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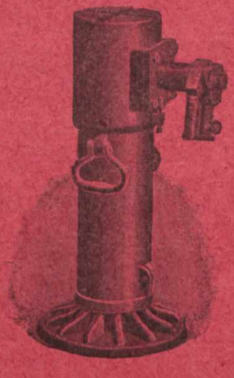


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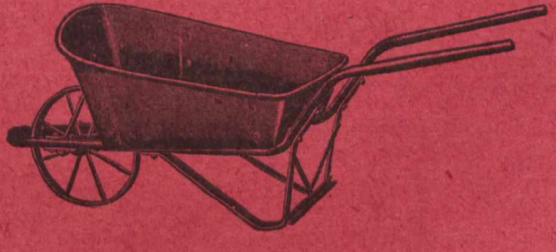

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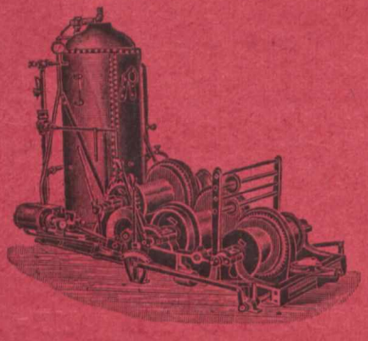

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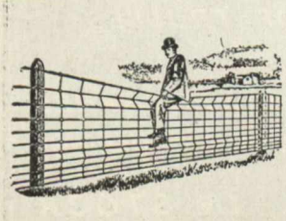

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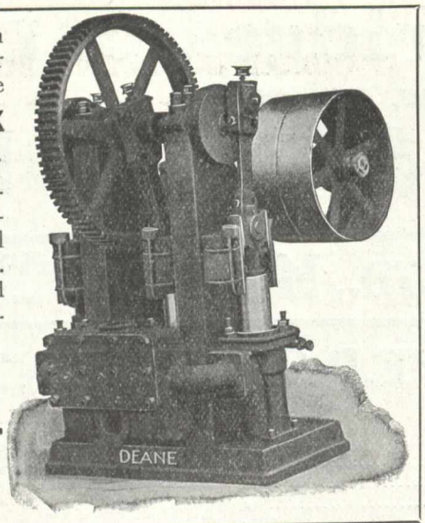

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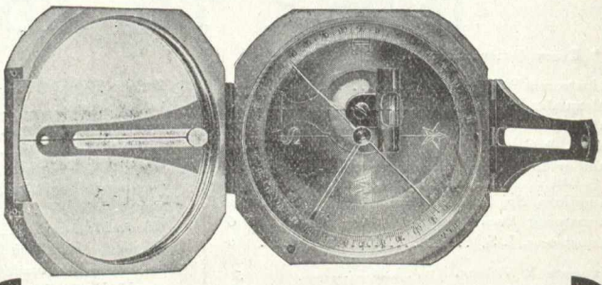

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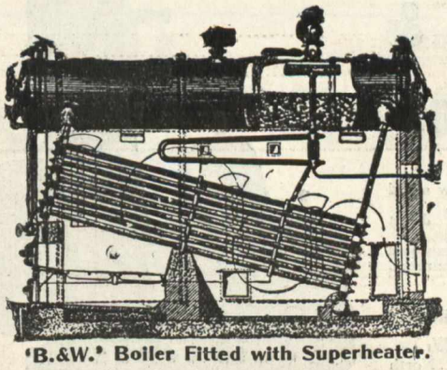
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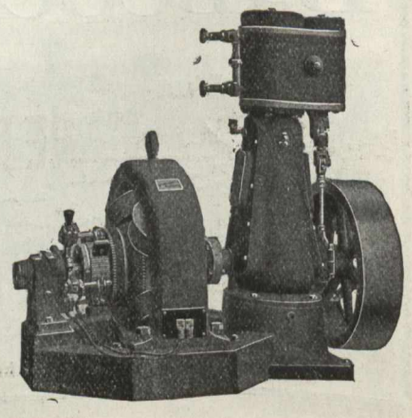

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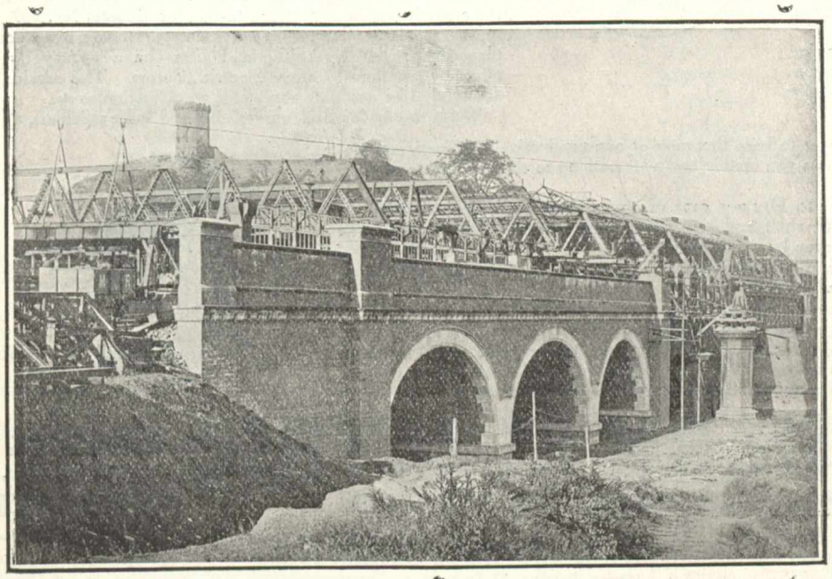

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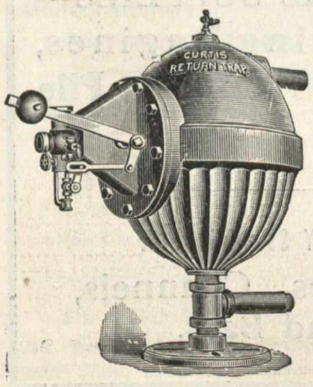

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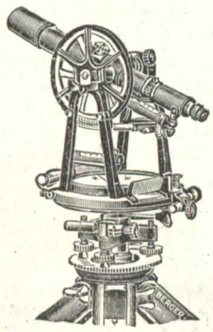

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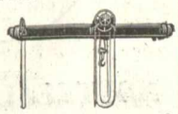

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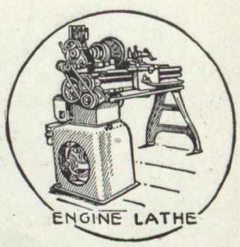

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NOTICE TO ADVERTISERS

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, APRIL 23, 1909.

CONTENTS OF THIS ISSUE.

For copies of our issue for April 9th, 1909, we will give one month's extension of subscription. If you do not require your copy, kindly forward it to The Canadian Engineer, Toronto.

"ENGINEERS' ESTIMATES."

It is a pity that so-called popular magazine writers do not confine their pen-splashings to tea and tattle, society piffle, and stories, the alleged facts in which no person can ever prove, while nobody wants to. The staff writers of such journals cannot be expected to know everything. That may be the reason they scribble about anything. When stepping away from the demi-tasse and "twencent" chatter, one expects at least that these scribes should master a few facts before attempting to shed any light upon them. The technical journal has no desire to monopolize the exposition and elucidation of subjects which are of peculiar interest to its readers. But when the popular papers fly off at a tangent in order to discuss technical matters, they should be sure of a correct base on which to fashion their structures of deep thought and the resultant conclusions.

The Canadian Courier, for instance, in a recent issue makes a strikingly poor analysis of Grand Trunk Pacific financing, and undertakes to classify engineers' estimates in a category of lies. This is the kernel of its philosophical nut: "Let us not forget in future that there are lies, blank lies, and engineers' estimates." What an easy sentence that is to drop from a penpoint, guided by a thoughtless hand! The Courier argues that the Grand Trunk Pacific has been as badly misled as the Government by engineers' estimates. That is amply proven, it continues, by the fact that the railroad has to come to the Government this year for a special loan of ten millions. Now, let us consider the facts. The total available guarantee for the prairie section of the Grand Trunk Pacific, as arranged by the Government and the railroad, amounted to $21,509,926, equal to $23,482 per mile for the 916 miles. Those are the figures of the Government and the Grand Trunk Pacific. The Grand Trunk Pacific's engineer estimated the cost per mile of that section at $34,059. The estimate of Mr. Schreiber, engineer to the Transcontinental Commission, figured the cost at $34,943, a difference of only $884 in the two engineers' estimates. Thus, financial provision of $21,509,926 was made by the railroad promoters and the Government, while the engineers' estimates showed that a sum of at least $32,007,448 would be needed. In other words, the engineers' estimates allowed for the ten millions which has just been loaned by the Government to the railroad; the promoters and the Government did not allow therefor. There is as much difference between the estimates of a promoter and those of an engineer as there is between the average accuracy of a so-called popular journal and the multiplication table. Thus falls to the ground the one specific case cited by the Courier.

While the Courier carelessly endeavored to fill space, it aroused at the same time the indignation of engineers generally. That is because they have the facts and "the national weekly" has not. Let us take a few examples of work done and compare the engineers' estimates with the final contract price:—

Work.	Engineers' estimate.	Contract price.
Toronto Bay tunnel.....	$325,000	$269,000
Waterworks steel pipe under Bay	200,000	190,000
New western channel	497,000	495,000
Cobourg breakwater	140,000	139,000
Scarlet Bridge	10,000	9,400
Middle Road Bridge	2,800	2,665

These figures speak for themselves. There are a thousand and one difficulties in estimating of which the Courier cannot be expected to have knowledge. On certain works competition in tendering is abnormally keen. In such cases, the successful contractor often has reason later to regret his close figuring. Where the difference between the engineers' estimates and the contractors' price is considerable, one will generally find on examination of the case that the contractor has made very little profit, or that he has even lost money. If engineers applied to their estimating the loose, slovenly, devil-may-care methods with which some magazine writers tinge their editorials, there would be gaping discrepancies in figuring which the Canadian Courier would see at least through its monocle. Until more care is taken in preparing newspaper editorials on technical subjects, the classification of the Canadian Courier will have to be changed to lies, blank lies, and national weaklies.

DAMAGE BY LIGHTNING.

Although not exactly an engineering subject, yet the question of damage by lightning is one of considerable importance to the engineer. In a recent report issued by the Department of Physics of the Agricultural College, Guelph, some interesting information in this connection is given. During 1908, the reported losses throughout the Province of Ontario through lightning were over seventy thousand dollars; and from the returns it is interesting to note that none of the buildings destroyed were provided with lightning-rods; nor does it appear that metal windmills or metal flagpoles add in any way to the danger from this source. In fact, they sometimes appear to act as a protection.

It is frequently stated that buildings on elevated ground are more likely to be struck by lightning than those in valleys, yet the report shows that the number of buildings injured on low lands or flat country are double the number struck on hills or elevations.

Proximity to a railway does not appear to be a source of danger, as only two of the buildings struck were within half a mile of a railway line, by far the larger majority being over a mile from the tracks.

Of the trees reported as damaged by lightning during 1908, we find one oak, one hemlock, two maple and two cherry trees. Between the years 1901 and 1908 the trees reported struck numbered 149. Of these, 40 were elm, 25 pine, 15 oak, 10 maple, 8 apple, 7 basswood, 6 poplar, 5 oak, 5 willow, 4 each of hemlock, cedar, balsam and spruce, 2 each of cherry, hickory and birch, and 1 beech, this last disproving the old Indian legend "that beech trees were never struck;" or is this the exception which proves the rule? Of the remainder, there was one each of butternut, fir, walnut, pear and thorn.

About the only thing these statistics prove is that damage is done by lightning. The compilation is interesting, however, and as the information becomes more complete and more detailed and the other attendant conditions specified, certain general laws may be deduced. This information is valuable, and it is to be hoped that it will be carried on from year to year, and that those who co-operate will be specific and accurate in the information they furnish.

RAILWAY CHARTERS IN CANADA.

In 1888 Canada had open for traffic twelve thousand two hundred miles of railway line. In 1908 there was being operated twenty-three thousand miles, an addition to Canadian steam railways of over one hundred miles per year. During that same period the Canadian Parliament granted 203 charters, authorizing an aggregate construction of 63,809 miles. This estimate does not include charters granted the four large Canadian companies, C.P.R., G.T.R., C.N.R. and G.T.P. Ry.

Of the total number of companies incorporated, only twenty-five have constructed any portion of the lines authorized, and eighty-six charters have lapsed. Eighty-eight charters have been given one extension of time, forty-two have received two extensions, and eighteen have received three or more.

Since 1900 one hundred and seventeen charters have been granted, of which twenty-six have lapsed, and of the twenty-five thousand miles authorized by those charters only four hundred miles have been constructed by these smaller companies, while the big four have built almost four thousand miles.

It looks very much as if independent roads were not likely to be encouraged nor flourish in Canada.

EDITORIAL NOTES.

The Board of Water Commissioners for Oshawa, Ont., have just published the report of W. S. Bowden, superintendent of the municipal system. If the waterworks departments of all Canadian cities would publish as full and complete financial statements, municipal officials would be able to compare very quickly the efficiency of their plant. Operating expenses and construction expenses are kept separate, as well as the cost of material for new construction and for repairs. The amount of metred water for manufacturing purposes is given separately. The total cost of installing the system, together with interesting details of costs, are also given.

* * * *

Labor troubles on the Transcontinental are again to the front. The foreman of a construction company has been charged with manslaughter, and workmen returning from the line are laying charges before magistrates. No man has a right to be inhuman. And, while there is not the slightest doubt that some foremen are hard "drivers," it is just as true that many laborers take every advantage of their employers; and one of the most aggravating conditions the contractor has to put up with is the tramp laborer and the "hanger-on" of every construction gang. The good workman seldom, if ever, has cause to complain of his treatment from a construction company.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Apr. 14		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Apr. 16 '08	Price Apr. 8 '09	Price Apr. 15 '09	Sales Week End'd Apr 15	Price Apr. 16 '08	Price Apr. 8 '09	Price Apr. 15 '09	Sales Week End'd Apr 15
Canadian Pacific Railway	8,920.6	$150,000	$100	1,490,000	1,305,000	155¾ 155	177	176 175	457	155 154¾	176¼ 176	175½ 175¼	1830
Canadian Northern Railway	2,986.9	.....	.....	177,800	165,200	.....	.....*1st. pref.109, 3rd pref. 48, ordinary 19⅞	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,568.7	226,000	100	744,283	685,281	.....	.....	.....	.....	.....	.....	.....	.....
T. & N. O.	305	(Gov. Road)	.....	31,573	16,556	.....	.....	.....	.....	185 184	212 211⅞	209½ 209	1299
Montreal Street Railway	138.3	18,000	100	69,558	62,280	.....	.....	125	200	100½ 99¼	124 123	124⅛ 124	626
Toronto Street Railway	114	8,000	100	71,635	63,338	100	.....	.....	208	.....	168 167	.....	.....
Winnipeg Electric	70	6,000	100	.....	.....	143½ 142½	170 160	170		.....		.....	

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

THE RELATION OF THE ENGINEER TO THE COMMUNITY.

By Cecil B. Smith.

The associations of twenty-eight years endear this University and this Faculty to me, and, although the student conditions of 1881 were not those of 1893, when I joined the teaching staff, and, although out of ashes has already arisen a new and greater, and, I trust, more perfect equipment for instruction, still I cannot but believe, and do recognize, that the old spirit prevails; that training is here considered of more permanent value than mere information; that culture and the man are essentials, and that the ultimate aim is to give to the world an ever-growing band of men of cosmopolitan attitude, who will not only fill acceptably their various technical positions, but will, by their relationship to their immediate surroundings, reflect credit on their Alma Mater and their country.

My object in addressing you is to suggest a permanent attitude of your mind and life, such that you, personally and individually, will, by your force of character and training, become vital facts in your various communities, and exert such an influence that the profession as a whole will receive an uplift.

In order to develop the idea it is necessary to outline the present condition, which is reflected by the newspaper, catering to public opinion. Much as one may resent it, deem it unjust, or otherwise dissent, still it must be admitted that, in the public mind, the term "engineer" is still vague, and from the man who fires a threshing engine to the cultured physicist, there is a gradual merging of duties, opinions, values, and relation to the public, that the profession in vain struggles to free itself from.

To some, an engineer is a mechanic, a hardy explorer, whilst learning and technique are often discounted by the suggestion of lack of "practical qualities," which is seldom or never suggested by the public in its attitude of mind toward the other learned professions.

The profession has attempted, but in vain, to establish a close corporation. The prejudice of the legislators against so-called class legislation has so far prevented this laudable object from being consummated, and the public has no protection against the glorified mechanic or the glib-tongued fakir. It, therefore, rests with the young men of the present generation to educate public opinion, so as to bring about a change of view, to stamp on the public mind not only the value of the engineer in taming the wilds and coaxing the electrical current along distant routes, but to vindicate his far greater value as a leader of business, of affairs, of projects, and of the public mind itself, in those ever-widening channels of transportation, heavy manufactures, mining, and the construction, maintenance, and more particularly even the management of public utilities.

To demonstrate the newspaper man's treatment of the profession, I exhibit clippings from four Toronto dailies, in which a quarter column is considered the value to the public of a report of a banquet and speeches of the Canadian Society of Civil Engineers held recently. At this banquet the leading engineers of Canada were present in large numbers. The gathering was representative, and yet, the only paper giving more than a skeleton reference was one whose editor spoke at the banquet, and his speech, given in his usual perfervid style, bulks largely in the report. On the same date and in the same issues is given the speech of a Toronto lawyer in Buffalo on the exhilarating subject of the Judicial Committee of the Privy Council; and yet, four and one-half columns of fine print is the value placed on the speech. Several conclusions may be reached: that the lawyer was of known eloquence, that the engineers were poor speakers and had no specific message to give to the public; but I consider that the real reason lies deeper, and that it is because the public mind has long been primed with the idea that the engineer is only and solely an engineer and a servant, not a leader; a voter, but not a moulder of public opinion; a bird of passage, who, must unfortunately, often be engaged at a small salary or for small fees to design and carry out public works, utilities, that have been conceived, financed and handled by other and so-called broader minds, and the management of which will revert to the non-technical man so soon as the constructive period has passed.

The exception proves the rule, and, much as we may inveigh against it, and amongst ourselves discuss the mistake which the public is making in placing so narrow an interpretation on the engineer; yet the broad facts are as stated, and the remedy lies with ourselves and ourselves only; for the world accepts people at their own valuation.

As a starting point, I would suggest that the generic cause lies in the trend of mind given to the technically trained engineer at the university, where we find that the student, outside of a thin veneer of cultural training, is crammed full of theory and detail, but seldom with the proper method of presenting an idea, and such a deficiency is often perpetuated by the ever-increasing technical duties which are placed on the young engineer immediately after graduation, whereby in a drafting-room or in field work his mind is crystallized into silent routine.

My suggestion as regards this is that more attention should be paid to culture studies, to class oratory and student literary and technical societies, where the young man should be encouraged, nay, obligated to acquire facility, terseness, and lucidity in presenting his case to his fellowmen, taught to think on his feet, to argue with calmness and control of temper, and develop a habit of temporary leadership.

Going beyond this, the graduate often fails to acquire business habits in college, and may miss the chance for many years afterwards, owing to his location or to his wandering habits, wherein he endeavors to broaden his experience and acquire business connections, but in doing so he loses what will be of far more value to him and to the profession, namely, the community standing.

From the moment a young lawyer or doctor graduates he instinctively locates and commences to acquire friends in church circles he is in evidence, in sports, in society, in business, a factor to be counted with, and by imperceptible degrees the community feels that his opinion, his friendship, and his leadership are worth while.

The present condition of engineering in Canada is partly due to our scattered population, and we may hope for better things as the conditions of life become more complex, wherein greater numbers of the engineers are required in each community and wherein the very complexity of life must force the public to rely more on the skill of the engineer.

But each of you may do much to hasten matters by a clearer view of your opportunities—I consider the remedy to lie in creating in the public mind a new idea of the profession. This may be done in many ways: Each of you should loyally support Canadian engineering journals and societies, and contribute freely to them. This is more opportune in your younger days than in later life, for if successful you may soon find that an accumulation of cares and interests may make this more difficult.

Then you may achieve local standing by active participation in local matters. Aloofness is never impressive for any length of time, and the man, however clever, who holds himself apart from every day affairs is soon forgotten.

Therefore, participate in activities quite apart from your profession. I cannot see any valid reason why engineers should not be aldermen, mayors, and members of Parliament as the opportunity presents itself. But this will only come if the engineer is an active citizen, who does not aggressively put forward his views as an engineer, but as a citizen, who makes use of his trained mind to lead his fellowmen.

Speaking again as a business man to you: How many engineers are such? How many can dictate letters clearly, draft attractive reports? Organize any affair, however simple? Present the case to his fellows as a business man? Convince them by his clearness of expression, argument and vision?

*An address before the McGill Engineering Society.

This leads, naturally, to another point of view, namely, vision and initiative, in which our outlook here in Canada should be of the brightest.

It is not my intention to disturb your minds by suggesting that you should aim to be promoters or speculators. This should merely be a remote contingency arising out of long experience and opportunity, but your mind should be trained to be in a receptive mood.

This may come naturally by your association in this wise: Every enterprise has its value, its merits, demerits, limitations, and relation to the public and to the nation, and no matter how humble may be your first position, if it be to run levels or trace a plan, you should find out what it is for. If a railway, what are the objectives, what products will it benefit? What are its revenues and cost, and wherein does it benefit the nation?

If a patent, what industries will it affect? If an electric utility, the investment, the quality, the revenue, the reasons for the types used. The cultivation of such lines of thought will fit you to judge the merits of a subsequent and perhaps similar project, and by degrees you will arrive at a point wherein your vision may be true in perspective and your initiative ready to take wing.

When to such a training you can couple a cultured mind and a sound judgment, leadership should follow as a natural consequence, and I can easily imagine that if the younger generation of our profession should develop along such lines that a more dignified tone will gradually assume such proportions and the mind of the public will be so moulded that a higher status will surely follow.

PERSONAL.

MR. E. P. FETHERSTONHAUGH, B.Sc., honor graduate of McGill University and member of the Canadian Society of Civil Engineers, has been appointed by the Manitoba University Council as lecturer in Electrical Engineering, his appointment taking effect in June. Mr. Fetherstonhaugh was the choice among fifty candidates for the position, many of the unsuccessful applicants being members of large universities in the East and South. He graduated from McGill in 1899, after which he spent five years in practical work with the firm of Fetherstonhaugh & Company, acting as manager of the Ottawa branch of that firm for four years. During the years 1905 to 1907 he acted as lecturer at McGill University under Professor Owens, where he gained a valuable knowledge both of the practical and teaching side of electrical engineering. He has for some time been with the Canadian Westinghouse Company in Winnipeg, and is a member of the Executive Committee of the McGill Graduate Society of Manitoba. With the appointment of Mr. Fetherstonhaugh a complete practical and theoretical course in Electrical Engineering will now be given at the University of Manitoba. On taking charge of the work in June Mr. Fetherstonhaugh will at once purchase the necessary apparatus for equipping the laboratories and will have everything in readiness for the opening of the session in October.

Mr. E. P. Fetherstonhaugh.

MR. A. LEOFRED was elected director of the Board of Land Surveyors, at the annual general meeting at Quebec.

MR. W. A. WINFIELD has been appointed manager of the Eastern Telephone Company with offices at Halifax, N.S.

MR. T. K. NICOL, formerly superintendent of the Necropolis Gardens, Glasgow, Scotland, has been appointed Parks foreman at Guelph, Ont.

MESSRS. W. S. WILLIAMS & FRANCIS P. BERGER, Consulting Engineers, Monadnock Building, San Francisco, Cala., have been retained by The Civic League as advisory engineers in connection with contemplated civic work.

MR. RICHARD WALLACE, late superintendent of the Buffalo Structural Steel Company, has been appointed superintendent of the new bridge shop of the Manitoba Bridge & Iron Works, Limited, of Winnipeg. Mr. Wallace has a wide experience as superintendent in several of the large American shops in the manufacture of railway bridges and steel structures and will, no doubt, be an important factor in developing this business at Winnipeg.

MR. DAVID POTTINGER, who has been appointed as one of the new managers of the Intercolonial, is a Canadian, born in 1843 at Pictou, N.S. He started railway work in 1863 as a clerk for the Nova Scotia Railway at Halifax, becoming cashier of the road. In 1872 he became station master of the Intercolonial at Halifax, two years later being promoted to general storekeeper, in 1879 he was chief superintendent and in 1892 was promoted to be general manager of Government railways.

MR. E. P. BRADY, the fourth Commissioner, was born in 1852, and educated at Newbury, Vt., served some time with the Passumpsic and other American railways. In 1888 he entered the service of the Canadian Pacific as train master, being later promoted assistant superintendent of the C.P.R. at Winnipeg, and in the following year was promoted as general superintendent of the Lake Superior division at North Bay. He resigned from the service last year, since which time he has not been connected with any railway.

MR. E. TIFFIN, a third Commissioner, was born at Hamilton, Ont., 1849, and started railway work with the old Great Western in 1863. He worked his way up and in 1871-5 was made station master at Brantford. Later he joined the Credit Valley Railway as general freight agent. Later he went to the States as south-western agent of the Commercial Express fast freight line at St. Louis, Mo. Returning to Canada in 1896, he joined the C.P.R. as general freight agent of the Atlantic division. In 1901 he was appointed traffic manager of the Intercolonial and in 1903 became general traffic manager of the Government railways.

MR. MATTHEW J. BUTLER, Deputy Minister of Railways and Chief Engineer of the Department of Railways, who is expected to be chairman of the Commission appointed to manage the Intercolonial Railway, was born at Deseronto, Ont., and educated at Toronto University. He started his railway career in 1879 as transitman on the Pembroke extension of the Kingston & Pembroke Railway. Later he was chief engineer on the construction of the Thousand Islands Railway and the Napanee, Tamworth & Quebec Railway. In 1889 he was appointed assistant chief engineer of the Atchison, Topeka & Sante Fe. Returning to Canada in 1891 he became chief engineer of Bay of Quinte Railway & Navigation Company, and in 1903 was appointed chief engineer of the Locomotive & Machine Company, of Montreal, and designed and built their shops here. In 1904 he was appointed assistant chief engineer to the National Transcontinental Railway Commission, and a year later succeeded Collingwood Schreiber as Deputy Minister of Railways and Canals. Mr. Butler also studied law, and in 1897 was admitted to practice at the Illinois Bar.

LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]

BREACH OF CONTRACT—DIRECT AND INDIRECT DAMAGES—WHAT DETERMINES AMOUNT.

Hadley vs. Baxendale.—The plaintiffs were owners of a large flour mill at Gloucester, England, the shaft of which having become broken, they sent it on May 24th to the defendants, who ran an express business, with instructions to forward to Greenwich. It transpired that this was the only shaft in the mill and that while this was unavailable the whole mill was at a standstill and the hands out of employment. Consequently the plaintiffs every day, until the shaft was returned, lost whatever profit their business was capable of yielding; the shaft, moreover, was being sent to certain engineers in Greenwich to serve as a model for a new one, and, of course, work on the new shaft could not be commenced until they received the old one. Nothing was said to the defendants about the urgency of the case when the shaft was handed over to them and nothing about the peculiar circumstances of the mill lying idle.

They received the shaft with instructions to ship at once but neglected to do so, and it lay in their custody at Gloucester until May 30th.

The plaintiffs claimed that the extra delay of six days was occasioned by the defendants' failure to ship obedient to instructions, and that the latter were responsible for the idleness of the mill for that much longer, and they brought action for breach of contract inasmuch as the defendants had not shipped or delivered the shaft within a reasonable time.

The trial Court allowed the plaintiffs damages, instructed the jury to take into account the special circumstances of the six days' delay and determined the amount accordingly, but the Court of Appeal thought the damages occasioned by the idleness of the mill were too remote, and altered the decision to that extent. 2 W.R., 302.

The decision is to the effect that in the absence of nothing being said, the defendants were justified in considering the shaft as so much old iron, as they had no knowledge of its special importance; and the true principle in cases of breach of contract is pointed out,—that the damages should be such as either result naturally from the breach of contract or at all events were within the contemplation of the parties when the contract was made. If there were any special circumstances, as in this case, and such was communicated to the other party, then such special circumstance was known and understood, and a failure to guard against it might be taken into account in assessing the damages. But in this particular case nothing was said to the defendants who consequently did not know of any peculiar risk and could not have it in contemplation when the agreement was entered into. Held that the damages must be confined to such loss as would ordinarily follow a breach of such contract, and as in the great generality of cases there would be no special or aggravating circumstance, these cannot be taken into consideration.

SKILLED LABOR—INCOMPETENCY.

The public profession of an art is a representation and undertaking to the world that the professor possesses the requisite skill and ability.

Harmer vs. Cornelius.—The plaintiff declared himself to be a painter and engaged with the defendant to enter his services as a painter at a stated salary.

The agreement was to last for at least one month and the master at once sent his man out of the city to an adjoining town where he himself would follow later with other men. Upon the master's arrival, some days later, he saw at once that the work was unsatisfactory and discharged the man who thereupon sued the master for breach of contract. The jury, upon whom devolved the duty of deciding as to the facts, declared in their finding that the plaintiff was not competent to perform the work but that he was not fraudulent in professing to be able.

The Court pointed out that misconduct in a servant is according to everyday experience a ground for discharge and that so far as they could see there was no material difference between a servant who could not and a servant who would not perform the duty for which he was hired. The result is in either case to deprive the master of that for which he bargained and he is justified in dismissing the man and may do so without incurring damages for breach of contract. 6 W.R., 749.

CONTRACT WITH MUNICIPALITY—NECESSITY OF BY-LAW.

Waterous Engine Works Co. vs. Town of Palmerston.—The council of the defendants corporations instructed their fire and water committee to make overtures for the purchase of a fire engine, and a month later the committee recommended that the town purchase a fire engine and hose from the plaintiff to cost $2,150. The plaintiff brought action to force the town to accept the engine and hose supplied and to pay $2,150.

The facts shown were that the council had passed a resolution adopting the recommendation of their committee, and that the contract had been drawn apparently in the presence and with the knowledge of the council, and this contract had been signed by the mayor of the town and by the clerk of the council, with the seal of the corporation attached. One provision of the contract was that the company should submit the engine to all tests which the corporation might deem necessary, and if the tests prove satisfactory and if the engine was found to be manufactured in accordance with the specifications, the price should become payable. The town engaged experts to make the test which was made June 19th and on the 20th these experts reported that the engine fully came up to the specifications with the exception that it took eleven and one-half minutes to get up steam and throw water, whereas the contract specified ten minutes as the limit. The experts further reported that this could be partly accounted for by the fact that the engine had six hundred feet of hose attached, whereas the contract called for only one hundred, and the trial judge, taking all facts into consideration, held that the engine did answer the test and was capable of getting up steam and throwing water within ten minutes specified. It was not shown that the town had ever accepted delivery of the engine. It had been shipped by the plaintiff to the town where it had been received and stored in the town's engine house, but beyond that it appears they had no use of it nor any control over it.

For some reason the corporation decided that they did not care to go through with the purchase of the engine and on July 21st they passed a resolution to the effect that, so far as they could legally do so, all negotiations with the plaintiff be dropped, and when the Engine Company found the town would not perform the contract they brought this action to enforce performance.

The section of the Municipal Act that gives municipal councils power to purchase fire apparatus and other equipment, says nothing about passing a by-law for the purpose,

but an earlier section enacts that the powers of municipal councils shall be exercised by by-law unless otherwise provided for. It will be seen that the section authorizing purchases does not make such other provision, and, therefore, the proper method is to do so by by-law.

The Court held that the want of a by-law was fatal and that the instrument relied upon, although under the seal of the corporation, was not valid.

The trial judge commented very unfavorably upon the conduct of the town towards the plaintiff but felt obliged to dismiss the action. 21 S.C.R., 556.

RIGHTS OF SUB-CONTRACTOR AND OWNER.

Farquhar vs. Zwicker.—The defendant, Zwicker, residing in Nova Scotia, let a contract to one Thompson for the erection of a house on certain lands on Lucknow Street. The contractor in turn sub-let the plumbing to the plaintiff Farquhar. When the plaintiff had completed the plumbing he obtained an order from Thompson, directed to the owner, in the following terms: "Please pay Farquhar the sum of $705, and charge to my account on building, Lucknow Street." Farquhar took the order to the owner who would not pay it just then, but agreed to pay it when the architect should certify that the work had been finished and properly performed. Shortly after this Farquhar managed to get the architect and the contractor all together. The architect told Zwicker that the amount was a proper one and that there were funds to pay it, and Zwicker then told Farquhar that it would be alright, and he (Zwicker) received the order and retained it when Farquhar went away but did not pay it at once.

The parties apparently did not contemplate any trouble at the time, but shortly after the contractor, Thompson, made an assignment. The legal effect of the assignment would be that Thompson's assets invested in the assignee; this would involve the amounts which were due to him by the owner under the original contract, and Zwicker would no longer hold anything to Thompson's credit as the amounts had passed to the assignee.

The Court was of the opinion that Farquhar having taken the order to the owner who received it and after leaving it with him had accepted the owner's undertaking to pay the amount and he could no longer have maintained an action against Thompson for the amount. The Court held that a novation of the debt had taken place, that Thompson was no longer liable, but Zwicker had become liable for the contractor's debt, and judgment was given for the sub-contractor against the owner Zwicker. 41 S.C.R., 30.

SALE OF PATENT AND RIGHT OF RENEWAL.

Peck vs. Powell.—The defendant, Charles Powell, had obtained a patent "for a cone pump and its connections" for five years, expiring on 19th July; but which included by statute a right of renewal for two further terms of five years each. On 1st of June preceding the expiry of the original five-year period he made a contract with the plaintiff, Peck, whereby he "granted, sold and set over to Peck all the right, title and interest which I have in the said invention, as secured to me by said letters patent within five counties . . to the full end of the term for which the letters patent are granted."

When the original term expired Powell renewed the patent but in his own name and for the entire Dominion of Canada and refused to assign the rights under the patent for this second term, claiming that the assignment or sale included only the residue of the term existing when the sale was made.

The Court held that the right of renewal was part of the defendant's "right and interest secured by the letters patent" and that under the Patent Act the right of renewal may be exercised by the original patentee or any one to whom he has meanwhile assigned his patent. It was, therefore, decreed that the defendant must execute such further documents as were necessary to secure to the plaintiff the right of renewal for both of the further five-year terms. 11 S.C.R., 495.

SEWER FLUSHING.

(Continued from Page 569.)

(Fig. 2) shows the syphon fixed in a tank which may be of any size or depth required for flushing purposes.

The syphon consists of a metal trap (A) surmounted by a metal dome (B). The water gradually rising in the tank displaces the water in the trap (A). The head of water in the trap being sufficient, however, to hold up the water in the tank until a given height is reached. The moment, that the point of equilibrium is passed, even by a single extra

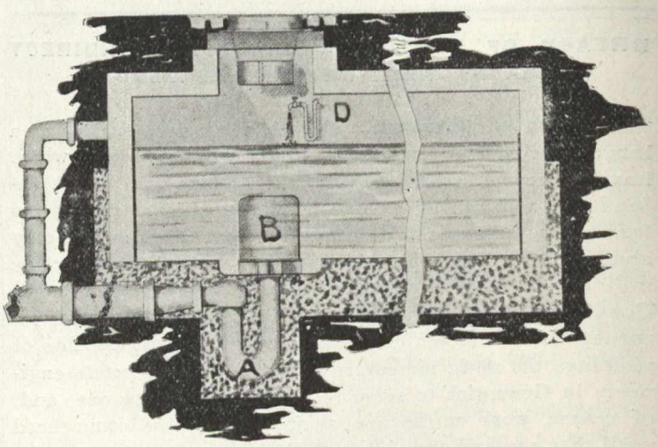


Fig. 2.

drop feed of water, the water in the trap is forced over the outlet and the whole body of water in the tank discharged by suction.

The outlet from the syphon is provided with a "swivel bend," which may be turned in any direction to suit the sewer to be flushed.

The feed is shown at the point "D" by means of an ordinary stop-cock, consequently the feed can be regulated to any amount required for flushing purposes, viz.; the flush may be fixed to discharge once a week, or any number of times per diem within practical limits.

An overflow is shown, in case of any obstacle entering from the street manhole cover, which may interfere with the working of the syphon.

The syphons are made in various sizes to suit the various sewers requiring flushing. Each size also carries with it its own depth or head of water required to discharge it.

(Fig. 3) shows a special adaptation of the principal for very shallow sewers, discharging a depth of water from 6 inches upwards. This form is used to a large extent for automatic feeds to bacteria filtering beds when it is a question of very little head to work on.

(Figs. 4 and 5) show how two or more syphons may be fixed in the one tank, each so arranged to discharge alter-

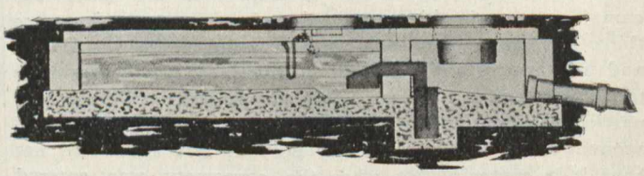


Fig. 3.

nately. Thus from one point, or tank, more than one sewer, may be automatically flushed. These also are used for alternately supplying filter beds.

In cases where there is an abundant supply of fresh water it is preferable to use such for flushing purposes. If not direct from the mains, water may at times be conveyed from streams at higher levels than the sewer.

At the head of sewers where there may be only a few houses connected, the flush is generally of an intermittent and poor character. In the case of the separate system of drainage the roof water may only form a mere dribble in the sewer. Much can be done by gathering the roof water, or

the bath wastes in sufficient quantities in storage tanks fitted with syphons, so that they may be discharged in bulk and in sufficient body not only to cleanse the immediate sewer, but also the continued length of main sewer.

The cost of providing efficient flushing arrangements for main sewage is extremely small, and apart from the cost

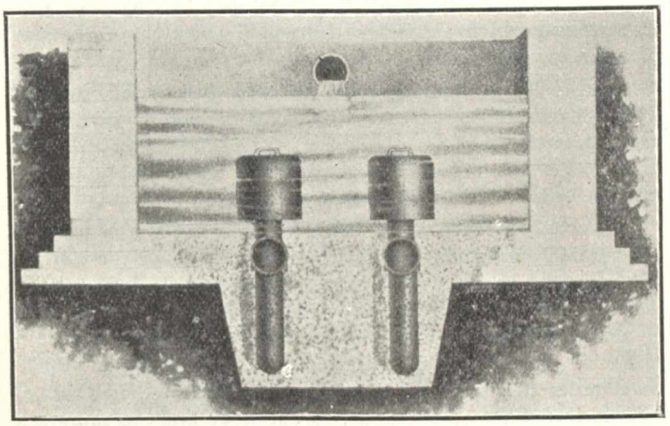


Fig. 4.

of water is only a first cost, requiring no maintenance. The amount of water, if judiciously placed and used, is very small indeed. It is a question entirely of concentration and requisite volume in proportion to the diameter of sewer to be flushed. We are certain of one thing, that, if more attention was given to this subject by municipalities, we would find

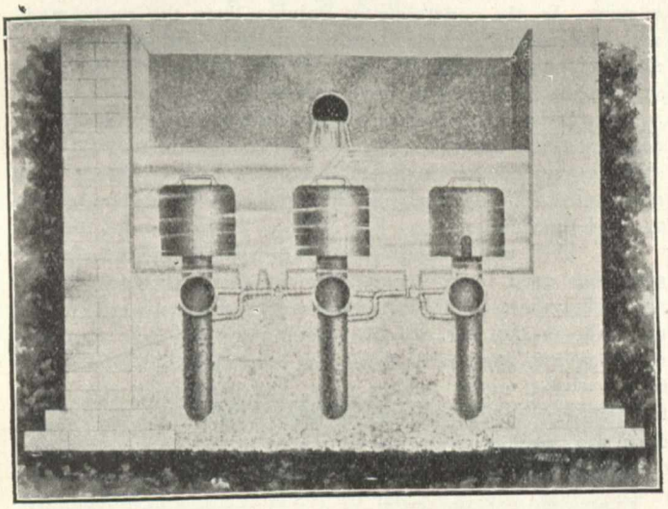


Fig. 5.

less talk for the necessity of sewer ventilation, and less complaints of street grating nuisances.

Rapid and thorough removal of sewage filth from the sewers, means practically no sewer gas with its attendant infection. The engineer who is content to put in a sewerage system which is merely a means of collecting sewage instead of disposing of it, has by no means fulfilled the duties which he was called upon to perform.

QUESTIONS AND ANSWERS

Questions or Suggestions are welcomed. They will be carefully considered by experts

E. R. G.—Writes, how often can you dose a sub-surface filter?

We take it that what is meant is the method of filtering or disposing of tank liquors by means of subsoil pipes placed underground, a system only applicable to private or very small installations. It is impossible to answer this question, unless data are given; (a) as to preliminary treatment for removal of solids; (b) quantity of sewage per day to be dealt with; (c) character of soil or other filtering material proposed to be used. If E. R. G. will supply the above, we will then endeavor to give the information required.

X.—Asks, which was first put before the public, the Septic Tank or Scott-Moncrieff Tank.

We presume that the writer refers to the "Septic Tank" included in the "Cameron" patent, as apart from this particular septic tank there were many of this character which preceded it.

The Cameron Septic Tank was brought before the public in 1895, the Scott-Moncrieff Tank in 1891, or 4 years previous. The Scott-Moncrieff system consisted of two processes; (a) septic action in what he called a cultivation tank; (b) nitrification or oxidation by means of percolating coke filters arranged in trays.

"The action of the cultivation tank is, both qualitatively and quantitatively, the same as that of a septic tank.*

*See Dunbar,—Principals of Sewage Treatment, page 96.

TESTS OF WATERPROOF CEMENT.

The St. Louis Sampling and Testing Co. has made a report to the Meramec Portland Cement and Material Co, Bank of Commerce Building, St. Louis, on their processes for producing a waterproof Portland cement, the conclusions of which are as follows:—

As a convenient method of judging of the merits of the proposed process for waterproofing cement we may compare it (from the results of tests made thus far) with the standard requirements already given as necessary to be fulfilled before any such process can be accepted as entirely satisfactory. It is not intended, of course, that this will furnish final and altogether conclusive proof of the merits of the process. As already stated, this is but a report giving results of what must be considered as a preliminary series of tests, leaving much still to be done on a more extended scale. Sufficient, however, has been accomplished to answer the inquiry for which this work was undertaken, and to entitle the process to respectful attention on the part of those interested and skilled in the preparation and use of cement.

1. The requirement that the waterproofing must be efficient seems to be met in a very satisfactory degree. The results of tests, as applied, show that the immersed samples, when removed from the water and quickly dried with a towel, gained slightly in weight, but the amount of this gain is comparatively small, even after long exposure, and the rate of gain is very slow. As compared with the results obtained with plain cement products, tested under similar conditions, the difference is very striking, and shows that the treatment proposed is remarkably efficient in giving resistance to the permeation of water.

While as yet there has been no opportunity to apply long-time waterproofing tests, such tests as have been made furnish evidence of value, and indicate that good results may reasonably be expected even after very long immersion in water.

The following group of tests, selected as representative from a large number, shows by comparison the effect of immersion upon plain and waterproof cement products, in each case the test pieces having been prepared under similar conditions, except in the matter of waterproofing.

The immersion was total, with one inch depth of water above the upper surface. Weights given are in grams:—

Neat Whole Briquettes.

	Duration of Immersion.				
	5 Min.		30 Min.		24
Dry Wt.	Wt.	Gain.	Wt.	Gain.	Wt.
		Plain.			
126.0	137.0	11.0	139.0	13.0	140.0
132.5	144.0	11.5	146.5	14.0	147.5
		Waterproof.			
134.5	136.0	1.5	136.0	1.5	137.0
136.0	137.0	1.0	137.0	1.0	137.0

Half Briquettes.

60.0	60.5	0.5	60.5	0.5	61.0
61.0	61.5	0.5	62.0	1.0	62.0

Hours.	7 Days.		14 Days.		21 Days.	
Gain.	Wt.	Gain.	Wt.	Gain.	Wt.	Gain.
14.0	140.5	14.5	....	...	....	...
15.0	140.0	15.5	....	...	....	...
2.5	137.0	2.5	137.0	2.5	137.0	2.5
1.0	137.0	1.0	....	...	137.0	1.5
1.0	....	...	....	...	....	...
1.0	....	...	....	...	....	...

From the above it will be seen that the plain cement briquettes showed a gain of 11 and 11.5 grams in weight after five minutes' immersion, while those of the waterproof cement gained only 1 and 1.5 grams in the same time; that water permeated the plain cement briquettes to the extent of 14.5 and 15.5 grams (over 11.5 per cent.), while it reached only 1.5 and 2.5 grams (less than 1.5 per cent.) in the waterproof briquettes. The half briquettes show practically the same results.

The following are selected as representative of a large number of briquettes showing the effect of waterproofing 1 to 2, 1 to 3, and 1-3-4:—

	5 Min.		30 Min.	
Dry Wt.	Wt.	Gain.	Wt.	Gain.
		1:2		
138.6	142.1	3.5	142.8	4.2
116.9	119.8	2.9	120.6	3.7
		1:3		
130.5	135.6	5.1	136.5	6.0
129.4	134.5	5.1	135.5	6.1
146.0	149.0	3.0	.....	...
		1:3:4		
142.0	147.0	5.0	148.0	6.0

24 Hours.		48 Hours.		26 Days.	
Wt.	Gain.	Wt.	Gain.	Wt.	Gain.
143.9	5.3	144.1	5.5	.....	...
121.4	4.5	121.6	4.7	.....	...
136.9	6.4	136.9	6.4	.....	...
.....	...	135.9	6.5	.....	...
150.4	4.5	.....	...	152.0	6.0
				5 Days.	
148.5	6.5	.....	...	148.5	6.5

The above results were obtained with total immersion of waterproof cement briquettes, and show that after a small amount of water is taken up the permeation practically ceases. On the other hand, in every case the plain cement briquettes very quickly take up 9 and 10 grams of water and are wet through.

The accompanying photograph shows even better than figures the effect of the waterproofing. This was taken within half an hour after the half briquettes were split, and shows very plainly the readiness with which the water permeates in 30 minutes the mass of plain cement briquettes, and, on the other hand, the great resistance given by the waterproofing, no appearance of moisture being visible in the neat briquettes after total immersion for 48 hours.

In the case of 1:2, 1:3 and 1:3:4 briquettes, those made waterproof show, when split, that the moisture has not penetrated more than about one-eighth of an inch from the exterior surfaces, even after 48 and 72 hours, and in fact as long as immersed. On the other hand, the plain briquettes of similar make all show, when split, complete permeation of moisture within 30 minutes to 2 hours. Such evidence as these occular demonstrations is very convincing as to the resistance to water permeation which this waterproofing process imparts to cement products of all kinds.

2. The requirement that the waterproofing must be effective throughout the whole mass of concrete is completely satisfied in this process, since the latter is applied for waterproofing cement before delivery for use, and it is intended that such cement shall be used for the whole mass of concrete. Nor should the additional expense in using the cement, made waterproof by this process be a serious matter, considering the great advantages resulting from having the structural work in which it is used waterproof throughout.

3. That the waterproof treatment should be such that it can be applied in the manufacture of the cement is also most fully met. While the treatment is capable of being applied to the finished cement at any time, it is especially intended that it shall be applied in the cement mills at the time of manufacture of the cement, and it is eminently adapted for application in this way. It will be appreciated that this is one of the many advantages the process possesses, and which simplifies the whole question of the use of a waterproof cement.

4. There is nothing used in this waterproof process which individually, or collectively as combined, could in any way affect the keeping qualities of the cement, and no other precautions are required beyond those which apply to the storing and handling of ordinary cement.

The only effect on the setting quality of the cement is a favorable one in that the ingredients used favor the control of the initial set to some extent, entirely satisfactory results in this respect being secured with an addition in any case of not more than one-half of 1 per cent. of gypsum or plaster of Paris. Repeated tests show that ground clinker to which no retarder has been added and with a flash set, is given a reliable initial set of one hour, to one hour and ten minutes, by addition of not over one-half of 1 per cent. of gypsum with the waterproofing compound.

5. The results of numerous comparative tests, with plain cement and the same to which the process has been applied, show that, so far as regards the tensile strength, constancy of volume and specific gravity, the waterproof cement compares favorably with the plain. The strength of the waterproof cement in all mixtures and for all lengths of time is fully equal to that of the corresponding plain cement. In the constancy of volume tests the parts made with waterproof cement remain firm and hard and show no signs of cracking, distortion or disintegration whatever. As yet no compression tests have been made.

6. Organic substances likely to undergo any change or decomposition are not used, and the inorganic mineral substances used are in such stable condition as to insure that no deterioration is likely to take place in the concrete due to their presence.

7. The requirement that the whole amount of ingredients used for waterproofing the cement should be so small that the total foreign matter in the cement, when put upon the market for use, will not exceed the best standard requirements, severe as it is for waterproofing cement, is fully satisfied under this process. An addition of not more than 2½ per cent. is needed, of the total ingredients, to produce the required waterproofing, leaving one-half of 1 per cent. for the addition of gypsum to complete the retarding of the initial set (which is aply sufficient) before reaching the limit of 3 per cent. total foreign matter at present required.

8 The requirement that the process in all its operations and conditions should be free from complex manipulations and narrow limitations is fully met. Indeed, simplicity throughout is one of the principal characteristics of this process. Besides providing the proper materials in suitable proportions, and a very simple treatment applied to these as a whole, it is only necessary to secure thorough and intimate mixture with the cement, which is done by machinery, of course, and in a reliable way. There is, therefore, every assurance that, in the application of the process, the results will be uniform and reliable.

9. It will be evident from what has been said of the process under 8 that little if anything in the way of machinery would be needed in addition to what is found in the cement mills as they are at present constructed and operated. The process could doubtless be applied at any existing plant in operation, without causing an hour's delay in the regular work, and with but a minimum expense incurred for any additional facilities that may be required.

10. The requirement as to the additional cost of the waterproofing treatment is very satisfactorily met. In a separate special report later on will be given full details as to the cost of applying the process. It will be sufficient at this time to state, however, that the cost at present market

values of the raw material required is such that, with the low cost for applying them to the cement, the waterproof cement produced by this process could be put upon the market on terms that should make it readily available for very general use.

Conclusion.

From the above it will be seen that, so far as the present series of tests have resulted, the process meets all the requirements set as a standard, and meets them in a very satisfactory manner. In view of this we feel justified in recommending the rocess as one in every way worthy of the serious attention of all who are interested and skilled in the manufacture and use of Portland cement.

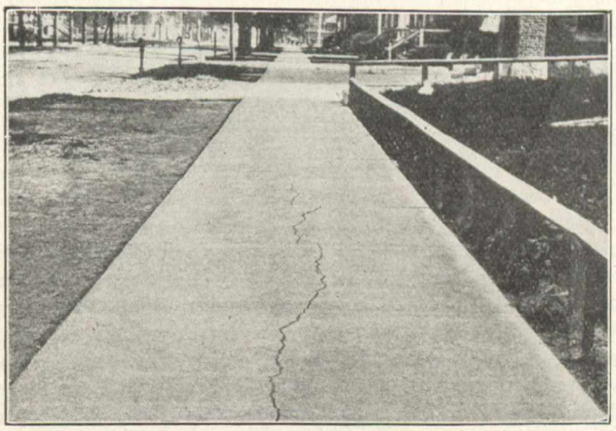
It is desirable, however, that in order to secure such conclusive and convincing proofs of the merits of the process as will be necessary, a more extended series of tests be now applied, covering the preparation of large enough test pieces to prove the waterproof results in concrete of full working size of aggregate and in all proportions likely to be employed. We would recommend also that, with some improved facilities which can readily be added here at our plant for grinding clinker and applying the waterproofing process on a considerable scale, sample lots of fifty pounds, or larger if necessary, be prepared of the finished product for suitable distribution, so that those whose opinion is entitled to weight in such matters may be satisfied by their own tests of the merits of this important and, likely to prove, most useful process.

WHY SIDEWALKS FAIL.

By W. M. Kinney.

For several years the Universal Portland Cement Co. (with which company I am connected) has been engaged in the study of the causes of failure of Portland cement sidewalks. While the number of such failures is small, when compared with the total number of walks laid, these failures are attributable to so many different causes which are easily prevented, that we have deemed the subject worthy of careful and systematic study to the end that such failures may be avoided.

In the fall of 1907, some 7,000 ft. of experimental sidewalk was laid near our mills at Buffington, Ind. Every 27 square feet of this walk was laid in such a manner that it differs in some detail of material, proportions, or method of manipulation from all other sections of the walk.



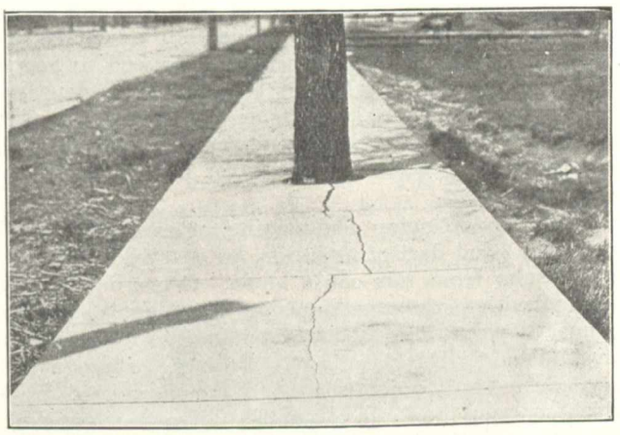
A Crack Resulting from Poor Foundation.

Records of these variations having been kept, it will be possible as time and the elements affect the poorly constructed walk, to gain a fair idea of the cause of failure.

However, as all conditions encountered in actual practice could not be worked out in this way without a large outlay of money, it was decided to employ six men to watch and make note of the methods used by some twenty-five contractors in and about the city of Chicago. In this work we had the co-operation of the contractors and city officials, so that our investigations were not hindered in any way.

One hundred and sixty jobs were examined, amounting to a little over four miles of six-foot walk, in which fifteen brands of cement were used. Careful field notes were made on each stretch of walk from the placing of the sub-base to the removal of outfit to the next job. Every condition which could be thought of as likely to have any effect on the walk was noted.

In this way a complete history was obtained for every slab, so that any future deterioration might be attributed to some irregularity in its construction. Attention was given to the methods used in mixing the materials, the proportions and size of batches, the consistency obtained, and the time elapsing between the addition of water and laying the concrete. The condition of the foundation, sub-base and base, when they were covered; the area covered by each batch; the time of placing, trowelling and finishing of each slab; and the general weather conditions were also recorded.



A Crack Resulting from the Growth of a Tree.

As you well know, poor materials and poor workmanship cause practically all sidewalk failures. Of these two, it can be safely said, workmanship is by far the most open to criticism. Poor materials, properly handled, may often give very satisfactory results, but careless manipulation of even the best materials usually leads to poor results.

When referring to poor materials used for sidewalk construction I mean the aggregate mixed with the cement. We can safely assume, I believe, that when purchased from reliable manufacturers the chances of obtaining a poor quality of cement are small, and particularly when compared with the many classes and conditions of fine and coarse aggregate encountered.

There is one precaution that should be mentioned in regard to cement. Avoid, whenever possible, the use of cement which has been stored so long in a damp warehouse that it has become lumpy. This is particularly advisable when the lumps do not break up easily during the process of mixing. Generally speaking, ageing improves cement, and when kept dry no harm should result from its storage. Very often the lower sacks in a high pile will be hard, but this hardening is due rather to weight than to dampness, and the cement flows freely from the sacks.

The great disadvantage in the use of lumpy cement is its failure to mix readily and its tendency to retard the hardening of the concrete. If the lumps are all broken up and the cement thoroughly intermixed with the aggregate, no apparent harm will result, though the hardening process will usually be retarded.

Returning to the question of aggregates, I believe I can state without danger of contradiction that all concrete failures due to the use of poor material can be ultimately traced to the presence in the aggregate of a large quantity of very fine material, either in the form of loam,

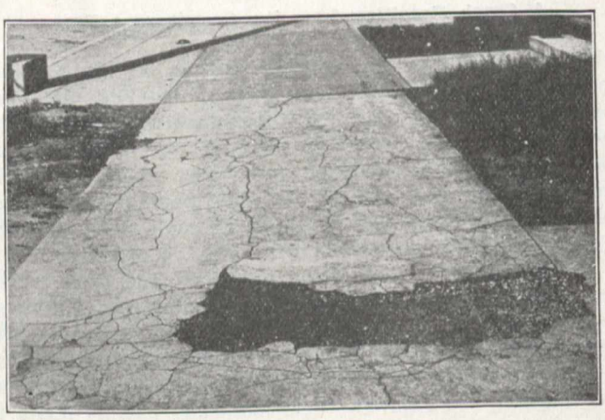
* Read before the Canadian Concrete Association.

clay or pulverized stone of some kind. This fine material occurs in two forms, either as dust in the aggregate or as a thin coating on the particles of the aggregate. Preventing as it does the covering of the aggregate particles with cement, this coating of fine material is exceptionally injurious to the concrete. Very often because of this condition the mortar has no bond on the larger aggregate and the individual stones may be readily removed.

The effect of fine material is most noticeable in the wearing course of a sidewalk or basement floor. The tendency of some walks to wear down in spots, and of basement floors to dust up rapidly, is undoubtedly due in the main to this cause.

Turning now to the question of workmanship, we find one of the principal causes of failure is due to the improper construction of the foundation on which the sidewalk is laid. In this connection it is well to bear in mind that the chief usefulness of concrete comes from its compressive, rather than its tensile strength, and as any weakening of the support under the walk puts the concrete in tension, the necessity for a solid foundation is quite apparent.

The proportioning and mixing of concrete usually receives a good deal of attention, so that poor work seldom results from this cause alone. Occurring in combination with some other improper handling it may lead to unsatisfactory results. A common form of poor construction under this heading is the case where a poor base course results from the use of an unscreened gravel which contains too large a quantity of sand as compared



A Failure Due to Bond Between a Solid Base and Weak Top.

with the larger aggregate. Generally speaking, any sand in excess of that required in conjunction with the cement to fill the voids in the larger aggregate has a tendency to materially weaken the resulting mixture. Often, by the elimination of a portion of the sand, better results can be obtained with less cement.

Unless the cement thoroughly covers all particles of the aggregate, poor concrete is found to result, and it is, therefore, unnecessary to emphasize the need of thorough mixing.

Coming now to the placing of the concrete, the cause which leads to the greatest number of failures is tardy application of the wearing surface. Being but a thin coat of a sand cement mixture, its bond with the base course must be of such a character that it can withstand the action of frost and other strains. It is essential, therefore, to apply the wearing course as soon after placing the base as possible.

Another type of failure similar to, but not so common as the above, is caused by the combination of a weak base with a good top course. Oftentimes cracks are visible only in wet weather, but the action of frost soon opens them up and spoils the work.

A joint should be provided where new walks abut old walks or curbing.

As a general rule unless the stretches of walk are very short these joints should be expansion joints of some sort. The fact that concrete has an expansion co-efficient nearly equal to that of steel is often lost sight of by the average sidewalk contractors. The result of this expansion may cause buckling of the wall.

A form of failure encountered more often in the smaller cities is due to the building of a walk around trees. Invariably the growth of the tree will crack the walk unless allowance is made for this growth; hence the advisability of providing for the growth.

A form of poor construction most generally found in small communities which can hardly be called a failure, but at the same time renders the work unsightly, is that work in which an uneven grade is maintained. This is, of course, an error that can be laid to the city engineer in that he does not provide or insist on a uniform grade.

We trust that our efforts will lead to the elimination of all such unsightly and useless work.

GROWTH OF TREES.

During January 1908 a number of the principal varieties of trees grown on the Government Experimental Farm at Indian Head, Sask., were measured, and Mr. Angus Mackay in his report gives the circumference in inches at two different heights, the altitude in feet, the situation, and the year when planted. Most of the trees mentioned would be one or two years old when set out in their present location:—

Variety.	Year planted.	Location.	Girth 1 foot above ground. Ins.	Girth 4 feet above ground. Ins.	Height. Ft.
Russian Poplar	1892	Isolated	57	42	40
American Cottonwood	1892	Windbreak	33	27	48¼
" "	1892	Isolated	45	48	41½
" "	1892	In clump	35	29	43
Native Maple	1892	Isolated	38	27	25
Native Elm	1892	Isolated	26	24	29¾
" "	1895	Arboretum	21	20	22¾
Native Ash	1895	Arboretum	18	16	22¾
Paper Birch	1900	Arboretum	17	15	22
Willow (S. daphnoides)	1895	Arboretum	20	17	25
Mountain Ash	1890	Arboretum	13	11	17¾
Riga Pine	1892	Plantation	21	18	26
" "	1892	Plantation	29	25	27¼
" "	1892	Isolated	18	16½	21½
White Spruce	1892	In clump	16	13	22¾
Blue Spruce	1895	Arboretum	15	11½	15¾
Balsam Fir	1897	Arboretum	17	11½	15¾
Tamarac	1896	Arboretum	17	15	22¾

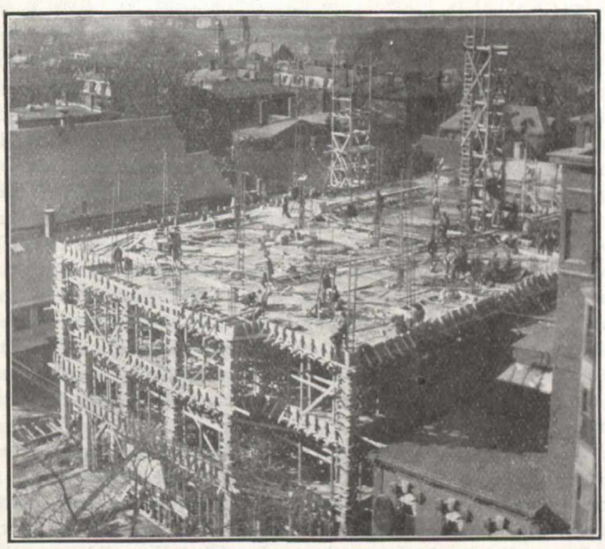
OBITUARY.

MR. A. J. BROWN, for many years a leading contractor of Toronto, died at Syracuse, N.Y., April 3rd, 1909. He was born in Williamstown, Glengarry County, Ont., October 25, 1832, and was the son of the late James Brown, an architect. For some time the late Mr. Brown was engaged in Indiana in the construction of the Ohio & Mississippi Railway, after which he came to help in the construction of the Hamilton & Toronto Railway, with headquarters at Oakville. On the completion of this line he went to Syracuse, N.Y., and engaged in the business of erecting bridges. In 1870 he returned to Canada and became engaged in the construction of large works. Among these were the iron bridge and rebuilding the jail at Cayuga, bridges at Caledonia and Hamilton, Brantford and at points between Port Dover and Stratford. The late Mr. Brown also had Government contracts for the work at the Hamilton Asylum, Brantford post office and custom house, Reformatory at Penetanguishene, Guelph Agricultural College, Kingston Asylum, Woodstock Court House, the School of Practical Science and the Redemptorist Fathers' Church, McCaul Street, Toronto. Deceased also had many paving and sewer contracts in Toronto.

A COMPOSITE OFFICE BUILDING.

In the design and erection of the new eight-story office building for J. P. Baxter, Portland, Maine, the Aberthaw Construction Company, Boston, employed a composite of reinforced concrete and brick. The latter material was used for the walls and the former for the frame and body of the building. Flat slab reinforced concrete floors were employed.

Late in August, 1908, the contract was let by Mr. Baxter for the foundations (already partly completed) for a building 80 feet front and 175 feet deep. No plans, other than those for the foundations, had been prepared, as it was undecided at the time whether to build an office or hotel building. The former was finally decided upon. After viewing a new reinforced concrete mill built by the Aberthaw Construction Company, of Boston, it was settled that this material should be used and that under a special agreement the entire matter of design and construction should be placed in the hands of the Aberthaw Company. The condition was made that the cost

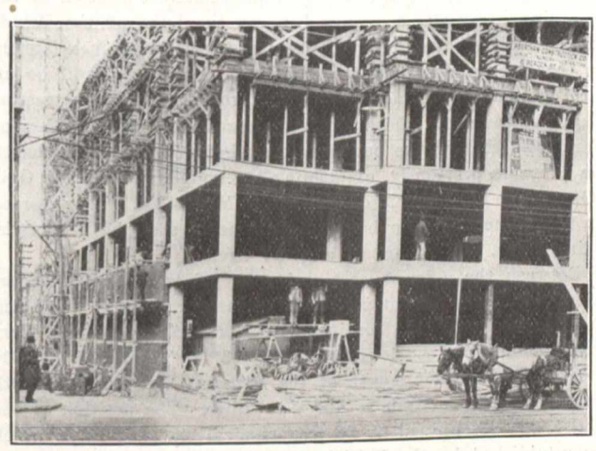


Baxter Building, Showing Centering and Elevator Towers.

must compare favorably with that of a similar size steel frame building.

The equipment for handling the concrete material was particularly efficient. In the basement was set up an electric motor driving a countershaft which in turn drove the mixer, the hoist, and some light machinery for sharpening tools, etc. A hole was left in the first floor of the building over the mouth of the mixer, and a hopper was built in this with the mouth directly over the intake of the mixer. Sand, stone, and cement were stored on the first floor; the piles of sand and stone being measured into front dump cars from which they were discharged into the hopper. Into the hopper was also dumped the cement and a valve discharged the whole into the mixer. Water was fed in from a barrel hung on trunnions and tipped into the hopper. An automatic dumping bucket operated on an elevator frame dropped into the hole in front of the mouth of the mixer so that the latter would discharge into it. Concrete was dumped by the bucket into a chute which discharged into a side dump car. This car ran on a circular track set up to the proper height from the centering of any floor, and the concrete dumped directly into the floor and very approximately into its final position. By this method the concrete was not touched by hand except in loading the sand and gravel cars, and what little shoveling was necessary after it was dumped into the forms. The concrete was mixed very wet and all stone passed a 1½-inch hole in rotary screen at the crusher.

The organization consisted of superintendent, boss carpenter, competent foreman for placing the reinforcement, and labor boss, with time-keepers and material clerk; and later on, brick boss, man in charge of carpentry, and the usual line of gang bosses. As is customary with the Aberthaw Company, the reports for all work were made out daily showing the number of hours employed on the different kinds of work and the number of units of work accomplished so that at the end of the day it was possible to classify the labor cost for each kind of work. Against each estimated or proposed cost of any part of the work was put down the actual cost of the same. In terms of per cubic foot, the cost of each section of the work was reduced to tangible units. The form work was reduced to cost of labor, lumber and nails or wire and the total given. The concrete work was itemized in a similar way, into concrete labor, general labor, cement, aggregate, plant, teaming and miscellaneous, and the total put down. By this means this cost of the work was readily compared with previous work of a similar nature. The general efficiency was compared from day to day and losses definitely placed, so that the latter could be overcome or minimized at least. The cost of placing steel reinforcement divided by the number of



Baxter Building, Showing Brickwork, Completed Concrete Piers and Concrete Floor Slabs.

tons gave the cost for that day of the handling of the reinforcing metal.

The detail costs of construction of columns and floor slabs, and of erection of steel are given in the accompanying table.

Baxter Building, Portland, Maine.

	Carpenter Work.	Lumber.	Nails and Wire.	Total.
Cost of Concrete Columns....	.133	.039	.001	.173
Cost of Flat Slab Floors	.078	.039	.001	.118

	Concrete labor.	General labor.	Cement.	Aggregate.	Team & Misc.	Plant.	Total.
Cost of Concrete Columns	.064	.004	.087	.084	.012	.022	.273
Cost of Flat Slab Floors	.043	.004	.087	.084	.012	.022	.252

	Weight, Tons.	Cost of Handling.	Cost per ton.
Steel	324½	$5,115.32	$15.76

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THE DATUM PLANE.

Otto Klotz, LL.D.

(Continued from Last Week.)

From the Lake of the Woods, westward, into the valley of the Red River, the station errors increase, and for a reason, which from our lack of knowledge of the underlying strata, must be conjectural. The escarpment of the Pembina Mountains (elevation would be a more appropriate term, height 1,695 feet) naturally draws the vertical southward, continuing to do so until the Turtle Mountains (of moderate elevation, 2,550 feet) are reached, which too deflect to the south. After entering the Coteau of the Missouri we pass along the southern base of the high ridge separating the waters flowing into the Gulf of Mexico from those flowing into Hudson's Bay, and find, naturally, a deflection to the north, increasing to a maximum, south of the Cypress Hills (3,800 feet). Beyond, the extrusive masses of the Three Buttes produce a violent disturbing effect. When we actually enter the tumultuous Rocky Mountains, with all their varied conditions of composition, of faults and dykes, and our lack of hypsometric maps, we are unable to even make a plausible estimate in which direction the local deflection is to be expected.

It is evident that observations at two places which are also geodetically connected, can only give the relative deflection of the plumb line. For the boundary between the Lake of the Woods to the summit of the Rocky Mountains, the commissioners agreed that the line joining any two adjacent monuments shall be an arc of the parallel. This was to apply, too, in the case of restoring any monument whose position was lost. This agreement differs from that of the boundary commissioners, who had charge some 17 years previously, of defining the boundary from the Gulf of Georgia to the summit of the Rocky Mountains. They agreed that the connecting line between monuments shall be a straight or direct line, i.e., an arc of a great circle.

Between the extreme east and west points, upon the watershed of the Rocky Mountains, and the eastern shore of the channel which separates the continent of North America from Vancouver Island in west longitude 114° 03′ 34″ and 123° 3′ 53″ respectively, the exact length of the boundary line upon the 49th parallel of north latitude is 409 4-10 miles. The position of the parallel was determined by 28 astronomical stations, 11 of which were established by the British Commission, 14 by the American Commission, and three were observed by both. Another station was fixed by the British Commission at Schweltza Lake, but it was at the time rejected on account of the apparently large deflection of the plumb line, though the after experience of the most accurate instrumental observations in that mountainous country led to the conclusion that the result at Schweltza was quite as trustworthy as any of the others. It is, however, not included in the final determinations.

At the first meeting of the commissioners at Semiahmoo, Aug. 13, 1858, it was concluded, after discussing plans for determining and marking the line as far as the Cascade Mountains, to be inexpedient at that time, in consequence of the great expense, consumption of time, and the impracticable nature of the country, to mark the whole boundary by cutting a track through the dense forest. It was therefore agreed to ascertain points on the line by the determination of astronomical points at convenient intervals on or near the boundary; and to mark such astronomical stations or points fixed on the parallel forming the boundary by cutting a track of not less than 20 feet in width on each side for the distance of half a mile or more, according to circumstances. Further, that the boundary be determined and similarly marked where it crosses streams of any size, permanent trails, or any striking natural features of the country. In the vicinity of settlements the line was to be cut a greater distance. Bessel's value of the figure of the earth was adopted.

From the two points on the parallel, dependent, respectively, on the Sumass and Schweltza astronomical stations, cuttings were made to connect the points. When the cuttings met there was found to be a discrepancy of 8″, say about 810 feet; they were, however, connected, though the line thus defined is obviously not strictly the boundary of the treaty. The distance is about 9¼ miles. This relative deflection of the plumb line, 8″, in so short a distance, is the largest on the whole 49th parallel, from the Lake of the Woods to the Pacific. When the cuttings on the parallel from Sumass and the British station at Semiahmoo met there was a discrepancy of 114 feet in the twenty miles, and between the U. S. astronomical station at the east shore of Semiahmoo Bay and the British one five miles east thereof, a discrepancy on the parallel of nearly nine feet was found, an error quite within the error of observation.

The only other cutting on the whole boundary line west of the Rocky Mountains, connecting adjacent astronomic stations, is between the Similkameen and the Columbia Rivers, a distance of 96 miles. The stations there in order eastward are: Similkameen (U. S.); Lake Osoyoos (Br.); 1st Crossing Newhoilapitkw (U. S.); 2nd Crossing Ishwointum (Br.); 3rd Crossing Statapoosten (U. S.); and on the Columbia (Br. and U. S.) From the point on the parallel at Lake Osoyoos, a line was run east and west 30 1-5 miles, connecting with similar points at Similkameen and at the 1st Crossing. The line was found to strike 509 feet north of the former point and north of the latter 364 feet, showing a marked deflection of the plumb line. When, similarly, an east and west line was run from a point on the parallel at Inshwointum, it was found to be south 300 feet of the point on the parallel at the 1st Crossing, and 180 feet north of the point at Statapoosten.

This shows, therefore, a discrepancy between the latitude of Lake Osoyoos (Br.) and Statapoosten (U. S.) of 844 feet, due to local attraction or difference of local attraction. After verifying the accuracy of the latitude observations, it was decided to adopt the mean parallel, based on the differences found between Similkameen and Statapoosten, a distance of 71 miles. This is the only part of the whole boundary line between the Lake of the Woods and the Gulf of Georgia where a mean parallel has been adopted for the boundary, instead of the astronomic parallel. These seventy-one miles were re-cut on the mean parallel. From the extremity of the mean parallel at Statapoosten, an east line was run to the Columbia, where a difference of 212 feet was found between the mean of the British and United States latitude determinations there and the mean parallel. The line (for final boundary), was thereupon deflected from Statapoosten so as to strike the above mean Columbia position of the 49th parallel.

As already stated, the Boundary Commissioners had agreed to understand the boundary laid out by them to consist of a series of straight lines between the successively marked points, without regard to the distances between these points or the curve of the parallel in the longer intervals. That they did upon the consideration that it was of the greatest importance that nothing should be left for future discussion of settlement, and that the operations should be final and conclusive. It may be stated that opposite the centre of the chord of 25 miles in length the departure from the 49th parallel would be about 40 yards, and of 12 miles, nine yards. Both these departures are probably far smaller than the deflection of the plumb line at the governing astronomical stations.

We have, therefore, in the actual boundary line of British Columbia, a deviation from the 49th parallel, as given in the treaty of 15th June, 1846, in so far that the straight lines replace the curve of the parallel between all the stations, and furthermore, that between Similkameen and Statapoosten the mean parallel was adopted instead of the astronomically determined points.

We have followed now the 49th parallel for 1,270 miles, about one-thirtieth of its circumference, and it has disclosed to us some of its vagaries as manifested in the latitude component of the deflection of the plumb line. This boundary line is the longest astronomic one on the earth, the nearest approach to it being the meridian separating West Australia from North and South Australia.

In connection with the deviation of the plumb line it may be interesting to quote a few extracts from Dr. J. B. Messerschmitt's report in the ninth volume of "Das Schweizerische Dreiecknetz, herausgegeben von der Schweizerischen geodatischen Kommission." . . . . If we connect all points having the same deflection in latitude, we will obtain lines fairly parallel to the direction of the mountains. They show plainly and markedly the relative attractions of the Alps and the Jura, as is to be expected, the influence of the former extending close to the foot of the latter. . . . In the neighborhood of Zurich the deflection is small, while at Lucerne it is 6″; at Zugerberg the deflection in latitude is nearly 9″; while at the Rigi, which is only 36 km. to the south, it is between 17″ and 18″. As we approach

the centre of the Alps the deflection decreases, being about zero a little to the south of St. Gotthard. Similar conditions obtain on the south side of the Alps. While at Biasca the deflection is small, it reaches 17″ at Lugano. . . . These conditions are not, however, confined to Switzerland, but apply equally to the whole Alpine region of Austria, Italy and France, where, however, the data are not as complete as for Switzerland. The direction of the plumb line is always perpendicular to the mountains; the deflection increases rapidly as the mountains are approached, and values as high as 30″ have been obtained, although in Switzerland the maximum is about 20″. If we compare the deflection on both sides of the Alps we obtain a difference of 50″ in a distance of 100 km. Remembering that 1″ in latitude is equivalent to 31 m. linear measure, it will be seen that the distance between two points, one north and the other south of the Alps, determined astronomically, will differ from that obtained geodetically by over 1 per cent. That is, in about 62 miles the distances will differ by 5,000 feet, or nearly a mile.

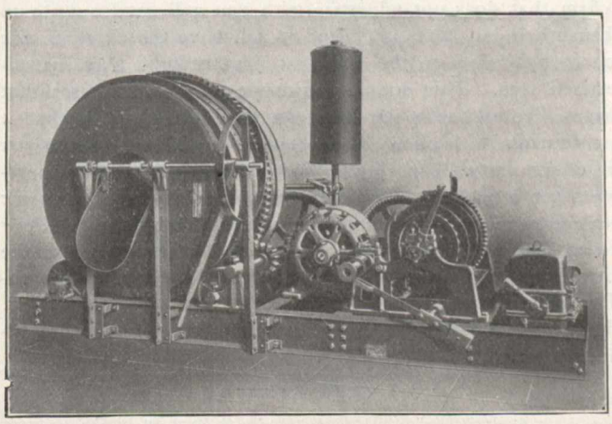
In conclusion, the same law or force which causes the deflection of the plumb line, determines the length of the seconds pendulum, preserves the planets in their orbits, and maintains the stability of the universe—is the law of gravitation. Our earth furnishes us with many interesting problems, and the very discordances observed—apparent though they are—tend to lead us on to unravelling the mysteries and intricacies of nature, and to unfolding the unity and harmony of the cosmos.

MOTOR-DRIVEN CONCRETE MIXER IN RECORD PERFORMANCE.

One of the most noteworthy buildings of reinforced concrete construction that have been erected in the West, is that being built for the Sacramento Hotel Company at the corner of Tenth and K Streets, Sacramento, Cal. This building is designed to provide in a substantial manner for catering to the demands of a city which entertains large conventions and is also the scene of legislative gatherings.

Messrs. Sellon & Hemmings, architects for the State of California, designed the building, employing an architectural treatment tending to the Mission style. The structure covers a lot 160 feet by 140 feet on a site a block distant from the Capitol, and consists of basement, first and mezzanine floors, and three floors for guests' rooms.

In planning for the construction of this large building, the Ransome Concrete Company of San Francisco, which is



Concrete Mixer, Motor Driven.

the general contractor, took pains to install an equipment which would be thoroughly reliable and durable, and also insure the rapid handling of materials.

The principal element of the plant, the concrete mixer and hoisting machine, was especially designed for the Ransome Concrete Company by C. G. Meyers, of Norman B. Livermore & Company, San Francisco, Cal., to meet the requirements of heavy continuous service. As shown in the accompanying photograph, the concrete machine consists of a No. 2, 1908 model, special combination Ransome concrete mixer mounted on a 10-inch steel I-beam frame. On the end opposite the mixer is mounted a Mead-Morrison single-drum hoist. Both mixer and hoist are arranged to be driven directly through gearing by a 30 horse-power type "CCL" Westinghouse alternating current motor operating at 850 revolutions per minute on 200 volt, 60-cycle, three-phase current and equipped with the necessary auto-starter. The mixer is provided with a Ransome patent water-measuring device and a No. 2 Ransome measuring hopper. The hoist is used in operating the Ransome concrete hoist-bucket. The whole arrangement forms a compact machine, the steel frame giving great stability to the outfit.

The mixer was set up in its permanent location in the basement under the sidewalk and retained in that location until all the concrete had been deposited in the building. Crushed rock and gravel was brought to the site by teams, and dumped into large material bins from which it was fed by means of a belt conveyor to a large charging hopper mounted above the mixer. After mixing, the green concrete was hauled by means of Ransome concrete carts to the molds.

That the arrangement as installed was an efficient one, is well demonstrated by a record made September 3, 1908, when the company placed 381 cubic yards of concrete in 8¾ hours. This involved the mixing of 315 cubic yards of rock, 158 cubic yards of sand and 572 barrels of cement; a total of 551 cubic yards of loose, dry material which weighed in the aggregate 1,427,000 pounds. The addition to this dry material of 460 barrels of water brings the actual weight of material handled to 1,547,600 pounds. All of this material was mixed in the No. 2 Ransome mixer, equipped, as mentioned above, with a No. 2 Ransome measuring hopper. It was hoisted on a No. 2 Ransome hoist bucket a height of 15 feet and dumped into a bin fitted with two Ransome concrete bin gates. From here it was distributed to the forms, using ten Ransome concrete carts as carriers.

The maximum haul for placing this concrete was 225 feet, the average haul 150 feet. By average haul is meant the distance which the material had to be carted, the round trip being twice that distance. In doing this work but ten men were used in wheeling the ten carts, each man handling his cart alone and working the full day, so that the average amount of material placed by each during the day weighed over 75 tons.

All this work was carried on under the direct supervision of the inspector for the architects. The material was thoroughly mixed in the mixer, and in addition was turned over four times in being handled between the mixer and the forms.

This record, so far as any published accounts are known, surpasses any similar record for quantity of concrete placed in one working day in the West, if not in the country, from a mixer of the size mentioned.

Norman B. Livermore & Company recently secured a contract from the State for two similar concrete-mixing and hoisting outfits to be used in the construction of the California State Prison at San Quentin.

Continued increases in passenger traffic are shown by the monthly figures issued recently by the B. C. Electric Co. During March a total of 354,675 passengers were carried on the company's lines, as compared with 320,770 the preceding month and 337,933 for the corresponding month last year. With the advent of the fine weather the volume of traffic has been steadily increasing. For the first three months of the year a total of 1,004,534 passengers have travelled on the company's system as compared with 982,243 for the same period in 1908, an increase of 22,291.

The Dominion Iron & Steel Company's plant made a record output during March in two of the most important items of production, namely, blooms and billets, and also in the matter of shipments, leaving far behind all previous figures. The following are the items in detail figures in tons: Coke, 37,000; pig iron, 22,215; steel ingots, 23,280; blooms and billets, 28,980; rails, 14,021; shipments, 30,122. The largest previous shipments were made in August, 1908, when the figures were 26,312 tons.

THE WRITE-UP.*

The exploitation of a manufactured product in the guise of reading matter is called a "write-up." It is not a literary word and it does not represent literature; it is the exponent of a commercial idea in the guise of scientific or technical information.

In the daily press you find yourself reading a paragraph that begins with a seductive reference to the "grandeur that was Greece or the glory that was Rome" and ends by recommending Snooks' soap. In the financial press you become absorbed in a picturesque account of South African mining only to discover that you have been inveigled into a consideration of the opportunity for sudden wealth presented by the shares of the Great Bullion Extended Mining Company in Southern Nevada. In a technical paper you plunge into a turbid description of pumps and their work in mines, to find that the purpose of the article is to recommend the Jones centrifugal pump manufactured by the Jones Company, of Jonesville, Tenn.

If you are good natured, not too busy, and possessed of a sense of humor, you laugh at yourself as the victim of a practical joke; if, however, your liver is sluggish, or you are a busy man, or do not appreciate foolery, you kick yourself for being deceived and there is developed a longing to express your sentiments to the responsible editor. Undoubtedly, the "write-up" is in the nature of an impertinence.

But beside the cruder forms of this insidious method of gaining publicity without payment, there are unaffected descriptions of manufactured products that appear in trade and technical papers. Thus the write-up becomes a specious indorsement of one advertiser's wares at the expense of the other advertisers, and eventually it is to the detriment even of the favored individual. For it is obvious that if a "write-up" is not as trustworthy as matter coming from an unprejudiced source, then it lessens the interest of the reading portion of the paper and renders the advertising less valuable. There is no escape from this conclusion.

The representative of a machinery firm brings a description of his works, with a photograph of the establishment, and wants it published as reading matter. The sight of it in the paper may gratify the members of that particular firm, but it is certain that it is of value to no one else, for the products of manufacture do not depend for their excellence on the appearance of the building in which they are made. Moreover, the insertion of such an article is not fair, for the advertiser is simply asking for so much gratuitous advertising in a part of the paper where he thinks he may get exceptional publicity. The reader is annoyed, for the "write-up" is not of interest to him; he does not rate Smith's pumps by the look of Smith's factory.

It comes to this, that anything which lessens the interest of the reading pages tends to hinder the purpose of the advertising; protect the reader and you safeguard the advertiser, for no one that has become annoyed or displeased with the reading matter is likely to spend much time over the advertisements; on the contrary, it is the satisfactory character of the articles that will cause a reader to hold a paper in his hands long enough to turn over the pages of advertisements.

But we shall be told that there are write-ups and write-ups; that what we have said may apply to certain forms of this method, but it does an injustice to the skilful write-up, which gives reliable information while incidentally fulfilling another purpose. This is a matter of opinion. Even the best of the stuff sent broadcast by the publicity bureaus of manufacturing companies is prejudiced; among the facts lurk fallacies; between the scientific data are sandwiched the exaggeration of a salesman. It may be a long way from the fervid rot of a corn doctor to the pseudo-scientific literature of a publicity manager, but there is every gradation between them and they are tainted by the same fatal defect.

It is the editor's duty to protect his reader; in so doing he advances the best interests of the advertiser, for by such methods the advertiser is given the best opportunity to win the attention of the reader. For this reason the signed article that masquerades as an independent statement, while really the puff of an advertiser, is particularly objectionable.

Not content with self-laudatory paragraphs, some manufacturing firms employ technical men to write articles for publication, in which the principles underlying certain types of machinery are specially advocated, so as to prepare the way for the reception of a recommendation of the machines themselves. Of course, there is no reason why the inventor or the manufacturer of a machine should not tell the truth in an interesting way, and it happens often that information concerning processes and devices can be obtained only from such sources. In that case, the position of the author should be frankly stated; it certainly would be deemed a courtesy to the reader and would tend to inspire confidence. Any feature of the reading pages that wins the confidence or commands the respect of the reader, by so much increases the value of the service given to the advertiser.

Is this Utopian and impracticable? We trust not. It is sound business, not poetry. The practice of recommending mining stocks and puffing companies in the editorial columns because they advertise their prospectuses on another page has died out in America, that is, among journals of any standing. In London the mining papers are still subventioned in various ways; the mining company pays for an account of its meeting, for the publication of reports, for reprints of the speech made by its chairman, and for sundry other ways in which it gets favorable publicity; the papers distribute praise or blame, or maintain an ominous silence, according to the amount of advertising taken with them. Paid matter appears in the heart of the reading pages, the right hand watches the left, the business department and the editorial are partners in a sordid business. And what is the result? The advertising pages have scarcely any value. Why? Because the reading matter is unreliable. There you have it.

In America the leading mining journals do not insert paid matter in their reading pages, and the only blemish is the "write-up," which is a sop to Cererus, the donation of extra publicity gratuitously to those who advertise, or are expected to advertise, in the paper. This reminds us of a petty form of "graft" operated in connection with write-ups. A firm that does not advertise with you will send a write-up "because it is interesting" and it will have the cheek to ask you to publish it to the end that its products may be advertised free. This does an injustice to the advertiser that pays. The excuse to be made for the "write-up" is that it is a courtesy to a client, a concession to one with whom you are doing mutually profitable and honorable business, therefore when a non-advertiser asks for advertising space in your reading pages he exhibits monumental effrontery. Your reader does not even have the satisfaction of turning to the advertising pages for further information. A young man obtained a testimonial as to his ability from his own mother. That is the "write-up" in its simplest form—interesting to the family!

*T. A. Rickard, in the "Mining and Scientific Press."

An agreement has been arrived at between the Council of Barrie, Ont., and the Webber Engine Company, a vote will be taken on April 12th. The town is to loan the company $40,000 on mortgage security for twenty years without interest, the principal to be paid back in sums of $2,000 per year. There are concessions of free light and water, and a fixed assessment of $20,000 during the mortgage period. It is stipulated that the company will employ a minimum number of fifty hands. It will manufacture producer gas engines and other like machinery. Mr. Simon Dyment will probably be the president of the concern, which will use the old foundry premises as a site for the new business. The company's office is at present in the Janes Building, Toronto, Mr. Coady being in charge there.

THE VALUE OF GAS POWER.

By Charles E. Lucke.

Power generation, for whatever purpose, should be considered as a manufacturing problem in which power is the product of the power factory or plant, and some form of fuel in general, together with water, lubricating oil, repair and cleaning material constitute the materials; and the means of manufacture, men and machinery. The cost of the manufactured product is dependent on the consumption of material and the expenditure of labor and capital invested in the machinery and other equipment. On this basis the selection of machinery for a power plant becomes a question of commercial engineering, carrying with it a strictly technical element of adaptability to the service. Given several types of possible engines and auxiliary power apparatus as equally adaptable as is generally the case, the ultimate selection must depend on the capability of the apparatus to manufacture power at lowest cost, all charges being properly considered.

In recent times the gas power plant involving gas producers for transforming solid coal fuel into fixed gas, together with gas engines for internally burning this gas and transforming some of the heat of combustion into work, has become a commercial competitor of the steam plant burning the same fuel under boilers. The first claims for recognition on the part of the gas engine were probably scientific rather than commercial and based on thermodynamic demonstrations of the inherently higher thermal efficiency of this method of transforming heat into work over the steam method. For perhaps a quarter of a century small gas engines were built and sold, and while incapable of giving service as good as steam engines, failed to compete chiefly because of the inability to use coal fuel. Experiments and study in large blast furnace plants in Europe resulted in a better designed mechanism and better engines, which, together with the gas producer developed and adapted for supplying them efficiently with gas from coal fuel, made possible the more complete competition of the gas with the steam power plant. So far as adaptability to the load requirements is concerned, the modern gas power plant competition with the steam plant is complete, but commercial competition on the basis of power cost is on the same basis as the various types of steam plants with each other. A comparison of gas with steam power plants will show that the principal differences are not in the labor, lubricating, cleaning and repairing costs, but rather in coal and water consumption per horsepower hour, in first costs and life. The gas power plant is unquestionably more efficient thermally than the steam plant, and likewise generally more costly. The coal cost of operation will be lower for the gas plant and higher for the steam plant, but this saving is offset by an increased fixed charge to higher first cost, and in some cases shorter life and greater property and building charges due to space occupied.

There is no longer any necessity for scientific demonstration of the possible high efficiencies of the gas engine and producer, but there is need of much information on actual coal consumption under the various conditions which affect it, as well as definite information on some of the characteristics of the gas power installation to permit of power comparisons with steam plants, which are so much better known.

One very important characteristic of steam plants is the wide variation in their coal consumption per horsepower hour with size, and this is in striking contrast to the gas plant, in which the coal consumption is practically independent of size. It will be found that the best steam plants of large size are so economical of coal, and cost so little in comparison with equal sized gas plants, that the gas plant cannot compete at present in power cost. This is especially true when coal is cheap, because in this case the coal charge is a small fraction of the total power cost and the low fuel consumption of the gas plant involves a saving of on what is only a small item. The gas plant suffers by comparison whenever the load factor of the plant is low, that is, when the total output in horsepower hours per year is low in comparison with total possible output for every day and all day operation at full load, because the fixed charges are a yearly sum and small output increases the fixed charges per power unit. There is, however, some offset to this load factor element, inasmuch as low load factor generally involves considerable stand-by losses, especially when the load fluctuations are sudden, and as the gas plant stand-by losses are less than for the steam plant, there would be a tendency to equalize in cost of stand-by fuel the gas plant's excess of first cost fixed charges over the steam plant.

In view of the above the gas power plant is to-day practically no competitor of the steam plant in larger sizes where coal is burned, except when coal is exceedingly high, higher than in most places in the United States. It is, on the contrary, a most formidable competitor in small sizes, the more so the higher the cost of coal and the smaller the size, so that the gas power plant which is most economical in power cost in comparison with steam, and which will be most used in the future, will be in the medium sizes involving units from 50 to 350 H.P., singly or combined up to any number. It must be remembered that combination of small units will prove quite an efficient combination with gas plants, because of the constancy of efficiency with size. This is not the case with steam plants and has led to the practice of using steam engines as large as possible up to what is convenient to handle. A gas plant of 2,000 H.P. will have about the same efficiency at full load with one 2,000 H.P. engine as with two 1,000 H.P. engines, four of 500 H.P., or twenty of 100 H.P., while on part plant load the smaller the individual units, the easier it will be to keep up the efficiency. A single engine will have its highest efficiency at about full load and will lose efficiency rapidly as the governor operates under part engine load. Units of the standard type engines halve their efficiency and double their fuel consumption per H.P. hour at about ¼ load. On this basis at 500 H.P. the single engine would have doubled its fuel consumption and its fuel cost per horsepower hour, whereas two of the 500 H.P. or five of the 100 H.P. carry the same load by shutting down the others would have suffered no fuel loss. This fuel cost effect of variation of individual engine load factor must not be confused with the fixed charge effect of change in plant load factor, which is the same no matter what the size of the units.

If a steam plant cost $75 per H.P. and a gas plant $125, then interest charged at 5 per cent. involves a charge of $3.75 per year for steam and $6.25 per year for gas. In a year there are 8,760 hours, so that if the plant worked every day and all day the fixed charges would be $3.75 per H.P. year steam and $6.25 per H.P. year gas, or .0428 per H.P. hour steam and .0713 per H.P. hour gas. If the coal consumption were 2 lbs. per H.P. hour for steam, which is good and equalled only in large and efficient plants, and the coal cost $3.00 per ton of 2,000 lbs., or .15c per lb., then the coal cost per H.P. hour for steam would be .30c. To overcome the difference in fixed charges of $(.0713 - .0428) = .0285$ per H.P. hour, the gas plant would have to operate on $\frac{.0285}{.1500} = .18$ lbs. less coal or have a consumption of $2.00 - .18 = 1.82$ lbs. per H.P. hour, which it can easily do. If, however, the plant operated full load for only one-fifth time, the fixed charges per H.P. hour would be five times as much and the fuel saving to overcome this must likewise be five times as much, or $5 \times .18 = .90$ lbs., requiring a fuel consumption of 1.1 lb. per H.P. hour for the gas engine, which is difficult but possible. When, however, the low load factor is obtained not by full load operation for a shorter time, but by both part time operation and part load operations of the individual unit, then the coal consumption of both plants would rise, but would rise more for the gas than for the steam, especially if the steam engine had a fairly flat steam consumption load curve. In this case the gas engine plant probably could not compete on the above assumptions. It would be still more difficult for the gas plant to compete if coal were $1.00 per ton, as it is in the coal districts, and often much less. At this price the coal cost per H.P. hour would be only one-third, or .100c, and the difference which the gas plant must save for 100 per cent. load factor $3 \times .18 = .54$ lbs., requiring an operation of 1.46 lbs. per H.P. hour also a possibility, and for the full load 20 per cent. of its time, $3 \times 5 \times .18 = 2.70$, which is more than is burned, and therefore utterly impossible. The competition between first cost, load factor, fuel cost and relative fuel consumption is thus most in favor of the gas plant when fuel is high, load factor high, the size of the plant small, and a number of small gas engine units in use instead of a few large ones.

It is such conditions as these that fix the best field of the gas power plant as that in which the medium and small unit can best be employed. Experience in Europe, and later but quite surely in America, has developed a typical form of this medium

sized engine having a horizontal, single-acting, four-cycle cylinder, expanding cylinder liner, exhaust and inlet valves vertically in line in the head at the cylinder axis, electric ignition, a throttle governor, and moderate speed and great rigidity of construction, to permit long life. In order that the information presented on the characteristics of the most useful medium-sized gas power combinations of the above from the product of the De La Vergne Machine Company of New York, has been selected as typical of the high-class machinery, having a cost probably as high as any. The cuts, Fig. 1 and Fig. 2, show the engine and suction producers, both externally and in section. Some of the important dimensions, with the weights and space occupied and the cost, are given in the following table. These costs are approximately correct, but are not to be taken except as guides, because constantly changing commercial or trade conditions will cause them to change most unexpectedly. The brake horsepower rating is based in all cases on 68 lbs. mean effective pressure and a mechanical efficiency of 82 per cent., although the mechanical efficiency is closer to 88 per cent. actually, and the possible mean effective pressure 87 lbs., with good gas and careful adjustment, as is shown by the following cards, Fig. 3, taken from one of these engines of 75 H.P. This large margin of rating conditions over maximum possibilities is allowed not so much to permit the carrying of overloads as to permit of maintaining full rated load without the best adjustments or with poor gas.

De La Vergne Gas Engines—Four-Cycle, Single-Acting.

Rated B.H.P. on producer gas	75	85	100	125	150	175	150	170	200	250	300	350
Number of cylinders	1	1	1	1	1	1	2	2	2	2	2	2
R.P.M.	170	160	155	145	135	130	170	160	155	145	135	130
Diameter of cylinder, mm.	430	460	490	540	590	650	430	460	490	540	590	650
Diameter of cylinder, inches	16 15/16	18⅛	19¼	21¼	23¼	25⅝	16 15/16	18⅛	19¼	21¼	23¼	25⅝
Stroke, mm.	700	755	800	876	955	955	700	755	800	876	955	955
Stroke, inches	27 9/16	29¾	31½	34½	37⅝	37⅝	27 9/16	29¾	31½	34½	37⅝	37⅝
Piston speed, ft. per minute	781	793	814	833	846	815	781	793	814	833	846	815
Size of air pipe, inches	7	7	7	8	8	10						
Size of exhaust pipe, inches	7	7	8	8	9	12						
Size of gas pipe, inches	7	7	7	8	7	8						
Crank shaft, diameter, inches	7 11/16	8¼	8⅞	9⅜	10⅝	11 13/16	7 11/16	8¼	8⅞	9⅞	10⅝	11 13/16
Diameter of heavy flywheel	10′-8″	11′-3″	12′-0″	12′-7½″	13′-5½″	14′-0″	14′-8″	11′-3″	12′-0″	12′-7½″	13′-5½″	14′-0″
Diameter of light flywheel	10′-11″	10′-10″	12′-4½″	12′-6″	13′-5½″	13′-9″	10′-11″	10′-10″	12′-4½″	12′-6″	13′-5½″	13′-9″
Weight of heavy flywheel, lbs.	16,700	17,200	21,000	27,200	40,600	50,200	16,700	17,200	21,000	27,200	40,600	50,200
Weight of light flywheel, lbs.	9,900	11,400	13,200	17,600	24,000	30,000	9,900	11,400	13,200	17,600	24,000	30,000
Weight of engine without wheel	24,000	28,800	34,600	42,800	48,200	50,300	46,500	55,800	66,600	83,000	93,000	97,500
Length over all, including heavy flywheel	17′-0″	18′-8″	19′-0″	21′-0″	22′-4″	23′-7″	17′-0″	18′-8″	18′-0″	21′-0″	22′-4″	23′-7″
Width over all, including outboard bearing	9′-2″	11′-9″	12′-1″	11′-9″	12′-4″	13′-10″	15′-9″	17′-8″	18′-2″	18′-4″	19′-8″	22′-1″
Square feet enclosing rectangle	156	219	230	247	275	326	268	329	345	385	439	521
Square feet enclosing rectangle, per H.P.	2.08	2.57	2.30	1.98	1.84	1.87	1.77	1.93	1.73	1.54	1.46	1.49
Height, bottom of frame to top of heavy flywheel	7′-8″	8′-3″	8′-8″	9′-3″	9′-9″	10′-2″	7′-8″	8′-3″	8′-8″	9′-3″	9′-9″	10′-2″
Cubic feet enclosing rectangular prism	1,195	1,807	2,061	2,229	2,681	3,314	2,053	2,714	2,988	3,561	4,280	5,297
Cubic feet per H.P.	159	213	206	180	180	190	136	160	14.9	14.3	14.2	15.0
Weight, including heavy wheel, lbs.	40,500	46,000	55,600	70,000	88,800	100,500	63,200	73,000	87,600	110,200	133,600	147,700
Weight, including heavy wheel, lbs. per H.P.	540	630	556	560	590	580	420	430	438	440	445	423
Depth of foundation concrete	6′-8″	7′-0″	7′-6″	8′-0″	8′-6″	9′-0″	6′-8″	7′-0″	7′-6″	8′-0″	8′-6″	9′-0″
Cubic feet concrete foundation	1,000	1,115	1,255	1,510	1,970	2,235	1,490	1,675	1,935	2,320	3,040	3,660
Cubic feet concrete foundation per H.P.	13.4	13.1	12.5	12.1	13.1	12.8	9.9	9.8	9.6	9.3	10.1	10.5
Cost per H.P. heavy flywheel, dollars	52.00	50.00	47.20	45.43	43.50	42.60	45.70	44.50	41.40	39.90	37.35	36.14
Cost per lb., heavy flywheel, cents	9.6	9.5	8.5	8.1	7.4	7.4	10.8	10.4	9.5	9.1	8.4	8.5

The square feet of enclosing rectangle is useful in estimating floor space and real estate necessary, and runs about two square feet per horsepower for single engines with outboard bearings, and between 1½ and 1¾ square feet per horsepower for twin engines carrying the driving pulley or electrical generator between them. Data on the cubic feet of enclosing prism is valuable in estimating building requirements, and appears from the table to vary from 160 to 200 cubic feet for single and 130 to 160 cubic feet per horsepower for twin engines. Concrete requirements for engine foundations refer to the material necessary to hold the engine only, but not to the sub-foundation necessary for a proper bottom on any particular soil. The cubic feet of concrete per H.P. is about 12 or 13 for single and about 10 for twin engines. Weights of the engine complete, including the flywheels, allow estimating transportation costs and serve also as a check on prices, as some machines, especially gas engines, are made very heavy to secure rigidity rather than strength. Rigidity is very important, as experience has proved that the life of an engine for continuous service is strongly dependent on it, so extra weight is a good investment. The heavy flywheels are desirable for electrical drives, or in cases where steady rotation is needed, while the light flywheels suffice for most belt and pump drives. By the table the weight per horsepower of these engines, single with the heavy flywheel, lies between 530 and 590 lbs., and for twin engines between 420 and 445 lbs., in striking contrast to some automobiles and boat engines, which by reason of high speed and light construction are as light as 25 lbs. per H.P., but which have a short life, even with their intermittent service.

The cost of these engines varies from $52 to $43 per horsepower single, and $46 to $36 per horsepower twin, which is apparently high when it is possible to buy multiple cylinder engines of higher speed and lighter construction for as low as $25 per horsepower in the larger of these sizes and $35 in the smaller. The explanation is largely to be found in the weight, and is indicated by the low cost per lb., which varies from 7½ to 9½ cents for single engines and 8½ to 11 cents for twin engines. It is interesting and instructive to compare these apparently high gas engine costs with the costs of other standard machinery on the pound basis. Thus, for the common duplex steam pumps of various patterns and sizes the cost will vary from 10 to 30 cents per pound, the high price applying to the smaller sizes. Steam and belt driven air compressors of one and two stages, single and duplex, single and compound steam ends, vary in price per lb. from 9 cents to 35 cents, the price not varying with size only, but with complications, and the larger sizes comparing in weight with the gas engines considered, the minimum compression cost comparing with the maximum of the gas engines. Some of the cheaper gas engines, selling for as low as $35 per H.P., will be found to have pound-costs as high as 18 cents. There is, in fact, very little power machinery built that will come under the minimum limits of these gas engine costs, 7½-11 cents; there are records of large Corliss engines costing as low as 6 cents, but this is unusual; simple high speed engines will run from 15 to 25 cents per lb. in the same weights as these gas engines.

The gas producers are built to operate with the fire and ash pit under pressure or with the fire under a slight vacuum and the ash pit approximately at atmospheric pressure, but for simplicity only the suction producers will be considered. They are adapted to anthracite coal and coke, and while they will operate on some bituminous coals, the trouble and expense due to caking in the producer and tar in the gas make this field not so attractive. The rating of the producers is based on a combustion of 15 lbs. of anthracite and 11 lbs. of coke per hour per square feet of grate bed. Variations in fuel are met by varying the height of the producer so as to permit of a sufficient time of contact between the fuel and the blast to permit of a complete gasification. The producer may be connected with the engine in various ways, but in general one of the methods standardized in Figs. 4 and 5 will be found to be possible and cheapest.

The cost of these producers, their weights and dimensions, are given in the following table, the dimensions referring to Fig. 6 and the horsepower rating referring to the engine which they will supply.

From the succeeding table the first cost of the engines, producers and buildings can be estimated. A suitable building can be provided at a cost of about 10 cents per cubic foot, which would bring the building cost between $10 and $14 per H.P. for both of the plant arrangements of Figs. 4 and 5. Producer foundations are so small as to be negligible in cost, but engine foundations can be put in for about 35c per cubic foot, so that the cost will lie between $3.50 and $4.50 per engine H.P. Starting equipment will include storage tanks, air pumps, motor

or engine driven, gauges, valves and connections, and will cost somewhere near $1.20 per H.P. The water supply should include a circulating pump and power to drive it, taking water from a nearby source, and should be obtainable for $1.50 to $2.00 per H.P., and it need not be installed at all if a supply of water is available under pressure. If no water is available, or is scarce, wells must be sunk or cooling towers installed to permit of using water several times over with only 10 per cent. to 15 per cent. loss by evaporation, but this contingency is not here considered. Direct current electric generators will cost about $20 per k.w. of builder's rating at standard speed, but as the generator is designed for considerable overload, the rated size in k.w. to

De La Vergne Suction Producers.

Size, H.P.	75	100	125	150	175	200	250	300	350
Dimensions a	50	60	60	68	68	85	85	97	97
" b	24	33½	33½	33½	33½	46	46	—	—
" c	33¼	46	46	46	46	59	59	59	59
" d	59½	73	73	84	84	101	101	119	119
" f	114⅜	120¼	120¾	144¼	168¼	144¼	144¾	168¼	192½
" l	129⅜	136⅛	136⅛	138⅛	138⅛	147¼	147¾		
" m	64⅝	65⅝	63⅛	64⅞	65¼	60⅛	60⅛		
" n	64⅝	77	77	79⅝	79⅝	99 5/16	99⅝		
" o	67⅜	80¾	80½	86	86	101½	101½		
" p	40	49½	49½	53⅝	53⅝	67⅝	67⅝		
" r	50¾	59	59	59	59	72¾	72¾		
" s	7	7	7	7	8	10	10	10	10
" x	13'-0"	15'-0"	15'-0"	18'-0"	18'-0"	21'-0"	21'-0"	24'-0"	24'-0"
" y	15'-6"	16'-0"	16'-0"	16'-6"	16'-6"	17'-6"	17'-6"	18'-6"	18'-6"
" z	20'-0"	24'-0"	24'-0"	27'-0"	27'-0"	32'-0"	32'-0"	36'-0"	36'-0"
Sq. ft. enclosing rectangle	260	360	360	486	486	672	672	864	864
Sq. ft. per H.P.	3.5	3.6	2.9	3.3	2.8	3.4	2.7	2.9	2.5
Cu. ft. prism, including head room	4,030	5,760	5,760	80.20	820.20	80.20	11,760	15,980	15,980
Cu. ft per H.P.	54	57	45	54	46	58	47	53·	45
Wt., lbs.	17,200	22,800	22,800	31,550	31,550	37,400	45,900		
Lbs. per H.P.	230	223	180	210	180	180	150		
Cost per H.P., dollars	18.94	18.85	15.09	15.90	13.63	14.00	13.50		
Cost per lb., cents	8.3	8.5	8.3	7.6	7.5	7.8	7.4		

couple with these gas engines is best determined by taking about ⅔ of the engine horsepower instead of the usual ¾. Furthermore, the engine speeds are much lower than the rated dynamo speeds in the ratio 1 to 2 approximately, which would bring the cost to about $40 per k.w. for direct connected units. For example, the 350 H.P. engine should have a generator of about 230 k.w. capacity at 130 r.p.m. The nearest machine of one of the prominent electrical manufacturers is a 250 k.w. at 125 r.p.m., which would cost about $8,000, or $32 per k.w. of manufacturer's rating, or $23 per engine H.P. The switchboard and interior wiring, including lighting of station, may be taken at about $10 per engine H.P., making the electrical equipment cost $33 per H.P. of engine rating for the direct connected units, or $22 for the belt-driven sets with twin engines. To cover small items like concrete floor, painting, plumbing, hoists and tools, a miscellaneous charge of $5 per H.P. is added to obtain a total cost per H.P. for four plants ranging from 75 H.P. to 250 H.P., two with single and two with twin engines, in the following table:

First Cost of Engine and Suction Producer.

Engine H.P.	75	150=2×75	175	250=2×125
Producer.	$18.94	$15.90	$13.63	$13.50
Engine.	52.00	45.70	42.60	39.90
Electrical equipment	33.00	22.00	33.00	22.00
Foundation.	4.70	3.47	4.48	3.26
Building.	13.00	13.60	10.10	10.70
Piping.	3.00	3.50	2.50	3.00
Starting equipment.	1.20	1.20	1.20	1.20
Water supply.	1.80	1.70	1.60	1.40
Miscellaneous.	5.00	5.00	5.00	5.00
Total.	$132.64	$112.07	$114.11	$99.96

POWER COSTS.

1.—Rating of Plant: 75 H.P. Sing'e Cylinder, 4-cycle, Eng. & Suc. Pro...
2.—Hours of operation per year ...
3.—Average engine load when in operation ...
4.—Coal consumption per B.H.P. hour ...
5.—Load factor ...
6.—Coal, cost per ton, Dollars ...
7.—Coal, cost per B.H.P. hour operation, Cents ...
8.—Standby coal cost, 15 per cent. of consumption = (15 x No. 7) ...
9.—Cost of oil per hour, Cents ...
10.—Cost of oil per B.H.P. hour ...
11.—Total coal and oil ...
12.—Total operating cost by adding (.1 x No. 11) B.H.P. (except labor)...
13.—H.P. hours per year ...
14.—Fixed charges per year, including labor and operation ...
15.—Fixed charges per H.P. hour including labor and operation ...
16.—Total cost of power per B.H.P. hour. ...
17.—Labor cost per year ...
18.—Labor cost per B.H.P. hour ...
19.—Total operating cost per B.H.P. hour (including oper. labor) ...
20.—Fixed charges per year (excluding oper. labor) ...
21.—Fixed charges per year (excluding oper. labor) ...
22.—Ratio oper. charge including labor $\frac{\text{per H.P. hour, No. 19}}{\text{Fixed charges, No. 21 (ex. labor hr.}}$..

4,380 = half time.

	Full. 1.1 50 per cent.					Half. 1.8 25 per cent.				
	2	3	4	6	10	2	3	4	6	10
1.	.110	.165	.220	.330	.550	.180	.270	.360	.540	.900
2.	.016	.025	.033	.049	.083	.027	.040	.054	.081	.135
3.	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
4.	.106	.106	.106	.106	.106	.212	.212	.212	.212	.212
5.	.232	.296	.359	.485	.739	.418	.522	.626	.833	1.247
6.	.255	.324	.395	.533	.813	.460	.574	.689	.916	1.372
7.				328,500				164,250		
8.				$3,052				$3,052		
9.	.930	.930	.930	.930	.930	1.860	1.860	1.860	1.860	1.860
10.	1.185	1.254	1.325	1.463	1.743	2.320	2.434	2.549	2.776	3.232
11.				$1,560				$1,560		
12.	.475	.475	.475	.475	.475	.950	.950	.950	.950	.950
13.	.730	.799	.870	1.008	1.288	1.41	1.524	1.639	1.866	2.322
14.				$1,492				$1,492		
15.	.455	.455	.455	.455	.455	.910	.910	.910	.910	.910
16.	1.60	1.74	1.92	2.20	2.84	1.55	1.68	1.80	2.05	2.55

The yearly fixed charges on this investment may be estimated as per the following table, in which item No. 1 represents interest and depreciation or sinking fund charged at 12 per cent.; No. 2 material and labor for repairs and maintenance, listed at 1.5 per cent., though practically nothing should be charged for the first and second years, it is this item that heavy construction will assist in keeping low. Labor is figured at $90 per month for one man and $40 per month for a helper for the small plant, and $100 and $50 for larger plants. The duties of the helper are to handle coal and ash and poke the producer and clean up; both men clean producer and two men are allowed to, even, the small plant, to permit of immediate repairs which will keep repair cost low. Labor is made a fixed rather than an operating charge, because the men must be kept on no matter what the load. Miscellaneous charges of 1½ per cent. include superintendence, insurance, taxes, etc.

Fixed Charges Per Year Per H.P. of Rating.

	75	150	175	250
1 Interest and depreciation at 12 per cent.	$15.92	$12.50	$13.69	$12.00
2 Repairs and maintenance at 1.5 per cent.	1.99	1.68	1.71	1.50
3 Labor.	20.80	12.00	10.30	7.20
4 Miscellaneous.	1.99	1.68	1.71	1.50
5 Total yearly charge per H.P. of rating.	$40.70	$27.86	$27.41	$22.20
6 Total yearly charge in round numbers.	30.52	43.00	48.00	55.50

The preceding table shows that the fixed charge yearly is not in proportion with the rating of the plant, so that the fixed charge per H.P. year or hour of output is an element that cannot be predicted with any certainty or formulated algebraically; it must be calculated for each special case.

In order to arrive at the total power cost there must be added to the above the operating charge, which may vary with the operating time and the consumption of raw material per unit, and this involves the plant efficiency and its variation with load as the principal element. The full load efficiency of units of this size is about the same for all and will correspond to about 13,250 B.T.U. per hour per B.H.P. for the plant of $\frac{2,545}{13,250} = 19.2$ per cent., which is divided into 25 per cent. for

the engine referred to brake horse-power or about 30 per cent. referred to indicated and 76 per cent. for the producer when all are in good adjustment. The proper adjustment of the engine and proper handling of the producer are very important and may affect fuel consumption much more than load, and because of this a good man must be employed as chief operator and he must have proper laborer assistance. This plant efficiency will correspond to a consumption of small anthracite of 1.1 pound yielding about 12,600 B.T.U. per pound as most of it does. For ordinary operating conditions with only one unit, as here assumed, the fuel consumption will be greater as the adjustments are not carefully attended to and as the load is decreased practically doubling at one-quarter load. This latter is important in considering the effect of load factor, because the engine might operate at full load for one-quarter time and burn 1.1 pound of anthracite per B.H.P. hour and have a load factor of 25 per cent., whereas with the same load factor due to one-quarter load operation all the time the fuel consumption would be 2.3 pounds per B.H.P. hour, or with the same load factor carrying half load for half time the fuel consumption would approximate 1.8 pounds per B.H.P. hour. This coal costs in various parts of the country, excluding the mines, from $2.00

QUARTER TIME.

3—	Quarter.					Full.				
4—	2.2					1.1				
5—	12.5 per cent.					25 per cent.				
6—2	3	4	6	10	2	3	4	6	10	
7— .220	.330	.440	.660	1.100	.110	.165	.220	.330	.550	
8— .033	.049	.066	.099	.165	.016	.025	.033	.049	.083	
9—8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
10— .424	.424	.424	.424	.424	.106	.106	.106	.106	.106	
11— .677	.803	.930	1.183	1.689	.232	.296	.359	485	.739	
12— .745	.883	1.023	1.291	1.858	.255	.324	.395	.533	.813	
13—		82,125				164,250				
14—		$3,052				$3,052				
15—3.720	3.720	3.720	3.720	3.720	1.860	1.860	1.860	1.860	1.860	
16—4.465	4.603	4.743	5.011	5.578	2.115	2.184	2.255	2.393	2.673	
17—		$1,560				$1,560				
18—1.900	1.900	1.900	1.900	1.900	.950	.950	.950	.950	.950	
19—2.645	2.782	2.923	3.191	3.758	1.205	1.274	1.345	1.483	1.763	
20—		$1,492				$1,492				
21—1.820	1.820	1.820	1.820	1.820	.910	.910	.910	.910	.910	
22—1.45	1.53	1.61	1.75	2.07	1.33	1.40	1.47	1.63	1.94	

	Half.					Quarter.				
	1.8					2.2				
	12.5 per cent.					6.25 per cent.				
2	3	4	6	10	2	3	4	6	10	
.180	.270	.360	.540	.900	.220	.330	.440	.660	1.100	
.026	.040	.054	.081	.135	.033	.049	.066	.099	.165	
8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
.212	.212	.212	.212	.212	.424	.424	.424	.424	.424	
.418	.522	.626	.833	1.247	.677	.803	.930	1.183	1.689	
.460	.574	.689	.916	1.372	.745	.883	1.023	1.301	1.858	
		82,125				41,063				
		$3,052				$3,052				
3.720	3.720	3.720	3.720	3.720	7.440	7.440	7.440	7.440	7.440	
4.180	4.294	4.409	4.636	5.092	8.185	8.323	8.463	8.741	9.298	
		$1,560				$1,560				
1.900	1.900	1.900	1.900	1.900	3.800	3.800	3.800	3.800	3.800	
2.360	2.474	2.589	2.816	3.272	4.545	4.683	4.823	5.101	5.658	
		$1,492				$1,492				
1.820	1.820	1.820	1.820	1.820	3.640	3.640	3.640	3.640	3.640	
1.29	1.36	1.43	1.55	1.80	1.23	1.29	1.32	1.40	1.56	

	175 H.P.									
	4,380 = half time.									
	Full.					Half.				
	1.1					1.8				
	50 per cent.					25 per cent.				
2	3	4	6	10	2	3	4	6	10	
.110	.165	.220	.330	.550	.180	.270	.360	.540	.900	
.016	.025	.033	.049	.083	.027	.040	.054	.081	.135	
10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	
.059	.059	.059	.059	.059	.118	.118	.118	.118	.118	
.185	.249	.312	.438	.692	.324	.428	.632	.739	1.153	
.204	.274	.343	.482	.761	.356	.471	.585	.813	1.268	
		766,500				383,250				
		$4,800				$4,800				
.620	.620	.620	.620	.620	1.240	1.240	1.240	1.240	1.240	
.824	.894	.963	1.102	1.381	1.596	1.711	1.825	2.053	2.508	
		$1,800				$1,800				
.235	.235	.235	.235	.235	.570	.570	.570	.570	.570	
.439	.509	.578	.717	.996	.926	1.041	1.155	1.383	1.838	
		$3,000				$3,000				
.385	.385	.385	.385	.385	.770	.770	.770	.770	.770	
1.14	1.32	1.50	1.86	2.59	1.21	1.35	1.50	1.79	2.40	

—Rating of Plant
2.—Hours of operation per year
3.—Average engine load when in operation
4.—Coal consumption per H.P. hour
5.—Load factor
6.—Coal, cost per ton, dollars
7.—Coal, cost per B.H.P. hour, cents
8.—Standby coal cost (.15 x No. 7)
9.—Cost of oil per hour, cents
10.—Cost of oil per B.H.P. hour
11.—Total cost and oil
12.—Total operating cost per B.H.P. hour, excluding labor
13.—B.H.P. hours per year
14.—Fixed charges per year, dollars, including operating labor
15.—Fixed charges per B.H.P. hour, including operating labor, cents
16.—Total cost of power per B.H.P. hour
17.—Labor cost per year, dollars
18.—Labor cost per B.H.P. hour, cents
19.—Total operating cost per B.H.P. hour, including operating labor
20.—Fixed charges per year, excluding operating labor.
21.—Fixed charges per B.H.P. hour, excluding operating labor
22.—Ratio 19/20

1—										
2—	2,190 = quarter time.									
3—	Quarter.					Full.				
4—	2.2					1.1				
5—	12.5 per cent.					25 per cent.				
6— 2	3	4	6	10	2	3	4	6	10	
7— .220	.330	.440	.660	1.100	.110	.165	.220	.330	.550	
8— .033	.044	.055	.099	.165	.016	.025	.033	.049	.083	
9—10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	
10— .236	.236	.236	.236	.236	.059	.059	.059	.059	.059	
11— .489	.610	.742	.965	1.501	.185	.249	.312	.438	.692	
12— .538	.671	.816	1.061	1.651	.204	.273	.343	.482	.761	
13—		191,625				383,250				
14—		$4,800				$4,800				
15— 2.480	2.480	2.480	2.480	2.480	1.240	1.240	1.240	1.240	1.240	
16— 3.018	3.151	3.296	3.541	4.131	1.444	1.513	1.583	1.722	2.001	
17—		$1,800				$1,800				
18— 1.140	1.140	1.140	1.140	1.140	.570	.570	.570	.570	.570	
19— 1.678	1.811	1.956	2.201	2.791	.774	.843	.913	1.052	1.331	
20—		$3,000				$3,000				
21— 1.540	1.540	1.540	1.540	1.540	.770	.770	.770	.770	.770	
22— 1.08	1.18	1.27	1.43	1.81	1.01	1.09	1.19	1.37	1.73	

	Half.					Quarter.				
	1.8					2.2				
	12.5 per cent.					6.25 per cent.				
2	3	4	6	10	2	3	4	6	10	
.180	.270	.360	.540	.900	.220	.330	.440	.660	1.10	
.026	.040	.054	.081	.135	.033	.049	.066	.099	.165	
10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	
.118	.118	.118	.118	.118	.236	.236	.236	.236	.236	
.324	.428	.532	.739	1.153	.489	.610	.742	.965	1.501	
.356	.471	.585	.813	1.268	.538	.671	.816	1.061	1.651	
		191,625				95,812				
		$4,800				$4,800				
2.480	2.480	2.480	2.480	2.480	4.960	4.960	4.960	4.960	4.960	
2.836	2.951	3.065	3.293	3.748	5.498	5.631	5.176	6.021	6.611	
		$1,800				$1,800				
1.140	1.140	1.140	1.140	1.140	2.280	2.280	2.280	2.280	2.280	
1.496	1.611	1.725	1.953	2.408	2.818	2.951	3.096	3.341	3.931	
		$3,000				$3,000				
1.540	1.540	1.540	1.540	1.540	3.080	3.080	3.080	3.080	3.080	
.97	1.04	1.12	1.27	1.56	.92	.96	1.00	1.08	1.28	

1.—Rating of Plant: Power costs for twin 150 H.P. (2 x 75) 4-cycle Eng. and auction producer
2.—Hours of operation per year
3.—Average engine load when in operation
4.—Coal consumption per H.P. hour
5.—Load factor
6.—Coal, cost per ton, dollars
7.—Coal, cost per B.H.P. hour, cents
8.—Standby coal cost (.15 x No. 7)
9.—Cost of oil per hour, cents
10.—Cost of oil per B.H.P. hour
11.—Total coal and oil
12.—Total operating cost per B.H.P. hour, excluding labor
13.—B.H.P. hours per year
14.—Fixed charges per year, dollars, including operating labor
15.—Fixed charges per B.H.P. hour, including operating labor, cents
16.—Total cost of power per B.H.P. hour
17.—Labor cost per year, dollars
18.—Labor cost per B.H.P. hour, cents
19.—Total operating cost per B.H.P. hour, including operating labor
20.—Fixed charges per year, excluding operating labor.
21.—Fixed charges per B.H.P. hour, excluding operating labor
22.—Ratio 19/21

	4,380 = half time.									
	Full.					Half.				
	1.1					1.8				
	50 per cent.					25 per cent.				
2	3	4	6	10	2	3	4	6	10	
.110	.165	.220	.330	.550	.180	.270	.360	.540	.900	
.016	.025	.033	.049	.083	.026	.040	.054	.081	.135	
15	15	15	15	15	15	15	15	15	15	
.100	.100	.100	.100	.100	.200	.200	.200	.200	.200	
.226	.290	.353	.479	.733	.406	.510	.614	.821	1.135	
.249	.319	.388	.527	.806	.447	.561	.675	.903	1.249	
		657,000				328,500				
		$4,100				$4,100				
.625	.625	.625	.625	.625	1.250	1.250	1.250	1.250	1.250	
.874	.944	1.013	1.152	1.431	1.697	1.811	1.925	2.153	2.499	
		$1,800				$1,800				
.270	.270	.270	.270	.270	.540	.540	.540	.540	.540	
.519	.589	.658	.797	1.076	.987	1.101	1.215	1.443	1.789	
		$2,300				$2,300				
.355	.355	.355	.355	.355	.710	.710	.710	.710	.710	
1.46	1.66	1.85	2.24	3.00	1.39	1.54	1.71	2.03	2.50	

to $6.00 per ton, and may at extremely distant points reach $10.00. On these figures the coal cost per H.P. hour can be estimated, but to each figure there is usually added about 15 per cent. for stand-by losses at starting when the plants shut down overnight every day, as is usually the case with single unit installations, especially for factory service. The cost of coal per pound is $\frac{2.00}{2,000} = .10c$ at $2.00, .15c. at $3.00, .20c. at $4.00, .30c. at $6.00 and .50c. at $10.00 per ton of 2,000 pounds. From these and the values of load factors, engine load and fuel consumption with load, the following figures for coal cost per B.H.P. hours are determined. The lubricating oil consumption does not depend on the load but only on the number of hours of operation and somewhat, though not very much, total yearly cost divided by the horse power hours generated to give the total cost of power per B.H.P. hour, as reported in line 16. As most power costs are reported for the operation only it is desirable that the labor item, here included under fixed yearly charges, be separated and added to the operating materials. The result is given in line 19, total operating cost per B.H.P. hour including labor and line 21, total fixed charges per B.H.P. hour excluding labor, which added together give line 16, the total power cost per B.H.P. hour. The last line gives the ratio of these operating costs to the fixed charges and is useful in comparing with other installations and as showing the relative importance of fixed and operating costs.

These tables are extremely instructive and will bear some study for besides giving values for the cost of power they

1—										
2—				2,190 = quarter time.						
3—			Quarter.				Full.			
4—			2.2				1.1			
5—			12.5 per cent.				25 per cent.			
6—	2	3	4	6	10	2	3	4	6	10
7—	.220	.330	.440	.660	1.10	.110	.165	.220	.330	.550
8—	.033	.044	.066	.099	.165	.016	.025	.033	.049	.083
9—	15	15	15	15	15	15	15	15	15	15
10—	.400	.400	.400	.400	.400	.100	.100	.100	.100	.100
11—	.653	.779	.906	1.159	1.665	.226	.290	.353	.479	.733
12—	.718	.857	.997	1.275	1.832	.249	.319	.388	.527	.806
13—				164,250				328,500		
14—				$4,100				$4,100		
15—	2.500	2.500	2.500	2.500	2.500	1.250	1.250	1.250	1.250	1.250
16—	3.218	3.357	3.497	3.775	4.332	1.499	1.563	1.638	1.777	2.056
17—				$1,800				$1,800		
18—	1.080	1.080	1.080	1.080	1.080	.540	.540	.540	.540	.540
19—	1.798	1.937	2.077	2.355	2.912	.789	.859	.928	1.067	1.346
20—				$2,300				$2,300		
21—	1.420	1.420	1.420	1.420	1.420	.710	.710	.710	.710	.710
22—	1.26	1.37	1.46	1.65	2.15	1.12	1.20	1.31	1.50	1.90

1.—Rating of Plant
2.—Hours of operation per year
3.—Average engine load when in operation
4.—Coal consumption per H.P. hour
5.—Load factor
6.—Coal, cost per ton, dollars
7.—Coal, cost per B.H.P. hour, cents
8.—Standby coal cost (.15 x No. 7)
9.—Cost of oil per hour, cents
10.—Cost of oil per B.H.P. hour
11.—Total coal and oil
12.—Total operating cost per B.H.P. hour, excluding labor
13.—B.H.P. hours per year
14.—Fixed charges per year, dollars, including operating labor
15.—Fixed charges per B.H.P. hour, including operating labor, cents
16.—Total cost of power per B.H.P. hour
17.—Labor cost per year, dollars
18.—Labor cost per B.H.P. hour, cents
19.—Total operating cost per B.H.P. hour, including operating labor
20.—Fixed charges per year, excluding operating labor.
21.—Fixed charges per B.H.P. hour, excluding operating labor
22.—Ratio $\frac{19}{21}$

			Half.				Quarter.			
			1.8				2.2			
			12.5 per cent.				6.25 per cent.			
2	3	4	6	10	2	3	4	6	10	
.180	.270	.360	.540	.900	.220	.330	.440	.660	1.10	
.026	.040	.054	.081	.135	.033	.049	.066	.099	.165	
15	15	15	15	15	15	15	15	15	15	
.200	.200	.200	.200	.200	.400	.400	.400	.400	.400	
.406	.510	.614	.821	1.135	.653	.779	.906	1.159	1.665	
.447	.561	.675	.903	1.249	.718	.857	.997	1.275	1.832	
			164,250				82,125			
			$4,100				$4,100			
2.500	2.500	2.500	2.500	2.500	5.000	5.000	5.000	5.000	5.000	
2.947	3.061	3.175	3.403	3.749	5.718	5.857	5.997	6.275	6.832	
			$1,800				$1,800			
1.080	1.080	1.080	1.080	1.080	2.160	2.160	2.160	2.160	2.160	
1.527	1.641	1.755	1.983	2.329	2.878	3.017	3.157	3.435	3.992	
			$2,300				$2,300			
1.420	1.420	1.420	1.420	1.420	2.840	2.840	2.840	2.840	2.840	
1.08	1.16	1.24	1.40	1.64	1.02	1.06	1.11	1.21	1.40	

250 H.P, = 2 x 125.
4,380 = half time.

			Full.				Half.			
			1.1				1.8			
			50 per cent.				25 per cent.			
2	3	4	6	10	2	3	4	6	10	
.110	.165	.220	.330	.550	.180	.270	.360	.540	.900	
.016	.025	.033	.049	.083	.026	.040	.054	.081	.135	
15	15	15	15	15	15	15	15	15	15	
.060	.060	.060	.060	.060	.120	.120	.120	.120	.120	
.186	.250	.313	.439	.693	.326	.430	.534	.741	1.155	
.205	.275	344	.483	.762	.358	.473	.587	.815	1.270	
			1,095,000				547,500			
			$5,500				$5,000			
.510	.510	.510	.510	.510	1.020	1.020	1.020	1.020	1.020	
.715	.785	.854	.993	1.272	1.378	1.493	1.607	1.835	2.290	
			$1,800				$1,800			
.165	.165	.165	.165	.165	.330	.330	.330	.330	.330	
.370	.440	.509	.648	.927	.688	.803	.917	1.145	1.620	
			$3,750				$3,750			
.345	.345	.345	.345	.345	.690	.690	.690	.690	.690	
1.07	1.23	1.47	1.87	2.69	1.00	1.17	1.33	1.65	2.32	

1—										
2—				2,190 = quarter time.						
3—			Quarter.				Full.			
4—			2.2				1.1			
5—			12.5 per cent.				25 per cent.			
6—	2	3	4	6	10	2	3	4	6	10
7—	.220	.330	.440	.660	1.10	.110	.165	.220	.330	.550
8—	.033	.044	.066	.099	.165	.016	.025	.033	.049	.083
9—	15	15	15	15	15	15	15	15	15	15
10—	.240	.240	.240	.240	.240	.060	.060	.060	.060	.060
11—	.473	.614	.740	.999	1.515	.186	.250	.313	.439	.693
12—	.542	.675	.814	1.1	1.666	.205	.275	.344	.483	.762
13—				273,750				547,500		
14—				$5,550				$5,550		
15—	2.040	2.040	2.040	2.040	2.040	1.020	1.020	1.020	1.020	1.020
16—	2.582	2.915	2.854	3.140	3.706	1.224	1.295	1.364	1.503	1.782
17—				$1,800				$1,800		
18—	.660	.660	.660	.660	.660	.330	.330	.330	.330	.330
19—	1.202	1.335	1.474	1.760	2.326	.535	.605	.674	.813	1.092
20—				$3,750				$3,750		
21—	1.380	1.380	1.380	1.380	1.380	.690	.690	.690	.690	.690
22—	.87	.96	1.07	1.27	1.69	.78	.87	.97	1.18	1.58

			Half.				Quarter.			
			1.8				2.2			
			12.5 per cent.				6.25 per cent.			
2	3	4	6	10	2	3	4	6	10	
.180	.270	.360	.540	.900	.220	.330	.440	.660	1.10	
.026	.040	.054	.081	.135	.033	.044	.066	.099	.165	
15	15	15	15	15	15	15	15	15	15	
.120	.120	.120	.120	.120	.240	.240	.240	.240	.240	
.326	.430	.534	.741	1.155	.493	.614	.740	.999	1.515	
.358	.473	.587	.815	1.270	.592	.675	.814	1.1	1.666	
			273,750				136,875			
			$5,550				$5,550			
2.040	2.040	2.040	2.040	2.040	4.080	4.080	4.080	4.080	4.080	
2.398	2.513	2.627	2.855	3.310	4.622	4.755	4.894	5.180	5.746	
			$1,800				$1,800			
.660	.660	.660	.660	.660	1.320	1.320	1.320	1.320	1.320	
1.018	1.133	1.247	1.475	1.930	1.862	1.995	2.134	2.420	2.986	
			$3,750				$3,750			
1.380	1.380	1.380	1.380	1.380	2.760	2.760	2.760	2.760	2.760	
.74	.82	.91	1.07	1.45	.68	.72	.77	.88	1.08	

on size. A single cylinder engine of 150 H.P. is usually found to use about one-half pint of cylinder oil per hour and one and one-half pints of bearing oil per hour, costing respectively 65 and 35 cents per gallon. The amount will be about the same for 125 H.P. and 175 H.P. and almost three-quarters for 75 H.P. Twin engines may be assumed to use twice as much as single engines of the same cylinder size. This brings the cost of cylinder oil per hour for 150 H.P. engine to 4 cents, and lubricating oil to 6.6 cents, and for a 75 H.P. to 3 and 5 cents respectively. Other small items, such as waste, paint, bolts, packing, cleaning material, will be covered by adding to the total about 10 per cent., which will also allow for a little lack of care in management. To the total of the operating charges, thus determined in the preceding table, is to be added the show all the elements entering into it, together with their relative importance. The total cost of power (No. 16) per B.H.P. hour increases with the cost of coal per ton, but by no means in direct proportion; thus, for 75 H.P. an increase of five times in the coal cost changes the total power cost as follows: Total power cost between 1½ times for half time full load as a maximum and 1⅛ times for quarter time full load as a minimum. This shows the importance of coal cost by itself. The effect on operating cost (No. 19) is not very different, as this is increased at the same time between 1¾ times to 1⅖ times, a little more, which is explained by the relation of operating and fixed charges (No. 22). The same limits will apply to total cost for the larger engines, so that the cost of coal per ton has no relation to the size of engine

so far as its effects on this total cost is concerned, but by reason of the difference in the ratio of operating to fixed charges the effect on operating cost will be different, lying between 1½ and 2½ times as the cost increases five times the cost of coal per ton.

The effect of increased size of engine is marked in its reduction of total power costs chiefly because the fixed charges are smaller per unit for the large ones. A similar reduction of operating cost is likewise the effect of increased size because oil and labor costs do not vary in proportion with size. Coal costs per H.P. hour are dependent only on cost per ton and on the individual load. The strongest factor in every case in fixing power costs is the load factor, especially where low load factor is the result of low individual engine load as will appear from all the tables.

The power costs for these plants are extremely low and cannot be met by steam plants of the same size operating under the same conditions except where coal is extremely cheap. Operating power costs like these varying from .73c. to 1.29c. per H.P. hour with coal at $2 per ton and on 50 per cent. load factor for 75 H.P. are quite impossible with steam, and even accounting for a lower fixed charge the difference cannot be made up because the operating costs lie between 1.6 and 2.8 times the fixed charges for these conditions. For the same conditions the total operating costs for the other sizes are summarized:

	Operating cost of power, cents per H.P. hour at 50% Load Factor.	
Engines	Coal at $2	Coal at $10
75 H.P. single	.75c.	1.29
150 H.P. twin	.52c.	1.08
175 H.P. single	.44c.	1.00
250 H.P. twin	.37c.	.92

These costs are just about commensurate with those of the largest steam plants of over 50,000 H.P., such as operate the electric railways and central station of the City of New York, and are absolutely unheard of in steam practice. Whether in any particular size a lower installation cost for a steam plant accompanied by a higher fuel consumption will make it a competitor can be roughly judged by the tables and ratios giving the relative importance of the various items but in small and medium sizes such as are here considered as typical in size of the average factory or small town plant, it will be found that the gas plant is superior as capable of producing power at a total cost varying from one-half to one-fifth as much as the steam plant.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6653—March 5—Amending Order No. 3809, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its line across Fifth Street, Grand Forks, B.C., as shown on plan filed under Case No. 2348A.

6654—March 5—Amending Order No. 3810, dated October 23rd, 1907, and authorizing Kettle River Valley Railway Company to construct its line across Alexandra Avenue, Grand Forks, B.C., as shown on plan filed under Case No. 2349A.

6655—March 13—Amending Order No. 6330, February 13th, 1909, by striking out the last clause and substituting therefor the following:—"Immediately upon the said council electing as aforesaid, it shall be authorized to construct the crossings it may elect to take, and at its own expense, and perform the necessary grading and furnish and lay down the necessary planking." And further ordering that the town of Dundurn, Sask., construct the said crossings, viz., permanent crossing 700 ft. south of Clarke Street, and a temporary crossing over the elevator track.

6656—February 6—Authorizing the C.P.R. to use and operate bridge at mileage 1.4 on the St. Luc section of its line of railway.

6657—March 20—Authorizing the C.P.R. to use and operate the bridge at mileage 85.4 of the Sherbrooke Section of its line of railway.

6658—March 20—Authorizing the C.P.R. Company to use and operate the bridges at mileages 19.6, 19.8, and 19.5, in the town of St. Johns, Que., and at mileage 43.8 over the old main line of the G.T.R., near the applicant company's south switch, Montreal Junction.

6659—March 20—Authorizing the C.P.R. Company to use and operate the bridges at mileages 12.6 and 20.5 on the Newport Section of its line of railway.

6660—March 25—Authorizing the C.P.R. Company to use and operate nine bridges on the London Section of its line of railway.

6661—March 25—Authorizing the Atlantic, Quebec and Western Railway Company to construct a steel trestle over Chouinard Gully at the east end of L'Anse aux Gascons, Que.

6662—March 25—Authorizing the A. Q. and W. Railway Company to construct a steel bridge over Little River, at Port Daniel, Que., at mileage 20.

6663—March 25—Authorizing the A. Q. and W. Railway Company to construct a steel trestle over Perry's Brook, at the west end of Newport, Que.

6664—March 25—Authorizing the A. Q. and W. Railway Company to construct the steel trestle over Anse a la Barbe Gully, Que., at about mileage 25 of its line of railway.

6665—March 8—Dismissing complaint of the Local Union of the United Mineworkers, Board of Trade, and Storekeepers, Taber, Alta., against excessive freight rates charged by C.P.R. Company on shipments of coal from Alberta, as well as the failure of the C.P.R. to supply a sufficient number of cars for movement of coal.

6666—March 6—Dismissing complaint J. G. Swinney, Cowley, Alta., re excessive rate charged by Dominion Express Company on milk shipments from Cowley to Michel.

6667—March 24—Authorizing the E. and N. Railway Company to construct a spur to and into the premises of the Imperial Oil Company, Vancouver Island, B.C.

6668—March 25—Authorizing the C.P.R. Company to use and operate eight bridges on the Toronto Section of its line of railway.

6669—March 8—Dismissing complaint F. W. Godsal, Cowley, Alta., against excessive rates charged by Dominion Express Company between Winnipeg and Cowley.

6670—March 20—Authorizing the C.P.R. Company to construct a branch line or spur from its main line along North Railway Station on the south side of the Regina Exhibition Grounds, in the city of Regina, Sask., to the western limits of the said city.

6671—March 16—Rescinding Order of the Board No. 6524, dated 16th March, 1909, authorizing the Municipal Council of the Township of Wainfleet, Ont., to lay a culvert under the track of the Buffalo & Lake Huron Division of the G.T.R., where the same crosses the side road between Lots 23 and 24, Concession 1, Township Wainfleet, Ont.

6672—February 13—Refusing application of the Board of Trade of Regina, Sask., for an Order directing the C.P.R. and the C.N.R. to provide and construct a union station in the city of Regina.

6673—March 26—Dismissing application of the Corporation of the town of Listowel, Ont., that the G.T.R. Company and the C.P.R. provide and construct a suitable switch connecting their respective systems, within the town of Listowel, for inter-switching purposes.

6674—February 8—Dismissing application of the city of St. Boniface, Man., for an Order directing the C.N.R. Company to comply with provisions of the Orders of the Board requiring the C.N.R. to divert Thibault and Meuron Streets, St. Boniface, Man.

6675—February 23—Dismissing application of C. T. W. Piper, of Vancouver, B.C., for Order directing the G.N.R. Company to construct a spur to the premises of the Britannia Trading & Lumber Company, Burnaby Lake, near Vancouver, B.C.

6676—February 11—Dismissing complaint of D. H. MacDonald & Company, of Fort Qu'Appelle, Sask., complaining against the excessive express rates charged by the Dominion

Express Company, as well as delays on the part of the company delivering express matter.

6677—March 26—Approving plans and specifications of the Corporation of the Township of Tilbury East for certain drainage work in the Township of Tilbury East, known as the "King and Whittle Improvement Drain," and the C.P.R. Company is also directed to temporarily remove the bridge upon four days' notice from the Corporation of the Township of Tilbury East, to permit dredge to cross and recross for purpose of cleaning the drain.

6678—March 26—Authorizing the A. Q. and W. Railway to construct bridge over the North River, at Port Daniel, P.Q.

6679—March 29—Directing form, size, and style, in which tariffs of tolls shall be filed by telegraph companies subject to the Board's jurisdiction.

6680—March 26—Granting leave to W. W. Beardmore, of the village of Acton, Ont., to lay a two-inch water pipe across the lands and under the tracks of the G.T.R. at Acton Station, Ont., and to connect the same with the water mains and pumping plant of the G.T.R.

6681—March 17—Granting leave to the Aberdeen Telephone Company to erect, place, and maintain its telephone lines under the tracks of the C.N.R. at the village of Aberdeen, Sask.

6682—July 14—Ordering the Peterborough Radial Railway Company to install and maintain derails on each side of the crossing of the G.T.R. on Charlotte Street and Water Street in the city of Peterborough, the said derails to be placed 100 feet from the nearest track of the G.T.R.

6683—March 29—Granting leave to the C.P.R. to construct its railway across the highways in the Tp. of Artemesia, County of Grey, Ont., at mileages 0.75, 1.04, 1.86, 1.90, 3.18, 4.33, and 4.43.

6684—March 29—Granting leave to the Erie Telephone Company to erect, place, and maintain its wires across the G.T.R. at the crossing of the concession line between the 12th and 13th Concessions, of Walpole, ½ mile south of Hagersville, Ont.

6685—March 1—Authorizing the Quamichan Mill Company, of Duncans, B.C., to construct a crossing over the tracks of the E. and N. Railway at a point 1½ miles north of Duncans Station, B.C.

6686—March 25—Granting leave to the C.P.R. to construct its railway across the highways in the Township of Glenelg, County Grey, Ontario.

6687—March 26—Granting leave to the C.P.R. to construct its railway across the highway in the Township of Bentinck, County of Grey, Ontario.

6688—March 26—Granting leave to the C.P.R. to construct its railway across the highways between Lots 50 and 51, Concession 1, Township of Glenelg, County of Grey, Ontario.

6689—March 29—Ordering all railways subject to the jurisdiction of the Board to file for the approval of the Board a tariff of additional maximum tolls, no greater than the tolls now being charged for the carriage of passengers in sleeping or parlor cars on its railway, to be entitled Standard Tariff of Maximum Sleeping and Parlor Car Tolls, and numbered C.R.C. No. 1.

6690—February 27—Directing the V. W. and Y. Railway to construct suitable highway crossings, cattle guards, planking and cross-fences at Rupert Street, in the Townsite of Hastings, B.C., as soon as the street is opened up, and an overhead bridge, not less than 20 feet wide at Nanaimo Street.

6691—March 26—Authorizing the C.P.R. to use and operate bridges on the Smith's Falls Section of its line of railway at various mileages.

6692—February 27—Granting leave to the Department of Lands and Works of British Columbia to construct a highbridge over the E. and N. Railway and the Wellington Colliery Company near Ladysmith Station, B.C.

6693—March 30—Authorizing the C.P.R. to construct, maintain, and operate five branch lines of railways, or spurs, in the town of Moose Jaw, Sask.

6694—March 30—Authorizing the C.P.R. to use and operate bridges over the Lachine Canal, Montreal, near Ogilvie Flour Mills Company's premises.

6695—March 3—Granting leave to the Honor, the Minister of Public Works of British Columbia, to construct a highway across the C.P.R. in the N.W. ¼ of Sec. 29, Tp. 23, R. 2, west of the 6th Meridian, B.C.

6696—March 30—Granting leave to the Welland County Telephone Company to erect, place, and maintain its telephone wires under the tracks of the M.C.R.R. in the Township of Bertie, County of Welland, Ont.

6697—March 26—Granting leave to the Montreal, Light, Heat & Power Company to erect, place, and maintain its power wires across the track of the C.P.R. where the same crosses the Lachine Canal, on the north side of the same.

6698—March 26—Authorizing the Corporation of the city of Fort William, Ont., to construct an outlet sewer under the tracks of the C.P.R. at Tarbut Street, Fort William, Ont.

6699—February 27—Directing the Nicola, Kamloops, and Similkameen Coal and Railway Company to improve all its diversions and highway crossings between Spence's Bridge and Nicola, B.C., particularly at mileages 28½ and 30½, from Spence's Bridge, B.C.

6700—March 30—Approving plan of the proposed spur or transfer track which the C.P.R. was authorized to construct from its line of railway at Holmfield, Man., to the line of railway of the C.N.R. and of the connection of the said spur with the C.N.R.

6701—February 19—Ordering amount of adjustment allowed shippers upon all railways subject to the Board's jurisdiction who are compelled to furnish car doors to enable cars to be used for traffic.

6702—March 25—Directing that the tolls and minimum carload weights on wooden telegraph, telephone, electric light, and trolley poles loaded on single cars, transported on railways between points east of Port Arthur, Ont., be not greater than the tolls and minimum carload weight provided in the Special, Local and Joint Tariffs of the companies to apply on common lumber; that in the case of poles too long for a single car and requiring more than one car for their carriage, the companies be authorized to charge not more than twenty per cent. higher than for single cars and not more than the 10th class rates; the minimum weight for the first car to be the same as herein prescribed for single cars, and for each additional car over which the load extends two-thirds of the single car minimum, the longest car in the series to be considered the first car. This ruling to apply on shipments from points in Canada to points in the United States, between which joint rail rates for general traffic are, or may be, made by the Canadian railway companies with the concurrence of their United States connections, the minimum weights to be in accordance with Rule 7 of the "Official Classification."

6703—March 30—Amending Order of the Board dated March 22nd, 1906, sanctioning location of the proposed line of railway of the Tillsonburg, Lake Erie and Pacific Railway Company in the Township of West Zorra, Counties of Oxford, Linwood, and Wellington, Ontario, by excluding from such approval that portion of the line which extends through the city of Stratford, Ont., and lands immediately adjacent thereto, that is, between mileages 22 and 28.

6704—March 31—Authorizing the C.N.O.R. Company to open for the carriage of traffic that portion of its line of railway between Queen Street and Cherry Street, Toronto, Ont.

6705—March 31—Granting leave to the C.N.Q. Railway to divert the Cap Sante Road, at about mileage 37 from the Quebec Bridge.

6706—March 31—Approving and sanctioning diversion of the C.P.R. main line between Crane Lake and Piapot, from mileage 65.32 to mileage 65.65, Sask.

6707—March 31—Granting leave to the Corinne Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. in the S.E. ¼ 2, Tp. 13, R. 20 and the N.E. ¼, Sec. 35, Tp. 12., R. 20, W. 2nd Mer., Sask.

(Continued on Page 565.)

ENGINEERING SOCIETIES.

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

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

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

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

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

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

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

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

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

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

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

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1909.

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

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

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

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.

CANADIAN STREET RAILWAY ASSOCIATION.—President, J. E. Hutcheson, Ottawa; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers; Secretary, C. L. Worth.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

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

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

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

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

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

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

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

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

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

COMING MEETINGS.

American Gas Power Society.—April 27. Quarterly meeting, Minneapolis, Minn. Secretary, R. P. Gillette.

American Society of Civil Engineers.—Annual convention, Mount, Washington Hotel, Bretton Woods, N.H., July 6 to 9. Secretary, Chas. W. Hunt, 220 West 57th Street, New York.

Air Brake Association.—May 11 to 14. Annual meeting at Richmond, Va. Secretary, F. M. Nellis, 53 State Street, Boston, Mass.

American Society of Mechanical Engineers.—May 4-7. Spring meeting at Washington, D.C. Secretary, Calvin W. Rice, 29 West 39th Street, New York City.

American Electrochemical Society. — May 6-8. Annual meeting at Niagara Falls, Canada. Secretary, Jos. W. Richards, Lehigh University, South Bethlehem, Pa.

American Foundrymen's Association.—May 18-20. Annual meeting at Cincinnati, Ohio. Secretary, Richard Moldenke, Watchung, N.J.

American Railway Association.—May 19. Annual meeting at New York City. Secretary, W. F. Allen, 24 Park Place, New York City.

American Waterworks Association.—June 8-12. Annual convention at Milwaukee, Wis. Secretary, John M. Diven, 14 George Street, Charleston, S. C.

American Railway Master Mechanics' Association.—June 16-18. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Building, Chicago, Ill.

American Institute Electrical Engineers, Toronto Section.—Friday, April 23, at 8 p.m. Address by Mr. Alexander Dow, Mem. A.I.E.E., of Detroit, on "Underground Conduits and Cables."

International Railway General Foremen's Association.—June 1 to 5, 1909, at Chicago. E. C. Cook, Royal Insurance, Chicago, Ill.

Master Car Builders' Association.—June 21 to 23, 1909, at Atlantic City, N.J. J. W. Taylor, Old Colony Building, Chicago, Ill.

National Electric Light Association.—June 1 to 4. Thirty-second convention, Atlantic City, N.J. Secretary, John F. Gilchrist, 29 West 39th Street, New York.

National Fire Protection Association.—May 25 to 27. Annual meeting at New York City. Secretary, W. H. Merrill, 382 Ohio Street, Chicago, Ill.

CONCRETE PAVEMENT CONSTRUCTION AT BOZEMAN, MONT.*

By C. M. Thorpe, City Engineer, Bozeman, Mont.

Bozeman is a small city of about 10,000 population, situated in the famous Gallatin Valley.

The matter of improving our main street has been discussed for ten or fifteen years. Plans were made in 1893 for macadamizing the street, but the proposition was voted down. In 1907 the city council created an improvement district for the purpose of paving with creosoted wood blocks on a concrete foundation. This was objected to and defeated by the property owners, who objected to the cost and wished further time to investigate. A committee of property owners was then appointed to carry on investigations and report to the city council the kind of pavement they desired. These investigations were continued by the committee and city engineer until early in 1908, when the committee reported unanimously in favor of concrete pavement.

Plans and specifications were at once prepared and bids asked for. In preparing specifications it was thought best to ask each bidder to submit the details of construction with his bid, as it was claimed that a patent had been granted on concrete pavement. The bids were opened July 2nd, 1908, and a prominent construction company of Salt Lake City, Utah, was found to be the lowest bidder and the contract was awarded to it at the following prices:—

For excavation, 50c. per cubic yard; for gravel fill, $1.25 per cubic yard; for concrete pavement (not including excavation or gravel fill), $1.95 per square yard.

The principal points in the construction of the pavement are these:—The street was excavated and rolled with a ten-ton roller; 3 inches of fine gravel was then placed on the rolled surface where so required by the engineer; where the foundation was found to be gravelly no gravel fill was required. The forms were then set. These consisted of 2 x 7 inch. plank, set with the top to grade and running across the street from curb to curb where there was no street railway track. Along the street railway track one side was constructed at a time. These forms were set 10 feet apart and steel headers set 10 feet apart between the forms, making blocks 10 ft. square. The foundation was then gauged to 7 inches below grade, and 5½ inches of concrete deposited in every alternative space and the same well tamped. The concrete consisted of one part Portland cement and six parts natural gravel; where the sand was found to be in the right proportion the gravel was limited to 2 inches in diameter.

Before the concrete was set the top, or finish coat, 1½ inches thick, was placed thereon and troweled into the concrete. This top coat consisted of one part cement, one part crushed boulders or pea gravel and one part sand, the crushed stone or pea gravel being limited to ½-inch diameter and the sand being coarse and as clean as could be obtained.

The wearing surface was marked off into squares 4 x 8 inches, with grooves about ¾-inch deep, made by using a plank, one edge of which was shod with an iron the shape of the groove. This marker was used by two men and pounded into the wet concrete with wooden mallets to make the groove. The surface was then brushed with a brush and left quite rough. The grooves, 4 inches apart, run across the street at right angles to the curb, and the grooves, 8 inches apart, are parallel with the curbs. It was allowed three weeks for setting before being opened for travel, during which time it was covered with sand and kept wet. Expansion joints were run across the street every 100 ft. and also along the curbs. These were filled with asphalt compound. The concrete and top coat was all mixed with two Smith mixers and wheeled into place in wheelbarrows.

When the first half of the pavement was opened for travel it had a more severe test than it will ever have again, as the travel was confined to one track and the gravel for use on the other half of the pavement was hauled over it. Still it showed hardly any wear, notwithstanding the fact that it was only three weeks old. The length of the street paved was 3,495 feet, amounting to 25,781 square yards.

The total cost of the pavement, including all items, was $2.28, the original estimate having been $2.40 per square yard. The brand of cement used was Western States, costing about $2.40 per barrel. The cost of sand and gravel was $2 and $1.25 respectively, and for labor $2.50 per day of eight hours.

I wish to say that we are more than pleased with the pavement. It is not slippery and no more noisy than brick; it is easily cleaned by washing with a hose from the fire hydrants, and, with the concrete curbs and sidewalks, makes a fine looking street. One thing that helped the committee to decide in favor of concrete pavement was the fact that we had several concrete crosswalks constructed four or five years ago in practically the same manner as the pavement, and, as these showed little or no wear, the committee was of the opinion that the smooth pavement would not be submitted to the hard usage which a cross-walk, with soft mud on each side, might receive.

We know there is nothing about this pavement to decay, and it will be as durable as the material put into it. I believe for the wearing surface great care should be taken to select hard, durable rock, and I believe the crushed rock is better than pea gravel. The sand should be carefully selected, hard and coarse, and enough cement used to thoroughly fill the voids.

I am inclined to think that if the grooving ran at angle of 45 degrees with the curb it might prevent the possibility of wearing into ruts which might be started by the grooves running parallel with the curb.

*Paper read at the Annual Convention of the Northwestern Cement Products Association.

RAILWAY ORDERS.

(Continued from Page 563.)

6708—March 31—Granting leave to the Stoney Beach Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. between Sec. 36, Tp. 6, R. 24, W. 2nd, and Sec. 31, Tp. 16, R. 24, west 2nd Mer., Sask.

6709 to 6718, inclusive—March 31—Granting leave to the Commissioners of Railways and Telephones for the Province of Saskatchewan to erect, place and maintain wires across the C.P.R. at various points in the Province.

6718—April 2—Granting leave to the C.N.O. Railway to erect, place, and maintain its telegraph wires across the wires of the G.N.W., the B.T. Company, Hawkesbury Electric Light & Power Company, at McGill Street, Hawkesbury, Ont.

6719—April 2—Granting leave to the C.N.O. Railway to erect, place, and maintain its wires across the wires of the Bell Telephone Company and Kossuth Marston's power transmission wires at John Street, L'Orignal, Ont

6720—April 2—Granting leave to the C.N.O. Railway to erect, place, and maintain its wires across the wires of the G. N. W. Telegraph Company, the Bell Telephone Company and Edwards Company's electric light wires at Mill St., Rockland, Ont., mileage 35.5, west of Hawkesbury.

6721—March 31—Authorizing the C.P.R. to cross with the second track of its main line from Toronto to Montreal, the tracks of the C. Atlantic Railway at St. Polycarpe Junction, Province of Quebec.

6722—April 1—Authorizing the C.P.R. to construct highway over its railway at mileage 132.9 from Romford, in the Township of Medora, district of Muskoka, Ont.

6723—April 1—Amending Order of the Railway Committee of the Privy Council, dated the 16th December, 1902, respecting interlocking, derailing, and signal system of the line of railway of the C.P.R. with the G.T.R. at or near the G.T.R. station, Tillsonburg, Ont., provided that the distant signal are located as indicated on the plan.

6724—March 31—Granting leave to the Commissioners of Railways and Telephones, of the Province of Saskatchewan, to erect, place, and maintain its wires across the track of the C.P.R. between Sec. 33, Tp. 11, R. 12, west 2nd mer., Sask.

THE
Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

PURIFICATION EFFECTS ON WATERS BY STORAGE.

(Metropolitan Water Board, London, England.)

Dr. A. C. Houston, of the Metropolitan Water Board Research Laboratories, has recently made enquiries into the amount of purification effected by storage of river waters before filtration.

He has recently presented to the Board a third report on this subject. The main part of the reports deals extensively with bacteriological and chemical features. The part appertaining to the construction and working of reservoirs, in connection with purification, is of value to engineers and others.

The question of the London (England) water supply is of particular interest to the people of the American continent, as the conditions compare more generally with our own. London obtains water for a population about equal to that of Canada from the River Thames and tributaries. This is surface water, taken from an area more thickly populated than any of our water sheds. It is consequently contaminated with both sewage and general surface pollution. The best known methods of purification are adopted, such as sedimentation and filtration, with the result that the death rate from typhoid stands at about 17 per 100,000 population, as compared with 25 at Paris and 18 at Hamburg, these cities representing treated river waters. At Montreal, where the water is untreated, the death rate is 38 per 100,000 from typhoid. There are, however, large cities, relying on river waters for supply, which are successful in producing much lower typhoid death rates than London. consequently, this city is by no means content.

It is being recognized that only a certain degree of bacterial removal efficiency can be obtained by sand filtration, the consequent number of bacteria remaining in a filtered water depending entirely upon the number in the raw water; that is, the maximum percentage of removal is fairly constant when filtration is carried out under the most favorable conditions.

Research work has, therefore, of late been almost entirely directed to methods for the maximum removal of bacteria, even before filtration. It is not a question of storage or sedimentation taking the place of filtration; it is a question of what maximum efficiency can be obtained by a combination of these methods.

In presenting to our readers part of Dr. Houston's report, we have in view its bearing on the much vexed question of, What is to be done with the water supply for Montreal? also, the question of increased storage in connection with the Coquitlam dam, Van. In the latter case many opinions have been given, both by engineers and others upon the effect that the raising of the water level may ultimately have upon the acknowledged present purity of the water. As far as we can learn, the evidence bearing upon this subject has been entirely of an opinionative character, based upon no known data or scientific basis.

In Great Britain it is customary to provide very large reservoirs, collecting surface water from uninhabited water sheds, by constructing large dams across valleys, with the proven result that the stored water gains considerably in purity by oxidation and sedimentation. It is not the custom to remove the surface earth or vegetation from such valleys, apart from the earth and vegetation which surround the reservoirs along their shallow margins. The shallow margins are generally bared to the clay or other non-vegetable producing material, and then pitched with sloping paving.

Quoted from Dr. Houston's Report, "Construction and Method of Working Storage Reservoirs."

This is largely an engineering problem, and it is not proposed to trespass on debatable ground. It is necessary, however, in this connection, to point out one or two matters which are of importance from the point of view of quality of water.

It is important that the inlets and outlets of the reservoirs should be so arranged as to permit of as complete a circulation of water as possible. If this matter is not attended to, part of the water reaching the filter-beds may have travelled by surface currents from inlet to outlet without practically any storage, while another part may have been stored for a length of time quite unnecessary for the purposes of safety. Over-stored water, too, may dilute and mask the bad quality of under-stored water, and this without destroying its potentially dangerous qualities. A storage reservoir in which the circulation of water is imperfect is economically a failure so far as the purification of water is concerned; and **conditions of stagnation may operate in encouraging growths of algæ.** It is probable that the "**continuous flow**" method is better than the "**quiescent**" method of working storage reservoirs, and that it is better to have a series **of small reservoirs rather than one large reservoir.**

There might be advantage in causing the raw river water to pass first through a small settling reservoir before entering the storage reservoirs proper. This would keep a good deal of the grosser and heavier suspended solids out of the main reservoirs, and such a small reservoir could be cleaned out comparatively easily when occasion arose.

At the very end of this report the difficult question is considered of whether the storage of raw river water should be fixed on a maximum or on a minimum basis. If the board elect to store raw river water on a minimum basis of thirty days' storage, it would be necessary to build reservoirs capable of holding far more than thirty days' supply of water, the reason being that sometimes, owing to conditions of floods or drought, the storage reservoirs are receiving little or no river water to make up for the water which is being daily abstracted from them for waterworks purposes.

On the other hand, if the board decide to store water on a maximum basis of thirty days' storage, this means that occasionally the storage will fall short; it may be far short of thirty days.

The former method means the construction of enormous reservoirs at an unremunerative cost, inasmuch as the storage would have to be unnecessarily prolonged under ordinary conditions, in order to provide thirty days' storage under exceptional circumstances.

The latter method would result in deterioration in the quality of the stored water during periods of stress and storm.

It is possible that the disadvantages of the latter method might be overcome in the following way:—

Mechancial filters, or "roughing" filters or precipitation tanks, might be interposed as a middle process between storage and sand filtration, and used only when the stored water results were unsatisfactory. As a matter of fact this process has been used (Puech's "roughing" filters) for many years in connection with the East London (Sunbury) works. Or, either as an alternative or in combination with the above, the same processes might be employed antecedent to storage, whenever the raw river water results were specially unsatisfactory.

I do not bring forward these suggestions in an engineering sense. Nevertheless, if the number of days of storage of raw river water is to be based on a maximum figure, they appear to me to be the only means of securing uniformly good results under all conditions of weather and state of river. During periods of drought it is obviously impossible to avoid temporary loss of volume of stored water. But when the volume of water in the river again allows of water being used for replenishing the storage reservoirs its quality could be enormously improved by suitable means. Conversely, during periods of flood the intakes need never, or hardly ever, be closed if temporary expedients could be devised to render the water reasonably satisfactory for storage purposes.

If these tentative suggestions are practicable, the water in storage reservoirs could always be maintained at top-water level, except during periods of drought; and in times of flood succeeding drought the water capacity content of the reservoirs could be restored without seriously fouling the water still remaining in the reservoirs.

Qualifying Considerations.

Certain qualifying considerations in connection with the subject-matter of this report are deserving of mention.

In the first place it is well to point out the danger of reasoning from the particular to the general. The facts presented by me in relation to the metropolitan water supply do not necessarily apply to dissimilar conditions in this country, or to similar conditions in other climates.

Secondly, knowledge of the subject dealt with in this report is limited. To await the culmination of knowledge is useless; on the other hand, precipitate action, on incomplete information, is to be deprecated. Progress lies in accepting, as basis for immediate action, a broad and common-sense interpretation of facts along with inferences that are not unduly speculative in character.

Thirdly, many of the pleas in favor of storage get their support from the results of artificial laboratory experiments. Although this has been unavoidable, the circumstance must not be forgotten, in view of the interests involved.

Fourthly, there is the element of uncertainty inseparable from relinquishment of old-established customs in favor of new departure in waterworks procedure involving what some persons may regard as hazardous experiments.

Fifthly, epidemiologists are displaying a not new, but aggravated, tendency to question the integrity of the reputed casual agents of certain water-borne diseases. Some, indeed, go so far as to consider that the typhoid bacillus and cholera vibrio may, in a casual sense, come to share the inglorious fate, in this respect, of the hog cholera bacillus.

While fully alive to the importance of these and other qualifying circumstances, my personal view in favor of the storage of raw river water remains unaltered.

Alternative Measures.

It is desirable to consider very briefly measures for the improvement of London's water supply that may be regarded as alternative to storage.

It must be premised, however:—

First, that for crude purposes of quantity of water, London must possess a huge reserve of storage capacity.

Secondly, that the water must be filtered, even if it were proposed on biological grounds to resort to sterilization processes of treatment.

Thirdly, that the London water supply has been taken over by the Water Board as a going concern, with all the machinery and waterworks plant pertaining to the old régime.

On biological grounds the only possible alternative to storage would, it seems to me, be sterilization.

As regards sterilization, perhaps no one in this country has been so favored as I myself have been with opportunities of studying the subject practically. Thus, I have had prolonged experience of the sterilization of sewage effluents, in the first place with the Royal Commission on Sewage Disposal, and, secondly, with the Water Board. I have also, in conjunction with Dr. McGowan, faced the responsibility at Lincoln of sterilizing the water supply of over 50,000 people during a prolonged period. No one could be more sympathetic to projects of sterilization or more favorable to its adoption, in particular and suitable cases, than I am, but in the case of London it is necessary to deal with existing facts and conditions which militate against its adoption.

Having regard to the necessity of storage (for purposes of **quantity,** apart altogether from questions of **quality),** to filtration in utilization of existing plant, and to the epidemiological history of the metropolis, the wholesale sterilization of London water appears to me, on available evidence, economically out of question, and, therefore, impracticable .

Disadvantages of Storage.

It is desirable that this aspect of the question should receive in this report, as in previous reports, full consideration.

(1) The serious expense of constructing huge reservoirs is worthy of the closest consideration.

But the cost of storage for "purposes of quality" is not to be estimated on the total expenditure involved, but only on that part of it which may be found to be in excess of that storage which is necessary for "purposes of quantity."

(2) Excepting part of the New River and East London supplies, nearly all the **raw** water has to be pumped into the storage reservoirs. That is, the great bulk of the river water does not flow by gravitation into the storage reservoirs, but has to be raised into them.

In so far as gravitation is not available for impounding purposes, acceptance of the principle of "active storage," * as opposed to "passive storage," necessarily involves increased expenditure in coal and in general pumping charges.

(3) Although it would be wrong to infer that **storage** often, or habitually or necessarily creates conditions inimical to filtration, there is inevitable danger that prolonged storage, especially if the water remains stagnant, may lead, seasonally or occasionally, to the abnormal and abundant development of vegetable growths; materials harmless in themselves, but resulting in the deterioration of the water as judged by chemical and physical standards, and causative of practical difficulties with its filtration.

In this connection it is impossible to forecast the future, or to offer any assurance that trouble will not arise in the future from this cause. On the other hand, there is the gratifying fact that usually the use of stored water prolongs the life of filters to a remarkable extent.

(4) Another plea commonly advanced against the **habitual** use of stored water is that when the river water

* Briefly, "active storage" means the habitual circulation of raw river water through the storage reservoirs and the use, uniformly, of stored water for filtration purposes; "passive storage" means utilizing the water in the storage reservoirs only during periods either of drought or flood, and the prevalent use of unstored water for filtration purposes.

is bright and clear there is no disadvantage, possibly even an advanage, in preferring it for filtration purposes.

It is true that during a considerable part of the year, when the meteorological conditions are favorable, the river water improves very considerably in quality as judged by most of, if not all, the ordinary analytical tests. It may also be the case that river water may sometimes be more amenable to filtration than stored water. It is true, too, that sand filtration is normally so effective a method of purifying water that the effluent from filters dealing with **raw** river water may sometimes be apparently as good as (possibly in some respects even better than) the effluent from filters dealing with stored water.

This ability † of sand filters to bring unfiltered waters of quite different character on to the same plane of apparent purity as the result of the filtration process is apt to create the impression that the quality of the water to be filtered is a matter of indifference. This view is undoubtedly unsound, though it is not easy to controvert it in a convincing manner. For example, one filter might be dealing with **raw** river water containing 100 B. coli per c.c. and another filter with the same water which, as the result of storage, contained only one B. coli per 100 c.c. of water. The filtration process would easily bring the **raw** river water to apparently the same condition as the stored water before filtration, whereas the stored water being already so pure could hardly be rendered much purer by the filtration process.

Yet from the biological point of view there can be no question which would be the safer water to drink. I would not seek in the least to minimize the value of filtration in tending to make unequal things equal, or apparently equal, but this should not lead to too easy faith in filtration irrespective of the quality of water to be filtered. It needs to be remembered that the chief source of pollution of river water is sewage, that the dangerous element in sewage is excremental matter, and that the amount of excremental matter discharged into the sewers from a given population does not vary with the seasons, although heavy rainfall influences greatly the amount of surface and subsoil water, which also reaches the sewers. It is not, indeed, contended that dry weather may not materially diminish the impurities actually reaching a river. Nevertheless, it is most desirable to keep in view this never-varying contribution to sewage of human excremental matter, much of which finally reaches the river in an imperfectly purified condition. **Considerations such as the above, coupled with the results of the routine examination of the river water, inevitably suggest doubt whether the raw waters, even during the best months of the year, are sufficiently free from impurities to be filtered without antecedent storage.** If it be admitted that the raw water is never wholly free from undesirable bacteria, which become largely, if not entirely, eliminated in the process of storage, and further, that sand filters do no more than afford a relatively, not an absolutely, effective barrier to the passage through them of these microbes, it is obvious that the filtration of adequately **stored** water cannot be attended with the same risks as the filtration of **raw** river water. That it may be difficult, or even impossible, directly to prove the full benefit of storage in this connection does not destroy the validity of the pleas in favor of using stored water for filtration purposes.

(5) An objection which may be legitimately cited against the continuous circulation of river water through storage reservoirs is that it inevitably leads to a gradual accumulation of mud at the bottom of the reservoirs.

This is a matter which deserves consideration in the future, because the fermentation of this accumulated mud is apt to cause some deterioration in the quality of the supernatant water. Of course the smaller reservoirs can be cleaned out periodically, but this involves considerable expense. It may be practicable, as suggested elsewhere in this report, that raw river water instead of being passed directly into the large storage reservoirs, might first be allowed to undergo some settlement in a reservoir small enough to allow of its being cleaned out occasionally without serious difficulty or expense. Alternatively, the great bulk of the suspended matter in the raw river water could be largely removed, antecedent to storage, by "roughing" filters or by precipitation tanks, but the cost of this as a **routine** measure would be serious. As a means of partially purifying specially impure river water which otherwise might be considered too impure to be impounded, such a project is, however, worthy of consideration.

(6) A possible disadvantage of using stored water is that the "blanket" or "skin" which forms on the surface of the sand in the filter-beds may not prove so effective a bacterial filter as that resulting from the use of raw river water.

There may be an element of truth in such a contention; but it is certain that sometimes the "stored water skin" errs on the side of being too impervious, and it is obvious that it is much less important to have a microbe-tight blanket when using comparatively safe stored water than when using potentially dangerous raw river water.

Subject to absence of abnormal development of algæ, there can be little question which kind of water engineers would prefer to use year in year out, and there can be no question from the bacteriological point of view that preference should be given to the stored water.

Further, it needs to be noted that the blanket formed on sand filters is not solely a passive accumulation of dead particulate matter derived from the water "feeding" the filters. It is an "active" skin, in that it is a mixture of living and dead suspended matter, built up not only from the "feeding" water per se, but from developmental changes occurring in this water as it lies on the top of the sand, and also doubtless in the skin itself.

My experience since 1905 of the quality of filtered water supplied to East London from the East London (Clapton) works, which deals, **after prolonged storage,** with the initially unsatisfactory Lea River water, does not lead me to think that this question of "stored water skin" versus "raw water skin" need necessarily be of vital importance.

To sum up, it is desirable to point out that most, if not all, of the real or assumed disadvantages of storage disappear if the use of stored water is regarded, not as an unalterable law of the Medes and Persians, but an elastic policy which can be departed from on occasions when the local conditions render this feasible and at the same time desirable.

† For lack of a better term this may be spoken of as "the reserve of purifying ability possessed by sand filters."

SEWER FLUSHING.

The one thing needful, but generally neglected in a sewage system, is adequate means of flushing.

Seldom, or ever, can self-cleansing conditions be obtained throughout a sewage pipe system. This applies, not only, to the "combined;" but, also to the "separate" system. There is some truth in the saying, "We never had smells until we had sewers."

With the "combined" system, taking both surface rainfall and domestic sewage, self-cleansing conditions absolutely cease immediately on the cessation of rain.

With the "Separate" system, taking only roof water, a proportion of area water and domestic sewage, self-cleansing conditions are partially interfered with on the cessation of rain.

A self-cleansing condition in a sewer exists, when the velocity of flow and depth of sewage in the pipe are such, that the solids are carried away by the liquid, and are not precipitated in the channel. The object of sewerage is the

most rapid and complete removal of sewage possible from populated districts. Where self-cleansing conditions cannot be maintained by the ordinary flow, an extra flow must be added, either to maintain the necessary velocity and hydraulic depth; or by intermittent and frequent discharge of an extra quantity of water, removing and washing away stranded solids. The latter, intermittent discharge, is generally adopted as the most practical and efficient method.

The conditions which arise through want of proper flushing are well known. With the "combined" system, they are made evident to the senses, in times of drought, by foul emanations from street gratings, defective cellar connections and plumbing fittings in dwellings. The "combined" system of drainage, unflushed, represents in towns, miles of underground piping charged with putrefying filth, generating sewage gases; the foul air outlets being generally in close proximity to dwellings.

With main sewers, or trunk sewers, where the flow may be fairly constant, the velocity should never be less than 2 feet per second. In "connecting-up" sewers serving smaller districts, 2½ feet per second, while tributary sewers should ensure 3 feet at least. These velocities depend entirely upon the amount of available fall, or road gradient. Everyone who has had to do with main drainage is perfectly well aware that it is at times impossible to ensure the necessary grades to provide self-cleansing velocities.

The recognized formula in connection with sewer velocities is that of Weisbach—and, although involving a biquadratic equation, is one of the most accurate we have. It includes a distinct coefficient for friction for every change of velocity.

The velocity is assumed to be equal to the head of pressure, so that the length of sewer to which each figure applies is equal to the velocity multiplied by the inclination.

The formula is as follows:—

$$V = \sqrt{\frac{2gh}{1 + e + \frac{cl}{d}}}$$

Where h = head of water in feet,
l = length of pipe in feet,
d = diameter of pipe in feet,
v = velocity in feet per second,
c = coefficient for friction in pipe,
e = coefficient of resistance for entrance of water into pipe,

$g = 32.2$, $c = .01439 + \frac{.016921}{\sqrt{v}}$ e is at an average = .505, but may be reduced to .08 by rounding off the inlet.

For h = v, and 1 : i = rate of inclination, then

$$v = \frac{2g}{1 + e + \frac{ci}{d}v}$$

$$\text{Velocity in feet per minute} = \frac{\text{Discharge in cu. ft. per min.}}{\text{area.}}$$

The velocity in feet per second falls below 2 feet, (the requirement for main sewers), running full or half full, when less grades are given than the following:—

Diameter of sewer.	Inclination.	Discharge per cu. ft. per minute running half full.
9 inch.	1 in 450	26.0
10 "	1 in 500	32.1
12 "	1 in 600	46.3
14 "	1 in 700	63.0
15 "	1 in 750	72.4
16 "	1 in 800	82.3
18 "	1 in 900	104.2

The velocity in feet per second falls below 3 feet, (the requirement for branch sewers), running full or half full, when less grades are given than the following:—

Diameter of sewer.	Inclination.	Discharge per cu. ft. per minute running half full.
4 inch.	1 in 90	7.9
6 "	1 in 130	18.2
9 "	1 in 200	40.4

No sizes larger than above would be used for branch drains.

As previously pointed out, it is in practice found impossible at all times to maintain efficient velocities. The engineer i. constantly faced with flat grades, compelling a larger diameter of sewer to carry the discharge at a lowered velocity. Velocities which allow solids to precipitate, result in a septic sewage liquor at the outfall, while the sewers are turned into septic tanks, producing a considerable nuisance and menace to health. It is not, that this trouble is confined only to lower lengths of sewer, perhaps located at considerable distances from the residential portion of the town. Sewer gases being generally warmer, and consequently lighter than the outer air, have a tendency to follow the upward grade of the sewer, and, emanate in considerable volume at the higher districts, just where the residential part of a town is generally located.

There have been many devices applied for purposes of sewer flushing. The most simple and usual is that of utilizing the sewage itself. This is done by providing a flap valve at the outlet end of a manhole. (See Fig. 1).

Fig. 1.

A chain from the ring base of flap is secured to a hook built in the wall of the manhole. On allowing the valve to close or fall over the outlet sewer, the manhole fills with sewage, providing a head which can be liberated, the full flush being exerted on the sewer. By the provision of valves at each manhole each section of the sewer can be so flushed.

The system, however, can only be applied, when (a) the sewers are water-tight, without leaky joints; (b) when the manholes are well built in cement and are water-tight; (c) when there are no branch connections from cellars, etc., providing low level inlets, through which the sewage may be forced back by the head in the manhole and length of sewer entering it.

Such a system is more applicable to lengths of outfall sewer into which there are no house connections.

Since the invention of the automatic discharge syphon, sewer flushing has become a practical and easy matter. It is merely a question of obtaining water, either direct from the mains or any other available source; or is often done in the case of the separate system of sewage, by regulated quantities from storage on the surface water system. Once the syphon with its tank is provided and the water laid on, and is regulated to the amount required, no further attention is necessary.

The automatic syphon is originally the invention of Mr. S. H. Adams, of York, England, and we are indebted to the Adams Company for the reproduction of the following cuts.

(Continued on Page 548.)

CONSTRUCTION NEWS SECTION

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

TENDERS.

Nova Scotia.

NORTH SYDNEY.—Tenders will be received up till Saturday, May 1st, for excavations, brickwork, stonework, concrete work and all the necessary iron beams, iron pillars and anchors; also the necessary flashing according to plans and specifications to be seen at the store of The Kirk & Whitman Tailoring & Clothing Company, Limited, North Sydney.

Quebec.

LACHUTE.—Tenders for fittings, Lachute, Que., Post Office, will be received until Friday, May 7th, 1909. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

MONTREAL.—Tenders will be received up to 12 o'clock, noon, on Wednesday, the 28th April, 1909, for the furnishing and erection of an asphalt paving plant for the City of Montreal, in the Road Department, Grand Trunk street yard, and on foundations built. Forms of tender and terms of conditions, together with all information, may be obtained at the office of the City Surveyor, in the City Hall. L. O. David, City Clerk.

NEW CARLISLE.—Tenders are invited by the New Canadian Company, Limited, for the steel superstructures of bridges and trestles, 14 in number, of a total length of 4,900 feet, which are to be erected on the Atlantic, Quebec & Western Railway, in the district of Gaspe, in the Province of Quebec. Further particulars are given in our advertising pages.

QUEBEC.—Tenders will be received until the 10th May, 1909, for the construction of an Annex to the Jacques Cartier Normal School, on Parc Lafontaine, Montreal, P.Q Until such date, plans and specifications of the work required may be seen at the Government Offices, No. 9, St. James Street, Montreal, Mr. R. A. Brassard, architect, every day, from 10 a.m. to 4 p.m. Alphonse Gagnon, Secretary, Department of Public Works and Labor.

Ontario.

BRANTFORD.—Tenders will be received up to Tuesday, the fourth day of May, next, for the supply of material and the construction of two concrete abutments for an iron bridge. The site of the bridge is about two miles north of G.T.R. station at Onondago Village. The abutments will measure 90 cubic yards. Tenders to be at a rate per cubic yard describing the quality and the proportion of the several ingredients to be used in the composition of the concrete. S. J. M'Kelvey, Clerk, Township of Onondaga, Tuscarora P.O.

BRANTFORD.—Tenders will be received up till noon on Saturday, April 24th, for the construction of the following works for the Township of Brantford: (1) A reinforced concrete arch bridge, span 65 feet over Whiteman's Creek, at what is known as Burrows' bridge; (2) a concrete pier on pile foundation and 2 concrete abutments for a bridge over Fairchild's Creek, near the residence of Daniel Whiting, Esq.; (3) a concrete arch, span 21 feet over Houlding's Creek, at what is known as the Atkinson Bridge. This work also includes the excavation of a new channel for the creek and the filling in of the old bridge; (4) a concrete arch, span 8 feet, opposite the property of Charles Ireland, Esq., near the schoolhouse in section 21. Plans and specifications may be seen at the office of W. H. Fairchild, C.E., Township Engineer, 54 Market Street, or at the office of James A. Smith, Esq., Township Clerk, Court House, Brantford.

LONDON.—Tenders will be received until Saturday, April 24th, 1909, for about 8,000 yards of earth filling at the east end of the Guest Bridge, on the line between concessions 4 and 5, London Township. Charles Talbot, County Engineer.

TORONTO.—Tenders for underground conduit will be received until April 30th, by the Electrical Department, city of Toronto.

TORONTO.—Tenders will be received until May 18th, 1909, for the supply of material and the construction of a water filtration plant. Further particulars appear in our advertising pages. Joseph Oliver (Mayor), Chairman, Board of Control.

TORONTO.—Tenders will be received until Saturday, the 15th of May, 1909, for 6,000 tons of coal. Address: Graham Campbell, Superintendent University of Toronto.

TORONTO.—Until April 27th, tenders will be received for the construction of asphalt, bithulithic and block pavements, concrete curbing and walks and sewers on various Toronto streets. For further particulars address: Joseph Oliver (Mayor), Chairman, Board of Control.

Manitoba.

WINNIPEG.—The Board of Control will receive until May 20th tenders for asphalt paving. M. Peterson, secretary.

WINNIPEG.—Tenders will be received on behalf of the municipality of Riverside by the undersigned, up to April 24th, for the erection of a timber Howe Truss Bridge, of two 100 feet spans on concrete pier, and pile abutments, over the Souris River on Section 8, Township 6, Range 18 west. Plans and specifications may be seen at the office of the Chief Engineer, Department of Public Works. R. Rogers, Minister of Public Works.

Saskatchewan.

ESTEVAN.—Tenders will be received until May 19th, for constructing a waterworks system and a main sewer. Further particulars appear elsewhere in this issue. Willis Chipman, C.E., Chief Engineer, 103 Bay Street, Toronto.

YORKTON.—Tenders will be received up to April 24th for drilling a deep well in connection with the waterworks plant in the town of Yorkton. R. H. Lock, secretary-treasurer.

British Columbia.

NEW WESTMINSTER.—Tenders are called for by the Provincial Engineer's Department for the painting of the New Westminster bridge. Tenders are to be sent to the Minister of Works, and must be in by Monday, May 3rd.

CONTRACTS AWARDED.

Nova Scotia.

HALIFAX.—The Board of Works have opened tenders for city supplies for 1909-10, and recommended awards as follows:—For scrap iron—Wm. McFatridge, $8 per ton; Hillis & Sons, $10; John Simons, $10.50. J. Simon's recommended for acceptance. Repairs to City wharf—Reid and Archibald, outer part, $835; inner part, $595; F. Mosher & Son, $782 and $633. Mosher & Sons recommended. Stone for breaking—E. Hartnett, 3½ cents per bushel to crusher, and 2½ cents to Poors' Association; A. E. V. Cross, 3½ cents crusher; D. McLellan, 2 cents Poor Assn.; S. Walker, 3¾ cents crusher; 2½ cents Poor Assn. Tender of D. McLellan for Poors Association recommended and it was decided to recommend that 25,000 bushels each for crusher be taken from Messrs. Hartnett & Cross. Teams and sprinklers—J. McGrath & Company, $5 per day for 2 horses and driver; H. C. Adams, $5 per day; M. Kileen, $4.50; A. J. Nicholson, $4.49, and $4 if worked every day; Robinson Bros., $4.25; Wm. Parsons, $3.90; Samuel Walker, $3.75. Samuel Walker's recommended for acceptance if he can provide the number of teams required, if not the next lowest tender for

the balance required. Brass stop cocks—W. Stairs, Son & Morrow, $1 for half-inch, $1.05 for three-quarter; McAvity & Son, St. John, 90 cents for half-inch and 94 for three-quarter; Canadian Brass Company, 60 and 85 cents. Latter recommended for acceptance. Granite—Tenders were received from the Kline Granite Company, A. W. Yeadon and Amos Yeadon and the latter's being the lowest was recommended. Drain pipe—Brookfield Bros., 500 feet 9-inch crock at 18 cents per foot, recommended for acceptance. New flat waggon—J. J. Carnell & Son, $135; J. H. Mont, $144; W. N. Brown, $100. Latter recommended. Cement—500,000 lbs.—Tenders from J. C. Calder (Sydney Cement Company), W. Stairs, Son & Morrow, Eastern Portland Cement Company, Melvin & Company, and Brookfield Bros. The tender of Brookfield Bros. being the lowest was recommended; 43¾ cents per 100.

Quebec.

MONTREAL.—Messrs. Henault & Hefferman were awarded the contract for a system of sewers for the municipality of St. Pierre. The work will consist of 16,000 feet of drain sewers, exclusive of manholes and specials and will cost about $100,000. The other tenderers for the work were W. G. A. McDonald and Bray & Bastien.

Ontario.

BRANTFORD.—The Buildings and Grounds Committee dealt with the contract for painting the fire hall, which was awarded to R. C. Chave and the total cost will be $84.

FORT WILLIAM.—Six tenders were received by the Fort William Street Railway Commissioners for building the car barns, as follows: Charles H. Sherwood, $16,200; Stewart & Hewitson, $17,345; M. H. Braden, $20,000; Cater-Halls Aldinger Company, $21,000; Finger & Holsworth, $22,800; Street Bros., $22,850. Chas. H. Sherwood was successful.

GUELPH.—Eight tenders were received for erecting the new steel bridge over the River Speed at Armstrong's Mills. The contract was awarded to the Hamilton Bridge Works Co. for the sum of $2,100, complete with flood as per plans and specifications finished by the engineers.

OTTAWA.—The contract for the supply and installation of heating apparatus in the public building at Kincardine, Ont., has been awarded to Keith & Fitzsimons, Toronto.

OTTAWA.—The contract for the substructure for the National Transcontinental Railway bridge over the Red River at Winnipeg will probably be awarded to Haney, Quinlan & Robertson, of Toronto, who are the contractors for the terminal shops at St. Boniface. The contract for the superstructure will go to the Dominion Bridge Co. The contracts have not yet been awarded by the Government, but it is understood these are the tenders recommended for acceptance by the National Transcontinental Commission. The substructure will cost about $245,000 and the superstructure about $240,000.

PETERBORO'.—The Board of Works will divide the contract for supply of castings, etc., for 1909 between G. Walter Greene & Company, Limited, and The Wm. Hamilton Co., of Peterboro', as the prices were the same. Sewer pipes for 1909 will be purchased from the Ontario Sewer Pipe Company, of Mimico, Ont., at a couple of cents per foot less than was paid last year. This tender was 6 cents per foot f.o.b. Mimico. The Hamilton Sewer Pipe Company tendered 6 9-10 cents per foot f.o.b. Hamilton.

ST. THOMAS.—The Council has given a three-year contract to Colin A. Walker to collect garbage from householders at nineteen cents a month for each house.

ST. THOMAS.—The following tenders were received by the Elgin County Council in connection with the construction of bridges:—Jamestown Bridge—Superstructure—R. McManus, $2,073; Petrolea Bridge Company, $2,370; C. E. Stafford, $1,892; J. W. Chivers, $1,900; J. McCandless, $1,961; J. Vincent, $1,594.75; Scoyne & Remey, $4,098; Walker & Williams, $2,438.85; J. T. Harper, $3,225. Steel work—Canadian Bridge Company, $3,320; Petrolea Bridge Company, $3,250; Hamilton Bridge Company, $3,300; Harris & Company, $3,760; R. McManus, $3,312; Jenks & Dresser, $3,390. The contract of the Petrolea Bridge Company for steel and of Joseph Vincent for superstructure was accepted. Philmore Bridge—Superstructure—R. McManus, $1,883; Petrolea Bridge Company, $2,205; O. D. & A. L. Oatman, $3,300; C. C. Stafford, $2,300; J. W. Chivers, $1,700; L. McCandless, $1,878; Jos. Vincent, $1,892.80; J. T. Harper, $2,996. Steel—Canadian Bridge Company, $3,800; Petrolea Bridge Company, $3,725; Hamilton Bridge Company, $3,670; Harris & Company, $4,225; Jenks & Dresser, $3,820; R. McManus, $3,758. The tenders of J. W. Chivers for superstructure and of the Hamilton Bridge Company for steel were accepted. Port Stanley Piling—Furnishing 250 piles—John McGuigan, $2 each; J. R. Gunning, $398 for all; E. A. Earnshaw, $2.95; C. F. Jackson, $2.06½; M. H. Penhale, $1.75; H. E. Johnston, $3; N. E. Burton, $2.90; J. H. Smale, $1.82; R. Moore, $625.44 for all; H. M. Ellison, $388 for all. Driving 250 piles—John McGuigan, $2.75 each; J. R. Gunning, $598. J. H. Smale received the contract to drive the piles and H. M. Ellison the contract for furnishing piles at $2.03 each.

ST. CATHERINES.—The City Council recommended the acceptance of the tender of Hodgins & Tait for $60 for painting the water carts and sweeper, the only tender received. Of the following tenders for street paving the acceptance of the tender of T. Riley for brick pavement and of Blight & Fielder, of Chatham, for asphalt block was recommended: Warren Bituminous Company Toronto—Bithulithic, $79,129,-82; Sheet asphalt, $74,236.56. R. Secord, Brantford—Westrumite, $64,804.98. T. Riley, St. Catharines—Johnsonburg brick, $76,464.58; Mack brick, $78,874.50. D. W. Mitchell Construction Company, Niagara Falls, Ont.—Conneaut block, $74,468.05; Johnsonburg brick, $78,083.42; Mack brick, $82,672.02; asphalt block, $92,591.16; Westrumite, $70,755.44. Louis Gipp, Buffalo—Bessemer brick, $80,997.40. Elliott & Riley, St. Catharines—Westrumite, $71,430.60. Blight & Fielder, Chatham—Asphalt block, $81,887.22. Newman Bros., St. Catharines—Penn brick, $72,982.04; Johnsonburg brick, $77,500.64; Mack brick, $79,910.56; asphalt block, $85,426.60. Three tenders were received for repairs to the Fire Hall: E. C. Nicholson, $175; T. Irvine, $148; George Wilson, $135; that of George Wilson will be accepted.

TORONTO.—The Board of Control awarded to the Milnes Coal Company the contract for the supply of coal for the waterworks. Their prices, which were considerably lower than those of other tenderers, are as follows: Bituminous coal, run of mine, by vessel, per ton, $3.40; coarse slack, $2.54; run of mine, in cars, $3.25; coarse slack, in cars, $2.50.

TORONTO.—The Temiskaming & Northern Ontario Commission have awarded a contract to O'Boyle Bros., of Sault Ste. Marie for the construction of culverts at mile posts 21½, 15¾ and 62½. The Dominion Wire Manufacturing Co. of Montreal were successful in their tender for 75,000 pounds of hard-drawn copper wire, No. 10 gauge, which is to be used in the building of new telegraph lines. The Thorne Cement Company of Toronto were given the contract to supply three carloads of cement.

Manitoba.

BRANDON.—R. N. Willoughby has secured the contract for the erection of a new building for the Y.M.C.A. at Moose Jaw. The ultimate cost of the structure will be close on $70,000.

WINNIPEG—Bithulithic & Contracting, Ltd., of Winnipeg, has been awarded a contract for 4,500 square yards of bithulithic pavement by the City of Calgary. The same company was recently awarded by the City of Edmonton contracts for this year's paving amounting to some $115,000.

WINNIPEG.—The Williamson Construction Company has sublet the contract for clearing, corduroying and ditching the right-of-way for the Winnipeg municipal power transmission line from the city to Point du Bois to J. D. Houston and M. Berger, of Winnipeg. The work will be proceeded with at once.

Alberta.

MEDICINE HAT.—The following contracts were awarded at a recent meeting of the City Council: New market building, J. L. Peard, $4,125; appointment of city scavenger,

Fred. Scott, $3.75 per closet; contract for pipe fittings, etc., James Rae, $2,264; wooden pipe, Pacific Coast Pipe Company, $5,772 (left on the table until further information is obtained in regard to wooden pipe); supplies for the City Hall, L. B. Sochran $53. The tenders for iron pipe were left in the hands of the committee to award the contract, when additional information is received. The tenders received for putting the roof on the grand stand were not opened. The contract for brass goods went to James Morrison Company, of Toronto, at $852.37, and for the hardware to the W. B. Marshall Hardware Company at $601.68.

British Columbia.

VICTORIA.—At a recent meeting of the City Council tenders were opened for sprinkling apparatus as follows: Brayshaw's Carriage Works for two sprinklers, steel tanks, $650; wooden tanks, $600. John Meston, steel tanks, $625; wooden tanks, $565. Messens Limited, Vancouver and Montreal, $566. The tenders were referred to the engineer and purchasing agent to report on at a later meeting.

Foreign.

DUNKIRK, N.Y.—The New York Central Railroad has placed an order with the Brooks plant of the American Locomotive Company for eighteen engines of the consolidated type. The contract calls for their delivery in June.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

HAMILTON.—Hamilton is to have a mammoth union station for the steam roads entering the city. With that purpose in view the Toronto, Hamilton and Buffalo Railway is acquiring all the property opposite the present station from James to John Streets and will probably also take in the next block to Catharine Street. The roads to use the new station will be the Canadian Pacific, T., H. & B., Michigan Central and Canadian Northern. The Grand Trunk may come in later.

MILLBROOK.—The Grand Trunk surveyors, under Mr. Going and Mr. Crompton, have returned from Toronto, and are again at work on the survey of the proposed new short line from Midland to the lake front.

NEW HAMBURG.—The town have decided to purchase $20,000 worth of preferred stock in the proposed People's Railway Company. The Metropolitan Railway Company may build the line which will run from Stratford to Guelph. The company's capitalization is $1,000,000, and other municipalities along the line will be asked to purchase stock in the enterprise.

OTTAWA.—Mr. William Wainwright, vice-president of the Grand Trunk Pacific Railway, who is here, says he has no knowledge of any difficulty with contractors in the West over the non-payment of moneys due them. He adds that officials of the company in Montreal have not been advised of it, and discredits the report. Mr. Wainwright says that rails are now laid from Winnipeg to Battle River, 675 miles, and the balance is graded to the foot of the Rockies. By June the line will be in operation from Winnipeg to Edmonton, and from Edmonton to Fort William in time for the fall grain-carrying trade. The whole line he expects to be completed by 1911.

STRATFORD.—It is understood that the plan of the St. Mary's & Western Ontario Railway Company is to work out a line from Stratford via St. Mary's and Exeter to Sarnia, with a branch northerly from somewhere between St. Mary's and Exeter to the Guelph and Goderich line, probably through Seaforth, and with the further extension of the Embro branch (the only line yet actually built) to Woodstock. The above line is to be built by the above company, under C.P.R. auspices and the line then leased to the C.P.R. An accompaniment to the above scheme is the extension on from Stratford northeasterly to the Guelph and Goderich line at or about Linwood. This is to be done under the Tillsonburg, Lake Erie and Pacific charter. When the above plans are completed, the result will be a new main line, practically, of the C.P.R. from Toronto to Sarnia via Guelph, Linwood, Stratford, St. Mary's, and Exeter.

TORONTO.—During the past year the engineers of the Temiskaming and Northern Ontario Railway have been engaged on a number of surveys, including branches to Larder Lake, Elk Lake to Gow Ganda, and an extension of the Charlton branch to Elk City.

BRANTFORD.—Fifty men are at work on the Grand Valley Railway between Brantford and Paris. All sharp curves are being taken out and the track put in good shape.

KINGSTON.—On the 16th April the Grand Trunk Railway, according to the order of the Railway Commission, was to file the plans for the construction of the subway at the Montreal Road crossing. On April 26th work must be begun on the subway, which is to be completed before August 1st.

KINGSTON.—The Grand Trunk Railway is making preparations to relay the double track between Brockville and Kingston with 100-pound rails.

WELLAND.—The Michigan Central have started a gang of 500 men, working both ways from here, replacing their eighty-pound rails with one-hundred-pound rails; also ballasting the roadbed and making other improvements.

Manitoba.

WINNIPEG.—Mr. D. B. Hanna, of the C.N.R., who returned from the East, April 12th, stated that his company had on order over two million dollars' worth of cars, coaches and other equipment to be delivered before harvest time.

WINNIPEG.—The C.P.R. is building a line to Duluth, which will virtually connect this city with Chicago, giving the most direct route at present available. This will run west from Duluth to Thief River Falls and join the main line of the Soo there. The work of construction started April 12.

WINNIPEG.—The C.P.R. has let the contract for the Jackfish cut-off, on the Superior Division, to W. T. Parsons. It will be about three miles long, and will be built seven miles east of Jackfish. The character of the country east of Jackfish was such as to make filling impossible because of muskegs and other difficulties encountered. It was, therefore, decided to abandon this portion of the line. The new section will run north of the present line. It involves the removing of 80,000 cubic yards of rock and cutting of a tunnel 300 feet in length.

Alberta.

EDMONTON.—One of the first lines to be built as a result of the Government guarantee of bonds will be the C.N.R. line to Athabasca Landing. A party of thirty men, in charge of S. A. Dixon, of Winnipeg, left on April 5th for Morinville to commence the survey of the extension from Morinville to Athabasca Landing. This line has been guaranteed by the local government to the extent of $13,000 per mile, and it is most probable that it will be completed this year. The surveyors will begin work north of Morinville and will work northerly toward the Landing. It is expected that the survey will be completed in the course of a month and that work will be started upon the projected line as soon as the frost is out of the ground.

EDMONTON.—The Canadian Northern is preparing to undertake the active construction of a line into Camrose and Calgary this season. Lines will run from Vegreville south, and another branch will be built from Camrose into Strathcona. The company will also penetrate the northern wilds, and expects to have trains running into Athabasca Landing within a year. Surveyors are now actively at work in the field.

LIGHT, HEAT, AND POWER.

Manitoba.

BRANDON.—The Municipal Light, Heat & Power Company, Ltd., of Brandon, has been incorporated with a capital stock of $50,000. The incorporators are: G. E. Knechtel, agent; Violet Knechtel, married woman, of Winnipeg; Malcalm B. Jackson, barrister; William A. Thompson, hotelkeeper; William Clark Fraser, Hamiota.

British Columbia.

VICTORIA.—There is a likelihood that the city will not make additions to the electric light plant this year as was intended. It was estimated that to provide for additional lights in the city an expenditure of $20,000 would have to be made. The aldermen are considering the question of taking from the British Columbia Electric Company sufficient to supply the needs for the present. The electric light committee engaged in the work inclines to the belief that it will be much cheaper to purchase additional power from the Electric Company than expend the sum necessary to install additional plant. It was estimated that if the Electric Company could provide for street lights at $38 each the city would effect a saving of $10,000 a year.

SEWERAGE AND WATERWORKS.

Quebec.

MONTREAL.—The by-law providing for the installation of a high-pressure water supply in the west ward for fire protection purposes has been ratified at Quebec, and the city will proceed without delay to put into operation the powers accorded it under that by-law. The plans for the system are complete. They call for a pumping station on the Place Royale, with a 20-inch suction pipe running a sufficient distance into the basin to provide and assure the necessary pressure. From Craig to St. Peter, and from Craig to St. Francois Xavier, and from these streets to McGill Street, 16-inch force pipes will be used. On McGill, Craig, St. James, Notre Dame, St. Paul and Common Streets, 10-inch pipes will be used. The work will begin with the least necessary delay.

Ontario.

GUELPH.—Some changes will be made in connection with the plans for the aerial beds which are to be constructed this summer to complete the disposal plant.

WINGHAM.—Wingham Council is dealing with the question of pure water and a test well will be sunk before the question will be submitted to the ratepayers, as to whether they approve or disapprove of spending several thousand dollars in securing a supply of pure water for domestic purposes.

British Columbia.

VICTORIA.—E. A. Wilmot, the dyking engineer of the Provincial Government, has been despatched to Prince Rupert to report upon the water supply of that place.

VICTORIA.—A new by-law has been adopted by the Council fixing water rates. For dwellings the rate grades from 85 cents per month for four rooms to $2.25 per month for fourteen rooms. The meter rates are as follows:—Within the city limits—For the first 2,000 gallons, or part of 2,000 gallons, $1. Residences—For all water over 2,000 gallons—for every 1,000 gallons, 12½ cents. All other—For all water over 2,000 gallons, but not exceeding 75,000 gallons per month, 22½ cents per one thousand gallons. For all water over 2,000 gallons, where the consumption per month is from 75,000 to 100,000 gallons, 20 cents per one thousand gallons. For all water over 2,000 gallons, where the consumption per month is over 100,000 gallons, 17½ cents per one thousand gallons. All meters to be read monthly. Meter rents—⅝-inch per month, 25 cents; ¾-inch per month, 25 cents; 1-inch per month, 50 cents; 1½-inch per month, 75 cents; 2-inch per month, $1; 3-inch per month, $1.50; 4-inch per month, $2. There shall be no meter rent on private residences.

VERNON.—The City of Vernon has been given permission to take fifty miners' inches of water from Long Lake for domestic and fire protection purposes. The Conteau Power Company, of Vernon, has filed its plans and data in connection with an application to take water from streams adjoining the city, for the purpose of developing power to be sold in Vernon, Armstrong and other centres. There is likely to be some opposition from users of the water for irrigation purposes.

FINANCING PUBLIC WORKS.

Quebec.

MONTREAL.—The municipality of Notre Dame de Grace is offering for sale $33,000, 4½ per cent., 40-year, waterworks bonds. Leon Descarries, secretary-treasurer.

Ontario.

PICTON.—A by-law to raise $10,000 to build sidewalks and streets in the village of Bloomfield carried by 34 majority.

Saskatchewan.

ESTEVAN.—Until April 26th the Town Finance Committee will receive tenders for $50,000, 5 per cent., waterworks, sewer and town hall debentures.

MOOSE JAW.—A by-law for $20,500 to provide for the construction of concrete and plank or wood walks and pavements will shortly be voted on.

British Columbia.

GREENWOOD.—The ratepayers by a vote of 116 to 2 have endorsed the proposed $50,000 bonus to be paid to the Greenwood-Phoenix Tunnel Company. Under the by-law bonus, which is in the form of debentures to be issued by the city, is to be paid in three instalments, $15,000 and 3,000 feet, $15,000 and 6,000 feet and the balance when the city limits of Phoenix are reached. Active operations must be under way by May 1st and the first 3,000 feet must be constructed by November 1st, 1911. The first section of the tunnel will be 6,000 feet long and 1,300 feet deep.

MISCELLANEOUS

Ontario.

GUELPH.—Two bridges will be built this year, the materials for which have not yet been decided upon. Tenders will shortly be called for. A number of culverts will be put in, while improvements to streets are also contemplated. The estimates for the year total $15,000.

ORILLIA.—Mayor Goffatt received from Mr. A. Carnegie an offer of $12,500 to build a free public library in the town of Orillia. The Council have decided to accept the amount, and will proceed with the building as quickly as the plans are provided.

Manitoba.

WINNIPEG.—Construction gangs are now out on the Regina-Brandon branch of the C.N.R. starting work on the erection of nine elevators for the British-American Co.

British Columbia.

VICTORIA.—The Municipal Council have given notice of their intention to pave a number of streets with wooden blocks or vitrified brick on a concrete foundation and to construct permanent sidewalks.

CURRENT NEWS

Quebec.

MONTREAL.—Upon the recommendation of City Surveyor Barlow, at a recent meeting of the Roads Committee, it was resolved to ask for funds for building a city asphalt plant in the western part of the city. The object in having another asphalt plant, Mr. Barlow explained was to save time in going from one end of the city to the other. It would greatly expedite work to have a place in the western part of the city for the men to get their supply. Ald. Gadbois and Ald. Proulx made applications for street pavings. These will be considered later.

New Brunswick.

FREDERICTON.—At the annual meeting of the St. John River Log Driving Company here on April 7th, the report of last year's business showed that about 70,000,000 feet of logs had been rafted, at a cost to the lumbermen of $1.05 a thousand feet.

British Columbia.

VICTORIA.—The Streets Committee recommended that the city engineer be authorized to obtain the necessary equipment for the rock crusher, and that the purchasing agent be authorized to purchase two new, double team, water sprinklers.

MARKET CONDITIONS.

Winnipeg, April 20th, 1909.

A decided strengthening up in prices in building requisites, is what a prominent dealer said, when asked as to the conditions of the local market. The outlook in Winnipeg is now very bright, and a great deal of building is under way. The dealer referred to above, stated that they had more teams delivering supplies now than at any time during their busiest period last year.

Common brick has taken a decided advance, and where a few months ago they were selling at from $8 to $10, the common article is now strong at from $8 to $12.

Crushed stone has also advanced in price and is bringing from ten to twenty-five cents a yard more, according to grade, than formerly. The whole tendency of the market is stronger, and now that the labor trouble has been settled, the present season in all probability will be the best in the history of the West.

There has been some talk of an advance in the price of lumber, but we are assured by a large local dealer that no advance is likely to take place, and he was prepared to take contracts at the usual price.

Winnipeg quotations are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.25 per 100 up to 15-inch.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Bricks.—$11, $12, $13, per M, three grades.

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Dynamite.—$11 to $13 per case.

Hair.—Plaster's, 80 to 90 cents per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

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

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Tool Steel.—8½ to 15c. per pound.

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

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Montreal, April 21st, 1909.

Markets in the United States, so far as pig-iron is concerned, show very little alteration, this week. It is worthy of remark, however, that the tonnage being booked shows quite a little increase, of late, this having been brought about, no doubt, by the reduction in prices. Also, it is thought, that purchasers have, in some cases, put off purchasing as long as they safely can and are now compelled to come in. The general feeling is that nothing save the uncertainty regarding the tariff now stands between buyers and sellers. A portion of the trade, however, would seem to favor the view that the uncertainty regarding the tariff, while seized upon as the most plausible explanation for the dullness of the market, really does not account for it, and that even when it has been disposed of it will be found that buyers are still holding off awaiting lower prices.

The situation in Great Britain appears to have improved somewhat during the week. The unsettled condition in the United States is certainly reflected upon the English market, to no small degree, but it does not seem to be sufficient of a factor to hold back trade entirely. The somewhat better demand reported a week ago still keeps up and, whatever the real feeling among the trade may be, the views which find expression are generally more hopeful, this being supported, also, by the volume of trade.

In Canada, it is said that domestic furnaces are doing a good trade, the western furnaces—such as Hamilton—being benefited to a considerable extent by the fact that the eastern furnaces,—such as the Dominion Iron and Steel, and Nova Scotia Steel and Coal—are not pressing sales. There is also a fair tonnage in English iron, and prices are held pretty firmly, all round.

A number of changes have taken place in the following list this week:

Antimony.—The market is steady at 9 to 9½.

Bar Iron and Steel.—Prices are easy all round, and trade is dull. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70.

Boiler Tubes.—The market is steady, quotations being as follows:—2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14¾c.; 4-inch, 19c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.50 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, 30c. per roll of 400 square feet; tar fibre, 55c.; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is now so cheap it is impossible for English, Belgian, German, or American to compete with it, so that these do not sell, save in rare instances. Very little, if any, will be imported this year. Quotations are for car lots, f.o.b., Montreal. Canadian cement is readily available at $1.40 to $1.50 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight.

Bar Iron and Steel.—Prices are steady all round, and trade is dull. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $2.00; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $2.10; smooth finish, $2.75.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.60 per 100 pounds; felt paper, $2.40 per 100 pounds; tar sheathing, No. 1, 35c. per roll of 400 square feet; No. 2, 35c.; dry sheathing, No. 1, 45c. per roll of 400 square feet, No. 2, 28c. (See Roofing; also Tar and Pitch).

Cement.—Quotations are for car lots, f.o.b., Montreal. Canadian cement is $1.55 to $1.65 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight. English cement is $1.65 to $1.85 per 350-lb. bbl. in 4 jute sacks (for which add 8c. each) and $2.20 to $2.40 in wood. Begian cement is $1.60 to $1.65 in bags—bags extra—and $2.10 in wood.

Chain.—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

Copper.—The market is about steady at 14½ to 15c. per lb. Demand continues limited.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 18c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3.50; 6-ft. wires, $4; 8-ft. wires, $4.50; 10-ft. wires, $5. Double strength fuses, $1 extra, per 100 fuses. Fuses, time, double-tape, $6 per 1,000 feet.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's eHad, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is steady. The following prices are for carload quantities and over, on cars, Montreal, delivery from dock being 35c. less; Canadian pig, $18.50 per ton, Montreal; No. 1 Summerlee, $18.75 to $19; selected Summerlee, $18.25 to $18.50; soft Summerlee, $17.75 to $18; Clarence, $17 to $17.25 per ton.

Laths.—See Lumber, etc.

Lead.—Trail lead is firmer, at $3.75 to $3.85 per 100 pounds, ex-store.

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

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

Nails.—Demand for nails is poor, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices.

Pipe.—Cast Iron.—The market continues steady at $33 for 8-inch pipe and larger; $34 for 6-inch pipe; $34 for 5-inch, and $34 for 4-inch at the foundry. Pipe, specials, $3.10 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized. The discount on the following is 69 per cent. off for black and 50 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2¼-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $31.50 to $32.50 is given for 60-lb., 70-lb., 80-lb., 85-lb., 90-lb., and 100-lb. rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅛, and $2.15 for ¼ andthicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.75 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 90c. per 100 pounds; and No. 2, 50c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

Tin.—Prices are 32c. to 32½c.

Zinc.—The market is steady at 5¾c.

Toronto, April 22nd, 1909.

The week has been uneventful. In several directions it is admitted that more is doing, but a general complaint is that orders are provokingly

(Continued on Page 43).

ARE YOU INTERESTED
in
Tool Steel
if so
We can supply you "SANDERSON BROS." make. ALL grades and all sizes
A. C. LESLIE & CO., Limited
MONTREAL
11

AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

AN INNOVATION IN ROUNDHOUSE HEATING.

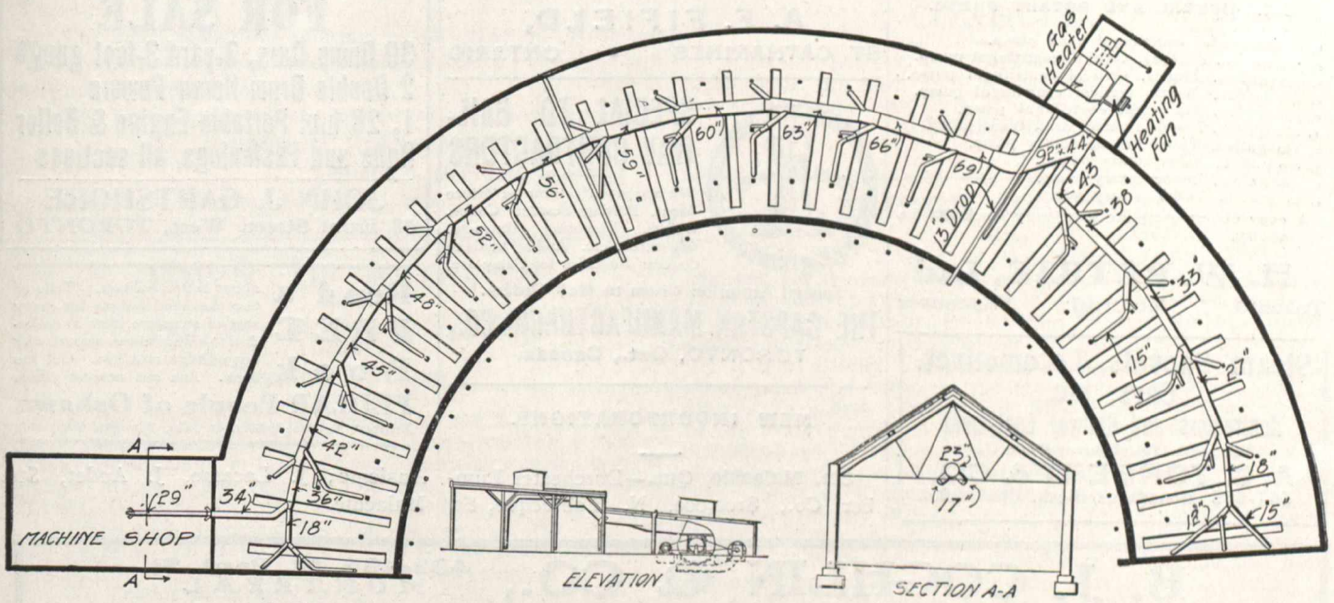
The roundhouse of the Missouri, Kansas and Texas at Parsons, Kan., is located in the Kansas natural gas belt. On account of its abundance in this region gas is a cheaper and more desirable fuel than coal. In designing a heating plant for this roundhouse, two alternative plans were considered.

First.—To use the ordinary fan system heater with steam coils and low-pressure gas-fired boilers; or

Second.—To furnish a gas furnace and direct air heater in connection with the fan system apparatus.

On comparing the cost of installation of the two systems, it was found that the second plan, i.e., using a direct-heat furnace, was coniderably cheaper.

As to the relative cost of operation, this would depend largely upon the type of direct heat furnace used. A report on a series of tests read by Mr. Jay M. Whitman before the American Society of Mechanical Engineers, December, 1905, shows that the efficiency of gas-fired boilers is seldom in excess of 65 to 70 per cent. It appears that this low efficiency is largely owing to the excessive amount of air which is used in the process of combustion. At first thought it would seem that the efficiency of the direct heat furnace would be even lower, since it is necessary to maintain a much lower furnace temperature, and a low furnace temperature usually means a low efficiency. However, this problem was undertaken by the engineering department of the Buffalo Forge Co., and plans were submitted providing for an efficiency of 90 per cent. at full capacity and with a maximum furnace temperature not exceeding 1,200 degrees, with a minimum temperature of waste gases about 400 degrees. The merits of this plan made the advantages of the direct furnace system decisive. Since these latter plans were accepted and the plant is now in successful operation, it is a matter of practical as well as engineering interest to show how these seemingly impossible results were accomplished.



Buffalo System of Ventilation and Heating—M. K. and T. Roundhouse.

General Arrangement.

The arrangement is well shown by the accompanying plans and photographs. The apparatus consists in general of a bank of vertical 4-inch boiler tubes expanded at top and bottom into wrought iron boiler plates. The space beneath the tubes is below the floor line, and is divided into two compartments. The first compartment A comprises the furnace proper, where the gas is burned under special conditions, described later. The other portion underneath the tubes, marked C, is simply an exhaust chamber for the waste gases. Above the tubes is located a single chamber B, which has a removable sectional cover to provide for cleaning and inspection of tubes. The path of the gases is thus upward through the tubes from chamber A to chamber B, hence downward through the tubes to chamber C. At B is an exhaust fan which handles waste gases. The bank of tubes is enclosed at top, bottom and two sides, and the current of air for heating purposes is drawn through by the motor-driven steel plate exhauster at E. From this fan the air, heated to temperature of about 170 degrees, is distributed through galvanized iron ducts in the usual manner. The all-important feature of this apparatus is the novel design of the burner, which enables the paradoxical result of a high efficiency with a low furnace temperature to be obtained.

Burner.

The general process consists in, first, burning the gas in firebrick combustion chamber at high temperature and with very small excess of air; and, second, mixing this small volume of hot gases at high temperature with a larger volume of the recirculated products of combustion at the relatively low temperature of about 400 degrees, giving a resultant temperature not exceeding 1,200 degrees. As will be seen from one of the illustrations, there are four firebrick combustion chambers, fed by sixteen gas-mixers. The firebrick combustion chambers are about nine inches wide exteriorly, and run parallel the entire length of the furnace. Each combustion chamber is supported upon a double-slotted cast-iron burner. The interiors of combustion chambers are provided with firebrick checker work, which becoming incandescent, provides for the complete combustion of the mixture of gas and air before it leaves the chamber. The cool products of combustion drawn into the exhaust fan are partly discharged through the small vertical stack. The greater portion is returned to chamber F under the burners. Thence, the gases pass upwards between the combustion chambers and are caused to mix thoroughly with the hot products of combustion by means of the cast-iron baffle plates, arranged as shown. Since the combustion has been completed within the firebrick combustion chamber, it is unaffected by the subsequent dilution with the cool products of combustion.

(Continued on Page 44).

CONTRACTOR'S SUPPLIES

FOR SALE

GENERATORS.

1, 100 K.W. alternating current, with switchboard and exciter.
2, 100 K.W. direct current, with switchboards.
1, 30 K.W. direct current, 250 volts
1, 1,200 light, Westinghouse incandescent dynamo.
1, 350 light, Brush incandescent dynamo.
1, 150 light, Sprague incandescent dynamo.
1, 100 light, incandescent dynamo, direct connected to 6" x 6" vertical engine.
1, 75 light, Eddy incandescent dynamo.
1, 35 light, Ball arc dynamo with 32 lamps.

MOTORS.

1, 92 H.P. Westinghouse, alternating current, 200 volts, with transformers.
1, 50 H.P. Jones & Moore, alternating current, 220 volts, with transformers.
1, 15 H.P. Jones & Moore, direct current, 250 volts.
1, 12 H.P. Consolidated, direct current, 250 volts.
1, 8 H.P. Consolidated, direct current, 250 volts.
1, 8 H.P. Jones & Moore, direct current, 250 volts.
1, 5 H.P. Gee, direct current, 250 volts.
1, 5 H.P. Three Rivers, direct current, 240 volts.
1, 3 H.P. London, direct current, 250 volts.
1, 2 H.P. Jones & Moore, direct current, 500 volts.
1, 2 H.P. Three Rivers, direct current, 240 volts.
1, 2 H.P. Jones & Moore, direct current, 110 volts.

CENTRIFUGAL AND ROTARY PUMPS.

1, 8" horizontal centrifugal sand pump.
1, 900 gallon, Northey, vertical centrifugal pump.
1, 735 gallon, Morris, vertical centrifugal pump.
1, 470 gallon, Morris vertical centrifugal pump.
1, 400 gallon, horizontal centrifugal pump.
1, 260 gallon, Morris vertical centrifugal pump.
1, 150 gallon, Taber bronze rotary pump.
3, 100 gallon, Taber rotary pumps.
1, 100 gallon, Lobee rotary pump.
1, 30 gallon, Taber rotary pump.

A copy of our complete machinery stock list for the asking.

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Steam Shovels, Locomotives, Cars, etc.
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JARDINE UNIVERSAL CLAMP RATCHET DRILL

Indispensable for Machine Repairs, Factories, Machine Shops, Bridge Builders, Track Layers, Structural Metal Workers, have use for it. Send for description.

A. B. JARDINE CO.,
HESPELER, ONT.

WRITE FOR PRICES
Water Wheel Equipment
CHEAP FOR CASH.

48" "VICTOR," Complete, Cast Iron Bridgetrees.
40" "JENCKES," Vertical, Gears & Shafting.
44" "LITTLE GIANT," Gears and Shafting.
33" "LITTLE GIANT."
Pair 35" "TRUMP," Horizontal Setting, Shafting, Bearings and Pulleys.
100 H.P. "DODGE" Friction Clutch.

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We are manufacturers of Mince Meat, Baking Powder, Coffee, Spices, Flavoring Extracts, Mustards, etc. And all kinds of Grocers' Sundries for Camp use.

Special Attention Given to Mail Orders.
THE CAPSTAN MANUFACTURING CO.,
TORONTO, Ont., Canada.

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Ste. Malachie, Que.—Dorchester Lumber Co., $100,000. N. Labrecque, St. Ansleme; J. Lacasse, J. Audet, Ste. Malachie.

FOR SALE. Great Bargains if you act promptly in D.C.
MOTORS
1—500 volt, 15 Kilowatt 900 R. 1—250 volt, 11 Kilowatt, 1150 R. 2—250 volt, 8 H.P. 1—250 volt, 10 H.P. 600 R. Built Specially for Hoisting Purposes.
All in First Class Order and no Reasonable Cash Offer refused
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30 Dump Cars, 3-yard 3-foot gauge
2 Double Drum Horse Powers
1, 20 h.p. Portable Engine & Boiler
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Proprietors of THE MONTREAL SPRING and AXLE WORKS
ENGINEERS AND RAILWAY SUPPLIES
SPRINGS TRACK TOOLS WIRE ROPE
CROW BARS GUY ANCHORS CHAIN
COTTON WASTE, Etc,

HAMILTON BRIDGE WORKS COMPANY, LTD.
Established 1872 at HAMILTON, CANADA.
BRIDGES—RAILWAY and HIGHWAY
STRUCTURAL STEEL 5000 Tons of Steel in Stock —BEAMS, ANGLES, CHANNELS, PLATES, ETC.
Manufacturers of Locomotive Turn Tables, Roofs, Steel Buildings, and Structural Iron Work of all descriptions

TENDERS CALLED FOR

WATER FILTRATION PLANT

NOTICE TO CONTRACTORS.

TENDERS will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on 18th May, 1909, for the **Supply of Material and the Construction of the Necessary Works in Connection with a Water Filtration Plant** for the City of Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and plans may be seen and forms of tender obtained at the office of the City Engineer, City Hall, Toronto.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

JOSEPH OLIVER (Mayor),
Chairman, Board of Control.

City Hall, Toronto, April 16th, 1909.

TOWN OF ESTEVAN

PROVINCE OF SASKATCHEWAN.

Tenders Wanted

Sealed Tenders will be received by the Secretary-Treasurer until Wednesday, May 19th, for constructing a Waterworks System and a Main Sewer, comprising 7,300 feet of Water Mains, 2,400 feet of Tile Sewer, also Steel Water Tower, Gasoline Engines, and Power Pump.

Plans and Specifications may be seen at the office of the Secretary-Treasurer, Estevan, or of the Chief Engineer, 103 Bay Street, Toronto, on and after April 22nd.

No Tender necessarily accepted.

L. A. DUNCAN, Esq.,
Secretary-Treasurer,
Estevan, Sask.

WILLIS CHIPMAN, C.E.,
Chief Engineer,
103 Bay St., Toronto, Ont.

(Continued from Page 574.)

small. Brick dealers in Toronto are busy, but cement dealers are not, and indeed profess to be rather discouraged over the slackness of demand. There is a fair movement of lumber, with prices very firm. As to building paper, roofing felt, sewer pipe, lime, etc., there is a distinct improvement.

The American tariff is not yet so near settlement that export merchants in that country can inform their Canadian customers definitely as to prices of construction material. Therefore we have nothing new to say as to structural steel or any other metal.

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

Antimony.—The market fairly active; price continues at 9½c.

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

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

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.75; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3¼-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. A moderate demand can be now reported, for shipment about 1st April.

Bricks.—Not for a dozen years has there been such a demand in Toronto for bricks as now. The price has advanced. We now quote $9.50 to $10.50 for common. Pressed also selling freely. Red and buff pressed are worth, delivered, $18; at works, $17.

Cement.—Price in 1,000-barrel lots $1.70 per barrel, including bags, or $1.30 without bags. Similar quantities, $1.55 to $1.60 per barrel, in load lots delivered in town, and bags extra. Movement confined mainly to small parcels.

Coal Tar.—Nothing doing, price maintained at $3.50 per barrel.

TENDERS WANTED

CITY OF SASKATOON

Sealed Tenders addressed to the undersigned will be received until 5 o'clock p.m., Wednesday, April the 28th, 1909, for the following:—

(a) One Brick, Steel or Concrete Smokestack with a height of 100 feet and inside diameter of 66 inches, together with corresponding smoke connection to boilers.

(b) Bricking in two 250 horse-power Robb Mumford water tube boilers.

Plans and specifications may be seen at the office of the Electrical Superintendent.

A marked cheque for $100 must accompany tender.

The lowest or any tender not necessarily accepted.

E. L. WHITE, Electrical Superintendent.
J. H. TRUSDALE, City Clerk.

CONDUIT

TENDERS FOR UNDERGROUND CONDUIT will be received up till April 30th by the City of Toronto, Canada. For specifications and form of tender apply—

ELECTRICAL DEPARTMENT,
City Hall.

BRIDGE TENDERS

Tenders are invited by the New Canadian Company, Limited, for the steel superstructures of bridges and trestles, 14 in number of a total length of 4,900 feet which are to be erected on the Atlantic, Quebec and Western Railway, in the district of Gaspe, in the Province of Quebec.

1. The Bridge Company is to agree to supply, build, erect, paint and complete the metal superstructures, and to frame, place and complete the wooden or rail floor system of the bridges referred to above, all in conformity with the specifications, drawings and strain and material sheets of the superstructures which may be had on application to the New Canadian Company, Limited, at New Carlisle, P.Q., and in conformity with Class 2 of the Standard Bridge Specifications of the Dominion Government, Department of Railways and Canals, Edition 1908, it being understood that both plans and specifications are to form part of the agreement.

2. All tenders are to be sent in duplicate, one copy addressed The New Canadian Company, Limited, New Carlisle, P.Q., and the other to be addressed to the Chairman, The New Canadian Company, Limited, Queen Anne's Chambers, Broadway, Westminster, London, S.W., England.

3. All tenders are to be sealed and to be marked on the outside "Bridge Tenders."

4. The New Canadian Company, Limited, does not bind itself to accept the lowest or any tender.

5. Newspapers inserting this advertisement without authority will not be paid for same.

6. All tenders to be posted so as to reach New Carlisle, P.Q., by 21st of May, 1909.

AEROPLANES AND HYDROPLANES.—I am prepared to manufacture Aeroplanes and Hydroplanes in accordance with Canadian Patent No. 105552, issued to me May 28th, 1907.—W. R. TURNBULL, Rothesay, N.B., Canada.

PATENT NOTICE

Notice is hereby given in regard to Canadian patent No. 98961, Flour Bolter, granted May 15, 1906, to John F. Harrison, that Allis-Chalmers-Bullock, Ltd., Montreal, owners of rights under said patent, is prepared to supply devices covered by this patent.

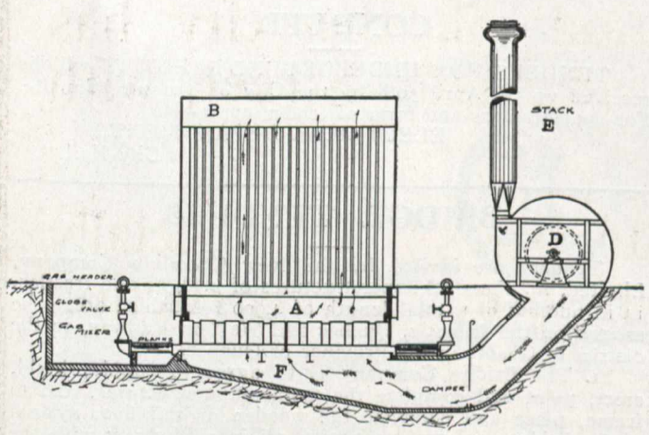
(Continued from Page 575.)

Efficiency of Burner.

It will be readily seen that, while a very large volume of gas is circulated to maintain a low temperature and secure an efficient transfer of heat, the actual amount of waste gas discharged is very small, being equal only to the volume of air required for perfect combustion. As this furnace is internally fired, all radiation is utilized, and the efficiency is practically that which would be calculated theoretically from furnace temperatures. As nine cubic feet of air and one cubic foot of gas are required for the production of 1,000 B. T. U., there will be lost approximately 60 B. T.U. with waste gases at 400 degrees out of every 1,000 B. T. U. produced, corresponding to an efficiency of 94 per cent.

Operating Cost Compared with Steam Plant.

In the Parsons roundhouse, which contains thirty-two stalls, and in addition a machine shop, approximately 8,000,000 B. T. U. per hour is required for heating to 65 degrees in zero weather. With the above type of gas-fired furnace a fuel equivalent of approximately 9,000,000 B. T. U. per hour would be required, while with a steam heating plant, using gas-fired boilers a fuel equivalent of about 12,000,000 B. T. U. per hour would be required. Under average temperature conditions it may be estimated that about one-half of the above heating values will be required; hence the gas-fired furnace will give a maximum economy of 3,000,000 B. T. U. per hour over the steam-heating plant,



Canadian-Buffalo Forge Co.'s Heating and Ventilating Apparatus.

and an average saving of 1,500,000 B. T. U. per hour, which is equivalent to approximately 1,500 feet of gas per hour. This at 12 cents a thousand means a saving of 18 cents per hour, or $3.60 per day of twenty-four hours. In addition to this, there is a great saving in the labor and attention required. The yearly saving may thus be estimated at not less than $400, which is 8 per cent. on the cost of the plant. In actual operation, however, the saving should be even greater than this, as the efficiency of a boiler plant is known to drop very rapidly when operated below its rated capacity, owing to the fact that the radiation and stack losses are practically constant at all loads, while, on the other hand, the percentage of stack losses in a gas-fired furnace decreases at the lower capacities, due to the lowering of the stack temperature.

Use of a Gas Furnace with Producer Gas.

It is interesting to note the statement that where natural gas is not available a gas furnace heating system may be operated quite as economically as a steam heating system. The average gas producer in the market, using soft coal, will give an efficiency of from 65 to 70 per cent. This would give a combined efficiency of gas producer and gas heater of from 59 to 63 per cent., while the average boiler, giving a maximum efficiency of about 65 per cent. at full capacity would give under the variable requirements of a heating plant only from 50 to 55 per cent., which leaves a considerable margin in favor of using a gas-fired furnace for heating in plants where steam is not used as a motive power.

Copper Ingot.—Firm and active, both abroad and here. Local price continues at 13½c. to 14c.

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

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

Roofing Felt.—More demand reported. Price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand has become quite active, and stocks are low.

Fuses.—Electric Blasting.—Double strength, per 200, 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25. Sheets continue in active request.

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

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

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Makers are holding prices stiff, and talk of an advance.

Lead.—Prices steady outside. This market holds firm at $3.80 to $3.90, with an active movement.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b., car. More is moving, in medium to small lots.

Lumber.—The greater ease in the money market having permitted or encouraged more building of warehouses or factories, the result is felt by the lumber trade in a marked demand for Southern pine of large dimensions. This wood, which has been scarce in this market, is beginning to come in freely, and some beautiful clear stuff, as large as 10 by 20 inches, is in stock. For hemlock there is a fair demand, with a scarcity of the longer lengths. It is noticeable that 32-inch lath are rising in price, as we foreshadowed a week or two ago, sales of several cars have been made lately at $1.50. Prices are rather stiff, all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.50.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3. Moving freely.

Pitch.—A little demand is perceptible; price continues at 70c. per 100 lbs.

Pig Iron.—There is more activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20.

Plaster of Paris.—Calcined, wholesale, $2; retail, $2.15. Trade normal.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

Rope—Sisal, 9½c. per lb.; pure Manila, 12½c., Base.

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.65	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

In steady demand; price 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75, according to size and quantity; if cut, $2.75 to $3; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Steel Rails.—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

Sheet Steel.—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

Tank Plate.—3-16, $2.40 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cyclops, 16c. "H.R.D." high speed tool steel 65c.

Tin.—Market more steady, with moderate activity. The price is higher, at 31c. to 31½c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—Business active, market firm at $5.25 to $5.50, outside market improved.

CURRENT NEWS.

Ontario.

LONDON.—The tenth well of the artesian scheme tested on Monday showed a flow of between 215,000 and 230,000 gallons per day. The success of this well demonstrates that the supply of good spring water is practically inexhaustible.

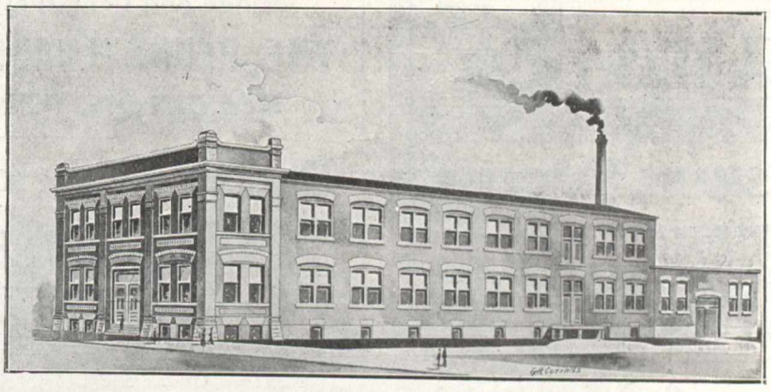
WATERLOO.—The Board of Works will advertise for an inspector for cement walks.

Alberta.

EDMONTON.—The City Council has adopted paving resolutions calling for the paving with bitulithic of a total area of 38,896 square yards, at an outlay of $116,688.

British Columbia.

REVELSTOKE.—The Hospital Board has decided to commence the erection of a new wing. When the design of construction has been approved the work will be put in hand at once.



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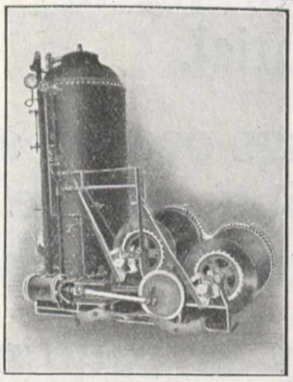

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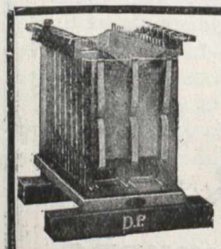

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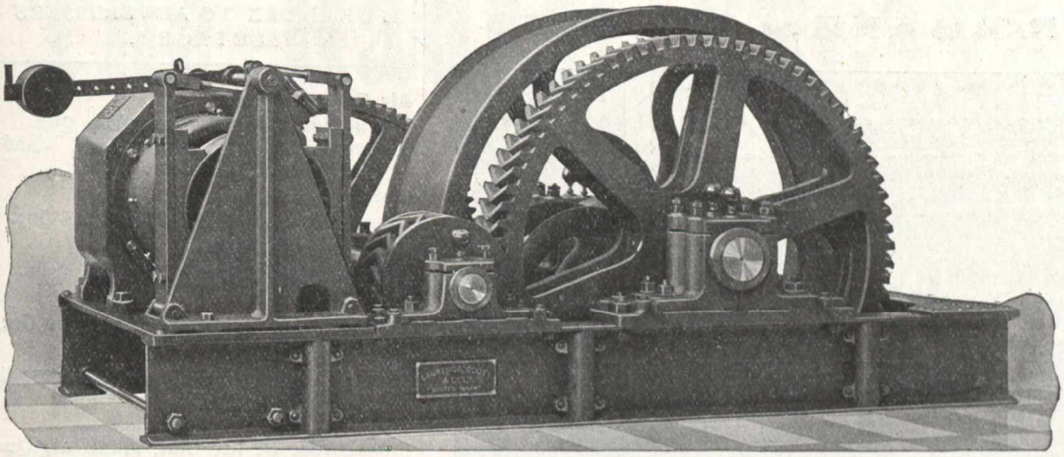

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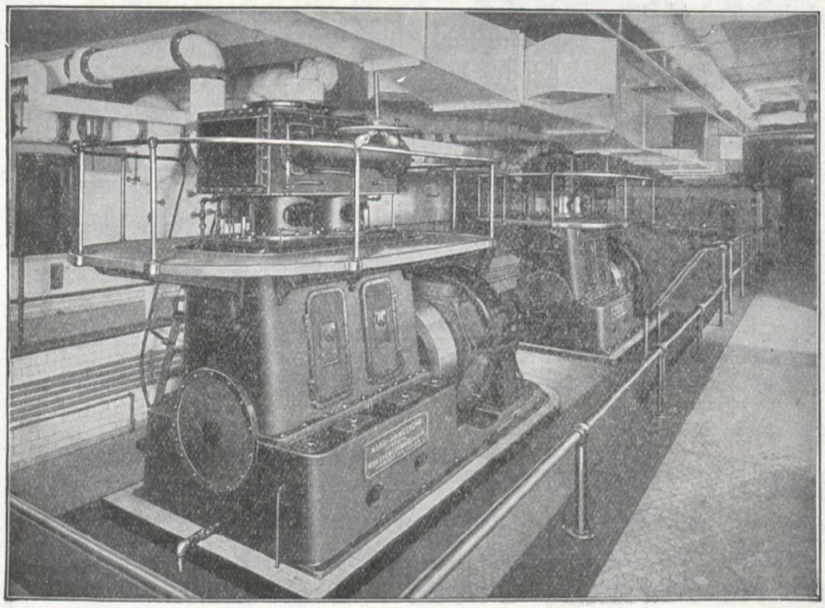

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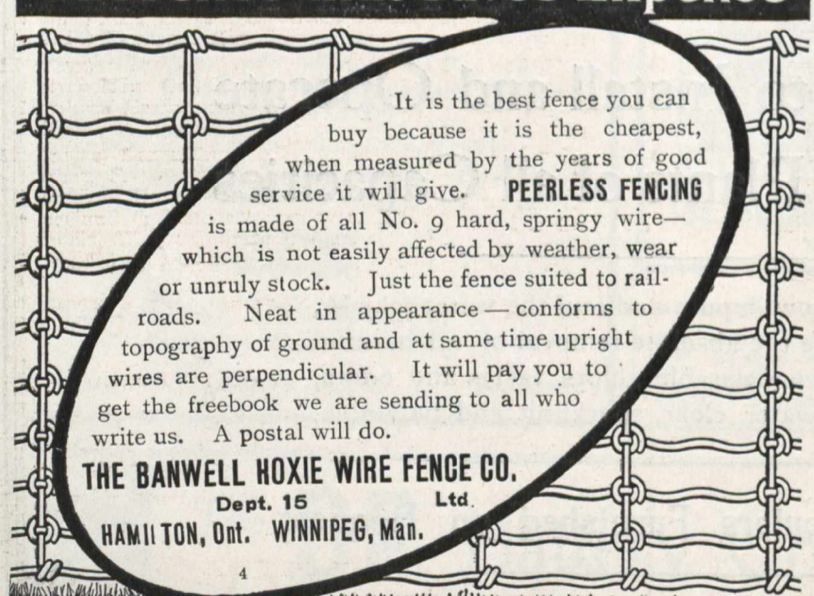

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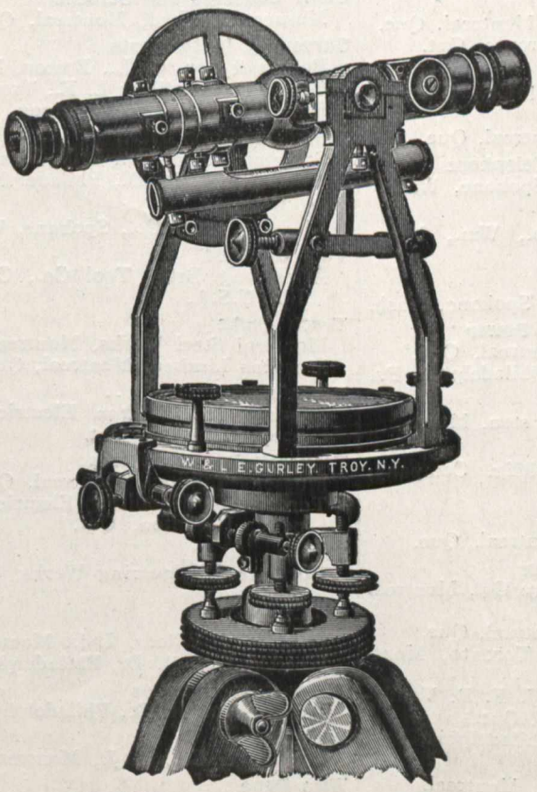

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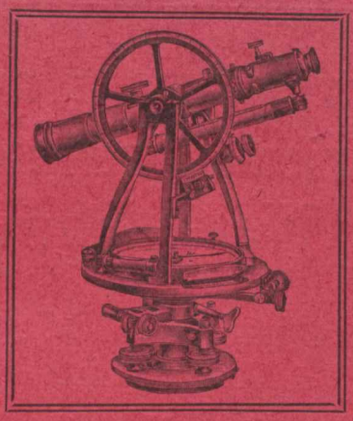

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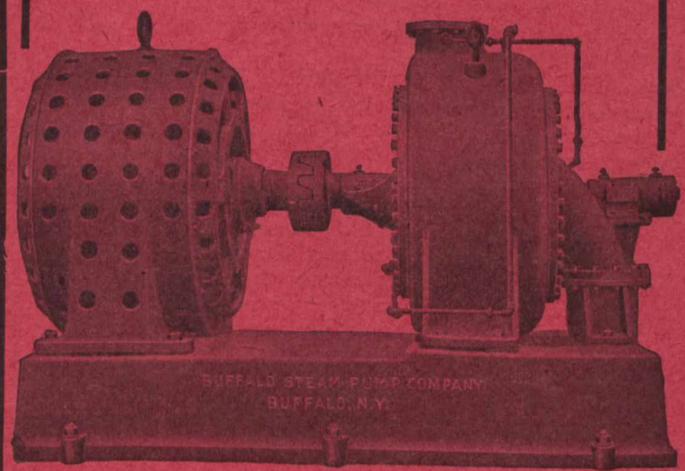

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