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The Canadian Engineer

ESTABLISHED 1893

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TORONTO, CANADA, SEPTEMBER 25th, 1908.

CONTENTS OF THIS ISSUE.

DOMINION RAILWAY COMMISSION.

For some time the public have been awaiting a definite announcement as to the men to be added to the Dominion Railway Board.

Almost since its organization the Board have been flooded with applications, and it has been only by heroic work that they have been able to keep their heads above water.

Not only is the Board enlarged, but they have power to arrange for simultaneous sittings, so that now innumerable questions that have been delayed will, no doubt, shortly be disposed of. In the past the policy of the Board appears to have been "never to take the initiative." Whether under new conditions this will continue to be their policy remains to be seen, but we hope it will not. The offices of the Board have been to relieve injustices, and with scarce an exception the press and people have united in acknowledging the justness of orders issued. With enlarged powers and increased facilities the Board should be soon in a position, through its officials, to take the initiative and cause the correction of those regulations or conditions that are apparently unjust.

Railway Boards, like other organizations, depend as much on the men as the methods. Their knowledge of conditions, their sympathies and their power to recognize the real question under consideration will be sorely tried by the many pleaders that will appear before them. The men selected will prove equal to the task of regulating our transportation companies.

Mayor Darcy Scott, K.C., of Ottawa, has been appointed Assistant Chief Commissioner. A successful railway lawyer, for years solicitor for one of the large Canadian railways, he will be familiar with many railway questions from the railway side. Were Mr. Scott simply a railway lawyer, his usefulness on the Commission would be doubtful, but he is more. A man experienced in municipal government and an officer of the Union of Canadian Municipalities, he has repeatedly given evidence of his ability to maintain even-handed justice.

The Hon. Thomas Greenway will be familiar with the transportation problems. A resident for years of the Middle West, he has had an experience reconciling conflicting interests.

Prof. S. J. McLean's appointment will be a most acceptable one throughout the Dominion, as he is a man of eminent qualifications for the position. It was largely through the investigations which were made by him into railway commissions of the United States that this institution was introduced into Canada. In that respect Prof. McLean is entitled to recognition as the father of the Railway Commission idea in Canada. Prof. McLean had a most brilliant career at Toronto University, from which he took the Mackenzie Fellowship in 1894-5, afterwards holding fellowships in Columbia University, New York, and in Chicago University. In 1897 he was appointed to the chair of history and economics in the University of Arkansas, from which he later removed to the professorship which he now holds in the University of Toronto.

Prof. McLean brings to the duties of his position on the Railway Board a mind trained in economics, and will be a most valuable addition to the personnel of the Board.

The full Board now consists of three lawyers, two university professors, and one farmer—but all men.

THE BRITISH PATENT LAW.

On August the 28th Section 27 of Mr. Lloyd George's patent Act came into force. This new Act has been much discussed. Some wonder that a Liberal Government in a supposed Free Trade country should pass such a measure.

This new Act is directed to checking the system under which foreign manufacturers have taken out patents in this country, not with any intention of working them here, but with a view—

(a) Of preventing British manufacturers from producing the patented article, and thus competing with them in their own or in any other markets; and

(b) Of protecting the patentees from rival manufacturers who would otherwise be enabled to import the patented articles into this country freely, and thereby reduce the cost to the consumer.

The first sub-section of Section 27 of the Act reads:—

> At any time not less than four years after the date of a patent, and not less than one year after the passing of this Act, any person may apply to the Comptroller for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively, or mainly, outside the United Kingdom.

The Act means, then, that those wishing the protection of a British patent must work to some extent in the United Kingdom—not an unreasonable request one would say, remembering that Germany, France and other Continental countries have similar measures.

A patent law is a restriction on trade. Perhaps a sort of necessary evil to encourage inventive genius in the community. Now Britain proposes to restrict the restriction.

Already the effect on British manufacturing centres is being felt. Two German syndicates which manufacture indigo, aniline dyes and similar goods, and two American firms, one of which makes boots and shoes and another cutlery, are arranging to establish in the United Kingdom; Leicester will have the Gillette razors made near the town; Willesden, Edmonton, and the metropolitan suburbs will profit by the erection of factories for typewriters, gramaphones, motors, etc.

It is not the foreigner alone who is affected by this Act, although public attention seems to have centred on Section 27. An equally important section is the 24th, which makes it the duty of a patentee, whether British or foreign, to satisfy the reasonable requirements of the public, not only by manufacturing to an adequate extent, but also by supplying the patented article on reasonable terms, in default of which he may be required to grant licenses compulsorily, or in the alternative have his patent revoked.

The Act apparently is one to be enforced by the public. Patents will not be revoked by the mere fact that a foreign patentee has not started manufacturing in this country, but the Comptroller's attention will have to be called to individual cases.

EDITORIAL NOTES.

Many cases of typhoid fever are reported from camps along some sections of the National Transcontinental Railway. In some districts the camp hospitals are crowded. It is hard to maintain good sanitary conditions in the surroundings usually found at such camps, yet the contractor will find that men will soon refuse to work on sections where there is much sickness, and money spent in keeping the camps clean, in lime for cesspools and in providing pure water is money well spent.

* * * *

From a comparative statement of the expenditure of Ontario municipalities for the years 1905 and 1906 one finds that in 1906 there was three-quarters of a million more spent in 1906 than in 1905 on roads, bridges, streets and parks. The only other noticeable variation was in connection with water and electric light works. in 1906 some $3,700 less was spent than in 1905.

PROPOSED REGULATIONS FOR CANADIAN RAILWAYS.

The Dominion Railway Board in a circular suggest some fourteen new regulations to assist in the operating of trains. Some of the changes are of minor importance to the travelling public. Section E, however, is an important possible change that will add to the safety of the traveller.

(E) The number that shall comprise the switching engine crews of such railway companies shall be left entirely to the judgment of the operating officials of such companies; on the main lines of such companies light engines shall not be run a distance greater than twenty-five miles in any one direction without a conductor, in addition to the engineer and the fireman, and on the branch lines, the operating officials of such companies shall determine the necessity of requiring conductors on the light engines.

Crippled cars are always a source of great annoyance to the operating department and the shipper. The Commission deal with this matter in the following sections.

(M) Crippled cars shall not be allowed behind the van in freight trains; cars, containing perishable freight or live-stock, crippled in minor respects, as for example, by a broken coupler, a coupler pulled out entirely or pulled out so as to destroy its usefulness to draw cars, draft timbers which allow the coupler to fall below the standard position, making it impracticable to couple with the freight cars without chaining, shall be chained up ahead of the car and taken to the first terminal for repairs when, in the opinion of the conductors of such trains, it is safe to haul such cars on chains. In no case are more than two such cars to be handled in any one train,—except, where more of such disabled cars have been damaged through wrecks or such causes, a special pick-up train is sent out to bring them in; crippled cars to be cleared from the main line at the earliest possible moment.

(N) A crippled car shall include one with any of the following defects, namely:—

1. A broken coupler.
2. A coupler puller out entirely, or so pulled out as to destroy its usefulness in drawing a car.
3. Draft timbers, that is, where the draft timbers have so spread or fallen down as to permit the coupler to fall below the standard position, rendering it impracticable to be coupled with other cars unless chained, besides making it unsafe to handle.
4. A cracked wheel.
5. A chipped flange over 2½ inches.
6. A broken wheel flange.
7. A bent axle or journal.
8. A broken arch bar or truck straps.

Such railway companies or their officers, agents, or employees, or any of them, disobeying or failing to comply with the provisions of these regulations, shall be liable to a penalty of $50 for every such disobedience or failure or breach.

NEW ADVERTISERS IN THIS ISSUE.

Structural Steel Company, Limited,
Montreal, Que.

W. C. Sterling & Son Company,
Monroe, Mich.,
Poles (Telegraph and Telephone)
Fence Posts, Ties.

MAINTENANCE OF ROADS.*

By D. C. Wedgeworth.

The importance of highway improvement depends not so much on its engineering elements, as on the fact that a real improvement adds a certain percentage to the value of the property it affects. The rural districts are beginning to understand that the slight increase in taxes, if spent on properly improved highways, is a good investment.

This work of improvement has been entrusted to the engineer, and it is safe to say that it has not proved a very simple problem. The usual method is to lay a macadam roadway. This has been to a large extent successful, but the writer believes that a slight alteration of the method will add to the life of the road and lessen the cost of construction as well as maintenance.

This cost is dependent on many things, mainly the source of supply of material, stone, filler, water, etc., and, unfortunately, the cost of improvement of a highway is a large factor in its treatment. Against increased cost may be balanced a cheaper construction with probably a poorer highway. For this reason the engineer must strike a fine balance between an ideal roadway at high cost and an inferior roadway at less cost. In arriving at a final result there should be no better criterion than the results obtained from methods and materials heretofore used.

Given a road having a porous yet stable soil, well drained, it is frequently found that a slight improvement of natural conditions affords a good roadway. The worst natural conditions require the best road, the most thought, and frequently the most expense. Under such conditions an ideal road may be prohibited by great expense.

The engineer is then forced to find the material and method of construction which will give the best road for the money to be expended; or, in other terms, the limit of expenditure is determined by the value of the results obtained per dollar of expenditure.

The basic principle of a macadam road is the placing of a suitable wearing surface over a solid base in such a way that the macadam will perform two functions, first, sustain the wear of traffic, and second, transmit to the base the loads imposed by the traffic.

Had the engineer always at hand—or the money to bring to hand—materials which would furnish the macadam capable of carrying out these functions, the problem would be more simple; but, to bring about these results with the materials at hand, calls for much thought, experience, and common sense.

Although the matter of general location and sub-base of a roadway is very important, it does not enter into this presentation, as the writer wishes to deal only with the construction of the macadam proper. Having settled upon the location and prepared the base, or sub-base, as the case may be,

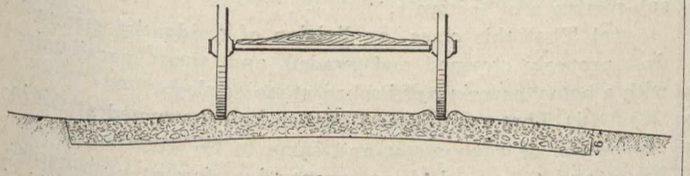

Fig. 1.

the present method has for its object the formation of a 6-inch layer of crushed stone, bonded and placed in such a way as to form a solid mass impervious to water. To this end a stone of good binding qualities must be found. This must be bonded with a proper filler, and the whole consolidated by successive manipulations until this result is approached as nearly as may be. The roadway is then put on trial; if it stands, the material and manipulations have been correct; if not, reasons and repairs are in order. Considering the varieties of stone and filler at hand, differing with various roads, it is rather remarkable that so large a percentage of roads shows satisfactory results.

The point the writer wishes to bring out is this: The stability of the macadam is dependent on the bond, and this is dependent on the filler and the manipulation. Under the best conditions, there are seasons of the year when this bond is temporarily destroyed by the action of freezing and thawing. Heavy loads, also, may destroy the bond before the load is transmitted to the base. This fact is shown by the early repairs necessary on roads built under the present method. It is a fact, also that when a country road is macadamized,

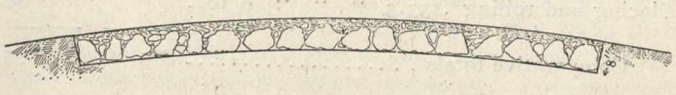

Fig. 2.

not only will the number of vehicles be increased, but the weight of single loads will be doubled.

Fig. 1 illustrates this point. The stones are pushed up on each side of the wheel track, and not down into the base, simply because the bond is not sufficient to hold them together. A close examination during repair work will show that this is exactly the case.

Proposed Method.—Would it not be a more logical and common sense way to place the stones in the macadam before crushing, as far as possible, than to break them up and try to bind them together again? Does a carpenter cut a post in sections with the intention of splicing it again when in the building? Why not save this expense of crushing and rolling as much as may be?

Fig. 2 represents a section built after the following method: Having prepared the base in the usual manner, the larger stones are hauled upon the base and placed near one another, no special care being taken, as that would take much time and cause expense. These stones, in their vertical dimension, should average about 7 inches for an 8-inch thickness of macadam. Smaller stones, from the crusher, or spawls from the quarry, are then drawn in, and the spaces between the large stones well filled. A wearing surface of about 2 inches is placed over all, and the whole well rolled. As much stone dust as the stone will take up is then applied, and the surface is puddled, as in the present method.

The large stones transmit the load directly to the base. Filler is not depended on to bind the whole together, as the smaller stone between the large ones will do this. In fact, very little filler will reach the bottom, thus leaving it open for drainage, and avoiding the danger of disintegration by frost.

Comparative Cost.—To make an accurate comparison between the cost of the present and the proposed methods, similar conditions must be imposed on each. On roads where local field stone can be used without crushing, and crushed stone can be imported at reasonable rates, the percentage saved will be greater than where all stone must be hauled from the quarry in either case. Whatever the conditions, there is a saving of 50 per cent. of the crushing and 40 per cent. of the rolling in comparison with the present two-course road. Another point not to be overlooked is the utilization of the total product of the crusher. This method takes out the dust and 1-inch to 2-inch stone, putting all the remaining product in one bin. This product should be used to fill the spaces between the large stones, and the 1-inch to 2-inch stone for the wearing surface. In case a local stone is used for the body of the road, and trap is imported for the top, very little crushing on the ground will be necessary, and the whole product, with the exception of the dust, may be put in one bin and used to fill the spaces between the large stones.

On an average road, with field stone convenient to the roadway, and a good limestone quarry along the road, a comparison of cost would be somewhat as follows:

* Discussion before the American Society of Civil Engineers.

Cost Per 100 Ft. of 12-ft. Roadway.

				Present method.	Proposed method.
Preparation of base, say average of 6 in. excavation or fill, with necessary rolling and grading...	22.2	cu. yd. at	$0 75..	$16 65	$16 65
Quarrying stone	23	" " "	0 50..	11 50	
Quarrying stone ...	15	" " "	0 50..		7 50
Hauling field stone .	15	" " "	0 25..		3 75
Crushing quarry stone	23	" " "	0 25..	5 75	
Crushing quarry stone	16	" " "	0 25..		4 00
Hauling crushed stone	23	" " "	0 32..	7 36	
Hauling crushed stone	16	" " "	0 32..		5 12
Placing and rolling .	133.3	sq. yd. at	0 15..	20 00	
Placing and rolling .	133.3	" " "	0 10..		13 33
Comparative totals				$61 26	$50 35

These figures are not intended to fit any particular case, but are taken as an average from cost items on several roads. The first item will vary considerably, and will affect somewhat the total percentage save under the proposed method. The cost of hauling field stone may vary, also, but, if stone walls are convenient, and if the stones are of moderate size or easily broken, the figure used may be reduced. The quantities used are, 23 cu. yd. of stone for the present method and 30 cu. yd. for the proposed method, giving a thickness of finished macadam of 6 inches in the former case and 8 inches in the latter. In the proposed method it is estimated that 50 per cent. of the volume will be crushed stone.

Where there are no field stones, but a good quarry is at hand, the estimate would be changed, as follows:

				Present method.	Proposed method.
Preparation of base				$16 65	$16 65
Quarrying stone . . .	23	cu. yd. at	$0 50..	11 50	
Quarrying stone . . .	30	" " "	0 50..		15 00
Crushing stone	23	" " "	0 25..	5 75	
Crushing stone	16	" " "	0 25..		4 00
Hauling crushed stone	23	" " "	0 32..	7 36	
Hauling crushed stone	16	" " "	0 32..		5 12
Hauling quarry stone	15	" " "	0 32..		4 80
Placing and rolling .	133.3	sq. yd. at	0 15..	20 00	
Placing and rolling . .	133.3	" " "	0 10..		13 33
Comparative totals				$61 26	$58 90

Under such conditions as abundant field stone with no quarry suitable for top stone, so that top stone would be imported in any case, trap might be specified for the top, and the estimate would be about as follows:

				Present method.	Proposed method.
Preparation of base				$16 65	$16 65
Hauling field stone ..	16	cu. yd. at	$0 25..	4 00	
Hauling field stone ..	22	" " "	0 25..		5 50
Crushing field stone.	16	" " "	0 25..	4 00	
Crushing field stone .	11	" " "	0 25..		2 75
Hauling crushed stone	16	" " "	0 32..	5 12	
Hauling crushed stone	11	" " "	0 32..		2 52
Trap, dumped in place	8	" " "	3 50..	28 00	28 00
Screenings (limestone)	5	" " "	2 25..	12 25	12 25
Placing and rolling ..	133.3	sq. yd. at	0 15..	20 00	
Placing and rolling .	133.3	" " "	0 10.		13 33
Comparative totals				$90 02	$81 10

Although these figures cannot be exactly determinate, owing to inability to apply them, as they are, to any particular road, the writer believes that, as an average, they are fair, and that they indicate a reduction in cost and the production of a superior roadway, in favor of the proposed method.

It may be said, in opposition to this method, that it is impossible to roll the loose stone of such depth into the spaces among the large stone of the base. This, however, the writer does not believe to be the case, as the sub-base is being constructed by this method on many roads. Why not make the roadway itself a sub-base?

One often hears it said that macadam roads cost too much, both at first and in maintenance, yet contractors are slow to take them at appropriation figures. It is the duty of the engineer to furnish the best construction for the least money possible. The effort at improvement, however, has been directed toward making the present method more thorough and more expensive.

Macadam is being laid over comparatively good roads, built before the days of rollers and stone crushers. In the finer product let engineers not forget entirely the methods and means of those who built before them, for they built well and at little cost. More stone and less expensive manipulation is a step in the right direction. Try it.

REPORT ON STREETS AND SIDEWALKS.

The council of the city of Moncton, N.B., appointed a special committee to report on permanent streets and sidewalks. The report is signed by City Engineer, J. Edington, and four members of the council, and although local in its application contains suggestions for city engineers in other districts.

Moncton is a city of about 10,000 people and contains within its limits about twenty-five miles of streets, roads and lanes.

The committee say in part:

In compiling this our report we have constantly kept before us not only the probable future requirements and demands of our municipality, but also a reasonable regard to any unnecessary advance towards increasing the taxes, and with that in view, have to the best of our knowledge and information formulated this policy of what we consider as economical, yet practical permanent work, at the same time being mindful not to increase the present assessment; in other words, that the best policy for permanent streets and sidewalks, adapted to Moncton, may be inaugurated on the most conservative, economical and adequate basis, not inconsistent with beneficial, substantial and lasing results.

Their recommendations are as follows:

1. For residential streets, with more or less heavy traffic.

(a) On account of the mileage of these sidewalks, the probable demand for the same within the next few years occasioned by the growth and expansion of the city, keeping in view the city's finances, we recommend for this division permanent sidewalks of asphalt and tar, with cinders or stone foundation from eight to twelve inches in depth, well underdrained, and to be from four to six feet wide, as the locality of each respective street may demand or require.

(b) If the residents along any street in the city of Moncton desire granolithic sidewalks they may have the same by contributing 50 per cent. towards the cost of material and construction, the other 50 per cent. to be provided by the city, said sidewalks to have the same width as described in sub-section a of section 1.

(c) That this class or division of residential streets be first properly crowned and graded, and then macadamized with a heavy covering of broken stone or slag.

(d) That curbing and gutters be constructed at the intersections of each street and same to be freestone or concrete, and to extend about twenty-five feet at each corner. Your committee recognizes the necessity of further curbing and gutters when the finances of the city allow.

2. For residential streets with light traffic we recommend as follows:

(a) That this division or class of permanent sidewalks be the same material and construction as set forth and described in sub-section a of section 1.

(b) That this division or class of permanent sidewalks be the same material and subject to the same financial conditions as sub-section b of section 1.

(c) That this class or division of residential streets be first properly crowned and graded, and then macadamized with a reasonable covering of broken stone or slag.

(d) That this clause be the same as sub-section d of section 1.

3. For business streets we would recommend as follows:

(a) In view of constant repairs that must necessarily be made from time to time, to the present water mains along Main Street, the overhauling of the gas main and the construction of telephone conduits thereunder, as well as the construction of a prospective street railway, we recommend to the council for permanent pavements on said streets vitrified blocks with concrete foundation, the said recommendation not to take effect until the said existing mains, etc., are either substantially repaired or replaced, and the said street railway system inaugurated; in the meantime, the necessary repairing and maintenance of said streets be carried on, and when necessary and essential the blocks taken up and replaced by "Bay Shore Spruce Blocks" without asphalt coating or covering.

(b) That granolithic sidewalks be constructed along Main Street.

SPECIFICATIONS FOR CONCRETE FLOORS FOR HIGHWAY BRIDGES.

The increasing cost of lumber and the almost impossibility to secure good sound timber has had a tendency to increase the use of concrete and brick for bridge floors.

The following is the standard specifications of the Ontario Highways Department for concrete floors for bridges:—

Fero-Concrete.

1. Unless otherwise specified, the flooring shall be of concrete reinforced with steel. Wheel-guards shall be of steel channels or of concrete, and such as will prevent the hubs of the wheels striking any part of the bridge. At each end of all spans over fifty feet, steel expansion aprons shall be used with concrete floors.

Material and Labor.

2. All necessary material, labor, appliances and implements shall be furnished by the contractor, and shall be such as will secure a satisfactory quality of work.

Steel Reinforcement.

3. The metal with which the concrete floor is to be reinforced shall be expanded metal, wire netting, steel bars or other metal approved by the engineer, and is to be completely surrounded by concrete, and it shall be so placed within the concrete and shall be of such tensile strength as to fully provide for the specified loading.

Thickness of Concrete.

4. Sidewalks shall be 4 inches in minimum thickness and shall be made with a slope ¼-inch to the foot towards the roadway. The minimum thickness of concrete in the roadway shall be 4 inches at the sides and 5 inches at the centre.

Down Pipes.

5. Down pipes, gratings and other openings or fixtures shall be placed in the walk or roadway wherever required, such openings to be measured continuously as part of the flooring.

Falsework.

6. Temporary framework or staging shall be erected to support the concrete flooring while in process of construction, this framework to be firm and substantial, of suitable lumber, and unless perfectly tight shall be covered with tar paper to prevent the concrete dripping through.

Portland Cement.

7. All cement employed in the work must be of a favorably known brand of Canadian Portland cement, and approved by the engineer. It shall be delivered in barrels or equally tight receptacles, and after delivery must be protected from the weather by storing in a tight building or by suitable covering. The packages shall not be laid directly on the ground, but shall be placed on boards raised a few inches from it.

Mixing Concrete.

8. The concrete shall be composed of gravel and Portland cement, mixed in the proportion of one part by measure of cement to five of fine gravel, no stones of which exceed one and one-half inches in diameter. The concrete shall be mixed on a platform placed close to the work by first spreading evenly a layer of gravel. Upon this shall be spread a proportionate quantity of cement, and the two thoroughly intermixed in a dry state. To this sufficient clean water shall be slowly added, and the whole again thoroughly mixed and brought to the consistency of a stiff mortar.

Wearing Surface.

9. The sidewalk and roadway shall have a wearing surface one and one-half inches in depth of sand and cement, mixed in the proportion of 1 part by measure of cement to 2 parts of sand, the sand to be clean, sharp, of varying sized grain and free from loam, earth or other impurities. The sand and cement shall be first mixed in a dry state, then sufficient water shall be added to properly moisten, and the whole shall again be thoroughly intermixed. This top coating shall be applied to the concrete base before the latter has set, so that a perfect bond between the two will be secured. The surface will be floated and trowelled until smooth and even, and shall be finished with a toothed roller, or as directed by the engineer.

Placing Concrete.

10. While the work is in progress, it shall be so arranged that a steady supply of mixed concrete will pass from the mixing box to the point where it is to be placed. At any time when the work is interrupted before its completion, or at the end of the day, a wet covering shall be placed over the last layer of concrete, and before the work of depositing the concrete is resumed this surface shall be thoroughly flushed with water to remove any foreign material which may have gathered thereon, and coated with a thin Portland cement grout. No cement shall be laid in wet or freezing weather.

As an indication of the consumption of crushed stone for macadamizing purposes and road building, for flux for blast furnaces, ballasting of steam and interurban railways, etc., the Allis-Chalmers Company has recently supplied to the Michigan Alkali Company a rock crusher which has a maximum capacity of six hundred tons of stone per hour for ten hours run, or 6,000 tons per day. The weight of this crusher is 200 tons, and its capacity is dependent upon the facilities for delivering the raw material from the quarries to the machine, which is facilitated by the use of steam shovels. This crusher will reduce a rock of 3 ft. x 4 ft. x 6 ft. and weighing approximately three tons, to very small cubes. The company report orders in hand for several of these gigantic machines which are already completed or in process of manufacture for installation this spring.

Thornhill, Ont.,
18th Sept., 1908.

The Publishers, the "Canadian Engineer,"
62 Church Street, Toronto, Ont.

Dear Sirs,—Some time ago a copy of the "Canadian Engineer" was handed to me. This was the first time I had seen your public ation, and as a result of looking over its pages of "Construction News" and "Tenders Called For" I was successful in obtaining a contract for work amounting to five thousand dollars. One page of reliable, well-selected news, such as the "Canadian Engineer" contains, is worth many pages of clipped items.

Yours faithfully,
Jesse Winger.

THE EVOLUTION OF THE THEORY OF THE HEAT ENGINE.*

At the outset of his remarks, Mr. Clerk dealt with the position of the steam engine at the middle of the last century. Even at that time it had attained to a high degree of perfection. Its development was, it is true, incomplete, but it had been successfully applied to all the great duties of the mine, the waterworks, the factory, the railway, and the steamship. The engines were mechanically excellent; the fuel economy was good, and they were built in units of thousands of horse-power. Steam power, in fact, was revolutionizing the whole of the social and industrial conditions of the globe. Notwithstanding this great material and engineering success, the world was in complete darkness as to the connection between steam motive power and heat. It was seen that motive power of almost any magnitude could be obtained by the agency of heat; but how it was obtained, and how much power was connected with a given quantity of heat was quite unknown. The fuel consumptions of existing engines were known, and certain modes of improving economy were evident, and engineers were busily engaged in testing these modes by the slow but sure methods of invention, design, construction, and operation in practical work; but in this they had but little aid from pure science. The science of thermo-dynamics did not yet exist. New light was dawning, however, which gradually illumined the whole world of pure science and engineering practice.

Men of the first rank in intellect—Newton, Cavendish, Rumford, Young, and Davy—had long before expressed the opinion that heat was not material in its nature, but was a mode of motion; but their opinions, although to some extent supported by experiment, made little impression upon the scientific world, and in 1850 we still find the most distinguished physicists adhering to the "caloric" or material theory of heat.

The great change from the errors of the old theories to the truth of the new was due to the work of Joule, Thomson, and Rankine, in Great Britain, and of Carnot, Meyer, Clausius, Helmholtz, and Hirn on the Continent. The story begins with the work of Carnot in 1824, who published in Paris that year a pamphlet, entitled "Reflections upon the Motive Power of Heat." He was attracted by the problem of the steam engine and the air engine. He saw that heat and motive power were connected in some manner, and he endeavored to settle in a quantitative way the limits of that connection by the invention of an ideal series of operations, by means of which the greatest conceivable amount of mechanical power might be obtained from a given quantity of heat under given circumstances.

To the acute and brilliant intellect of William Thomson it became apparent that he had in the Carnot cycle a powerful instrument capable of widely general use, apart altogether from the theory of heat engines; and he used it in a most skilful way to give definiteness and universal application to the idea of temperature, as Professor Larmor states, "elevating the idea of temperature from a mere featureless record or comparison of thermometers into a general principle of physical nature."

After discussing Thomson's work on the subject, the address stated that long before 1850 the equivalence of mechanical work and heat quantity had been accepted by many scientific men, and Rumford had, indeed, made measurements of a rough kind. It remained, however, for Joule experimentally to determine the mechanical equivalent in the most accurate manner, and place what is now known as the first law of thermo-dynamics upon the sure basis of absolute experimental determination. His first paper was read before the Cork meeting of the British Association in 1843, and at the Oxford meeting, in 1847, he read another on "The Mechanical Equivalent of Heat," describing the results of experiments with paddles rotating in liquids driven by falling weights. By these years of work he had absolutely demonstrated the equivalence of heat quantity and mechanical work, so that no loophole of escape seemed possible; it appeared as if the material theory was rendered intellectually impossible to the trained intellect. This was not the fact, however, as is evident from both Joule's and Thomson's accounts of that British Association meeting.

The brilliant work of Meyer, published so early as 1842, is held by some to have anticipated to a large extent both the work of Thomson and of Joule. Undoubtedly Meyer formulated true ideas, and carried his generalizations through a wide range. Helmholtz also very early arrived at similar conclusions to those of Joule and Thomson. Undoubtedly great credit is due to Meyer, Helmholtz, Clausius, and Hirn, and Thomson himself recognized this in the most generous way. The ideas of Thomson and Joule now form so much of the basis of all reasoning upon motive-power engines that there is some little danger to the present generation of forgetting what they owe to these two great men. To appreciate the step made by them it is necessary to consider the position of motive power produced by heat at about the middle of the last century. At that time many attempts had been made to displace the steam engine as a heat engine by air engines in various forms—both engines heated externally and those heated internally, now known as internal combustion engines. Papers read at the Institution of Civil Engineers in 1845 and 1853, and the discussion of those papers by eminent men of the day, supply an accurate measure of the knowledge possessed by the engineer of the principles of action of his heat engines. Many distinguished names occur in these papers and discussions, including James Stirling, Robert Stephenson, Sir George Cayley, Charles Manby, James Leslie, C. W. Siemens, Hawksley, Pole, W. G. Armstrong (afterwards Lord Armstrong), Edward Woods, E. A. Cowper, D. K. Clark, Benjamin Cheverton, Goldsworthy Gurney, George P. Bidder, Professor Faraday, Isambard K. Brunel, Captain Fitzroy, and F. Braithwaite. At the date of the later of these discussions Brunel had already designed the "Great Eastern," in 1852, with her engines of 11,000 horse-power. Armstrong was a Fellow of the Royal Society, and had started the Elswick Works and invented the Armstrong gun. Robert Stephenson was at the height of his fame. He was then a member of Parliament, president of the Institution of Civil Engineers, and a Fellow of the Royal Society. Siemens was a young man, but was busy on the regenerative furnace; he had considered regeneration as applied to steam engines, although his work on the air engine was still to come.

In conclusion, the author remarked that the modern internal combustion motor is the successor to the air engine, so fully discussed by eminent engineers of fifty-five years ago; and the forebodings of even so eminent a man as Faraday as to its ultimate success have proved unfounded. Great difficulties have been encountered, and many discrepancies have had to be explained, but a minute study of the nature of the working fluid has rendered it more and more possible to calculate the efficiencies to be expected under practical conditions. At the present time we can deal with almost any cycle or any working fluid with some fair approximation to an accurate result. Much work, however, is required before all problems of the working fluid can be said to be solved with regard to any heat engine. Indeed, it may be said that, under modern conditions of the use of steam, even the properties of the working fluid—steam—have not yet been satisfactorily determined. The mere question of specific heat, for example, of steam and its variations of temperature and pressure, is now under review, and important experiments are in progress in Britain and on the Continent to determine those properties. The properties of the working fluid of the internal combustion motor are also the subject of earnest study by many Continental and British investigators. Notwithstanding all the perplexities involved in the minute study of the imperfect heat engine cycles, we are in a very different position to-day compared with the engineer of 1853. We know all the broad laws as to the conversion of heat into work, or of work into heat; and, numerous as are the problems yet to be solved, we, at least, profit by the guiding light set out for us by Kelvin, Joule, and Rankine.

*Abstract of the address of Dr. Dugald Clerk, F.C.S., before the Engineering Section of the British Association.

AS SEEN BY OTHERS

The Quebec Bridge.

Engineering News.—The task of the engineering committee (on the Quebec Bridge), is a very great one. Difficult as it would be under any circumstances, the progress and results would be certain beyond question to engage the most careful attention of the engineering world. As matters actually stand, this attention will be multiplied—by the stimulus of the intense interest awakened by the collapse of the first bridge. There will be a more anxious, a more rigid, scrutinizing of the conclusions and the designs produced by the committee. This fact renders their work correspondingly more delicate and of greater responsibility, and therefore more difficult. Judgment of fine metal will be needed. May it not be corroded by the steam rising from the ever-boiling pot of Canadian politics! May the committee accomplish its task successfully and worthily.

* * * *

The Basis of Cost.

American Machinist.—The great activity in improving the methods of machine construction has for its prime object the reduction of cost, by which is meant reduction in wages cost. The cost of an article consists of three items—wages, material and burden—and it is the first of these which has been the subject of attack all along the line. It has been asked of late in a good many quarters if this effort has not gone too far and if, in the search for a reduced wages cost, the item of the cost of the equipment has not been largely lost sight of, and an outgrowth of this comparatively new question is the further one: Should not the aim at the largest possible output per dollar of wages be changed into an aim at the largest possible output per dollar of investment? For, to a considerable extent, the two aims are antagonistic.

* * * *

Where Were the Fire Rangers?

The Globe.—It seems strange that after the destruction of a railway bridge had been discovered in the evening a train should be wrecked the following morning through running over the embankment. Operating expenses should not be reduced to the danger point.

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The Dredgers Afraid.

The Yarmouth Times.—It is reported from Ottawa that several dredging contractors are arranging to sell their plants to the Government. Some of these political dredgers have been making big profits on contracts which were obtained without effective competition. They do not know what the election may bring forth and are disposed to protect themselves by transferring their business on favorable terms to a friendly Government.

* * * *

Contract Conditions Again.

Iron and Coal Trade Review.—At the present time a great many municipal bodies are again inviting tenders for the supply of coal, and the singular conceptions displayed in the forms issued to the trade for signature of what it is right and proper to ask the seller to agree to, lead us once more to revert to the well-worn, but none the less important topic of contract conditions. Again and again we have insisted that reform in this respect is badly needed, and the opinions we have expressed are emphatically endorsed by the trade.

* * * *

The Disuse of C. E. by Civil Engineers.

Engineering Contracting.—One who has occasion to refer to the technical periodicals and transactions of twenty years ago will find innumerable mentions of civil engineers by name, and almost always with the letters C. E. after the name. It was a matter of pride as well as a means of professional identification that led to the practice of using the suffix C. E. Latterly this practice has almost died out—and why?

Unquestionably the practice came into disrepute because of its abuse. Men who had little more knowledge of civil engineering than is needed to run a compass imitated the real civil engineer, by adapting their title and using its abbreviation after their own names.

* * * *

Cost of the Tunnel.

Guelph Mercury.—The tunnel under the Hudson River, which is 1,833 yards, cost $10,000,000. The Northumberland Strait, between Prince Edward Island and the mainland, is thirteen and a half miles, and in making the tunnel one could not commence on the edge of the sea. There would have to be an allowance of several miles on the island and mainland; so that the tunnel would be not less than sixteen miles, and at the rate per yard, at which the Hudson River tunnel was constructed the total cost would be $160,000,000. The tunnel would be the first big submarine tunnel in the world, and Canada would have felt herself able to afford what Great Britain, with all her wealth, has not yet afforded—namely, a similar tunnel from the south of Scotland to the north of Ireland.

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Danger in Flight.

The Hamilton Herald.—The first areoplane tragedy occurred yesterday, when Orville Wright's machine, carrying himself and Lieutenant Selfridge, fell to earth through the breaking of a rod. The lieutenant was killed and the inventor was terribly injured.

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The problem of flight has been solved; but that is not to say that the aeroplane will soon (or ever) come into use for the carrying of passengers or freight. The tragedy of yesterday indicates one of the reasons why. The machine is necessarily in construction so fragile that the danger of breakage is real and ever-present, and the consequences of a breakage are almost sure to be serious. In our time at least, the strong probability is that the aeroplane will be an expensive toy and its use will be confined to men of leisure who love a pastime the more when there is a dash of danger in it.

* * * *

The Steel Industry.

The Railway Review.—There is no lack of confidence in the steel industry over a return to almost normal conditions next year. Evidences abound on every hand. Structural steel necessities promise to be especially large. What the outcome of car building will be is not clear. Guesses have been made by some reputable railroad authorities that at least one hundred thousand cars will be required within the next six months. Railroads generally have permitted minor repairs to run behind and these necessities will soon add to the sum of new orders. Bridge building will be entered upon with considerable vigor. Inquiries for forty thousand tons are pending this week, but immediate orders are not probable for all of it. Inquiries for thirty thousand tons of rails are on the market. Each week develops unexpected sources of demand. The tone of the entire market is stronger and with low prices and the possibility of advancing prices, new business is presenting itself.

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The Railway Board.

The Toronto Telegram.—Assume that D'Arcy Scott, K.C., had practised law in a public rights environment.

Would D'Arcy Scott, K.C., have been allowed to step from the solicitorship of a public ownership league into the assistant-commissionership of the Dominion Railway Board?

Assuredly not.

Nobody asks that a public rights zealot should be put next in authority to the head of the Railway Commission.

Everybody has a right to protest when an anti-public rights zealot is appointed as assistant to Hon. J. P. Mabee.

If only railway lawyers are eligible for legal vacancies on the Railway Commission, why was the local solicitor of the C.P.R. at Ottawa chosen instead of W. H. Moore, of the Canadian Northern, or H. B. McGiverin, champion of other railway interests?

MECHANICAL DEFECTS IN RAILS.*

By J. P. Snow,

Bridge Engineer, Boston & Maine.

Mr. Howard has shown us that he finds evidence of unsoundness in all of the rails that he has examined. Some of these rails have, nevertheless, done magnificent service. This demonstrates that when conditions are favorable, either by accident or by intelligent control, the defects unavoidable in our present rail-making processes can be tolerated without undue risk.

I have heretofore discussed the three types of defects named above before other associations, but I wish here to extend what I said at our last annual meeting and to put on record my later convictions on the subject.

White streaks generally run into fissures if followed far enough. They do not extend very deep, generally not over ⅛ in., and they occur at different depths, sometimes at the surface, generally a little ways inside the surface. They occupy the zone of the ordinary gas-holes that occur so generally in ingots. Their plane is generally parallel to the axis of the rolls; that is, perpendicular to the surface of the base and top of head and parallel to the surface of the web and sides of head. On the fishing surface of head and base the plane of the seams is dragged by the rolls into positions practically parallel to the surface. The fissures accompanying this type of seams are very straight and they frequently have a granular appearance as though they had been weakly stuck together before rupture, like soldered surfaces. I attribute these seams and fissures to gas bubbles in the plastic steel of the ingots, and from this supposed origin I call them gas-seams.

Gas-holes or blow-holes, as called by some, have been discussed by many metallurgists, notably by Prof. H. M. Howe and Mr. E. Von Maltitz before the Am. Inst. of Mining Engineers. I commend the paper on "Blow-Holes in Steel Ingots" by the latter author to all interested in this subject. (Inst. Mining Engineers, Toronto meeting, 1907.) Our member, Robert Job, illustrates these seams in a paper before the New York R. R. Club, November, 1906, and they show on many lantern slides prepared by Mr. Howard. If these gas-holes are deep-seated in the ingot, so that the seams will be from ⅛ to ¼ in. inside the surface of the finished rail they do not seem to be of vital significance. They appear to form at the junction of the columnar crystalline shell of the ingot and its amorphous central core. Proper means for deoxidizing and quieting the steel coupled with moderately slow teeming to the molds has the effect of decreasing the number of gas-holes and causing them to be deep-seated instead of near the surface.

Rolling-flaws are actual figures in the surface of the rail. They are generally somewhat crooked and their planes are frequently inclined to the normal to the surface. Their sides are generally fluted and look bluish like mill scale. They are frequently very minute, but are sometimes easily visible on a new rail as a distinct mark several feet long.

In all of the crescent base breaks that I have examined, including those occurring in service and those produced artificially, it has always been possible to detect the longitudinal seam from which the break started. In the great majority of cases the seam has been of the class that I call rolling-flaws. Most of the rest have been gas seams on the surface.

These flaws appear to me to be the result of checks, cracks or tears in the skin of the ingot or bloom, such as Captain Hunt told us about at our 1907 convention. I believe this class of defects to be responsible for more broken rails than all other classes combined. Their remedy is obvious.

Inclusions of manganese salts, called slag inclusions by Dr. P. H. Dudley and others, are very common and very fatal when near the surface of the head. This feature was well discussed and illustrated in the discussion last year by Dr. Dudley. Manganese sulphide in particular is very brittle and is probably the cause of most of the failures from split heads. On the other hand, my observation has failed to indicate that these inclusions have very much to do with base breaks, the flaw from which the break starts being, with very few exceptions indeed, a smooth seam face instead of a fracture. Dr. Dudley and Mr. Maltitz show that by adding the spiegle when the bath is hot and allowing sufficient time for the reactions to complete themselves and the resulting salts to rise into the cinder before the metal is teemed into the ingot molds, the danger from these inclusions will be lessened. It stands to reason that if the deoxidizing agent is added to the more or less cooled bath in the ladle that the reactions will be sluggish and that nodules of oxides, silicates and sulphides will be caught in the solidifying mass in the ingot, and when rolled will be drawn into seams, such as we see in split heads and the like.

A fourth type of unsoundness is due to segregation. This leads to crushing of the head, flow of metal and rapid wear rather than to absolute breakage. It can be controlled to some extent, according to Professor Howe, but it is inevitable to a greater or less extent when steel passes from a liquid to a solid state. Segregated material in the head of a rail especially if near the surface, is very objectionable, but if confined to the base will lead to but little trouble. Two ways of attaining this end are open, viz., by throwing the ingots down before freezing is complete and controlling the turns so that the top of the ingot, as it lies in the soaking furnace, shall be formed into the base of the rail, and, second, by rolling the ingot to a slab about 7 in. by 15 in. and splitting it at the last pass by cutting disks or otherwise, and rolling each billet into rails in such a way that the base shall be formed from what was the central part of the slab.

The rails examined by Mr. Howard and those that I have opened up with a hammer show excellent metal where sound. The delerterious effects of improper heat treatment, after the metal has solidified, do not seem to be in evidence to an important extent. In fact, I believe that our recent requirements of shrinkage for heavy rails of the A. S. C. E. pattern are inconsistent and all wrong. It is unsound steel that we should guard against. Dry air for the converter blast and proper deoxidizing and careful teeming will do much towards keeping gas-holes deep-seated and preventing slag inclusions; reasonable treatment in the rolls will prevent rolling flaws; the ever-present segregation can be made harmless by confining its location to the base and web of the rails; and all of these requirements can be covered without decreasing the output of a mill if the plant is built and organized with these points in view. Moreover, more of the melt will finish as No. 1 rails than under present methods.

I believe the investigations that Mr. Howard has started should go on. We need examinations of rails rolled under rational regulations of the recarburizing process, as, for instance, those made under Dr. P. H. Dudley's specification. We want examinations of open-hearth rails. We need to have the imperfections of each of these classes compared with those of the ordinary Bessemer rail of to-day, and we want all kinds of rails available, tested for rolling flaws. We want the scoring of the base that results from the higher speed of the edge of the roll over that of the rail investigated, to see if its effect is deep-seated. We want the effects of the straightening gag fully explored, and we want these features photographed, discussed and correlated so that they can be fully understood. We want blooms and cobbles examined to find, if possible, the origin of these various defects, and we want ingots opened up in order to study the various phenomena of cooling. Especially we should have a quarter of an ingot opened on the diagonal to show the conditions of columnar crystals and entangled gas-holes at the corner where crystals from two sides interfere. The difference in this feature between ingots with square and well rounded corners should be observed.

It is possible that shelly corners of the rail may be due in large measure to the conditions caused by the corners of ingots being too nearly square. We want the chemistry of the streaks and segregated portions thoroughly examined, and we want all this done by disinterested and unbiased parties, who

* Discussion of Mr. Howard's paper, presented at the Convention of the American Society for Testing Materials.

can draw conclusions that may lead to improved manufacture as well as to means of testing, so that consumers may test for soundness in addition to the present test for absence of brittleness.

ENGINEERING SOCIETIES.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, E. A. Evans, Quebec; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, J. Galbraith; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1908.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, E. A. Hoare; Secretary, P. E. Parent, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, C. H. Mitchell; Secretary, T. C. Irving, Jr., Traders Bank Building.

MANITOBA BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

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

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

CANADIAN MINING INSTITUTE.—413 Dorchester Street West, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. G. Chace, Secretary, Confederation Life Building, Toronto.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; Secretary, Calvin W. Rice.

SOCIETY NOTES.

The British Association.

The British Association closed their meeting at Dublin on September 8th. The report of the engineering section covers some 33 pages, and The Times gives the following abstract:—

Report of Gaseous Explosions.

To engineers the investigation of gaseous explosions was chiefly of interest because of its bearing upon the theory of the internal combustion engine. The committee had hitherto considered it mainly from this point of view, conceiving that a limited interpretation of their reference would be necessary if their labors were to lead to any result within a reasonable time, and that the limitation adopted should be determined by the fact that the committee had been initiated by the Engineering Section. The test of practical value or interest had been applied for the purpose of selecting from among the large number of questions arising in connection with explosions those which were proper subjects for investigation by the committee, not with the idea of limiting such investigation to the practical aspect of these questions.

The first requisite for predicting the performance of a gas-engine was to know the rise of temperature, and the consequent rise of pressure, produced by the explosion. In proceeding to analyze the indicator diagram given by the engine with the object of accounting at each point for the heat which had been put in, a knowledge of the energy function was required, that is to say, of the law connecting temperature with total heat supplied. The heat accounted for on the diagram was the work which had been done plus the heat contained in the gas. The latter item could be calculated from the temperature if the energy function were known. The balance unaccounted for, which it was usually the object of such investigations to find—whether in the steam-engine or the gas-engine—was the heat which had been lost to the walls or had been suppressed owing to incomplete combustion. In fact, the internal energy of the gases at high temperatures played much the same part in the analysis of gas-engine phenomena as the total heat of steam in investigating the working of the steam-engine.

The ideal cycle which had hitherto been used in discussing the performances of gas-engines was the well-known air-cycle. This was based upon a special assumption as to the form of the energy function—namely, that it was a linear function of the temperature at high, as it was known to be at low, temperatures. The specific heat of the working substance was taken to be constant and equal to 19 foot-pounds per cubic foot, or 4.8 calories per gramme molecule. In the state of ignorance as to the real form of the energy function which prevailed until quite recently, this assumption was as good as any other, since it was impossible to say that the value of the energy derived from it was further from the truth than any other value which might be assigned to it. So far as was known, the differences between the indicator diagram of a real engine and the corresponding air-cycle diagram might have been wholly, or almost wholly, due to what have been called "non-essential imperfections"—that is, to heat loss and to incomplete combustion. Recent researches, however, on the properties of the gases at high temperatures had definitely shown that the assumption of constant specific heat was erroneous, and had given sufficient information about the magnitude of the error to show that it was of material importance.

Measurement of the Internal Energy or Specific Heats of Gases at High Temperatures.

The results of most experiments on the energy of gases had been expressed in the form of tables or formulæ giving the specific heat (referred to unit mass of the gas) in terms of the temperature. It would have appeared preferable for most purposes to have exhibited them in terms of internal energy per unit volume. That was the form most convenient for purposes of thermodynamic calculation, and it had the further advantage that it expressed the actual quantity measured. In nearly all the experiments on the specific heats of gases the increase of energy in unit volume associated with a large rise of temperature was measured; and in most the lower limit of temperature was near that of the room. The rate of change with temperature, of the energy so determined, had been sometimes called th "true" or "instantaneous" specific heat, and sometimes "thermal capacity." The committee were of opinion that a definite name should be given to this important quantity, and they suggested the name "volumetric heat," which if adopted should include in its significance that the measurement to which it related was made at constant volume and was referred to unit volume of gas. The term "specific heat" could then be restricted to its usual meaning, which referred to unit mass of the substance. Convenience of calculation was promoted if the unit of volume taken was that corresponding to the grammes molecule under standard conditions which was sufficiently nearly the same for each of the gases under consideration, and equal to 22.25 litres. In the report, internal energy and volumetric heat have been expressed as calories per 22.25 standard litres; and the zero of temperature from which the energy was reckoned (except where otherwise stated) has been taken to be 100°C., in order that steam may be included on the same basis as the other gases.

The experimental work already done on this subject was as follows:—

(1) Constant pressure experiments: Regnault, Wiedemann, Witkowski, Lussana, Holborn and Austin, Holborn and Henning. The gas was heated from an external source in these experiments, and was at atmospheric pressure.

(2) Experiments in which both volume and pressure were varied, the gas being heated by compression. The recent experiments of Clerk, and the determinations of the velocity of sound in hot gas by Dixon and others, belonged to this class.

(3) Constant volume experiments. To this category belonged the explosion experiments of Mallard and Le Chatelier, Clerk, Langen, Petavel, Hopkinson, and others, and Joly's determinations with the steam calorimeter. In the explosion experiments the gas was heated by internal combustion.

The discussion of the results obtained led the committee to the conclusion that a large number of the observations must have been affected by systematic or other errors, and that redeterminations were very necessary. The committee, therefore, asked that they should be reappointed, and that funds should be placed at their disposal to enable them to undertake the necessary experimental work.

Included in the report was a brief account of some interesting experiments made by Professor Coker with a view to determining the range of temperature in the inner skin of the metal wall of a gas engine cylinder. He found the fluctuation in temperature above the mean to be only 7° Fahr. as a maximum, which was in general accordance with measurements made by Professor Hopkinson on explosions in closed vessels.

American Institute of Electrical Engineers.

The Toronto Section of the American Institute of Electrical Engineers opened their fall course of meetings in the form of an excursion to Niagara Falls, Ont. Saturday, September 19th, 1908. Over twenty members and their friends joined the party. At Niagara Falls the delegation was welcomed and many courtesies were offered by the superintendents of the three Canadian power companies.

Visits were paid in the morning to the generating stations of the Electric Development Company of Ontario and to the transformer stations of the Electric Development Company and the Canadian Niagara Power Company. After luncheon at the Clifton Hotel the party proceeded to the generating station of the Canadian Niagara Power Company and the Ontario Power Company.

Members of the party remarked upon the very rapid growth of the power load delivered by these three generating stations, and were also pleased that a large share of this load is going to points in Ontario, particularly Toronto and Welland.

The members of the Section took advantage of the gathering to make a presentation to the retiring secretary, W. G. Chace, of a handsome club bag in recognition of his interest in the work of the Section throughout the past two years, Mr. Chace having severed his connection with the Executive of the Section owing to his approaching departure for Winnipeg.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

5226—August 27—Authorizing the Lakefield Portland Cement Company to lay and maintain a line of cast iron pipe, under the track of the Canadian Northern Quebec Railway where the same intersects the Lakefield Portland Cement Company's land easterly three acres of Lot No. 74, Parish of Pointe aux Trembles, County of Hochelaga, P.Q.

5227—August 27—Granting leave to the Lakefield Portland Cement Company to erect, place, and maintain its power line and telephone line across the track of the Canadian Northern Quebec Railway, where the same intersects the Lakefield Portland Cement Company's land easterly three acres of Lot No. 74, Parish of Pointe aux Trembles, County of Hochelaga, P.Q.

5228—August 27—Granting leave to the Department of Public Works of the Government of the Province of Saskatchewan to construct a highway across the tracks of the Canadian Pacific Railway in the south-west ¼ of Section 2, Township 18, Range 14, west 2nd Meridian, being about ½ a mile east of Qu'Appelle Station, Sask.

5229 to 5237 inclusive—September 1—Granting leave to the Bell Telephone Company to cross the tracks of the G.T.R. and C.P.R. at nine different points in the Provinces of Ontario and Quebec.

5238—September 1—Granting leave to the Caledon Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at a point 4½ miles east of Caledon Station, Ontario.

5239 to 5241 inclusive—September 1—Granting leave to the Caledon Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. near Caledon Station, Ontario.

5242 to 5245 inclusive—September 1—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at four different points in Ontario.

5246—September 1—Granting leave to the Northern Pipe Line Company, Limited, to lay gas pipe or main under the tracks of the G.T.R. where the same crosses Lot 4, in the 2nd Concession, Township of Raleigh, County Kent, Ontario.

5247—September 1—Granting leave to the Norfolk County Telephone Company to erect, place and maintain its wires across the track of the G.T.R. at the intersection of the Centre Town Line, at Renton, Township Townsend, Ontario.

5248—September 1—Granting leave to the Bell Telephone Company to erect, place, and maintain its aerial wires across the C.P.R. at public crossing 100 yards south of Snelgrove Station, Ontario.

5249—September 1—Granting leave to the Princeton & Drumbo Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at Governor's Road Crossing two miles east of Eastwood, Ont.

5250—September 1—Granting leave to the Bell Telephone Company to cross with its wires the track of the C.P.R. at public crossing 1 mile east of Conception Station, P.Q.

5251—September 2—Granting leave to the C.P.R. to construct its branch line across certain streets to premises of William McPherson, at Abbotsford, B.C.

5252—September 2—Authorizing the C.P.R. to construct, maintain, and operate a spur to and into the premises of William McPherson, at Abbotsford, B.C.

5253—September 2—Granting leave to the Ontario Power Company of Niagara Falls to erect, place, and maintain its wires across the track of the P.M.R.R. at Welland, Township of Crowland, County Welland, Ontario.

5254—August 27—Authorizing the Lakefield Portland Cement Company to lay water pipe under the track of the Montreal Terminal Railway three acres east of Lot No. 74, Parish Pointe aux Trembles, County Hochelaga, P.Q.

5288—September 16—Authorizing the C.P.R. to construct two additional tracks across Dundan Street, south of the existing tracks, and also to construct one additional track across the southerly end of Vickers Street, on the southerly side of the four tracks already constructed across the said street, Fort William, Ont.

5289—September 16—Authorizing the Guelph and Goderich Railway Company to construct a branch line of railway, 1,803 feet in length, in the village of Milverton, Ont.

5290—September 16—Authorizing the Sarnia Street Railway Company, Limited, to erect, place and maintain its electric power, trolley, and feeder wires across the tracks of the G.T.R. between Sarnia Tunnel Station and Point Edward, where the same crosses Christina Street, in the town of Sarnia, Ont.

5291—September 15—Authorizing the Bell Telephone Company to erect, place, and maintain its telephone wires (underground) across the tracks of the C.P.R. at Notre Dame de Grace Road, Montreal, P.Q.

5255—August 27—Granting leave to the Lakefield Portland Cement Company to erect, place, and maintain its power line and telephone line across the track of the Montreal Terminal Railway three acres east of Lot 74, Parish of Pointe aux Trembles, County of Hochelaga, Province of P.Q.

5256—September 2—Approving of location of the Canadian Northern Railway Company's railway through Townships 13-15, Ranges 15-27, west of the Principal Meridian, Manitoba.

5257—September 1—Authorizing the Canada Atlantic Railway Company to construct, maintain, and operate spur to and into the premises of W. J. Campbell, Ottawa, Ont.

5258—September 1—Granting leave to the Burnt River Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. between Craig and Austin's mill, and the G.T.R. office, and Crego Street at the corner of Main Street, village of Kinmount, Ontario.

5259—September 1—Authorizing the C.P.R. to construct, maintain, and operate spur to and into the premises of W. J. Campbell, Ottawa, Ontario.

5260—September 1—Directing the arrival and departure of trains of the G.T.R. at Omemee Station, Ontario.

5261—September 2—Approving of the C.P.R. Company's Crow's Nest Branch between Peigan and Crow's Nest, Alberta.

5262—September 2—Authorizing the C.P.R. to open for the carriage of traffic the track of the double track of that portion of its Smith's Falls section between Kemptville Junction and Mountain, and the second track of that portion of its line of railway from Mountain to Finch, Ontario.

5263—September 1—Granting leave to the G.T.R. to cross with its railway the railway of the Canada Southern Railway near the Grand Trunk Railway Company's south yard at Fort Erie, Ontario.

5264—September 1st—Granting leave to the Napierville Junction Railway to connect its track with the track of the G.T.R. near Lacolle, P.Q.

5265—September 1st—Authorizing the Municipal Council of the Township of Hagar to construct a suitable crossing over the tracks of the C.P.R. where the railway intersects road between Lots 12 and 13, Concession 3, Township of Hagar, Ontario.

5266—September 17—Authorizing the Trans-Continental Railway to cross with their track the track of the C.P.R., at Grade, at a point near St. Basile Station, County of Portneuf, P.Q.

5267—September 17—Authorizing the G.T.R. to construct, maintain, and operate a branch line or siding from a point on the Lakefield Branch of the company's railway, on Rabbit Street, South of Church Street, in the village of Lakefield, Ontario, thence northerly along, upon, and across the northern boundary of Lot No. 26 on the east side of Rabbit Street.

5268—September 17—Granting leave to the Grand Trunk Pacific Railway Company, to construct its railway across certain highways in the Province of Manitoba, from mileage 112.801 to mileage 124.00.

5269—September 3—Granting leave to the British Yukon Railway Company,to open for traffic that portion of its branch line extending from the 106th mile post, on its line of railway, as now constructed and operated south of the town of White Horse, and thence in a north-westerly direction to the "Best Chance Mine" in the Yukon Territory, a distance of about eight miles.

5270—August 26—Authorizing the Department of Public Works of the Province of Manitoba to construct a highway across the Arcola Branch of the C.P.R., being an extension southerly of Main Street, in the town of Arcola, Sask.

5271—September 8—Authorizing the North American Telegraph Company, to erect, place and maintain its wires across the tracks of the G.T.R. at the G.T.R. main line, Campbellford, Ont.

5272—September 9—Authorizing the Mills Telephone Company, to erect, place and maintain its wires across the tracks of the C.P.R. at a point east of Thamesford, Ontario.

5273—September 9—Authorizing the C.P.R. to operate its trains over the crossing of the Souris Branch by the main line of the G.T.P. Railway at Headingly, Man., without stopping.

5274—September 8—Authorizing the North American Telephone Company to erect, place and maintain its wires across the tracks of the G.T.R. at Paper Mill Siding, Campbellford, Ont.

5275—September 8—Authorizing the North American Telegraph Company to erect, place and maintain its wires across the tracks of the G.T.R. at a point near Paper Mill Siding, Campbellford, Ont.

5276—May 26—Authorizing the G.T.P. Railway Company to construct its railway across certain highways in the Province of Manitoba, from mileage 84.543 to mileage 112.801.

5277—August 14—Approving and sanctioning the alterations in the grade and other changes necessitated by the building and reconstruction of the second track of the 20th District of the G.T.R.'s line of railway between the eastern limits of the city of Brantford and the western limits of the town of Paris, Ont.

5278—September 15—Authorizing the Rural Municipality of Pipestone, Manitoba, to erect, place and maintain its telephone lines across the tracks of the C.P.R at a point 2 miles west of Reston, Man.

5279-81-82—September 15—Authorizing the Rural Municipality of Pipestone, Manitoba, to erect, place and maintain its telephone lines across the tracks of the C.P.R. at Bardel, 4 miles west of Reston, and 5½ miles west of Reston, Man.

5280—September 15—Authorizing the G.T.P. Railway Company to transport on construction trains, or by special service if necessary, over that portion of its line of railway from Winnipeg, Man., to Battle River, Alta., prospectors, harvesters, and settlers, with their effects, between the said points; and to be relieved from liability to penalty for contraventing any of the provisions of the Railway Act in that behalf.

5283—September 15—Authorizing Alphonse A. Grange, Montreal, P.Q., to lay a water pipe under the tracks of the C.P.R. at Epiphanie, P.Q.

5284—September 15—Authorizing the Consumers' Gas Company, Toronto, Ont., to lay, at its own expense, a 20-inch gas pipe under the tracks of the G.T.R. on Eastern Avenue, Toronto, Ont.

5285—September 15—Authorizing the Consumers' Gas Company, to lay a 36-inch gas pipe under the tracks of the G.T.R. at Tecumseh St., Toronto, Ont.

5286—September 15—Authorizing the city of Toronto, to lay at its own expense, a 20-inch water main across the lands and tracks of the G.T.R. and the C.P.R., between the westerly boundary of a road sixty-six feet wide and running westerly from Dufferin Street, and the easterly boundary of Earnbridge Avenue, in the city of Toronto.

5287—September 16—Authorizing the Harrietsville Telephone Company to erect, place and maintain its wires across the tracks of the G.T.R. where the same intersect the cross road between Lots 10 and 11, Concession 4, Township of North Dorchester, north of the River Thames, about ⅛ mile west of the G.T.R. depot, Dorchester, Ont.

5292—September 15—Authorizing the Manitoba Government Telephone Commission to erect, place, and maintain its wires across the tracks of the C.P.R., at ¾ mile west of McDonald Station, Man.

5293—September 15—Authorizing the Sidney-Bell Telephone Company, to erect, place, and maintain its wires across the tracks of the G.T.R. at a point in Sidney Township, County of Hastings, Ont., about 2 miles west of Belleville Station.

5294—September 15—Autorizing the C.P.R. as Lessee of the V. & L.I. Railway to construct, maintain, and operate a branch line of railway from a point on the centre line of the Lulu Island Branch, at Station 68 plus 76, thence in a northerly direction to and into the premises of the Vancouver Lumber Company, on Lot 526, Vancouver, B.C., a distance of 1,152 feet; also another spur commencing from a point on the

centre line of the said branch at Station 69 plus 52, and extending in a north-easterly direction, to and into the premises of the said company, to a point on the westerly limit of Bridge Street, a distance of 560 feet.

5295—September 15—Authorizing the Manitoba Government Telephone Commission to erect, place, and maintain its wires across the tracks of the C.P.R. at Methven, Man.

5296—September 15—Authorizing the G.T.R. to construct, maintain, and operate a branch line from a point on the applicant's railway west of the Chaudiere Junction, and east of the Chaudiere River, in the Parish of Charny, P.Q., thence in a south-easterly direction through the Parish of Charny and the Parish of St. Jean Chrysostome, to the premises of the Chaudiere Lumber Company, with two spur tracks running westerly from the south-easterly end of the said branch line.

5297—September 16—Authorizing the Consumers' Gas Company to lay a 20-inch gas main under the tracks of the C.P.R. on Eastern Avenue, Toronto, Ont.

5298—September 16—Authorizing the Consumers' Gas Company to lay an 8-inch gas main under the tracks of the C.P.R. on Christie Street, Toronto, Ont.

5299—September 16—Authorizing the Consumers' Gas Company to lay a 20-inch gas main under the tracks of the G.T.R. on Eastern Avenue, Toronto, Ont.

5300—September 16—Authorizing the Lumsden Radial Telephone Company to erect, place and maintain its wires across the tracks of the C.N.R. at Lumsden, Sask.

5301-2—September 16—Authorizing the Manitoba Government Telephone Commission to erect, place and maintain its wires across the tracks of the C.N.R. at Mariapolis, and two miles east of Swan Lake, Man.

5303—September 17—Authorizing the Q. M. & S. to cross with its track, at rail level, the railway of the G.T.R. (Three Rivers Branch), near St. Gregoire Station, P.Q.

5304-5-6-7-8—September 17—Authorizing the Manitoba Government Telephone Commission to erect, place, and maintain its wires across the tracks of the C.N.R. at one mile east of Altamount; 1½ miles northeast of Mariapolis; 2 miles west of Somerset; 3 miles west of Miami; and at Main Street, Somerset, Manitoba.

5309—September 17—Authorizing the C.P.R. to open for traffic that portion of the double track of its main line between Fort William and Winnipeg extending from Linke to Savanne, mile 59.6 to 71.9; from Carlstadt to Niblock, mileage 89.9 to 97.5; from mileage 106.2, Shiba, to 112.6, English; from mileage 124.7, Tamarac, to Bonheur, all on the Fort William Section; and from mileage 38.5 to mileage 15.1 Scoril, on the Ignace Section, all in the Province of Ontario.

5310—To follow.

5311—September 17—Authorizing the Rural Municipality of Wallace, to erect, place and maintain its wires across the tracks of the C.N.R. between sections 21 and 22-26-10, Virden, Man.

5312—Amending Order of the Board No. 5269, dated the 3rd September, 1908, by striking out clause 2 in the said order.

5313—To follow.

5314—September 17—Authorizing the Lumsden Radial Telephone Company, to erect, place, and maintain its wires across the tracks of the C.N.R. on River Street, Lumsden, Sask.

5315—September 17—Approving by-law of the Q. M. & S. Railway authorizing the General Passenger and Freight Agent of the company, D. I. Roberts, to prepare and issue tariffs of the tolls to be charged on all traffic carried by the applicants.

5316—September 17—Approving by-law of the Wabash Railroad Company, authorizing the Chief of the Tariff Bureau, F. A. Barber, to prepare and issue tariffs of the tolls to be charged for all traffic carried by its railway.

5317—September 17.—Authorizing the G.T.R. to operate its trains over the crossing of its railway by the C.P.R., near the asylum, in the city of London, Ont., without being brought to a stop.

ON THE MEASUREMENT OF LARGE INDUCTANCES CONTAINING IRON.*

By Sir Oliver Lodge, F.R.S., and Benjamin Davies.

We have had occasion lately to measure large inductances, up to and above 100 henries, with core consisting of subdivided iron in a nearly-closed circuit, as used for certain telegrahic purposes with very weak currents. Since the inductance may vary rapidly with strength of current, it is necessary in any measurement to imitate the conditions of practice, and to determine the inductance as a function of current under those conditions. To this end we have designed a maximum-amplitude galvanometer, consisting of a well-damped coil moving dead beat in a strong magnetic field, and attached to a mirror so that the amplitude of its excursion can be observed. It can subsequently be calibrated by means of a steady current giving the same deflection. The inductance to be measured is connected up in series with this galvanometer, and with a specially designed alternator of small power and known frequency $p/2\pi$, giving a sinuous or simply harmonic current. A switch allows the inductance to be suddenly replaced by a non-inductive adjustable resistance, R′; and when under these conditions the same oscillation is produced in both cases, then the self-induction is equal to that equivalent resistance divided by the frequency constant, or $L=R'/p$. The strength of the current involved in this measurement is known by imitating the deflection with a known steady current; and the main measurement consists simply in observing the deflection caused by the sine alternator at a measured frequency, either with the inductance, or with the adjustable non-inductive resistance, indiscriminately. It is to be understood that the ohmic resistance of the wire wound on the self-induction is low. If not, a correction must be applied for that, which is easily done, since $\sqrt{R^2+p^2L^2}=R'$. The following empirical expression is found able to give the self-induction of a nearly closed magnetic circuit excited only by very weak currents since for such currents it is found to be practically constant.

$$L=\frac{k\,n^a}{(G+g)^b}$$

where n is the number of turns, G the width of the air-gap in millimetres, and the other quantities are constants to be determined by experiment: though a will naturally be nearly 2. In an actual case of a nearly closed magnetic circuit the following values were found:

$a=1.99$; $b=0.47$;
$k=18$ henries; and $g=0.1$mm.

Results.—The result of this method of measurement applied to inductance coils of this type shows: (1) that measurements based on a determination of the square root of mean square of current would serve fairly well for low magnetizing forces; (2) that the self-inductance of such coils is for weak currents nearly independent of frequency, or say for all frequencies up to about 20 per second, when the magnetizing force does not exceed .04C.G.S.; (3) that the self-inductance of a nearly closed magnetic circuit is a definite and dependable function of the width of the air-gap for moderate currents and frequencies.

* Abstract of paper read before Section A at the Dublin meeting of the British Association.

Rangers on the Coeur d'Alene forest reserves in Northern Idaho, beginning seventeen miles east of Spokane, have received orders from the department at Washington to gather seeds of tamarack and white and yellow pine, which will be sown broadcast on the snow the coming winter in places where no tamarack or pine trees are grown. Several hundred thousand acres of forests are included in the reserves.

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.

New Brunswick.

ST. JOHN.—Tender for St. John harbor wharf extension will be received at this office until 4 p.m. on Monday, October 5th, 1908, for the construction of an extension to the wharf in West St. John harbor, St. John County, N.B., according to a plan and specification to be seen at the offices of E. T. P. Shewen, Esq., Resident Engineer, St. John, N.B., C. E. W. Dodwell, Esq., Resident Engineer, Halifax, N.S., J. L. Michaud, Esq., Resident Engineer, Merchants Bank, Building, Montreal, and at the Department of Public Works, Ottawa. Nap. Tessier, Secretary, Department of Public Works, Ottawa.

Quebec.

MONTREAL.—Tender for sewers will be received at the office of the city clerk until noon, Friday, the 2nd of October, 1908, for the construction of sewers in the undermentioned streets or sections of streets, with the necessary connections according to the sections and specifications on view in the office of the undersigned, viz.: First Avenue, from Masson Street to Cote Visitation Road, in St. Mary Ward (Rosemount); Aylwin Street, from Hochelaga Street to Sherbrooke, Hochelaga Ward. John R. Barlow, City Surveyor, City Surveyor's Office, City Hall.

PLESSISVILLE.—Tender for public building, Plessisville, P.Q., will be received at this office until 4 p.m. on Thursday, October 1st, 1908, for the construction of a public building at Plessisville. Nap. Tessier, Secretary, Department of Public Works, Ottawa.

QUEBEC.—Tender for closing gap in the Carillon dam will be received at this office until sixteen o'clock on Monday, the 28th September, 1908. Plans, specifications and the form of the contract to be entered into can be seen at the office of the Superintending Engineer of the Quebec Canals, No. 2, Place d'Armes, Montreal, on and after Thursday, the 17th September, 1908. J. W. Pugsley, Acting Secretary, Department of Railways and Canals, Ottawa.

Ontario.

HAMILTON.—Tender for combined gas and electric light fixtures, Armoury, Hamilton, Ont., will be received at this office until 4 p.m. on Thursday, October 8th, 1908, for combined gas and electric light fixtures at the Armoury, Hamilton, Ont. Plans and specification can be seen and forms of tender obtained at this department, and on application to Messrs. Whitton & Stewart, architects, Hamilton, Ont. Nap. Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tender for construction will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, until twelve o'clock noon of Monday, the 28th day of September, 1908, for the work required for the construction, in accordance with the plans, profiles and specifications of the Commissioners, of the following sections of the Transcontinental Railway, viz.: (1) Districts "D" and "E"—From a point designated on the plans of the Commissioners, being at the western end of Fauquier Bros.' Abitibi contract, in the Province of Ontario, in a westerly direction for a distance of about 104.24 miles. Date of completion, 31st December, 1910. (2) District E—From a point designated on the plans of the Commissioners, about sixty miles west of the easterly boundary of District "E," in the Province of Ontario, westerly to the end of Fauquier Bros.' contract, north of Lake Nepigon, a distance of about 100 miles. Date of completion, 31st December, 1910. Plans, profiles and specifications may be seen in the office of the Chief Engineer of the Commissioners at Ottawa; also in the office of John Aylen, Acting District Engineer, North Bay, Ont., and T. S. Armstrong, Nepigon, Ont. P. E. Ryan, Secretary, Transcontinental Commission.

PERTH.—The Forged Car Wheel Company, of Perth, Limited, offer for sale by tender the whole of their assets, comprising patents, machinery, buildings, site. Said tender to be opened October 7th, 1908, at 12 o'clock, noon. For further particulars apply to A. T. Wilson, Esq., the Company's Secretary, Perth, Ont.

OTTAWA.—Tenders for timber will be received until noon on Thursday, the 8th day of October next, for the undermentioned railway ties and timber, namely: Lot 1, 25,000 cedar ties and 500 cords of shingle bolts, to be cut from dead and fallen trees by the Indians of Manitoulin Island, unceded part, during the ensuing winter; and delivered on the shore of Lake Huron at convenient points for shipment. Lot 2, 10,000 cedar, tamarack and hemlock ties, to be taken out by the Indians of Garden River Band during the ensuing winter, and delivered on the banks of Echo River, Garden River, Root River and St. Mary's River. Any further information desired will be given on application to Mr. C. L. D. Sims, Indian agent, Manitowaning, Ont., for Lot 1, Mr. W. L. Nichols, Indian agent, Sault Ste. Marie, Ont., for Lot 2, or to the undersigned for both lots. J. D. M'Lean, Secretary, Department of Indian Affairs, Ottawa.

Manitoba.

WINNIPEG.—Tender for locomotive shops will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, until twelve o'clock noon of the 8th day of October, 1908, for the construction and erection complete, in accordance with the plans and specifications of the Commissioners, of locomotive shops east of Winnipeg. P. E. Ryan, Secretary, the Commissioners of the Transcontinental Railway, Ottawa.

WINNIPEG.—Tender for filling will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, until twelve o'clock noon of the 8th day of October, 1908, for the filling required in connection with the preparation of site for shops on the Transcontinental Railway, about six miles east of Winnipeg. Plans, details and specifications may be seen and forms of tender obtained at the office of Mr. Hugh D. Lumsden, Chief Engineer, Ottawa, Ont., and Mr. S. R. Poulin, District Engineer, Winnipeg, Man. P. E. Ryan, Secretary, the Commissioners of the Transcontinental Railway.

CONTRACTS AWARDED.

Ontario.

GANANOQUE.—There was one tender only for extension of waterworks as advertised. This was from R. J. Wilson, whose prices were: Trenching in earth, $1.15 per lineal foot; rock, $3.25 per cubic yard; manholes, $50 each; flush tanks, $50 each; lampholes, 9-inch tile, 25 feet, 20 cents per foot; valve chambers, $2 per foot; catch basins, $2 per foot; furnishing and setting hydrants, $45 each; furnishing and setting valves, $20 each.

OTTAWA.—Contracts for the construction of the two sections of the National Transcontinental Railway, west of Lake Abitibi, tenders for which were received last month, have been awarded to O'Brien and McDougal, who were the lowest tenderers. Contracts for the two remaining sections in Quebec, east of Lake Abitibi, have also been awarded to Mc-

Dougall and O'Brien. The contracts are in the aggregate for about 350 miles of road.

Manitoba.

WINNIPEG.—Tenders have been received and opened for the supply of 50,000 arc lamp carbons as follows:

Tenders.	Name of Carbon.	Total Amount F.O.B. Winnipeg.
No. 1	Fubius Honrion	$1,025.00
No. 2 .....(a)	Honrion	1,050.00
.....(b)	Sorius	1,200.00
.....(c)	Electron	1,350.00
No. 3	Schiff's	1,075.00
No. 4	Sieman's	1,196.20
No. 5	Electra	1,300.00
No. 6	Electra	1,467.05
No. 7	Arco	1,850.00

The tender of Chas. Goodyear, Winnipeg, No. 1, at $1,025.00 was accepted.

British Columbia.

VANCOUVER.—The second section of the Westminster Chilliwack Railway was given to Messrs. Ironsides, Rannie and Campbell at the following prices:

Clearing, $148 per acre.
Grubbing, $250 per acre.
Earth, 25 cents per cubic yard.
Hard pan, 45 cents per cubic yard.
Loose rock, 50 cents per cubic yard.
Solid rock, $1.00 per cubic yard.
Overhaul, 1¼ cents per station.
Free haul, 1,000 feet.
Cedar box culverts, $19 per 1,000 ft. B.M.
Plank box culverts, $22 per 1,000 ft. B.M.
Timber in trestles, $27.50 per 1,000 ft. B.M.
Piling delivered, 10 cents per lineal foot.
Piling driven, 23 cents per lineal foot.
Total amount of contract, $175,000.

Foreign.

WHEELING, W. VA.—Abstract of proposals for building abutment for dam No. 19, Ohio River, opened on August 10th, 1908, by Capt. F. W. Alstaetter, Corps of Engineers, U.S.A., at Wheeling, W. Va.:

Article—	Designation.	Quantity.	Pennsylvania Contracting Co., Pittsburg, Pa.	Ohio River Contract Co., Evansville, Ind.	J. P. Curtis, M. H. Shumway, Portsmouth, O.
Common excavation . . .	cu. yd.	3,500	$0.85	$1.00	$1.25
Rock excavation	cu. yd.	195	3.50	3.00	2.00
Fill	cu. yd.	1,900	0.95	1.00	0.50
Base for paving	cu. yd.	270	1.75	2.50	2.00
Riprap	cu. yd.	650	3.50	4.00	5.00
Concrete	cu. yd.	1,140	9.75	8.50	7.50
Placing iron and steel.	pound	1,200	0.02	0.02	0.03
Placing pipe and fittings.	lin. ft.	70	0.25	0.25	0.05
Total amount of bid . .			$19,366.50	$18,991.50	$18,094.50

SEWERAGE AND WATERWORKS.

Quebec.

RIMOUSKI.—Messrs. Ouimet and Lesage, civil engineers of Montreal, have been appointed by the town of Rimouski, Que., to investigate the town's system of waterworks, and draw up a plan for their improvement. The town takes its water from a lake some five and one-third miles distant, through a pipe which passes up and down hill and is sometimes below the level of the reservoir. Apparently the pipe is too small and besides does not deliver the amount of water it would seem to be capable of. Messrs. Ouimet and Lesage will recommend a plan for improvement.

Ontario.

WESTON.—Mr. Willis Chipman, C.E., Toronto, has been engaged by the council to make a report on a possible water supply for the town.

TORONTO.—Mayor Oliver is anxious to push the trunk sewer. He informed City Engineer Rust that he must have the specifications printed by October 15th, as the contract should be let by November 1st. The City Engineer intimated that the work could not be rushed so fast as this, but the Mayor insisted on his directions being carried out.

TORONTO.—The Board of Control have authorized the City Engineer to make arrangements with the Cameron Septic Tank Company of Chicago for the use of their septic tanks in the new sewage disposal plant. The United States Supreme Court recently decided that these tanks are patentable. Mr. Rust made satisfactory arrangements with the company in connection with the Woodbine plant.

British Columbia.

VICTORIA.—Mayor Hall will recommend to the council meeting to-night that a by-law be introduced authorizing the raising by way of loan of $150,000 for the installation of a system of surface drainage. This by-law will shortly be submitted to the ratepayers for their sanction.

LIGHT, HEAT, AND POWER.

Ontario.

INGERSOLL.—For several years, and particularly since Niagara Power became a live issue with the municipalities of Western Ontario, there has been much difference of opinion here as to the nature of the contract between the corporation and the Ingersoll Electric Power & Light Company. It has been claimed that the town cannot proceed to distribute Niagara Power without acquiring the local plant. With the hope of solving the problem and ascertaining the town's position before any definite action is taken regarding a distributing plant, the council has decided to get the opinion of some eminent lawyer.

MICHIPICOTEN FALLS.—The Algoma Power Company (head office, Berlin, Ont.) is now completing the construction of its power plant at Michipicoten Falls, Ontario, and at the same time is trebling the capacity by installing a second unit of 1,000 horse-power, and a third of 400 horse-power, as well as a separately driven exciter of 125 horse-power for the whole station. This company's plant, although not completely finished, started commercial operation in January this year, having several gold mines in the Michipicoten district as its first customers. Last month a contract was entered into with the Lake Superior Corporation for the supply of electric power for operating its Helen iron mine. This entails the immediate construction of a 12-mile transmission line from the power station, and the installation of electrical equipment in the mine of over 1,000 horse-power in motors as well as the new generating apparatus at the power station. The contract for the supply to the Helen mine provides that all connections and current be ready by December 1st next, and the power is to be supplied 24 hours per day. The contract is for a period of ten years. The Algoma Power Company has purchased the electrical equipment for both the Helen mine and the power station, and also a portion of the hydraulic apparatus from Allis-Chalmers-Bullock Company, of Montreal, and the remainder of the hydraulic equipment from the Jenckes Machine Company, of Sherbrooke, Que. The transmission line is now under construction by the company's own force. Mr. C. H. Mitchell, Traders Bank Building, Toronto, is the engineer.

ORILLIA.—The new dam at the town's power plant, at the Ragged Rapids, which has been under construction for three seasons, has now been put into use. This is the third dam the town has built at the rapids, and has cost $70,000.

Manitoba.

WINNIPEG.—At the meeting of the city council a letter was read from F. Morton Morse, secretary-treasure of the Winnipeg Electric Railway Company, offering to supply the city with electrical power for a term of ten years or longer to the guaranteed amount of 10,000 horse-power delivered at the city limits for the use of the city and for manufacturing purposes at the rate of $18.40 per horse power per annum. The above price is only 40 cents per horse-power above the price to be secured under the municipal power scheme. In the power prospectus, it is stated that power will be secured under municipal ownership at $18 per horse-power.

Saskatchewan.

REGINA.—The city is considering the securing of cheaper power by the erection of a power house at the Dirt Hills, about sixty miles from the city, where there is said to be an abundant supply of excellent soft coal, and transmitting the power to the city by electric cables.

British Columbia.

VICTORIA.—A building permit has been issued to the British Columbia Electric Company which will add a storage and battery room to its present building on Store Street. The addition which will be of brick, one storey in height, and cost $4,000, will be fitted up with the necessary appliances for storing electricity. At present there is considerable waste of power which, with the appliances to be installed, will be conserved.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—Despatches from Minneapolis say, that the Chicago & Great Western Railroad Company, with all of its terminal facilities, rolling stock, motive power and equipment, soon becoming the sole property of and a subsidiary line to the vast system of the Canadian Pacific Railroad Company seems to be a certainty, according to unofficial information from headquarters of the Great Western in St. Paul.

MONTREAL.—The latest blue prints made in the engineer's office at Montreal show that 1,225 miles of the Transcontinental line are now under contract east of Winnipeg, and that tenders are called for the construction of 576 miles more, which will bring the total under construction up to 1,802 miles. On the Western section west of Winnipeg, 1,214 miles are now being built, and tenders are called for the construction of 179 miles more. This leaves but 562 miles still to be let. The total mileage that is being built by the Grand Trunk Pacific Company, including the Lake Superior branch, is 1,955 miles.

QUEBEC.—The annual general meeting of the Temiscouata Railway Company was held at the Chateau Frontenac. The reports submitted showed a very satisfactory result of the year's working of this important line, there being a considerable increase in receipts over the previous year. The retiring board of directors was re-elected, as were the following officials: President, Mr. Frank Grundy; Vice-President, Mr. J. H. Walsh; Secretary-Treasurer and General Manager, D. B. Lindsay; Superintendent, Mr. G. G. Grundy.

Manitoba.

WINNIPEG.—F. W. Morse, vice-president and general manager of the G.T.P., announced that the G.T.P. will be opened for freight and passenger traffic to Wainwright, 666 miles west of here on September 14th.

WINNIPEG.—A party of fifty men under E. H. Drury, C.E., the Government engineer, left on September 19th for Split Lake, 160 miles from Fort Churchill, there to take up the survey work for the Hudson's Bay Company Railway to be built by the Government. From there the expedition will divide into three parties, two going down the Churchill and one down the Nelson Rivers. The parties already engaged will work towards them, thus there will be five parties in the field all winter.

Alberta.

EDMONTON.—J. G. Legrand, of Montreal, chief bridge engineer of the G.T.P., stated to-day that the Battle River and Clover Bar bridges will be finished by November 1st, so that the steel could be laid westward to Edmonton. The foundation of the Pembina River bridge will be finished by February 1st, 1909. Steel will be laid to Pembina from Edmonton this fall, and the superstructure of the bridge will be finished by spring. The contracts for bridges across Wolf Creek and Battle River will be let shortly. Mr. Legrand stated that the earth under one of the Battle River bridge piers had been washed away and the pier has settled. It may have to be renewed later, but is not delaying the bridge construction.

British Columbia.

VANCOUVER.—The Canadian Pacific has at present two large survey parties locating a railway line through Pine Pass, in the Rockies; also a line to Dunvegan, on the Peace River. Pine Pass has been twice surveyed, once by the Great Northern. It is next to Yellow Head Pass, where the Grand Trunk Pacific is going through, the easiest route to the Pacific coast.

Foreign.

DETROIT, MICH.—The Michigan Central Railroad has contracted with the local plant of the American Car & Foundry Company for the repair of five thousand freight cars. The road has not at the present time that number of disabled cars, but will furnish them at the rate of 150 to 200 at a time till the company's rolling stock is in first-class condition. This is in addition to the work being done at the M.C.R. car shops, which are running nearly full capacity. It will give employment to nearly one thousand men at the A. C. & F. shops for two months.

MISCELLANEOUS

Quebec.

MONTREAL.—The Canadian General Development Co., under contract from the Department of Railways and Canals, Quebec canals division, will in a few days turn loose a small army of workmen on the construction of the canal turning basin which is to be built near Montreal in the village of St. Paul.

Ontario.

TORONTO.—The Architectural League of America met last week at Detroit. Mr. Acton Bond of the firm of Bond & Smith, and Mr. J. M. Lyle, of Toronto, were sent as delegates of the Canadian branch of the League.

British Columbia.

PRINCE RUPERT.—The closing down of the British Columbia Tie & Timber Company's sawmill at Seal Harbor, two miles east of town, came as a great surprise to the people of Prince Rupert. This action of the company cannot be accounted for here, and the motive is hard to understand, as there is a big demand for lumber at the present time, and sawmills in this vicinity have orders for more lumber than can be turned out.

Foreign.

BUFFALO, N.Y.—Announcement is made by the National Battery Company of Buffalo, that the receivership under which this company has been operating since last February was terminated August 19th. All claims against the National Battery Company have been settled and the entire property has been restored to the stockholders. It is also stated that full control of the reorganized company has been secured by The Cutler-Hammer Manufacturing Company of Milwaukee, well-known as makers of battery charging rheostats and other electric controlling devices. The plant of the National Battery Company will remain at Buffalo but the business will be conducted under new management and with ample capital.

PERSONAL.

MR. GEO. A. BROWNE, of the C.P.R. engineering staff, Muskoka, has been transferred to Shawinigan Falls, Que.

ALFRED CLEWORTH, constructional engineer and manufacturers agent, has moved his office and show rooms from the Janes Building to 8 Ruskin Avenue, Toronto.

MR. JOHN FINDLEY, of Architect N. R. Darrach's office, St. Thomas, Ont., won the first prize for architectural drawings in the Art Department of the London Exhibition.

MR. F. P. GUTILIUS, assistant chief engineer C.P.R. Eastern lines, has been appointed general superintendent of the Lake Superior Division C.P.R., succeeding Mr. F. P. Brady, who has resigned.

DR. EDWARD P. HYDE, now of the Bureau of Standards, after October 1st will organize and direct a Department

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1 refitted 48" x 20' with 52 3" tubes.
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1 13" and 23" x 30" tandem compound, Wheelock.
1 refitted 14" x 34" R. H., Wheelock.
1 9½" and 14½" x 12" automatic tandem compound.
1 8" and 13" x 18" automatic tandem compound.
1 refitted 12" x 10" Westinghouse Junior.
1 refitted 12" x 12" Armington & Sims.
1 refitted 10" x 10" Leonard, peerless, self-oiling.
1 new 10" x 15" Jewel.
1 nearly new 8" x 12" Erie, centre-crank.
1 refitted 6½" x 9" Armington & Sims.
1 rebuilt 7" x 10" Leonard, centre-crank.

PORTABLE ENGINES AND BOILERS.

1 refitted 9" x 12" portable engine and boiler.
1 refitted 9" x 10" semiportable engine and boiler.
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1 refitted 8" x 10" portable engine and boiler.
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1 8" centrifugal sand pump with hose and pipe.
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1 Heine Water Tube Boiler, 70 h. p.
3 Heine Water Tube Boilers, 125 h. p.
2 Yarrow Water Tube Boilers, suitable for Tugs or Steamers.

NEW INCORPORATIONS.

Acton, Que.—Canadian Pulp-Wood Co., $25,000; T. Lovett, P. Lovett, L. Gauthier.

St. Agapit, Que.—Beaurivage Lumber Co., $25,000; N. E. Demers, A. Demers, E. Paquet.

Milverton, Ont.—Phoenix Oil and Gas Co., $100,000; J. Torrance, R. Miller, R. Lederman.

Sarnia, Ont.—Sarnia Realty Co. $100,000; F. C. Watson, Miss E. J. Pashley, M. A. Sanders.

Lorrainville, Que.—Bellehumeur Co., $50,000; J. de St. Laon, A. Feypell, A. Lapresle, Ville Marie.

Ingersoll, Ont.—Ingersoll Nut Co., $100,000; J. L. Ross, A. W. Holmsted, T. A. Silverthorn.

St. Catharines.—North Lanark Marble and Granite Quarries, $150,000; W. H. Wylie, Mrs. M. M. Wylie, G. H. Phillips.

Port Arthur, Ont.—Ruttan Estates, $300,000; Mrs. O. M. Ponton, Toronto; H. N. Ruttan, Winnipeg; W. S. Ruttan, Port Arthur.

Blenheim, Ont.—Farmers' Long Distance Telephone Co., $40,000; N. Watson; M. H. Newcombe, J. Whittington, Harwich Township.

Listowel, Ont.—Standard Milling Co., $40,000; R. H. Stewart, Palmerston; H.

(Continued on Page 26.)

POSITION WANTED

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of Physical Research, under the auspices of and at the expense of the National Electric Lamp Association. Dr. Hyde with a considerable and sufficient staff will opperate his department with entire freedom from commercial suggestion and with the same frank publicity which has characterized his work at the Bureau of Standards.

MR. JOHN G. SULLIVAN, who has been manager of construction for the C.P.R. Eastern lines since April 1907, has been appointed assistant chief engineer C.P.R. Eastern lines, with head office in Montreal. Mr. Sullivan has seen service with the Great Northern, Columbia and Western, and for a number of years was C.P.R. division engineer on construction, with head offices at Winnipeg. For a year and a half he was associated with John F. Stephens on the Panama Canal.

MARKET CONDITIONS.

Montreal, September 23rd, 1908.

In the United States, some hesitation is being noted among buyers because of the impending elections and it is feared that this may become pronounced, especially as producers are asking prices which buyers are not prepared to pay. The pig-iron market has held firm throughout the United States, but some Valley and Central West furnaces are keenly competing for the business that is going in their sections, and in isolated cases, reductions are mentioned. These, however, are not understood to be general. Production by merchant furnaces is increasing somewhat, and this may have the result of keeping prices down for a further period than was expected. Some negotiations are pending in Pennsylvania on large blocks of basic iron for the latter part of this year and the first half of 1909, but thus far it has not been learned that business has resulted. Generally speaking, the market is quiet and fairly firm.

Mail advices from Great Britain say that non-renewal of the German pig-iron syndicate brought out some selling. German makers are precluded from selling except at syndicate prices for delivery before the first of January, 1909, but it is not impossible that as the stocks in makers' hands are heavy, there may be some severe cutting at a much earlier date. This competition is likely to reduce shipments from Great Britain considerably. Shipments this month have been good, but stores show an increase of 7,400 tons for the fortnight. Prices of hematite iron, other than Cleveland, have advanced one to two shillings per ton, and a good deal of buying has been put through for home consumption.

Nothing new has developed in the local market. A small amount of business is passing, but receipts are small and sales are mostly of Canadian made. Prices continue steady at last week's advance.

Very few changes have taken place throughout the following price lists:—

Antimony.—The market is steady, at 9½ to 10c.

Bar Iron and Steel.—Prices are steady all round, and trade is decidedly dull. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged