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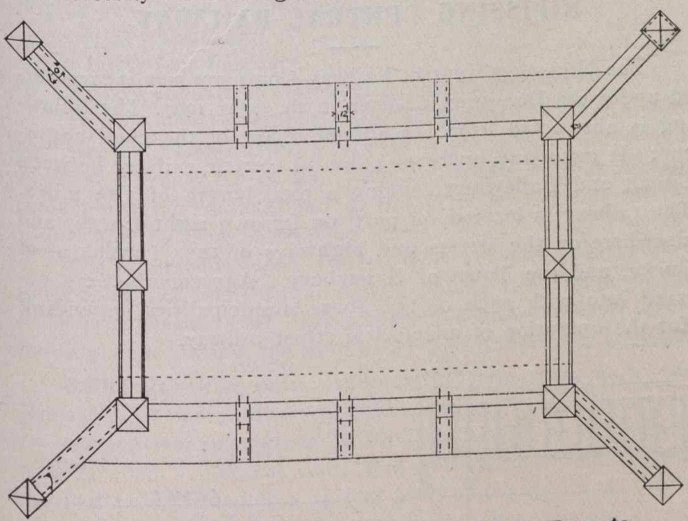
The Canadian Engineer

An Engineering Weekly

REINFORCED CONCRETE ARCH, NORTH TORONTO

By E. A. JAMES, B.A.Sc.*

For the last year the wooden bridge which carried Albertus Avenue across a creek about a quarter of a mile west of Yonge Street has been in an unfit condition for traffic. As this road leads only to land that is just being opened up, the necessity for a bridge has not been felt.

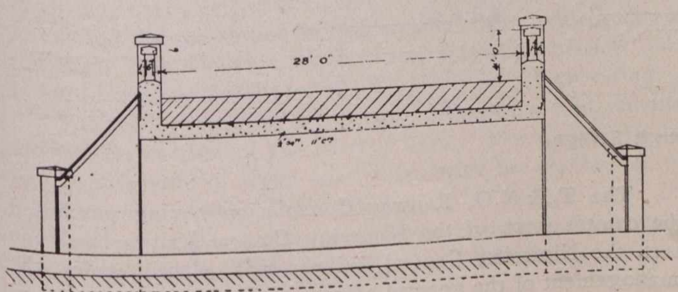


Plan of Bridge for Albertus Avenue, North Toronto.

In the spring of this year, however, it was decided to erect a permanent bridge and one which would harmonize with the surroundings.

The situation is a ravine about 20 feet deep and 150 feet wide. Through the ravine a stream flows in the fall and in winter freezes and forms an ice jam on a small scale. In the summer the bed is quite dry.

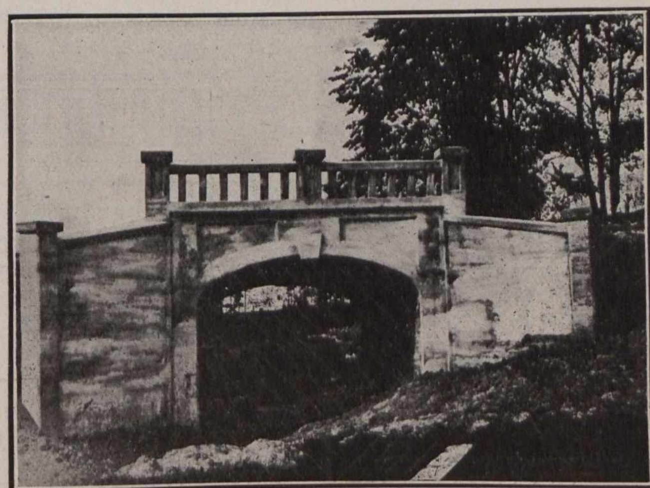
The type of bridge decided on was a reinforced concrete arch on abutment walls and with wing walls to hold back the fill. The span is 14 feet and the height from bed of creek to soffit is 12 feet. The clear width between parapets is 28 feet.



Longitudinal Section Through Bridge.

The foundations were put in during wet weather and are 4 feet below datum (the bed of the stream). The material is a compact sandy clay. The original foundation designs were for a slab foundation 1 foot below datum, but on excavating this did not give a good enough bottom. A 2-foot bed of concrete was placed in the excavation and the foundation placed in this. The material was dumped down in barrow loads from a platform 10 feet high, on which the mixing was done. As the foundation was very soft, the concrete was put down as dry as possible. The concrete was mixed by hand in about ¼ yard batches, the proportions for the foundations being 1 of cement to 7 of pit gravel.

The forms were started about datum level, and consisted mostly of 2-inch by 4-inch uprights with 1 inch planed tongued and grooved boarding. The forms were strutted from the outside with 3-inch by 8-inch lumber, also tied together with wire spaced about 2 feet in either direction. The front forms of the abutment were carried up to springing level and also the uprights of the back, but the boards in the rear were put in as the concrete rose.



View of Bridge on Albertus Avenue, North Toronto.

The reinforcement in the abutments is ½-inch twisted steel, spaced at 24-inch centres for the vertical rods and 12-inch centres for the horizontal rods. In the wings the reinforcement was ½-inch twisted rods at 12-inch centres both horizontally and vertically. The reinforcement for the wings was ½-inch twisted bars at 12-inch centres both horizontally and vertically tying into the abutments. As the space between the steel in the abutments and the forms was only 2 inches by 3 inches, it was found rather difficult to pack and work the concrete at the face, but good results were secured

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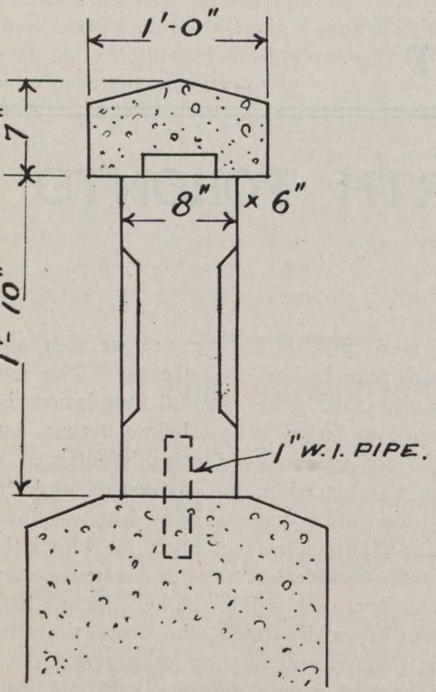
When the abutments were about 4 feet above datum, cracks began to show. These cracks occurred especially where a mark had been made in the surface as with a hoe, or a footprint. As it was thought that the rather heavy rains, experienced about this time, might have softened the ends of the abutments, levels were taken every other day for a while, but these did not indicate enough settlement to account for the cracks.



Detail of Hand Rail.

Tests made of each car load of cement delivered on the work showed good results as to soundness and setting powers. The use of wet concrete was stopped and when a drier mix was used an improvement occurred. The use of gravel without any stone was probably a contributory cause.

The abutments were carried up to within 6 inches of the springing and then the ribs for the centering were put into place. There were ten ribs, made up from 2-inch by 6-inch lumber. No wedges were used. The lagging was 2-inch planed lumber, and was covered with wax paper. The arch was put in all on the same day.

The caps for the posts at the end of the wings and abutments were cast separately with a 1-inch pipe dowel to bond with the mass of concrete. The railings on the parapets were cast separately with two lugs at one end, such as would just give distance between the railway posts. Forms were set up for the large post tops, and two 2-inch by 4-inch scantlings were fastened across in such a way that the small posts could be hung on small pieces of 1-inch board with the bottoms just at the level of the sills of the spandrel walls. Another sill was then formed over the tops and when these set, the railings were securely held.

The forms for the outside walls were removed in one week and the arch forms in four weeks. The face was filled with a grout of 1 cement to 1 sand and all rough places filled with mortar.

The backing was put in by wheel scrapers.

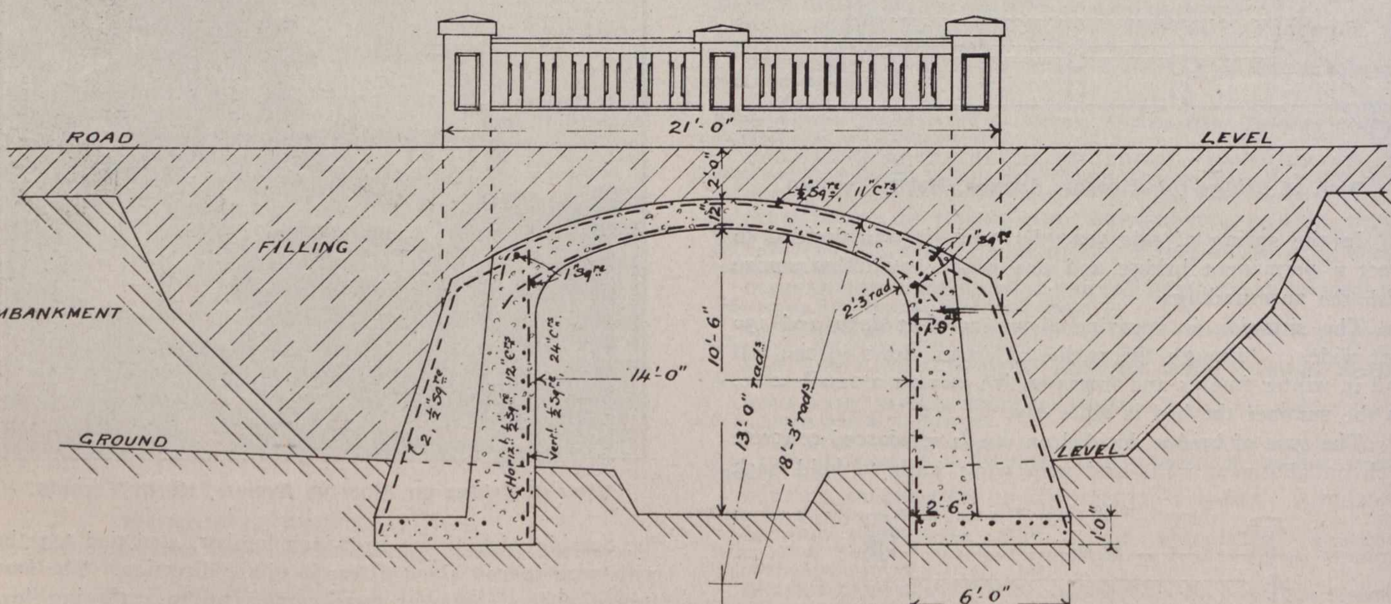
The cost of the construction work when reduced to unit prices were as follows:

Material Delivered at the Works.

Stone, 2 in., per cubic yard	$ 2.30
Gravel, per cubic yard	2.10
Steel, per lb.	.045
Lumber for forms, per M.	38.00

Labor for Work.

Concrete, per cubic yard	$ 1.10
Forms, per cubic yard of concrete	1.25
Earth excavation, per cubic yard	.29



Cross Section Through Bridge.

NIPISSING CENTRAL RAILWAY.

The Nipissing Central Railway Company was incorporated under the Dominion Charter in the year 1907. The following is abstracted from the annual report of the chief engineer: It owns and operates a line of electric railway between Cobalt and Haileybury, having a total length of 5.15 miles. The railway is located, in part, on its own right-of-way, and elsewhere on the streets and highways of the Township of Bucke, and the Town of Haileybury. Agreements were entered into with each of the above municipalities, providing for the operation of an electric street railway.

The T. & N.O. Railway Commission having purchased the capital stock of the Nipissing Central Railway on June 21st, the Nipissing Central Railway was placed under the management of the general officers of the T. & N.O. Railway. The affairs of the two railways are kept quite separate. There is a local superintendent and cashier in charge of the Nipissing Central Railway, reporting to the appropriate officials of the T. & N.O. Railway.

Route.—The Cobalt terminus is at the foot of Argentite Street. The location is in a general north-easterly direction from Cobalt, on private right-of-way on the west side of the

T. & N.O. right-of-way, crossing the latter by an overhead crossing at Argentite, thence along the Cross Lake Road to the Townsite of North Cobalt, thence along King Street, Lakeview Avenue, and Main Street, thence across private right-of-way to Georgina Avenue, Haileybury, thence northerly along Georgina Avenue to Blackwell Street, easterly along Blackwell Street to Ferguson Avenue, northerly along Ferguson Avenue to Browning Street.

Service.—A regular half-hour service is maintained between Cobalt and Haileybury from 6 a.m. to 11 p.m. At rush hours and on holidays the service is increased as may be necessary to accommodate the traffic.

Rolling Stock.—The following rolling stock was taken over with the Nipissing Central Railway:

3 42-foot double truck closed passenger coaches, each equipped with 40 h.p. motors, air and hand brakes, air whistle, arc headlamps, pilots, snow flangers, traffic recorders, and all necessary appliances necessary for an up-to-date electric trolley system.

1 combination baggage and passenger car, equipped with appliances similar to passenger coaches referred to above.

2 trailers of the same composition as the coaches, but having, of course, no motors.

1 four-wheel van.

2 thirty-foot flat cars.

1 small industrial standard gauge locomotive.

The locomotive referred to being practically of no use to the Nipissing Central Railway, was disposed of to advantage, brought down to North Bay Junction, where it is at present undergoing a general repair in the T. & N.O. shops, at the request of the firm purchasing same.

The other equipment referred to is all at present in very good condition, some slight repairs having been made to the passenger coaches; air brakes inspected and necessary overhauling done during the months of September and October.

Buildings.—The only buildings in connection with the Nipissing Central Railway are the car barn, which is situated between Haileybury and North Cobalt, and an office and waiting room. The car barn is a galvanized iron structure 150 feet by 60 feet, being 20 feet high at the eaves. A single track runs into this building which branches off into three, one track running over an inspection pit. Considerable repairs were made during the summer months to the roof of barn, rendering it in good serviceable condition.

The sub-station located in car barns consists of two motor generator sets of 400 h.p. and 200 h.p. capacity respectively.

Transmission System.—Power is obtained from the British Canadian Power Company's sub-station at Cobalt. A 2,200-volt transmission line connects the Power Company's sub-station with the Nipissing Central Railway sub-station in the car barns at North Cobalt. Another transmission line connected the sub-station at North Cobalt with power plant of the High Falls Power Company, but this transmission line is not in use, as the High Falls Company is not operating.

The trolley wire is No. 000 grooved section and, having no feeders, carries all the current used. The overhead system is composed of span wire type, with the exception of eighteen pole lengths of bracket type.

Roadbed.—The roadbed was never properly ballasted and some heavy expenditures for ballast will be necessary in the coming year.

Extensions.—An extension of the Nipissing Central Railway from its present terminus, Browning Street, Haileybury, to New Liskeard, also a freight spur to the Government wharf and Foster's Mill, are under consideration. Surveys for these have been completed, and negotiations are now being carried on for the necessary franchises from the towns of Haileybury and New Liskeard and Township of Bucke.

CANADIAN ROAD SYSTEMS.*

By W. A. McLean.†

Efficient system and organization form the key to highway improvement. If the laws and plan of administration are properly arranged, all details will be taken care of. If the system is well designed, ratepayers and citizens will have at their service a powerful machine, perfect in all its parts, that will produce finished highways, durably built, adapted to the service they are to perform, well maintained, and at a minimum cost.

System implies an effective means of procuring necessary funds, a fair and just method of distributing the cost, a general management based on good business principles, the application of engineering skill to design, and construction carried on with the best utilization of power and labor.

The creation of a thoroughly efficient system of highway construction and maintenance is a task which, in Canada and the Canadian Provinces, is being actively considered and dealt with. While some satisfactory progress has been made, measures to the present time have been those of the formative stage. Evolution rather than revolution has been the history of legislation in countries of the north, and highways systems and measures of Canada are following that general rule.

The Canadian form of government is similar to that of the United States in some respects. Canada is a union of Provinces, with a Federal administration at Ottawa, just as the United States is a federation of States with seat of government at Washington. Each of the nine Provinces has its own legislature, as have each of the States; and the provinces are again divided into local municipalities—the rural being townships and counties, and the urban are villages, towns and cities—but as in the States, local government varies in the different provinces.

The Canadian Constitution, "The British North America Act," defines the powers and jurisdiction of the Provincial and those of the Federal or Dominion Government. Under that Act legislation respecting public roads and municipal organization is within the authority of the Provinces, although the Dominion Government has power to subsidize road construction. The tendency in each Province (with certain exceptions) until recently has been to regard the opening and grading of roads in new territory as a Provincial function, while the real improvement and construction of these roads is a municipal function as settlement becomes established and municipal organization is created.

Canada has a geographical backbone, a rocky mineral region about the centre of the continent, extending northerly from Lake Superior to Hudson's Bay. West of Lake Superior the four Provinces of Manitoba, Saskatchewan, Alberta, and British Columbia are comparatively new, having been developed since the construction of the first Canadian transcontinental railway, the Canadian Pacific Railway, in 1886. East of the Lake Superior region are the old Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island.

British Columbia.—British Columbia, on the Pacific coast, is traversed by the Rocky Mountains, and municipal organization is, therefore, interrupted. In consequence, the Provincial Government has always contributed largely to road-building. At the present time a special fund is being spent on the construction of trunk roads at the rate of $5,000,000 annually under the direction of the Department of Public Works. Stone for macadam roads is plentiful, but the grading of mountain highways is expensive. The trunk roads now being built have an important scenic value,

* Paper delivered at American Road Congress, Atlantic City, October 5th, 1912.

† Chief Engineer of Highways for Ontario, Canada.

and upon completion will attract many tourists. In the past ten years approximately $15,000,000 has been spent by the Province on roads and bridges, but the expenditure of an equal amount in the three years, 1912-14, is now outlined.

Saskatchewan and Alberta.—Saskatchewan and Alberta, occupying the prairie country north of Montana and North Dakota, were granted provincial organization in 1905, and are in a pioneer stage of development. Earth roads, with bridges, are the present need, and very little has been done toward good broken stone or gravel roads. Each of these Provinces has a Provincial Highway Department, however, and is drawing largely on its resources for road expenditure. The Provincial Governments in each case are grading and bridging the main roads. As fast as settlement permits, three or four townships are organized into Local Improvement Districts, with councils, to expend money raised by local taxation. In the case of Saskatchewan, an annual provincial appropriation (in 1910, the sum of $60,000) was set aside to be drawn upon by the municipalities under a plan of Provincial aid. The chief Provincial expenditure in these Provinces is applied, however, to trunk highways by the Provincial Highway Departments through their own foremen. Steel and wooden bridges are also erected by permanent "bridge gangs." The Provincial Departments also carry on educational work. In Saskatchewan a special appropriation of $5,000,000 for trunk roads was made the last session of the Legislature, of which $1,500,000 will be spent this year, in addition to the usual appropriation of $400,000 from current revenue. In Alberta a special grant of $1,000,000 was made this year for a central north and south trunk road in addition to the usual sum of $250,000 from current revenue.

Manitoba.—Manitoba has for several years had a Provincial Highway Commissioner, whose duties were largely educational. At the last session of the Legislature (January, 1912), two important Acts were passed. One of these, the Act Respecting Provincial Highways, set aside $200,000 annually for Provincial aid to main roads. Townships are permitted to lay out a special system of main highways and this plan, with specifications, are to be submitted to the Provincial Highway Department. If approved by the Provincial authorities, the township may issue thirty-year debentures and proceed with the work, receiving a grant of two-thirds of the expenditure from the Province. In this way it is expected that a serviceable system of Provincial roads will be constructed.

The other Act, known as "The Good Roads Act," is one which relates to minor roads, and does not provide Provincial aid; but requires any township undertaking the improvement of these roads to submit the plans to the Provincial authorities, and upon approval the township may issue fifty-year debentures to meet the cost, which debentures may be guaranteed or purchased by the Provincial Government. The work done under this Act is also subject to the inspection and approval of the Provincial Highways Commissioner.

Ontario.—Ontario is, physically, in two parts—old Ontario, settled for over a century, and with complete municipal organizations; and new, or Northern Ontario, now being opened for settlement. In New Ontario the Provincial Government is this year spending about $850,000 on colonization roads—opening and grading the road allowance—and about $250,000 for bridges.

In Old Ontario the local municipalities are spending yearly about 1,100,000 days of statute labor and $1,400,000 in cash. A large proportion of the latter goes into durable concrete culverts and concrete and steel bridges.

The Highway Improvement Act of Ontario is one of the most successful of Canadian road measures. County councils (composed of reeves of the local municipalities composing the county) are empowered to pass a by-law assuming for construction and maintenance a system of main highways.

To this work the Provincial Government contributes one-third of the cost of construction as the work progresses. The Provincial Highway Department fixes certain regulations as to construction and management, inspects from time to time, and co-operates with the municipalities to obtain good results, but the active control is vested in the county councils through their own county engineer.

This Act has been in operation for eleven years, and the annual outlay under it is steadily increasing. In 1911 the total expenditure was $711,000, of which the Province contributed one-third.

This Act is largely educational in its aim, but at the same time is producing much excellent work at a low cost. The educational effect has several features:—

(1) It brings about an increasingly high standard of road construction, which teaches the public what good roads are and how they should be built.

(2) It instructs county councillors in road construction and impresses upon them the principles of good organization.

(3) The roads and organization become models which are observed and imitated by the township councils, so that all roads are affected.

(4) It enables the Provincial Highway Department to prescribe good principles, and the results of investigation, in an effective way.

The Ontario Highway Department is also constructing, at various points, model roads at the sole cost of the Province, or with a partial contribution from the municipality in which the road is built.

Quebec.—The Province of Quebec has been extremely active in the matter of road construction, and has adopted several measures of a progressive character:—

(1) The Province loans road-making machinery to municipalities making request, and has ten complete outfits for this purpose.

(2) Grants are made to local municipalities which dispense with the labor tax, and build an extent of durable gravel or stone road. Nearly 600 out of a total of 1,000 townships are this year taking advantage of the measure.

(3) The sum of $10,000,000, borrowed under 41-year bonds, has been set aside for main highways. Municipalities may, for their construction, draw upon that sum, and are only required to meet one-half the interest (2 per cent.) on the moneys so used for the term of the bond issue, the Province meeting the sinking fund and remainder of the interest.

(4) Three Provincial highways, aggregating 350 miles in length, are now under construction. To this work the local municipalities pay $1,000 per mile, and the Provincial Government contributes the remainder.

New Brunswick.—New Brunswick has not as yet developed a broad policy leading to permanent road construction, but the Provincial Engineer, by means of a contribution to county and parish construction, is enabled to bring technical instruction to bear on the work. The Province appropriated $100,000 annually for this purpose.

Nova Scotia.—Nova Scotia is very actively canvassing the road question. The Province is sub-divided by county organization only, and the counties levy a statute labor tax amounting to about $250,000 annually. But the Province spends about $200,000 annually on road construction through an active and well-organized Provincial Highway Department. The Province constructs all bridges costing over $500.

Prince Edward Island.—Prince Edward Island, the smallest but one of the most fertile of the Provinces, has an isolated position in the Gulf of St. Lawrence. Except in the case of two cities, there is no municipal organization, and the Provincial Government exercises direct control of all the roads. The Province is divided into thirty-eight districts, each having about 100 miles of road, and a road overseer is in charge of the work in each. The Province spends about $32,000 annually in maintaining earth roads, and very little macadamizing has yet been done.

The Federal Government.—The Dominion Government at the last session introduced a bill to provide for grants to Provinces to aid in highway improvement to be distributed according to population, and also to provide for direct expenditure on construction by the Dominion. The bill passed the House of Commons, but the Senate, while approving of subsidies, objected to the Dominion Government making direct expenditures. The amendments of the Senate were not acceptable to the Government, the bill was not re-introduced into House of Commons, and the measure thus failed to become law.

Summary.—Canadian road systems have been, to the present, without enormous Government appropriations or other spectacular features, and construction, as a rule, has been of a comparatively inexpensive type. Rather it is sought to build as substantially as possible for present requirements, and to establish efficient systems of maintenance that will thicken and widen the road crust as traffic requires. Such a policy will, we believe, lead to the more rapid and economical extension of good roads without creating large public debts that will embarrass the future.

Summarizing the situation briefly, Canadian Provinces have about 250,000 miles of public highways. Each of the Provincial Governments contribute directly to road improvement, generally in the form of Provincial grants, where municipal organization permits. Such grants, rightly directed, help the people to help themselves, combine all energy into one effort, and have a highly educative value. Each of the Provinces has a Highway Department for building roads with which the educational object is more or less associated. The Canadian Highway Association is now carrying on an extensive propaganda to construct a road 4,000 miles in length from Halifax to Victoria while the Ontario Good Roads Association, the Manitoba Good Roads Association, and other organizations are doing much to form public opinion. As a result of the interest created, Provincial appropriations are now being made in millions where they were formerly made in thousands. This year the total Provincial expenditures, apart from municipal levies, will amount to $10,000,000. Canada has developed splendid railway and waterway systems, but it is evident that an era of common highway building is being entered upon, that will connect the trunk lines of transportation with the homes and daily life of the people.

DURABILITY OF PORTLAND STONE.

"Experiments on the Weathering of Portland Stone," was the subject of a paper by Dr. J. S. Owens, before the Engineering Section of the British Association. The investigation was initiated by Dr. Des Voeux and was being made for the Coal Smoke Abatement Society. Its object was to find the connection between smoke and the well-known deterioration, by sulphating, of stones containing a large proportion of calcium or magnesium carbonate, when exposed to city air.

The stones were subjected to the following conditions for periods varying from 105 to 687 days: (a) Broken without exposure; (b) broken after exposure to natural conditions out of doors in the country and in London; (c) broken after having been kept indoors in the country and in London; (d) broken after having been exposed, while embedded in soot, to country and London air. The experiments were still in progress.

THE USE OF MOTOR TRUCKS IN ROAD CONSTRUCTION AND MAINTENANCE.

The use of motor trucks has rapidly increased during the last year. In a recent issue of the Concrete-Cement Age, Mr. Rollin W. Hutchinson, Jr., gives some data and costs regarding their use on road construction and maintenance. He says that those who have made a careful study of economic road maintenance have generally conceded that the neglect on the part of cities, towns and townships promptly to repair their roads has brought about an excessive maintenance cost. It is generally accepted as a truism that $50,000,000 is being spent for road building in the United States every year and not 1 per cent. of this is expended for their maintenance.

If two men with the proper equipment were kept constantly employed going over the roads in their territory equipped with materials and tools with which to properly repair trifling defects, the annual expense of such repair work would be considerably less than is now the case with the plan of periodical repair work.

From all information obtainable, it appears that a new piece of road is generally allowed to take care of itself for the first year or two, and at the end of that time the neglect properly to repair what were originally trifling defects has allowed the road to get in frightful disrepair, requiring a very considerable sum to restore it to its former condition.

Very many miles of road could be taken care of by a motor truck operating daily and covering all of the roads in the care of the city or county where it is to work. This truck could be provided with changeable bodies, one of these bodies to be of box construction to carry sand, gravel, crushed stone and top dressing as might be required; at other times tar kettle and material for building roadside fires. The other body could be for water for sprinkling.

A small hole or rut worn in a road, if neglected, will have its sides gradually torn down by continuous traffic and develop into a large hole, requiring the expenditure of a considerable sum to effect proper repairs.

With the advent of the motor truck and automobile it is believed that the business men in every community have come to realize the importance and economy in maintaining good roads.

Depreciation on all vehicles, both horse-drawn and motor-driven, is very considerable where poor roads exist, or where good roads are allowed to get in bad condition for the want of prompt repair.

A manufacturer in advertising the hill-climbing ability of its pleasure cars uses the winding road ascending Eagle Rock Mountain in the Oranges, New Jersey, as a test climb, and many a car has attempted the ascent of this mountain and faded pantingly away before reaching the summit of a grade which runs from 15% to 17%.

Knowing these facts one would hardly look here for a heavy vehicle of any kind operating otherwise than down hill. Modern transportation equipment must however, meet and cope with local conditions, surmounting grades and other difficulties.

The Joseph Murphy Sons C., Hoboken, N.J., employ at Eagle Rock quarry a 7-ton Mack truck with dumping body, on this steep mountain road, hauling broken stone from the Eagle Rock quarry to various points on both sides of the mountain.

The quarry is three-quarters of the distance up the road from the base of the mountain, at a point where the road verges into an abrupt curve, which adds to the difficulty of the ascent, which is here at its steepest.

In the summer of 1911 the truck averaged 55 miles in nine trips a day, hauling 63 tons, or more than five times the work possible with a team of horses making four trips, carrying three tons per trip, or twelve tons in the same time.

There are a number of stone quarries in the vicinity of Baltimore which could use motor trucks to good advantage and with considerable saving. MacMahon Bros., Mt. Washington, with 5-ton and 4-ton Mack trucks, with automatic dumping bodies, and the Schwind Quarry Co., with a 3-ton Packard, are using the motor truck for hauling broken stone for road building. In order to show what could be done in this line, Messrs. Hook and Ford, engineers for MacMahon Bros., ran a week's test with a 5-ton Mack truck with automatic dumping body in competition with a four-mule-team wagon, hauling broken stone for road building from the Dickeyville quarry with the results given below. The truck had to make ten miles to a round trip, as against nine for the team, on account of having to go a mile out of the way on the trip from the quarry in order to avoid a bridge which was too weak to carry when loaded. One mile of the trip loaded was up a 14% grade. The average amount of gasoline consumed was 29 gallons; average amount of oil consumed, 2 gallons; average working hours, 10; average time loading, 3 minutes; average time unloading, 10 minutes; total load carried, 60,000 pounds; number of trips, 6; total mileage, 60 miles. There were three rainy days in the test period, so that most of the time the roads were soft and in bad condition.

Another advantage in the use of the truck is in the spreading of the stone. It took the truck ten minutes to spread the stone as shown, which the contractor stated was done better than could be done by hand and saved the labor of two men working with shovels for one hour. This spreading was regulated by opening the tail board the proper distance and thus letting the truck travel slowly over the road with the body in an inclined position. The results of the comparative tests of motor trucks and mule equipment as made are:

4-Mule-Team Hauling 4½ Tons Per Day 27 Miles.

First Cost.

4 Mules at $325.00 each	$1,300.00
Harness	75.00
Wagon	250.00
	$1,625.00

Mules.

Interest on ½ investment at 6%		$ 48.75
Insurance on team		32.50
Depreciation 20%		325.00
Fixed charges per day (assuming 225 working days per year)		1.85
Wages per day	$1.84	
Feeding at 60c. per head	2.40	
Stable man	0.25	
Veterinary's service	0.20	
Shoeing	0.30	
*140 days' feeding at 40c. per head, $224.00...	0.99	
Total daily operating cost		$6.18
Fixed charges per day		1.85
Total charges per day		$8.03

5-Ton Dump Truck Hauling 5 Tons Per Day 60 Miles.

First Cost.

Truck	$5,300.00

*Due to the mules not working, quarry being shut down owing to cold weather.

Truck.

Interest on ½ investment at 6%		$159.00
Insurance on truck 2½% on 80% of ½ value		53.00
Depreciation on truck (not including tires)		480.00
Fixed charges per year		$692.00
Fixed charges per day		3.07
Wages per day	$2.50	
Maint. 4½c. per mile	2.70	
Tires 6c. per mile	3.00	
Gasoline 4c.	2.40	
Oil	0.60	
Total daily operating cost		$11.80
Fixed charges per day		3.07
Total charges per day		$14.87

4-Mule team hauls 13¼ x 4¼ = 57.37 ton miles per day = 13.9c. per ton mile.

5-ton truck hauls 5 x 30 = 150 ton miles per day = 9.9c. per ton mile or a saving of 4c. per ton mile or $6.00 per day.

THE TREATMENT OF EFFLUENTS FROM TRICKLING FILTERS.

The effluents from two trickling filters at the Lawrence Experiment Station of the Massachusetts State Board of Health are passed through a settling tank holding about 5½ hours' flow and are then applied at the rate of 10,000,000 gal. per acre daily to a filter having 2 feet of sand of an effective size of 0.23 millimeter. This filter was operated continuously during 1910, much like continuous water filters, except that when clogged the whole body of sand in the filter was washed in place by an upward current of water from below. The filter was washed 68 times during the year, the average quantity of water filtered between washings being about 39,000,000 gal. per acre.

The results obtained with this filter and settling tank furnish an interesting illustration of the future purification of trickling filter effluents by natural means, according to a report by Messrs. H. W. Clark and S. DeM. Gage. The nearly stable worked-over suspended matters coming from the trickling filters settle out readily in the settling tank, but these suspended matters were capable of further fermentation and disintegration, as is shown by the fact that during the warm months, in spite of the frequent removal of sludge, there was some floating scum on the tank, with a certain amount of gas formation. This fermentation must not be confused with putrefaction however, as no appreciable odors were produced. The clarification begun in the settling tank was completed in the filter, and the final effluent never contained more than a slight turbidity.

The purification process going on in the settling tank and in the filter was the reverse of nitrification, the nitrates serving as the source of oxygen for further oxidation of the soluble matters. This is evident by the reduction in the amount of nitrates and increase in the nitrates and free ammonia in the applied effluents in their passage through the settling tank and through the filter. This was in a measure a retrograde process, but is undoubtedly the process taking place when such trickling filter effluents flow into water low in dissolved oxygen. The amount of nitrates remaining in the effluent, and the fact that this effluent always contained an appreciable amount of dissolved oxygen, insured a complete stability at all times, and this fact was confirmed by negative putrescibility tests throughout the year.

HIGHWAY ENGINEERING EDUCATION.*

By Arthur H. Blanchard, M.Am.Soc.C.E.†

The educational training of the engineer who may enter that branch of civil engineering devoted to the economics, construction and maintenance of highways should be considered from two standpoints: first, the essentials, which, from an educational point of view, are considered as prerequisite to a successful career in highway engineering; and, second, practical methods of securing this training under American conditions.

The American youth who has expressed the desire to enter the profession of engineering has various channels open to him. The usual course followed is to enroll in one of the four-year engineering courses designated as civil engineering, mechanical engineering, electrical engineering, chemical engineering or mining engineering. There are, however, notable deviations. Several institutions and some engineers advocate a broader training for the engineering profession than is possible in the ordinary four-year course, and in fact believe that the profession of engineering demands the same type of training as is now universally recognized as desirable for men entering the legal or medical profession.

Usually the American boy, in entering on a technical career, has not fully made up his mind as to the particular field in which he is most interested. In the four year courses he has in some cases one, and in others two years in which to make up his mind as to which of the five general branches of engineering referred to above he wishes to enter. It is self-evident that the ideal training is one which will prepare a student upon graduation to enter any one of the numerous fields of engineering. At least it is possible that a comparatively wide field of activities will be open to a man whichever one of the above courses he takes in the technical school.

Having these general facts in mind, attention will now be riveted upon the situation which confronts the young man who may be one of our future highway engineers. Let us suppose, for example, that he has decided to devote four years to securing a technical education and that there is offered to him the four-year course in civil engineering and a four-year course designated as highway engineering. Which course should he take? The evils of over-specialization in the undergraduate engineering course have been fully discussed in the Society for the Promotion of Engineering Education. Suffice it to say in this discussion before the general public interested in highway improvement that the graduate of the civil engineering course on the one hand has before him a large field of activities for all of which he is equally well equipped. For instance, he may enter the field of structural engineering, sanitary engineering, railroad engineering, geodetic engineering, hydraulic engineering, highway engineering, irrigation engineering and in many cases mechanical, electrical and mining engineering. On the other hand, a graduate from a so-called four years course in highway engineering has, if the course is made up of the subjects which the title implies, only a limited field in which he considers that he is particularly proficient.

The consensus of opinion of eminent highway engineers and educators is to the effect that the highway engineer of the future requires the broad foundation which the four-year course in civil engineering gives. A knowledge of practically all of the subjects included is found of value in the manifold duties imposed in the various positions which he may occupy in the service of municipalities, states, counties, towns, estates, contractors' organizations, consulting engineers' offices, and manufacturing companies.

In the consideration of the training received and the subjects covered in the four-year course in civil engineering relating especially to highway engineering, it is of interest to note the present status of highway engineering in the civil engineering courses of American universities and technical institutions. An examination of the latest catalogues received from ninety-two institutions in the United States offering courses in civil engineering showed that seventy-eight included a text-book-lecture course in highway engineering in the curriculum. The number of recitation-lecture hours in the various courses may be arranged approximately in the following groups: thirteen, 15 hours or less; twenty-eight, 30 hours; seventeen, 45 hours; six, 60 hours; six, 75 hours; three, 90 hours, three, 120 hours; one, 135 hours; and one, 165 hours. Fifteen give some instruction in laboratory work, while ten include special courses in highway surveying. In the case of institutions devoting over ninety hours to highway engineering, the general civil engineering course covers three years, while a highway option is taken in the fourth year. A comparison of the present status of highway engineering education, as outlined above, with the conditions described by Logan Waller Page in his valuable paper on "Highway Engineering," presented before the Society for the Promotion of Engineering Education in 1909. is certainly encouraging, especially when it is remembered that only three years have elapsed. In 1909, according to Mr. Page, fifty per cent. of the institutions investigated did not include a course on highways in the civil engineering curriculum, while it is noted that of the courses in ninety-two institutions examined by the speaker, eighty-five per cent. now give a course in highway engineering.

The importance of the subject of the economics, construction and maintenance of roads and pavements in the United States at the present time demands that more prominence should be given to the course in highway engineering in civil engineering curricula. Having in mind the various component parts which go to make up the curricula, it appears that a well-balanced civil engineering course under present conditions should contain a three-hour course of one year in length devoted to highway engineering.

In such a course lectures and text book work should cover the following topics: historical review of the construction of roads and pavements; preliminary investigations incident to construction; principles of surveying and mapping peculiar to highway work; design of highways; drainage and foundations; construction and maintenance of earth, sand clay, gravel and broken stone roads, including a consideration of the materials which enter into their construction; general consideration of bituminous materials as such and their use in the construction of bituminous surfaces, and bituminous macadam, bituminous concrete, sheet asphalt and asphalt block pavements; the construction and maintenance of wood block, stone block, brick and cement concrete pavements; dust prevention, street cleaning and snow removal; construction of car tracks and pipe systems; comparison of roads and pavements; construction of sidewalks, bridges and culverts; and a general treatment of economics, highway administration and highway legislation.

Laboratory work should be limited to what is sometimes called lecture demonstration work by the officers of instruction. In other words, although it is advisable that the methods of testing all kinds of bituminous and non-bituminous road materials should be brought to the attention of

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* Presented before the American Road Congress at Atlantic City on October 3rd, 1912.

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students in civil engineering by actual demonstrations in the laboratory or lecture room, it is not considered advisable to devote the time necessary for each student to run through complete tests as is done by students in the laboratories devoted to the testing of structural materials. In two to five afternoons all the fundamental tests employed in the examination of bituminous and non-bituminous road materials could be demonstrated before a group of from twenty-five to thirty men if the laboratory equipment was properly arranged and the work well planned out. Two to three afternoons would suffice if the testing of bituminous materials were covered in a course given by the department of chemistry. Unfortunately, at the present time very few instructors in chemistry are familiar with bituminous materials, hence the methods of testing will have to be worked up by civil engineering instructors. Eventually some of the time now given by the department of chemistry to carbon compounds or quantitative analysis in courses for civil engineering students can be profitably devoted to the chemistry of bituminous materials.

A limited number of inspection trips covering the economics of highway location, and the construction and maintenance of various types of roads and pavements will be of value.

The time devoted to road or street surveys in some institutions, in addition to the regular work in railroad surveying and general surveying, is of questionable merit. Although there are many problems in highway surveying which are different from those encountered in other branches of surveying, it is doubtful if it is necessary or expedient to use up valuable time on this work considering the number of subjects which it is necessary to include in a broad course in civil engineering. The speaker's experience with civil engineering graduates who have worked under him on highway work has led to the belief that a graduate in civil engineering, who has had a good course in railroad surveying and in railroad curves, together with a comprehensive course in highway engineering, as outlined above, is admirably equipped to occupy the minor positions in a field party on highway surveys. In these positions he may acquire, either through advanced study or special instruction, the information and practice necessary to occupy the position of chief of party and the higher positions in the highway department connected with the bureau of surveys. It is, however, advisable in certain instances, where practicable, to divide the time devoted to railroad surveying so that a highway survey outside built-up districts may be added to the course together with the preparation of plans, cross-sections and estimates.

In further consideration of the special training which will be of benefit to those entering the field of highway engineering, the educational plans which have been evolved to elevate the profession and to equip men thoroughly for this field of engineering work, foreign practice will be given consideration first.

Great Britain affords an illustration of one method by which well trained highway engineers may, under favorable circumstances, be secured. Fortunately for the British engineer, his position in highway work is much more permanent than in the United States. There are several reasons why such is the case. Among others may be mentioned the recognition by the British public that the principle of continuity in office of capable engineers results generally in economical and efficacious construction and maintenance of public works. Those American engineers who visited Great Britain at the time of the Brussels International Road Congress in 1910 will, without doubt, find the majority of the prominent highway engineers of England occupying the same positions or higher positions when they attend the Third International Road Congress to be held in London in 1913. This is not a long period, but could the same observation be made in regard to the personnel of many of our great state highway departments for a similar period? It should be stated, however, that the subordinate positions in the United States being, in many cases, under civil service regulation are more permanent than those effected by political exigencies. This condition of permanency of position of high officials in Great Britain means that it is possible for young men who are attracted to highway engineering to enter the department of some county or municipal engineer, and, proving capable, to acquire a valuable experience under the continued leadership of an able engineer. In this position a young man of the right calibre, by hard work, including a large amount of home study, may equip himself for the highest positions in highway work in Great Britain. Another safeguard of the British engineer, and an incentive to highway engineers in embryo, is the admirable practice which has been adopted in many cases requiring that applicants for a certain class of positions shall hold certain grades of membership in the Society of Municipal and County Engineers and in other cases certain grades of membership in the Institution of Civil Engineers of Great Britain.

France offers an entirely different type of training for men who are going to enter the field of highway engineering. All the important positions in this branch of the public service are occupied by picked men especially educated and trained for the service. After a preliminary general service covering as a final period that comparable with the four years high school training in this country, men of high standing are admitted to the Ecole Polytechnique, the course in which is practically two years in length. Upon graduation from this school, the men of high standing are allowed to select one of the several national schools, provided openings exist, in which they will secure special training for the public service in a given field. Those who enter the Ecole Nationale des Ponts et Chaussees devote three years to a general course in civil engineering under the leadership of engineers of the highest grade in the Department des Ponts et Chaussees de France. During the vacations these men are allotted to service on the construction of roads and bridges in various parts of France. It is evident that the training thus obtained is admirable and that the personnel of the engineering staff of the department of roads and bridges of France is exceptionally high.

In America, while in some cases an attempt has been made to give as special instruction in highway engineering a four years undergraduate course in this subject, this method has not given particular satisfaction for the reason previously noted. Excellent work has been done by many universities in several parts of the country in giving extension courses to groups of men interested in various phases of highway improvement. Very little advanced work, however, has been done through the medium of the American university. The United States Office of Public Roads has evolved a scheme by which men may secure a certain amount of advanced instruction and training in that part of highway engineering dealing with highways outside of built-up districts. This plan is to place the student engineers in the charge of men in the service of the Office in various parts of the country on different kinds of highway work. When it is impossible to work in the field, the men do a certain amount of office work at Washington, receiving instruction by means of lectures on certain phases of highway engineering and also do laboratory work on the testing of both bituminous and non-bituminous road materials.

In 1911, through the generosity of Charles Henry Davis, president of the National Highways Association, there was founded at Columbia University a graduate course in highway engineering. The object in founding this course was to elevate this branch of the engineering profession and to provide an opportunity for men engaged in highway work to obtain advanced instruction and training in the various phases of highway engineering under the most favorable conditions. For many reasons it is fortunate that the first course of this character should be found at a university presided over by a president and trustees who look upon the work of the university from an exceptionally liberal standpoint. While maintaining the high character of all degrees conferred, nevertheless these men believe in opening the courses of instruction to any mature man provided he has the prerequisites for any given course and earnestly seeks information. Likewise it is fortunate that the administrative authorities allow the introduction of an innovation as far as the period of attendance is concerned inasmuch as the graduate course referred to is given in the period from December 1st to April 1st. An engineer, therefore, who desires to take all the graduate courses in highway engineering and allied subjects which fulfil the requirements for the master's degree will necessarily be in attendance for two winter periods, the equivalent of one collegiate year. The selection of this period in which to give the instruction was based upon the prevailing idea among leading highway engineers that it would be feasible for many men to obtain a four months' leave of absence during the dull period of the year. This prediction has been found to be correct.

As this plan is somewhat of an innovation in engineering education, it may be of interest to cite certain facts in connection with the attendance during the winter period of 1911-1912, which was the first period under this plan. Although the graduate courses were not brought to the attention of engineers until November, 1911, there were in attendance fifteen men affiliated with highway work, thirteen of whom registered as candidates for the master's degree. It is of interest to note that this group included men connected with state highway departments, contractors' organizations, municipal departments, engineering-sales departments of manufacturing companies, county highway departments and consulting engineers' offices. The experience of these men ranged from one to twelve years. They came from widely distributed localities, Connecticut, Massachusetts, New York, Pennsylvania, Maryland, North Carolina, Alabama, Panama and British Columbia being represented.

The curriculum of the graduate work in highway engineering comprises advanced courses in the economics and design of roads and pavements, including a thorough discussion of bituminous surfaces and bituminous pavements; highway bridges and culverts; mechanical appliances used in highway gineering; road and street surveying and highway design; highway laws and systems of administration; management engineering; bituminous and non-bituminous road material laboratory courses; seminars in highway engineering literature; chemistry of bituminous materials; engineering geology; optical mineralogy, and inspection trips covering various types of roads and pavements and manufacturing plants producing highway materials.

A large staff of non-resident lecturers in highway engineering, which includes many of the most prominent highway engineers and chemists in the United States, is employed to give instruction on specified subjects forming an integral part of the various courses. It was decided to throw these special lectures open to the engineering public and to hold the same during evening sessions in order that this feature of the work may be of maximum benefit to all that may find the university accessible. An attendance of from fifty to one hundred engineers at many of the lectures during the past winter period showed the interest taken in the many problems of highway engineering presented.

During the 1912-1913 winter period a special arrangement will be introduced which is considered of particular interest to practicing highway and chemical engineers. Many, who cannot secure a four months leave of absence, have expressed the desire to devote from six to seven weeks at Columbia University in securing information relative to the manufacture and testing of all kinds of bituminous materials and their use in the construction and maintenance of bituminous surfaces and bituminous pavements. Arrangements have, therefore, been made so that courses covering the above subjects may be taken either independently or as an integral part of the unified graduate course in highway engineering. During a continuous period of about six weeks, beginning in the latter part of December and ending during the first week of February, three courses will be offered as follows: Two weeks will be devoted to a demonstration lecture course on the mining, manufacture and testing of all kinds of bituminous materials; the next two weeks will be devoted to a course on bituminous surfaces and bituminous pavements; while during the final period of two weeks will be given a laboratory course in which those enrolled will test various types of bituminous materials, make analyses of unknown materials, and write specifications covering the use of bituminous materials under varying conditions. Each course will comprise forty lectures or eighty laboratory hours, depending upon the character of the course.

During the coming year at Columbia it is expected that another innovation will be introduced inasmuch as, in connection with the graduate work in highway engineering, there will be founded several research fellowships by various manufacturing companies. The research workers holding these fellowships will investigate problems of particular interest and value to the manufacturing concerns founding the same. It is expected that many problems of wide interest to those engaged in highway work will be thoroughly investigated through this medium. While admirable work has been done along many lines in the research laboratories of our universities, the speaker earnestly hopes that more attention will be given in the next decade than in the past ten years to the multitude of problems in highway engineering which demand the best efforts of investigators for their ultimate solution.

COAL FOR PANAMA CANAL SHIPS.

Montreal capitalists, including several of the promoters of the Kingston (Jamaica) Street Railway, are behind a project known as the Port Royal Floating Dry and Coaling Docks, Limited. It is the intention of the company to furnish coal to ships using the Panama Canal, which will pass by Port Royal both ways. As a matter of fact, a steamer coming from Liverpool or New York and going to the Far East or Pacific ports makes the first call for coal at Kingston and her last on the return voyage. It is 5,000 miles to Liverpool, 4,000 to Gibraltar, 1,600 miles to New York, and from Kingston to Colon at the mouth of the canal the distance is but 580 miles.

The intention of this company is to build a first class floating dock in England and then tow it to Jamaica, meantime building the coaling station and work shops on land donated by the government. The government will also give thirty years exclusive franchise, besides the valuable site, will admit all the materials and dock duty free and also take a block of the common stock, paying for the same and allowing the interest to be deferred.

The cost of the enterprise is estimated at $2,000,000, and it is understood that a year will be required to build the drydock and local works. There will be a bond and stock issue.

NEW TYPE OF MINE LOCOMOTIVE.

The haulage of cars in and about a mine is a big factor in operative economics considered either from the operating cost or the danger of gas ignition in mines where gaseous conditions are liable to be met with. There have been up to the present, four methods of haulage in general use, hand power, horse-driven, chain and cable drive or electrical. The new type is operated by an internal combustion motor and is entirely self-contained.

Haulage by hand power is allowable only on the smallest of workings; horse driving is expensive in the extreme; chain and cable drive is troublesome and economical only in the richer portions of the mine. Electrical driving is satisfactory under certain conditions, but must be constantly supervised to insure economical operation; then again, there is a great possibility of sparking, a condition that is almost fatal in mines emanating explosive gases. The gasoline locomotive, considering its many good points, would appear to have a great future.

Figure 1. depicts one of these machines in operation in England, where they are manufactured by Messrs. Ironside Son and Dyckerhoff, 40 Mincing Lane, London, E.C. The engine frame is of most substantial dimensions, and carries not only the engine, but also the transmission gear shafts, change speed gears, clutches, etc. A rigid power unit is produced by this means and owing to the absence of universal joints any trouble that might arise following an accident is eliminated. The engine is of a design prepared

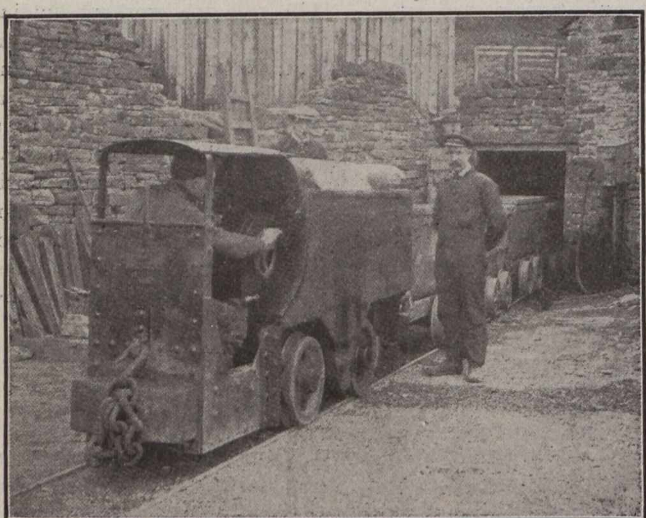

Fig. 1.

by the makers with all the cylinders fitted with liners, which may be renewed with a few minutes' labor, and of the horizontal type, well balanced. The speed of this engine is rated for 300 r.p.m. and may be accelerated to about 20 per cent. above this rating, should conditions call for such. When throttled down, as during a rest, the engine speed is only 150 r.p.m. and the fuel consumption is economized accordingly. The design of the engine almost eliminates vibration.

In a locomotive of this type, designed with a view of safe working in mines of a gaseous nature, a carburetter that could throw a flame outside the cylinder would be fatal to its use in mines of this type; consequently the makers have given much attention to this portion of the machine and supply a carburetter that will not give an explosive mixture outside the working cylinder. With this mixing device the fuel consumption is guaranteed to not exceed 0.66 pound per British horsepower per hour at full load with petrol as a fuel.

Some of these machines are in operation in the coal collieries in the province of Alberta and for two years have given much satisfaction. We regret that we are unable at the present time to secure photographs of these machines, but as they are much similar to the one illustrated their general outline will be made clear.

SEWAGE TREATMENT VERSUS SEWAGE PURIFICATION.*

By George C. Whipple.

The art of sewage purification has been making progress during recent years. Of this there is no doubt. The nature of the advance, however, has not been that which the popular mind believes it to have been. It has not been in the direction of making sewage more nearly resemble drinking water so much as it has been in adjusting the treatment to particular needs, making the treated sewage fit for discharge into some particular stream or lake, taking into account the subsequent use of this water. The greatest progress has not been in obtaining a higher degree of purity for sewage effluents, but rather in the invention of methods and devices applicable to conditions not previously encountered. To illustrate the general results of that notable series of experiments made a quarter of a century ago by the Massachusetts State Board of Health, at Lawrence, was that the application of sewage to land according to the method known as intermittent sand filtration was the one best suited to the local conditions of that State. Time has proved that this conclusion was correct, and the plants that have been constructed have on the whole given satisfactory results. Intermittent sand filtration gives a relatively high degree of bacterial efficiency. But sandy soils of the proper character do not exist everywhere in the United States; they do not exist in England. Large areas are required and it is not often that these can be found at the proper elevation near large cities. Therefore, this excellent method of sewage purification is much limited in its application. The need of processes to fit other conditions led to the use of improved screens, of chemical precipitation works, of septic tanks, of sprinkling filters, of contact beds, processes excellent in their way, but as ordinarily operated not capable of purifying the sewage to the same extent as the older method of treatment on land.

Yet, and this is the point of my paper, these miscellaneous processes all go popular under the name "Sewage-purification plants." In a certain sense this is correct, for they contribute to the removal of the objectionable ingredients and living organisms in the sewage. The sanitary engineer, knowing the nature of the results, makes a proper mental discount of the term and is not deceived. The layman, however, takes the word "purification" at its face value and is deceived. How many times do we hear city officials proudly boast that the sewage of their city is in no way dangerous because it is purified in a septic tank, when it would seem that the use of one's nose and the application of a little common sense would lead to a different conclusion?

There is no more fatal error in logic than failure to properly define the premises; nothing contributes so much to controversy and misunderstanding as the use of terms of

* A paper read before the general session of the American Public Health Association, Washington, D.C., September, 1912.

uncertain meaning. The speaker believes that much of the prevailing discussion with respect to the advisability of adopting this or that method of guarding water supplies against infection and of preserving the quality of the water in our waterways has been confused in the minds of many on account of the use of the term "sewage purification" to cover methods and processes that do not make the sewage pure.

It is gratifying to observe that there is an increasing tendency among sanitary engineers to substitute for the term "sewage purification" the words "sewage treatment." Notably, George W. Fuller has adopted this language in his recent admirable treatise on sewage disposal. It is to be hoped that its use will become general. If not, the term "sewage purification" will inevitably become degraded, as people come to learn, as they must, that not all so-called purification plants really purify the sewage. The term "sewage treatment" does not imply complete purification and is, therefore, the more general and the better term.

Using the words in their most obvious meaning, let us ask the question, ought the sewage of our American cities to be purified? Generally speaking, no. To do so would be enormously expensive, and in most cases the results accomplished would not be commensurate with the cost. Ought the sewage of our American cities to be treated in some way before being discharged? Generally speaking, yes. There are relatively few instances where raw sewage can be discharged into streams or lakes without causing objectionable local conditions or dangers of a sanitary character. The nature of the treatment required will vary all the way from a mere straining out of the grosser solids to a combination of processes that results in actual purification.

We hear it said that in England practically all of the sewage is purified. Is this true? Yes, if it is meant that the sewage is submitted to some process that improves its character, but no, if it is meant that these processes completely remove the organic matter and free the sewage of its dangerous bacteria. For example, we like to refer to the interesting sewage works at Manchester and Salford with their great septic tanks and contact beds and sprinkling filters, and we speak of them as purification plants. Do we realize, however, that analyses of the sewage effluents show that during a large part of the time they fall below the standard of purity established by the Mersey and Irwell Joint Committee, a standard that cannot be regarded as too strict if we maintain a reasonable meaning of the word "pure." The biennial report of Hugh Stowell, chief inspector for the Mersey and Irwell district, dated May, 1912, states that out of 126 sewage works, 23 per cent. were non-efficient, this being an improvement over 34 per cent. as shown by his previous report. At Manchester 22 per cent. of the samples were below the established limit for organic matter of "one grain of oxygen absorbed per Imperial gallon in four hours," at Salford 12.8 per cent. of the samples were below standard. This is not intended as a criticism of English methods of treatment, which, on the whole, are well adapted to their particular needs, but merely to illustrate the danger of using loose phraseology.

Or to take another illustration, can the water-supplies of our lakes be protected by purifying the sewage that enters them? Many laymen think so, and ardently advocate the construction of sewage-purification plants and oppose water filtration. Would they say the same if they realized that most so-called sewage-purification plants only partially remove the dangerous substances from the sewage, and that complete removal is impracticable on account of the expense and the almost insuperable difficulty of treating all of the sewage at times of storm? Would not these well-meaning people have a clearer conception of the problem if instead of using the broad misleading word "purification," we used the term "sewage treatment," or still better, some term that described definitely he results accomplished by the different processes.

With laws being framed in various States, to control the pollution of rivers and waterways, it is high time that popular misconceptions should be corrected and that the different phases of this complicated problem should be made clear. In the first place it should be more definitely understood that in the treatment of sewage there are two very different functions to be considered. One is to get rid of the foul, putrescible matter with its accompanying offensive smell; the other is to get rid of living disease-producing organisms. One is very largely a physical and biochemical problem; the other is chiefly bacteriological. One does not directly concern the public health; the other may. In practice, these functions overlap but they may be kept separate.

Is it not the popular conception of the function of sewage-disposal plants that they are intended primarily to protect the public health? Is not this the theory upon which some of the recent legislation is based? It certainly appears so. But is this idea correct? Does the treatment of sewage by the ordinary process materially improve the public health? Are sewage works a success from the hygienic point of view? It is a vital question and one that has not been sufficiently considered from the standpoint of cost and result.

Sanitary history has shown that when polluted water-supplies have been purified by filtration, the typhoid fever death rate of the community has lessened and the public health has otherwise materially improved. And it is a matter of easy reckoning to tell that the financial benefits represented by the saving of human lives and the prevention of sickness have far exceeded the cost of filtration. Taking the cost of efficient water purification at $10 per 1,000,000 gallons, and allowing a per capita water consumption of 100 gallons per day, the process pays for itself if it reduces the typhoid fever death rate by 4 per 100,000.

No such record can be shown for the purification of sewage except perhaps in the case of a few small plants built for the protection of the water-supply of some large city, and even here it is difficult to measure the number of lives that have been saved. The complete diversion of sewage from the drainage area of a public water-supply has repeatedly been of hygienic benefit. So has the introduction of sewer systems in cities and towns where none existed before. But the purification plants that have been constructed for the large cities of the world have not the saving of many human lives to their credit, so far as the best available evidence shows. The reason is obvious. They have not, as a rule, been built for that purpose, popular ideas to the contrary notwithstanding.

Sanitarians abroad have long recognized the fact that river water-supplies cannot be protected against the danger of infection by any of the known methods of purifying sewage discharged into the river above the waterworks intake. Instead they depend upon the filtration of the water-supplies themselves. In Germany the filtration of surface water-supplies is required by law and no difficulty has been found in building water-filtration plants capable of purifying water after it has received what would be regarded in this country as a large amount of sewage. In Germany and in England sewage-disposal works are built primarily to remove organic matter and prevent streams from becoming foul. Therefore, when public health authorities in this country compel large cities to construct sewage-purification plants for the avowed purpose of protecting water-supplies taken from the rivers below them, they are attempting to accomplish the impracticable, and are compelling the expenditure of money without adequate returns. The most that can be expected in this direction is to lessen the burden placed upon the water filters and in some instances this may be desirable.

The pollution of water-supplies is not the only thing involved in this matter. Sometimes it is a question of protecting shellfish supplies, or of bettering the sanitary condition of the water at bathing beaches. These may be fairly classed among the direct sanitary benefits of sewage treatment, but here the treatment to be of benefit must be quite complete and, therefore, expensive, while the number of lives saved is probably small.

It would not be right to balance the cost of sewage purification against the saving of human lives, were it not for the fact that our cities are subject to debt limits and that money is needed for many other purposes that affect the public health; for cleaner streets, for better care of schoolhouses, for parks and playgrounds, and for the special needs of the department of health in securing safer milk and food supplies, and for all sorts of hygienic and sanitary inspections. In view of the steadily increasing tax rates in our large cities it behooves sanitarians to find out for each city in which direction money allotted to the saving of human lives will do the most good. In other words, how can the most lives be saved for a dollar? Whatever the answer may be, it is not likely to be found in the purification of sewage.

That the sewage of most American cities should be subjected to some form of treatment is conceded. The need will increase as our cities increase in size and number. The problem at hand is to determine the most appropriate treatment for each case, bearing in mind the results that can be accomplished, the peculiar local condition, the cost of construction, maintenance, depreciation and operation.

Processes of treatment perform one or more of three functions: clarification of the sewage, oxidation of the organic matter and removal of bacteria. The effect of the methods of treatment now available and in common use are given by Fuller in his treatise already referred to as follows:

Method.	Percentage purification. Suspended matter.	Organic matter.	Bacteria.
Fine screens (30 mesh or finer)	15	10	15
Sedimentation	65	30	65
Septic treatment	65	30	65
Chemical precipitation	85	50	85
Contact filters*	85–90	65–70	80–85
Sprinkling filters*	85–90	65–70	90–95
Intermittent sand filters*	95–99	90–98	98–99

* The figures for the last three forms of treatment are on the assumption that the sewage is given some form of preparatory treatment before it is applied to the filters, and that with the sprinkling filters the effluent is allowed to settle.

It is evident that some of the processes that are used primarily to prevent sewage from producing foul conditions do also remove many bacteria and to the extent that they do improve the sanitary quality of the treated sewage. Often this can be accomplished at low cost, while to effect a reasonably complete and useful bacterial removal would very greatly add to the expense. This treatment of sewage to a less degree than that of complete sanitary purification may pay, even though the direct hygienic aspects of the case be ignored, for whatever eliminates public nuisances adds to the comfort of the public, and tends to restore depreciated real estate values.

The above ideas are not new to sanitary engineers; they know the limitations of the various methods of treatment; they know how well they work when kept in order, and how grievously they fail when not properly operated and enlarged as need requires; they are able to determine what methods or combination of methods are best suited to any case. Yet in common parlance and in official reports they continue to say "sewage purification" when they mean something less. Perhaps a better term than "sewage treatment" can be found, but let us at least be more particular in the use of terms describing the processes discussed, lest the cause of sanitation suffer a reaction from the over-zealous interest of laymen based on false conceptions.

A METHOD OF RECONNAISSANCE SURVEYING.

A method of making reconnaissance surveys herein described has been used for a number of years by a mining engineer who has been employed in examining small mines and prospects in Central America, and was described some time ago in the Engineering and Mining Journal.

There are few mines near the railroads; a journey of two or three days or more may be necessary to reach them, and often the roads over which one must travel on mule back, have never been surveyed. The question as to whether the mine can be profitably worked is often dependent upon the transportation problem, or the possibility of developing power from the nearby water courses. A map of the roads showing in a rough way the topography of the immediately adjacent country is of considerable advantage when such questions have to be considered.

The method that has been used for such reconnaissance surveying is essentially that used by military men. The data for a map are collected as the party travels over the road. The distances are measured by time, the bearings by compass. Starting from a given point the compass man reads the bearing to a certain conspicuous point on the road ahead; the timekeeper notes the time of starting for and arrival at that point, which gives, approximately, the distance. Arriving at that point, another in the road ahead is selected, its bearing from the first observed, and the time taken to reach it recorded. In such manner the bearings and distances of successive points on the road are determined and from the data a map is plotted.

Allowances must be made for the different gaits of the mules, which will vary from 10 to 80 minutes to traverse a mile—horizontally. To make these allowances, some experience is necessary. In starting out, the mule is "standardized" by taking the time required to walk a measured distance on a level road. Such tests are made several times throughout the day in order that allowances can be made for the slower gait of the animal as he becomes fatigued. It is also necessary to allow a different gait in going up and down hills which will in turn vary with the length of the hill and condition and tortuousness of the road. On a level road a mule will average better than 350 ft. per min., four miles per hour, or a 15-min. gait; on steep, rough hills it may make only 66 ft. horizontally per min., or an 80-min. gait. In time the observer becomes experienced in making allowances for gait and greater accuracy is possible.

In keeping notes, the left-hand page of the note book is ruled vertically for: Course, bearing, time of starting, time of arrival, elapsed time, gait factor (indicated by the time required to traverse one mile), and calculated equivalent horizontal distance. On the right-hand page the note-book keeper writes notes and makes sketches to indicate the topography to each side of the road, the rocks out cropping, their strike, dip and character, the rivers and streams crossed and any other features that may be desirable.

It is advisable to make frequent observations by aneroid to determine the relative elevations along the road as profiles of at least certain portions of the maps may be wanted. The plotting of the maps is done each night when stopping in some town and the topographical notations are sketched in from the notes while the day's journey is still fresh in mind.

While these maps are far from accurate they are often most useful for making tentative plans that will eventually be based upon accurate surveys made by the usual methods. The plotting of the outcrops often gives an excellent idea of the formation of the region, and, above all else, the engineer becomes familiar with the country far more quickly than would otherwise be the case. Of course, such work delays traveling but the delay is negligible when the value of such records is considered.

As for accuracy, the engineer who has so extensively used this system in Central America has stated that, with a squad of men having had a little experience, two such surveys, over different roads, each about 80 miles long, measured in a roughly circular course, have checked within a mile. Such checking may seem absurd to surveyors but for the purpose of such work an error of one in 80 is accurate enough.

WATER PURIFICATION VIEWED FROM THE HYGIENIC STANDPOINT.*

By Allen Hazen.

The progress in water purification from a hygienic standpoint has been very rapid in the last decade. This progress has been of two kinds. First, there has been a great increase in the number of water supplies that are being purified with satisfactory hygienic results; second, there has been an advance in the standards of efficiency, and in the methods available for reaching them in practical work.

Filtered Water Statistics.—The growth in the purification of water is shown by Table 1.

Table 1.—Population Supplied with Filtered Water at Different Dates.

Year	Population in U. S. Cities of More Than 2,500 Inhabitants.	Population Supplied with Filtered Water. Sand Filters	Mechanical Filers,	Total.	Per Cent. of Urban Population Supplied.
1870	....	None	None	None	0
1880	13,300,000	30,000	....	30,000	0.23
1890	21,400,000	35,000	275,000	310,000	1.45
1900	29,500,000	360,000	1,500,000	1,860,000	6.30
1910	38,350,000	3,883,000	6,922,000	10,806,000	28.20

From Table 1 it appears that the population supplied with purified water increased more than five-fold in each of three successive decades. In 1910 28 per cent. of the whole urban population of the United States was so supplied.

Twenty years ago a considerable proportion of the largest cities of the United States were supplied with water polluted by sewage and notoriously injurious to health. At the present time this practice has mainly ceased. There are still a few of the larger cities that supply water that, in some respects, is not of as good quality as could be desired. But all of the larger cities that supplied notoriously bad water at the date mentioned have improved their supplies in one way or another, and in many or most cases filtered water of excellent quality is supplied at the present time. The smaller cities have followed in the same way but more slowly. While there are some exceptions, a majority of them now have water of at least fair quality.

* Paper presented before the International Congress on Hygiene and Demography, Washington, D.C.

The statistics above relate to filtered water. They cover only part of the whole field, for in the last years other means of treating polluted waters have come into general use which are important from a hygienic standpoint. No statistics have been compiled to show what additional population is supplied with water so treated, but if it were taken into account it may be conservatively stated that from one-half to two-thirds of the whole urban population of the United States is now supplied with water that has been purified to a greater or less extent.

Advance in Filtration Methods.—The advance in the methods of purifying water from a hygienic standpoint has not been less important than the increase in population supplied with purified water. Some years ago methods of water purification were in common use for treating highly polluted waters which secured the removal of bacteria to the extent of 97 and 99 per cent., and occasionally with well-built and well-operated plants, higher percentages, up to 99.5 and even 99.9 were obtained. These figures relate either to all the bacteria in the raw water or to some portion thereof shown by the methods of examination commonly used. The presumption was that any injurious bacteria that there might be in the raw water would be and actually were removed in as great proportion as were the kinds that could be counted. This was always a matter of some uncertainty and there was reason for thinking, in some cases at least, that the removal of pathogenic bacteria may have been more complete than the removal of bacteria in general. However this may be, it is true that cities supplied with water drawn from highly polluted rivers purified by filtration to the extent above mentioned, were as free from diseases which could be attributed to the public water supply, as cities supplied with upland water of the best quality.

It was obvious that filtration was a relative and not an absolute protection against the impurities of the raw water. Some bacteria undoubtedly passed through the filters, and if pathogenic bacteria were present in the raw water a few of them might pass the filters and reach those who used the water. If a river had a population of 100 per square mile on its catchment area, and if the filter plant removed 99 per cent. of the bacteria, the water after filtration might be compared with water from a river otherwise similar, but with a population of one per square mile.

There was some indication that a falling off in bacterial efficiency had an appreciable effect upon the health of the community. There were notable cases where filters of inferior or inadequate construction, or operated with less than the usual degree of skill, produced, temporarily or permanently, effluents inferior from a bacterial standpoint to those otherwise produced by the best filter plants; and there were cases where diarrhoea, typhoid fever and other indications of water pollution among those who used the water had followed such falling off in efficiency.

Skilful Operation of Filters.—Skilful manipulation of filters must be regarded as equally important with good design in securing at all times an output of well-purified water. The best designed plants may produce poor or bad effluents with careless or unskilful manipulation, and skilful manipulation will do much to improve the average quality of the effluent from old plants not representing modern standards of construction. As the years have gone by, and the number of water purification plants has increased, there has been found a rapidly increasing number of men who have had experience and have acquired skill in operation; and the fact that such men have been available and have been secured to operate purification works has been a most important element in the improvement in the average results that have been secured.

It is more difficult to keep filters up to a high standard of efficiency during the cold weather of winter and early spring than at other times, and failures of this kind were most frequent at this season of the year. It was perhaps a fair inference that if the use of raw water caused a very great amount of disease among those who used it, and if poorly filtered water during the winter caused a slight though perceptible increase in the same diseases that were caused by the raw water, that the smaller number of bacteria normally passing into the effluent might produce an effect upon the health of those using the water, even though this effect was too small to be measured by such vital statistics as could be obtained.

In the last years the practice of treating filter effluents, as well as raw waters, with hypochlorite of lime has become very common. Applied in very small amounts to clear waters that that do not contain too much organic matter, it produces an extraordinary effect in killing bacteria. This substance had been used for many years as a disinfectant, but usually in much larger quantities. It was something of a discovery to find how efficient it was in extremely small doses in killing bacteria in water free from turbidity and organic matters. This condition certainly could not have been anticipated from earlier practice with it or from the literature on the subject.

Alternative Germicidal Treatments.—Hypochlorite of lime is by no means the first or only substance that has been proposed and used experimentally, and applied in practice in a few small installations for many years. Ozone has been tried repeatedly, but the practical difficulties of carrying out the ozone process effectively, and the great expense of doing it, have operated as obstacles to its general introduction. Hypochlorite of lime seems to have precisely the same bacterial effect as ozone, and it can be applied more easily and is free from some of the uncertainties that have been found adherent to the ozone process. Ozone has some advantages, and if means can be found for overcoming present difficulties its use will be another step in advance.

Sulphate of copper and other metallic salts have also been proposed for killing bacteria as well as algæ in water. It is permissible to use such a substance if it is applied to the raw water prior to filtration so as to secure a disinfecting action, and then have the metallic residue removed in the process of filtration. Some of these processes proved to have merit, especially in connection with filtration, but their use was always limited by the unwillingness of most of those in charge of waterworks to use metallic substances which were more or less poisonous.

The use of hypochlorite of lime has practically superseded all such metallic substances, as it is more efficient and is quickly decomposed in the water into substances that are not poisonous, and within reasonable limits cannot be, by any possibility, injurious.

Other methods of killing the bacteria in filter effluents have been proposed, among which may be mentioned the use of the ultra-violet rays; but no plants for treating water in this way upon a practical scale have been installed in America, and the process is, therefore, one for future consideration rather than of established position.

Hypochlorite of lime has considerable power from a hygienic standpoint, even when applied to the raw water and without filtration. In this case a larger dose must be used and it frequently must be a variable one, because enough must be applied to furnish oxygen for organic and other matters in the water capable of rapid oxidation in its presence, and still leave a sufficient excess to perform its germicidal work. The amount required for the oxidizable matters obviously depends upon the composition of the water, and this frequently fluctuates rapidly from day to day and even from hour to hour. The treatment of raw water has been less efficient and is less satisfactory than the treatment of filtered water, and has not infrequently resulted in occasional overdoses which have been objectionable in the water.

From a hygienic standpoint, the use of hypochlorite of lime is probably the most important event, after the extension of filtration works in the last decade, and where filtration is employed it permits the delivery of water in which the bacteria have been removed uniformly and certainly to the extent of 99.9 per cent. or more.

The use of this process has made it possible to deliver from filter plants of good construction water that is uniformly of excellent hygienic quality. There is no reason to believe that any appreciable danger will result from the use of such water, even when drawn from the most highly polluted sources that are now in use for public water supplies.

With the great extension of filter plants and the development and use of these supplementary processes, the time is rapidly approaching, and has, in fact been reached for a large part of the urban population of the country, when public water supplies cease to be agents for the transmission of disease. On the other hand, many experiences in widely separated cities should teach that constant care is the price of safety, and that every reasonable effort must be made to prevent the occurrence of any condition that would interrupt, even temporarily, the efficiency of the processes that are relied on for safety.

Sewage Purification.—The processes that have been successfully applied for the removal of bacteria from water may be applied, with modifications adapting them to the change in conditions, to removing bacteria from sewage. There has been a renewed effort under the stimulus of these new methods, to secure the disinfection of all sewage to be discharged into rivers and lakes from which public water supplies are taken. This impulse represents a most commendable interest in public water supplies and a desire to protect them from pollution.

It must be recognized, however, that it is more difficult and expensive to remove bacteria from sewage than from drinking water, and the process, even under the most carefully controlled conditions, is at the present time far less certain in its operation when applied to sewage.

The question of the combined or separate system in sewers, the treatment of storm overflows and the treatment of street washings discharged by drains which do not carry sewage, all have to be considered in connection with this general question.

Up to the present time improvement in public water supplies has come almost entirely through methods of improving the water used. Improvement of water supplies by purifying the sewage that flows into the water from which they are taken has played hardly an appreciable part in the improvement of water supplies in America.

Looking at the matter broadly, these conditions must be expected to continue for the present, and further improvement in water supplies is to be expected from improvements in methods of purifying the water, and from increased care and faithfulness in carrying them out rather than from the more extended use of sewage purification.

A contract has been signed between the town of Greenfield Park, Que., and the Montreal and Southern Counties Railway Company, in which the town gave the railway company a twenty-one years' franchise, and the latter agreed to give the town a satisfactory electric train service, to be inaugurated on or before July 1st, 1913. Suggestions have been made that the service will be in operation by the end of this year.

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THE MUNICIPAL ENGINEER

The city of London has lost the services of their city engineer, Mr. George Wright. Mr. Wright has handed in his resignation as the result of certain statements and criticisms made by the mayor and members of the city council.

The number of engineers who have held the city engineership of London is rapidly increasing. The most recent to have accepted the position only to leave it at an early opportunity are Mr. Graydon and Mr. A. H. VanCleve. Mr. Wills McLaughlin was city electrical engineer also for a period of a few months. These men are known to the profession throughout Canada as capable men and good engineers. What, then, is the trouble in London? Were these men unable to meet the requirements of the position?

The answer is the same one that may be given to the recent trouble in Calgary, when Mr. J. T. Childs, the city engineer, resigned, and to the investigation now pending in Ottawa into the city engineer's department: the absolute lack on the part of city councils of the elementary principles of fairness in dealing with municipal officials, and their utter ignorance of the conditions of engineering work.

Mr. Childs was forced to retire from the city engineership of Calgary after many years of service as the result of a most absurd accusation. Mr. Wright now resigns from the city engineership of London on the trivial charge of poor construction of certain sidewalks. A knowledge of the facts which led up to both of these resignations must convince an unprejudiced observer that the day of usefulness of city councils is rapidly passing.

Suggestions have been made recently as a result of the constantly recurring troubles between city councils and city engineers, that the Canadian Society of Civil Engineers should take up an active policy with the aim of securing more just treatment for the members of the profession following this line of work. We doubt very much if any good purpose would be served by interference on the part of the Canadian Society in the endeavor to ameliorate conditions. The constant criticism and the nagging and fault-finding of municipal councils is due primarily to their comparatively low order of education, and, therefore, to their consequent inability to understand the engineer's work. The members of municipal governing bodies are chosen, as a general rule, on account of their political ability and wire-pulling capacity; and these qualifications are not usually developed in marked degree in the modern, well-educated man. The doctrine of the survival of the fittest is well exemplified in the usual city council of to-day; and the fittest there, is the vote-getter, the man who may be called a "good mixer."

The present method of election of city council by popular vote is not conducive to the obtaining of a high standard of municipal governing body, and it is the city engineer who has been the first to feel the evils of the system.

As we have said, we do not believe that the Canadian Society of Civil Engineers can do anything to help conditions. The trouble lies in the city councils, and the remedy is there also. Until the commission form of municipal government is brought into force, trouble will continue to develop between the city engineer and the municipal governing body.

Engineers with municipal training, and inclination for municipal work, will be cautious in accepting a position as city engineer of London after the past history of the position.

CANADA AND THE NICKEL SUPPLY

While it seems unlikely that the Dominion government will prohibit the export of nickel from Canada except to Great Britain—a suggestion made recently—the hint is a key to an interesting story. Prior to the time of war crisis, such a prohibition might prove an effective weapon. The official reports of mineral production in Ontario show that in 1910, the latest year for which such figures are available, there were raised from the nickel-copper mines of Sudbury 652,392 tons of ore, of which 628,947 tons were smelted in the blast furnaces and put through the converters. The product was 35,033 tons of Bessemerized matte, 23.6 tons of ore being thus required on an average for one ton of matte. In this quantity of matte there were contained 18,636 tons of nickel, last year's output, 13,141 tons, being exceeded by 5,495 tons, or over 41 per cent. The production of 1910 was much the largest since the nickel mines of Sudbury were opened, a quarter of a century ago, and stamps this field as being the most important source of nickel in the world. The value of the nickel contents of the matte, on the basis of what it is worth —or estimated by the producers to be worth—at the point of production is $4,005,961.

To the output of the Sudbury mines must be added, for the sake of completeness, the nickel contents of the silver ores raised at Cobalt, estimated to amount to 504 tons, bringing the total yield of nickel in 1910 up to 19,140 tons.

Monel metal, an alloy of nickel and copper, which has been placed on the market by the Canadian Copper Company, and which is produced by that company without separating the metals or either of them from the matte, has aroused great interest. It is asserted that the proportions in which the nickel and copper occur in the Canadian Copper Company's ores are almost precisely those required for the alloy, which are about 67 per cent. nickel and 27 per cent. copper, and that by careful attention to the furnace charge a Bessemer matte can be produced within one per cent. of that required in making Monel metal. Considerable quantities of this alloy are now coming into use. It is claimed to possess great strength and to be practically non-corrodible. It has been employed as castings in the manufacture of propellers for vessels of the United States navy and private yachts, in pump linings, steam turbine nozzels and valve fittings for superheated steam, in dairy machinery, refrigerating plants, and pickling apparatus in steel mills; in rod form, for pump rods, bolt and nut stock, steam turbine parts, stock for drop forgings, electrical apparatus, motor boat shafting, pickle pins and valve stems; as sheets, for roofing railway terminals and other large buildings, for mine screens and chutes, smelter roofs, skylights and window frames, boat sheathing, cooking utensils and chemical apparatus, also for steam turbine blades; in the form of wire for wire cloth, motor cycle spokes, rope for mine hoists and cableways, nails, screws, rivets, etc.; and many other applications where high tensile strength, combined with non-corrosive features are essential.

The use of nickel for coinage purposes is spreading. In 1909 the Government of Turkey was authorized to put out an issue of coins made of nickel or aluminium. The latter metal, upon being tested, not having given satisfactory results, nickel was decided upon, and it has been resolved to issue 120 millions of 5-para pieces, 120 millions of 10-paras, 70 millions of 20-paras, and 20 millions of 40-paras, in all 330 million pieces. The money is all to be coined in four years and issued in twenty.

The only other important source of nickel is the island of New Caledonia, whose output, however, in proportion to the whole, is now much less than that of Sudbury. Societe le Nickel, whose production is of New Caledonian ores, operates refineries in France, England and Germany. From 1900 to 1909 the French production fell from 1,700 to 1,200 tons, while that in England rose from 1,500 to 2,800 tons, and in Germany from 1,400 to 3,100 tons. Thus in 1909 the total output of nickel from New Caledonia was 7,100 tons. In the same year the yield from the Sudbury mines was 13,141 tons.

EDITORIAL COMMENT.

A statement from Ottawa this week does not bode well for the success of navigation in Hudson Bay. The naval service department, it is said, has had to abandon the scheme to send coal to points in the Hudson Straits for steamers owing to the refusal of the insurance company to insure the vessel which was to be sent. The vessel chartered was the Eric, owned by the Job Brothers, St. John's, Nfld. It is a sealing vessel, strongly built and equipped for ice work, yet the insurance company would not take the risk, chiefly because in case of accident very few vessels are in the vicinity to render assistance. The Pacific Coast outlet for Western Canada has no such drawback.

GENERAL NOTES.

The precipitation of the month of September was somewhat less than average the larger part of British Columbia, and over Eastern Quebec and the Maritime Provinces, while over the remainder of the Dominion, exclusive of the Districts of Nipissing and Muskoka in Ontario; and of Southern Saskatchewan and perhaps some areas in Northern Alberta, it was in excess. The excess was particularly marked in Southern Manitoba, and in the Lower Ottawa Valley, where almost double the average quantity was recorded. Light snow fell in some few localities in the Western Provinces, and severe thunderstorms occurred in all the Provinces.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for September, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	2.8	—1.56
Edmonton, Alta.	1.1	—0.40
Swift Current, Sask.	1.1	—0.23
Winnipeg, Man.	5.5	+3.58
Port Stanley, Ont.	2.9	+0.11
Toronto, Ont.	3.28	+0.43
Parry Sound, Ont.	3.5	—0.06
Ottawa, Ont.	4.3	+1.68
Kingston, Ont.	4.8	+2.20
Montreal, Que.	6.4	+3.01
Quebec, Que.	3.3	—0.47
Chatham, N.B.	2.3	—0.83
Halifax, N.S.	3.4	—0.61
Victoria, B.C.	0.7	—1.40
Kamloops, B.C.	0.8	—0.19

SPILLWAY CAISSON DAM.

Enough of the material for the floating caisson for Gatun Dam Spillway has arrived on the Isthmus from the United States to allow the contractors for its fabrication and erection, the McClintic-Marshall Construction Company, to begin the erection within a short time, is the statement in the current issue of The Canal Record. Inasmuch as the caisson will not be required until after the coming dry season, it will be erected at an elevation between 55 and 60 feet above sea level, on the lake side of the east wing of the dam, there being ample time to complete the caisson before the rise of the lake surface above elevation plus 50 feet; while shortly after the spillway gates have been closed, further to raise the lake, the caisson can be floated off and held ready for service.

The caisson is to be used as a temporary dam for the passages between piers of the spillway dam, when it is desired to repair the Stoney gates by which the passages will ordinarily be controlled to regulate the surface of the lake. When a gate is to be repaired, the caisson will be towed from its moorings at the side of the spillway, and swung into place between the piers supporting that gate. Water will be let into the caisson through intakes below the water line until it sinks into position on top of the ogee and against the vertical seats provided on either side. The downstream side of the caisson will then be six feet six and three-fourths inches from the face of the gate After the placing of the caisson, the gate will be raised slightly to unwater the space between it and the caisson. This will cause a heavy pressure from the lake on the caisson, forcing it more tightly in place, and will afford room for workmen to operate on the upstream side of the gate.

When it is desired to remove the caisson the gate will be lowered and the space between it and the caisson will be filled with water, to the level of the lake, through a pipe passing through the caisson and controlled by a valve. The pressure of backwater having been relieved, the caisson will be pumped out and floated away.

In outward appearance the caisson will be a simple rectangular box. The framework, consisting of vertical and horizontal girders, supporting a system of intercostals to form the skeleton, will be covered on both sides with steel sheathing plates, so as to form a watertight box into which will be put a sufficient amount of concrete ballast to cause it to float upright and at the proper depth in the water. Timber keels and side sills are provided to make tight joints with the ogee between piers and the vertical seats against which the caisson will rest when in use.

The horizontal girders, three in number, and the top truss will be 49 feet 6 inches long by 4 feet 3 inches wide, with web plates ½-inch thick. They will be bolted at the ends to the two vertical girders, 22 feet 6 inches long, 5 feet 9½ inches wide, and ½-inch thick in the web; and each of the three long spaces thus formed will be crossed at right angles by nine vertical intercostal plates ⅜-inch thick. This sheathing will vary in thickness according to the pressure on it, from ⅜ to 7-16 of an inch. All of this material will be of specially tested structural steel.

For ballast, concrete will be laid approximately two feet six inches deep over the entire bottom girder, with a slight grade toward a sump near the centre. A number of movable concrete blocks, eight inches square by six inches deep, will be placed on top of this as a means of adjusting the ballast.

The pipes for letting water into the caisson are located above the second girder, holes in which will allow the water to drain to the bottom. These pipes are two in number, four inches in diameter, and controlled by long-stemmed valves operated from the girder above. Swash bulkheads will minimize the rolling of the water within the caisson, assuring steadiness. The flange pipe, through which water will be let into the space between caisson and gate at the conclusion of repairs to the latter, is at the same level as the filling pipes and between them. It will be ten inches in diameter, of cast-iron, and controlled by an extension valve similar to those for the filling pipes.

The pump for unwatering the caisson, to float it, is to be of the horizontal force type, hand-operated by two handles. It will have a 6-inch stroke, and will draw water from the sump in the ballast through a 3-inch suction pipe and force it out through a 2½-inch discharge pipe, emptying through the side of the caisson about a foot below the top. When the caisson is sunk in place on its seat, its top will be two feet eight inches above the surface of the lake at the maximum elevation of 87 feet above sea level.

Trap doors and ladders will be provided to allow workmen access to the interior of the caisson. The top truss will be decked over with yellow pine lumber; and the keels and end sills will be of white oak. The caisson complete will contain approximately 53 tons of structural steel. The caisson for Miraflores spillway will be of identical construction.

DETERMINATION OF STRESS.

Professor E. G. Coker read a paper on the "Experimental Determination of the Stresses in Springs and other Bodies by Optical and Electrical Methods" before the Engineering section of the British Association.

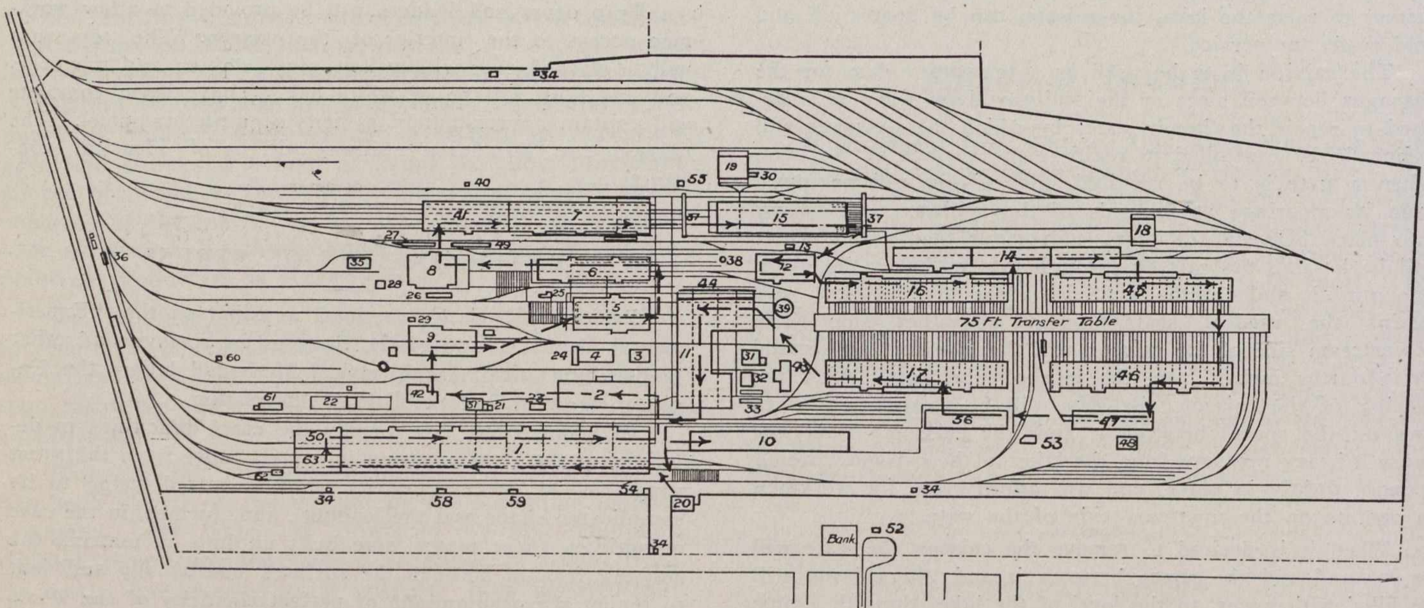
He pointed out that usually the chief difficulties in determining the state of stress in a body arose from the great variations of stress intensity which occurred owing to its complicated shape and the loading; and, further, in the case of springs where plates were built up into a matrix, the rubbing friction between the surfaces was usually sufficient to render the assumptions of perfect elasticity of the whole body somewhat untrustworthy for purposes of calculation, although each plate might be regarded as fulfilling the elastic conditions perfectly.

Methods of experiment were described by optical and electrical methods of general application to stress problems. In the first method, models of springs were constructed of transparent materials for which it was shown that the stress distribution was very similar to that in steel. These models permitted of determinations of the difference of principal stresses at any point, and an important result was that the optical effect of a pure shear was proportional to twice the numerical value of one of the principal stresses. Examples of plate springs and flat-coiled springs were considered in detail, and the general distribution of stress was illustrated by diagrams and natural-color photographs of springs viewed in polarized light. The second method depended on the fact that steel and other metals when subjected to stress within the elastic limit experienced a change of temperature—a diminution for tension stress and an increase for compression stress—proportioned to the stress. The effect at any point, therefore, was due to the sum of the principal stresses, and in coses of pure shear the effect was zero—a noteworthy difference from the first method. The paper described some attempts to utilize the difference in the electrical condition of stressed and unstressed metals for determining the stresses in materials.

The new United States Navy collier, "Jupiter," is fitted with electrically driven engines. She has a displacement of 19,300 tons, and is designed to carry 12,000 tons of coal as cargo, and for a maximum speed of fourteen knots. The machinery is reported to show a considerable saving of weight as compared with the reciprocating engine.

THE ANGUS SHOPS OF THE CANADIAN PACIFIC RAILWAY.

The Canadian Pacific Railway maintain at this point, which is near the city of Montreal, the largest and best equipped shops in America for the maintenance and manufacture of railway rolling stock. It would be impossible to secure even a slight idea of their immensity from a photograph but in order to show something of their extent the drawing, Fig. 1, has been prepared. The various buildings may be located and identified by reference to the following table, the numbers of which correspond with those on the drawing.



1. Locomotive shop.
2. Grey iron foundry.
3. Pattern shops.
4. Pattern storage.
5. Car machine shop.
6. Truck shop.
7. Freight car shop.
8. Wheel foundry.
9. Frog and switch shop.
10. General store.
11. Blacksmiths' shop.
12. Power house.
13. Shavings vault.
14. Cabinet and upholstery shop.
15. Planing mill.
16. Passenger car paint.
17. Passenger car erecting.
18. Hardwood kiln.
19. Softwood kiln.
20. General offices.
21. Oil house.
22. Scrap platform.
23. Moulding sand shed.
24. Core sand shed.
25. Scrap bin.
26. Sand shed.
27. Moulding sand shed.
28. Wheel breaker shed.
29. Coal bin.
30. Lumber yard office.
31. Iron shed.
32. Coal shed.
33. Scrap platforms.
34. Watchman's shelters.
35. Coke and wood storage sheds.
36. Locomotive track scale.
37. Transfer table.
38. 75,000-gal. tank, elevated.
39. Reservoir, 500,000 gals.
40. Freight car painters' clothes shed.
41. Freight car paint shop.
42. Lunch room No. 1.
43. Lunch room No. 2.
44. Scrap iron shed.
45. Passenger car paint shop.
46. S. E. Passenger car shop.
47. Upholstering shop.
48. Carpet beating shed.
49. Sand shed.
50. Flue and Flanging shop.
51. Store for castings.
52. Passenger shelter.
53. Hard coal bin.
54. Hose house.
55. Hose house with tower.
56. Brass shops.
57. Coal bin.
58. Asbestos shed.
59. Oxy-acetylene gas house.
60. Rail saw office.
61. Coal bin.
62. Sand blast shed.
63. Tender and tender truck shop.

Further information regarding these shops may be secured by reference to our issue of January 24th, 1912, which was one of the daily numbers issued in Montreal during that month.

THE SUPPLY OF NICKEL.

The situation in the Sudbury district, Ontario, with respect to the competition in the supply of nickel for use in the nickel-steel industry, has changed considerably in the past few months, states the Iron and Coal Trades Review. The International Nickel Company, acting through its subsidiary company, the Canadian Copper Company, has, up to the present, been the main producer from the Sudbury district, controlling in all about 70 per cent. of all the Sudbury output, which output represents about 75 per cent. of the total nickel product of the world. The Mond Nickel Company has produced about one-fourth of the Sudbury output, while the International Nickel Company has also large interests in the new Caledonia fields. At one time, the International Nickel Company was controlled by Mr. Charles M. Schwab, but about 1907 the control was taken up by Messrs. Converse, Monel, Delamar and Thompson. Prior to Mr. Schwab's advent into nickel, Mr. Joseph Wharton, of Philadelphia, Judge Burke and Mr. Richie, of Cleveland, had been dominating factors in the nickel situation. Recently the International Nickel Company extended its capital from $10,000,000 to $50,000,000. This will result presumably in a close alliance between the International Nickel Company and the United States Steel Corporation, in effect at least. While the International has been strengthening its position and increasing its activities, a Canadian company, known as the Dominion Nickel and Copper Company, has made some important purchases of new properties. This company is controlled by two very strong financial interests represented by Mr. J. R. Booth, of Ottawa, and Mr. M. J. O'Brien, of Montreal. At the same time there have been indications of activities of certain other strong interests in the Sudbury district. It has been reported that the American Smelting and Refining Company has made an investigation of the district, and has taken extensive options. Some smaller interests have sought to enter the nickel field, principally representing English and German connections that are now using nickel extensively, principally for naval and military equipment.

ASPECTS OF STEAM RAILWAY ELECTRIFICATION.

The advent of electricity into the steam railway field has not been very rapid. However, several railways in the United States have adopted electricity as motive power for suburban or interurban service. Professor C. L. de Muralt, in an article published in the Railway Age Gazette, outlines the present status of steam railway electrification. We present the article in full.

Let us see what has thus far been accomplished in trunk line electrification and what is likely to be done in the future.

We have to-day at least seven prominent steam railways that are using electricity as motive power on one or more of their main line divisions.

(1) The Baltimore & Ohio, at its Baltimore terminal.

(2) The New York Central, at its New York City terminal.

(3) The New York, New Haven & Hartford, at its New York City terminal and at the Hoosac tunnel.

(4) The Pennsylvania, at its New York City terminal, and on parts of the West Jersey & Seashore.

(5) The Great Northern, at the Cascade tunnel.

(6) The Grand Trunk, at the Sarnia tunnel under the Detroit River.

(7) The Michigan Central, at the tunnel under the Detroit River.

With the exception of the West Jersey & Seashore, every one of these electrifications was caused through the presence of a tunnel, which made further operation by steam locomotives either difficult or impossible. Whatever economies in operation were secured through the use of electricity may be said to have been incidental in all these cases.

Does this mean that electricity will be restricted to places where tunnels form a hindrance to steam operation? A careful examination of the matter shows nothing to confirm such a view. Smokelessness is only one of the advantages of electric traction. As matters stand to-day it will hardly be considered its most valuable one. There is one that is likely to prove of much greater importance. It is the fact that the electric engine possesses inherent qualities, which make it a much more powerful traction machine than its steam rival. To show just how this characteristic has already been utilized and to what extent it is likely to influence further developments is the purpose of this article.

The work which any given engine can do is dependent on three things, tractive power, boiler power and engine power, and it is limited in three ways.

(1) The tractive power is limited by the weight of the engine, or rather by that portion of the weight which is placed on the driving wheels. Any increase in weight on drivers means a proportional increase of tractive power, and for any given weight on drivers there is a certain maximum power which the engine can exert, and beyond which it must necessarily slip its wheels.

(2) The size of the boiler determines the quantity of steam which can be produced in a given time, and thus limits the steam producing or boiler power. If the engine uses more steam than the boiler can produce, the boiler pressure will fall and the engine will then be unable to turn the wheels.

(3) The capacity of the cylinders in a steam engine, or of the motors in an electric engine, limits the mechanical or engine power. If these parts are not sufficiently powerful, then the engine will be stalled, even while utilizing to the utmost a full pressure of steam and while yet unable to slip the drivers.

It may be said at once that the last is in general an unpardonable fault for any engine to have, because it is an absolutely needless sacrifice of a good part of its working capacity. With proper care in the design of its steam cylinders, or proper choice of the electric motors, it is always feasible to make the engine power in excess of either the tractive power of the boiler power, or both. The limit to the work which can be done by a well designed engine need therefore never lie in its motor part. It is always due either to insufficient tractive power or insufficient boiler power.

On these two points the electric engine shows its superiority over the steam engine. The electric engine has the boiler in the power house, and its size can thus be determined without reference to the limitations which are imposed on the boiler of the steam engine by the physical characteristics of the track and of the fireman. In other words, by proper design the limitations of the boiler power. can be entirely removed in any system of electric traction.

Similarly, we find that the limitations of tractive power may be practically eliminated wherever electricity is used, because the electric motor lends itself to subdivision of power with such ease, that it is quite possible, in case of necessity, to turn any desired number of axles into driving axles, and thus to utilize any desired part of the weight, up to the full weight of the train, for tractive purposes. The tractive power which is thus made available is away beyond anything that is likely to be demanded in railway work.

Now, let us see how these two characteristics of the electric engine may be utilized.

Our contention is, that electricity is peculiarly suitable for the relief of all congested spots on the present steam roads. We have two main cases of congestion, namely, terminals and ruling grades.

We started by saying that the electrification of the New York terminals of the New York Central, the Pennsylvania and the New Haven railways was largely caused by the necessity of avoiding smoke in the tunnels that form a part of these terminals. But it would be wrong to assume that the matter stopped there. The men who had charge of these installations fully realized the other advantages which were thus incidentally placed at their disposal. In such cases it is especially the removal of the limitations on tractive power which is of considerable value.

It is a fact well known to all superintendents of motive power that it is difficult to make a fast schedule in dense suburban passenger traffic, even with the most powerful steam engines especially designed for such service. The reason is that with steam locomotives there is a distinct limit to the amount of weight that can be placed on the drivers, From this results a limit to the tractive power, and consequently a limit to the ease with which heavy trains can be started and brought up to the speed. Even the highest obtainable rate of acceleration is too low to give a really satisfactory schedule speed when stops average about one mile apart. Furthermore, the number of cars that can be hauled in such a train is distinctly limited.

Electricity changes the situation completely. Any number of axles can be equipped with electric motors, and thus the tractive power can be raised to any desired amount. In actual practice an electric train can readily be accelerated two or three times as fast as even a light steam train, and there is practically no limit to the number of cars that can be placed in an electric train. The congestion is thus relieved in three ways, first, by the possibility of using larger trains; second, by the chance of higher schedule speeds, and third, by the greater ease with which the trains can be moved out of each other's way, that is to say, by the possibility of decreasing the interval between trains. In actual practice all three methods are usually combined with resultant satisfaction to passengers as well as the railway.

In the case of congestion due to severe grades, on otherwise level or low-grade lines, the conditions are reversed. In such instances the maximum tractive power is usually quite sufficient; in other words, the obtainable acceleration is satisfactory, but it is the boiler power which causes trouble. In order to lift the train up the grade, the engine must consume more and more steam until a point is reached when the boiler is unable to produce any longer what the engine requires. Then, either must the train weight be reduced, or its speed, or both. This is what actually happens on the ruling grades of most of the lines crossing the Alleghenies, the Rockies, and other mountain ranges. Helper engines mitigate the nuisance to a certain extent, but there is a limit to the number of helpers that can consistently be used on one train, and when this limit is reached, the trains are made lighter at the bottom of the grade, or their speed is cut down, or both.

Here, again, we find that the use of electricity completely changes the situation. There is no limit to the power which the boilers in the far-off power house can produce, and this power can very readily be carried to the engines in the form of electric current by means of the third rail or overhead contact line. Thus it is possible to concentrate sufficient power in an electric locomotive to take any train up the grade in the same composition in which it arrives at the bottom of the grade, and with the proper type of motor this can be done at the same speed at which it is run on the level. The congestion produced by the grade is thus effectively removed. In fact, one might almost say that for electric operation the vertical profile of a road loses all of its terrors, and trains can be taken over the most broken profile almost as well as over the level road.

We see, therefore, that the excess power of the electric engine can be made useful in at least two ways. The electrification of terminals is likely to make further steady, but comparatively slow progress. As a matter of fact, there are not very many places where terminal congestion has reached such a state as to make the use of electricity necessary, or even very important. The electrification of heavy grades, however, is destined to find more and more favor, especially because the business of the country is on the increase and any congestion now existing is therefore likely to be aggravated in the near future. At the Cascade tunnel of the Great Northern a heavy grade has been electrified in addition to the tunnel, and the results there obtained are certainly quite encouraging.

As regards the electric system to be used, too much importance has been attached to this subject in the past. There are to-day at least three well established electric systems, namely, the continuous current or direct current system, the single-phase alternating current system, and the three-phase system. Any of these can no doubt be used to electrify almost any service found on American roads. Which is the best for any given case can readily be determined by men who are expert in such matters. Generally speaking, the continuous current system will probably be found best suitable in terminal electrification work and the three-phase system in grade work. The single-phase system, for which rather extravagant claims have been made at times, does not seem well suited for work of the heavy kind. It is true that Mr. Murray claims that the New Haven saves 15 per cent. by the use of the single-phase system, but his claim has in no way been substantiated, and those who know believe that the case is the other way round, and that the New Haven would be better off if it used one of the other two systems. But this is, indeed, not a vital point. Just as there are many different types of steam engines, and at least three types of approved valve gears, so is there room for many different kinds of electrical motors.

The fact which is important is that in the electric locomotive of proper design we have an engine of much greater working capacity than can ever be obtained in a steam engine. This greater capacity can be used, either to give greater acceleration in terminal work or to move heavier trains at higher speeds over ruling grades. the latter employment in particular is likely to prove of great value in the case of roads where a severe grade produces a congestion, and thus a decrease in the traffic capacity of the whole line.

In a future article we will investigate whether grade reduction, or the use of Mallet engines, or both together, can afford as great a return on the capital invested, or offer the same operating advantages as electrification.

SHERBROOKE RAILWAY REPORT

"During the year," states President C. J. McCuaig, of the Sherbrooke Railway and Power Company, in the annual report, "some important steps have been taken in connection with the company's affairs, and the scope of its operations has been extended by the acquisition of several companies, with established businesses, in the district between Sherbrooke and the international boundary line. Legislation was obtained at the last session of the Quebec legislature ratifying these contracts and still further extending the company's powers. The companies acquired consist of the Eastern Townships Electric, the Stanstead Electric and the controlling interest in the Lennoxville Light and Power Companies.

"To provide funds for the purchase and extension of these properties, building transmission lines, and the extension of the company's main system, the company issued $348,500 additional bonds and $348,500 stock, which they have sold.

"Negotiations are pending for the sale of another large block of the company's power and it is reasonable to expect that a market will be found for the greater portion of the remainder of the power developed before the expiration of the year.

The following is the statement of profit and loss for the year ending June 30 last:—

Railway and power operations:—			
Gross earnings		$64,500.71	
Operating expenses		43,616.98	
Net earnings			$20,883.73
Real estate:—			
Rentals			$ 990.65
Stanstead and Eastern Township's Electric Company's			
Gross earnings		$23,148.58	
Operating expenses		12,975.63	
			$10,172.95
Lennoxville Light and Power dividend			$ 800.50
Net profit for 1912			$32,847.83
Balance at credit, 1911			3,694.46
			$36,542.29
Less:—			
Bond interest	$41,077.06		
Less interest charged to portion of system under construction	8,000.00		
		$33,077.06	
Accidents written off:—			
Railway department	$ 552.86		
Power department	570.82		
		$ 1,123.68	$34,200.74
Balance carried forward to the credit of profit and loss			$ 2,341.55

ELECTROLYTIC DISPOSITION OF SEWAGE.

The treatment of sewage is taking on added importance as time goes on and the necessity for preventing further pollution of lakes and streams increases. Mr. F. C. Caldwell, in the June bulletin of the Ohio State University, takes up the present status of electrolytic methods of purification. In the following we present his discussion.

The electrolytic purification of sewage is not new, patents covering the system have been taken out in England nearly a quarter of a century ago. It has, however, been recently revived with such a degree of success, as makes it fitting that it should be considered by this association, to the members of which its general adoption might be of considerable importance.

The material to be handled is made up of domestic sewage, sometimes accompanied by factory wastes and more or less diluted with storm water. Domestic sewage is made up of organic matter that is animal and vegetable, partly dissolved and partly suspended in water. There are also present vast numbers of bacteria often thirty to fifty million in a cubic inch. Factory waste when present may be of any one or more of many kind and affects the problem differently according to its nature. It is therefore not considered in this paper.

The degree of dilution of the sewage to be handled will vary greatly, depending both upon the habits of the population and upon the amount of storm water. In general, it is much more dilute in this country than in Europe. The large proportion of water greatly increases the difficulties of handling the sewage.

The presence and action of the bacteria constitutes one of the most important factors in the problem. They may in general, be divided into two classes, the purifying, also called anaerobic, because they flourish without oxygen, and the oxidizing or aerobic, which as indicated by their name, require oxygen for their best development.

The purifying bacteria operate in the sewers and in any closed reservoir or septic tank in which the sewage may be held. They are helpful in that they digest or liquify any solid portions, but to their action are due the offensive odors which characterize stale sewage. It is therefore essential that their action should be for the most part stopped before the sewage is turned into rivers or other water.

The oxidizing bacteria on the other hand, oxidize or "burn up" the organic material reducing it to simple, stable and inoffensive matter in which condition it ceases to be a nuisance, especially when further diluted with river water. As indicated above, their action is promoted by the presence of air and goes on without offensive results even after the sewage has been turned into the river. They can, however, act only effectively upon finely divided matter, and it is therefore usually desirable for their action to be preceded by that of the putrifying bacteria.

There are also to be considered the disease producing bacteria, originating in the human body. Of these the most notable is the typhoid bacillus. These, if simply run into the river water will remain alive for considerable periods, but they do not flourish under such abnormal environment and are not difficult to eliminate. In many plants it is not considered necessary to sterilize against such bacteria except at times of epidemics.

Any system of purification, to be a success, must leave the sewage inoffensive in appearance and in odor. Practical elimination of the disease producing bacteria is also desirable. Generally, also, the sewage must be to such an extent oxidized that there will be no danger, under the conditions of its disposal of purification again setting in. It is not sufficient to eliminate the putrifying bacteria as there are enough to be found in the river or other water to start the process and once started the rate of increase is enormous. It has been estimated that under unnaturally favorable conditions one bacterium would in twenty-four hours give rise to sixteen and one-half millions.

Granted that a new system accomplished these functions satisfactorily, it would still remain to be demonstrated that it did so more economically than other methods already available.

Before inquiring into the effectiveness of the electrolytic method it will be well to describe its operation. The following relates to the latest plant, a description of which has been published, namely, that at Oklahoma City, (population in 1910, about 64,000). This plant was put in operation on March 29, 1911, and was designed to handle 750,000 gallons of sewage per day. One or more of three flumes 18 x 20 in cross sections and 30 feet long received the sewage. This comes from the city through a conduit about a mile in length and the flow through this is an important factor as it assists in the mechanical disintegration of the sewage as well as serving as a septic reservoir for the action of putrifying bacteria. Each flume is designed to care for 250,000 gallons of sewage per day. The electrolysis is effected by ten groups of iron plates, each group consists of 27 plates, 3-16 x 10-24 spaced ½ inch between surfaces. These may be likened to the elements of a storage battery of such size as to nearly fill up the flume, and with their faces parallel to its sides. Alternate plates are positive and negative, and are connected to bus bars run along the edges so that all the groups of plates are in parallel. The bus bars are supplied by a 3-kw. motor generator set with current at from 1½ to 3 volts. Each flume takes normally 270 amperes. A reversing switch is included in the circuit, and changing the direction of the current once or twice a day equalizes the wear on the plates and removes the deposit which forms upon them.

To prevent excessive electrolysis at the upper edge a copper binding is used. The plates are gradually dissolved and take part in the chemical action upon the sewage.

The effluent is discharged into a so-called "dry gulch," and the sediment deposited in the flumes is periodically flushed out into the same gulch.

The Oklahoma plant was established on the strength of the results obtained from one installed at Santa Monica, California, population 11,000 to 18,000, depending upon the time of year, in June, 1908, and was modelled closely after it. The Santa Monica plant, however, discharges the effluent into the ocean 1,600 feet from shore. In passing, it is interesting to note the surprising lack of knowledge of things electrical evinced in the installation of this system. For example, magnets were placed over the plate electrodes for the purpose of intensifying the action of the current upon the sewage, but were easily removed.

We come to the perplexing question—Does the electrolytic method satisfactorily "purify" the sewage? Two causes of purification are claimed, namely, the production chemicals which are strongly oxidizing or chlorinating in their nature and the production of oxygen itself in the so-called nascent state, in which it is very active chemically. That such chemicals are formed and that they do operate to destroy the bacterial life they reach and to some extent to oxidize the organic matter itself is undisputed. The part played by the nascent gases is more doubtful as it seems to have been well established by Geo. W. Fuller in an extended investigation at Louisville (see his "Sewage Disposal," page 557) that such oxygen is almost entirely used up in attacking the iron plates. Further, the gas ceases to be nascent almost immediately after its formation on the surface of the plates and hence any direct action due to it would only take place in a very thin layer next to the plates, so that a small portion of the liquid would be affected.

An illustration of the efficacy of the electric current in the destruction of bacteria is found in some tests made some time ago by Dr. C. B. Morrey, of the Ohio State University, and the author, on the electrolytic sterilization of milk. In a sample of market milk containing 19,480,000 bacteria per cubic centimeter, an application of 2.5 amp. at 2,000 volts alternating current for 15 seconds reduced this number 99.97 per cent. Another similar test showed a reduction 98.7 per cent. and a third, in which the milk was inoculated with diphtheria bacteria in very large numbers, showed their practically complete destruction. Chemical examination of the milk showed no changes which would account for the sterilization nor could this be accounted for by the heating which took place.

The evidence seems quite conclusive that where the sewage has received suitable disintegrating and digesting or purifying action previous to the electrolytic treatment the effluent, immediately after each treatment, is practically odorless and free from bacteria. The question which does not seem to be satisfactorily answered is "Has organic matter been so far oxidized that it can be relied upon not to again putrify and thus develop a nuisance in the stream through which it flows?"

The experience at Santa Monica where the effluent, in comparatively small amount, is deposited in the ocean over a quarter of a mile from shore cannot be taken as indicative of the results which would follow where a comparatively small stream were made use of. . The case of Oklahoma City, where the effluent is run into a dry gulch, is perhaps more instructive, though even here the conditions are so different from those usually met with in this part of the country that they should not be given too much weight. There being presumably no other water in the gulch through most of the year, there might be no such supply of putrifying bacteria as would be found in most streams. Again, if the soil is sandy the effluent may sink in before it has had time to develop further putrification. The effluent as it comes from the plant may be somewhat antiseptic, which would discourage the growth of putrifying bacteria for a considerable period. This condition, however, might soon cease if the unoxidized sewage were diluted in a relative small stream.

On the other hand, the advocates of the system claim that the organic material is actually oxidized or rendered non-putrescible and most of the evidence given in the published accounts is to the effect that whatever the sewage seemingly ought to do, it practically does not purify after being subject to the electrolytic treatment, and after all "the proof of the pudding is in the eating," though we might not go so far as to say that the proof of the sewage is in the drinking.

Unfortunately the available data is not sufficiently definite to enable one to apply with great confidence the results obtained at the plants already in operation to the other and different conditions elsewhere. The evidence, however, is certainly strong enough to warrant an interested observation of the plants already installed, even if one prefer that the other man be the next one to try the experiment.

So far the operative side of the problem alone has been considered. The economic aspects are even more difficult to pass judgment upon with the available data.

While great claims are made for the economy of the system the accounting upon which they are based does not seem sufficiently definite to be convincing. This is unfortunate since it should be entirely possible for a competent and experienced sanitary engineer to make a conclusive report based on the experience of the two plants now in operation. Such report would at least apply to conditions similar to those under which these plants are operating, though of course any new proposition would have to be considered on its own merits.

The experimental plant established at Crossness, a suburb of London, by the original inventor, W. Webster, in 1889, and which was identical in principle with those of today, though different in certain details, seems never to have led to any further application of the principle, though all the obtainable evidence is to the effect that it was successful in its operation. The further fact that during the twenty years following in which so many and such costly experiments were made in sewage purification, the process was never further developed by sanitary engineers is significant.

On the other hand, weight must be given to statements that the Santa Monica plant has been enlarged and that Oklahoma City is constructing a second plant with a capacity of 2,250,000 gallons. It is also to be noted that present-day purification methods are much more costly both in fixed and operating charges than those of 20 years ago and hence this system would be in a better position to compete with them. Again, the fact that sanitary engineers are not usually electrical engineers may have induced them in the past to favor methods which were more familiar to them.

The following cost data are taken from the reports published in the electrical press.

First cost of Santa Monica plant (2 flumes, 550,000 gal.) including pumps, buildings, and forebay, $18,000. Monthly expenses of operating, including pumping, $400. Cost of energy for the year 1909, $159.95, at three cents per kilowatt-hour. Two men are employed at $85 per month but they do other work for the city. The proposal for a filtration plant to do the same work was:

First cost of Oklahoma City plant, $16,000 (cut about 20 per cent. below this figure in order to introduce the plants).

Operating Costs.

	Per annum.	Per mil. gals.
Current (at 5 cents)	$709.50	$ 2.59
Attendant	660.00	2.41
Lights	40.00	.15
Renewal of plates	200.00	.73
Depreciation	100.00	.37
Interest, 5 per cent.	800.00	2.92
	$2,509.50	$ 9.17
Sinking fund, (5%, 20 year)	1,000.00	3.64
	$3,509.50	$12.81

Another process, also invented by Webster, which employs electricity and was extensively exploited in 1894, makes use of an antiseptic solution produced electrolytically from sea water or salt solution. It seems to have been conclusively demonstrated that such solution has no advantage over antiseptics bought from manufacturing chemists and is more costly for ordinary conditions. Improvements in this method recently suggested by W. B. Ball, but still in an experimental stage may alter this situation.

Another interesting development is the use of ozone electrically produced for sewage purification. It is claimed that 215 grams of ozone can now be produced per kilowatt hour by the Meeker ozonizer and that a contract for a complete sewage treatment plant has been entered into with the city of Trenton, N.J. No data are at present available.

In conclusion it appears that the verdict for the electrolytic purification of sewage must be at the present time "Not proven, but very interesting."

HARBOR IMPROVEMENTS AT ST. JOHN'S, N.B.

St. John's activity during the last year is due chiefly to the enormous expenditures being made on harbor works, but there is also an increase in the number of factories. The Norton Griffiths Dredging Company are bringing in a fleet of powerful dredges to work in Courtenay Bay, and there are already five dredges and a stone lifter at work in the western harbor and the channel. The Norton Griffiths Company are steadily enlarging their mammoth plant at the site of the breakwater and dry dock in Courtenay Bay, and work will be continued throughout the winter. At West St. John work has been begun on the foundation of the Canadian Pacific Railway grain elevator, and this work will be steadily continued throughout the winter, as well as also the work of constructing new wharves at that point.

The Canadian Pacific Railway finds it necessary to erect a large addition to its office building at West St. John. It has also asked the city for a considerable strip of land at Fairville for an extension of its railway yards. The Intercolonial Railway is adding to its yard capacity storage room for 300 additional cars. The street railway company will extend its line in the direction of East St. John and its electric light system the whole way

Interesting developments are taking place at Coldbrook, three miles out on the line of the Intercolonial Railway. Formerly there were extensive rolling mills at this point, and it was quite an industrial centre, but of late years industry there had ceased. The Maritime Motor Car Company is building an automobile factory to be ready by February 1st, and has discovered on its property a deposit of fine brick clay and a brick-making establishment will be added. The Coldbrook Realty and Development Company, which has planned a garden suburb there, will erect before spring several cottages for workpeople.

USE OF PEAT IN GAS PRODUCERS.

On account of the lack of suitable coal deposits in the central Provinces of Canada and the rapidly decreasing supply of wood, the Canadian Government has taken an active interest in the exploitation of peat bogs with the view of developing from these deposits a fuel supply independent of outside sources.

Not only has the use of peat as fuel been considered, but the question of its utilization for producer gas has also received attention. A producer has been installed at the Fuel-testing Station, Ottawa, and exhaustive investigations have been conducted to determine the suitability of peat for this purpose. It is stated that very gratifying results have been obtained.

Mr. B. F. Haanel, chief engineer of the Division of Fuels and Fuel-testing of the Department of Mines, Canada, who discussed these results in a paper presented before the Eighth International Congress of Applied Chemistry, explains that the process used in manufacturing peat fuel mechanically treats the raw peat and utilizes the sun's heat for drying.

The raw peat is fed into a pulping mill consisting of a series of revolving knives rotating against fixed knives. By this treatment a homogeneous mass is secured, and by breaking the cell walls the contained moisture evaporates more easily. After thorough pulping the peat is taken to the drying field, spread out, cut into blocks of suitable size and thoroughly dried. The moisture content is reduced by this process to 25 or 30 per cent., below which it is not considered economical to proceed.

On account of the hand labor involved the estimated cost of one ton of peat fuel is about $2, including interest on capital invested and a profit of 15 cents per ton. To put the industry on a paying basis it is recommended that the excavation and spreading should be performed automatically and on a large scale. A plant is now being installed to meet these requirements.

On account of the low heating value of peat fuel it is not considered suitable for steam raising, though well adapted for producer gas production.

The high percentage of nitrogen in Canadian peat thus far examined peculiarly adapts it for plants designed for ammonia recovery. The nitrogen in the peat is recovered as ammonia sulphate, for which there is a large demand in the fertilizer industry.

However, the common type of producer employed for peat is not constructed for the recovery of by-products, but rather to burn the fuel with the highest possible thermal efficiency. The Körting producer erected at the Fuel-testing Station, Ottawa, is of this type, and is designed not only to obtain the complete gasification of all the combustible components in the peat, but to destroy rather than recover any of the by-products.

It was found necessary to modify the type of producer in some details before economic results were obtained but without going into details the investigation, in the opinion of Mr. Haanel, has proved that the peats tested are an economic source of power.

THE EFFICIENCIES OF A HYDRO-ELECTRIC SYSTEM.

The accompanying table gives an outline of the losses and efficiencies, for 1911, of the Seattle Municipal Light and Power Plant. This matter was presented by J. D. Ross in a recent paper before the Pacific Coast section of the American Institute of Electrical Engineers. The figures

Outline of Losses and Efficiencies for 1911, Seattle Municipal Light and Power Plant.

	Per cent all-day efficiency.	Total 1911 input, kw-hr.	Average 1911 input, kw.	Total 1911 loss, kw-hr.	Average 1911 loss, kw.	Per cent loss.	Per cent of penstock input.	Per cent of total loss.
Generating system	54.4	52,639,000	6,009	23,990,300	2,739	45.6	45.6	75.3
Penstocks	97.7	52,639,000	6,009	1,214,900	139	2.3	2.3	3.8
Generating station	55.7	51,424,100	5,870	22,775,400	2,600	44.3	43.2	71.5
Water wheels	60.7	50,758,900	5,795	19,944,400	2,277	30.3	37.9	62.6
Generators	93.5	30,814,500	3,518	1,990,800	227	6.5	3.8	6.2
Exciters	....	665,200	76	665,200	76	....	1.3	2.1
Station lights and control	....	175,000	20	175,000	20	....	0.3	0.5
Transmission system	91.6	28,648,700	3,270	2,413,500	276	8.4	4.6	7.6
Step up transformers	96.1	28,648,700	3,270	1,126,000	129	3.9	2.1	3.5
Transmission lines	98.6	27,522,700	3,141	378,000	43	1.4	0.7	1.2
Step-down transformers	96.6	27,144,700	3,098	909,500	104	3.4	1.7	2.9
Distributing system	79.2	26,235,200	2,994	5,448,700	622	20.8	10.3	17.1
City substation	98.7	26,235,200	2,994	346,400	40	1.3	0.7	1.1
S. Lights and control	....	317,400	37	317,400	37	1.2	0.6	1.0
Switchboard meters	....	....	.....	29,000	3	....	0.1	0.1
15,000-volt system	92.5	11,587,000	1,323	868,600	90	7.5	1.6	2.7
15,000-volt lines	99.2	11,587,000	1,323	93,500	11	0.8	0.2	0.3
15,000-volt transformers	93.2	11,493,500	1,312	775,100	88	6.8	1.5	2.4
Series street lights	86.3	2,672,800	305	367,200	42	13.7	0.7	1.2
Transformers	95.0	2,672,800	305	133,700	15	5.0	0.3	0.4
Series circuits	90.8	2,539,100	290	233,500	27	9.2	0.4	0.7
Cluster street lights	79.1	1,486,000	170	310,000	35	20.9	0.6	1.0
Cluster transformers	87.8	1,486,000	170	181,000	21	12.2	0.3	0.6
Underground cables	90.1	1,305,000	149	129,000	15	9.9	0.2	0.4
2,400-volt commercial system	76.2	13,178,400	1,612	3,123,700	357	23.8	5.9	9.8
Feeder regulators	98.6	13,178,400	1,612	178,500	20	1.4	0.3	0.6
Primary feeders	96.0	12,999,900	1,592	521,600	60	4.0	1.0	1.6
Transformers	88.8	12,478,300	1,532	1,391,000	159	11.2	2.6	4.4
Secondaries	92.9	11,087,300	1,373	782,600	89	7.1	1.5	2.5
Customers' meters	97.6	10,304,700	1,284	250,000	29	2.4	0.5	0.8
Direct-current system	35.7	673,200	77	432,800	49	64.2	0.8	1.4
Motor-generator	38.0	673,200	77	417,000	48	62.0	0.8	1.3
D-C. circuits	95.0	256,200	29	12,800	1	5.0	....	....
Customers' meters	98.8	243,400	28	3,000	.....	1.2	....	....

Summary: Total power loss....31,852,500 kw-hr. Average 3,636 kw.
Total power delivered to customers....17,304,900 kw-hr. Average 1,975 kw.
Total power delivered to street lamps.... 3,481,600 kw-hr. Average 398 kw.
Total delivered power....20,786,500 kw-hr. Average 2,373 kw.

Over-all efficiency, 39.5 per cent.

[1 kw-hr. at the customers' premises requires 1,364 gals. (5,163 liters) of water from Cedar Lake at average head of 590 ft. (179.8 m.)].

given are believed to approximate closely the true values, since great care was taken in the measurements made by frequently calibrated instruments. All results have been checked in as many ways as possible.

The Seattle plant is a hydro-electric system delivering water to two 1,500 kw. Pelton units and two 5,000 kw. turbine units under 600 ft. head through two pipes approximately 3½ miles long, one of which is 67¾ and the other 49 ins. inside diameter. The current is transmitted at 60,000 volts through two lines to Seattle, a distance of 38.7 miles, and is there distributed at 15,000 and 2,400 volts for use by approximately 20,000 customers and for the city street lighting.

SMELTING COBALT-SILVER ORES BY VACUUM ELECTRIC FURNACE.

The problem of smelting the difficult arsenides in the vacuum electric furnace was discussed recently by Colin G. Fink of the General Electric Co. at the April meeting of the American Electrochemical Society. He described experiments carried out with the idea of ascertaining whether ores, particularly complex or "rebellious" ores, such as smaltite, containing arsenic, sulphur, phosphorus or similar elements, could be more readily and more economically reduced in a vacuum.

Experiments were made with the treatment of smaltite ore from Canada, in a vacuum electric furnace. Simple heating of the ore without any additions was first tried, but without great success. Up to temperatures of about 1,500° C., but 40% of the arsenic present in the ore is expelled. It is only after exceeding the melting point of cobalt that a further reduction of the arsenic is brought about. If silver is present in the ore, it distils out at about 1,300° and can be collected in a chamber fitted into the cooler portions of the furnace.

Since it proved difficult to reduce the ore by intense heating, Dr. Fink tried the effect of additions. Of all those he tried the most effective was calcium carbide or a mixture of calcium carbonate and carbon.

With a mixture of 20 parts $CaCo_3$ and 6.4 CaC_2 and 30 parts ore, when the charge was heated at 1,500° C. for 1½ hours, the arsenic in the product was 2.1%. In this case the calcium oxide and carbide react with each other:

$2CaO + CaC_2 = 3Ca + 2CO.$

And the metallic calcium combines with the arsenic:

$CoAs_2 + 3Ca = Ca_3As_2 + Co.$

Calcium arsenide separates from the reduced cobalt as slag and part of the arsenic is volatilized.

The second part of Dr. Fink's paper describes experiments made with Nipissing ore. One lot analyzed 9.65% cobalt, 4.65% nickel, 28.65% arsenic, 18.06% silver, 39% gangue.

The behavior of this ore was similar to that of the smaltite ore. When heated alone a splendid separation was obtained into crude silver (83% ag), metal speiss, and slag.

The dividing line between silver and speiss is exceedingly sharp in the vacuum furnace product. A number of comparative runs were made in a carbon resistance furnace of the Moissan type, the gas pressure in the furnace being one atmosphere. Although a separation of the crude silver, speiss and slag was obtained, it was very incomplete and the volume of arsenic fumes evolved was very annoying.

In the vacuum furnace it was found convenient to make the runs in two stages. During the first stage the temperature was maintained at about 1,250° to 1,350° for 2 hours. At the end of this time, instead of cooling down or tapping off the three components, the temperature was still further increased to 1,550° to 1,600° and the charge kept there for about 3 hours. At this temperature the silver distilled out, leaving the speiss and slag behind.

The composition of the charge at the end of the first stage was, crude silver (lowest layer) 27%; speiss, 47%; slag, 20%, and arsenic (distillate) 8.5%. The addition of 5 to 10% of coke facilitates this separation of silver, speiss and slag. Its action is partly chemical, as a reducing agent, and partly physical, insofar as it keeps the charge porous, allowing the gases to escape readily. The crude silver of three runs assayed 81.34, 82.21 and 83.77% silver. There was no silver found in the slag, and none in the distillate at the end of the first stage. At the end of the second stage (1,600°) all of the silver was in the distillate and none in either speiss or slag.

IMPROVEMENTS IN ACETYLENE GAS GENERATION.

Acetylene is a gas that has been known to chemists for many years, but its recent introduction before the public is due almost to an accident. Some years ago a Canadian chemical experimenter, according to report, was treating a mixture of coke and lime with the electric arc in a confined crucible; just what he was hoping would result from this fusion is not stated, but the results in his first estimation were a failure. A drop of water happened to fall on the discarded mixture and this is the story of the discovery of calcium carbide.

The daily and scientific press of that day immediately seized the discovery as the philosophers stone and simple, sure directions for the construction of an acetylene generator appeared in almost every technical paper; but they failed to realize what every veteran inventor must come to understand, that there is a long stride between laboratory discovery and a complete successful marketing of the commercial product. Companies that were to manufacture acetylene generators were organized all over the world, but very few have thrived. Of some seventy concerns organized in the city of Toronto for this purpose three are still in existence.

All these generators depend on one of two principles; either the calcium carbide was brought to the water or the water was brought to the calcium carbide. The gas was evolved in tremendous volumes absolutely raw and unpurified, and in this condition was burned on a tip so arranged that a draught of air was created that kept the burner from clogging, for acetylene is very rich in carbon.

An English company taking the name of Carbic, Limited, have revolutionized acetylene gas generation by improving the means of applying the calcium carbide to the water instead of attempting any great novelties in the generator, as so many companies have.

Under the patents of this company calcium carbide, ground to the size of small beans, is mixed with two common and inexpensive substances and then heated to 120 degrees F. The sticky mass which results is placed in the die of a power press and forced to assume the shape of a brick or tablet and when this is cool it is ready to be packed and shipped.

There are many advantages in using calcium carbide under this form of which the following are a few.

There is no ash left; all the by-products are in the form of a thin sludge which may be entirely removed by opening a cock at the bottom of the generator.

The cake does not deteriorate when the generator is not operating.

The cake dissolves away from the bottom.

The ingredients in the cake serve as a purifier and the gas comes off very pure and almost odorless.

The generator does not heat.

The gas is generated very slowly.

The cakes may be left exposed to the air for several days without damage.

The cakes are very low in price and quite light for shipping.

A branch of this company has been established in Toronto, and will manufacture the products as well as a fine line of generators. Among the generators to be manufactured will be a contractor's night lamp that gives a powerful white light at an exceedingly low cost of operation, and a generator to be used in the production of acetylene for metal welding in conjunction with oxygen. Other lamps for specific purposes will also be manufactured. Reference will be made to the office address of this company in a future number of The Canadian Engineer.

REPORT ON RAILWAY ENTRANCES TO CITY OF OTTAWA.

A report was made some time ago by Mr. W. F. Tye, Consulting Engineer, and Mr. N. J. Kerr, City Engineer, on the proposal of the Canadian Pacific Railway to enter the city of Ottawa. An abstract of the report follows:—

The city of Ottawa, lying in the horseshoe curve formed by the Ottawa and Rideau Rivers, is curiously hemmed in both by nature and art. The rivers, canals, and railways form three distinct barriers to the city's progress. The outer barrier, formed by the Ottawa and Rideau Rivers, has, independent of the railways, only eight outlets in a distance of nine miles, namely: the Chaudiere, Interprovincial, Sussex Street, Minto, St. Patrick's, Cummings', Hurdman, and Bank Street Bridges. The second barrier, formed by the Ottawa River and Rideau Canal, has only six outlets in six miles, namely: the Chaudiere, Wellington-Sparks Street, Laurier Avenue, Cartier Street, Bank Street, and Bronson Avenue Bridges. The third barrier, to a great extent the same as the second, is formed by the Ottawa River, Rideau Canal, and the Isabella Street line of the Grand Trunk Railway, and has only six outlets in five miles.

The Ottawa River must always remain a deadline to Ottawa's growth in that direction, and can only be crossed by expensive bridges. The Rideau River has not so far proved a serious obstacle, as it is at too great a distance, but it will only be a few years with Ottawa's present rate of growth until many bridges must be constructed to give access to the lands beyond.

The growth of the city has been rapid. The annual report of the Assessment Department shows the population since 1881 to have been as follows:—

Year.	Population.	Increase %.
1881	25,633	
1891	43,229	68.6
1901	60,689	40.4
1902	61,151	
1903	61,597	
1904	63,234	
1905	65,120	
1906	67,572	
1907	76,260	
1908	80,284	
1909	83,360	
1910	86,106	41.8

In twenty-nine years the growth of the city has been 60,473, or equal to the whole population in 1901. It seems reasonably safe to assume that the rate of increase for the last ten years will be maintained for some time to come, and that the population in 1920 will be at least 125,000. If so, the area between the Isabella Street branch of the Grand Trunk Railway and the Rideau River should be completely built up.

The Rideau Canal and the Isabella Street line of the Grand Trunk Railway are at the present time seriously impeding the city's growth. This can be appreciated by noting the very much superior class of buildings on the city side of the Rideau Canal as compared with the very poor class on the other side, and noting a considerable growth at Ottawa East and Ottawa South, where bridges have already been constructed across the canal, and the almost entire absence of buildings between these points where no bridges have so far been constructed. A poor class of buildings and an absence of substantial growth is also to be seen adjoining the Isabella Street line of the Grand Trunk Railway. Both the canal and railway should undoubtedly be diverted to locations where they will be a benefit to the city, and not a detriment as they now are.

The railways, for the convenience of the public, must reach the heart of the city, which is now and probably always will be in the vicinity of the Parliament Buildings. The valley in which the Rideau Canal has been constructed forms the natural access to this portion of the city; and the railways may be located in this valley so as to give the greatest good to the city with the minimum amount of inconvenience. Streets, crossing from one side of this valley to the other, must of necessity be carried on high-level bridges, and the presence of the railways underneath will not seriously add to their cost.

The manufacturing district between the Ottawa and Rideau Rivers is now and probably will remain in the vicinity of the Chaudiere Falls. The future extensions will depend on the location of such connections as Ottawa will have with the Georgian Bay Canal, but it is almost certain that such extensions will be to the westward. Railway facilities must, of course, be given to this manufacturing district, and the problem which now confronts the city is to so connect these two districts by rail as to give the maximum of efficiency to the railways with the minimum of inconvenience to the city.

Recommendations.—The following recommendations are made on an assumption that assurance can be had from the Dominion Government that the Georgian Bay Canal will be constructed in the reasonably near future.

1st—That the Rideau Canal through the city be moved from its present location to a new location in the western portion of the city approximately as shown on the maps, and that it be rebuilt to the same standard as the Georgian Bay Canal, and to a connection with it.

2nd—That a Railway Reserve be established from the deep cut on the Rideau Canal to the Sparks Street bridge. This reserve to consist of the canal bed and a strip 55 ft. wide, on the west side of the canal from the deep cut to Laurier Avenue, and all the canal lands, exclusive of streets, as shown on the plan, from Laurier Avenue to Sparks Street. This reserve south of Laurier Avenue would be 135 ft. wide sufficient for nine tracks, and should be used by all steam or electric railways (the Grand Trunk excepted) now or hereafter seeking entrance to Ottawa, on terms to be decided by the Railway Commission.

3rd—That the city give its consent to the construction of a tunnel between the Central and Union Stations.

4th—That the city purchase from the Grand Trunk Railway Company that portion of its Canada Atlantic Railway lying between the east side of Concord Street, in Ottawa East, and a point at or near Breeze Hill Avenue. That the land so purchased be resold for building purposes, or used for an east and west boulevard, to be extended eastward by way of Echo Drive and Gladstone Avenue, Tempelton or Somerset Street, to and across the Rideau River, and westerly in two branches, one to the Richmond Road and one to Carling Avenue.

5th—That the Grand Trunk join in the construction of the Wellington Street tunnel, or be given running rights through it on equitable terms. That its Parry Sound line be carried through the tunnel, over its Canada Atlantic main line from the west portal of the tunnel to a point near Laurel Avenue, thence with a curve to the right to join the present right-of-way near Bayswater Avenue.

6th—That no additional railways be hereafter permitted in the area bounded by the present Rideau Canal, Wellington and Preston Streets, except in the Railway Reserve.

7th—When found necessary by the growth of the city, the grades of the Canadian Pacific, Grand Trunk and Canadian Northern be raised at the crossing of the Rideau River at Hurdman's Bridge to permit of proper subways for streets, drives, etc.

The advantages to the city of such a rearrangement of the traffic arteries seem manifest.

Rideau Canal.—The change in the Rideau Canal would give a deep-draught modern harbor connected with the Georgian Bay Canal, and one which could be extended indefinitely up the present Rideau Canal as occasions demand. A definite location is not shown for this canal, as it would require extensive surveys to actually determine, but it would be somewhere in the vicinty of the route shown.

If the Dominion Government spend from $100,000,000 to $150,000,000 in building the Georgian Bay Canal, it should not hesitate to spend an additional one or two per cent. to get direct connection with the city of Ottawa—the greatest traffic centre between Georgian Bay and Montreal.

Such a modern, deep-draught canal, giving entrance to the city of ocean-going vessels, with branch railways on either bank, with a superabundance of power within easy transmission distances, and large deposits of iron within easy reach, should make a manufacturing centre second in future possibilities to none on the continent.

The present Rideau Canal could be closed with a dam in a line with Main Street and Robert Street, Ottawa East, and the portion between that and Dow's Lake used as a pleasure lake in summer and an open-air skating pond in winter. Streets could be carried over it wherever desired at low cost with a large saving to the city. This would at once increase the value of the land between the canal and river and make it available as a high-class residential district. All of this can be done at an actual saving to the city of over $500,000.

Placing the railways in the proposed reserve and through the tunnel would put them where they would be doing the very least damage possible to the city and giving the most effective service. It would firmly anchor the Canadian Pacific main line to the city of Ottawa. It would give the Canadian Northern, the Canadian Pacific, the electric lines, and all other railways, an entrance to the heart of the city, and convenient to the business and residential districts.

Removing the Grand Trunk Isabella Street line would naturally improve what should be a fine residential district, and materially increase real estate value in the neighborhood. The ultimate cost to the city should not be high. The cost of necessary subways, bridges, etc., estimated at $500,000, would be saved. A portion would be recouped by the sale of the land, and additional taxes from the increased values of real estate would materially reduce, if not completely wipe out, the balance.

The suggested change would give the Grand Trunk an equally good line. Some inconvenience would no doubt be found in the necessary change in the Grand Trunk yards, but the heart of a great city is not a fit and proper place for through yards such as these are. They should be located outside the city, as land in their present location is entirely too valuable for such use.

The proposed line could be had with grades not to exceed 0.65 per cent., and there are many steeper grades on this branch. The principal objections are that a level crossing of the Chaudiere branch of the Canadian Pacific Railway would be necessary, and the work to rejoin their Parry Sound line would be rather heavy.

It is a matter of great importance to the city that a Transcontinental Railway, such as the Canadian Northern will soon be, should have satisfactory terminals, and the proposed arrangement will give it as good facilities as either the G.T.R. or the C.P.R., and so put it into direct competition with those roads.

The advantages to the city of an Inter-Urban Electric Raiway depends in a great measure on the ease and convenience with which it can be reached, and the proposed arrangement would put the terminals of the electric line right into the heart of the city, and close to the Ottawa Street Railway, making access to it easy from any part of the city.

With the exception of a few unimportant spurs and the Canadian Pacific Railway through Mechanicsville, the proposed changes would eliminate all level crossings, and put Ottawa in this respect in a better position than any city on this continent.

Alternative.—The foregoing recommendations are based on a well-founded assumption that the Georgian Bay Canal will be built in a reasonable time, and if so built, that the Government will rebuild the outlet of the Rideau Canal as a branch of the Georgian Bay Canal to the same standard as the main canal.

If, on proper representation to the Government, it is found that this canal will not be built for many years, and if it is considered undesirable to close the outlet of the Rideau Canal, we recommend that a strip 107.5 feet in width be taken on the west bank of the canal for a railway reserve from the deep cut to Laurier Avenue, together with all canal lands, exclusive of streets, from Laurier Avenue to Sparks Street, and that the foregoing proposals be modified as shown on the accompanying plans. This modification consists principally in raising the proposed grade through the tunnel between eleven and twelve feet, and continuing the 0.4 per cent. grade to the Union Station, where a lift in the grade of the C.P.R. tracks of one to two feet would be necessary. The only objectionable feature in this recommendation to the railways would be the lift-bridge necessary across the canal at the deep cut.

Objections to Alternative Proposition.—It would be objectionable to the city, however, in a number of ways. It would take an unduly large portion of the driveway. The roof of the tunnel being so much higher would interfere with the new relief sewer at Kent Street, necessitating an inverted syphon. The new grade would be so high at Wellington Street as to make necessary a viaduct, and it would also be difficult to get overhead crossing on the streets between Lett and Broad. Should it be necessary to make a level crossing at Broad Street it is recommended that the railway line be deflected to the north of the station.

The new line to connect with the Interprovincial bridge, as shown on the plan, would occupy an undesirable position. It would pass under the post-office and destroy the Customs abode now between the post-office and canal.

A bridge would be required across the Rideau Canal opposite the new G.T.R. station to permit the present G.T.R. tracks to be connected with the tracks through the tunnel.

This alternative is only recommended in the event of the Georgian Bay Canal not being built, and does not in any way affect our recommendation as to the purchase and removal of the Isabella Street branch of the G.T.R. between Concord Street and Breeze Hill Avenue.

The following maps, plans, etc., accompany this report:—

Map of Ottawa, showing proposed changes.

Plan and profile of the proposed new line from the Central to the Union Stations.

Plan and profile of the alternative new line from the Central to the Union Stations.

Cross sections of the canal and driveway, showing lands to be taken for the proposed Railway Reserve.

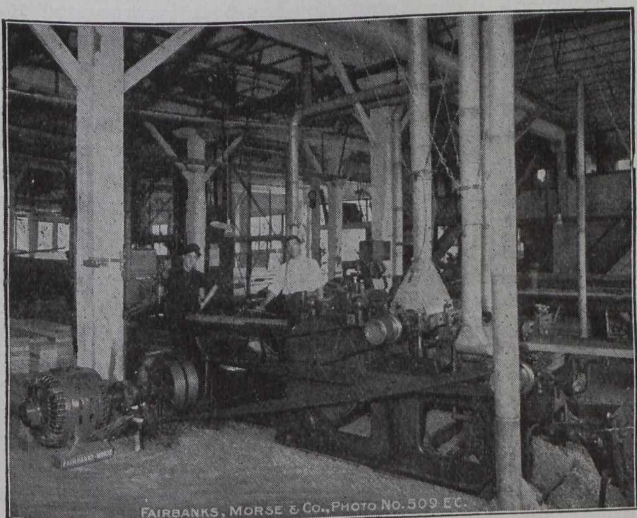
Profile of the proposed new G.T.R. connection near Bayswater Avenue.

From the British Columbia marine yards at Esquimalt will shortly be launched the steel steamship "Princess Maguinna," the largest vessel ever built in British Columbia waters. She will be employed in the coasting service of the Canadian Pacific Company. The engines and boilers are being built by British manufacturers. The vessel will be fitted as an oil burner.

ELECTRICAL EQUIPMENT OF A LARGE PLANING MILL.

By W. G. Hesser.

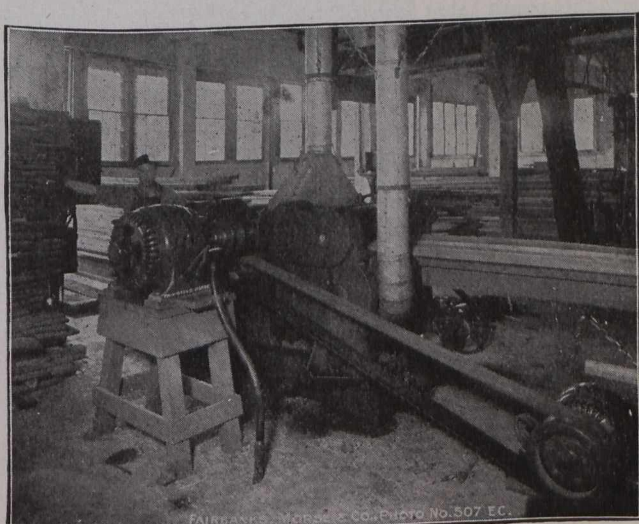
The Louisville Planing Mill and Hard Wood Flooring Co. is incorporated under the State laws of Kentucky for the purpose of manufacturing interior and exterior millwork, sash, doors and high-class stair work. The plant covers approximately 75,000 sq. ft., employs 90 men, and uses about 500,000 ft. of lumber annually, which is manufactured into various kinds of interior and exterior finish.



S. A. Wood Inside Moulder, Driven by 25 H.P. Fairbanks-Morse Motor.

This plant formerly operated its own power plant, but after being destroyed by fire, installed entire new woodworking machinery, operated by motors in the most up-to-date style of drive. Practically, all the machines are direct-connected as shown in the schedule following.

All motors are of the Fairbanks-Morse manufacture, and are 3-phase, 440-volt, 60-cycle. The total horse-power of motors installed is 294, of which 246 H.P. operates on individual drive, and 48 H.P. on group drive as shown in schedule.



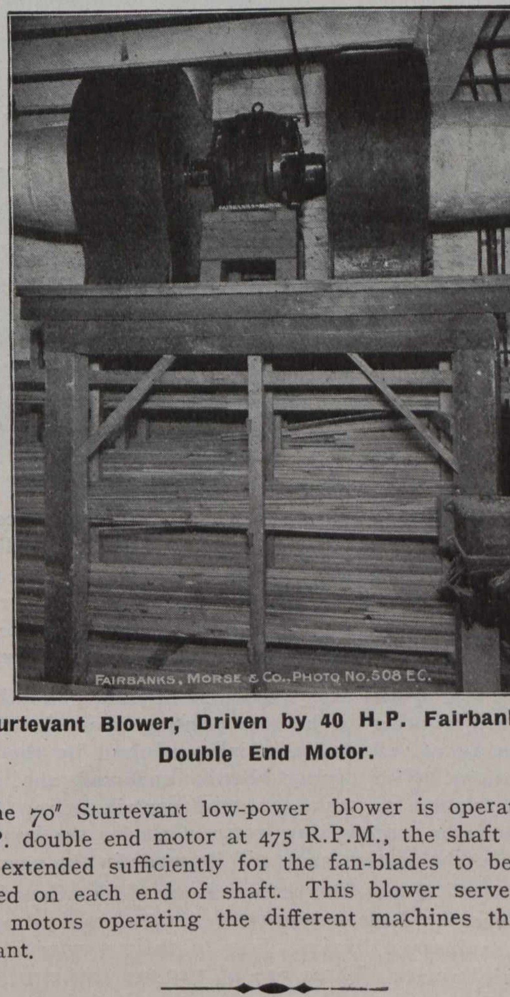
30 x 12 Double Surfacer, Driven by 20 H.P. and 7½ H.P. Fairbanks-Morse Motor.

The principal points of interest in connection with the electrical equipment of this plant is the extreme limit of speed, which is rather unusual for this class of motor. The planers have the motors directly attached to the cylinders, motors operating cylinders at a speed of 3,600 R.P.M., motors being directly connected through flexible couplings.

The double surfacer shown in cut is operated by a 20 H.P. motor at a speed of 3,600 R.P.M., direct connected to the upper cylinder through flexible coupling. The lower cylinders of this machine is belted to a 7½ H.P. 1,750 R.P.M motor.

While there are some few cases where the planer cylinders are operated by induction motors direct connected to cylinders, the direct connecting of motor to the cylinder of the double surfacer is entirely new in this territory, and is proving successful and is giving most excellent satisfaction.

The triple drum sander is driven by a 20 H.P. 570 R.P.M. motor, direct connected through flexible coupling to the countershaft on machine.



70" Sturtevant Blower, Driven by 40 H.P. Fairbanks-Morse Double End Motor.

The 70" Sturtevant low-power blower is operated by a 40 H.P. double end motor at 475 R.P.M., the shaft of motor being extended sufficiently for the fan-blades to be directly mounted on each end of shaft. This blower serves readily fifteen motors operating the different machines throughout the plant.

PORT MANN NOT TO BE OCEAN TERMINUS.

Port Mann will be the train assembling centre for the Pacific section, says Sir Donald Mann, at Vancouver. It will be an available centre for the distribution of coal and other freight into the interior, but it will not be our ocean terminus. "We will have our car repair shops and our assembling yards at Port Mann. In all the chief cities of Canada the railways are moving their assembling yards out some distance from the centre of the city. This is being done for several reasons. For one, inside property is too expensive, and another the smoke nuisance caused by shunting has caused many complaints. Most of the yards in Toronto are now five or six miles away from the Union Station. The Grand Trunk has moved its yards out to Mimico and we are moving out also."

COAST TO COAST.

Hamilton, Ont.—The population of this city, according to the latest census, is 89,000, and the assessment $67,000,000.

Moose Jaw, Sask.—The work on the new C.P.R. dam on Manitoba Street East is progressing slowly, but steadily.

Fort George, B.C.—Recently discovered copper deposits found to the west of this town are causing considerable activity among miners residing here.

Winnipeg, Man.—Surveys have been started in order that the line of a proposed railway, to be known as Canada to the Sea, and extending from this city to the Gulf of Mexico, may be ascertained.

Vancouver, B.C.—Vancouver business men, including a few in the immediate surrounding country, have purchased pleasure yachts from Seattle parties, during the last two years, to the amount of over $250,000.

Montreal, Que.—The Canadian Pacific Railway has arrived at an agreement with the owners of the collier Helvetia, which was sunk in the St. Lawrence by the Empress of Britain on July 27th last, and have paid them the sum of $300,000 as compensation.

Ottawa, Ont.—A delegation representing the National Builders' Exchange waited upon Hon. W. T. White with a demand for an imposition of higher duty on every kind of building stone, save rough quarry blocks, coming in from the United States. Consideration was promised the delegates.

Ottawa, Ont.—The medical health department of this municipality recently added a dose of hypochlorite to the water about six times stronger than ordinarily prescribed, and advised the citizens to allow their taps to run in order that the mains might be sterilized. In conjunction with this all dead ends of mains were opened.

Nelson, B.C.—Experiments to show the existence of the platinum group of metals in the ores of the Granite-Poorman mine have been commenced by A. Gordon French and his son, Thomas French, before W. Fleet Robertson, provincial mineralogist. The demonstration is taking place at the Granite-Poorman mill and will probably occupy several days.

Montreal, Que.—The students attending McGill University are working to have a printing press installed for the printing of all the materials required by the various organizations. The faculty heartily endorsed the scheme, but were unable to make financial contributions; the students, however, are making every effort for the installation, and it is probable that such will be made in the near future.

Montreal, Que.—The management of the Canadian Express Company have inaugurated a new era in transportation of expressage by installing to their service a number of electric trucks. Three are of two-ton capacity and two of one-ton capacity. They have a speed of from 10 to 12 miles an hour, which is more than double the efficiency of the old horse truck, and will travel for 45 miles on a single charge. The large vehicles are 166 inches in length over all and 76 in width. The others are 149 inches in length and 72 in width, respectively.

Winnipeg, Man.—Thirty-eight tons of foodstuffs of all kinds was condemned and ordered destroyed by the city health department during September, according to the monthly report submitted to the committee. The largest item was fruit, of which 31 tons was seized. Five tons of vegetables and half a ton of canned goods were the other largest items. During the month the dairy inspectors made 471 inspections 131 milk samples and 4 cream samples were taken for analysis. One prosecution for milk below standard and one for cream resulted and convictions were obtained in each case. Seven cows were tested for tuberculosis and all passed. Over 100 samples of water were taken for analysis.

Ottawa, Ont.—The Department of Trade and Commerce is issuing a circular letter to the principal boards of trades throughout Canada, asking for information on the possible development of natural resources in each locality. This information, when obtained, will be forwarded to the Imperial Royal Commission, which is now in session in England, with Hon. G. E. Foster as a member. The letter asks for details as to what industries could be suitably developed to work up raw materials which are already produced under profitable conditions, and as to existing obstacles in lack of capital, labor or means of transportation hitherto preventing development of these industries.

Montreal, Que.—A company has been incorporated under the Dominion Companies Act with the title, Siemens Company of Canada, Limited, who will act as sole representatives of the "Associated Siemens Companies" in Canada. The head offices of the new company will be situated in the Transportation Building, Montreal, and the existing offices in Toronto and Winnipeg will be taken over in due course as branch offices. Mr. Arthur S. Herbert, the present Canadian manager, has been appointed general manager; Mr. J. W. Brooks, manager of the Toronto office, and Mr. C. W. Stokes will continue, as hitherto, manager in Winnipeg.

Spokane, Wash.—Plans for the entertainment of delegates to the fifteenth Annual Convention of the American Mining Congress, which meets in Spokane, November 25th to 29th, include a big excursion to the Coeur d'Alene district in Idaho. Civic bodies and owners of the great lead producers will join in perfecting arrangements that will throw the entire district open to inspection. Trips will be made through the big tunnel of the Bunker Hill and Sullivan mine to some of the immense stopes now being mined; to the Morning and other properties of the Federal Mining and Smelting Company, and to the Hercules at Burke. It is expected that fully 500 visitors will be transported on the special train that is scheduled to leave the city early on the morning of the last day of the week. The return will be made either Sunday evening or Monday morning.

Niagara Falls, Ont.—An attempt was made to run a car over the new girder rails laid by the N.S. and T. on the curve at the corner of Erie Avenue and Bridge Street, with the result that one of the large St. Catharines cars was almost derailed. The test showed that the gauge of the track is too wide, the flange of the car wheel which should engage with the flange of the rail being more than an inch from true, and it is probable that the work will have to be done over. The track at that point is entirely completed, and the tearing up and relaying of the rails will involve great additional expense and loss of time. The rails are laid on steel ties, which are firmly embedded in concrete and brick, making it a difficult task to tear them loose. The rail is of the girder type, but different to the rail approved by the city council, in that the flange is narrower, leaving no room for free play of the car wheel flanges. The rail approved by the council had a wider flange and does not turn up at such an acute angle.

CORRECTION.

In the issue of *The Canadian Engineer* of October 10th, page 589, in the article on "Briquetting Bituminous Coal," the statement was made that the Inverness Railway and Coal Company are installing a briquetting plant at Inverness, C.B. The context would lead the reader to believe that this plant is of Belgian manufacture. Our attention, however, has been drawn to the fact that this plant is of English make, and we are therefore glad to make this correction.

ESTIMATORS AND ENGINEERS.

Attention is called to the card on another page of this issue of a new engineering firm in Toronto.

The firm, Kortright & Greene, estimating and quantity engineers, will undertake estimating, taking off quantities from plans, foundation reports, supervising, and all branches of engineering for contractors and engineers. There is undoubtedly a great necessity here for such a firm, and the idea of technically trained men with practical experience in this field work, deserves the hearty encouragement of all. Both members of the firm have had wide engineering experience, which, combined with their technical training, thoroughly qualifies them for such work.

PERSONAL.

MR. GEO. WRIGHT, City Engineer of London, Ont., has tendered his resignation to the City Council.

MR. WM. WORTHINGTON, B.A.Sc., has been appointed assistant engineer in charge of sewers for the city of Toronto.

Mr. E. M. HAMILTON is at Cobalt, engaged in completing the new Nipissing mill, which will shortly be put in commission.

DR. WILLIAM B. MUNRO, a native of Almonte, Ont., has been appointed Professor of Municipal Government at Harvard University.

DR. REGINALD A. DALY, a native of Napanee, Ont., has been appointed to the head of the Geological Department of Harvard University.

MR. JOHN P. WAGNER, sales-manager of the Consolidated Expanded Metal Companies, of Pittsburg, Pa., was a visitor to Toronto last week. It will be remembered that we noted in a recent issue that Messrs. Alfred Rogers, Limited, had obtained the exclusive selling-rights in Ontario for the expanded metal manufactured by the above firm. Mr. Wagner is a graduate of the University of Berlin, Germany, and has had a great deal of experience both in engineering design and construction. His work has been located both in Canada and the United States, the Simpson and Globe Buildings in Toronto being representative of the work done here.

John P. Wagner.

MR. G. I. EVANS, Mechanical Engineer of the Canadian Pacific Railway, Montreal, Que., has been appointed Superintendent of the locomotive shops at Angus, Montreal.

MR. J. D. SHIELDS, B.A.Sc., assistant engineer in charge of sewers for the city of Toronto, has tendered his resignation. He is going abroad for a short trip and will then look after his private interests which have necessitated the city's employ.

MR. G. HALL SCOTT, of London, England, and MR. ALBERT BROOKS, Montreal, representatives of Sir John Jackson, Limited, of Edinburgh, are in Victoria to look over the site and complete investigations on which to base a tender for the work on the breakwater.

MR. ALEXANDER ALLAIRE, until recently the manager of the Foundation Company, Limited, with headquarters at Montreal, has been appointed the manager for Western Canada of the Foundation Company, with headquarters at Winnipeg and New York. Mr. R. Chadwick, who was Mr. Allaire's chief assistant at Montreal, steps into the managership of the Montreal office. The western interests of the company have developed to such an extent that it became necessary to open the office in Winnipeg.

Alexander Allaire.

Mr. Allaire is of French descent, was born in Brooklyn, N.Y., and received his engineering education at the Stevens Institute of Technology at Hoboken, N.J. He graduated in mechanical engineering in 1901, and, after four years of practical experience in mechanical work, he joined the Foundation Company in the United States. About two years ago this company decided to start an independent Canadian company. A Federal charter was obtained, and Mr. Allaire was selected as manager of the Canadian company, with offices in the Bank of Ottawa Building, Montreal. A number of important works have been carried out by the Foundation Company, Limited, during the past two years, and the opening of the western office is a natural result of the increased amount of work which has developed in Western Canada.

DR. FRANCIS W. MERCHANT, director of Technical and Industrial Education of Ontario, has gone on an extended tour to Europe to study the technical-school systems in operation there.

MR. J. H. CUNNINGHAM, recently resident engineer, has been appointed superintendent of Extension colliery, in British Columbia, owned by the Canadian Collieries (Dunsmuir), Limited. He succeeds Thomas Russell, resigned.

MR. FRANK KOESTER, Consulting Engineer, has removed his office from 115 Broadway to 50 Church Street, New York. Mr. Koester recently finished the plans for a central asphalt repairing plant of 3,000 square yards daily capacity, for which he was retained by the Borough of Manhattan.

MR. W. F. TYE, President of the Canadian Society of Civil Engineers, has been appointed by the Government to investigate work done in the construction of the National Transcontinental Railway under the old commission. An investigation has been in progress for some months by

George Lynch Staunton, K.C., of Hamilton, and F. P. Gutelius, formerly with the C.P.R.

OBITUARY.

MR. PETER ARNOT, proprietor of the firm of Peter Arnot and Son, is dead; he was well known in engineering and contracting circles. Among the important works executed by him are the sea walls at Sunnyside and the Exhibition grounds in the city of Toronto and the lake front at Hanlan's Point, Toronto Island. He was born at Ashburnham, near Peterboro, in 1849. He entered the contracting business in 1875 with Mr. Charles Robertson as partner; this firm was dissolved in 1905 and Mr. Arnot took over the entire business. He is survived by a widow and several children.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—General Section Meeting will be held in the Rooms of the Society, 413 Dorchester Street West, Montreal, Oct. 24th. Chairman, Henry Holgate.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary. Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan Kennedy. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre: Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke, Pipestone, Man.: Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.