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MISSING

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WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

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TORONTO, CANADA, NOVEMBER 19, 1909.

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ACCIDENTS.

The question of ensuring the safety of life and limb is one that should enter into the engineer's design and the workman's execution. It is just as much a part of construction as of operation. No opportunity for increasing safety should be neglected. As man to man we owe this to our fellows, and on the plane of industrial conditions the prevention of accidents is a good investment.

The Fidelity and Casualty Company, of New York, in a recent publication, entitled "The Prevention of Industrial Accidents," points out with great emphasis that by far the larger number of accidents are due to negligence—negligence sometimes only by the one who suffers.

The absolute prevention of accidents is impossible; yet there is a wide field for work, and by inspection, legislation and co-operation the waste may be much reduced.

The employer has his part to do. He must provide suitable surroundings, pure air, sufficient light and plenty of room. A man working under good, healthy conditions will be less apt to blunder than the over-worked, crowded, sickly individual, with little interest in what he is doing or what he does.

The employer should also provide well-designed machinery, hoists, scaffolds, or whatever his men are working with or on. It is his duty to see they are working in guarded surroundings. They give their time and energy and thought to him—for a price. He does well to include in that price a care for their safety. He knows what is required of them, and will not allow a workman through ignorance to suffer. New men require careful instruction, followed by wise supervision. It may be all true that a man's value increases as the want of supervision decreases. But knowledge must be gained before the workman becomes careful and prudent. Sometimes he becomes an expert by imitation, sometimes by reflection and experience. But instruction is necessary.

ENGINEER'S SKETCH BOOK.

Every engineer who aspires to advance in his profession should learn to sketch—all the better if he can sketch rapidly and with good taste. It is just as necessary for the engineer to be able to make an accurate, understandable sketch as it is for him to be able to write a good letter or furnish an understandable drawing.

Drawing is a universal language, in picture, in cartoon, in plan. It conveys ideas practically impossible with the spoken or written word.

Aside from the training that comes with the clear thinking necessary to produce a good sketch, the engineer is preparing a record which will preserve permanently the information he or his chief may require.

A good sketch will suggest ideas and furnish information at a glance that pages of written matter will not convey. It places the whole situation before the eye so that the mind may quickly grasp the idea.

A companion to the sketch book is the camera. We have in mind an exceedingly interesting and valuable report on an hydro-electric proposition, in which was incorporated a photograph of the power house site and a neat sketch of the power house and dam. It conveyed at once a good, general idea of the location, and gave some suggestions as to the possibilities of the scheme.

A sketch book and camera are almost as necessary to the engineer to-day as the chain and compass.

EDITORIAL NOTES.

Last week the report of the Dominion Railway Board was laid on the table of the House of Commons by the Minister of Railways and Canals. In referring to accidents on Canadian railways, it gives a list of 438 persons killed and 1,201 injured during the year ending March 31st, 1909. Of the killed, 26 were passengers, 191 employees. The balance—almost one-half of the total—were trespassers. Truly, the public must be protected against their own folly. And yet when the railways prosecute, in the public interest, the trespasser, long and loud is the protest.

* * * *

The fearful, and, we trust, truly accidental catastrophe that occurred on a British Columbia electric railway recently is sure to raise the whole question of the operation of trains of cars on roads with very steep grades. We have Canadian electric roads hauling two, three or four cars of freight on grades as high as 10 per cent. and all the train crew located on the motor car. A following car breaks away, and there is no one to check it until much damage has been done. Ordinary good sense prevents the motorman following such a train from approaching very closely, yet there are many situations where his caution will not protect. Long grades, curves, obstructed view, and darkness, make it impossible for him to ward off all danger from runaway cars. Legislation should require efficient brakes and sufficient and properly located crews on all trains, whether the lines be trunk, urban, suburban or interurban. Only a kind Providence delayed so long such a fearful accident as that of last week. Let the warning be heeded.

THE TRAINING OF AN ENGINEER.*

"Once we fully grasp the fact that it is impossible in any university course to accomplish more than a part of the preliminary training of the engineer, and that the work of the university school is not to make engineers, but to fit men in the best way possible to become engineers, we find stress should be laid, in a college course, on principle and not on the innumerable details in engineering practice."

The text I have quoted is, I believe, a correct one; but the application thereof will lead to a wide variance of opinion. I think the engineering student should know his Arithmetic, Algebra, Geometry and Trigonometry, Analytical Geometry and Elementary Calculus, Applied Mechanics and Strength of Materials, Physics, Chemistry, Mineralogy and Geology, the rudiments of Metallurgy, Biology and Silviculture. He should have a sufficiently thorough acquaintance with English Literature and Language to be able to keep in touch with the best thought of the age. To this same end he should read Ethics and Natural Law, Psychology and First Principles of Knowledge, Political Economy, and have a rudimentary knowledge of Latin and Greek, and of at least one foreign language, preferably French. A knowledge of the Law of Corporations and Contracts and Real Property is also essential.

So far I have not dealt with much of a technical nature. His fourth year might be specifically devoted to Stresses in Structure, Design, etc. But the summer is the best time in which to familiarize him with practical work; the college cannot teach it, and ought not to try, in my view of the best course.

Of course, technical books are in use which cover the ground fully. Too much reliance should not be placed upon the formal lecture. I should require the student to get up his text and "quiz" him upon the work; the teacher would merely explain difficult points. The "quiz" not only brings out the student's ability to answer questions, but serves the more important object of training him to express correctly what he means. Incidentally, a "quiz" puts the entire class on the qui vive, and is the best means of impressing principles on the mind.

I think the teacher should select actual cases from time to time and place them before the class, requiring each student to work out his own solutions. In practice the problem, when it arises, is never before the practical man as a problem in Mathematics, Physics, or some other subject with a well-recognized source for solution, as is usual in the examples in the back of the text book. The data are all mixed up. Where am I to look for inspiration, to what branch of my studies does the matter belong? The thing needed is the educated mind. If I were to say there is too much instruction and not enough education, I should express about what I mean.

* M. J. Butler, Deputy Minister of Railways and Canals and chairman of the Intercolonial Railway Commission, in "The University Monthly."

COMING MEETINGS.

American Society of Refrigerating Engineers.—December 6. Annual meeting in New York City. Secretary, Wm. H. Ross, 154 Nassau Street, New York City.

New Jersey Sanitary Association.—December 3-4. Annual meeting at Laurel-in-the-Pines, Lakewood, N.J. Secretary, J. A. Exton, 75 Beech Street, Arlington, N.J.

Montana Society of Engineers.—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton H. Moore, Butte, Mont.

American Institute of Chemical Engineers.—December 8-10. Annual meeting at Philadelphia, Pa. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

American Association for the Advancement of Science.—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

American Society of Agricultural Engineers.—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

Association of American Portland Cement Manufacturers.—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia, Pa.

METHOD OF CALCULATING HORSE-POWER.*

The engineer often finds it necessary to utilize an available waterfall or stream for power purposes. But before the wheels, turbines, or whatever method of developing the power, are installed, he must know the horse-power of the stream or fall.

The problem of calculating the horse-power of a waterfall or running stream is reduced to a simple formula, which any miner of ordinary intelligence can work out. It is based on the assumption that a horse-power is equal to 33,000 pounds lifted one foot per minute. This is the basis used in computing horse-power in any type of power developing machine. It is really more than the average horse is capable of, rather than less, as is generally supposed, the horse being able to lift only 22,000 pounds one foot per minute.

On this basis, however, that of 33,000 pounds lifted one foot per minute, the horse-power of a waterfall or stream is found by multiplying together the number of cubic feet of water which fall per minute, the vertical height or "head" in feet through which it falls, and the number, 62.3, this being the weight of a cubic foot of water in pounds; then divide the product of the whole by 33,000 Reduced to a formula, the problem appears as follows:—

$$\text{Horse-power} = \frac{\text{Cu. ft. per Min. x Vertical ht. ft. x 62.3 pounds.}}{\text{33,000-ft. pounds.}}$$

To better explain this formula, let an average case be supposed: Over a fall 20 feet high 1,000 cubic feet of water is discharged per minute. This problem would take the following simple form:—

$$\frac{\text{1,000 cu. ft. x 20 ft. x 62.3}}{\text{33,000-ft. pounds.}} = \frac{124,600}{33,000} = 40.71$$

horse-power.

It will be observed that to use this formula the miner must know the amount of discharges of the waterfall in cubic feet per minute. This, however, is not difficult to ascertain. By careful observations the cross-section area of the fall is learned and computed; this is then multiplied by the rate or velocity of the fall in feet per minute. This will give the number of cubic feet of water discharged per minute. In this, as in all other problems of like nature, the results are only approximate; but the main idea is to be as accurate as possible in making observations and securing data. It should be remembered that the formula itself is right; if errors occur, it must either be in the observations or in the final calculations.

The power of the waterfall will be developed by a breast-wheel, overshot, turbine or other type. But whatever the type, there must necessarily be considerable loss. Even though the miner has been careful in his observations, and has correctly calculated the horse-power by the above rule, he must allow for loss in the selecting of the wheels. Thus, an undershot realizes only one-fourth or, at best, one-third the actual power of the fall; a breast-wheel realizes one-half; an overshot wheel from two-thirds to three-fourths; a turbine from 0.75 to 0.87, and even as high as 0.90 of the fall, depending upon the skill of workmanship in manufacture and the manner in which it is installed. While an undershot or breast-wheel costs less to place, unless the miner has "water to throw away," it is far cheaper in the long run to place a good overshot wheel or a turbine.

Sometimes the miner wishes to utilize the power of a running stream, and would like to know how much it is capable of developing. To make these calculations it is presumed that the stream is confined at its point of proposed use to a flume of known dimensions. As the stream must be so confined before the water-wheel is placed, the estimates or figures for such conclusions will not be difficult to secure. About the only type of wheel that can be used in developing the power of a running stream is that with simple float-boards, instead of buckets or flanges. Thus, the wheel is driven by the ordinary or natural current of the stream without any appreciable fall like that in the preceding case. To apply the formula already given in calculating the water power of a running stream, the miner should first learn the virtual head, or rate of flow of the current. This is done by using floats, and by taking a number of observations between given points, "time" the speed of the floats and learn the velocity of the stream in feet per minute. Having thus found the head, the miner must next find the quantity of water which passes any given area of the stream in a minute. Thus, to use an average case, let it be supposed that the velocity or rate of flow of the stream is 250 feet per minute, and that the immersed part of the water-wheel float is 6 feet long and 1 foot wide or deep; then the area of the part of the wheel which receives the force of the current is 6 by 1, or 6 square feet. Hence, the formula for finding the cubic feet per minute would be in this case:—

6 sq. ft. x 250 ft. per min. = 1,500 cu. ft. per min.

The vertical height, or head of a running stream would virtually be the "grade" of the stream for a 10-foot section, or merely that portion used where the wheel is installed. In average cases this would amount to 0.19 or 0.2. Thus with the cubic feet of discharge per minute ascertained, and the head known, the miner will then proceed to find the horse-power by the formula given above for waterfalls. To use the case just cited, the results would be as follows:—

$$\frac{\text{1,500 cu. ft. per min. x 0.19 vert. ht. in ft. x 62.3 pounds.}}{\text{33,000 ft. pounds.}}$$

= 0.54 horse-power.

In a running stream, as in a waterfall, there is considerable loss when the utilization of its power be attempted. As but one type of wheel can be used, it is estimated that this loss in running streams is 0.6; that is, the wheel actually realizes only 0.4 the actual power of the stream. Hence, in the case just given the power developed would only be 0.54 by 0.4, or 0.216 horse-power. Multiplying this by 33,000 foot-pounds, it will be found that the wheel would be capable of lifting 7,128 foot-pounds per minute. But a rough allowance would still have to be made for friction of the journals, cutting the actual power of the wheel down to 7,000 foot-pounds per minute, which would be very close to what such a wheel, driven by a current of this velocity, head and size would develop.

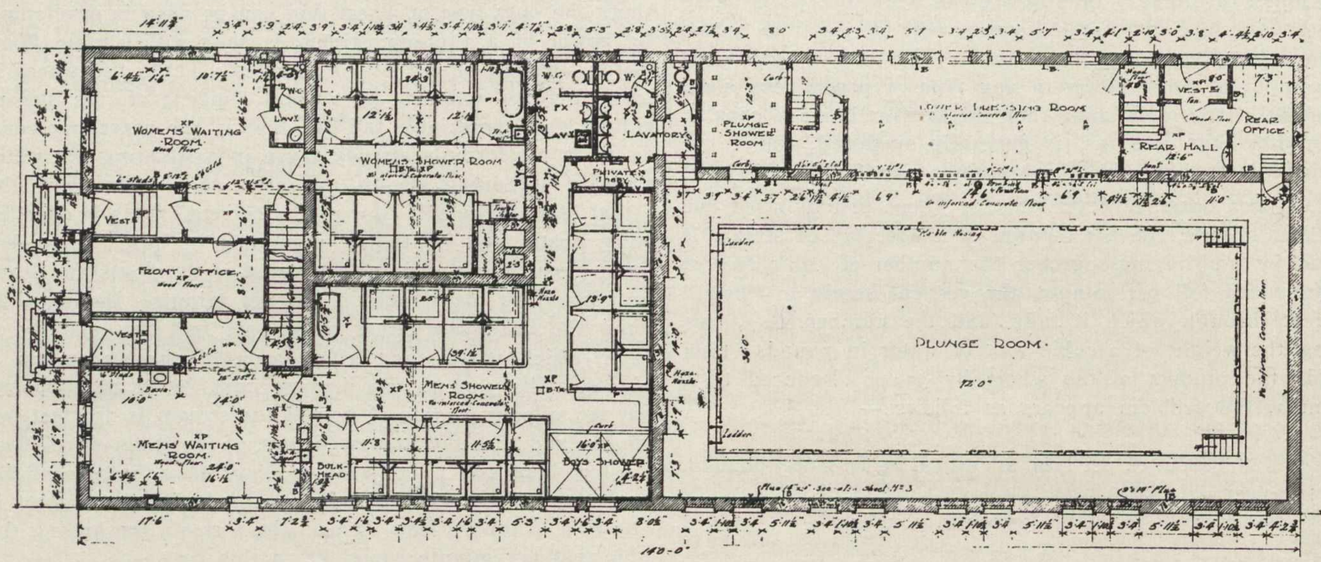
In measuring the velocity of a running stream, the miner should not make his calculations upon the surface speed of the current. The usual method, and that most likely to give average results, is to use a float which is submerged to a depth of one-half the width or depth of the wheel paddle; that is, if the paddle of the wheel dips into the water one foot, the float for estimating the velocity of the current should be submerged six inches.

*Abridged from an article by Dennis Stovall in The Mining World.

HARRISON BATHS.

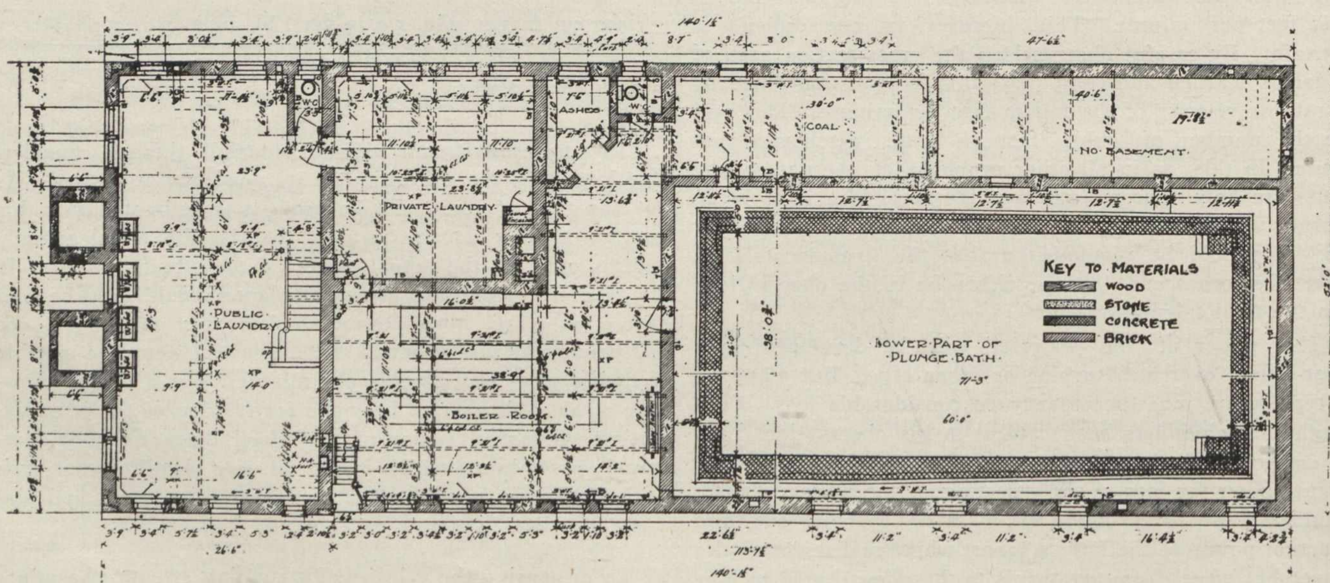
Handsome Institution Recently Established by the City of Toronto.

A welcome innovation in the history of the city of Toronto was marked by the erection and the completion, this month, of a public bath-house.



FIRST FLOOR PLAN

From the accompanying illustrations may be formed some idea of the structure, which cost $46,000, and has a frontage of 52 ft. 3 in. on the south side of Stephanie Place by a depth of 140 ft. 1½ in. It is of brick, stone, and concrete, the front portion for a depth of 26 ft. 6 in. being two-storey and basement, the balance one-storey and basement, but owing to the fact that the shower and plunge rooms are spacious and lofty, the elevation is practically uniform throughout.



BASEMENT PLAN

Concrete was used exclusively in the construction of the swimming pool which was waterproofed with a water-repelling compound mixed at the same time as the concrete. The interior walls and divisions of the showers are of Italian marble, while glazed tiling is also extensively used. The floors are of reinforced concrete. A key to the materials of construction is given in the accompanying plan of the lay-out.

The operation of the institution is under the direct supervision of Mr. Roland C. Harris, the property commissioner, who, in 1906, investigated the question of establishing baths, and, in his report said:—"I cannot too strongly recommend the erection of a public bath house. When first instructed to look into the question, I regarded it largely as a philanthropic fad, but, after viewing its offices and work, was thoroughly imbued with the absolute necessity of its creation and existence."

Cost of Maintenance.

Appended is a reliable estimate of the cost of operating the plunge from 2 p.m. to 11 p.m. daily (Sunday excepted), and the showers from 9 a.m. to 6 p.m. daily, with the exception of the Sabbath, when the hours will be 9 a.m. to 12 noon:—

	Rate per Annum.
Superintendent (with free living quarters, heat, light, water, etc.)	$ 700 00
Female attendant	500 00
Instructor	1,200 00
One ticket seller	624 00
Three cleaners and attendants	2,184 00
1st engineer	1,000 00
2nd engineer	900 00
Coal, 400 tons at $6 per ton	2,400 00
Oil, repairs, etc.	300 00
Towels, soap, etc.	300 00
Lighting, power and gas	800 00
Miscellaneous	500 00
	$11,408 00

Swimming Pool. Note Reflection in Water.

The estimated cost of operating the baths sixteen hours daily, from 7 a.m. to 11 p.m., is $16,592 per year.

Lay-out of Building.

The building, for practical purposes, is divided into two sections. The front portion with a depth of 66 feet, contains an office, separate waiting room for males and females, with lavatory accommodation. In the women's shower department are eight showers and one bath tub, the latter for aged and sickly people and infants. In the men's section are fourteen showers, tub and two gang showers for boys. The showers are of the non-scalding type—the cold water being first admitted to the mixer.

The rear section of the premises has a depth of 74 feet, and contains office, plunge room 72 ft. by 36 ft., locker rooms, lower and upper dressing rooms, balcony and plunge showers. The pool is 59 ft. long by 26 ft. wide, with a maximum depth of 8 feet and a minimum of 4 feet, and contains about 62,000 gallons of water, which is changed daily and kept at an approximately uniform temperature of 78 degrees Fahrenheit, by two 50 horse-power, horizontal return tubular boilers, built by the John Inglis Company, of Toronto. Each boiler is 48 inches in diameter, and 14 feet long, and contains 52 three-inch tubes. The shell of the boilers, which were designed to carry a working pressure of 100 pounds, is five-sixteenths thick, and the heads three-eighths.

In conjunction with the heating apparatus, "Tobey" heaters were supplied by The J. L. Mott Iron Works, of New York City.

There are one hundred lockers and two hundred bathers have been accommodated at one time. The public showers are absolutely free, and each patron is provided with soap and towel. A charge of ten cents is made for use of plunge Each bather is provided with a towel, but must furnish his own bathing suit or trunks.

Before admission to the pool, every person is compelled to take a shower bath. The Corporation reserves the right to deny to any person the use of pool upon repayment of admission fee. In this way those filthy of person, and others suffering from skin diseases are debarred.

The City has retained a well known physical instructor to furnish lessons and advice to bathers, and the baths are daily increasing in popularity. During the first week they were used by nearly two thousand persons. On Saturday, November 6th, 795 used the plunge, while 304 used the showers.

The establishment of the baths is due to the untiring efforts of Controller Dr. William S. Harrison, from whose address at the formal opening we quote:—

"The way to cleanse the masses is to cleanse the individual, and to make a man clean in person is to inspire him with a desire for clean surroundings. Uncleanliness of person leads to toleration of filth and unsanitary conditions at home. A man with a clean and healthy body is more likely to have a clean and healthy mind, and one who respects himself is more likely to respect the rights of others. The public bath is local in effect but national in influence. A public bath is a working monument typifying the community's appreciation of civic health and cleanliness."

MODERN ROADMAKING.*

By W. W. Crosby, Chief Engineer, Maryland Geological Survey.

Since the beginning of the first efforts for artificially constructing a road surface on which to travel repeatedly with animals or vehicles, man has been at work for centuries trying to put down "something which would stay put." The necessity for constantly and frequently doing over again something already done has been universally regarded as irksome and uneconomical. Certain results of use have been, temporarily perhaps, regarded as unavoidable and the restoration of these defects has been accepted with a certain amount of resignation by the majority of the workers. The futility of other common burdens has been generally recognized, but the bearing of them has frequently been accepted because the local conditions seemed to prevent their avoidance. The brighter minds and more progressive among the road workers have however, as to-day, recognized that the reduction of the burdens of road maintenance was a goal at which to aim and have laboured unceasingly and with much success towards it.

Improvements in connection were first made perhaps by the substitution of a stoned surface for that of the natural soil, with the object of avoiding, to some extent at least, the annoyance and expense of the more frequent attention required by the latter. This was followed by improvements in the methods of applying the metal that would not only result in a surface that such would prove more satisfactory from every point of view, but also would reduce the first cost. It should, of course, be clearly understood that main-

* Paper given before the Convention of Roadmakers at Columbus, Ohio.

tenance costs include a proper consideration of the initial expense or "investment," as well as the actual charges for performing the repairs themselves.

Possibly the erection of bridges and waterways came next in the line of progress and then improvements in the methods and the selection of materials for their construction.

Later was inaugurated such a consideration of the traffic and its resultant strains on the road as would tend to result in a permissible reduction in the amount of the "investment," without danger to the satisfaction with the result, and as would still further reduce the maintenance charges by a reduction in the factor of interest on the investment.

At the present time, the latter item is perhaps uppermost in the minds of highway engineers. A proper consideration of the amount and character of the traffic on a road is the basis for an accurate determination of the kind and amount of work to be done on it, and an essential also in this connection is an accurate record of the costs of repairs under known conditions of the locality, of the construction, and of traffic.

In 1907 the writer, after considerable investigation, was impressed with the unfortunate lack of knowledge on the part of highway engineers generally, concerning the amount and character of the traffic over those sections of modern roads where otherwise important conclusions might have been drawn because of the completeness of the records of the details of their construction, but from the lack of this information regarding traffic, where actually the most valuable conclusions were lost, and he then suggested in a published article the desirability of obtaining, and recording for the general benefit, detailed data of this sort. He desires here to express his cordial appreciation of the work that has since been done in this line by Messrs. Johnson of Illinois, Blanchard of Rhode Island, and by the Massachusetts Highway Commission and others, and to express his belief that the results of their work will be greatly appreciated by all highway engineers. Without just such data in connection with the records of the construction of the roads themselves, it would be impossible to prove the value of the methods of construction used, or the real value of the investment made, to say nothing of drawing a fair comparison in maintenance costs.

Just at this period, it seems to the writer that the profession of highway engineering is undergoing a greater transition than ever before. With the awakening of its importance as a branch of the science of engineering has come almost simultaneously a wonderful change in the traffic conditions to be met. It is to be regretted again that records of previous traffic conditions are not available for purposes of comparison, and the best that can be done now seems to be to secure without loss of time these records from such places as have experienced to the least extent the change mentioned.

Under the new traffic conditions, previously accepted standards seem to be unfit for following and new ones seem desirable. Many minds are at work on the problem and undoubtedly it will soon be solved. The writer believes that the solution will not only meet the new demands, but will also result in even greater economy than existed in many cases previous to the change in the traffic.

The writer wishes to call attention to what he believes an important point in this connection. He regrets the tendency apparent in some quarters to throw away, in view of the recognized agreement that even the best water-bound "macadam" is unfit for the new traffic conditions, all the carefully arrived at conclusions regarding its construction and to start entirely afresh with some, at least, new materials, ignoring the work of many years. He believes such a course most unwise and that there are still many of the old principles that should be firmly adhered to. Admitting the introduction of a cementing medium to the broken stone aggregate as necessary for modern work, it by no means follows that the original principles of proper foundation, sufficient drainage, etc., etc., can be ignored simply because of the presence of this cement. On the contrary, any departure from these fundamentals should be most carefully considered and only made continuously. The reduction to the minimum of the voids in the "metal" is as important now, if not more so, as ever before.

It may quite likely be true that the sizing of the pieces of metal may be advantageously modified to secure better results and to partially, perhaps, offset the cost of the introduction of the cement, but it is just as likely that even greater care will have to be exercised in the performance of the sizing. It is probable that readily available materials, heretofore excluded from use because of their lack, for instance, of cementing qualities, will be made available for the use of the cement, but it is also likely, as has been suggested by Secretary Fletcher of the Massachusetts Highway Commission, that even greater care will have to be exercised in the selection of the metal in order to provide for future traffic changes induced by the new road surface itself, and that materials heretofore successfully used will henceforth have to be rejected. Let us "hold fast to that which is good" and try to develop, rather than to attempt to create just at this time, and until the information referred to as desirable in the matter of traffic conditions, and new data now being collected concerning the character, use and results of the cement media, are available.

An apparent tendency, in certain instances, to abandon all previous conclusions as to construction methods and materials, and further to issue a dictum that future work should all be done along certain lines seems to the writer regrettable and inopportune. It seems to him that conclusions along general lines will be attainable in the near future, though of course it should go without saying, allowances will always have to be made for local conditions, but that in the meantime, much work will have to be done and a large amount of information from many sources will have to be secured.

CONCRETE WEAKENED BY HEAT.

That the builders of reinforced concrete structures have room for some improvement in their methods, is evident from a report made by Mr. G. A. Stange, adjuster for a Chicago firm. It concerns a loss on the reinforced concrete building of F. B. Klock at South Elgin, Ill., used for the manufacture of drugs. The adjusters contended that the concrete floors and ceiling were not damaged sufficiently to be torn down, but the owner claimed that the concrete had been weakened by the intense heat, about 60,000 pounds of drugs having burned.

It was decided to test the building by putting a weight of 400 pounds to the square foot on the panels, which were to be held defective if they deflected more than 3-16 of an inch, that being the original test made by the architect when the building was turned over to the owners. Tests were made of eight panels involved in the fire, all of them showing considerably more than 3-16 of an inch deflection with only 250 pounds weight to the square foot. When the same weight was applied to panels in other portions of the building not affected by the fire the deflection was less than 1-10 of an inch. In consequence a total loss was allowed on six panels and a compromise on two.

The adjusters hold that had the building been of any other construction than concrete it would have been totally destroyed, owing to the tremendous heat engendered by the drugs burning. The expansion of the reinforced steel under the intense heat is believed to account for the weakening of the concrete.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

SEWAGE SLUDGE AND SEPTIC ACTION.

The Canadian Engineer of December last year published a review of the fifth report of the Royal Commission on Sewage Disposal, in which the following statement relative to septic tank treatment was made: "The conclusions of the Royal Commission appear to point to the advisability of some improvement to the septic tank as now used. The only point in its favor in comparison with other methods appears to remain in the fact that a percentage of the sludge is dissolved by putrefaction and hydrolysis. The main point against the system is that the 'liquor' is not constant, and that the suspended solids in the effluent increase in the event of the sludge being allowed to collect. This suggests that if it is desirable to eliminate sludge by putrefaction, then the putrefactive process should take place apart from contact with the liquid sewage. This might be done by withdrawing the precipitated sludge immediately from the sedimentary tanks into other tanks built specially for its reception, in which septic action could be carried on for any length of time desired without affecting the effluent liquor."

Those who have been following recent published literature on the question of dealing with sewage solids will have noted that the whole tendency in improved methods has been in the direction of the immediate removal of settled solids from contact with the supernatant liquor.

No doubt appears to remain as to the fallacy of the claim of total sludge elimination by septic action; and that the reason why the level of settled sludge becomes stationary after obtaining a certain depth is simply explained by the now understood fact that solids practically equal to the amount in the incoming sewage pass out of the tank in finer divided particles. Further, it is also acknowledged that the gradual increase of solids in the tank effluent is due to the effervescent septic action, the rising of the gas bubbles carrying back into the liquor the solids in fine particles.

Hence, the problem of separating the putrefying settled solids as rapidly as possible from the liquid forms the most important feature in modern methods of removal of solids.

In last week's issue of the Review we published in full a paper read before the British Association of Municipal and County Engineers by Mr. James P. Norrington, C.E., entitled "Some Notes on the Separation of Solids from Sewage and Waste Liquors." This paper has been widely discussed and remarked upon, both in Great Britain and the States.

The paper chiefly describes the German Kessel tank. This tank is on the same principle as the Dortmund tank, as far as sedimentation is concerned; but a new feature is introduced, inasmuch as the tank is fixed above the level of the inflowing sewage, syphon action being arranged, so that the sludge is removed at a level of from two to three inches below the level of the inflowing sewage, no pumping being required.

The sludge is continuously removed from the tank by aid of its specific gravity being greater than water, while floating matter is drawn off by an ingenious device. A sludge deposit chamber is constructed entirely apart from the tank, and the solids once removed cannot regain contact with the liquor.

A second form of tank (rectangular) is also described in which the total capacity of an effective plant may be kept down as low as half an hour's flow of the maximum volume to be dealt with. The writer of the paper refers to the installation of this type of tank at Dorchester, where at least 25 per cent. of the total volume of sewage is brewery refuse. The proportion of suspended solids removed from the crude sewage in this manner is as high as 96.5 per cent.

The writer states: "The principal involved in both these types of separators is that, after the water has done its work of transporting the polluting solids from the house to the spot where they can be dealt with, the sooner it is separated from the sewage solids the better."

In this connection it is interesting to note that the above principle has been acted on in connection with the proposed separator tanks for the Toronto sewage outfall works. It will be remembered that the consulting engineers, Messrs. Watson, of England, and Hering, of New York, recommended that the sludge be removed daily by means of electric pumps, and be conveyed away from the separator tanks to a spot where putrefactive action could take place without affecting the flowing liquid.

The recognition of the principle that septic action in sludge should take place apart from the action of sedimentation will have a practical effect on the size and design of separator tanks. Referring to an article in this Review of May 14th (this year) dealing with the removal of solids, this question is fully dealt with on the basis of Steurwagel's experiments on sedimentation of solids, in which from one to two hours' capacity flow is all that is shown to be required for the tanks. It is usual to build septic tanks of capacities equal to from twelve to twenty-four hours' flow of sewage, and it appears that the only result obtained from these tanks is that the sewage is passed over a large area of putrefying and fermenting sludge, which cause the effluent liquid to take up an amount of solids in fine particles about equal to the volume of heavy solids which have settled from it in its passage through the tanks. In effect, practically, the sewage, although apparently, is no purer than at its entrance to the tanks, and is chemically in a condition which makes it very difficult to oxidise on filter beds as compared with fresh sewage liquid.

For the past few years great attention has been given to the purification of the liquid sewage by nitrification, and it is now being recognized on every hand that the successful purification of the liquid sewage depends almost entirely upon the immediate and rapid removal of the solids from contact with the fresh liquid sewage.

THE COST OF CLEARING WATER IN SETTLING BASINS.*

By S. Bent Russell,† M. Am. Soc. C.E.

We find that the settling basin may not readily be dispensed with, in preparing surface waters for municipal use. In many cases the settling basin seems to be in competition with filtration as a means of making city water satisfactory. In other cases we find the settling basin an important part of the modern filtration plant. Moreover, in mechanical filter plants the tendency seems to be that more work shall be done in the settling basin and less in the filter. This brings up a desire for more information as to the cost of treating water by the simple method of settling.

We find, however, that it is not easy to formulate rules for estimating the cost of settling water. The cost of pumping and of filtering water may be estimated when the quantity and lift are known. The cost of settling basins, however, would seem to depend more upon local conditions. In this paper your attention is directed to the factors that enter into the cost of settling water and certain data from existing waterworks will be given that will be of assistance perhaps in making rough preliminary estimates.

In the general problem before us we have, besides the factors that enter into the cost of settling proper, the dependent factors, loss of head and repumping. We must also consider certain balancing advantages attendant upon repumping, etc.

When a river is the source of supply the use of settling basins usually involves repumping the entire quantity of water as it is more economical to have the basins near the intake. In some cases the two pumpings may be at one combined plant, but it will often be better to have two pumping plants connected by a low pressure or gravity conduit. The saving on the conduit will go to make up for the duplication of pumping plant. If a loss of head is allowed in the basins, they can be used for storage. This will give an advantage in case of damage to the intake or of ice stopping the supply. Moreover, when basins at the intake are used, high pressure engines can be more favorably placed for economical maintenance, and we may note here that pump valves for high pressure will last longer with settled water. Another important saving is from keeping mud and grit out of our pump mains and distribution pipes and meters, and this saving should offset part of the cost of settling the water.

If the settling is to be followed by filtration, we find a saving in both first cost and in operation of the filters as a result of the sedimentation in a large majority of cases. In small plants it may be desirable to run the river pumps only part of the time each day. In such a case basins for combined settling and storage will be profitable.

Let us suppose that we have a river pumping station and a high pressure pumping plant supplying the town, so connected that settling basins may without complication be placed between them. How much will our expenses be increased by the improvement? Although our problem is now greatly simplified, we still find it quite a complicated one and determined by local conditions. The daily quantity to be handled and its rate of increase, and the character and amount of sediment are important. The kind of soil and rock, climatic and flood conditions, drainage, kind of building material available, cost of land, etc., must be considered. The operating organization of the waterworks and financial conditions must be reckoned with. We must know whether coagulants are to be used or not. A coagulating plant may be considered as auxiliary to the settling basins.

We may assume that the basins can be operated with or without loss of head and consequent extra lift by the pumping engines. The cost of settling may be divided into the following items: Interest, depreciation, repairs, operation, clearing, increased lift, pumping cleaning water, coagulating, pumping for coagulating plant, and ground rent. The item of coagulating may, of course, be subdivided into similar heads.

Let us take up some of the above items separately. Interest on first cost will usually be the most important item. Four types of settling reservoirs may be considered: (I.) basins formed by damming a natural valley; (II.) earth embankment basins; (III.) masonry walled basins; (IV.) covered reservoirs.

Reservoirs built for settling will usually cost somewhat more than service reservoirs of the same capacity and type on account of provisions for cleaning and special connections and for baffle walls, weirs, etc. The cost of service and storage reservoirs, however, may be taken as a guide. Table I. gives the cost of a number of reservoirs and the cost per million gallons capacity. The Sudbury reservoirs are included as a matter of interest although they are not paved and are not of a type that could be used for larger proportions of sediment. A covered reservoir is also given although settling basins will seldom need to be covered.

At a meeting of the British Association of Waterworks some years ago, Mr. W. Ingham (see files of water and gas reviews) stated that a covered reservoir of 300,000 gallons capacity had been built for £5 10s. per 1,000 gallons capacity. This would in our units be about $22,900 per mililon United States gallons. Mr. Ingham also gave the following analysis of the cost of reservoirs:—

Open Reservoirs.

Excavation	15 per cent. of total cost.
Floors	35 " " "
Walls	50 " " "

Covered Reservoirs.

Excavation	10 per cent. of total cost.
Floors	24 " " "
Walls	28 " " "
Roof	38 " " "

While discussing the first cost let us anticipate a bit and assume that the total charges for running a system of basins is 8 per cent. of the first cost. Then if the basins cost $1,000 per million gallons' capacity, the expenses would be $\frac{1,000 \times 8}{100 \times 365}$

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* From a paper before the Convention of the Central States Waterworks Association, Columbus, Ohio, Sept. 28.

† Consulting Engineer, 415 Locust Street, St. Louis, Mo.

= $0.219 per million per day, i.e., a million gallons can be stored one day for 21.9 cents. If the basins cost $5,000 per million gallons the storage costs $1.095; if the cost is $10,000, it costs $2.19 per million gallons per day.

The item of depreciation is dependent on the life of the plant. Now a reservoir is like a baby's shoe—it is usually outgrown before it is outworn. As a basis for depreciation we must estimate how long the reservoir will prove useful to the municipality.

Repairs should be but a small item. Large repair bills usually point to faulty construction.

The cost of operating depends in some degree upon the size of the plant and upon the quantity of water passing through. The cost should be greater with intermittent flow than with constant flow. In many plants the cost will be inconsiderable.

The cost of cleaning is dependent upon the quantity of water handled and the proportion of sediment removed. The area, or dimensions, of the floors will influence the cost. The inclination of floors and drains, etc., are important factors, and the character of the sediment must be considered. This item is of some importance, where there is much sediment, and to keep this cost within proper limits we are justified in adding considerably to the first cost of the plant. In the years 1900 and 1901 the Compton Hill service reservoir at St. Louis was cleaned under the direction of the writer. About 27,000 cubic yards of mud were removed from one basin. Owing to the flatness and roughness of the floor and lack of proper facilities this work cost about 7.5 cents per cubic yard.

This would indicate that under similar conditions 1,200 gallons per million would be wasted for cleaning basins. This would amount to about 1/10 per cent. per million gallons for pumping, which is inconsiderable.

It is a matter of interest to note the following items in regard to coagulation at St. Louis: For the year ending April 1906, the cost of coagulating was $3.99 per million United States gallons, divided as follows:—

Lime	$1.740
Sulphate of iron	1.532
Labor	0.622
Power	0.086
Repairs	0.010

These figures do not include pumping for coagulating plant nor fixed charges. Since that time a new coagulating plant has been built, in which modern elevating and conveying machinery with automatic controlling devices is used. It is designed to operate with a smaller force of men than the old plant. The contract price for the building with conveying machinery was $89,500. This did not include all the machinery. If we take interest, depreciation, and insurance at 10 per cent., and assume 100,000,000 gallons per day, we would have 24.4 cents per 1,000,000 gallons treated.

The amount of water that must be repumped for coagulating will depend upon the design of the plant. As a matter of interest we may note that in the Cincinnati plant for the year 1908, with an average of 44,000,000 gallons treated per day, about 1,00,000,000 gallons per day is drawn from the settling basins through the lime saturators, while 1.5 cubic

	Class	No. of basins	Total capacity million gallons	Cost	Cost per million gals. capacity	
Boston, Sudbury, No. 2	I.	1	530	$ 71,472	$ 135	
Boston, Sudbury, No. 4	I.	1	1,400	813,846	570	Soil stripped
Boston, Sudbury, No. 6	I.	1	1,530	910,300	600	Soil stripped
Cincinnati	I.	2	330	1,276,000	3,865	Settling
Harrisburg, Pa.	II.	1	4	21,485	5,371	Settling
Minneapolis, Minn.	II.	2	93	442,328	4,750	Service
St. Louis, C. H.	II.	2	60	271,671	4,528	Service
Cincinnati, O.	II.	3	22	206,300	9,170	Settling
Cincinnati, O.	II.	1	19	136,500	6,970	Storage
St. Louis, B. P.	III.	4	65	578,437	8,900	Settling
St. Louis, No. 1-6	III.	6	168	1,021,087	6,080	Settling
St. Louis, No. 7-8	III.	2	80	523,609	6,545	Settling
St. Louis, Baden	III.	1	50	250,066	3,126	Storage
Coshocton, O.	IV.	1	0.320	4,310	13,470	Service

In that same year 233,126 cubic yds. were removed from the settling basins at the Chain of Rocks reservoir for 1.017 cents per cubic yard, or less than 1/7 of the cost at Compton Hill. This difference is partly on account of the greater inclination and smoothness of the floor of the basins and better waste-pipe connections.

The item for increased lift will depend mainly upon the cost of fuel, on the daily quantity of water and on the class of pumping engines.

The amount of water wasted in cleaning basins will depend on the effectiveness of the design, on the character and quantity of sediment, etc. In the years 1885-1888, about twelve cubic yards of mud per million gallons supply were washed out of the St. Louis basins. Some notes by the writer show that for the new basins at the Chain of Rocks, Nos. 1-6, where no coagulant was used, about 100 gallons of water were required to wash out 1 cubic yard of mud.

feet per minute of filtered water is used for slaking lime and 2.5 cubic feet per minute for dissolving sulphate of iron.

The last item on our list is ground rent. It will be, of course, in some degree proportionate to the size of the plant, but will also be determined by conditions that are local.

If now we add up the estimates made for the items given, the sum will be the cost of settling proper. This cost without coagulation will not be strictly proportional to the first cost of the plant, but it seems probable that it will be nearer to that than to a value in proportion to the volume of water treated.

The best information to guide us will be the records of waterworks that have used settling basins for a long time. Tables II. and III. are compiled from the records of the St. Louis Waterworks, and cover the period of use for settling of the basins at Bissell's Point. They were installed in 1871, and were used for treating the city supply for twenty-four years, after which and to the present time they have been used for storage of clear water. Table II. shows the expenditures each year for the last fifteen years of settling, and the average daily consumption of water in million gallons.

Table III.—Cost of Settling Water, Bissell's Point Basins, St. Louis, 1881-1894.

	Cost per million gallons settled	Cost per year in per cent. of first cost	Cost in per cent. of coal bills, low duty plant*	Cost in per cent. of coal bills, high duty plant†
Interest	$2.82	5.	47.5	113.
Depreciation .	.79	1.4	13.4	32.0
Repairs	.054	.068	.92	2.17
Operating ...	.281	.34	4.72	11.25
Cleaning	.198	.23	3.35	7.99
Increased lift.	.329	.585	5.6	5.6
Total	$4.472	7.623	75.49	172.01

Average Daily Consumption of Water in Millions of United States Gallons.

Year	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
Daily Av'g.	12.9	14.5	16.4	17.9	20.1	20.9	22.3	23.0	25.0	25.1

In 1882, the first repairs of magnitude after installation were made. In 1889 leaks and breaks were repaired. In 1890 joints were repointed and the coping was dressed. In Table II. the cost of coal for pumping for the last 10 years is also given for comparison The 8th column gives the cost of coal for pumping with a lift of about fifty feet from the river to the basins. The seventh column shows the cost of pumping the clear water into the city distribution system with a lift of about 200 feet.

There were four basins, each of about 16,225,000 gallons storage capacity. They were designed for a consumption of about 30,000,000 per day with a quiet settlement of about twenty-four hours. They were operated on the intermittent flow, or fill and draw system. The head lost was about fourteen feet. Provisions for cleaning were fairly good.

Table III. shows the cost of settling water at the old Bissell's Point basins, expressed in four different ways. The first cost of the settling basins was $578,500 and the interest was arbitrarily taken at 5 per cent. The annual depreciation was figured in the following manner: The basins were intended to do for a consumption of 30,000,000 gallons per day, but as the average rate of using is always less than the maximum for a growing plant making extensions from time to time, a rate of 28.1 million gallons has been taken, and as for the first years of use the rate was very small, it was thought that the service was equivalent to twenty-one years at 28.1 million gallons per day. An annuity of $2.80 at 5 per cent. will redeem $100 in about twenty-one years. For salvage, 50 per cent. of the cost of the basins was taken off, as it was considered that the basins are worth for storage purposes one-half of the orginal cost. This gives us an annual depreciation of 1.4 per cent.

In the third column of Table III. we have each item expressed in annual cost per cent. of first cost. This disregards the quantity of water handled. The footing for this column shows 7.623 per cent. To this we may add 0.28 per cent. for rental of land, and get 7.9 per cent. as the total annual charge. It might be well to add a small charge for accident insurance to provide for damage by earthquakes or other calamities. Therefore we might say that to run settling basins like those used at St. Louis from 1871 to 1894, would cost in round numbers about 9 per cent. per annum of the first cost.

Table II.—Cost of Settling at Bissell's Point Basins, St. Louis, Mo.

Year	Operating	Pay Roll Cleaning	Repairs	Materials Repairing	Daily consumption	Coal per million gallons High service	Low	Total
1881	$ 2,588.00	$ 1,405.48	$ 245.00	....	27.5	......	......	......
1882	2,400.00	2,875.00	1,259.57	....	28	......	......	......
1883	2,400.00	1,876.71	....	....	27.5	......	......	......
1884	2,417.50	2,034.00	341.60	....	24.8	......	......	......
1885	2,400.00	3,276.00	185.56	....	26.9	$4,885	$1,738	$6,623
1886	2,400.00	2,195.36	187.93	....	30.5	4,600	1,889	6,489
1887	2,448.56	2,137.50	26.17	....	30.5	4,442	1,934	6,376
1888	2,449.11	1,865.41	560.17	$ 157.78	32.7	4,375	2,345	6,720
1889	3,991.25	2,927.35	908.30	129.83	32.3	3,850	1,904	5,754
1890	4,020.00	1,386.00	1,139.63	334.88	35.2	3,462	1,763	5,225
1891	4,020.00	1,411.20	1,233.56	468.69	38.6	3,298	1,587	4,885
1892	4,028.00	2,286.26	36.67	397.16	42.1	3,484	1,830	5,314
1893	4,319.97	2,810.89	170.55	629.74	47.5	3,805	1,969	5,774
1894	4,617.99	3,519.19	171.95	809.10	52.9	3,779	2,041	5,820
1895	4,588.26	2,688.20	......	....	....	....	......	......
Total	$49,088.64	$34,694.55	$6,466.66	$2,927.18	477.0			
Average						$3,998	$1,900	$5,898

In the fourth column of Table III. the cost is expressed in per cent. of the cost of coal used for pumping for both the river and the high-lift pumps. This is given because the cost of pumping will serve as a familiar yardstick for waterworks men. The footing shows that the cost of clearing the water was about 75 per cent. of the cost of coal used for such pumping. The pumping engines used were of low efficiency. In the last column of Table III. the cost is compared with coal for pumping if engines had been used of as high efficiency as those now in use at the St. Louis waterworks. The footing of this column shows that the cost of clearing the water was nearly 75 per cent. higher than the cost of coal. These values do not include any allowance for rental of land nor for accident insurance.

* Figures based on actual cost of coal used.

† Cost of coal taken at 42 per cent. of the actual cost as the cost if the engines had been as economical of fuel as those now in use.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8540—October 15—Approving plans and specifications of the municipal corporation of the Township of Colchester, North Ontario, re Pinkerton Drain, under lands and tracks of the M.C.R.R. between lots 14 and 15 in 13th concession in said township.

8541—November 3—Granting leave to the Montreal & Southern Counties Railway to open for the carriage of traffic portion of its railway extending from its terminus at Youville and McGill Streets, Montreal, P.Q., to St. Denis Street, town of St. Lambert, P.Q.

8542—November 2—Granting leave to the M.C.R.R. to construct, maintain, and operate spur track to the premises of the Postum Cereal Company, Windsor, Ont.

8543—November 3—Approving and sanctioning location of C.N.O. Railway Company line through Townships Pickering, Scarborough, and York, Ont.

8544—November 3—Granting leave to the C.P.R. to construct its railway siding across the public crossing near Mc Adam Junction, N.B.

8545—November 3—Approving and sanctioning change of location of the V. V. & E. Railway & Navigation Company branch line from Sapperton and Fraser River Lumber Company, B.C.

8546—November 3—Authorizing the G.T.R. to construct, maintain, and operate branch line to and into the premises of the Noxon Company, Limited, Ingersoll, Ont.

8547 to 8552 Inc.—November 4—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at Myrtle Station, Ont.; T. H. & B. Railway, Irondale, Ont.; C.P.R. Tel. line 1½ miles north Warden Station, P.Q., Orangeville Station, Ont., ¼ mile north of Warden Station, P.Q., and the M.C.R.R. at Hewitt Station, Ont.

8553—November 4—Granting leave to the Tuckersmith Municipal Telephone System, to erect, place, and maintain its wires across the track of the G.T.R. at the side road between the 1st and 2nd concessions of the Township of Stanley, County Huron, Province Ontario.

8554—November 3—Granting leave to Eugene Danis, to erect, place, and maintain wires across the track of the C.P.R. at Lacoste public crossing between mile posts 96 and 97, Lacoste, P.Q.

8555—November 3—Authorizing the corporation of the city of Ottawa, Ont., to lay and thereafter maintain tile pipe sewer under the track of the C.P.R. on Yonge Street, Ottawa, Ont.

8556—November 4—Granting leave to the M.C.R.R. to operate its train over, upon, and through the connection with the G.T.R. at Bathurst Street, London, Ont.

8557—November 3—Granting leave to the Markham & Pickering Telephone Company, Limited, to erect, place, and maintain its wires across the track of the G.T.R. where the same intersects the side road between Lots 15 and 16, 8th concession, Township Markham, Ont.

8558—November 3—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for F. Gobeille, at Mile End Station on said railway.

8559—November 3—Authorizing the C.P.R. to construct, maintain, and operate branch line or spur, across Ave. "D" and across Lot 38, Block 3, in town Saskatoon, Sask., for Saskatoon Tent & Mattress Company, Limited.

8560—November 3—Authorizing the G.T.R. Company to construct maintain, and operate branch line to and into the premises of T. E. Manley Chew, across Old Sturgeon Bay Road, Township Tay, Ont.

8561—November 4—Granting leave to the C.P.R. to construct two extra tracks across Third Avenue in town of Pincher, on its Crow's Nest Pass Branch, Alberta.

8562—November 4—Granting leave to the Government, Province Saskatchewan, to construct a highway crossing over the right of way of the C.N.R. Company adjoining the east end of the station grounds in the N.E. ¼ Sec. 5, Tp. 44, R. 16, west 3rd Meridian, Saskatchewan.

8563—November 4—Granting leave to the Orford Mountain Railway Company to deviate public crossing across its track on Lot 23, R. 7, Tp. Melbourne, County of Richmond, P.Q.

8564—November 3—Extending for a period of one month the time within which the V. V. & E. Railway & Navigation Company were directed to install interlocking plant required to be provided by Order No. 7478, dated July 6th, 1909, to the Fraser River Lumber Company at New Westminster, B.C.

8565—November 3—Authorizing the C. W. & Lake Erie Railway Company to construct, maintain and operate branch line of railway, or spur, on several streets in the city of Chatham, Ont.

8566—November 3—Authorizing the C.P.R. to change its line of railway at Ste. Agathe, P.Q., and to remove its station buildings.

8567—November 3—Granting leave to the Hydro-Electric Power Commissioner of Ontario, to erect, place, and maintain its transmission wires across the track of the C.P.R. on part of Lots 12 and 13, B. F. To. of North Oxford, Ont.

8568—November 3—Granting leave to the Hydro-Electric Power Commission of Ontario to erect, place, and maintain its transmission lines across the track of the C.P.R. at Lot 35, Con. Gore, Township of Puslinch, County Wellington, Ont.

8569—November 3—Granting leave to the municipality of the corporation of the city of Calgary, Alta., to erect, place, and maintain, at its own expense, its electric light and power wires across the main line of the C.P.R. at 15th Street, Calgary, Alta.

8570—November 3—Granting leave to the Nipissing Power Company, Limited, to erect, place, and maintain its transmission lines across the track of the G.T.R. at Callander, Ont.

8571—November 3—Granting leave to the Nipissing Power Company, Limited, to erect, place, and maintain its transmission lines across the track of the G.T.R. at Nipissing Junction, Township Ferris, Ont.

8572—October 29—Rescinding Order of the Board No. 5907, dated December 23rd, 1908, authorizing the G.T.P. Railway to construct a bridge between Watson's Island & Kaien Island, B.C., the Government of British Columbia objecting to the same.

8573—October 27—Authorizing the Vancouver & Lulu Island Railway Company to cross Grenville Street in municipality of Pt. Grey, with the tracks of a branch line of its railway, B.C.

8574—October 27—Authorizing the C.P.R. to construct branch line to the warehouse of the Great Northern Transfer Company, Vancouver, B.C.

8575—October 27—Approving and granting leave to the V. V. & E. Railway Company to join its tracks with the

(Continued on page 575).

CONCRETE TRUSS BRIDGE: THE FIRST IN CANADA.*

The architect says with truth of the bridge engineer that he aims only at results which are useful and scorns the beautiful. The general form of a steel truss is often decided upon with no thought of æsthetic design, and a few dollars afterwards spent on ornamental railings or other details will never remedy the defect. And yet mathematics and æsthetics go hand-in-hand, and a simple steel truss with the upper panel points lying on the singularly graceful curve, the common parabola, can be designed with more economy of material than the unsightly steel truss with parallel chords. If the cost of the former would be greater under present conditions, then shop practice and facilities are principally to blame. But shop practice is no bugaboo to the designer in concrete, and the form of truss which is the most economical is also the one which is the most natural and the most beautiful. The massive and gracefully arched compression chords are, perhaps, the most notable features of the few concrete truss bridges which have as yet been built.

The seven-panelled parabolic bowstring truss, illustrated above, was built on the Middle Road, between the counties of York and Peel, and officially opened to traffic this month. An examination of it will show that the maximum stress in the lower chord is the same for all its members, consequently the same number of steel rods are used from one end of the chord to the other—a great advantage in construction.

The vertical members of the web system are tension members, and the diagonals are of the nature of counter-braces, carrying no stress for live load covering the entire floor or from the dead load, and acting alternately in compression and in tension for a moving load.

The compression chord, 22 in. by 24 in. at the middle segment, is only slightly reinforced with twelve rods, ¾-in. round, and bonded with smaller rods spaced 6 in. apart, except at the panel points, where somewhat elaborate detailing is resorted to in order to make the bond perfectly secure between the hangers and the chord. The maximum compressive stress for this chord is 430 pounds per square inch for the concrete and 6,450 pounds for the steel, or about 500 pounds per square inch for concrete and steel acting together.

The maximum tension in the lower chord is 16,000 pounds for the steel, the concrete not being considered to act in tension.

In order not to cause internal stress in the concrete by some of the rods not being straight at the time the concrete is poured, and in order that hair cracks should not develop under 16,000 pounds tension in the steel the rods were given considerable tension before the concrete was poured by an ingenious device of the contractor.

A Concrete Truss Bridge on the Middle Road, between the Counties of York and Peel, Ont.

The bridge was designed for a load of ten tons on two axles, two-thirds on the rear axle, and a distributed load of 100 pounds per square foot. A very liberal impact allowance was adopted of one-half the live load.

Extraordinary care was taken to avoid poor bonding of successive days' work. For this purpose cracked ice was laid in bags upon the last concrete placed at night, and this was found to be perfectly plastic the next morning, as if it had just been poured. This method of keeping concrete from setting by placing ice upon it, and thus securing a perfect bond between concrete placed on successive days, was the invention of Mr. O. L. Hicks, the contractor for this bridge. It is here mentioned by his permission for the benefit of any who may wish to use it.

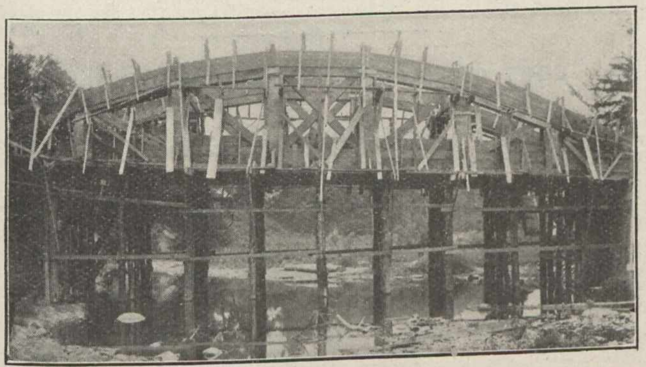
The length of the bridge is 80 ft. in the clear; roadway, 16 ft. wide; height above water, 14 ft. at one end, 18 ft. at the other, making a grade of 5 per cent. It contains upwards of thirteen tons of steel, and weighs nearly 200 tons. Provision was made for expansion at one end by brass plates sliding between steel plates. It was tested at the official opening with a concentrated

* By Frank Barber, of Barber & Young, bridge and structural engineers, Toronto, Ont.

load of ten tons moving across the bridge, and by a herd of seventy cattle, all that could crowd upon the bridge, weighing probably thirty-five tons. The vibration under these loads was very slight.

The reinforcing consisted of plain, round rods except for the floors, which were reinforced with No. 10 standard expanded metal as manufactured by the Expanded Metal and Fireprofing Co., Toronto.

The mixture used was one of cement to three of aggregate, consisting of sand and crushed stone, so proportioned as to leave a minimum of voids. The bridge was concreted in one week by making special efforts, and the forms and floor were kept wet for another week. The concrete matured without showing any checks or hair cracks. Two inches was chiselled off the caps of the newel posts after the concrete had set as they were thought to be too large, and the mortar was found to be as hard as the stone which was embedded in it, for the stones would crack through quite as readily as the mortar. Owing to a misunderstanding these caps were left rough, but the writer regards this as a mistake. They should have been dressed smooth to harmonize with the rest of the bridge. Whatever may be the life of lean concrete mixtures, which are often used in massive work, the engineers believe that concrete proportioned in the above-mentioned way will endure indefinitely and grow harder and stronger with age.



The Middle Road Truss Bridge, showing Forms in Position.

In designing this truss the engineers believed that the joints required the most attention. It is easy to proportion all the members of a concrete truss so that perfect confidence may be placed in it if only the joints may be relied upon. The engineers tried to detail the bridge so that any member would fail in the body rather than at a joint. A description of these details is not here attempted, as it would, perhaps, be too technical to be of much interest to the general reader.

Compared with the ordinary (unhinged) concrete arch, the concrete truss has advantages and disadvantages. In the arch the horizontal thrust is resisted by the abutments, which are more or less perfectly restrained from spreading by the natural beds of the abutments—clay, rock, or whatever it may be. In the concrete truss the horizontal thrust of the arched compression chord is resisted by the steel rods in the lower chord. The advantage of this for the truss is that the toes of the arched chord are perfectly tied together at all times, and the upper and lower chords expand and contract together with temperature changes, provision for which is made by sliding bearing-plates at one end of the truss. Again, the tendency of the arched chord to deform for different positions of a concentrated load is resisted by the web members of the truss so that the line of resultant pressure in the compression chord does not move from the centre of its section. For this reason the chord segments act as posts, and are proportioned by their area.

In the arch, on the other hand, the abutments often spread somewhat, causing cracks in the spandrel walls. Again, temperature stresses and moving loads cause deformation of the arch-ring, which causes the line of pressures to vary in position. Even in a well-designed arch, where the resultant pressure never leaves the "middle third" of the section, the unit pressure at certain sections of the ring will be zero at the intrados and double the average at the extrados for certain temperatures and loadings, which state will be reversed for other conditions. Thus the section of the arch-ring must be proportioned by its moments of inertia, and will be greater than if the arch could be braced against deformation like a truss. We believe that bracing, where it is possible, is better and more economical than increasing the section.

To recapitulate, the arch has the great advantage, that no lower chord is necessary, or, to put it another way, the natural earth forms the lower chord; but the abutments are often not rigidly held from spreading, temperature stresses are considerable, and deformation must be resisted by making the arch-ring very heavy. In the case of the truss, an expensive lower chord must be supplied, but the toes of the arched chord are more rigidly held together by it than is often the case in arches, there are no temperature stresses, and the tendency to deformation is perfectly resisted by a web system, and a minimum amount of material results.

The Commissioners of York and Peel, for whom the bridge was built, were without exception delighted with the structure. When tenders were opened the bid for the concrete truss was found to be the second lowest, four tenders for a steel bridge being higher and one lower. Warden George Henry, of York, well supported by Warden Jackson, of Peel, spoke strongly in favor of the concrete bridge as being the most suitable bridge, and the cheapest in the end. Concrete was felt to be especially suitable for a bridge on a grade. Here teams cannot be prevented from trotting over it. The resulting vibration is likely to loosen joints and crystallize the steel, but is almost non-existent in concrete.

The reason that a truss was adopted at the Middle Road rather than an arch was that the truss bridge utilized the old stone abutments and an arch design could not.

Considère, the eminent French engineer, was the originator of the concrete truss, and he has built several of them in Europe. The approaches to the Sparkman Street Bridge at Nashville, Tenn., are also of this form. The bridge here described is the first concrete truss to be built in Canada.

The Commissioners for whom the bridge was built are Warden Henry and Commissioners Annis and Harris, of York, and Warden Jackson and Commissioner Kennedy, of Peel. The contractor was Mr. O. L. Hicks, of Humber Bay.

The bridge was designed and erected under the supervision of Barber & Young, bridge and structural engineers, of Toronto.

A PAGE OF COSTS
ACTUAL, ESTIMATED and CONTRACTED

COST OF REPAIRS TO STEAM SHOVELS.

Repairs to steam shovels at Empire shops during the fiscal year 1909 cost only seven-eighths of a cent per cubic yard of material excavated, according to The Canal Record. The total cost of these repairs was $197,612.42, and the material excavated amounted to 22,583,099 cubic yards. The shop cost does not include the cost of repairs made in the field or that of repairs made to steam shovel parts taken to the shops while the shovel is kept in service by substituting other parts. These repairs are known as field repairs and are made in the field shops and on the work, often while the shovel is waiting for cars.

A statement of the cost of steam shovel repairs in the three construction divisions from January, 1908, to June, 1909, inclusive, a period of 18 months, follows:—

	Divisions.			
Item.	Central.	Atlantic.	Pacific.	Total.
Cubic yards	27,752,750	4,148,997	1,980,069	33,881,816
Field cost	$596,059.02	$51,786.74	$19,917.58	$667,763.34
Shop cost	$283,746.76	$51,782.61	$22,246.75	$357,776.12
Cost per cubic yd.:	Cents.	Cents.	Cents.	Cents.
Division	2.14	1.25	1.01	1.97
Shop	1.02	1.25	1.12	1.06
Total	3.16	2.50	2.13	3.03

The shovels in the Central Division are subjected to harder and more constant usage than those of the other two divisions. Of the 101 steam shovels in the Canal and Panama Railroad service 61 are in the service of the Central Division, most of them in Culebra Cut.

COST OF SPREADING BROKEN STONE.

The stone was hand-broken and in piles along the roadway, Yonge Street, York County, Ontario. The average haul from the pile to their place in the macadam road was 600 feet. The force employed at the work was:—

1 man spreading 10 hours at 20 cents per hour....	$ 2.00
5 men filling, 50 hours at 20 cents per hour	10.00
2 cart boys, 20 hours at 10 cents per hour	2.00
2 carts with horses, 20 hours at 15 cents per hour.	3.00
Total cost, 10 hour day	$17.00

Work done:—

October 11th, spread	3.5 toise*
October 12th, spread	4.0 toise
October 13th, spread	4.75 toise
Total spread	12.25 toise

12.25 toise, or 98 cubic yards cost to spread, $51.00;
or $4.16 per toise;
or 52½ cents per cubic yard.

*Toise is 12′ x 6′ x 3′, or 216 cubic feet.

COST OF EXPERIMENT IN OILING STREETS.

During the past summer the city of Ottawa, Ont., applied oil **once** to about one and a quarter miles of roadway. The cost was as follows:—

Oil f.o.b., Ottawa	$236.93
Demurrage on car	4.00
Labor putting on	30.00
Preparing special taps, valves, etc.	28.55
Expert fees	25.00
Total	$324.48

Or almost $260 per mile.

This is much higher than it would be for regular work, but it is of value as to the cost of experimenting with oil for dustlaying.

Advocates of oiled roads place the cost at from $75 to $90 per mile.

COST OF REPAIRS TO ROLLING STOCK.

On the Intercolonial Railway the cost of repairs to rolling stock was during 1907-8-9 as follows:—

Passenger cars,	1907-8	per car mile	0.0194 cents.
" "	1908-9	" " "	0.0172 "
Freight car	1907-8	" " "	0.0073 "
" "	1908-9	" " "	0.0078 "
Locomotives ..	1907-8	" " "	0.0794 "
" ..	1908-9	" " "	0.0828 "

ESTIMATING COST OF STEEL BRIDGES.

In October, 1909, the city of Toronto, Ont., called for tenders for steel superstructure for the Wilton Avenue bridge. It was estimated that the bridge would require about one million pounds of steel. As a fair estimating price for such work the following table may be of some interest:—

Tender.	Steel Superstructure. Bulk Sum.	Estimated Weight—lbs.	Price Per lb.
No. 1	$51,725.00	1,066,500	4.85c.
" 2	45,645.00	1,037,708	4.41c.
" 3	45,622.07	990,080	4.61c.
" 4	64,872.67	1,079,218	6.01c.
" 5	48,200.00	1,000,000	4.82c.
" 6	35,809.00	875,644	4.09c.
" 7	54,500.00	1,080,000	5.05c.
" 8	56,000.00	1,120,000	5.00c.
Average price of eight tenders			4.85c.

It will be noticed the average price **including** the engineer's tender (No. 8) is 0.15 cents below the engineer's estimate, and **excluding** that tender the average price would be 4.83 cents or 0.74 cents per pound above the price of the successful tenderer.

Tenders No. 2, 3 and 4 were those of firms in Great Britain.

THE COST OF POWER.*

Relative costs per kilowatt-hour for different kinds of power plants having a maximum load of over 30,000 K.W. Distribution of maintenance and operation.

	Reciprocating Steam Plant.	Steam Turbine Plant.	Reciprocating Engines and Low-Pressure Steam Turbines.	Gas Engine Plant.	Gas Engines and Steam Turbines.	Hydraulic.
Maintenance.						
1 Engine room, mechanical	2.59	0.51	1.55	5.18	2.84	0.51
2 Boiler or producer room	4.65	4.33	3.55	1.16	1.97	....
3 Coal and ash-handling apparatus	0.58	0.54	0.44	0.29	0.29	....
4 Electrical apparatus	1.13	1.13	1.13	1.13	1.13	1.13
Operation.						
5 Coal	61.70	55.53	52.44	26.52	25.97	....
6 Water	7.20	0.65	0.61	3.60	2.16	....
7 Engine room, labor	6.75	1.36	4.06	6.76	4.06	1.36
8 Boiler or producer room labor..	7.20	6.74	5.50	1.81	3.05	....
9 Coal and ash-handling labor...	2.28	2.13	1.75	1.14	1.14	....
10 Ash removal	1.07	0.95	0.81	0.54	0.54	....
11 Electrical labor	2.54	2.54	2.54	2.54	2.54	2.54
12 Engine room lubrication	1.78	0.35	1.02	1.80	1.07	0.20
13 Engine room waste, etc.	0.30	0.30	0.30	0.30	0.30	0.20
14 Boiler room lubrication	0.17	0.17	0.17	0.17	0.17	....
Relative operating cost per cent...	100.00	77.23	75.87	52.94	47.23	5.94
Relative investment per cent.......	100.00	75.00	80.00	110.00	96.20	100.00
Probable average cost per kilowatt.	125.00	93.75	100.00	137.50	120.00	125.00
Probable fixed charges per cent...	11	11	11	12	11.5	11

For steam turbine plants larger than 60,000 kw., the cost per kilowatt may be reduced to $75.

COST OF HEATING A ONE ROOMED BUILDING.

The following figures represent the cost of heating a public school in Ontario. The inside measurements of the building are 31 feet long, 23 feet wide, and 14 feet high. There are two entrances protected by the porches which also have doors. The windows have a total of 108 square feet of glass. The room was heated by a furnace in the basement, and having compared the cost of heating several buildings of this class, find these figures represent the average very well.

1904.

6.5 tons coal	$46.13
2 cords wood	15.00
	$61.13

1905.

7 tons coal	$52.18
¼ cord wood	2.50
	$54.68

1906.

9.5 tons coal	$73.76
1¼ cords wood	5.93
	$79.69

1907.

5 tons coal	$36.50
1 cord wood	5.00
	$41.50

1908.

10 tons coal	$70.00
Wood	1.40
	$71.40

Total for 5 years	$308.40
Average cost per year	61.68

Or to heat 10,000 cubic feet per year cost $61.68, or about 62 cents per 100 cubic feet per year.

*From a paper by H. G. Scott, before the American Institute of Electrical Engineers.

SOCIETY NOTES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

As a result of the ballot canvassed on November 13th the following have been elected to the various classes of membership in the society:—

Member.

T. Aird Murray, Toronto.

Associate Members.

C. C. Chataway, Winnipeg; F. G. Goodspeed, St. John, N.B.; J. B. Strauss, Chicago, Ill.; W. G. Webster, Dunnville, Ont.; G. C. Williams, Walkerville, Ont.

Transferred from Associate Member to Member.

G. G. Grundy, Fraserville, P.Q.; Louis A. Herdt, Montreal; G. A. Janin, superintendent of waterworks, Montreal; W. P. Wilgar, Nepigon, Ont.; F. A. Wilkin, Winnipeg.

Transferred from Student to Associate Member

W. H. Blanchet, Peterborough, Ont.; W. J. Blair, New Liskeard, Ont.; W. G. Brown, La Tuque, P.Q.; E. V. Collier, Ottawa; A. P. Deroche, Ottawa; J. M. Donaldson, Croydon, Eng.; G. R. Ewart, jr., Makawell, Hawaiian Islands; G. H. Ferguson, Toronto; J. B. Harvey, Montreal; L. L. Hurtubise, Ste. Claire, Que.; W. L. Malcolm, Kingston, Ont.; A. W. McMaster, Toronto; A. G. Tapley, Pointe du Chene, N.B.

* * * *

Central Railway and Engineering Club.

At the meeting of the Central Railway and Engineering Club of Canada, held at the Prince George Hotel, Toronto, on Tuesday evening, November 16th, Mr. George H. Henderson of the Schofield-Holden Company, read an interesting paper on "The Gas Engine, Its Origin and Commercial Use." President C. A. Jeffers presided.

* * * *

Ottawa Branch, Canadian Society of Civil Engineers.

The first annual meeting of the Ottawa Branch of the Canadian Society of Civil Engineers was held in the Russell House on October 6th last. The election of officers for the year 1909-10 resulted as follows: Chairman, W. J. Stewart; Managing Committee, Arthur Bruce, A. A. Dion, A. T. Phillip, R. Donaldson, Naulon Cauchon; Secretary, S. J. Chapleau, Resident Engineer's office, Department of Public Works.

An expression of thanks by Mr. George A. Mountain, President of the Can. Soc. C.E., was made on behalf of the branch to the retiring chairman, Mr. Charles Coutlee, and the other officers of the initial management committee. Beyond this only routine business was transacted.

A reading and writing room for the branch is being prepared at No. 177 Sparks Street and will be ready for occupancy early in December.

There are about 107 members of all grades of the society resident within the Ottawa district.

(Continued on page 575.)

PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

In the two preceding problems the determination of the stress in the various members of the cantilever truss (Fig. 67) was arrived at by graphical means, although a little trigonometry was occasionally made use of. It is possible, however, to arrive at these quantities analytically as indicated in the following discussion. In order to simplify matters, the reader is advised to draw the Statical Diagrams (Figs. 68, 70, 72, 75, and 77) on a loose sheet of paper so that they may be readily referred to.

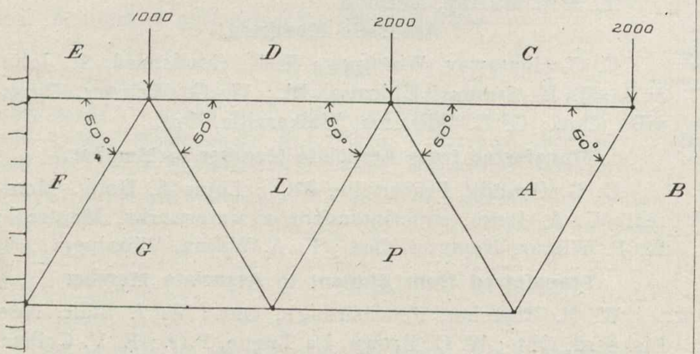


Fig. 67.

The following facts must be kept in mind throughout the problem:—

The **magnitude** of the X of any force = (magnitude of force) × (cosine of angle of inclination of force to the horizontal).

The **magnitude** of the Y of any force = (magnitude of force) × (sine of angle of inclination of force to the horizontal).

Also, if a set of forces be in equilibrium, $\Sigma X = 0$, and $\Sigma Y = 0$.

Analytical Determination of the Stress in the Members of the Cantilever (Fig. 67).

Consider the forces acting at the point BCA as shown in the Statical Diagram (Fig. 68). These forces are in equilibrium. Therefore, $\Sigma X = 0$; $\Sigma Y = 0$.

$\Sigma Y = Y_{BC} + Y_{CA} + Y_{AB} = 0$ .... (1.)

Now, since CA and AB are unknown forces, the Y_{CA} and Y_{AB} will be assumed positive.

$Y_{BC} = -BC \sin 90° = -BC = -2,000.$

$Y_{CA} = CA \sin 0° = 0.$

$Y_{AB} = AB \sin 60° = AB.\frac{\sqrt{3}}{2}$ .... (2.)

Substituting these values in equation (1.).

$$\Sigma Y = -2,000 + 0 + AB.\frac{\sqrt{3}}{2} = 0.$$

$$AB = 2,000.\frac{2}{\sqrt{3}} = \frac{4,000}{\sqrt{3}}$$

If, now, this true value of AB, which is a positive quantity, be substituted for AB in equation (2.), it is seen that the assumed positive sign of the Y of AB remains unchanged. The assumed sign of the Y of AB is, therefore, correct; i.e., the Y of AB is positive.

If Y_{AB} is positive, i.e., acts upward, AB is found to be a force acting against the pin. The member AB is, therefore, in compression $\frac{4,000}{\sqrt{3}}$ pounds.

For the same point:—

$\Sigma X = X_{BC} + X_{CA} + X_{AB} = 0$ .... (3.)

$X_{BC} = BC \cos 90° = 0.$

$X_{CA} = CA \cos 0° = CA.$ X_{CA} assumed positive since CA is unknown............ (4.)

$X_{AB} = AB \cos 60° = AB.\tfrac{1}{2}. = \frac{4,000}{\sqrt{3}}.\frac{1}{2} = \frac{2,000}{\sqrt{3}}$

Substituting these values in (3.).

$$\Sigma X = 0 + CA + \frac{2,000}{\sqrt{3}} = 0.$$

$$CA = -\frac{2,000}{\sqrt{3}}.$$

Substituting this true value of CA (a negative quantity) into equation (4.), the X_{CA} is seen to be negative. If X_{CA} is negative, CA must be a tensile force (acts away from the pin). From this, then, the member CA is seen to be in tension $2,000/\sqrt{3}$ pounds.

The forces acting at the point BAP, as shown in the Statical Diagram (Fig. 70), are in equilibrium.

$$\Sigma Y = Y_{BA} + Y_{AP} + Y_{PB} = 0.$$

$$-BA \sin 60° + AP \sin 60° + PB \sin 0° = 0.$$

$$-\frac{4,000}{\sqrt{3}}.\frac{\sqrt{3}}{2} + AP\frac{\sqrt{3}}{2} + 0 = 0.$$

$$AP = \frac{4,000}{\sqrt{3}}.$$

From the positive sign of this result the Y_{AP} is seen to be positive; i.e., the force AP acts away from the pin. The member AP is, therefore, in tension $\frac{4,000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{BA} + X_{AP} + X_{PB} = 0.$$

$$-BA \cos 60° - PB \cos 60° + PB \cos 0° = 0.$$

$$-\frac{4,000}{\sqrt{3}}.\frac{1}{2} - \frac{4,000}{\sqrt{3}}.\frac{1}{2} + PB = 0.$$

$$PB = \frac{4,000}{\sqrt{3}}.$$

The positive sign of the result shows that the X_{PB} is positive. PB must, therefore, act against the pin, placing the member PB in compression $\frac{4,000}{\sqrt{3}}$ pounds.

The forces acting at the point PACDL are in equilibrium, and act as represented in the Statical Diagram (Fig. 72).

$$\Sigma Y = Y_{PA} + Y_{AC} + Y_{CD} + Y_{DL} + Y_{LP} = 0.$$

$$-PA \sin 60^\circ + AC \sin 0^\circ - CD \sin 90^\circ + DL \sin 0^\circ + LP \sin 60^\circ = 0.$$

$$\frac{4,000\sqrt{3}}{\sqrt{3}} \cdot \frac{}{2} + 0 - 2,000 + 0 + LP \cdot \frac{\sqrt{3}}{2} = 0.$$

$$LP = \frac{8,000}{\sqrt{3}}.$$

The positive sign of the result shows that the Y_{LP} is positive; i.e., acts upward. In accordance with this, LP must act against the pin, placing the member LP in compression $8,000/\sqrt{3}$ pounds.

For the same point:—

$$\Sigma X = X_{PA} + X_{AC} + X_{CD} + X_{DL} + X_{LP} = 0.$$

$$PA \cos 60^\circ + AC \cos 0^\circ + CD \cos 90^\circ + DL \cos 0^\circ + LP \cos 60^\circ = 0.$$

$$\frac{4,000}{\sqrt{3}} \cdot \frac{1}{2} + \frac{2,000}{\sqrt{3}} + 0 + DL + \frac{8,000}{\sqrt{3}} \cdot \frac{1}{2} = 0.$$

$$DL = -\frac{8,000}{\sqrt{3}}.$$

The negative sign of the result shows that the X_{DL} (since the X equation is being used) is negative. DL is, therefore, a tensile force (acts away from the pin); i.e., the member DL is in tension $\frac{8,000}{\sqrt{3}}$ pounds.

The reader is advised to try and determine the stresses in the remaining members before referring to the solution as herein given.

(These solutions will be given next week.)

SOME OBSERVATIONS ON THE STABILITY OF DAMS.

By J. F. Jackson, M.W.S.E.*

In view of the rapidly growing interest in the subject of water power development and reservoir storage of water for various purposes, it has seemed to the writer opportune to present for discussion some more or less unorthodox observations on the manner of calculating and constructing the various generally accepted types of dams.

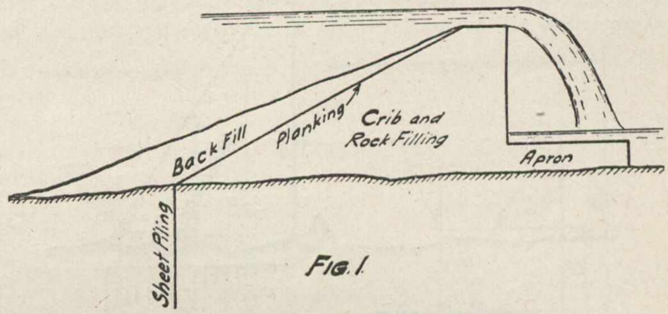
In the old-fashioned timber dams, hundreds of which have been built for logging and power purposes, on all sorts of foundations, it was customary to give the water-tight surface of dams a slope upstream, generally two or more horizontal to one vertical, making a cross section something like Fig. 1 in the case of an overfall dam. In case the height was considerable, the apron would be divided into two or more steps, to break the fall of the water.

For the purpose of a coffer-dam of moderate height on solid rock or impervious bottom, the same general idea is satisfactory, as shown in Fig. 2.

In this diagram the planking is shown laid at slope of one to two. Note the position and direction of the resultant of water pressure. Little theoretical study, as far as the writer knows, has been given to these forms of dams.

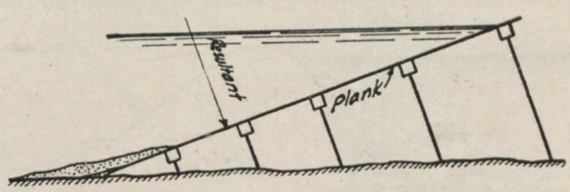
It is obvious in each of the above cases that the weight of the water and the back filling have been a large or the entire factor in the stability of the dam, both against sliding and overturning. "Castor Fiber," who belongs to the oldest race of dam builders, has always utilized the weight of water for stability, and some of his achievements have been truly remarkable. The lower part of his dams are always open for drainage. The writer contends that his work is more scientific than that of some of our modern builders, as will be demonstrated later.

Now when it comes to the construction of masonry dams, the first ones were probably built entirely by guess, but some of them stood up. A precedent having been established, in course of time, mathematicians came along and found that



Cross Section of Timber Dam.

masonry structures having a factor of safety of two against overturning and of one against sliding on their bases were actually standing up. Therefore a coefficient of friction of 0.6 or 0.7 was assumed, and a sufficient weight of masonry provided to resist the horizontal hydrostatic pressure of the reservoir. Hence we have the standard triangular or trapezoidal section as shown in Fig. 3, in which the resultant pressure of water and masonry usually falls just inside or at the middle third of the base, so that pressure begins practically at zero at the inner heel and increases to a maximum at the outer toe, as illustrated above, provided the structure acts as a unit. The pressure of water and weight of masonry are such that the coefficient of friction is barely sufficient to resist sliding. In fact, if it were not for the dove-tailing into rock at the base of the dam and into the walls of the gorge between which the dams are built, there would be many more failures by sliding than there have been. However, so far as



Cross Section of Coffer-Dam for Shallow Water.

mathematics are concerned, we have the astounding fact that in masonry structures of immense importance, and in perhaps no other cases, engineers are content to follow in the rut and build with a factor of safety of one! So much for precedent. Further than this, as soon as you assume hydrostatic uplift, or that water enters under the edge "A" of your dam, your precious friction coefficient is partially destroyed, and the dam fails. It is only fair to say that most engineers now make some attempt to drain toward the downstream toe of the dam. (See Transactions of Am. Soc. C.E. Vol. 34. Notes on High Masonry Dams by John D. Van Buren, for argument in favor of a section of masonry dam taking into account hydrostatic uplift. Of course, the form of masonry dam is somewhat circumscribed by the fact that no tension

*Read before the Western Society of Engineers, June, 1909.

is assumed on the upstream face, but the writer nevertheless believes it quite possible to develop a form of masonry dam in which the weight of water and possible back fill is utilized to add stability, and may propose something of that sort in the future. He surely believes that the ordinarily accepted coefficient of friction as indicated above and the factor of safety of two against overturning, should not be accepted as sufficient..

In earth dams, the writer believes, of course, that the section should be something like that shown in Fig. 4.

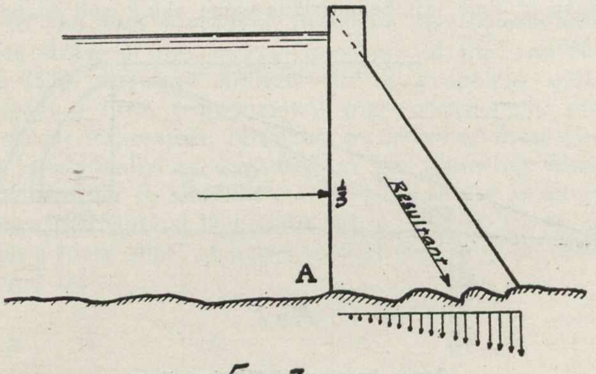


Fig 3

Typical Cross Section of Masonry Dam.

The same idea applies to an earth dam, a rock fill dam or like structure with a cut-off planking, reinforced concrete, steel plate, or common puddle. In every case water-tightness should, if possible, be secured as near the water itself as possible, and the vertical components of the hydrostatic pressure should be equal to or exceed the horizontal ones. Western engineers have already followed this idea to some extent in earth and in rock fill dams with planking.

Designers of concrete dams have usually followed the standard masonry profile or something near it. It is human nature, in engineering matters as in other affairs, to follow and develop an established idea, sound or unsound, to its utmost limits, while a new one or a very old and forgotten one, must make its way slowly.

Happily, Bainbridge with his steel dam, and Ambursen with his concrete dam, and the idea of the reinforced concrete

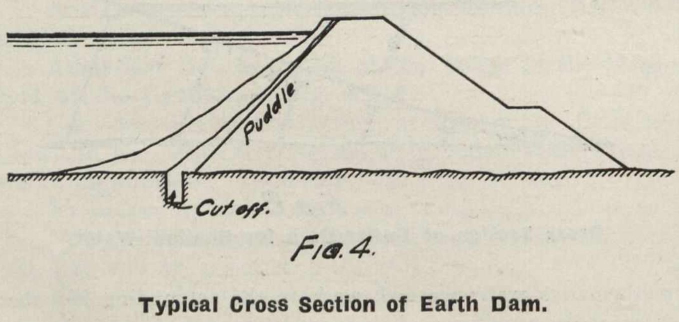


Fig. 4.

Typical Cross Section of Earth Dam.

retaining wall came along, so that it is now in order to consider a dam having a water-tight face capable of taking tension. Bainbridge's dam consists of a series of inclined bents covered on the upstream side with water-tight concave plates. (See Journal W. S. E. Vol. X, p. 615.) In this dam, water pressure is of course taken normal to the water-tight face (Fig. 5). The column loads are taken directly to the rock bottom, and tension of face plates is taken up by anchor rods, as indicated. If not founded on rock, the design must be altered radically, as indicated further on.

Although the Ambursen dam (Fig. 6) utilizes the weight of water to some extent, in my opinion it does not, as ordinarily constructed, provide much greater stability against sliding than the standard profile, though it does thoroughly provide against hydrostatic uplift by the open construction of its base. The main idea of Ambursen's patent was apparently to so construct the water face of his dam with reference to the cross walls that the direction of water pressure at any point should fall within the base.

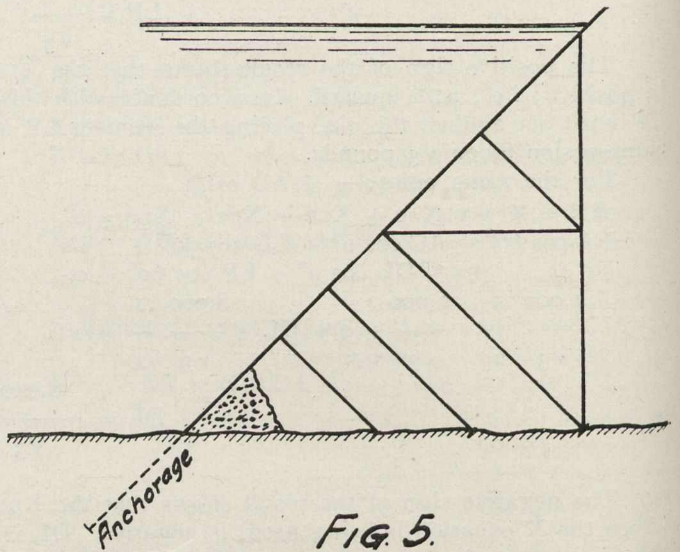


Fig. 5.

Cross Section of Bainbridge Steel Dam.

Of course, the calculation of stability of a steel dam on rock bottom, with given factors of safety, is very much simpler and more certain than even the design of a steel railroad bridge, and the writer believes that the time is coming when the merits of this construction will be much more appreciated by engineers than is the case at present.

In designing the cross section of a steel dam about 100 feet high, the writer accidentally hit on the idea of making

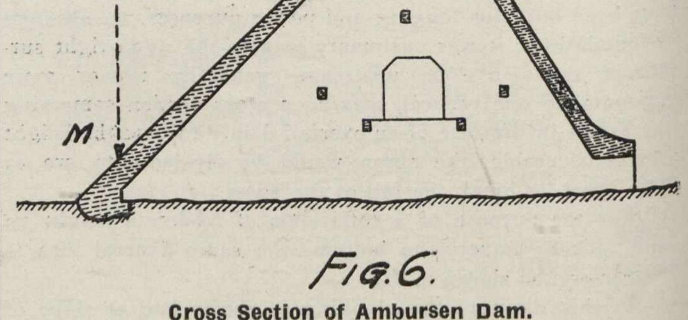


Fig. 6.

Cross Section of Ambursen Dam.

the part near the top, where hydrostatic pressures are light, near'y vertical, and sloping the part near the bottom, where hydrostatic pressures are heavy, until it was nearly horizontal. This resulted in a saving in construction cost, and a greatly increased factor of safety against sldiing and overturning.

The idea illustrated in Figs. 7 and 8, where the plating on the lower section is supported directly in concrete, cheap masonry, or other fil'ing, while the upper part is of steel construction. The amount, position, and direction of resultant pressures depend on the exact shape of the water-tight surface. The vertical water pressure may be made 1.5, 2 or even 3 times the horizontal pressure, depending on the width of base: and the resultant pressure of all, weight of water and structure, may be brought as near the centre as desired. In Fig. 7 is shown a dam of considerable height, and in Fig. 8 one of moderate height.

The limits of this idea are shown in Fig. 9. Suppose we have a dam built of a small bent plate: calling the height 24 in., the base 14 in., the horizontal water pressure would be 2,

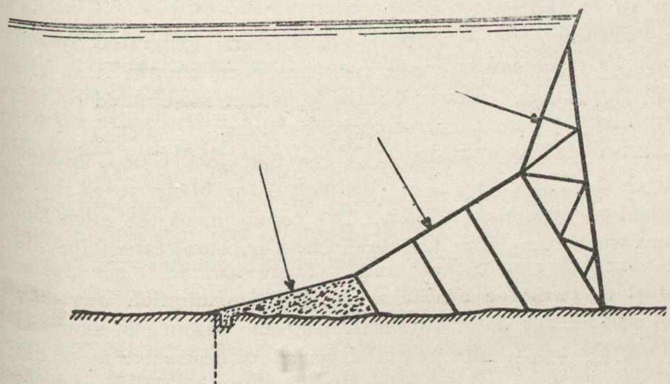


FIG. 7.

Cross Section of Suggested Concrete and Steel Dam.

applied at 8 in. from the base; the vertical pressure would be 2.33, applied at 7 in. from the bend. The resultant would be 3.1, applied practically at the bend. The structure would be just a little more than stable against overturning, and a friction coefficient of 0.86 would be sufficient to prevent its sliding.

In case the base were 24 in. and the height 24 in., as in Fig. 10, the horizontal water pressure would be 2 as before, and the vertical pressure would be 4, and the resultant 4.5, falling at a point one-third of the distance from the bend to

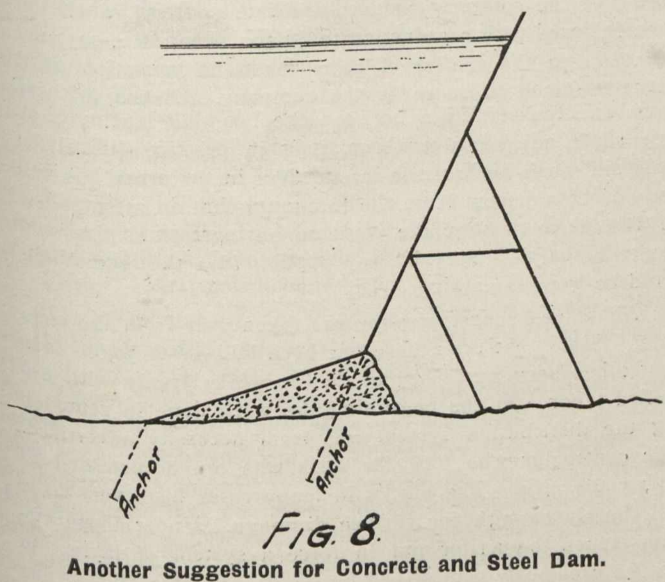


FIG. 8.

Another Suggestion for Concrete and Steel Dam.

the upstream edge of the horizontal plate. This resultant would stand two vertical to one horizontal, giving a coefficient of 0.50 to just prevent sliding. If you prevent leakage at "A" and your plate is stiff enough to prevent bending, you will have, due to water pressure alone, a small dam as safe against overturning and safer against sliding than the standard profile. It is evident, then, that in a dam having a base equal to its height, the sum of all horizontal pressures is exactly that due to the depth of the water, no matter what the shape of the water-tight surface, and it is possible to utilize the vertical pressures from a minimum of zero to a maximum of two times the sum of the horizontal forces, and to bring the resultant of both forces from a horizontal direction to an inclination of two vertical to one horizontal, as shown. Of course, in the practical structure of steel of the Bainbridge type or of concrete, wood, or other material, we would curve the tension face in some manner, and in making our calculation add the weight of the structure itself.

In Fig. 11 is shown the proposed section of a reinforced concrete dam having a concave water-tight face. Please note the position and direction of the resultant of the water pres-

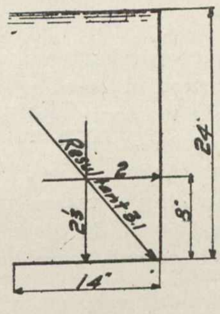


FIG. 9.

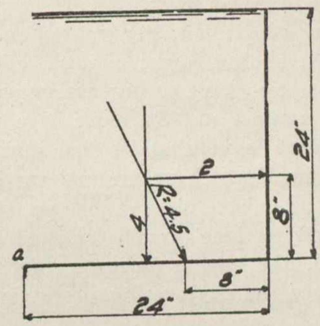
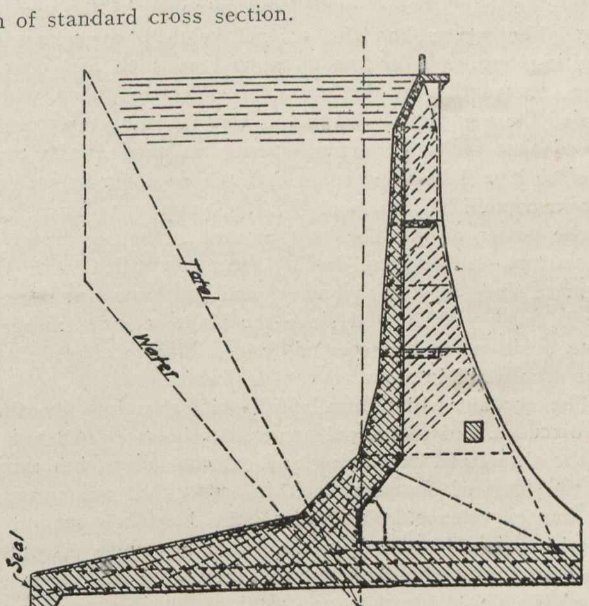


FIG. 10.

Cross Sections Showing by Bent Plates the Principle of Dam Suggested by Author.

sure and also note that the total resultant falls about half way between the centre and the 1/3 point. It is designed to be a very heavy and substantial structure, but contains only about one-half the amount of concrete of that required in a dam of standard cross section.



Cross Section
FIG. 11.

Proposed Typical Section of Reinforced Concrete Dam Suggested by the Author.

In this particular case the water pressure resultant stands at an angle of five vertical to four horizontal, and the total resultant at eleven vertical to five horizontal, and the structure very evidently has some stability against both overturning and sliding. A spillway section employing this principle also works out very favorably in either steel or concrete.

The patent office has recently recognized this principle of using hydrostatic pressure on a concave face to add stability to dams, etc. So far as the writer knows, this is the first recorded recognition of the hydrostatic principle involved. He does know, however, of a mining engineer out West who once built a small concrete dam wrong side to, and with very good results.

The modern inside buttressed reinforced concrete retaining wall employs a similar idea, but the earth pressures are not hydrostatic. In the earthen dam with masonry core wall, the hydrostatic pressure against the core is of course greatly modified (but nobody knows how much) by the presence of the earth fill on the water side. Its design is eminently a matter of guess work.

In conclusion, my contention is that a factor of one against sliding is not enough, and that we should turn the hydrostatic force to our assistance, instead of working entirely against it. We must have weight to secure stability, and there is nothing for that purpose quite so cheap as the water itself which we are undertaking to confine.

If the above observations on dam stability of various new and old sections provoke spirited discussion of the ideas involved, the writer believes that a service will have been rendered the engineering profession.

MUNICIPAL GAS PLANT EXPERIENCES.*

By C. E. Moore, C.E., Santa Clara, Cal.

The town of Santa Clara has one of the two municipal gas plants on the Pacific Coast, so far as known to the writer. There is nothing remarkable about this plant except the fact of its being owned and managed by the municipality. The writer has for several years been acting as consulting engineer for the town, and as such had charge of the construction of the water and electric plants which preceded the gas plant. When gas was taken up it naturally followed that the same arrangement was carried into that. Therefore it will be understood that the engineer as well as the town council had much of the gas business to learn, and that the writer of this does not assume to be an expert in gas matters. However, having been identified with the enterprise since its establishment, and continuing at present to be in touch with it, and since the plant occupies rather a unique position, it has seemed that a brief account of its career may be of interest.

The account will naturally fall somewhat into the lines of a discussion of municipal ownership, but this will not be with the object of establishing any extreme views, but rather with the idea of drawing such inferences as are possible from our experience. Regarding the broader question of general municipal ownership, the writer has come in contact with it in many other places and inevitably his views are somewhat colored by the sum total of all this experience, but the effort will be here to confine deductions as strictly as possible to those following from this case.

To make the situation clear, it will be necessary to first state in a brief way the cause which led up to this particular municipal ownership. Twelve years ago the town of Santa Clara took up the ownership of water supply. For this there were several powerful reasons, the chief one, perhaps, being the necessity for better fire protection. The plant was successful from the start.

There was also a desire for a more extended system of street lighting, and it seemed advisable to take that up in connection with the water plant. This plant was installed ten years ago. It also was satisfactory, and the people came to have considerable pride in the plants. Every town, like an individual, likes to have something to talk about, and the municipal plants came to be the thing to talk about in Santa Clara. The matter now passed beyond the case of necessity, and the later movements along this line have been largely the result of the impetus of the idea. Municipal ownership became a specialty. Commercial electric lighting was taken up by buying the property of the electric lighting company, remodeling and extending the system and combining it with the street lighting.

Current for this purpose was formerly generated by the town, but for several years past has been bought from the San Jose Light & Power Company, and it is supplied by the Standard long-distance transmission lines.

Gas has been supplied by the San Jose Gas Company (later the Light & Power Company), for many years, by a pipe line from their works. The condition of the town has been such that there had been little encouragement for the company to extend their lines. There had been no special effort to push the business, and the consumption was only 10,000 feet per day. However, with the coming of renewed life to the town there began to be felt a desire for more extended service. Chiefly the development of the gas plant may be considered as due to the idea which had taken root. There was no particular dissatisfaction with the company, and the movement was entirely devoid of enmity to it. Accordingly all the property of the company in the town was purchased at a valuation made by an expert agreed upon by both parties. The transaction was amicable and satisfactory throughout.

There has since been considerable consumption (chiefly for fuel purposes), and the output at present is 35,000 per day. The price of gas was at first fixed at $1.75 per thousand, that being the price charged by the gas company. Later for service in San Jose the company made the rate $1.50, but no reduction was then made by the town. Still later the company reduced the rate to $1.25, when the town followed with a reduction to $1.50. That is to say, the town has in the matter of rates made no reduction until virtually forced to do so by the company. Of course there is no direct competition between the two, but inasmuch as they serve adjoining territory, it is in practice difficult to maintain much higher rate in one than in the other. It will perhaps be apparent from the foregoing that an attempt has been made to manage the plant on business principles, and not to be carried away by any popular idea that something could be got for nothing.

About 10,000 feet of pipe was taken over from the company. Since that time there has been laid about 50,000 feet.

It has been necessary to do the work largely with unskilled labor. At the beginning the work done in remodeling the distribution system was from necessity advertised. The contractor who took the work was not accustomed to laying the pipe. The blocks in many cases have very little fall, barely enough for surface drainage. Under these circumstances the writer put in force a system of laying to grades previously established by levels, and this system has been followed for extensions. This is done so simply, with so little trouble, and with such good results from entirely unskilled labor in grading the trench, that it would seem good policy for any company working in a flat country to follow the same system. In the old pipes, laid in the old way, with a spirit level, there have been frequent stops and stoppages. In the new mains there have not been any at all. The number of drips is by this system kept small, and these are located at convenient points. It may be that some gas

* A paper before the California Gas Association.

companies use similar methods, but so far as I know they generally do not. The exact methods used had previously been developed on sewer work. Now as to the conclusions which may be drawn from our experience:

First, the plant and business needs continual and watchful care. In our case the care has been provided, and consequently the business has been successful. It has been very fortunate that there have been few changes of officials. The office of President of the Board, or Mayor, during all this time has not changed. The chairman of the water and light committee also is an old-timer, and has from the first been identified with the business. Questions of policy have been given careful consideration; just as careful as though it had been their own business. The result has been a good profit, but it is very easy to see how the balance might have been the other way. This is the chief danger that confronts any scheme of municipal ownership, namely, that men of ability may not be willing to give their attention to the town's business, or that the people will not have the good sense to keep that sort of men at the head of affairs.

Second, as to the ability to meet emergencies. We had an experience of this kind growing out of the partial wrecking of all plants by the earthquake. This rests upon the men and not upon the system. In our case we feel that we have no cause for regret, inasmuch as water was supplied in about 24 hours, and gas in three days. This goes back to the first question of management.

Third, the ability to provide extensions.

In this particular the municipality is decidely at a disadvantage. Whereas, a company can in this case borrow money to meet a large increase in the demands upon it, a municipality can not do this except a bond issue, which cannot be resorted to in all cases. Consequently it is necessary to look well ahead and provide far in advance for such extensions of magnitude as are likely to be necessary.

Fourth, as to the attitude of customers. In these matters we are dealing not only with gas but with human nature, and this is practically the same the world over. There is an occasional demand for lower rates, in the case of the town, as there would be with the company. There is the same distrust of meters. About half the consumers consider the collector and meter reader to be their natural enemy. The people's pride in the plant is chiefly in the abstract, and does not particularly affect their attitude toward bills, and service. And yet it is not quite fair to let the question go at that, for there is a certain amount of feeling of individual ownership, which probably makes the conduct of these matters a trifle smoother than in ordinary cases.

Fifth, general conclusions.

The conviction of the writer is that no municipality should be advised to undertake the management of plants for the sake of profit, solely, as an individual or company may do. There should in general be other and stronger reasons. In the case of water, there often are such reasons. As we leave water supply and look along the line of other utilities, we find that in general these causes have less force. This does not mean that gas should be supplied at cost. In the first place, in a developing community extensions and increased facilities in every way are certain to be needed. If gas is supplied at cost all this must be accomplished by taxation.

Secondly, the question of exact cost is a precarious one at best. It must include all unexpected and emergency expenses and can really only be determined after a long term of years.

The probability is that selling at a cost determined from ordinary expenses would finally result in the plant requiring support from other resources of the town.

SOCIETY NOTES.

(Continued from page 569.)

Toronto Branch, Canadian Society of Civil Engineers.

At a meeting of the Toronto branch of the C.S.C.E., held in the Chemistry and Mining Building of the University of Toronto, on Monday evening, November 15th, Mr. Allen Hazen, consulting engineer, of New York, who was recently engaged by the City of Toronto to give expert advice in connection with the installation of a filtration plant, delivered an interesting lecure on "Water Filtration." The developments of the past eighty years were traced and illustrated by lantern slides. Views and diagrams relating to the water supply of different cities in Europe and the United States were also shown, the references to the plant at Albany, New York, the fundamental details of which are included in the scheme adopted by Toronto, being especially interesting. Of interest to many were the figures quoted to show the desirable effect the installation of meters has on the amount of water consumed.

Mr. J. G. G. Kerry, C.E., chairman of the Toronto branch of the society, presided at the meeting, and among others present were Dr. Sheard, City Engineer Rust, Dean Galbraith of the Faculty of Applied Science, Dr. Oldright, Mr. J. Fleming Goodchild and Dr. King, representing the Toronto Academy of Medicine.

RAILWAY ORDERS.

(Continued from page 565).

tracks of the British Columbia Electric Railway Company near Front and Columbia Streets, Vancouver, B.C.

8576—October 27—Dismissing application of the city of Vancouver for an Order authorizing the opening of Clarke Drive across the tracks of the C.P.R. Company, that city.

8577—November 3—Granting leave to the Nipissing Power Company to erect, place, and maintain its transmission lines across the track of the G.T.R. Company at Nipissing Junction, in Township of Ferris, Ont.

8578—November 3—Granting leave to the G.T.P. Railway to carry freight traffic over its line of railway from Battle River to Edmonton, Alta.

8579—November 2—Authorizing the C.N.Q. Railway to take parts of Lot No. 213 in Parish of St. Charles Borromee, and parts of Lot No. 2 in town of Joliette, County Joliette, P.Q., for the purpose of securing the efficient operation of its railway.

8580—November 2—Dismissing application C.P.R. for Order extending provisions of Order No. 7813, dated July 3rd, 1909, authorizing the city of Toronto to construct bridge to carry the highway and tracks of the Toronto Street Railway Company over tracks of the C.P., G.T., and C.N.O. Railways, where such tracks cross Queen Street East in said city, so as to provide that when said bridge is completed it be closed for pedestrian and vehicular traffic.

8581—November 2—Dismissing application of city of Toronto, Ont., to construct high level bridge over Don Improvement and Canadian Pacific, Grand Trunk, and C.N.O. Railways at Queen Street, Toronto, Ont.

8582—November 9—Granting leave to the C.P.R. to load and unload on the Lord's Day to and from car ferries plying between Ashtabula, Ohio, and Port Burwell, Ont.

8583—November 5—Authorizing (temporarily) the tariff of tolls the Bell Telephone Co. shall charge, and form of agreement to be made between it and several rural telephone companies in the Province of Ontario.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coultee, Box 560, Ottawa; S. J. Chapleau, Box 203.

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ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES. — President, H. H. Gaetz, Red Deer, Alta.; secretary-treasurer, John T. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Company, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE. — Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY. — President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

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

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB. — President Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

(Continued on page 50.)

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	Earnings Week of Nov. 14, 1909	Earnings Week of Nov. 14, 1908	Toronto Price Nov. 5 '08	Toronto Price Oct. 28 '09	Toronto Price Nov. 4 '09	Toronto Sales Week End'd Nov. 4	Montreal Price Nov. 5 '08	Montreal Price Oct. 28 '09	Montreal Price Nov. 4 '09	Montreal Sale Week End'd Nov. 4
Canadian Pacific Railway	8,920.6	$150,000	$100	$2,130,000	1.676,000		184½	184	116	178½ 178	184½ 184	185 183	379
Canadian Northern Railway	2,986.9	......	......	369 800	264,500	......	......	......	......	......	......	......	......
*Grand Trunk Railway	3,536	226,000	100	924,271	854,223	......	*1st. pref. 108½, 3rd pref. 57½, ordinary 23½					......	......
T. & N. O.	334	(Gov. Road)	......	......	......	......	......	......	......	......	......	......	......
Montreal Street Railway	138.3	18,000	100	75,817	68.215	......	......	......	......	199¾ 199½	209 208½	208 206	160
Toronto Street Railway	114	8,000	100	75,498	67,891	......	123⅜	123¼ 123	325	106¼ 106	124½ 123½	123 122¾	528
Winnipeg Electric	70	6,000	100	......	......	169½ 168½	182½	184 183½	40	169	......	183	......

* G.T.R. Stock is not listed on Canadian Exchanges. These prices are quoted on the London Stock Exchange.

T. & N. O. EARNINGS

The earnings of the Temiskaming & Northern Ontario Railway for the week ended November 7th, were:—1909, $33,458.81; 1908, $17,286.63; increase, $16,172.18.

* * * *

The earnings of the Guelph Junction Railway for the quarter, ending 30th September, 1909, amounted to $7,492.26, as against $6,706.88 for the same quarter of last year. This will make the total amount of receipts during the year $25,756.79, as against $22,378.10 received during the same period last year.

ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously Given:—

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston

TORONTO AND YORK RADIAL.

President, William Mackenzie.
Manager, W. H. Moore.
Chief Engineer, W. B. Boyd.
Purchasing Agent, A. M. Grantham.

Kind of Road: Suburban.

Length of Road:

Double track, 0 miles.
Single track, 81 miles.
Total in single miles, 81.

Character of Service:

Car equipment, 56; type, G. E. Co. and Westinghouse.
Power of motors, 35 h.p. to 75 h.p.
Method of controlling, simple controllers and master controllers.
Method of braking, air and spindle.
Gauge of track, 4 ft. 8½ in., and 4 ft. 10⅞ inch; weight of rails, 56 and 60 lbs.

Power:

Direct current, D.C.
Alternating current, A.C.
Voltage of transmissions, 16,000.
Trolley voltage, 550.
Frequency of transmission for A.C., 60 cycles.
Number of phases, 3-phase.

WINDSOR, ESSEX AND LAKE SHORE RAPID RAILWAY COMPANY.

President, W. C. Crawford, Tilbury, Ont.
Vice-President, John Piggott, Chatham.
Managing Director, W. T. Piggott, Kingsville, Ont
Chief Engineer, W. A. Chisholm, Kingsville.
Purchasing Agent, W. T. Piggott, Kingsville, Ont.
Superintendent, A. W. Westman, Kingsville, Ont.

Kind of Road: Interurban.

Length of Road, in miles:

Total in single miles, 37.28.

Character of Service:

Type, Westinghouse, No. 132, A.C.
Number of motors, 14.
Power of motors, 100 horse-power.
Method of controlling, potential hand control on passenger motor cars; multiple-unit potential control on locomotive.
Method of braking, S.M.E. air brake on passenger motor cars; standard automatic and straight-air combined on locomotive.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 60 and 80 lb. used. Switches, sidings, and stub ends use the 60 lb.

Power:

Two direct connected units, 500 K.W. each.
Direct current, none.
Voltage of transmission, 13,200 volts.
Trolley voltage, 6,600 volts.
Frequency of transmission for A.C., 25-cycle.
Number of phases, single.

THE OTTAWA ELECTRIC RAILWAY COMPANY.

President, A. Ahearn.
Superintendent and Purchasing Agent, J. E. Hutcheson.
Secretary and Treasurer, James D. Fraser.

Kind of Road: Suburban and Street Railway.

Length of Road, in miles:

Total in single miles, 40.

Character of Service:

Car equipment, No. 160; type, open and closed.
Number of motors, 200; power of motors, 30, 40 and 50 horse-power.
Method of controlling, ordinary.
Method of braking, hand and Westinghouse air.
Gauge of track, 4.8½.
Weight of rails, 70 to 80, T

Power:

Direct current, 600 v.
Trolley voltage, 600 v.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

Nova Scotia.

HALIFAX.—Tenders will be received until December 6th, for 3,000 feet of 2½-inch rubber hose, to stand a pressure of 300 lbs. per square inch on delivery, and 200 lbs. in ordinary fire service. A 3-year guarantee is required. Bids submitted some time ago, for the same material, on another basis, were returned. Mr. F. W. W. Doane is city engineer.

Quebec.

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

HULL.—Tenders will be received until Monday, 6th December, 1909, for pumping equipment. R. W. Farley, City Engineer. (Advertisement in the Canadian Engineer.)

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

QUEBEC.—Tenders will be received until Tuesday, the 30th November, for the building of the substructure of the Quebec Bridge. The general specification and form of tender will be ready about November 20th; but in the meantime contractors are invited to visit the office of the Quebec Bridge Board of Engineers, Canadian Express Building, Montreal, for the purpose of securing preliminary information to enable them to submit tenders for this work. L. K. Jones, secretary, Department of Railways, and Canals, Ottawa.

Ontario.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

PETERBORO.—Tenders will be received until November 20th for heating, plumbing and wiring the public library. Mr. John E. Belcher, C.E., architect. Mr. S. R. Armstrong, city clerk.

TORONTO.—Tenders will be received until Wednesday, November 24th, for pole line supplies. Specifications may be seen at the Electrical Department. Jos. Oliver, (Mayor), Chairman, Board of Control. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until December 7th for annual supplies, including:—Cement, gravel, paving materials, lumber, pipe, bricks, etc. Further particulars are given in our advertising columns. Mr. Joseph Oliver, (Mayor), Chairman, Board of Control.

TORONTO.—Tenders will be received until Monday, November 22, for additions and alterations to the Toronto General Post Office. Plans may be seen at the office of Mr. Thomas Hastings, clerk of works, Customs Buildings, Toronto; N. Tessier, secretary, Department of Public Works, Ottawa. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders for electric wiring in the branch library on the north-west corner of Gerrard Street and Broadview Avenue will be received up to Thursday, November 25th. E. S. Caswell, Secretary-Treasurer, Toronto Public Library.

Manitoba.

HARTNEY.—Tenders will be received up to December 6th, at 5 p.m., for the construction of a pile bridge across the Souris river on section 25—5—25, near Lauder. Plans and specifications may be seen at my office in Hartney. T. B. Woodhull, secretary-treasurer, Municipality of Cameron.

ROSSER.—Tenders will be received up to Saturday, November 27th, for the sale of one 40 horse-power gasoline walking dredge. W. H. Beachell, secretary-treasurer.

WINNIPEG.—Tenders will be received for drainage, requiring approximately the removal of over 200,000 cubic yards of material, up to noon of Monday, the 22nd of November. Arthur Stewart, 323 Main Street.

Alberta

CALGARY.—Tenders will be invited by this municipality for six additional new steel cars of the pay-as-you-enter type. They are to be five feet longer than the cars now in use, and will be equipped with air brakes. Exclusive of the motors, it is expected that they will cost approximately $25,000, f.o.b. Calgary, for early spring delivery. Mr. J. T. Child is the city engineer.

CONTRACTS AWARDED.

New Brunswick.

MONCTON.—Tenders for valves were received as follows: Sumner Company, $105.80; Peiler, McKenzie & Lodge, $131.75; Canadian Fairbanks Company, St. John, $129. The lowest was accepted. The J. E. Masters Coal Company was given a contract for 500 tons of Gowery coal at $2.75 f.o.b., Moncton.

Quebec.

MONTREAL.—The City of Montreal recently invited tenders for the construction of a five-foot circular sewer, with the necessary connections, on Sherboroke Street, from Victoria Street to Drummond Street, and received the following, that of Henault & Hefferman, $25,266 being accepted:—

Henault & Hefferman	$25,266.00
Gilbert & Toussaint	28,988.25
Canadian General Developing Company	33,307.95
L. Gignere & Company	28,987.50
M. Lapointe	32,476.50
M. Dineen	25,474.50
John Leahy & Company	32,827.50
Michael Maisan & Company	36,769.50
Decarie & Taillefer	25,488.75

NOTRE DAME DE GRACE.—The contract for the new school was awarded to the Canadian Construction Company at $13,400 for one-half the job, or $20,400 for completed work. Other tenders were: Morrison $23,000; Whitaker $24,000.

Ontario.

BRACEBRIDGE.—Contracts for general work and the equipment of a new power plant were awarded a few days ago. The following tenders were received:

"A," General Division: For construction of general works of the hydro-electric development of Wilson's Falls, Muskoka River, consisting of dams, coffer dams, rock excavation, concrete walls, foundations, etc.:

*Canadian Contracts, Ltd., Toronto	$19,341.00
Williamson Construction Company	19,923.75
Blair & Hill	21,000.00

"B," Hydraulic Machinery, including 1,100 horsepower turbine, 35 horse-power turbine, governor, penstock, etc.:

*Wm. Kennedy & Sons, Owen Sound, Ont.	$ 8,100
Morgan & Smith	9,000
William Hamilton & Sons	8,850
Jenckes Machine Company	7,592
Allis-Chalmers-Bullock, Ltd.	13,196

"C," Electrical Machinery, including generator, exciter, switchboard, etc.:—

*Canadian General Electric Co., Toronto	$6,724
Chapman & Walker, Toronto	9,150
Kilmer & Pullen Company, Toronto	7,200
Allis-Chalmers-Bullock, Ltd.	6,975
Westinghouse Electric Company	7,625

* Accepted.

BERLIN.—For the construction of a paved roadway on King Street, between Water and Scott Streets, the following tenders were received:—

General Cont. Co., curb to curb, creosote block	$36,700
Henry Dotzenroth, curb to curb, vitrified brick	38,228
" " curb to curb, asphalt block	43,695
" " Scoria between rails, asphalt block	48,695
" " brick between rails, asphalt block	42 195
Warren Bit. Co., brick between rails, bitulithic	31,200
" " brick between rails, sheet asphalt	30,125
" " brick between rails, bitulithic	32,300
" " brick between rails, sheet asphalt	31,225
Blight & Fielder, curb to curb, vitrified brick	34,358
" " " brick between rails, asphalt block	37,540
" " " curb to curb, asphalt block	39,939
" " " Scoria between rails, asphalt block	43,122
John McGuire, curb to curb, vitrified brick	36,800
Godson Const. Co., curb to curb, vitrified brick	41,887
" " " brick between rails, sheet asphalt	37,400
" " " Scoria bet. rails, sheet asphalt	43,641
" " " brick between rails, asphalt block	41,960
" " " Scoria bet. rails, asphalt block	49,400
John Conn, curb to curb, vitrified brick	37,246
" " brick between rails, asphalt block	40,746
" " curb to curb, asphalt block	41,946
" " Scoria between rails, asphalt block	42,946
Excelsior Const. Co., curb to curb, vitrified brick	36,698
" " curb to curb, asphalt block	41,755
I. M. Clemens, curb to curb, vitrified brick	37,716
Const. & Paving Co., curb to curb, vitrified brick	35,300
" " " " brick bet. rails, sheet asphalt	33,500
" " " " Scoria bet. rails, sheet asphalt	39,380
" " " " curb to curb, asphalt block	46,373
Forest City Paving & Construction Co., concrete	23,430
" " " " " creosote block	35,077
" " " " " curb to curb, vitrified brick	32,605

The contract was given to the Warren Bituminous Paving Company, of Toronto, at $32,300, for bitulithic material Their tender provides for a 5-year guarantee, according to specification.

HAMILTON.—The Smart-Turner Machine Company were recently awarded the following contracts: Prince Edward Island Railway, duplex outside packed plunger pump; Northern Crown Bank, Toronto, automatic feed pump and receiver; the Ontario Iron and Steel Company, a vertical centrifugal pump; the Kirkfield Portland Cement Company, a side suction centrifugal pump.

KINGSTON.—Michael Sullivan, of Kingston, was awarded a contract for masonry and carpentery, in connection with new chemical building, at $59,634.

OTTAWA.—The contract for the ten circuit repeater switchboard and storage battery was awarded to the Northern Electric and Manufacturing Company of Montreal, for $8,497.

Manitoba.

BRANDON.—Mr. James A. Fouch and W. Adam Folty, the erecting engineers for the Laclede-Christy Clay Products Co., of St. Louis, Mo., and the Kerr-Murray Manufacturing Co., of Fort Wayne, Ind., are here in connection with the installation of the new gas plant of the Brandon Gas and Power Co., the former company having the contract for the retort benches and their complete installation, and the latter company for the supply and erection of all the general machinery, including exhausters, condensers, scrubbers, and purifying boxes, with all necessary pipes and connections.

Alberta

LACOMBE.—Contracts for an auxiliary steam plant at the new power house and for the repairs to the dam, to cost $4,000, were awarded at a recent council meeting. The engines and boilers will be supplied by the Waterous Engine Works Co., of Brantford, Ont., and Councillor Mobley, will supervise the repairs to the dam.

British Columbia.

NELSON.—The Nelson Iron Works have been given a contract for the iron work required in the construction of a bridge over the Slocan River at Slocan Junction, giving connection between Thrums and Slocan Junction, and forming a link in a through road from West Robson to Nelson. The bridge will be 213 feet in length and will cost $10,000. The Provincial Government is doing the work.

VANCOUVER.—The contract for fifty miles of wire-bound wood pipe for the municipality of South Vancouver, to cost $70,000, has been awarded to the Municipal Construction Co., of this city. This is by far the largest contract for wood pipe ever placed with one firm in Canada.

LIGHT, HEAT, AND POWER

Ontario

BROCKVILLE.—Brockville's civic light and power department closed its fiscal year on September 30th, and from the report just published it is found that the receipts during the year were $51,915.36. The operating expenses were $43,453.33, leaving a balance of $8,462.03 profit. From this debentures amounting to $7,597.32 were paid, leaving a net gain of $864.71. The plant was purchased nine years ago, and since then gas and electric light has been reduced from $2 to $1.12½ net per 1,000. The population of Brockville is 8,950.

GALT.—Mr. Edward B. Merrill, consulting engineer, of Toronto, has reported to council, fixing the value of the electric lighting plant which the Galt Gas Co. has offered to sell to the corporation as a distributing plant in connection with the Hydro-Electric Power scheme. Mr. Merrill finds that the value of the plant proper is $63,000, according to the original cost, with deductions for depreciation, $44,000, and, so far as it would be directly available for Hydro-Electric power purposes, $35,000. The report was referred to the Light Committee.

OTTAWA.—The council of the village of Eastview favor the installation of an electric light plant to supply the whole village with electricity at $15 per horse-power per year.

TORONTO.—A board of arbitrators has been sitting at Toronto for several days to determine the value of water privileges on River Winnipeg, of which the Hudson's Bay Company and the Keewatin Power Company were expropriated by the town of Kenora. The undeveloped water power rights were valued by Mr. Alexander Pringle, M.C.S.C.E., and Mr. Wm. Kennedy, Jr., M.C.S.C.E., both of Montreal, as well as by Mr. Clement Herschell, C.E., of New York. The valuations were $5,000 to $10,000; $10,800 and $48,000. The arbitrators will resume the hearing on January 4th, 1910.

TRENTON.—The by-law submitted to the ratepayers for the purpose of validating an agreement handing over the water power franchise to the Trenton Electric & Power Company was defeated by a majority of 239.

Manitoba.

BRANDON.—Engineer Harper, who is supervising the installation of gas in this city, expects that the remainder of the mains will arrive about the end of this week, when the work of laying the pipes for the present season will be resumed. Work on the new steel gas-holder is in full swing and satisfactory progress is being made. Mr. James A. Fouch and Mr. W. Adam Folty, representatives of the Laclede-Christy Clay Products Co., of St. Lewis, Mo., and the Kerr-Murray Manufacturing Co., of Fort Wayne, Ind., who have contracts for equipment and machinery, arrived here a few days ago, and the work of construction will now be pushed to completion.

Alberta

LACOMBE.—By the end of the month the new electric light plant now under construction will probably be completed. Contracts have been awarded to Councillor Mobley for repairing the dam at a cost of $4,000, and to the Waterous Engine Works Co., of Brantford, Ont., for an auxiliary steam plant. Mr. E. J. Tett has been appointed manager of the plant.

British Columbia.

KAMLOOPS.—The report of the electric light committee on the proposals submitted by the Shuswap Power Company was adopted at a recent council meeting, the report recommending that a counter proposal be made the company, of $30 per annum per kilo on a peak load of 225 kilos, the whole matter to be subject to the approval of the consulting engineer, Mr. H. K. Dutcher, of Vancouver, B.C.

RAILWAYS—STEAM AND ELECTRIC.

New Brunswick.

FREDERICTON.—Surveys have been commenced for a new branch railway in York county, and when completed the new road promises to be an important adjunct to the C.P.R. system in New Brunswick. The new railway will be about fourteen miles in length, and will run from Millville, on the Gibson branch of the C.P.R., through Temperance Vale, and out to Southampton, following the course of the Nackawick valley, and thence up the eastern end of the Pokiok bridge across the St. John River. A staff of engineers in charge of Chief Engineer Holt is now engaged in making the surveys, and if actual work is not started this winter it will commence with the first opening of spring.

Ontario

LONDON.—Track elevation in London has been the subject of much talk here during the past few days. A letter received by the mayor from the Dominion Railway Commission stated that the Board desired to be informed of the position of negotiations between the city and the railway company regarding the elimination of level crossings. In his letter Mr. J. P. Mabee, Chief Commissioner of the Railway Board, said: "The legislation of last session contemplates this Board initiating steps towards the abolition of level crossings, but before taking these in London it would like to be informed of what has been done by the city council looking towards the elevation of the Grand Trunk tracks through the city. It is thought by authorities that track elevation in London will involve an expenditure of $250,000. Since January, 1900, twenty-five railway accidents have occurred on the streets of London.

TORONTO.—The C.P.R. Co. desire to make some changes in the plans for the proposed high-level bridge on Queen Street East. They suggest that instead of putting in a solid fill trestle work should be permitted. The company also suggested an alteration in the floor system. In these alterations it is hoped to cut down the cost of the bridge by about $18,000.

TORONTO.—It is stated on good authority that Mackenzie & Mann have added another to their string of Ontario railway properties, by purchasing the Irondale, Bancroft and Ottawa Railway. This line which is about 50 miles in length, runs from Kinmount Junction on the Grand Trunk's Lindsay-Haliburton branch to within a few miles to Bancroft, in the northern part of Hastings County. It has been in operation about 20 years.

Alberta.

CALGARY.—Six new tracks two thousand feet long, which the C.P.R. are adding to their sidings here, will be completed in a day or two.

Saskatchewan.

LEBRET.—The G.T.P. surveyors are back from Regina, to which point they have surveyed a new line from Balcarres. Mr. Wilkie is in charge.

British Columbia.

NEW WESTMINSTER.—The British Columbia Electric Railway Company recently announced that their line would be extended to the Fraser River mills.

PHOENIX.—Mr. J. B. Tierney, of W. P. Tierney & Company, has charge of the construction of a branch line of the C.P.R., from Phoenix to Wellington Camp. Mr. H. B. Walkem, of the C.P.R. engineering staff, is directing the work, which is to be completed by February 1st, according to the contract.

PRINCE RUPERT.—Contracts are let on the G.T.P., and grading is under way between Kitselas and Hazelton, 80 miles. This work is considerably lighter than that of the lower part of the river and the contracts let are consequently much larger. It is not expected that anything can be done toward starting work beyond Hazelton this year. Following is a list of the contractors and the mile at which their work begins:—McDougall & Rankin, 102; D. A. Rankin, 112; M. Sheedy, 122; Moran & Chiene, 124; A. L. McHugh, 138; P. Salvus, 142; Bostrum & Kullander, 145; Sheedy & Paget, 155; Dan Stewart, 159; Norman McLeod, 162; Freebery & Stone, 8-172; Foley, Welch & Stewart, 5-175; Duncan Ross, 3-178.

England.

LONDON.—The Government has decided to grant $675,000 towards the Collooney & Blacksod Bay Railway. When this is constructed London will be only fourteen hours from Blacksod Bay, from which Halifax, Nova Scotia, is distant only three and a half days.

CEMENT—CONCRETE.

Ontario.

HASTINGS.—The concrete landing pier at the dam is now completed as far as the cement part is concerned. The iron tie posts have been bedded in the concrete and everything is ready for the dredge to come along in the spring and rip out the strip of rock which was the old water front and was used as a coffer dam while the wall was being laid.

SEWERAGE AND WATERWORKS.

Ontario.

TORONTO.—The Board of Control is considering the installation 11,137 feet of new water main with 36 hydrants.

OTTAWA.—The village council of Eastview are considering plans for a drainage system. Mr. Charles H. Keefer, M. Can. Soc. C.E., of Ottawa, who reported on the main sewers of Ottawa some years ago, has been advising.

Alberta.

HIGH RIVER.—Waterworks will probably be installed here very shortly. The question is receiving much attention.

FINANCING PUBLIC WORKS.

Ontario.

LINDSAY.—About New Year's Day the ratepayers of Lindsay will vote an a by-law to provide $55,000 for schools.

TORONTO.—In Sept. last we stated that City Engineer Rust had prepared a report on the proposed Bloor Street viaduct and estimated the cost of two bridges, grading, paving and engineering at $619,000. This figure did not include land damages. The question was revived again at a meeting of the Board of Works last week, and the board decided to recommend to the City Council that a by-law to include $150,000 for land damages be submitted at the January elections.

British Columbia

VANCOUVER.—By the corporation of the township of Richmond tenders are invited for the purchase of $275,000 waterworks and $75,000 road improvement debentures up to December 1st. S. Shepherd, C.M.C.. Rural Route No. 1, Eburne, B.C.

MISCELLANEOUS.

New Brunswick.

ST. JOHN.—The City Council decided at a recent meeting to engage as assistant to Mr. William Murdoch, the city engineer.

Quebec.

MONTREAL.—On Monday, Mr. G. W. Stephens, of the Montreal Harbour Commission, outlined the scheme planned for harbour development here. Briefly it is expected to make water porterage possible by lessening the currents; to give water access by way of the canals to Western Canada and the United States; to create manufacturing and warehousing sites having direct rail connections over all lines with every port of the continent; to reduce the handling charges on every ton of freight coming to the port. The scheme will probably cost $12,000,000. The project is to be laid before Parliament at this session.

MONTREAL.—Arrangements have been completed for the establishment of a drydock at Levis, Que., according to a cable from the Old Country, received here on Monday. The interests involved are the Canadian Pacific, the Allans, Harland & Wolff, the Belfast Shipbuilding Company; Sir Charles MacLaren, representing John Brown & Company, of Sheffield; Mr. Davis, of Levis, who conducts the present salvage and drydock business there, and the McArthur-Perks Co. of Canada. The same interests have made a definite proposal to the Canadian Government, which they expect will be accepted, for a drydock in St. John. The constructors have decided not to erect this drydock at the Canadian Pacific wharf in St. John, but somewhere around Partridge Island.

Ontario.

HAMILTON.—A new bolt and bar mill will be built here in connection with the Hamilton Steel and Iron Company. The expenditure for new works will be large.

OTTAWA.—While a definite conclusion will not be reached until next week, it is regarded as likely that the new Quebec Bridge will be built upon the cantilever, rather than suspension principle.

WELLAND.—A new industry, the Electro Steel Company of Canada, is to locate here. The site embraces fifty acres. The officers are: President, Tyson S. Dines, St. Louis, Mo.; vice-president, George S. Goodrich, Saratoga, N.Y.; secretary, A. S. Ragame, St. Louis, Mo. The capitalists behind the enterprise are Pittsburg men, who have large interests in the United States steel and iron trade. The billet mill, for which the contracts are placed is on the south side. Five steamers are chartered to deliver cargoes of ores from the Lake Superior mills before the close of navigation.

British Columbia.

VANCOUVER.—The Dominion Wire Manufacturing Company, of Montreal, is locating in Vancouver, and will manufacture wire nails for the trade on the Coast.

VANCOUVER. — The Pacific Creosoting Company, of Seattle, has secured a site on Burrard Inlet and will establish a plant. Several Vancouver capitalists are associated.

VANCOUVER.—The D'Olier Engineering Company, of Philadelphia Pa., have an expert here in connection with the tests that are being made of the high pressure pumps.

VANCOUVER.—After having spent four seasons in survey work in northern British Columbia waters, being principally engaged in surveying the various deep-sea approaches to Prince Rupert, the coast survey ship H.M.S. "Egeria" returned from the north last week in charge of Captain Parry.

VICTORIA.—City Engineer Topp recommended the purchase of street flushing machinery at a recent meeting of the council, who are considering the question of street cleaning.

PERSONAL NOTES.

MR. E. J. TETT has been appointed manager of the new power plant at Lacombe, Alta.

MR. JAMES WHITE, who has been Dominion Geographer since 1884, was recently appointed secretary of the Commission for the Conservation of Natural Resources, which was sanctioned last session. Mr. E. R. E. Young will probably succeed him as geographer. Mr. Young left for England last Monday to attend the International Geographical Congress.

OBITUARY.

MR. ALEXANDER COMPTON, a well-known contractor, formerly of Charlottetown, P.E.I., was drowned near his home at Flat River, P.E.I., on November 15.

MR. GEORGE H. PEDLAR, only son of Mr. George H. Pedlar, sr., president of the Pedlar People, Ltd., of Oshawa, died on Monday, at the General Hospital, Toronto. Mr. Pedlar was thirty-six years of age.

WATER METERS FOR TORONTO

In referring to the consumption and waste of water, at a meeting of the Canadian Society of Civil Engineers, held in Toronto on Monday evening, Mr. Allen Hazen, consulting sanitary engineer, of New York, said that Toronto would have to curtail the great waste of water by the installation of meters. Mr. Hazen quoted figures and showed diagrams illustrating how this had affected the amount of water consumed in European and American cities where the plan had been adopted. There are about sixty thousand water services in Toronto, with less than three thousand meters in use, and to install meters costing $12 each would involve an expenditure of $720,000, said Mr. C. L. Fellowes, the waterworks engineer, who believed that it would be an economy in the end.

Dr. Sheard, the medical health officer also thought that meters should be installed. The average daily consumption of water per capita in Toronto last year, was 90.1 gallons.

On the 26th March, 1909, The Canadian Engineer published an article containing statistics affecting some thirty or forty cities in Canada where waterworks have been installed. The information gathered showed that the consumption of water varies from 25 to 283 gallons per capita per day, a remarkable variation. Figures showing the effect of meters and reflecting the conditions existing in other countries were also given.

MARKET CONDITIONS.

Montreal, November 16th, 1909.

Advices from Pittsburg are to the effect that makers and sellers of pig-iron do not seem to be looking forward to any very heavy buying for delivery during the balance of the year 1909. It would seem that practically all the large buyers in the district are pretty well covered for their requirements for some time in advance, occasional filling orders being about the only business in view for the next month or so. In addition to this, many customers have now made their purchases for delivery over the first quarter of 1910, and there is little doubt that in some cases purchases have also been made for the first half. There are also reports to the effect that some contracts for foundry iron have been made for second half 1910, but such business is very rare. There are many instances, on the other hand, it is stated, of furnaces which have not as yet accepted orders from their general customers for first quarter and a much greater number have refused to do business on the present basis for later than July first. One of the strongest arguments in favor of high prices is the assurance that higher prices will have to be paid for coke, so that $17.50, valley, for No. 2 foundry for forward shipment is little more than equal to $15 on a basis of present cost of production. It looks as though the consumption of iron in many quarters is greater than was expected at the time contracts were made, so that the situation seems to be quite firm, throughout.

Mail advices from Glasgow state that the tendency of the pig-iron warrant market has been a little reactionary, with a restricted business at gradually receding prices. Quotations, however, continue fairly steady, and holders are fairly confident, notwithstanding the prospects of dear money. There is practically no change in either the home or continental demand, but advices from the United States continue strong and hopeful regarding the future.

Shipments from Middlesboro for the ten months ending October 31st amounted to 1,018,145 tons, against 1,127,999 for the corresponding period of 1908; 1,507,437 tons for 1907; 1,239,787 for 1906. In 1899, shipments amounted to 1,148,521, but for the intervening years, the shipments were smaller than for the present.

Shipments are now very large in the local market and, in fact, importers seem to think that, in the matter of the tonnage of iron brought into the country, it is not impossible that the present year may turn out to have made a new high record for Canada. From now till the turn of the year, it is not likely that a great deal of new business will be done, and after the end of this month it cannot be expected that shipments will amount to much. Meantime, not only in pig-iron, but in all lines of hardware and iron and steel products, there is much activity, every one being anxious to take advantage of the low water freights. The market continues quiet, so far as price changes are concerned, however, as the following list will show:—

Antimony.—The market is steady at 8 to 8¼c.

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:— 1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c. 4-inch, 18 1-2c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch)

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

Copper.—Prices are strong at 14 to 14¼c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

Laths.—See Lumber, etc.

Lead.—Prices are about steady at $3.55 to $3.65.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are firmer at $2.45 per 100 pounds, base of 5¼ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

Tin.—Prices are unchanged, at 32½ to 33c.

Zinc.—The tone is steady, at 6 to 6¼c.

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Toronto, November 18th, 1909.

One might suppose, from the continuous demand in Toronto for lumber for dwellings that prices must be firm to the point of advancement. But much of this which moves is of a lower grade, which indeed is offered ofte at prices below present cost of production. And it can hardly be that the erection of cheap dwellings will continue at such a pace as has characterized the past year or two. Even speculative builders must learn that there are a great many buildings vacant. There is much lumber on hand outside the city, which will prevent a rise of price in the immediate future.

The iron market is firm, and in some grades prices higher. Founders are looking for pig but hardly willing to pay advanced prices. Structural steel in the States is very firm and some shapes are higher. Other metals are, as a rule, steady in price. Extraordinary activity exists in automobile factories in the States, which are ordering largely of certain shapes of steel for future delivery.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—Demand active and price higher at $9.25 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

Coal.—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

Copper Ingot.—Demand quite heavy, and price advanced to 14¼c. Supply adequate.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steadv.

Fuses.—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

Iron Pipe.—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

Lead.—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

Lumber.—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

Pitch and Tar.—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

Pig Iron.—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

Ready Roofing.—Dealers report a large demand, the prices being as before, per catalogue

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100