wire interval, thereby being able to read, on the ordinary 13-ft. rod, 2,600 ft.

It is seldom necessary to record vertical angles along the shore; it is frequently necessary, however, to do so in getting the topography, as the lake or river may have steep banks. Distances read with the whole interval are more accurate than with the half intervals. The length, of course, between stations (1) and (2) on the plan (Fig. 1), should be more carefully measured and read than the side shots.

The left page of the field book is for the notes (see Fig. 2) and the right page is used for the plan of the survey (Fig. 1). The stations of the traverse is designated by numbers, the side shots by letters. In the first column of the left page, enter the letter of the side shot or number of station sighted on. The second column is for distance read or estimated. The third column for the bearing, for convenience from 0° to 360°; the fourth column for the vertical angle which, as already said, may generally be neglected; the fifth column for the corrected distance, and the remainder of the page for remarks. It will only be necessary to make the corrected distances, fifth column, is the sights from one instrumental station to the next.

At each instrument station enter in the notes the estimated horizontal distance between high and low-water marks. The nature of the shore, whether sandy, gravelly, rocky, marshy, etc. The nature of the bank, the surrounding land, whether low, marshy, swampy, high, steep, rocky, dry, timbered, etc., and all necessary topography in the vicinity. Also, note the nature and extent of the slopes toward the lake or river, and the approximate depth of the water where it can be obtained.

Soundings should be taken at each instrument station when practicable. When the lake is shallow fewer soundings will be necessary. For soundings, procure a ¼-inch hemp rope, attach 2 or 3 lbs. of lead and mark every foot of the rope with small pieces of string. Mark every ten feet with a strip of red bunting or other woollen material, and every five feet with a strip of blue bunting. An ordinary 13-ft. level-rod answers.

**Plotting the Survey.**—Make the plot on ruled or cross-section paper on a generous scale. Commence by plotting carefully the instrumental stations; then mark the north and south points of each station; put a fine needle through the centre of the protractor and plot the side shots.

The stations are plotted by placing the diameter of the protractor parallel with lines of the paper and marking the course. A straight line is drawn between the two points so marked and the length of the course is plotted with the scale. After all the stations have been marked, the side shots are plotted by putting the needle through the centre of the protractor. A careful plot of the course of the traverse is accurate enough for the purpose of the survey.

In the case of inclined sights, these may be reduced by means of the slide rule. The constant of the instrument may be neglected except perhaps in the case of instrument stations.

The plot can now be transferred by one of the several well-known methods or plotted directly in the 400-ft. scale map of the preliminary.

Any topographical information that will facilitate the finding of the best ground for the final location, must not be overlooked in the traverse.

---

The total production of gold in Canada, in placer and mill bullion and in smelter products in 1914, is estimated at 770,374 fine ounces, valued at $15,925,044, as compared with 802,973 fine ounces, valued at $16,598,923, in 1913, showing a decrease of $673,879 or about 4 per cent. Of the total production in 1914, about $5,695,508 was derived from placer and alluvial mining—$6,050,690 in bullion from milling ores, and $4,228,846 from matte, blister copper and other smelter products, etc. The production in Nova Scotia and Quebec is small compared with the other provinces, but shows an increase of over 25 per cent. in 1914. The Ontario production, $5,546,356, shows an increase of over a million dollars due to the extension of milling facilities in the Porcupine field. The production in British Columbia was $5,277,343. The Yukon production shows a falling off of $721,384, the total in 1914 being $5,125,396, as against $5,846,780 in 1913.

## SEPARATION OF GREASE FROM SEWAGE.

THE present-day tendency toward utilization of all waste products has led to much experimentation with a view to turning to some profitable account the sewage which was formerly wasted. Enormous quantities of sewage sludge are produced yearly by the most commonly used methods of purification. Getting rid of this sludge has heretofore formed a large item in the cost of sewage disposal and no profit except in isolated instances (its sale as fertilizer, etc.) may be derived from it. One of the most valuable by-products obtainable from sludge is grease, and due to the failure of other schemes to produce a marked reduction in the disposal cost, the attention of many investigators has concentrated upon the problem of the extraction of grease from sewage.

Various processes have been evolved for the recovery of this grease, the most successful of which is the installation at Bradford, England, where the large percentage of fat in the sewage from the wool industry is peculiarly favorable to a profitable extraction of grease. The sewage is passed through detritus tanks and then through revolving screens. Sulphuric acid is then added to the sewage in such quantities as to give an excess of about 50 parts per million of free sulphuric acid; the sludge being precipitated in continuous flow tanks. This sludge contains an average of 78% moisture and 7% of fatty matter. It is then raised by compressed air into the sludge-pressing houses, where it is screened, acidified with sulphuric acid, heated to 190° C. by exhaust steam in open vats, and then pressed. The presses are heated by steam so that the fatty matters are kept fluid and pass away from the presses with the liquor. The fatty matter is then separated from the water, purified and sold. In 1907 a slight profit was reported, but as overhead charges were not included, this profit is to be questioned.

Experiments recently made at Boston, Mass., have indicated that the treatment of raw sewage by sulphur dioxide gas produced by the burning of pyrites facilitate the separation of fats to a marked extent. The cost of acidification in this manner is claimed to be slight as compared with the use of sulphuric acid. The sludge is dried and the fat extracted with some solvent. The process, however, has not passed the experimental stage and so has not been tried on a working scale.

An interesting set of experiments is described by Messrs. P. N. Daniels and J. R. Rosenfeld in "The Cornell Civil Engineer" for October, 1915: These experimenters sought to ascertain whether the treatment of raw sewage by sulphur dioxide gas facilitated the separation of fats to a marked extent and whether the cost was much cheaper than the sulphuric acid process.

The experiments were conducted at the sewage disposal plant of the city of Ithaca. The city has a normal population of about 15,000, but during most of the year an additional 5,000 is added through the students of Cornell University. As Ithaca contains few manufacturies, little trade waste finds its way into the sewage flow which averages approximately 3,000,000 gallons a day. The sewerage also contains a large amount of infiltrated water. An average of about five sets of runs made between 3 and 4 p.m. upon sewage from the inlet channel early in the fall gave the following results: Total solids, 394 parts per million; solids in suspension, 115 parts per million. An average of five sets of runs made in April, 1914, upon sewage taken from the same place at 12:30 p.m. gave total solids as 725 parts per million, and a value of 910 parts per million for total solids taken

## ASPHALT AND ITS USES.

Mr. Charles Ekstrand, M.E., in a paper on "Asphalt, Its History, Manufacture and Uses," read before the Brooklyn Engineers' Club, sums up in the following way the points that are important to obtain a good asphalt:

(1) The selection of the best crude oil for good asphalt production.

(2) The proper treatment for the material required.

(3) As low heat as possible, and that heat applied the shortest possible time.

(4) All the heavy oils, such as lubricating oils, which do not evaporate quickly, must be retained in the asphalt.

(5) No mixing of oils, or of asphalts obtained from different oils must be done, as each oil varying in its chemical constituents, varies also in its physical characteristics and requires different treatment.

(6) It must be uniform in character and tests.

The treatment that asphalt should receive during its reduction, depends on the uses to which the asphalt is to be put.

There are two main divisions in the treatment of asphalt, *viz.*, distillation with the addition of steam, and of air.

In the first method the oil is heated to about 300° F. when steam is introduced through perforated pipes into the bottom of the vessel, the temperature gradually raised until it is sufficiently high to distill over enough of the lower boiling point fractions, in order to leave a residue which fulfils the requirements of the material wanted. The steam in this case acts as a cooling agent and also as a mechanical carrier of the light hydro-carbons which it is desired to drive off.

The asphalt so made is suitable for paving, either sheet asphalt or penetration method, for waterproofing, saturating, roofing, etc.

Its high boiling point, small percentage of loss at elevated temperature (300-400° F.), slight change at extreme temperatures, and slight action of water makes it extremely well adapted for the above uses.

Following are the characteristics of a paving asphalt of a penetration widely used:

| | | | |
|---|---|---|---|
| Sp. Gr. at 77 | 1.048 | Sol. in 76° naphtha | 78.6% |
| M. P. (Mabery) | 143° F. | Sol. in carbon tetrachloride | 99.85% |
| Pen. at 32° F. | 1.7 m.m. | Sol. in carbon bisulphide | 99.9% |
| Pen. at 77° F. | 5.5 m.m. | Loss on 20 grams 5 hrs. 325° F. | 0.3% |
| Pen. at 115° F. | 19.6 m.m. | Flash open cup | 550° F. |
| Ductility at 77 | Over 100 c.m. | Ash | None |

The range in penetrations between 32° and 115° F. shows an interesting characteristic of the heavy crude asphalts. Its high ductility is generally considered in its favor. For waterproofing, an asphalt of a higher penetration is generally used.

The test of such material follows:

| | | | |
|---|---|---|---|
| Sp. Gr. | 1.045 | Sol. in carbon tetrachloride | 99.9% |
| M. P. (Mabery) | 130° F. | Sol. in carbon bisulphide | 99.9% |
| Pen. at 77 | 8.3 m.m. | Loss on 20 grams 5 min. 325° F. | 0.5% |
| Ductility at 77 | Over 100 c.m. | Ash | None |

The asphalt must be of good saturating qualities, small effect of temperature changes, and insoluble in water to make it effective. For roofing, a higher melting point material is usually used.

There is more asphalt used for road building than for all other purposes put together. Numerous methods of application have been in use for years and new methods are constantly being devised. For the heaviest traffic, such as that prevailing in business streets of a city, the sheet asphalt on concrete foundation is very satisfactory and lasting. Other methods of application are the bitulithic or graded method, Telford bituminous macadam, Topeka mixture, penetration method, etc. The best method for any street or road should be carefully determined by an engineer having intimate knowledge of the various methods, and a careful consideration for the weight of traffic to which the street will be subjected after paving. To make a good asphalt pavement it is necessary to have good asphalt, but very poor paving can be done with good asphalt. The asphalt being only the binder and the waterproofing, the wear and tear comes on the stone and sand, and it is necessary that these are of the highest quality and properly graded so as to have a compact mass with just enough of bitumen to bind each particle together and to prevent moisture from penetrating below the surface. It is also necessary to have a good foundation so that no sagging or sinking can take place under the traffic load. Having all the above of the very best that can be found, they only constitute 50 per cent. of what is necessary for a good asphalt pavement. The other 50 per cent. lies in the judgment used in selecting the proper hardness of the bitumen and in the care with which the materials are graded and mixed and applied. In other words, one-half of a good pavement depends on the quality of material, and the other half depends on the quality of brains, labor and application.

The greatest enemy to a good asphalt pavement is moisture. It is necessary that the bitumen be absolutely free from moisture, that the stone and aggregates are free from moisture when mixed with the bitumen, and that the mixture is kept free from moisture until it is laid in place and rolled down to a compact mass. If the stone is put down cold, containing more or less moisture, and the bitumen is put on hot, when this hot bitumen surrounds the stone, the moisture will be expanded and forced toward the surface, forming a film between the stone and the bitumen, which will prevent a perfect union between the two. Eventually disintegration will take place, and more moisture admitted to the interior of the pavement, ruts will form and grow, and the road will soon be a horrible example. The only thing to recommend the system is its low first cost. Maintenance will necessarily be heavy.

Following are some points that are important to consider to obtain the best results in asphalt paving:

(1) Select the best quality asphalt.

(2) Select the proper grade of asphalt for the traffic load expected on the street, and for the condition of the street, *i.e.*, a sunny street and heavy load need a harder grade of asphalt, a shaded street and a light load needs a softer grade of asphalt.

Climatic conditions should also be taken into account.

(3) Select the best and hardest wearing material for the aggregates.

(4) Adequate foundation, and a good crown on the street so as to shed all surface moisture rapidly.

(5) Proper proportioning and mixing of the aggregates so as to have a minimum of voids.

(6) Proper proportioning of bitumen so that every particle of the aggregates are coated and no more.

(7) Heating of all the materials so that no moisture is present during the mixing and application.

(8) A thorough rolling so that the aggregates are squeezed together in a solid mass.

---

## INFLUENCE OF TEMPERATURE ON THE STRENGTH OF CONCRETE.

THE general use of concrete in various kinds of construction and at all seasons of the year renders important a knowledge of the effect of temperature upon the strength of this material. It is of special economic importance to the contractor or the builder to be informed concerning the strength of concrete at early ages under different temperature conditions so that he may know when to remove forms and what loads may be safely applied to the different parts of a structure.

The subject of temperature influence is dealt with in a bulletin recently issued by the engineering experiment station of the University of Illinois. The author, Prof. A. B. McDaniel, of the department of civil engineering, presents the results of three groups of tests on (1) forty-five 6 x 6-in. cylinders; (2) fifty-one 6-in. cubes, and (3) sixty 8 x 16-in. cylinders, under such temperature conditions as were allowed by the facilities available. Professors A. N. Talbot and Ira O. Baker co-operated with Mr. McDaniel in planning the tests and in interpreting the data. The quality of the materials chosen is representative of the ingredients of concrete work in the middle west.

All the concrete was composed of 1 part cement, 2 parts sand, and 4 parts broken stone, by weight; corresponding to 1 part cement, 2.2 parts sand, and 3.6 parts broken stone, by volume. The materials for each specimen were weighed out separately and then mixed. The mixing of the concrete for Group I. was done with a trowel in a large galvanized iron pan. The cement and sand were first mixed dry to a uniform color and spread out in a layer of uniform thickness over the bottom of the pan. The stone was then added, and the whole mass given four complete turnings, which secured thorough incorporation of the dry materials. Water was added, and the material turned until thoroughly mixed. The concrete was gathered together in a compact mass, in one end of the mixing pan, so as to reduce evaporation losses to a minimum. The time of mixing of each specimen was kept as nearly constant as possible.

The concrete used in Groups II. and III. was mixed in similar manner to that of Group I., but was mixed on the concrete floor of the laboratory with shovels. The specimens were classified according to the form of test specimen and storage conditions, as shown in Table I.

**Table I.—Description of Test Specimens.**

| Group | Set | Specimens: Number | Specimens: Form | Number and Age of Specimens When Tested. |
|---|---|---|---|---|
| I | A<br>B<br>C | 15<br>15<br>15 | 6 x 6-in<br>cylinders | 5 specimens of each set; at 7, 14, and 28 days. |
| II | D<br>E<br>F | 15<br>18<br>18 | 6-in.<br>cubes | 3 specimens of each set: at 4, 7, 11, 14, and 28 days. |
| III | G<br>H<br>I<br>M | 15<br>15<br>15<br>15 | 8 x 16 in.<br>cylinders | 3 specimens of each set; at 3, 7, 10, 14, and 28 days. |

The forms used for Group I. were sheet-iron cylinders 6 in. in diameter and 6 in. high. The specimens of Group II. were molded in three-gang cube forms made up of two 6-in. channels and plates placed 6 in. apart. The forms for the specimens of Group III. were sections of standard 8-in. wrought iron pipe, 16 in. long. The forms were removed from the specimens after a storage of two days. Table II. shows the weight of the dry materials, the per cent. of water in terms of the total dry materials, the temperature of the room and of the concrete, and the average time of molding.

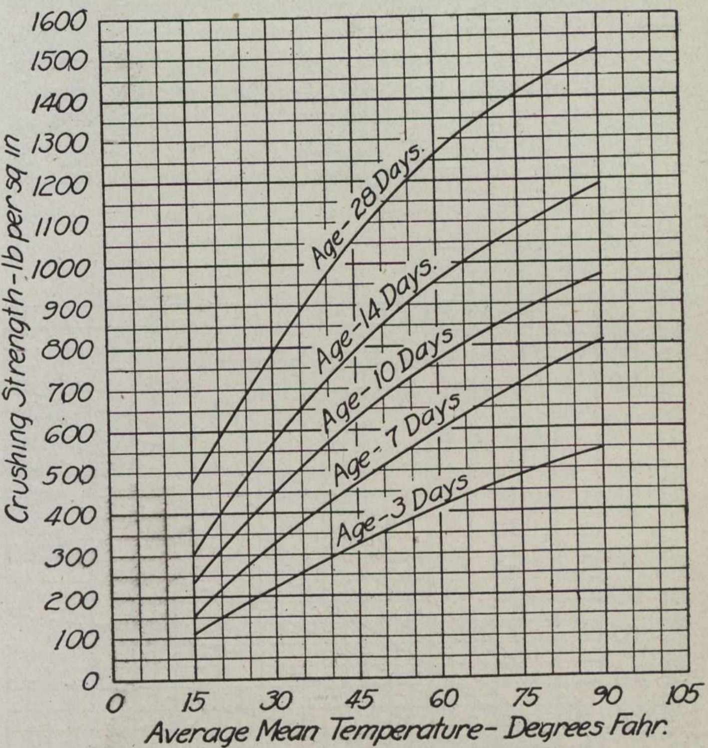


**Fig. 1.—Relation of Strength to Temperature for Different Ages.**

Prof. McDaniel draws the following general conclusions from the results obtained:

Under uniform temperature conditions, there was an increase of strength with age within the limits of the tests. For any temperature the rate of increase decreases with the age of the specimen; and this rate of increase is less correspondingly at the lower temperature conditions. For the specimens tested, under normal hardening temperature conditions of from 60 to 70° F., the compressive strength of the concrete subjected to a uniform temperature at the ages of 7, 14, and 21 days may be taken as approximately 50 per cent., 75 per cent. and 90 per cent.

**Table II.—Data Concerning Molding of Specimens.**

| Type of Specimen | Set | Average Time of Molding, minutes | Average Temperature: Air | Average Temperature: Concrete | Weights of Materials: Cement lb. | Weights of Materials: Sand, lb. | Weights of Materials: Stone, lb. | Water per cent. |
|---|---|---|---|---|---|---|---|---|
| 6 in. cylinders | A<br>B<br>C | 8.5<br>8.5<br>8.5 | 32° F<br>65<br>84 | 70° F.<br>71<br>70 | 2.17<br>2.17<br>2.17 | 4.34<br>4.34<br>4.34 | 8.68<br>8.68<br>8.68 | 10.0<br>10.0<br>10.0 |
| 6 in. cubes | D<br>E<br>F | 7.0<br>7.0<br>7.0 | 77<br>75<br>71 | 70<br>70<br>69 | 2.42<br>2.42<br>2.42 | 4.84<br>4.84<br>4.84 | 9.68<br>9.68<br>9.68 | 10.0<br>11.0<br>10.0 |
| 6-in. cylinders | G<br>H<br>I<br>M | | 68 | 69 | 10.2 | 20.4 | 40.8 | 9.3 |

of the strength at 28 days, respectively. For lower temperatures the percentage values are less; and for higher temperatures the percentages are higher. The relation between the percentage values at the ages of 7, 14, 21 and 28 days is nearly the same for temperature conditions from 30° to 70° F. However, the values for the lower temperatures should be used with caution.

Concrete which is maintained at a temperature of 60° to 70° F. will at the age of one week have practically double the strength of the same material which is kept at a temperature of 32° to 40° F.

Figs. 1 and 2 may be used to determine the representative strength of concrete similar to that used in these tests, for various temperature conditions and for ages up to 28 days. These diagrams may be used with a fair degree of approximation to ascertain the relative

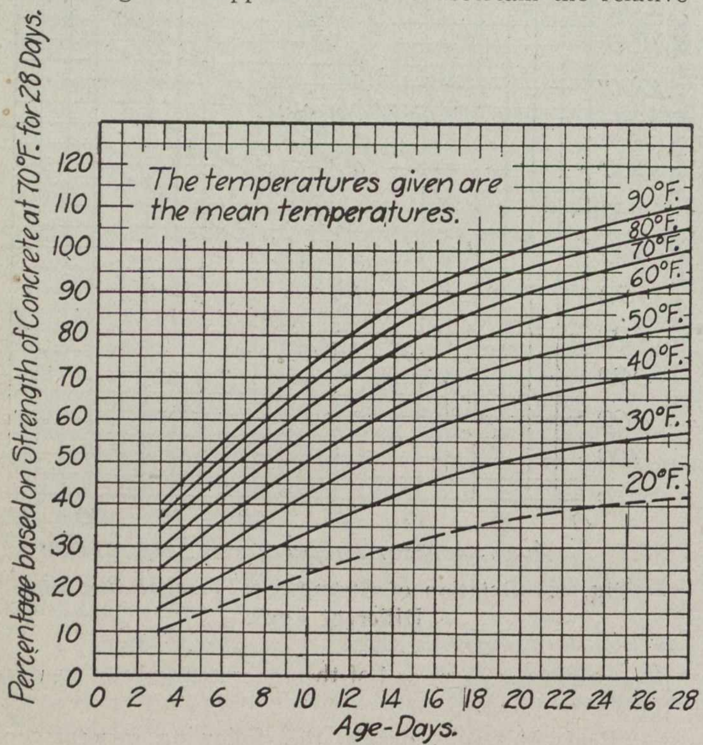


**Fig. 2.—Percentages of Strength for Different Temperatures.**

strengths which concrete of ordinary practice may be expected to attain at the different temperatures. It should be noted that generally in this investigation the specimens were stored under temperatures which were nearly uniform during the whole storage period. In set F the variations in temperature include a number of alterations above and below the freezing point and the specimens were seriously injured. The results accord with the well-known effect of freezing and thawing upon green concrete.

---

The yearly gold production of the world at the present time is estimated at about $470,000,000, of which nearly two-thirds are produced in the British Empire.

According to a trade and commerce report, the output of the principal minerals in Japan proper during the year 1914 was as follows:—

| | |
|---|---|
| Gold (ozs., troy) | 164,987 |
| Silver (ozs., troy) | 4,615,422 |
| Copper (lbs.) | 133,704,725 |
| Cast-iron (metric tons) | 60,400 |
| Coal (metric tons) | 10,310,430 |
| Kerosene (United States' gallons) | 76 000.000 |
| Sulphur (tons) | 54,500 |

## SUPPLEMENTAL POWER FOR HYDRO-ELECTRIC PLANTS.

In a paper presented at the Philadelphia meeting of the American Institute of Electrical Engineers on October 11th, Mr. J. F. Vaughan outlines the functions of steam or other forms of prime mover power plant furnishing relay and supplemental power for systems, whose normal source of power is water, as follows: I., standby for breakdown; II., relay for low water; III., supplemental for carrying peak of load; IV., as base load capacity when load dominates the water power and water power becomes supplemental to steam.

The characteristics of the supplemental plant types corresponding to the above functions are: For functions I., II. and III., low fixed charges and low standby cost; for functions I. and III., quick starting; for functions II. and III., moderate operating costs; for function IV., low operating costs.

The plant types are: I. Classified by ownership—(1) Power Company's; (2) Power Customers'. II. Classified by origin—(1) Existing plants; (2) Extension of existing plants; (3) New plants. III. Classified by equipment—(1) Second-hand equipment; (2) Cheap new equipment with simple auxiliaries; (3) High economy equipment with full auxiliaries.

The author represents the relative commercial value of the functions of the supplemental plant in various ways; for instance, assuming the entirely new system, whose market is created by the water power development and grows gradually through a term of years until it exceeds the capacity of the water power available. Assuming for discussion a term of 25 years, the relative value of each function for various periods expressed in per cent. of the total commercial value of a supplemental plant is tabulated as follows:

| | 1st year | 2nd year | 5th year | 10th year | 25th year |
|---|---|---|---|---|---|
| Breakdown (I) | 100 | 75 | 50 | 10 | 0 |
| Low Water (II) | 0 | 25 | 50 | 15 | 0 |
| Peak Capacity (III) | 0 | 0 | 0 | 25 | 0 |
| Base Load (IV) | 0 | 0 | 0 | 50 | 100 |
| Total | 100 | 100 | 100 | 100 | 100 |

These relations are further explained by tabulating according to functions and characteristics:

| Breakdown | Low water | Peak | Base load |
|---|---|---|---|
| Quick start | Low investment | Low investment | Reliability |
| Low investment | Economy | Quick start | Economy |
| Reliability | Reliability | Reliability | Low investment |
| Economy | Quick start | Economy | Quick start |

It is evident that in order to minimize fixed charges, the existing steam capacity should be utilized as far as possible whether it belongs to the water power company or its customers, and insofar as the supplemental capacity is required for standby, or for small annual output—that is to be used to produce kilowatt capacity, and not kilowatt-hour output—even inefficient, second-hand, or otherwise low-grade plant may be well adapted to the purpose.

As the supplemental plant is called on to furnish a larger proportion of the demands of the system—that is, as it operates on a higher and higher load factor—the higher class of equipment required may not be found so readily available in existing plants. While this is particularly true in the smaller power systems, larger communities may provide higher class installations, either in the form of mill equipment or public service plants. In the older communities, where large systems have grown up, supplied from well-developed steam installations, water power supply may be obtained from local small sources, strictly supplemental to the steam plant, or may be brought in over transmission lines from some outlying water power system. In the latter case, the ideal would be obtained by a traffic agreement between the two companies by which the water power system could utilize to the full the capacity of the steam plant to relay its own system during low-water periods, and could furnish the steam plant in return surplus power to reduce the fuel consumption of the steam plant.

The author presents curves to indicate graphically, by a hypothetical case, how the system load would naturally be divided between the water power and supplemental plant. It is assumed that the water power plant has sufficient pondage to enable it ultimately to carry the daily peaks, leaving the base of the load to be handled by the steam plant. The curves represent the four stages indicated by functions I., II., III. and IV., expressed above and relate to the following cases:

(1) The system load is assumed to be equal to but not exceeding the low-water capacity of the water power plant.

(2) The load exceeds the low-water capacity and equals that of the water power plant. Steam supplement is required during low water.

(3) The load exceeds at all times the water power plant capacity calling for the daily use of the steam plant to carry part of that load. During normal water, water power takes the base reducing the hours of daily steam operation. During low water, when water is insufficient to carry the whole base to allow steam to operate on short hours, the capacity is used to better advantage by handling the base by steam.

(4) The load exceeds the water power capacity at all times to such an extent that steam dominates the output. The water power then, by taking advantage of its pondage provides the peak load capacity and reduces its hours of daily operation.

In order to illustrate what has been the general experience and practice of public service corporations utilizing water power in the eastern states, the author collected information from a number of the more important companies as to the general policy of the companies in utilizing the existing capacity in steam plants of their customers, also the general principles followed in the sale of power calling for supplement either by the customers for their own protection, or by the company for its own or its customers' benefit. The situation consists of three classes, somewhat at variance with the above ideal classification. They are:

(1) Markets already existing either wholly supplied from steam or with steam dominating, and gradually absorbing transmitted power.

(2) New, or recently developed water power installations or extensions seeking new markets are usually more or less supplemented by steam.

(3) Power sources extended either by re-development or by interconnection with other powers by means of electric transmission to better serve the territory covered.

The power customers having steam plants available for auxiliary use are of three classes:

(1) Public service railway, light and power companies.

(2) Mills having their own steam plants.

(3) Other water power developments having surplus steam plant capacity.

In addition, information was sought on the extent to which the various companies have found it advisable to relay their water power; the extent to which they had been able to obtain the use of their customers' steam capacity; the principal uses to which the supplemental plants had been put; the general location of supplemental capacity; the general method of getting and paying for the customers' supplemental capacity; the methods employed of quick steaming and starting; and the organization for, and time necessary to start and pick up the load.

A company operating about 50,000 kw. of water power capacity started out a few years ago with the idea of utilizing through contract agreements the steam capacity of its customers, and although unusually successful in carrying out this principle, nevertheless the company has found it advisable to provide its own supplemental plant to the extent of about 15 per cent. of its hydraulic capacity. In the last few years the proportion of its relay power has increased from about 2.5 per cent. to about 20 per cent. of the total kilowatt-hour generated, the latter figure representing the year 1914, which was a period of unprecedented drought. This company's ponds are sufficient to allow the water power plants to carry the bulk of the daily peaks making it necessary, as a rule, to call on the customers only at such times as they can spare the power.

The contracts with the customers furnishing supplemental power in general provide that, on request of the company, the customers shall supply power in such quantities and at such times as it may be required, provided this does not interfere in any way with their regular business. Such power is strictly "off peak" and requires no expense on the part of the customer for additional equipment.

The steam plants, of both customers and company, are used primarily for low-water supplement and only rarely for breakdown relay.

Another large company with about 5,000 kw. in water power started out on the assumption that what New England wanted was primary power, but it has seen fit to reverse its policy and now furnishes principally secondary power, depending on its customers to supply all the supplemental power required. In this way the company relays its water power to about 85 per cent. of its capacity. These customers are public service companies in general lighting and power business.

The principal use made of the customers' steam plants is for low-water supplement, although they are depended on for breakdown relay as well. Two have only enough capacity to handle their own loads and operate only when required to help out the water power. The third furnishes during low water the supplemental power required by the water power company in handling its other business. By an agreement with the first two customers the company furnishes them power at a price which warrants them in shutting down their steam plants, but does not require them to provide any additional capacity for the needs of the water power company. As the summer peak of the third coincident with the low-water period is only half their winter requirements they can furnish all the relay required by the company also without additional equipment. The company pays the customer a kilowatt-hour rate sufficient to give him a reasonable profit, but without any additional installation charge.

The two plants which are shut down when not required for relay can be started and pick up their loads in two or three hours. The third plant, operating continuously is always ready for breakdown relay duty. With the aid of forced draft kept for this purpose it can pick up two-thirds the capacity of the water power plant in twenty minutes. Similar apparatus now going into the other steam plants will enable them to pick up their loads in thirty or forty minutes.

Each steam plant has a permanent organization sufficient to start up at any time.

In carrying out plans for a very considerable increase in its present water power capacity the company expects to obtain from existing steam plants of new customers all additional steam relay required. In addition to above, the company has a power interchange agreement with another hydro-electric system by which it takes from that system, power up to about one-fifth of the total demand and furnishes them low-water relay in return.

Of the total annual output of the system a little over 20 per cent. is furnished by steam, including a small amount from the interconnected transmission system.

A third important system, including four water power plants aggregating 15,000 kw., operates three steam plants relaying the system to approximately 37½ per cent. of its capacity, and in addition has an interchange agreement with a customer operating both steam and water, from whom it can get up to 2,000 kw. in prime power.

The steam plants are used almost entirely for low-water relay, as far as possible carrying the base load when operating. The secondary use of these plants is for breakdown and to relieve the water power plants of the daily peaks. The relay power is furnished part as lighting and part as railway current. The plants were already built when taken over by the water power system and furnish excellent low investment sources of power near the centres of their respective markets.

In each active steam plant water is kept in one boiler and fires ready to kindle kept under enough boilers to enable the station to pick up its load. Ordinary disturbances are taken care of by duplication of transmission lines, and during bad thunder storms low steam pressure is kept up.

Sub-station operators form a nucleus of an operating organization for the steam plants to be completed from carmen, linemen and trackmen.

The proportion of the company's output generated by steam is approximately 5 per cent.

A fourth system relays its water power to about 30 per cent. of the capacity, of which about one-quarter comes from a customer. About one-half of the total annual output is generated by steam.

A fifth system aggregating 6,600 kw. in water power is relayed by steam to about one-quarter of this capacity. Owing to power obtained from another water power system the amount of steam generated by the company's plant is very small. Of the above so-called "steam" power about one-quarter is oil-driven. None of the customers' plants are depended upon for relay.

A sixth system developed to 12,000 kw. has a steam reserve, including customers' equipment, of 3,500 kw. or nearly 30 per cent., about one-third of which is obtained from customers' plants. The reserve is confined entirely to breakdown and low-water relay.

One of the company's steam plants is at the water power plant and the other at a substation, originally an independent plant. The chief customer's plant is at the delivery end of a transmission line.

Customers' relay power is obtained on demand and paid for at a fixed rate per indicated h.p.-hour or per metered kw.-hour. No special organization is maintained for handling the supplemental capacity. Starting time is given as two hours.

A seventh system, with 9,000 kw. of water power and relayed to a small extent only, has contracted with another public service company operating a steam capacity of 16,000 kw. and a small water power auxiliary to take relay power during low water up to 4,000 kw. and to furnish it in return secondary power when and in such quantities as it can be spared, the kilowatt-hour rates to be based on an interchange of power mutually beneficial, rather than for distinct profit to either. In this case the steam capacity is supplemental during low water and a breakdown relay at all times. The water plant is at one end of a duplicate transmission line and the steam plant at the other, while the load is distributed at several points along the line.

An eighth system, one formerly depending chiefly on water power, has grown so in recent years that to-day water is of minor importance. Ten years ago the steam output amounted to only 3,000,000 kw.-hour while the water power plant furnished 11,000,000 kw.-hour per year. At that time the principal use of steam was for low-water relay, next, to carry the peak, and lastly, as breakdown capacity. To-day the steam capacity is 16,000 kw. and the water power only 2,400 kw., the relative kilowatt-hour outputs of steam and water being in the ratio of 4:1. Under the interchange power agreement with the seventh water power system previously spoken of, the steam output will be replaced to a large extent by additional water and in exchange will be held as reserve to supplement the water power during low-water periods.

A ninth system, operating three water power plants aggregating 5,300 kw., is supplemented by steam to the extent of 900 kw., or about one-sixth. The proportion of the company's output generated by steam is about 5.5 per cent. In addition, the company purchases 2,500 kw. of power from a customer operating water power, who takes from another hydro-electric system which in turn depends largely on its customers for steam relay.

Other systems, ranging in water power capacity from 10,000 kw. to 1,150 kw., are relayed in extent ranging from one-half to one-quarter of their respective capacities.

The principal uses for their steam is for low-water and breakdown, and to a less extent to help on peak load. None depends on its customers for steam power. Some keep banked fires allowing them to start in from 15 to 30 minutes, and part require two hours or more to organize crews to start from cold boilers. One has a gas producer plant which has not yet been called into service, another an oil engine installation, and another is considering oil firing for its boilers.

Most of them keep skeleton crews ready among their hydraulic plants and sub-stations to be completed on call from other departments.

With few exceptions, plants, either taken over in consolidation of properties, or rebuilt or extended, utilize existing installations or second-hand apparatus, keeping down their idle investment, and those few exceptions are largely continuously operating, high-class plants belonging to customers or built for the purpose of high-grade relay of relatively high annual output.

**Table Showing the Extent of Supplemental Plant Capacity and Output in Per Cent. of Water Power Capacity.**

| | Water power kw. capacity. | Per cent. steam capacity. | Per cent. steam output. |
|---|---|---|---|
| 1 . . . | 50,000 | 15 | 2.5 to 20 |
| 2 . . . | 5,000 | 85 | 20 |
| 3 . . . | 15,000 | 40 | 5 |
| 4 . . . | 12,000 | 30 | 50 |
| 5 . . . | 6,500 | 25 | very small |
| 6 . . . | 12,000 | 30 | —— |
| 7 . . . | 9,000 | 50 (?) | —— |
| 8 . . . | 2,400 | — | 20 (formerly) |
| 9 . . . | 11,400* | (16,000 kw.) | (present) |
| 10 . . . | 5,300 | 17 | 55 |

*Including customer's plant.

The general conclusions that may be drawn from the somewhat limited data at hand are:

(1) That steam relay is depended on in widely varying proportions of water power capacity, depending partly on the character and regulation of the streams, partly on the character of power demanded, and more and more on the extent to which the systems are interconnected with others for the interchange of power.

(2) That, on the whole, the companies have been successful in utilizing the existing steam capacity of their customers.

(3) That the principal uses to which supplemental capacity has been put are: (*a*) Relay for low water; (*b*) breakdown; (*c*) peak capacity; (*d*) base load.

(4) That the supplemental plants, being largely old plants belonging to companies formerly supplying their own individual markets, since consolidated into more or less comprehensive systems, are generally scattered among local centres of distribution.

(5) That only in rare cases have provisions been made in special equipment or organization for quick starting, and that for this reason quick starts are rarely made. In certain cases, however, where such relay is of importance oil firing is being introduced and in rarer cases gas and oil engines.

## MAGNESITE DEPOSITS IN BRITISH COLUMBIA.

Magnesite, one of the most valuable of the non-metallic minerals, has been found in large quantities along the shore of Lake Atlin, in the north-eastern part of British Columbia. Seven claims have been located by Vancouver parties, and plans are being made for working the deposits. This ore is shown by analysis to be exceptionally pure, running as high as 98 per cent. in magnesium carbonate. The world's supply has so far come from California, Greece and Austria. On account of the war the latter source is cut off, and since this was the most important, there is an extraordinary demand for the mineral which British Columbia will soon be in a position to supply.

Magnesite consists of magnesia, 48 per cent., and carbon dioxide, 52 per cent., and used, after calcination, to make bricks for refractory furnace lining, nonconductive covering for steam pipes, boilers, etc. Magnesium salts, especially the sulphates, are used in the arts and in medicines, also in the paper industry, and in connection with the pulp industry of this province. This new discovery may prove to be of special value, since the chief value of the spruce forests in British Columbia is in their paper-making possibilities, and the fact that magnesia necessary to the manufacture of a finished product is right at hand, may result in greatly increasing the importance of the pulp industry.

## ACTIVATED SLUDGE TREATMENT COSTS.

IN *The Canadian Engineer* for October 28th, 1915, a description was presented of the new plant at Milwaukee for the treatment of sewage on a large scale by the activated sludge process. Mr. T. C. Hatton, the chief engineer of the Milwaukee Sewerage Commission, in describing the development at the Dayton Convention of the American Society of Municipal Improvements, gave some important estimates of cost relating to the extensive experimental work carried out under his supervision. Fig. 1 is a diagram showing the quantity and cost of air required for the process. In this particular case the amount of air used per million gallons of sewage is based upon the use of a tank of 9 ft. average depth. The final cost of aeration is, however, nearly independent of the depth of tank if the rate of aeration per square foot of tank surface remains constant, as if the depth were doubled the volume of air per gallon of sewage would be halved, but its pressure doubled. As

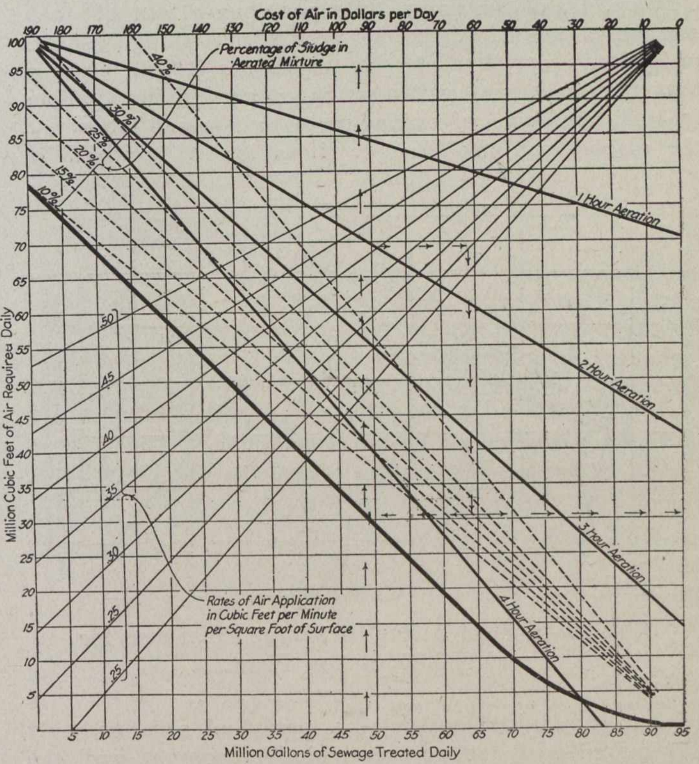


**Fig. 1.—Cost and Quantity of Air for Activated Sludge Process.**

an example of the use of the diagram the arrows show the procedure for 50,000,000 gal. of sewage, 2 hours aeration, 0.25 cu. ft. per million rate of air application and 25 per cent. of sludge. The cost is derived as follows:—

Begin at the bottom of the diagram with the number of gallons of sewage treated daily. Run vertically to the selected period of aeration, then horizontally, to the selected rate of air application, then vertically to the percentage of sludge, then horizontally to the heavy curve, and thence vertically to the cost in dollars per day. To find the amount of air in millions of cubic feet per day run horizontally to the left instead of to the heavy curve. In this manner the cost may be arrived at of producing the air per million gallons treated per day under varied conditions as to period of aeration, rate of air application per square foot of tank surface and percentage of activated sludge maintained in the tanks. This cost includes all boiler-room labor and all overhead charges, such as interest, sinking fund and depreciation.

In Fig. 2 a similar method is shown, but in this case the costs embrace all overhead charges, such as interest, sinking fund and depreciation and operating costs, including boiler-room labor, but excluding engine-room and plant labor. Tankage is provided for 1½ times the average daily flow, and the sedimentation period is ½ hour. Pumping of sludge is figured in as 30 cents per million gallons of sludge pumped on the basis of 10 cents per million gallons one foot high.

In Fig. 2 the method of procedure is as follows: Select the required rate of air application on vertical line to the extreme right. Run from this point horizontally to the left to the required period of aeration, then run vertically to the required percentage of sludge in the mixed liquor, and thence horizontally to the left for the cost in dollars per million gallons of sewage treated.

It was stated by Mr. Hatton that in Milwaukee the most satisfactory results have been obtained by using 0.25 cu. ft. of air per minute per square foot of tank surface, a period of 4 hr. aeration with a sludge content of 25 per cent. By referring to Fig. 2 it will be seen that this treatment will cost $5.30 per million gallons treated, exclusive of engine-room and plant labor and the disposal of the sludge. If a lower standard of

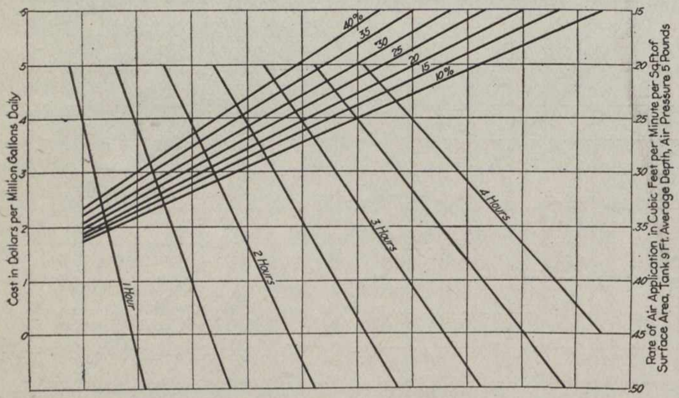


**Fig. 2.—Cost of Activated Sludge Treatment for 50,000,000-gallon Plant.**

effluent is required and a 3-hr. period of aeration only is required with 20 per cent. sludge content and the same rate of air supply, the cost will be seen to be $3.95 per million gallons treated.

Both charts are based upon rectangular tanks holding an average depth of 9 ft. of liquor, the depth which has so far seemed most applicable to the Milwaukee situation. The Milwaukee tanks are, in fact, circular, they having been designed before any results had been obtained from the continuous flow method. Mr. Hatton felt there were only two processes available for satisfactorily treating the sewage of Milwaukee, the activated sludge process with continuous flow or fine screening followed by Imhoff tank sedimentation, followed by chlorination. If the former process proved a failure the latter would have to be adopted. The tanks were, therefore, designed so that they could be used as the digestion chambers for an Imhoff tank installation by removing the sloping bottoms and baffle walls. It is felt, however, that rectangular tanks are more suitable for the process. In them the air-diffusers can be placed across at right angles to the direction of flow, thus avoiding possible short circuiting of the liquor. Again, the air piping system can be more conveniently placed and without requiring any pipes to be embedded in the concrete. Cheaper forms for construction is another advantage. But whatever form of tank designed the width of the running-through channel should not exceed 6 to 8 ft. to get the most economical disposition of the air.

## SHORT COURSE IN HIGHWAY ENGINEERING.

The University of Michigan announces the second annual short course in highway engineering to be given by the College of Engineering in co-operation with the state highway department at Ann Arbor, February 21st to 25th, inclusive, 1916. The instruction staff will be composed of members of the faculty and of the state highway department. In addition, special lectures will be given by the following highway engineers: A H. Blanchard, Professor of Highway Engineering, Columbia University, New York; Charles S. Reeves, Chief Chemist of the Office of Public Roads, Washington, D.C.; W. S. Gearhart, State Highway Engineer of Kansas; William Kelly, Chairman of the Dickinson County Road Commission, Vulcan, Michigan; I. O. Baker, Professor of Civil Engineering, University of Illinois; A. W. Dean, Chief Engineer of the Massachusetts State Highway Commission.

## THE QUESTION OF MUNICIPAL RESEARCH.

In his report for 1914, Morris L. Cooke, Director of Public Works for Philadelphia, Pa., states that the question of research work in connection with the activities of a city is one which must be considered very carefully. Taking the country as a whole, the cities have undertaken, relatively speaking, no research work up to date. In view of the tremendous opportunity for such work and in face of the fact that at some of the universities and research institutions great fortunes are being spent, the isolated pieces of work carried on in municipalities are almost negligible. Mr. Cooke is of the opinion that a part of the work now done by our cities could more properly be done elsewhere. At the present time the colleges and research institutions are the places for so-called "pure science." The net result of work of this kind carried on under existing municipal conditions is apt to be too small to warrant its being undertaken. The atmosphere in which the work of the average municipal laboratory is carried on is not especially encouraging to those types of work where results may be delayed or very definite results perhaps not even assured. On the other hand, there are varieties of work which can best be done by the cities in connection with construction.

"Some day there will perhaps be instituted a generously endowed foundation for municipal research through which it may be possible to coördinate efforts of this kind in a number of different places. When this step is taken a new day will have dawned for municipalities. Graft, inefficiency and political interference will disappear in proportion as we are able to establish definite scientific and engineering standards covering different municipal activities."

# Editorial

## RESOURCES, ADMINISTRATION, INVESTIGATION AND CONTROL OF WATER POWERS.

Repeated reference has been made in the editorial columns of some of our contemporaries regarding the controversy in the United States between advocates of federal and state ownership over water rights, with special reference to the control of water power development.

It would appear that the water power situation in the western states of the Union has reached an exceedingly acute condition owing to the endeavor of federal authorities to impose a federal administration of water power, which administration the advocates of state control strongly oppose on the ground that the conditions proposed by the federal authorities are so theoretic and idealistic that not only will the development of new water powers be prevented, but the extension to existing plants would be delayed. Unfortunately the controversy has developed into one between the conservation propagandist and the so-called water-power trust and between the advocates of federal and state rights. It is questionable whether the federal authorities and the state authorities who are directly concerned in the providing of an efficient administration in the best public interest, will be able to evolve from the present confusion a satisfactory scheme of administration, at any rate for some time.

It is very gratifying, indeed, to know that water power administration in Canada, especially in the western provinces where our own federal authorities exercise control, has reached a stage where there is workable accord between government administrative officers, water power companies, and the general public. While there may be some minor features of administration which are not quite satisfactory, it must be remembered that the art of development, use and distribution of electricity is of recent growth, and it would be unreasonable to expect administration to keep pace with the tremendous advances that are constantly being realized in the electrical world.

The water power situation in Canada is a fortunate one, indeed. With resources almost limitless, with her chief centres of population well within the zones of economic hydro-electric supply, and with exceedingly rapid progress in hydraulic power development and utilization, she has advantages which, coupled with her mineral, forest and agricultural resources, bespeak a phenomenal growth of industry. The Dominion is doubly fortunate, therefore, in being free from bitter controversy in the matter of water power administration, investigation and control.

There is little doubt that the well-arranged and carefully handled portrayal of these resources, as carried out by the Water Power Branch of the Department of the Interior at the Panama Pacific Exposition and the International Engineering Congress, will result in personal investigations by many engineers and financiers of other countries. Coming to Canada, they will find such complete and reliable information, including meteorological, hydrographical, topographical and even economical data, respecting our western power zones, as to be thoroughly well impressed, not only with the vastness of the latent resources, but also with the admirable scheme of administration which controls them, and the efficient system of investigation whereby the important data has been and is continually being compiled.

## THE COST OF IMPURE WATER.

It is of tremendous importance to the people that health should be safeguarded by every possible means. Formerly they were inclined to be fatalists when epidemics occurred in their midst, but to-day, by the process of education and enlightenment, they are coming to see that what is preventable, should be prevented. And yet there are still communities which live in apparent complacent satisfaction, although dangers lurk in their water supplies. The reports of the health departments of provinces, cities, towns and villages, indicate that there is room for improvement. Water-borne diseases are too prevalent for a progressive country to be proud of and, doubtless, pressure is being brought to bear on the recalcitrant authorities.

The report of the International Joint Commission which inquired into the pollution of boundary waters clearly and emphatically points out the polluted character of waters which are, even to-day, drawn upon to supply some of the communities that are located on the shores of the Great Lakes. That it is possible to select and treat such waters is proved by the health statistics of those cities which have adopted adequate measures to do so. It is, of course, rather costly to install plant to supply wholesome water, but the cost of impure water being intangible it is not often taken into account.

It is not possible to reduce the cost of impure water into terms of dollars and cents in the same manner as in the case of installing plants and operating them. On the one hand we have not only loss of lives but there is also the loss due to the potential wealth-producing power of such lives. No loss of life can be regarded with equanimity—it has its reflection on the social, commercial and national affairs of our nation. Conservation of life has become the twentieth century demand.

An excessive prevalence of typhoid fever, especially in the winter and spring months, is, according to the high authority of Dr. Allan J. McLaughlin, due in greatest measure to sewage pollution of water used as a source of public water supplies. It is scarcely necessary to-day, in the light of indisputable evidence, which is available, to submit proofs that polluted waters induce disease, which is exceedingly costly to eradicate. Past serious outbreaks of typhoid fever in well-known Canadian cities cost an immense amount, in actual dollars and cents, to stamp out the disease. Lincoln and Maidstone in England had also to suffer huge losses in business and in hard cash. The cost of stamping out an epidemic is always great and imposes unjustifiable burdens on the innocent sufferers and an excessive one on the ratepayer. If that same amount of money were invested in efficient filters and chlorinating plants, and on the careful management of the same, the communities would derive a far greater return.

It does not follow because filters, etc., are installed that typhoid fever will vanish. Lincoln had filters, but owing to severe climatic conditions and consequent inefficient filtration a serious epidemic occurred. "The mere installation of a filter plant," writes Dr. McLaughlin, "does not assure safe water. Intelligent and careful operation with daily bacteriological control are necessary to secure a safe effluent, and this is particularly true where the raw water is taken from a grossly polluted river. Inefficient management of any form of water purification plant may be productive of disastrous results."

The menace of our water supplies is due more to the intermittency of serious pollution which presence is unknown until it is announced by an acute outbreak of fever, than to a steady and persistent measure of contamination which, being known, induces the authorities to adopt necessary precautions. The efficiency of these precautions may be appreciated by the standard of the typhoid fever death rate. It is commonly estimated that the value to the state of a mature life is at least $5,000, and the preventable loss of a life owing to the apathy, negligence or incompetence of those put in authority, means the reduction of our national wealth by the above amount. If the nation were to impose a fine on the guilty local authority to recover such losses, there is no doubt there would be stern and active efforts made to avoid the fine. But is the duty in this matter less potent in the absence of a fine?

The average typhoid fever death-rate in large cities in Northern Europe is less than 5 per 100,000, but in North American cities the average is much higher. The following tabulation, taken from the Public Health Journal, shows the death rate per 100,000 of population for 1914:—

| | | | |
|---|---|---|---|
| Birmingham | 1.9 | Los Angeles | 7.5 |
| London | 3.3 | Winnipeg | 7.9 |
| Edinburgh | 3.4 | Milwaukee | 8.2 |
| Leeds | 4.8 | Boston | 8.8 |
| Manchester | 5.0 | Cleveland | 9.6 |
| Sheffield | 5.5 | St. Louis | 11.7 |
| Liverpool | 5.7 | Washington | 12.7 |
| Cincinnati | 5.7 | Detroit | 13.6 |
| New York | 6.0 | Pittsburgh | 15.2 |
| Belfast | 6.5 | Dublin | 15.5 |
| Chicago | 7.1 | Buffalo | 15.9 |
| Philadelphia | 7.4 | Montreal | 16.9 |
| Toronto | 7.5 | New Orleans | 20.9 |
| | | Baltimore | 22.4 |

Toronto has succeeded in materially reducing its typhoid death rate. In 1911 it was 20 per 100,000; in 1912, 12.1; in 1913, 10.4; in 1914, 7.5. It is hoped that this pronounced diminuendo scale will continue until the best British records are surpassed.

It is reasonable to expect Canadian cities to make strenuous efforts to reduce their typhoid death-rate to the present Toronto standard. During the years 1903-1912 statistics show that in Ontario—where the records have been kept for many years—the averages of 30 places ranged from 0 to 183, but the range in one year was from 0 to 422 per 100,000! Some deductions, no doubt, must be made for imported cases, but the margin for this is not great. The statistics of other provinces show a typhoid death rate which can be reduced by proper precautions.

Apart from the national loss due to preventable deaths, there is the local loss caused by the dislocation of business, by prolonged unemployment due to sickness, and other conditions incidental to epidemics, which, if they were expressed in money, would astound the authorities. Business men dislike the publication of news concerning epidemics because it harms trade, but they forget that the suppression of such news means the absence of protection to visitors. Business men have always been the leaders in formulating public opinion in favor of the adoption of measures which will tend to improve trade, with the result that many sanitary improvements have had their geneses with tradesmen. London obtained its first great water supply by virtue of the tradesmen demanding it, as the losses due to diseases were disastrous. There are many examples of this nature to prove that it is very costly to supply impure water or to tolerate other unsanitary conditions. It is true economy to install plants before an outbreak of disease, for it costs less and gives greater satisfaction than to bear the losses already incurred and afterwards install the plants—thus doubling the financial burden.

## MODEL CONCRETE ROAD AT SARNIA, ONTARIO.

IN the Provincial Government report of 1914 on highway improvement in Ontario a description is given of the laying of a model concrete road at Sarnia, Ont. The road is 5,946 feet in length; the concrete being 16 feet wide and 7 inches thick, with gravel shoulders 4 feet wide on each side. The work was carried out in accordance with the specifications for concrete roads as contained in the report of the Ontario Office of Public Roads, for the year 1913. The mixture was composed of 1 part of cement (of which 10% by volume is hydrated lime) and 4 parts of gravel, laid in one course. The road before improvement was unmetalled, flat and undrained. The methods employed were as follows:—

Grade stakes having been placed by the engineer down the centre and along the sides of the road, the earthwork was commenced. The sod was ploughed and carried away to the side of the road with drag scrapers. The open gutters on the side of the pavement were then formed by ploughing and scraping the earth into the centre of the road. This earth being free from humus was very valuable for building up the subgrade, which had been lowered by removing the surface sod.

As soon as the gutters had been roughly formed and the earth disposed of as described, the road roller was put at work compacting the earth base. Each time the roller had passed over the whole subgrade, the road grader was put on to remove irregularities from the edge of the subgrade, which tended to fall away under the weight of the roller.

Meanwhile a contract had been let for tiling both sides of the road with a tiling machine. The machine straddled the gutter, in the bottom of which the trench was formed, and the tile were put about 3 feet deep, as nearly as the surface grade would permit. The price for this work was 50 cents per rod, which was very favorable as compared with hand-work, and much better results were obtained.

As soon as the subgrade on the most distant portion of the work had been prepared gravel was deposited on the road in a continuous row two loads wide and two loads deep. This was done to provide sufficient surplus of gravel for a thin layer between the subgrade and the concrete, and also for a surplus which was used to cover and protect the newly laid concrete.

The gravel used on the work was supplied from the St. Clair River at Point Edward and was delivered by scows operating with a clam shell. The price paid was 45 cents per cubic yard, delivered on the dock. At the same time a storehouse was built at a convenient spot on the side of the road, to store cement and lime to be used for the concrete pavement.

When sufficient gravel had been hauled to keep the concrete mixer going for two weeks, a gasoline concrete mixer was installed in front of the storehouse, and a large concrete pavement mixer was moved to the road. The gasoline mixer was used to mix the cement and hydrated lime. Ten per cent. by bulk of lime was used. The machine used for this work was rented from a local contractor and was operated by seven men and a foreman who also ran the engine. The lime was kept in the storehouse and the cement was hauled from the car directly to the machine, where it was mixed with the lime, rebagged and either placed in the storehouse to be kept as a reserve supply, or hauled directly to the concrete mixer. Ordinarily a car of cement was mixed with the necessary lime in a day and a half.

When the larger concrete mixer was fitted up satisfactorily, the superintendent suspended grading operations temporarily and devoted his attention to the concrete work. The manner of carrying on this work was as follows:

A 1¼-inch iron water main was connected to the town's hydrant and laid in the gutter. This pipe was provided with tees and plugs at about every 150 feet. Shut-off valves were also inserted in the pipe line at several convenient places. By providing 100 feet of 1-inch rubber hose which was attached to the pipe by means of the tees, a constant supply of water was available at any point and at any and all times for moistening the subgrade, mixing the concrete, and for keeping the finished concrete wet while it was setting.

Ordinarily 20 men and 1 team in addition to the engineer were required to operate the machine. The men were arranged as follows: 1 superintendent, 1 working foreman, 1 team delivering cement-lime mixture, 1 man handling cement at mixer, 8 gravel shovellers, 2 men wheeling gravel to mixer, 1 engineer, 1 fireman, 1 man dumping bucket, 2 men shovelling concrete and operating first template, 2 concrete finishers, 2 extra men for watering concrete, removing forms, greasing expansion joint strips, and covering concrete with gravel.

The two concrete finishers also operated the box template and set the wooden curbs or concrete forms.

Stakes 25 feet apart were driven to line and grade daily by the engineer in charge. Lines were stretched on the top of these stakes by the finishers, and intermediate stakes approximately 4 feet apart were driven to support the curbs.

As the concrete hardened, it was covered with the excess gravel which had been hauled for that purpose, and shovelled outside of the concrete forms. This gravel when kept damp protected the concrete from the hot sun and prevented it from drying out too rapidly.

As the concrete work advanced, it was deemed advisable to continue the grading under an additional subforeman. The hauling of gravel was also resumed, and the engineer for the concrete mixer operated the roadroller after hours in the evenings. This did away with the necessity of hiring an extra engineer whose time would not be fully occupied.

When the concreting was finished and the concrete had been allowed from ten days to two weeks to set, the gravel covering was shovelled off and the expansion joints, which were 30 feet apart, were cleaned out. The joints were then half filled with building sand and the remainder filled to overflowing with paving pitch. This pitch was applied by means of a portable tar kettle to heat it and a cone-shaped ladle with a ½-inch runner at the bottom. This runner could be regulated by a plug at the end of an iron rod leading up to the handle of the ladle.

As the concrete pavement was only 16 feet wide and the traffic quite heavy, gravel shoulders 4 feet wide were added at each side. As water-washed gravel was used, it was found necessary to bond it by raking limestone screenings into it.

The prices paid for labor were somewhat high owing to local conditions, and were as follows:

| | |
|---|---|
| Foremen .................... | $2.50 to $4.00 per day. |
| Engineers .................... | 40 cents per hour. |
| Laborers .................... | 25 cents per hour. |
| Teams .................... | 55 cents per hour. |

Hydrated lime was first used in a short experimental section of concrete pavement at Windsor, constructed by the Highways Department in 1912; and this material was used throughout the work in Sarnia. The lime was obtained from the Central Prison Farm at Guelph, where it is manufactured by prison labor. Hydrated lime has been previously employed in making waterproof concrete, and its value in this regard is well known. The effect of the lime is to act as a void filler, at the same time increasing the plastic and flowing qualities of the mortar. In this way a denser mixture results, tending, it is believed, to a tougher, better wearing, and more uniform quality of concrete, making a mortar which adheres more strongly to the stone, and lessening the danger from incomplete mixing and tamping.

Recent tests have shown also that the expansion of concrete is due more to the presence of moisture than to change of temperature. The denser concrete, it is believed, will have less tendency to movement due to expansion and contraction than one in which hydrated lime is not used, and it is probable that the liability to transverse cracks in the pavement is thereby lessened.

Use in pavements is a severe test of the durability of any material. Spread in a thin layer over the soil, it is fully exposed to the destructive influences of climatic and weather conditions—extremes of frost and heat, snow, slush and rain—combined with the wear of narrow steel tires, iron-shod horses, and the bending, crushing effect of heavy loads. The use of hydrated lime at Windsor and Sarnia should do much to determine whether the practical benefit of hydrated lime is equal to its theoretical value.

The unit cost per square yard of concrete was as follows: Grading and ditching, $0.155; mixing lime and cement, $0.084; hydrated lime (29 tons), $0.022; cement (3,462½ bbls.), $0.367; gravel (3,117½ cu. yds.), $0.294; labor on concrete, $0.200; expansion joints, $0.011; drainage, $0.111; gravel shoulders, $0.187; supervision, $0.057; tools and sundries, $0.054. Unit cost per square yard, $1.542.

The report, to which we are indebted for the above data, was prepared under the direction of Mr. W. A. McLean, Commissioner of Highways for Ontario.

## MULTIPLE BASKET STRAINER FOR POWER PLANT OR PUMPING STATION INTAKE LINES.

SELF-CONTAINED water strainers of the removable straining basket type, are now well established as a necessary part of power plant and pumping station equipment for the protection of pumping engines, general service pumps and condensers from solid matter contained in the supply water. This type of strainer has an advantage over foot-valve screen boxes and gratings, in that it can be installed in any part of the supply main or in direct connection with pumping and condensing units for easy accessibility. The effective straining area of the baskets can be made to any desired size, usually two to six times greater than the area of the pipe line, and each basket can be individually removed for cleaning without interrupting the flow of water through the remaining baskets.

The strainer illustrated is of this type, and is the standard design of strainer built by the Lagonda Manufacturing Co., of Springfield, Ohio, with the exception of an improvement in design for automatic raising and lowering of the individual baskets for cleaning in place of the hand wheel and screw stem method. The hand wheel and screw stem design for raising the basket is thoroughly satisfactory, but for large sizes of strainers, where

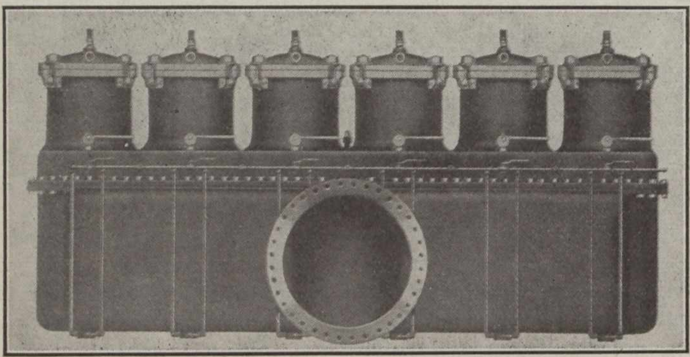

**Fig. 1.—A 42-inch, 6-basket, Hydraulically or Compressed Air-operated Strainer, Showing Control Valves, Piping and Cam Lever Locking Device.**

the baskets are large and heavy and the travel long, the manual operation is relatively slow and more or less laborious. In this new design the baskets are raised and lowered by air or water pressure, and the operation is almost instantaneous without exertion on the part of the operator.

Fig. 1 shows a complete hydraulic or air-operated strainer of the six-basket type. Each basket is an independent unit, with cleaning chamber valve and air or water control, so that each can be independently raised, removed and cleaned without interference with the operation of the remaining baskets.

Fig. 2 is a section of the strainer through one basket, showing the construction and operation of the baskets and raising mechanism. The straining basket is rigidly supported on a circular base or disc which also serves as a valve seat when the basket is raised. Attached to the disc is a cylinder of small diameter, the whole moving freely up and down on a piston and piston rod, rigidly connected to the strainer body. The piston rod is provided with two conduits, communicating with the upper and lower sides of the piston and connected as shown through a four-way control valve to the pump or compressor supply. The operation of raising or lowering a basket is then similar to the simple operation of an air brake. Throwing the handle of the four-way valve to one side, pressure is applied to the top side of the piston and the basket is raised to the cleaning chamber. The basket support or lower valve seat engages the sliding valve collar of the strainer, carrying it up with the basket to completely close the cleaning chamber or bonnet. The air or water pressure is sufficient to seal the valve water-tight, but for assurance against possible leakage or chance lowering of the disc while a basket is removed, there is supplied a cam lever locking device on either side of the strainer bonnets, as shown. With the basket raised, the handle of this locking device is raised in a vertical position, then swung around until the projecting support shown in Fig. 2 is swung under the valve disc. The handle is then drawn down into the horizontal position. The cam draws the support tight up against the disc, insuring a tight fit and locking it in place. When the

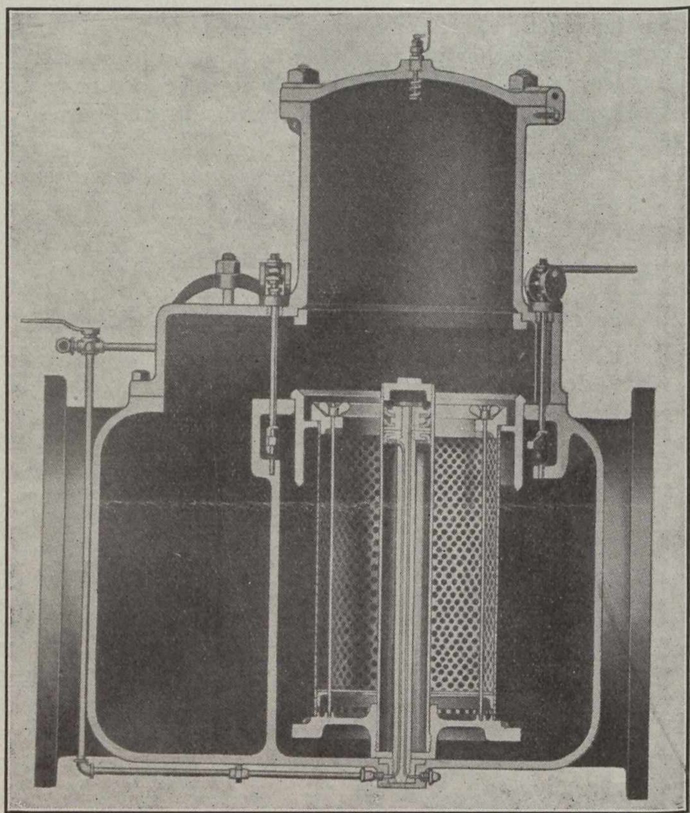

**Fig. 2.—Section Through End Basket, Showing Cylinder and Control Valve.**

basket is raised the top of the cylinder engages and raises the indicator rod in top of flange cap which shows the basket is in cleaning chamber. As soon as the basket is lowered, the spring pulls the indicator rod down, showing the basket is in straining position. In the flange cap a pet cock is provided for relieving any pressure in the cleaning chamber, so the hinged flange cap can be easily unbolted and opened for the quick removal of the basket. With the basket reinserted, the flange cap bolted down, the basket is lowered into position by releasing the locking device and throwing the handle of the four-way control valve to the opposite side. The control valve is then thrown to the middle position, cutting off pressure from the basket cylinder when in the normal working position.

This design of automatically operated strainers is especially suited for power plants and large pumping stations, where the rapidity and ease with which the baskets can be removed and cleaned is essential.

# COAST TO COAST

**South Vancouver, B.C.**—Mr. S. B. Bennett, municipal engineer, reports that up to October 15th $32,000 had been spent on sewer work in the municipality this year.

**Calgary, Alta.**—The Centre Street bridge, the construction of which has been temporarily delayed owing to a prolonged consideration by the city council of its finances, will now be proceeded with.

**Victoria, B.C.**—The northwest sewer is rapidly being completed. South of Pine Street it is practically finished with the exception of the manholes, and the work is proceeding north through some heavy open cut and several pieces of tunnel work.

**Stratford, Ont.**—About 6,160 lineal feet of pavement and 18,700 feet of sidewalks have been constructed this year, according to Mr. A. B. Manson, city engineer. The amount is less than last year owing chiefly to the unfavorable weather conditions during the summer months.

**Saskatoon, Sask.**—It is expected that the 25th Street bridge will be ready for service in a month. Considerable filling is required in the approaches, and several stretches of sidewalk are also necessary. The concrete work of the bridge proper has been completed, however.

**Winnipeg, Man.**—It is reported that steel laying is rapidly progressing on the Victoria Beach line of the C.N.R., and that the work will shortly be completed. Victoria Beach is 72 miles from Winnipeg, and about 14 miles of track laying has yet to be done.

**Winnipeg, Man.**—Among the many propositions in the air for the supply of natural gas to various cities in the West, there is one which aims at supplying Winnipeg from wells south of Lethbridge, Alta. This undertaking would involve pipe lines over 700 miles in length.

**Edmonton, Alta.**—Grading has been finished to within 8 miles of McMurray, on the Alberta and Great Waterways Railway. Steel is about 75 miles back, and will reach McMurray early in March, it is now expected. Ballasting was completed some weeks ago to Lac la Biche.

**Three Rivers, Que.**—It is reported that over 1,000 men are at work on the new dam across the St. Maurice River above La Loutre Falls, some 200 miles north of La Tuque. The St. Maurice Construction Company was awarded the contract by the Quebec Streams Commission last summer.

**Guelph, Ont.**—Mr. T. J. Hannigan, secretary of the Ontario Hydro-Radial Union, announced that the municipalities through which lines have been surveyed for hydro-radials would likely be called upon in January to vote on the routes, plans, etc. A number of group conferences will be held during November and December.

**Edmonton, Alta.**—On the Oliver-St. Paul de Metis Railway grading is rapidly being completed. It is expected that over 100 miles of the railway, which will be 117 miles in length, will be entirely graded before work closes down for the winter. It passes through a rolling country and many heavy cuts in clay formation have been necessary.

**Niagara Falls, Ont.**—The Canadian Niagara Boulevard has now been practically completed from Niagara Falls to the Fort Erie ferry landing, and the stretch of highway built by the village of Fort Erie from the ferry landing to Queen Street, through a contract let to the Simcoe Paving Company, has also been practically completed.

**North Vancouver, B.C.**—According to an interim report of Mr. A. M. West, city engineer, for the first 9½ months of this year, engineering expenditures have been as follows: Board of Works, construction, $18,744.17; Board of Works, maintenance, $5,618.91; waterworks, $15,928.84; parks and cemetery, $5,336.84; local improvements, $2,509.91.

**Toronto, Ont.**—Hon. Robert Rogers, Minister of Public Works, stated last week that arrangements had been reached respecting the defective harbor work in Toronto, and that the contractors had been instructed to immediately proceed with the reconstruction recommended in the recently presented report of the board of engineers appointed last July to make a complete investigation.

**Lethbridge, Alta.**—Construction work is to be pushed by the C.P.R. on an additional 25 miles of track from Foremost, Alta., east to a point about 10 miles from Lake Pakowki. This will form part of the through line between Weyburn, Sask., and Lethbridge, Alta., and when this section is finished there will only be a gap of about 44 miles between the line now terminating at Altawan, Sask., and the east end of the Foremost extension.

**Ottawa, Ont.**—With a view to maintaining control of some most valuable undeveloped water power sites along the Winnipeg River in the interests of carrying out a comprehensive scheme for power development ranging upwards of 114,000 h.p., the Dominion Government has purchased a strip of land along the river from a Chicago holder. The policy of the government in regard to water powers is that no permanent title should pass from the Dominion for a property dominating water power.

**Guelph, Ont.**—At a meeting of delegates from the various municipalities interested in the proposed system of hydro radials for the province, held in Guelph on October 27th, the Hydro-Electric Power Commission submitted plans for a system of radial railways to connect Toronto, Port Credit, Milton, Guelph, Berlin, Stratford, St. Mary's, London, Strathroy, Arkona and Sarnia. The proposal was presented by Sir Adam Beck, chairman of the Commission. A resolution was adopted in favor of the scheme, and another advocated a campaign to urge its early construction.

**McLennan, Alta.**—On November 1st a new train service was established on the Edmonton, Dunvegan and British Columbia line. Trains leave Edmonton at 8 p.m., making a night run to McLennan. A day run is then made to the end of steel, either on the main line of the E. D. & B. C. to the Smoky River, where the new bridge is being erected, or north over the Central Canada line to a point about seven miles from Peace River Crossing. Grading on the former line has been completed westward to the Spirit River. Grading on the Central Canada has been completed. On the Grande Prairie branch, grading is also nearing completion and steel will be in place by February.

**Toronto, Ont.**—Although the contractors, Messrs. Quinlan and Robertson, have had to contend with considerable quicksand in connection with foundation work for the Don section of the Bloor Street viaduct, practically all the piers have been finished far enough to allow steel work to begin. With favorable weather for the next few weeks, concrete work will have reached the stage whereby superstructure can be proceeded with without delay during the winter months. It is understood that a large amount of the steel has already been fabricated and is ready to be delivered at the site. Equally good progress has been made over the Rosedale section, and the Dominion Bridge Company has already made a start on the steel work.

**Montreal, Que.**—More trouble is being experienced with the city's water conduit which occasioned considerable inconvenience and danger from fire early in January, 1914. The Cook Construction Co., engaged in enlarging the aqueduct which parallels the conduit for a considerable distance, have four electrically operated pumps at work removing water escaping from the conduit into the canal works. The aqueduct has already been widened to its projected width of 182 ft. from the intake at Lachine as far east as the Verdun Hospital branch. The retaining wall along the north side is now nearly 2½ miles in length, and the wall along the southern bank has not been commenced as yet. The canal itself is about 7 miles long, with a proposed depth of 22 ft. The city's proposition to extend its waterworks system, expending some $9,000,000 before its programme is carried out, was referred to in our issue of last week.

## PERSONAL.

P. GIFKINS has resigned as general manager of the Dominion Atlantic Railway and is succeeded by Mr. George E. Graham.

DUNCAN CAMPBELL, for several years superintendent of construction for the Canadian Northern Railway, has been appointed superintendent and assistant general manager of the C.N.R. between Edmonton and Vancouver.

C. T. DELAMERE, acting engineer of construction of the Canadian Pacific, at Montreal, Que., has been appointed acting engineer maintenance of way, Eastern Lines, vice A. C. Mackenzie, appointed acting general superintendent, Atlantic division.

JOHN STOCKS, formerly deputy minister of public works for the province of Alberta, is a member of a new Public Utilities Commission appointed by the government of that province. He has been deputy minister since 1905, for four years prior to which he was assistant chief engineer of public works. For 20 years Mr. Stocks was connected with the construction department of the Canadian Pacific Railway, for the greater part of the time being superintendent of construction and maintenance between Swift Current and Laggan.

## OBITUARY.

Mr. G. H. Duggan, general manager and chief engineer of the Dominion Bridge Co., Montreal, has suffered the loss of his son, Lieut. H. S. Duggan, B.Sc., who succumbed to wounds while serving with the Royal Engineers in France. The deceased, who was a graduate in engineering of McGill University, was formerly in the employ of the Dominion Bridge Co. at Toronto, but when the war broke out he went to England to investigate for his company into the manufacture of war munitions. While there he was granted a commission in the corps of Royal Engineers. Lieut. Duggan was 22 years of age.

## ADDRESSING MAIL TO MEN AT THE FRONT.

The post office department at Ottawa, in order to facilitate the handling of mail at the front and to insure prompt delivery, has requested that all mail be addressed as follows:—

(*a*) Regimental Number ..........................
(*b*) Rank ..........................
(*c*) Name ..........................
(*d*) Squadron, Battery or Company. ..........................
(*e*) Battalion, Regiment, (or other unit) Staff appointment or Department ..........................
(*f*) CANADIAN CONTINGENT ..........................
(*g*) British Expeditionary Force ..........................
(*h*) Army Post Office, LONDON, England. ..........................

Unnecessary mention of higher formations, such as brigades, divisions, is strictly forbidden, and causes delay.

## C.N.R. APPOINTMENTS IN ONTARIO.

G. P. MacLaren has been appointed division engineer of the Toronto district of the Canadian Northern, with office at Toronto, Ont.; A. J. Gayfer has been appointed division engineer of the Lake Superior district with office at Capreol, Ont.; J. D. Evans, division engineer at Trenton, Ont., has been appointed supervisor of bridges and buildings, with office at Trenton; F. McKay, supervisor of bridges and buildings at Toronto, has been appointed supervisor of bridges and buildings, with office at Capreol, Ont.; E. Myers, roadmaster at Trenton, Ont., has been appointed supervisor of track, with office at Rosedale, Toronto, Ont.; W. M. Jacklin, inspector of tracklaying on construction at Port Arthur, Ont., has been appointed supervisor of roadway, with office at Hornepayne, Ont.; J. MacDonald, supervisor of track, Central Ontario and Quinte districts, at Trenton, Ont., has been appointed supervisor of track with jurisdiction over Maynooth, Picton, Irondale and Tweed subdivisions, Toronto district, with office at Trenton; J. R. Audet has been appointed supervisor of roadway, Capreol to Oba, Lake Superior district, with office at Capreol, Ont., and E. Haystead, supervisor of track at Parry Sound, Ont., has been appointed supervisor of track, with office at Capreol.

## COMING MEETINGS.

NATIONAL MUNICIPAL LEAGUE.—Annual convention to be held at Dayton, Ohio, November 17th to 19th. Secretary, Clinton Rogers Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Annual meeting to be held at New York December 7th to 10th. Secretary, Calvin W. Rice, 29 W. 39th Street, New York.

**We have had made up on stiff cards for handy reference purposes the Charts for Specific Speed and Diameter of Hydraulic Turbines by R. L. Hearn, B.A.Sc., which were published in our issue of October 21st, 1915. Those interested in these tables may secure a copy by applying to the office of The Canadian Engineer.**