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ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

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CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR

Editor—E. A. JAMES, B.A. Sc.

Business Manager—JAMES J. SALMOND

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TORONTO, CANADA, SEPTEMBER 24, 1909.

CONTENTS OF THIS ISSUE.

Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.

TECHNICAL SOCIETIES.

With the end of September comes the opening of the engineering societies throughout the country. Many engineers look upon the old evenings of fall and winter as delightful times for private reading and quiet evenings in the home. Others take an interest in technical societies and clubs and such institutions as may be used to improve their knowledge of the different branches of engineering and make them more efficient in their chosen calling.

Already we have heard on the street the perennial complaints: "Some members use our club to their own advantage too much."

"Why this waste of time?"

"Such general papers are of no value."

"Some papers last year were so highly technical in character that we could not listen to them."

That all money and time spent by and at these organizations is well spent we do not pretend to believe, but with all their faults these societies are strong factors in the professional life of the engineer.

We wonder sometimes if the "dissatisfied member" recognizes that those who get the most out of the society are the members who put most in. Because a man gets good because he does good, don't "grouch," but dig in and take your part. Do something to increase the standing and influence of the society. If you cannot read a paper, aid in discussion, interest someone who can. If you know of an engineer who has had good experience and is likely to be able to give an interesting paper, let the Executive know, and every chance you get boost, don't knock.

We do think, though, that the membership in general might be more largely interested in the work of each society if special committees were appointed, and under the direction of experienced chairmen they were led to investigate certain engineering problems.

Every city that has a branch of the Canadian Society of Civil Engineers or an Engineers' Club has also a university. The university in each instance has a capable staff and a laboratory. Both the university and the society would gain by demonstrations, tests and experiments made with the university plant and machinery.

The varying branches of Canadian industries require the engineer. Few engineers have the laboratory equipment that will enable them to investigate problems. The engineering societies and the universities should unite and assist.

Why not make a start in **your** society this autumn?

CHEMISTRY AND ENGINEERING.

The recent report of a chemist on a water supply for a Canadian town has impressed the necessity of a closer alliance of chemistry and engineering, or, if you like, engineering and chemistry.

In the industrial plants throughout Canada the chemist has made many discoveries which were rapidly converted into successful manufacturing ideas, and for these the chemist must receive full credit. But as a rule the trained chemist is locked up in his laboratory and shut out from the world of affairs, the equipping, the designing, the producing and the finishing end of the establishment. To direct the work of the chemist, to make full use of his discoveries, to secure full returns from his efforts, requires the knowledge and skill of the engineer.

The engineer is required to build, on commercial lines, the laboratory apparatus of the chemist. The chemist must guide and assist the engineer, and carry on cheaply in the laboratory experiments that would be ruinous if conducted in the factory or in the field by the engineer.

Happy the firm that can secure, in one person, the chemist and the engineer! This is seldom possible. Usually the combination is not profitable, but always the engineer and the chemist should understand each other and should co-operate.

WATER CONSUMPTION.

The Water Commissioners for the city of Galt, Ont., have had considerable trouble locating the great water consumption or water waste that has been taking place. Recently, they put a meter in a local manufacturing establishment and found, in thirty-seven days, twenty-one hundred cubic feet, or for a year one million three hundred and twelve thousand five hundred gallons were used. For this, ten dollars was being paid.

Doubtless this was a great surprise to the Galt board, and there are surprises in store for any board of water commissioners that are able to install meters on an unmetered system.

Metering water supply systems is the fair way—fair to the taxpayer, the water user and the waterworks department, and the discovery of such conditions as were found at Galt will do much to educate those responsible for such installations.

CEMENT MARKET IN NEWFOUNDLAND.

The increased cost of lumber and timber in the island has made the Newfoundland builder look to cement as a suitable building material, and greater quantities of cement are being used annually.

Last year Belgium imported into Newfoundland almost as much cement as did Canada. It is true the annual consumption of cement in the island is not large, the imports not exceeding 22,000 dollars, but the trade commissioners expect great growth in cement imports, and Canadian manufacturers should be able to enter the field and hold their own against Belgium and Great Britain.

TIMBER CROPS.

In 1882, Cook Brothers, lumbermen, cut over the township of Sprague, a timber berth near the Serpent River in Ontario. This year the Saginaw Salt and Lumber Company have cut several million feet from the same limit, the Cook Brothers having thrown the limit up in 1882 as valueless. In twenty-seven years the saplings had grown to merchantable timber.

Another example is that of Cobden township, west of Blind River, Ontario. Some years ago an Ottawa firm cut over this limit. This year Moore & McDonald took off a second cut, and secured more than did the limit owner at the first cut.

The Ontario Government regulations now prohibit the cutting of trees less than ten inches in diameter and require that limit holders avoid injuring the growing crop, so that we may now expect to hear of regular crops of timber.

STRESSES IN MASONRY DAMS*

William Cain, M. Am. S.C.C.E.

*Concluded from page 312, Vol. XVII.

On comparing these formulae with those of the writer, it will be observed that the absolute term in the value of q and a consequent term of the first degree in x, in the value of p', are lacking in Mr. Hill's formulae. This results from taking the inner face as vertical. Although the coefficients also differ, it is seen that the numerical values are very nearly the same.

In Fig. 6 are shown, on a drawing of the dam, to scale, the lines of the centers of pressure for reservoir full and empty.

To the right, and under the word "factors," are certain numbers, written in the form of fractions. For any joint, the upper number gives the factor against overturning, or the number by which it is necessary to multiply the water pressure down to the joint, to cause the total resultant to pass through the outer edge of the joint considered. The lower numbers give the ratio of the weight of masonry above a joint to the water pressure corresponding.

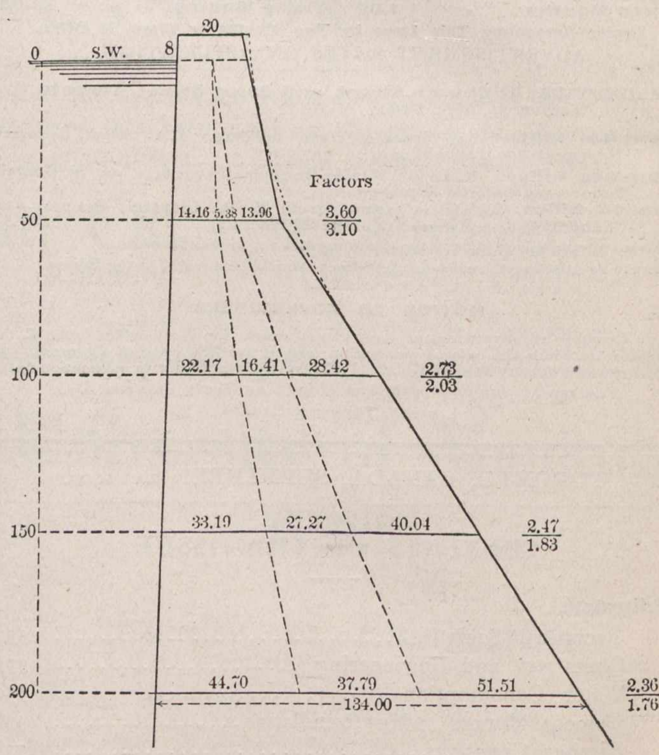


FIG. 6.

It is believed that these "factors" should increase from the base upward, to allow somewhat for earthquakes, expansion of ice in freezing, etc., since the effect of such accidental forces is proportionately greater on the upper joints.

Stresses due to water infiltration are not included here; neither are stresses due to temperature changes.

The unit stresses, f, in pounds per square inch, acting parallel to the adjacent face, are as follows, and refer to the outer edges of the joints, for reservoir full, and to the inner edges, for reservoir empty:—

h,	f at outer edge,	at inner edge.
50	85	58
100	136	133
150	204	180
200	275	228

The stresses, f, are normal pressures on planes perpendicular to the respective faces, and are the greatest stresses that can be experienced in the dam. In fact, they are greater than the true stresses, since the trapezoid law is not exact, particularly near the base, as before remarked. It would then seem that the dam, thus far, is safe, since the maximum unit stress is less than concrete, even, is subjected to daily, in good practice.

For an actual construction, the outer face should be curved, from near h = 50 to the top, as shown by the curved dotted line in Fig. 6.

The subject of the stresses in masonry dams has caused a great deal of discussion among British engineers in the last two or three years. The subject was reopened by Mr. L. W. Atcherly and Professor Karl Pearson,* who gave the results of certain experiments which seemed to indicate considerable tension across vertical planes near the outer toe. The late Sir Benjamin Baker, Hon. M. Am. Soc. C. E., also published† the results of experiments on a model dam of stiff jelly, and very recently, the "Experimental Investigations" of Sir J. W. Ottley and Mr. A. W. Brightmore‡ on elastic dams of "plasticine" (a kind of modeling clay) and the experiments of Messrs. J. S. Wilson and W. Gore§ on "Indian Rubber Models" have been presented.

It is not the object of this paper to discuss these later experiments; but it may be remarked that they show very plainly that no tension exists near the outer toe, but that tension does exist at the inner toe, where the dam is joined to the foundation, and it has become a serious matter how to deal with it. The influence of the foundation in modifying the distribution of the stresses at the base of the dam was found to be very great, causing the shear there to be more uniform than higher up, where the parabolic law, nearly as given by the formulae above, was found to hold. Also, above some undetermined plane, a small distance above the base, the usual "law of the trapezoid" was found to be approximately correct, leading to stresses on the safe side at the outer toe. This law leads to stresses at the outer toe of the base considerably in excess of the true ones.

It was found, from the rubber models particularly, as theory indicates, that the greatest normal pressures are exerted at the down-stream face, for reservoir full, and they act in a direction parallel to that face.

* Minutes of Proceedings, Inst. C. E., Vol. CLXII., p. 456.

† Ibid, Vol. CLXII., p. 123.

‡ Ibid, Vol. CLXII., p. 89.

§ Ibid, Vol. CLXII., p. 107.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7986—September 1—Authorizing the Georgian Bay & Seaboard Railway Company to divert road allowance between concessions 9 and 10, Township of Tay, County of Simcoe, at mile 7.12.

7969—September 1—Ordering the C.P.R. to provide and construct at its expense highway crossings on the line dividing Range 1, N.E., Range 1, S.E., at mileage 2.9 and 3.5 from Megantic.

7970—September 2—Authorizing the Corporation of the Town of Orillia to lay sewer pipe under the track of the G.T.R. at Orillia, Ont.

7971—August 31—Authorizing the C.P.R. to construct branch line in the City of Winnpeg into the premises of McColl Brothers.

7972—August 31—Granting leave to the Pacific Coast Coal Mines, Limited, to cross by means of an undercrossing, the tracks of the Esquimalt & Nanaimo Railway Company in the Cranberry District, B.C.

7973—May 4—Approving plans submitted by Cameron & Co., Limited, of Ottawa, Ont., for siding to connect with the tracks of the G. T. Ry. near Aylen Lake Station, on its Ottawa Division.

7974—Sept. 2—Authorizing the Town of Arnprior to lay sewer pipe under the G. T. Ry. at Ida St. Arnprior, Ont.

9775—June 1—Granting leave to the Montreal Park & Island Ry. Co. to appeal to the Supreme Court of Canada upon the following question:—"Whether it is right or proper for the Board in making the said Order to overlook the contract bearing date the 7th day of November, A.D., 1907, and made between the said Montreal Park & Island Ry. Co. and the Municipality of Notre Dame de Grace.

7976—June 8 — Granting permission to the Montreal Street Railway Co. to appeal to the Supreme Court of Canada upon the following question:—"Whether upon a true construction of sections 91 and 92 of the British North America Act and of section 8 of the Railway Act of Canada, the Montreal Street Railway Co. is subject in respect of its through traffic with the Montreal Park & Island Ry. Co. to the jurisdiction of the Board of Railway Commissioners of Canada.

7977—Sept. 3—Authorizing the C.P.R. to deviate portion of it line as constructed, between mileage 38 and mileage 39, West of Nelson, B.C.

7978—Sept. 3—Authorizing the C.P.R. to construct industrial spur through lots 37 to 43 inc. of Lot 5 in Parish Lot 47, St John, Winnipeg, Man.

7979 and 7980—Aug. 31—Authorizing the Corporation or the City of Toronto, Ont., to lay water pipe under the C.P.R. at Osler St. and Symington St., Toronto, Ont.

7981—Sept. 3—Authorizing the C.P.R. to construct and operate twelve industrial spurs, each crossing 7th Ave., at Regina, Sask.

7982—Sept. 3—Authorizing the Corporation of the City of Toronto, Ont., to construct a section of the High Level Intercepting Sewer between Tiverton and Carlaw Avenues across the land and under the track of the G.T.R., Toronto, Ont.

7983—Sept. 3—Approving plan submitted by the C.P.R. showing proposed double fifteen-foot one-beam girder of Bridge No. 55.5, Western Div. Sirdar Sec. of its line.

7984 and 7985—Sept. 7—Approving location of the C.N.R. Co.'s line up the North Thompson River, B.C.; mileage 46 to 55; and through Tps. 34-35, and Ranges 1-8; mileage 44.84 to mileage 93.85, Sask.

7986—Sept. 7—Authorizing the Drain Comm. for the Tp. of East Oxford, Ont., to construct drain pipe under the track of the Port Dover & Lk. Huron Ry. Co., near Woodstock, Ont.

7987—Sept. 3—Granting leave to the Coldstream Tel. Co. to place its wires across the track of the C.P.R. at Komoka, Ont.

7988—Sept. 1—Granting leave to the Yellow Grass Rural Tel. Co. to place its wires across the track of the C.P.R between Sections 13 and 14, Tp. 10, R. 17, West 2nd Mer.

7989—Sept. 7.—Granting leave to the Markham and Pickering Tel. Co. to place its wires across the track of the G.T.R. between lots 10 and 11, 5th Con., Tp. Markham, Ont.

7990 to 7998 inc.—Sept. 3—Granting leave to the B. T. Co. to place its wires across the tracks of the G.T.R., M.C.R. R. and C.N.R. at eight points in Ontario and one in Quebec.

7999—Sept. 7—Amending Order No. 5956 dated Dec. 22nd, 1908, directing the Que. Montreal & Southren Ry. to construct stations at Sorel, P.Q., & Pierreville, eight months from Dec. 22nd, 1908, by granting an extension of six months from Sept. 7th, within which to construct said station at Sorel, P.Q.

8000 to 8002 inc.—Sept. 3—Granting leave to the Man. Gov. Telephone Sys. to cross the tracks of the C.N.R. (1) and C.P.R. (2) at three points in the Prov. of Manitoba.

8003 and 8004—Sept. 1—Granting leave to the Alta. Gov. Tel. System to place its telephone wires across the track of the C.N.R. at two points in the Prov. of Alta.

8005 and 8006—Sept. 1—Granting leave to the Gov. of Sask. to cross the tracks of the C.N.R. with its 'phone wires at two points in the Prov. of Sask.

8007—Sept. 7—Exempting the British Yukon Ry. Co. from provisions of Order No. 7473, dated May 4th, as to the construction and maintenance of fences on either side of its right of way and of gates at farm crossings and of cattle guards.

8008 to 8010 inc.—Sept. 7—Granting leave to the Canadian Machine Tel. Co., Ltd., to place its wires across the track of the G.T.R. at Lindsay and Burford, Ont.

8011 to 8014, inc.—Sept. 7—Granting leave to the Corp. of the Village of Burlington, Ont., to lay water main under the tracks of the G.T.R. at four points at or near the Village of Burlington, Ont.

8015—Sept. 7—Approving deviation of Montreal Road by the C.N.R. in the Tp. of Cumberland, Co. of Russell, Ont., mileage 41 west from Hawkesbury, subject to the conditions that the road as diverted be put by the C.N.R. in as good order as the existing road.

8016—Sept. 8—Approving by-law of the G.T.P. Ry. appointing A. B. Smith, manager of the Telegraph Co., to prepare and issue tariffs of tolls to be charged for the transmission of telegraph messages over telegraph lines owned and operated by the company.

8017—Sept. 8—Approving and sanctioning location of the G.T.P. from east line of Sec. 1, Tp. 53, R. 23, to south line of Sec. 3, Tp. 52, R. 24, west 5th Mer. Dist. of No. Alta.

8018—Sept. 8—Granting leave to the B. T. Co. to place its wires across the track of the M.C.R.R. at P. C., ½ mile east of Welland, Ont.

8019—Sept. 8—Authorizing J. A. Coleman, of Winger, Ont., to lay gas pipe under the tracks of the G.T.R at P. C., two miles west of Marshville Stn., Ont.

8020—Aug. 26—Authorizing the Pembroke Lum. Co. to lay water pipe under the track of the C.P.R at or near the foot of Agnes St., Pembroke, Ont.

8021—Sept. 8—Authorizing the Corp. of the Town of Barrie, Ont., to lay sewer pipe under the tracks of the G.T.R. at Bayfield St.

8022 and 8023—Sept. 8—Granting leave to the Sask. Gov. Tel. to cross with its wires the track of the C.P.R. at two points in the Prov. of Sask.

8024 to 8026 inc.—Sept. 8—Granting leave to the Canadian Machine Tel. Co., Ltd., to place its wires across the track of the G.T.R. at three streets in the Town of Lindsay, Ont.

8027—Sept. 8—Authorizing the Orford Mt. Ry. to construct bridge No. 6 over Fyfield Brook, at Eastman, P.Q.

8028—Sept. 8 — Authorizing the C.P.R. to construct bridge No. 125.2, Cascade Sec., over roadway near Vancouver, B.C.

8029—Sept. 8—Authorizing the Esquimalt & Nanaimo Ry. Co. to construct bridge No. 14.0 over Niagara Ravine, B.C.

8030—Sept. 8—Granting leave to the P.M.R.R. to move east derail and semaphore installed at Walkerville Jct., Ont., at Jct. with the C.P.R. to a point fifty-three feet further away from the crossing.

8031—Sept. 7—Granted leave to Robert Henry Edgar of Bowling Green, Ont., to place telephone wires under the tracks of the C.P.R. at Waldemar, Tp. of Amaranth, Lot 2, Con. 10, Ont.

8032—Sept. 9—Authorizing the Muncp. Corpn. of the Town of Gravenhurst, Ont., to lay water service main under the tracks of the G.T.R. at Brock and Muskoka streets, Gravenhurst, Ont.

8033 to 8035 inc.—Sept. 9—Granting leave to the Sask. Gov. Tel. Sys. to place its wires across the track of the C.P.R. at Carievale, Sask., and two other points in the Prov. of Sask.

8036 to 8041 inc.—Sept. 9—Granting leave to the B. T. Co. to cross the tracks of the C.P.R. and G.T.R. at various points in Ontario.

8042—Sept. 9—Granting leave to the Canadian Machine Tel. Co., Ltd., to erect its wires across the track of the G.T.R. at Burford, Ont.

8043—Sept. 9—Approving location of G.T.R. Co.'s station at Bluevale, Ont.

8044—Sept. 9—Granting leave to the Centre Thorah Tel. Assn. to cross the track of the G.T.R. with its wires in the Tp. of Thorah, Ont.

8045 and 8046—Sept. 9—Granting leave to the B. T. Co. to cross the track of the T. H. & B. Ry. near Grimsby, Ont.; and the M.C.R.R. at Bridgeburg Stn., Ont.

8047—Sept. 9—Authorizing the V. V & E. Ry. & Nav. Co. to construct bridge No. 439 over Similkameen River, between Keremeos and Princton.

8048—Sept. 9—Granting leave to the Corp. of the Village of Stirling, Ont., to erect electric power wires across the track of the G.T.R. at Old Marmora Rd., Stirling, Ont.

8049—Sept. 9—Approving of location of C.N.R. Co.'s line up the No. Thompson River from Nekaliston Creek to Coldwater River, B.C.

8050—Sept. 9—Approving location of the C.N.R. Co.'s line through Tps. 9-5, Ranges, 33-34, West Principal Meridian, and ranges 1-6, West 2nd Mer., mileage 16.09 to mileage 65.16, Prov. of Sask.

8051—Sept. 9—Authorizing the Q. Ry. L. & P. Co. to construct, maintain and operate proposed branch line of "Y" at St. Joachim, Co. of Montmorency, P.Q.

8052—Sept. 9—Authorizing the C.P.R. to lay its tracks across 18th St., Brandon, Man.

INEFFICIENCY OF DAY LABOR IN MUNICIPAL WORK.

The recently published reports of Metcalf & Eddy, of Boston, consulting civil engineers to the original Boston Finance Commission, are exceptional in the thoroughness with which facts have been collected and marshalled to specifically show the inefficiency of day labor in municipal work. They found the Sewer Department to be reeking with abuses. To inefficiency and lack of discipline were added inadequate inspection and the pernicious effects of contracts given through favoritism at excessive prices. In fourteen years the annual expenditures on account of sewerage had increased 175 per cent., while valuation had increased only 44 per cent. and the population but little more than half as much.

Inefficiency was manifestly the goal toward which the Department was steadily keeping its course. Of about 775 men engaged upon day labor nearly 70 per cent. were over 50 years, and nearly 20 per cent. over 60 years. Not only were many of the force physically incapable of doing a fair day's work, but discipline was practically lacking—each man was a law unto himself, subservient only to the politician to whom he owed his position. But not content with insuring inefficiency and increasing the force through such means, the defined measure of a day's work was in many cases so established as to become absolutely ridiculous were the matter not so serious.

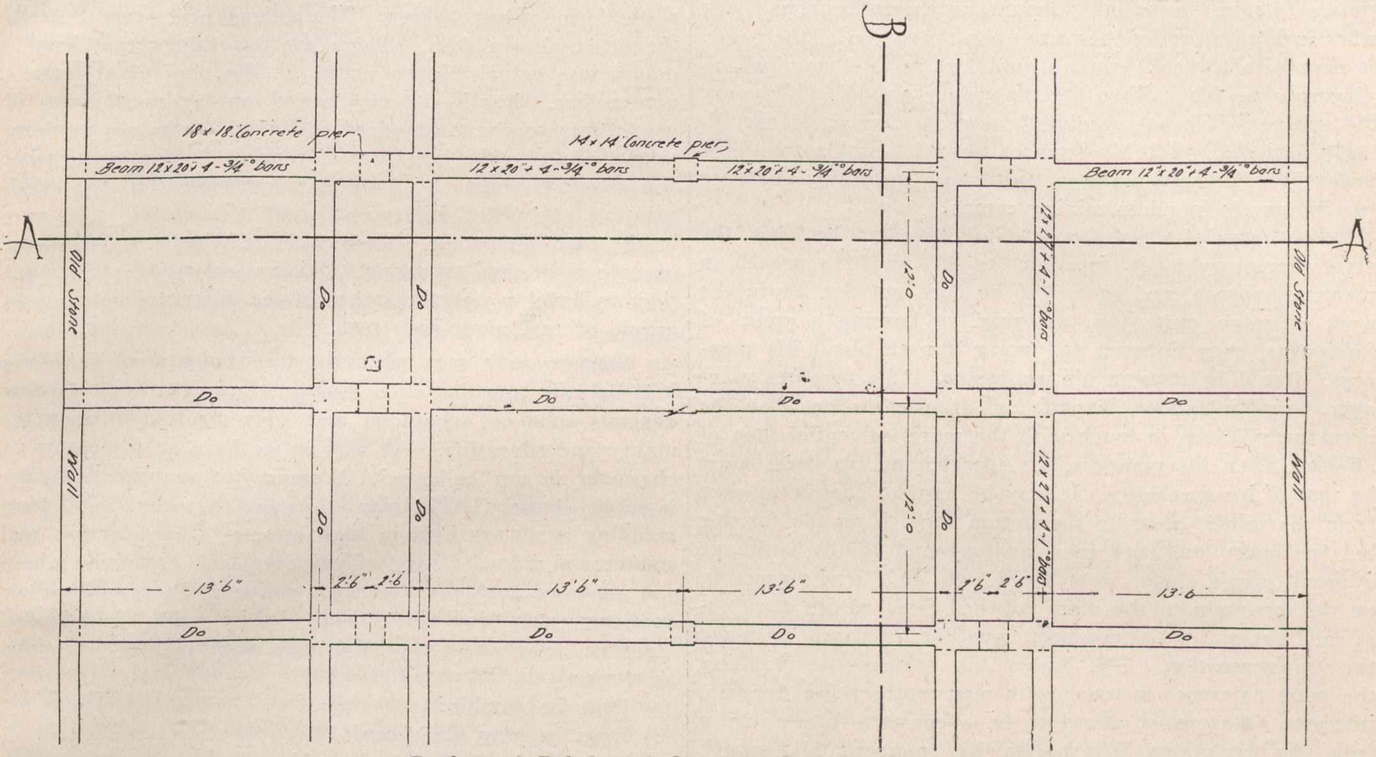
One time-keeper carried a book from the office to the job once or twice a day; a carriage painter worked an hour some days, and on many days never appeared at all; two men were stationed on a dump for more than a week after the wagons ceased to visit it; one man had nine lanterns to fill and clean each day, another twelve; some had only to hang up rubber boots to dry; a "syphon" man attended an hydraulic siphon which needed no attention; a "rubber goods repairer" who ordinarily had nothing to do sometimes assisted a clerk who had little to do; one storekeeper hardly ever appeared in the storeroom; a "stenographer" at $1,600 per annum seldom reported for any duty except that of political messenger; a "janitor" drew pay for seven weeks while he was sojourning in Europe. In ten districts, out of 579 men, 144 were employed as watchmen or in other positions, which required little effort, and 60 of these performed work of exceedingly slight value, or none at all. Inspectors were frequent offenders, and many of their written returns were practically useless. In some cases they were written wholly from imagination. The inspectors of catch-basins inspected usually from three to six basins a day, rarely over ten, although a fair day's work is fifty. Catch-basins which did not exist were included in the cleaning contracts at a fixed and excessive price; other basins were included in more than one contract, and paid for twice.

A SIMPLE REINFORCED CONCRETE TRESTLE

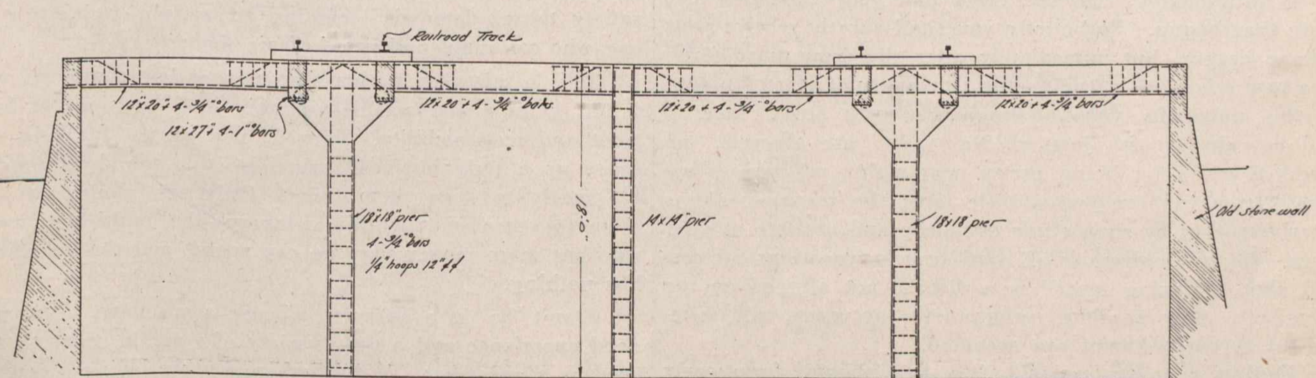
Among those manufacturing concerns aiming to reduce fire losses, maintenance charges, and insurance rates, by replacing their wooden structures with reinforced concrete, is the Jackson Manufacturing Co., Nashua, N.H. This company recently had built by the Aberthaw Construction Co., Boston, Mass., a reinforced concrete coal trestle capable of supporting the heaviest coal cars. It covers the entire length of their coal pocket and is limited in width by the stone retaining walls of the pocket. The illustrations shown herewith give a very good idea of the design.

The new trestle is designed for two parallel tracks 32 feet apart at a level slightly higher than 18 feet above the bottom of the pocket. The stone retaining walls 64 feet apart, furnish support for the ends of the cross beams. With this exception the entire structure is of reinforced concrete.

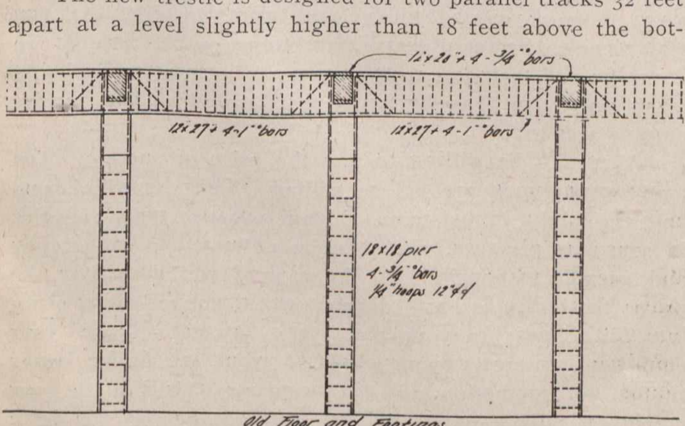
Further support than that given by the retaining walls is furnished by three rows of longitudinal columns, one row in the middle and two on each side, the two latter having spread tops for the purpose of adequately supporting the two parallel beams of 12 by 27 inch section, under each track. The middle row of supporting piers are 14 by 14 inch section while those on either side are 18 by 18 inch. The latter are reinforced by four ¾-inch steel bars in the corners, stiffened by ¼-inch hoops, 12 inches on centres. The 14 by 14 inch piers are similarly reinforced.



Design of Reinforced Concrete Coal Trestle.



Reinforced Columns Supporting Trestle.



The transverse beams, 12 feet centres, which rest on their ends on the stone side walls, intersect the heavier longitudinal beams directly over the columns or supporting piers. The 12 by 27 inch beams have steel reinforcement consisting of four 1-inch bars in each beam near the bottom. These are turned up near the supports to take care of the shearing stresses. Steel stirrups are extensively used as an aid in the reinforcement. The tie beams are reinforced by four ¾-inch bars in a manner similar to those under the tracks except that the use of stirrups is discontinued along the middle portion. All beams are reinforced near the top surfaces over all piers to take care of the tensile stresses at these points. The old floor and footings were used as a foundation for the supporting piers. The entire construction is heavily built with the view of accommodating the largest coal cars.

CHARACTERISTICS OF THE ARTIST-ENGINEER.

By Victor C. Alderson.*

The characteristics of an artist-engineer may be divided into four main groups—physical, personal, intellectual, and moral. An engineer is called upon to do hard work. His physical frame should be capable of enduring long, continuous strain. Especially should his heart be sound, for work in high altitudes is severe upon the action of the heart. A man with a weak heart should not regard mining engineering as his calling. His physique would not endure the strain. While not absolutely necessary, yet it is exceedingly desirable, that his stomach should be able to digest heavy bread, soggy potatoes, and tough meat, for such are too frequnetly found in mining camps.

The more successful a mining engineer becomes the more necessary is it for him to be above reproach in manners, speech, and dress. If he does not rise above the work of mine surveying, assaying, or bossing a gang of foreigners, then he need not worry himself about his manners. But if he rises in his profession, if he becomes manager, superintendent, expert, or artist-engineer, then he necessarily comes in touch with the more influential men of affairs. Then his manners, his speech, and his dress must be that of his associates. It may be hard to change at once from the miner' boots to the button shoe, from the forcible but inelegant language used underground to the language of gentlemen's clubs, from the rough and ready greeting on the mountain to the more polished form of the drawing-room. Yet the artist-engineer must be prepared to make the transformation. The higher his professional standing the more he comes in touch with men representing financial interests. He cannot afford to be a curiosity blown down from the mountains. His habits, his manners, his speech will all count for or against him. It is well for a young engineer to bear this in mind, for while these personal characteristics do not make a man, yet they help mightily.

It is almost superfluous to say that a sound technical training is a requisite for an engineer, yet I mention it only as an introduction. Do not think that your education has more than begun. To be sure you shall shortly receive your college degree, but immediately after that you must enroll in a new school of learning—the University of Hard Knocks. In this university you will be judged with strict severity and not always with justice. No "cuts" are allowed; no credit is given for being pretty near right; no excuses are taken when you are just a little late; the manager seems utterly cruel if by chance you oversleep and are late at your work. In this University of Hard Knocks vacations are few and short; "spring fever" is a disease not allowed on the premises; only absolute promptness, accuracy, and successful accomplishment are accepted.

During your professional life you should form early certain habits that will do much to mould your intellect in the right way; that is, you should read, think and write.

Read. For your reading you should eliminate as far as possible the "flotsam and jetsam" of the daily paper; that is, the sensational features. Select the real news of the working world, discard the rest. Do not, under any circumstances, depend upon the daily press for your intellectual stimulant. Select one or two of the better technical papers, read them carefully, digest them thoroughly, and make their contents absolutely your own. In this way you will be able to keep in touch with the best professional thought and practice.

After reading, think. Do not be deluded by the thought that one reading is enough. After reading an important article, make a synopsis with headings and subheadings. See if the writer has made a logical presentation of his topic. Ask yourself how you could improve it. Try to recall other articles on the same subject. If the article is argumentative, weigh carefully the arguments presented, think out some of your own, and then draw a conclusion. In other words, study your technical papers carefully. There is no professor in this University of Hard Knocks to bother you with examination questions; you will not be "passed" in any subject; but when the opportunity for advancement comes, "the powers that be" will decide whether or not "you are fit for more than the thing you are now doing."

Write. Do not fail to begin early a simple yet systematic form of note-taking. The artisan never takes notes; the artist always does. There are few things that keep a man's intellectual life so active as the plan of systematic note-taking. Try it—it may make an artist-engineer of you. After you have advanced sufficiently to have something to contribute to the literature of your profession, write what you have and send it to some technical paper. If it is worth printing, the editor will accept it. If it is worthless, as may be the case, do not be discouraged; read more, think more, observe more, and try again. Editors are not heartless; but they do have an unerring sense of the difference between an article of real merit and trash.

Strange as it may seem to you, young men, I believe it is literally true that three-fourths of an engineer's success depends upon his character and only one-fourth upon his ability and education. Yet why do we have no professors of character in our colleges? A smart but unprincipled man is to be shunned. The man of good character and good standing is always held in high esteem. Character has real commercial value. If any of you ever seek a position where you are to be put under bond you will find that your bonding company will look into your habits with coldblooded scrutiny. They will ask about you such pointed questions as these:—

Does he gamble?

Does he play the races?

Has he ever been intoxicated?

Has he ever been guilty of any dishonorable act?

These questions are not asked from any morbid curiosity, but simply to determine from a purely business point of view whether you are a good moral risk—one which the bonding company can assume. The man who cannot satisfy these demands remains an artisan-engineer; the one who can may, perhaps, become the artist.

It is a mistaken notion that men of low character, who drink, gamble and act dishonorably hold positions of high trust and responsibility. They do not, or not for long, because as a pure business principle it is too dangerous or too costly to keep them there. Only two classes of men seem to come outside this category—the multi-millionaire, who has more money than he can spend, and the hobo, who has nothing.

Don't be in a hurry to choose a specialty. You may need experience and a wide variety of work in order to succeed as a specialist. At first when you are laying a foundation for future success be content with a living salary. Pronounced success will bring its own financial reward. Avoid small, petty, professional jealousies. They injure you more than they do the man of whom you are jealous. Seek to learn from every one—even the humblest worker. Remember that in all things high and fine you get only as you give. Give of your knowledge and talents in order that you may receive. Secret processes are going out of fashion. In scientific and technical matters you can gain more by being frank and open than by being secretive. You will receive only as you give.

Above all be willing to pay the price of success. Too many young men are not so willing. They hope to spend half the night in boisterous living, exhaust their energies in sensuous pleasure, and then be promoted to higher pay and greater responsibility. To succeed you must pay the price; that price is hard, diligent work, supported by absolute faithfulness to your employer's interest. Make your employer's interests your own. If you are fit for better things, for promotion, for advancement, it will be to your employers' advantage to call on you. If you pay the price for success, success will be yours.

* President Colorado School of Mines. Abstract of an address delivered before South Dakota School of Mines.

It is unfortunate that the engineering profession in general and mining engineering in particular has no such well-established code of ethics as prevails in law or medicine. While the advice, "caveat emptor" (let the purchaser beware) is always sound, yet we can hold only in contempt the promoter who capitalizes a barren hole in the ground, and mines, not in the ground, but in the pockets of his dupes. Such men should be placed in a class of Separators, because all they do is to separate people from their money. While there is no crystallized code for you to follow, yet you can make one for yourself.

Let me urge upon you to keep in mind always the ideals which will make of you artist-engineers. Few men have put this thought in a more striking way than William Ellery Channing. Remember it:—

"To live content with small means; to seek elegance rather than luxury, and refinement rather than fashion; to bear all cheerfully, do all bravely; to listen to the stars and birds, to babes and sages with open heart; to study hard, think quietly, act frankly, talk gently, await occasions, hurry never; in a word, to let the Spiritual, unbidden and unconscious grow up through the common; this is to be My Symphony."

UNION OF SASKATCHEWAN MUNICIPALITIES.

The fourth annual convention of the Union of Saskatchewan Municipalities was opened on Tuesday, September 14th, by His Honor Lieutenant-Governor Forget in the presence of a representative number of delegates, who were welcomed by the Lieutenant-Governor and the mayor of Regina. Following addresses by the president and Hon. J. A. Calder, who spoke on "Municipal Government," two illustrated lectures—one on "Water Supply and Purification," by Mr. T. Aird Murray, C.E., of Toronto, consulting sanitary engineer to the Saskatchewan Government; and the other by Dr. R. M. Seymour, Provincial Medical Health Officer, on "Milk in its Relation to Public Health," were listened to with considerable interest.

LATE CONSTRUCTION NEWS.

CURRENT NEWS.

New Brunswick.

ST. JOHN.—English prospectors have struck natural gas at a depth of one thousand feet in Albert county.

Ontario.

OTTAWA.—The city council almost unanimously passed a by-law sanctioning the purchase of a site for a civic incinerator plant at a cost of $10,000.

OTTAWA.—Dr. Eugene Haanel, Director of Mines, recently stated that arrangements are being made for establishing the first electric smelting plant in Canada in connection with the Sault Ste. Marie iron and steel industries. The Lake Superior Company is arranging for the construction of a number of furnaces similar to those now in successful operation in Sweden.

PORT ARTHUR.—Competitive preliminary plans for a library building, to cost $25,000, are invited by J. Wink, librarian.

TORONTO.—City Engineer Rust recently estimated the cost of a viaduct from the present terminus of Bloor Street, at Sherbourne Street, to Danforth Avenue, in connection with the proposed extension of Bloor Street, at $619,000. This did not include land damages.

TORONTO.—Tenders for the burned over sections of Mississauga forest reserve have been accepted by the provincial government. The successful tenderers are James Munro, Pembroke; Booth and Shannon, of Biscotasing, who get two berths; W. B. Russell, Toronto; Richard Frier and J. G. Forgie, Pembroke. The average price is the highest yet obtained for timber berths rights. The best price tendered for white pine on the berths is $11.37 per thousand feet board measurement and the lowest $10.55, while for red pine, jack pine and spruce the highest price is $8.55 and the lowest $3. This is in addition, of course, to the usual stumpage and rental dues.

Manitoba.

WINNIPEG.—Messrs. Pratt & Ross, structural and civil engineers, of Winnipeg, new advertisers in this issue, report having had a splendid season's work. They were the designers of the larger Horse Show Pavilion in Winnipeg; have prepared the plans for the new C.N.R. station at Brandon, and also for the alterations in the splendid new Grange Hotel, Winnipeg. Mr. Pratt designed the Fort Rouge C.N.R. shops this season also, and Mr. Ross is manager of the construction of the Union terminus at Winnipeg for the C.N.R. and the G.T.P. The firm are consulting hydraulic engineers for the Winnipeg Electric Railway, and have also a very difficult piece of work on their hands just now in the reconstruction of the sewer and waterworks system at Carman, Man.

The Brydges Engineering and Supply Co., of Winnipeg, are supplying two of their Daniels gas engines and gas producer plants, along with two pumps, for use in the C.N.R. shops. The pumps will have a capacity of 500,000 gallons per day, each unit, and the plant is to be ready by the end of November.

A total of 6,960 new applications have been made to the Provincial Telephone Commissioners since January 1st. Of these, 5,790 have been accepted, of which 3,240 are in the rural districts, while the remaining 2,550 are in towns. The Commissioners think it necessary to construct 4,000 miles of new lines this year.

British Columbia.

PRINCE RUPERT.—A shot, in which were used 25¼ tons of virite and 800 pounds of dynamite was fired here last week. It is estimated that 45,000 yards of rock were broken up, and most of it into small pieces.

VANCOUVER.—Machine and locomotive works to cost $300,000 will be running in Vancouver within six months, according to the plans of the Sumner Iron Works Co., of Everett, Wash., whose officials recently closed a deal with John Hendry, whereby they acquired, for $25,000, 30 acres of land in Burnaby.

MISCELLANEOUS.

Nova Scotia.

GLACE BAY.—The reconstruction of the Marconi station at this point will be commenced at an early date. Mr. Marconi has just arrived from Europe to superintend the work.

Ontario.

ELK CITY.—Twelve miles of the new wagon road from Elk Lake to Gowganda have been graded. Work is being done from the Elk Lake end, and the entire twenty-seven miles are to be completed by December 1st.

KINGSTON.—The matter of dredging and re-opening the Wolfe Island canal is being discussed in civic circles here. The canal, which was formerly six feet deep and now only three, was closed in 1890.

OTTAWA.— Three hundred thousand dollars will be spent on the improvement of roads in Carleton County, which comprise 210 miles of the chief highways. A permanent engineer will be engaged and $15,000 will be spent in equipment, including steam roller, steam shovels, graders, stone crushers, etc. All the roads will be levelled, well drained and graded where necessary. Warden Dow, Mr. W. R. Cummings and Mr. W. J. Armitage have been untiring in advancing the scheme. The provincial government refunds to the county one-third of the cost of the road, the salary of the engineer and the cost of the equipment.

SAULT STE. MARIE.—The directors of the Lake Superior Corporation state that the plant will be enlarged.

Manitoba.

WINNIPEG.—The Canadian Westinghouse Company have purchased a site in Winnipeg on which they will erect

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Sept. 14 1909	1908	STOCK QUOTATIONS TORONTO Price Sept. 17 '08	Price Sept. 9 '09	Price Sept. 16 '09	Sales Week End'd Sep. 16	MONTREAL Price Sept. 17 '08	Price Sept. 9 '09	Price Sept. 16 '09	Sale Week End'd Sep. 16
Canadian Pacific Railway	8,920.6	$150,000	$100	$1,836 000	1,431.000	...	180½ 180⅜	182½ 181¾	375	170½ 170¼	181 180	182¼ 182	940
Canadian Northern Railway	2,986.9	...	...	239 700	202,800	...	...	...	...	...	...	...	...
*Grand Trunk Railway	3,536	226,000	100	897.498	806.696	...	*1st. pref. 107½, 3rd pref. 58⅞, ordinary 24¾					...	...
T. & N. O.	334	(Gov. Road)	...	34,388	18,554	...	...	...	...	...	...	...	...
Montreal Street Railway	138.3	18,000	100	76,361	74,730	...	...	...	...	179 178	225½ 214	214 213½	169
Toronto Street Railway	114	8,000	100	114,488	106,946	...	126 125½	124½	250	103½ 103	125½ 125	124½ 124¼	512
Winnipeg Electric	70	6,000	100	...	...	167½	187	170	40	170 165	187	187	...

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

a large building this fall, which is to be eventually seven storeys high but probably only four storeys will be finished by December 1st, when it will be occupied. James McDiarmid will build it and J. H. G. Russell is the architect.

WINNIPEG.—The Western Iron Works, who make a specialty of ornamental Iron work have had a busy season and are working up to their full capacity to keep up with orders in hand. They have practically all the contracts for ornamental Iron on most of the large buildings in Winnipeg as well as many throughout the West.

PERSONAL.

MR. J. K. ROBERTSON, M.A., of Perth, has been appointed lecturer in physics in Queen's School of Mining, Kingston. He is an honor graduate of Toronto University.

MESSRS. PEACOCK BROS., engineers, and representatives in Canada for well-known British engineering firms, have moved their offices from the Canada Life Building to 68 Beaver Hall Hill, Montreal.

MR. GEORGE CUNLIFFE of Winnipeg, who has just been appointed C.N.R. trainmaster at Brandon, has entered upon the duties of his new position and is inspecting the lines west of Brandon, over which he will have control.

MR. MANLY B. BAKER, B.A., B.Sc., has been appointed Professor of Geology by the School of Mining, Kingston, succeeding Prof. R. W. Brock. Mr. Baker has been lecturer in geology at the mining school for the past three years and has proved himself a good teacher and well qualified to become head of the department. Mr. Baker is a native of Stratford.

MR. A. A. TISDALE, who has been connected with the Grand Trunk and Grand Trunk Pacific Railways in Montreal for some years, has just been appointed superintendent of the Lake Superior Division of the Grand Trunk Pacific. with headquarters at Fort William. Mr. Tisdale entered the service of the Grand Trunk about fifteen years ago as a junior clerk. Later he was appointed secretary to Mr. F. H. McGuigan, and afterwards assistant to Mr. W. G. Brownley, general transportation manager. Latterly he had been assistant to Mr. E. J. Chamberlin, vice-president and general manager of the Grand Trunk Pacific lines.

OBITUARY.

MR. T. C. GREGORY, a civil and mining engineer, who was concerned in the building of the Great Western Railway, now merged with the Grand Trunk Railway, is dead.

It is announced that commencing with November 1 next, 773 engines and the Austrian State Railways will use liquid fuel, and probably in a short time liquid fuel will also be introduced on all the mountain railways, especially on the lines of Bregeuz, Trieste, and Pontebu. The reasons assigned for the change are that the supply of coal to these lines is a very expensive item, and the damp atmosphere of the mountainous districts considerably lowers the calorific power of coal, the tunnels being soon destroyed by the smoke and gases produced, while the possibility of making an agreeable smokeless journey into these districts, it is hoped, will attract more tourists from abroad, and thus indirectly raise the profits of the State.

QUEBEC RAILWAY.

The annual meeting of the Quebec Railway, Light & Power Co. was held last week.

Among the figures contained in the annual report, which show the remarkable progress of the company, were the following:—

Gross earnings	$724,648
Operating expenses	444,300
Net earnings	$280,348
Interest on bonds and dividends on stock, paid	$240,046
Surplus	$ 40,301

The surplus added to the surplus account advances its total credit to the sum of $462,947.

The directors were re-elected as follows:—Mr. W. G. Ross, president; Mr. Frank Ross, vice-president; Rodolphe Forget, M.P., William Price, M.P., the Hon. Senator R. Mackay, L. C. Marcoux, J. N. Greenshields, K.C., N. Belleau and Frank W. Ross.

CALGARY STREET RAILWAY.

Calgary pay-as-you-enter municipal street railway system continues successful. The Labor Day receipts show that 19,023 passengers were carried during the day. The average daily receipts are now over the $400 mark. Six more cars are to be ordered.

MONTREAL STREET RAILWAY

The earnings of the Montreal Street Railway for eleven months of the fiscal year show a surplus of $995,576, against $927,397 last year, an increase of nearly 7½ per cent. For the week ended September 18—Old Home week—the earnings were very large:

1909	$87,521
1908	73,130
Increase	$14,391

TORONTO STREET RAILWAY

Gross and net earnings of the Toronto Railway Company for the month of August as well as the earnings for the eight months of the year to August 31st were:—

		Increase
Gross earnings, August	$ 333,223 09	$ 33,290 10
Net earnings	167,166 54	16,859 65
Gross earnings year to date	2,477,310 22	202,183 60
Net earnings to date	1,211,245 89	188,638 71

Toronto Street earnings for the week ended September 18th, were:—

1909	$79,109
1908	70,995
Increase	$ 8,113

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

SEWAGE DISPOSAL.

REMOVAL OF PUTRESCIBILITY*

CHAPTER VI.

Percolating Filters

We have seen, that, the principal of the contact bed is based upon a false supposition. It was at first taken for granted, that, the actual work of breaking up the organic matters contained in sewage occupied a short space of time; and that, this space of time was represented by the period of contact. We have further seen, that, such is not the case; but, that, the period of contact is not occupied by biological action, but by a physical one of absorption. The organic matter is extracted from the sewage, and deposited on and in a gelatinous film which gradually covers the surface of the filter material. This physical action is succeeded by a biological one, only, after the liquid is removed from the filter, air taking its place.

The working of a contact bed may be summed up as follows:—

The Contact Bed{two processes} 1st physical—absorption. 2nd biological—nitrification.

In order to obtain the maximum working efficiency, it is necessary to maintain equilibrium between these two processes.

With Reference to the Physical Action

1st—Long periods of contact should be given, in order to obtain the requisite thickness of film ensuring the maximum absorption.

2nd—The periods of contact may be gradually reduced as the film increases (or the filter matures).

3rd—When the filter has arrived at full maturity, (viz., a maximum of organic matter is being absorbed) the period of contact may be reduced to a few (say five) minutes.

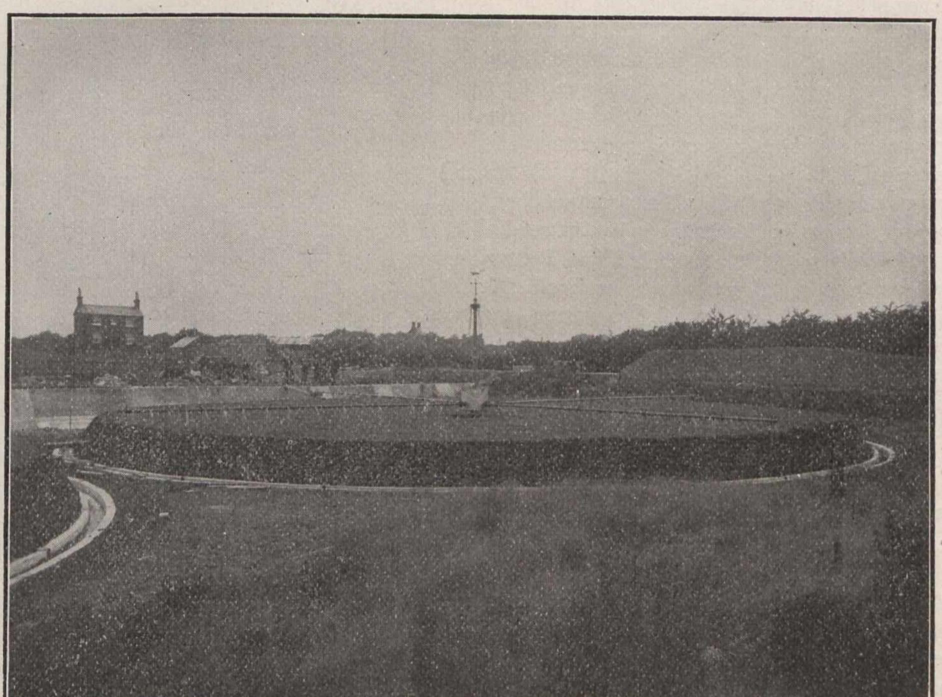
With Reference to the Biological Action

1st—With a new filter, very little matter is absorbed, consequently only a short time for nitrification is necessary.

2nd—As absorption increases, and more collected matter is to be oxidised, the period of aeration, or nitrification, must be increased proportionately.

3rd—When the filter is fully matured, and is absorbing a maximum of organic matter, then a period of aeration or nitrification, must be given to deal with the total amount of absorbed matter, otherwise the filter becomes clogged.

We have given briefly the data which exist relative to the above periods, gathered from experiments and observations made by the Royal Commission on sewage disposal, as well as those of Dr. Dunbar; of the Hamburg Institute of Hygiene. These data, although generally useful, point to a conclusion (already referred to) that, the proper, and most efficient working of any individual plant, can only be arrived at by local observations and experiments in connection with the plant in question.



Percolating Filter Bed.

Now, the question must naturally arise:—Does not the whole problem of the difficulty of maintaining equilibrium, lie in the separating of the two processes, viz., the physical and the biological ?

Let us ask ourselves the following questions:

(a). If oxygen is necessary to nitrification, why exclude it at any period?

(b). If filling a filter with sewage (as in the case of the contact bed) drives out all the air; why fill it ?

(c). If it is possible (with a mature filter) to absorb practically all the organic matters from sewage, in the space of a few minutes, then why not have oxygen present at the same time that this absorption is going on ?

The answer to all of the above questions is, the "Percolating Filter.

*These articles are specially prepared for this Review, by Mr. T. Aird Murray, Consulting Engineer, Toronto.

Santo Crimp and Dibden, when they made the "Barking" experiments, lacked information on three important points which have since been made clear, viz:

1st—The problem of even distribution of sewage over a filter, so that it came in contact with the whole of the filtering material.

2nd—A lack of knowledge of bacterial action as to when it took place.

3rd—No knowledge of the physical action of absorption, presented by the formation of the film.

The contact bed was the evolution of the lack of this knowledge. The percolating filter is the evolution of this knowledge.

The problem, at first, to be answered appeared a simple one. It was hypothecated, as a deduction from the Massachusetts experiments that, any sort of hard, broken material, arranged as a filter, would produce nitrification results at higher rates equally, or, even better than soil. The whole question to be settled was that of intermittent distribution. It was further taken for granted (as it was believed at Massachusetts) that the nitrification process took place immediately on the sewage coming into contact with the filter material.

Presumably, Santo Crimp and Dibdon said to themselves, "we will fill the whole of the filter area with sewage, so that every drop of the sewage will come in contact with the bacteria—become thoroughly nitrified—and pass off as a non-putrescible effluent." With the knowledge and data available at that time, such a deduction is understandable. The arrangement got over the whole difficulty of even distribution. It was simplicity in itself, ensuring absolute contact; and if the premises had been correct, a maximum efficiency would have resulted.

Of course, during all this period, when contact beds were accepted by many, as the final solution of sewage disposal, there were others such as Scott, Moncrieff and Professor Dunbar, of Hamburg, etc., who perceived the basic fallacy, and pointed to the necessity of thorough aeration and that, nitrification could only take place in the presence of air. Contact beds (if well looked after, and the equilibrium maintained) did their duty in producing non-putrescible effluents. This was, after all, just what was required of them. Results are what are looked to, and in most cases no one at first could complain of the results.

It was gradually found, however, that the good results at first obtained from contact beds developed diminution. Some way, or another, the equilibrium could not be maintained. The beds showed signs of clogging in many cases. The filtering material had to be washed or renewed or the beds given prolonged periods of rest. People, generally, began to ask themselves, if after all, this biological solution to the sewage question, was not like others in the past. "A great expense without finality."

Unfortunately, at first, exponents of the contact bed system, were carried away by enthusiasm. Too much was promised of bacterial action. It was held, that, even if raw sewage (from which the solids were not removed) was treated on such beds the whole sludge difficulty could be obviated. At Leeds, England, experiments in this direction were actually carried out; resulting, of course, in ultimate clogging of the beds. (See Royal Commission on Sewage Disposal—Fifth Report.)

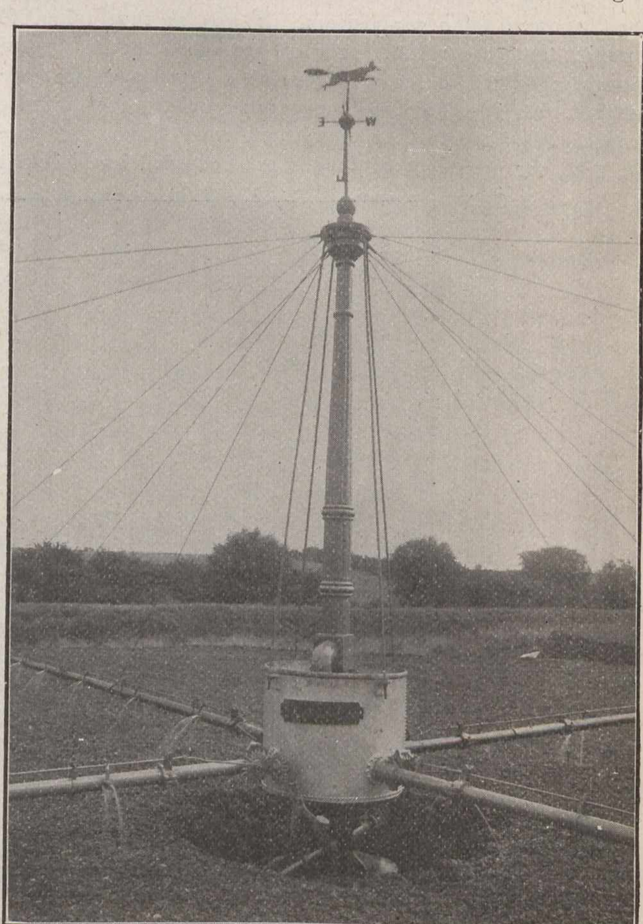
The same enthusiasm has been repeated, with reference to the septic tank treatment of solids. It was held, that, this process, finally, got rid of the sludge question.

Now, septic tank efficiency has dwindled down to a factor of 25% digestion or destruction of sludge (according to the Royal Commission) or 5% (according to German experiments). It has, further, been shown that septic treatment of solids is antagonistic to the ultimate production of a non-putrescible effluent by nitrification.

The septic method of treating solids has been combined with contact bed treatment. The combination being designated "anærobic," followed by "ærobic" treatment. The first (the anærobic) being applied to some putrefactive process by which the solids in sewage were said to be eliminated, and the second (the ærobic) by which the remaining constituents of the sewage are oxidised or nitrified.

One of the fallacies in the above combination, rests in the fact, that, there are provided anærobic conditions in both the septic tank and the contact bed; and, that, the decomposition of carbon compounds commenced in the septic tank are carried forward in the contact bed during the period of contact.

Now, it is easy to criticize after the event, and proclaim the reasons why the contact bed has not fulfilled its many promises; but, are we going to claim for the percolating filter all these promises which were at first adduced in favor of the contact bed. We trust not. The percolating system of biological sewage disposal, no matter with what preliminary system of removal of solids it is combined, does not get rid of the sludge difficulty. The sludge, like the poor, is always with us. In fact the maintenance of a continued efficiency in producing a non-putrescible effluent by means of a percolating filter, depends upon the thoroughness of the preliminary method of removal of solids from the sewage.



Sprinkler.

The main features of the percolating filter as compared with the contact bed are as follows:—

1st—The filter is never in a condition of liquid saturation.

2nd—At no period is air excluded from the filter.

3rd—Absorption of the organic matters from the sewage, by virtue of the film formation is continuous.

4th—Nitrification of the absorbed organic matter is continuous.

5th—The physical action of absorption and the biological action of nitrification are carried on simultaneously.

We at once see that the chief difficulty in working the contact bed, viz., the timing of the periods of contact and aeration, is overcome, as the two actions are carried on together. It must, therefore, become a question, as far as efficiency is concerned, not so much in the working of the filter as in the sufficiency of the area to provide (a) the necessary amount of superficial area of material to present a scum surface capable of absorbing practically all the organic matters (b) the necessary area and porosity of the material for the growth of the nitrifying organisms to keep pace with the absorption. Given these two factors in proportionate combination, and equilibrium as between the physical action and the biological one should be maintained.

Efficiency must, however, also depend upon the method of working and application of the sewage to the filter, as for instance, (a) Even distribution of the sewage over the whole surface of the filter, (b) That the sewage be not presented in the form of bulk, but broken up into drops or spray, (c) The porosity be of an open character, that the drops of sewage will not fill the pores to the exclusion of air, (d) That the passage of the drops of sewage through the filter be sufficiently slow, to give ample time for the absorptive film to extract from each drop of sewage the organic impurities contained, (e) That the liquid supplied to the filter never is under pressure, beyond the gravity inherent to each independent drop, so that there is no flushing of the filter.

If due consideration be given to the above points, percolating filters may be constructed which will perform efficient duty for terms of from 10 to 15 years without it becoming necessary to cleanse the filtering material.

The above points will receive further consideration in detail in following issues.

(To be Continued.)

SOME PROBLEMS IN CIVIC HYGIENE.

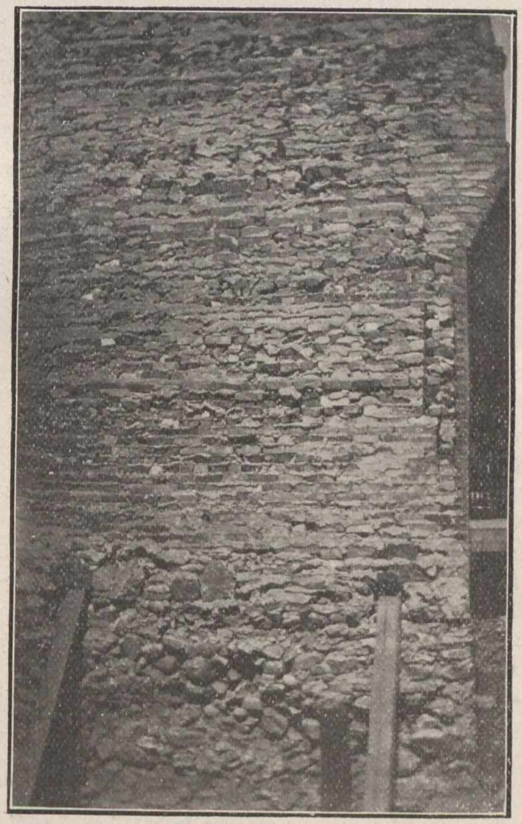
Good building and good inspection are so closely connected with hygiene and sanitation that a building department should work in harmony with the sanitary; indeed, they should be combined. There is more than the mere economic aspect. For instance, if weak cement is used in the concrete foundation, or not enough or an inferior grade of mortar in the case of a stone foundation, presently the structure is in an unsound and consequently unsanitary condition. Plumbing becomes unstable and develops defects. This applies to drainage also, all leading to complications affecting health, besides providing harbor for vermin; the latter are recognized as carriers of disease, as they transmit filth to food-stuffs and so to the occupants.

The accompanying illustration from a photo taken in one of the poorer districts of Toronto, just now being cleared for the new General Hospital, provides interesting material for study in this connection. It shows the side-wall of a story and a half building. This wall was built flush with another building, the removal of the latter exposing defective masonry and foundation work. Bricks are in every conceivable position, and with little or no mortar to hold them. A portion of the stone foundation was so bad that it evidently fell out in a heap when the neighboring wall was removed. The props have been placed in position as a belated, but somewhat useless, measure of safety. The building had evidently been built not more than three or four years. A wall of this description might readily cause an accident similar to the one which occurred but a short distance from this spot, in which a young man working on the building was killed by the falling bricks.

Stable, Seven Feet From Cottage Door.

Another source of unhygienic conditions is newly built up land. This is altogether apart from any odors or gases arising from the land, or from contamination of water in wells, etc., the conditions arising being very similar to those which have just been described. The structure settles and develops fissures and cracks and breakages, and soon becomes a menace to health.

Infrequent inspection during the process of building opens up the way for all sorts of abuses of the building bylaws. Even after the general construction is finished there are the location of stables, privies and outhouses to look after. These are often placed in the closest proximity to the rear and even to the front of the house, especially in the poorer districts, as this photo, taken on Centre Avenue, Toronto, will show. This photo shows a couple of cottages in the rear of dwelling houses and stores, making the conditions immensely worse than where located in the usual way along the street. To the left is a horse-stable within six or seven feet of a cottage door. Horse manure is well-known to be the favorite breeding place of the house-fly, which has been well named "the typhoid fly.". The danger of these breeding places to all sections of the city is apparent when we consider that the fly walks over filth of all kinds and may then fly direct to the table of the rich as well as the poor, in this way carrying and disseminating the bacteria of disease.



Faulty Masonry.

Strangely enough, even the classes who appreciate the value of cleanliness are not awake to the disease carrying propensities of the house-fly and take both insufficient precautions for keeping the fly from foods of various kinds and also in many cases fail to realize that they are providing a breeding-place for the fly at their own back doors in the uncovered garbage cans, which are so frequently found. Lack of information as to the habits of the "typhoid fly" is responsible for this; but what can be expected when the civic garbage department itself provides for a collection only twice a week in the hottest kind of weather, leaving plenty of time for fly reproduction, and also for the garbage to become fermented and putrid.

Rats and mice, which harbor in rickety, badly constructed buildings, have long been recognized as carriers of disease, but there is evidently room for a well-directed campaign against the fly, as well as against other vermin which infest the house. It would be easy to show, in this connection, that an immense saving could be effected for the city as well as for the householder, not to mention a probable decrease in the number of deaths throughout the season.

The back-door is the trouble. This is the fountain-head of civic ills, not the front door. Cut No. 3 illustrates this very nicely. The parks and the streets are important adjuncts to public health and enjoyment, but fail entirely to make amends for neglect elsewhere. In cut No. 3 we have the uncovered garbage receptacle, as well as rubbish scattered

A Back-yard in "The Ward."

about promiscuously. At the right-hand side of the illustration we have the same conditions. A food receptacle projects from the window. This is rickety and allows a free entry of flies.

It is a mistake to think that it is "only a dirty foreigner." In the first place filth is international. It is of no particular nationality. There are ignorant and dirty people of every race under the sun. It is also a mistake to think that the effects of civic neglect and ignorance can be isolated. The result of every blunder of this sort permeates the whole community, consquently the need for action.

No. 4.—Filthy Gutter.

The importance of attention to street cleaning is shown in illustration No. 4. The street is the playground of the child, and the only hope for the future of any city is proper consideration for the health, recreation and education of children, not to mention the claims of the adult to comfortable and hygienic conditions.

In making the investigations which form the subject of this article, filthy back yards were the common thing, and, as stated before, it improves matters very little by stating that this was one of the poorer districts. There should be no filthy districts in a well-managed municipality. Bakeries and butcher-shops galore were found in the closest companionship with stables and rubbish heaps, street-corner ice-cream also figurel in the proceedings, as quite a number of carts and equipments were found in the vilest surroundings, showing that the outcry against these is by no means unwarranted.

Serious as the subject may be, it seems that little in the way of improvement will be accomplished until our authorities themselves appreciate the necessities of the situation.

ECONOMICAL DEVELOPMENT OF WATER POWER.

The large number of water power developments examined by Charles T. Main, mill engineer and architect, of Boston, a very large percentage have been developed with wheel capacity sufficient to use all of the water from six to seven months in an average year, and during the remaining months water would go to waste. The period of economical development varied with each particular case; in some instances it was stated by engineers to be nine months. It is this variation which complicates the problem of the economical development of water power.

Mr. Main shows that the factors which enter into the problem are on one side the cost of the water power development and the fixed charges on the same, plus the cost of water if anything is paid for it, and on the other side the saving which can be effected by the use of such a plant.

The cost of the dam will be a constant for any size of wheel development, other things being equal. The head gates, canal, racks, feeders, wheels, wheel-pits, and tail-races must be increased in size and cost for the purpose of using a larger amount of water than the flow in the average month or six months of an average year, and the fixed charges for such increase in cost, plus the cost of water, represent the annual cost of the corresponding increase in water power.

The saving due to such increase in water power is represented by the saving in coal on supplementary steam plant, necessarily run with such a varying water power, plus the cost of attendance and supplies on steam plant if it can be shut down entirely during the months of maximum power on the wheels. As the water power is increased in size to use water for a greater number of months, the cost of such increase for each additional month makes a saving for a less number of months, and there comes a time when the saving on steam power is less than the fixed charges on the additional cost of water power plant. Where these two items balance depends upon the following conditons:

(1) Cost of running the water power plant for each increment of power.

(2) Saving effected by the decreased use of steam power.

The variation in the cost of the water power plant per horse-power is very large. The principal causes for this are the variation in head and distance from the source of supply of the water to the point of discharge. The cost of construction will also vary with local conditions.

The saving effected would also vary largely, depending principally upon the number of hours run during the day, the cost of coal, and whether by increasing the size of water power plant the auxiliary power plant could be stopped during the months in which the water power was producing full load.

At the end of 1908 the miles of electrified steam railroad track in Great Britain worked solely by electricity was 204½, and partly by electricity 200½.

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.]

DEFECT IN WHEEL.

Gaiser vs. Niagara, St. Catharines, etc., Ry. Co.—It appeared that in May, 1908, the defendant company took a number of their cars after being laid up for the winter and sent them out with an excursion party, and it appeared also that the defendant company made no careful or particular examination of the wheels before putting the cars in use. The cars were heavily loaded, and when proceeding slowly around an easy curve the flange on one of the hind wheels broke, causing a derailment and throwing the plaintiff from the car and causing her serious injury. An examination later showed that the flange broke because of a defect in the shape of an airhole, such defect having existed at the time of the manufacture.

The company were unable to show that their employees really did anything in the way of testing the wheels except to cast an eye upon them to ascertain that they looked all right; but, of course, the kind of defect in question could not be detected by an ocular inspection, but a professional inspector stated that tapping would disclose a blow-hole in a cast iron wheel if close enough to the surface to break through, which was what happened in this case. The company were held liable for the damage sustained.

19 O.L.R. 31.

There is a distinction in the degree of responsibility for apparent defects and for latent or hidden defects. The company would be in any case responsible for damages arising through running their cars with apparent or open defects, for the mere fact of using an appliance with an obvious defect is proof of negligence, but the defect shown in this case was a hidden one and difficult to detect even considering reasonable skill or diligence had been used. It was not the existence of the defect but the fact that the company failed to discharge their duty of examining the equipment thoroughly and skilfully, which rendered them liable, and had the wheels been given a **careful** mechanical inspection prior to being used, the company would have avoided responsibility.

FENCING OF RAILWAY.

Cortese vs. C.P.R.—Section 254 of the Dominion Railway Act provides that wherever the railway "passes through any locality in which the lands adjoining are not inclosed and either settled or improved, the company is not required to erect or maintain fences, gates, etc." along its line.

The plaintiff Cortese was owner of a ranch the north limit of which approached within 800 yards of the limits of the Town of Fernie, B.C., and also his lands had a frontage of 450 feet upon the defendant's right of way.

In August, 1907, a number of animals owned by plaintiff got onto the railway track and were killed by the defendant's train, and the plaintiff claimed compensation, saying that the company were bound to fence their track. The defendants disputed liability upon grounds that the lands adjoining their line were not "enclosed or improved" within the terms of the statute, and that therefore there was no duty upon them to protect their line by fencing. The evidence showed that the plaintiff's ranch had only one short fence upon it, and that other lands between the ranch and the town were mostly sold off in small lots, but only occasional lots were built upon or fenced. The statute does not say that the mere proximity to the town should cast upon the railway company any duty to fence its line, and the court exonerated the company.

13 B.C.R. 322.

FIRE FROM LOCOMOTIVE—RAILWAY RESPONSIBLE.

Fraser vs. Pere Marquette Ry. Co.—Section 298 of the Railway Act provided that "wherever damage was caused to crops, ... plantations or buildings and their contents by fire started by a railway locomotive, the company, whether guilty of negligence or not, should be liable for such damage." The plaintiff was the owner of certain marsh lands, which lands were not close by the line of the defendant company, but lay some miles distant from it. He had cured and baled a considerable quantity of marsh hay and brought same to a siding, at Wallaceburg, Ont., where it lay upon the ground awaiting shipment to the purchaser, and, while lying thus, it was burned by fire undoubtedly from a locomotive. The plaintiff claimed that the baled hay was within the terms of the above section, and brought action for the value of the hay lost. The Ontario Court of Appeal has recently given judgment, holding that the plaintiff's hay was not within the terms of the above section. The grass upon the plaintiff's land had undoubtedly been included within the general term "crop," but after being cut, cured, baled and sold, and indeed, transported, a number of miles on its way to the purchaser, the court held it had ceased to be "crop" and was now merchandise. There was therefore nothing in the Act which would cover the hay unless it had been stored in a building, which was not the case. The court also commented on the fact that whereas the act was no doubt passed for the protection of property owners along the line, this hay was grown upon lands a considerable distance from the railway and entirely outside the danger zone.

18 O.L.R. 589.

Had the plaintiff shown that the fire occurred by negligence of the company, he could, of course, have succeeded anyway, but the plaintiff made no allegation of negligence, merely saying that the fire started from a locomotive. He claimed that he was within the particular class provided for by section quoted above, but as he failed to prove that the claim was within that class, he failed altogether.

The statute has been changed at the last sittings of the Legislature, so that now it includes **any property.**

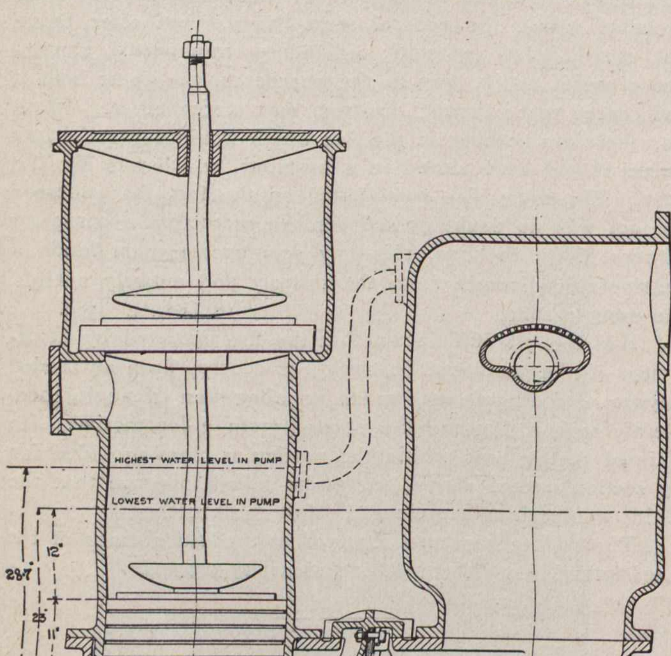
HAZARDOUS EMPLOYMENT—UNSKILLED WORKMEN.

Linden vs. Trussed Concrete Steel Co.—The defendants, who were contractors for the erection of an eight-story building in the City of Toronto, used an outside hoist for the purpose of raising materials required in the construction of the different floors. This hoist stood close to the building, and was built in sections as floor after floor was added to the building. When the roof section of the building was reached the last section of the hoist was commenced, and the foreman sent up two skilled carpenters accustomed to working on high buildings, and, as they wanted an assistant, he sent up also a laborer, named Linden, to hand material to them. The workmen proceeded by placing a platform, about eight feet square, to form a floor, upon which they worked while erecting the uprights and adding the braces outside the uprights. They had placed this platform and were busy with the braces, but had not placed any temporary railing or guard rope around the platform, when the laborer, handing material, stepped onto the platform, tripped and fell forward, pitching beyond the platform and receiving injuries from which he died next day. His widow brought action for damages suffered by reason of his death.

The jury found that it was negligence on the part of the contractors to omit to have a guard rail or rope around the small platform upon which men were expected to work at such a distance from the ground, and entered a verdict for the plaintiff. It was held also that a different degree of care was necessary as between the skilled workmen and the laborer. The former were accustomed to such work, and, in fact, made it their business, and while the work was not unusually hazardous to them, it must be considered as such to the laborer, accustomed to working on larger floors and near the ground. Reasonable prudence should have suggested that it was hazardous to order him to work at such a height, and all due precautions should have been taken for his safety. 17 O.L.R. 540.

NOTES ON VERTICAL AIR PUMPS.

The following paragraphs were written to draw attention to a point which is almost universally overlooked in designing the vertical single-acting air pumps generally applied to factory engines. The writer's attention was first drawn to it when trying to find out the cause of a bad vacuum in the condenser of a tandem horizontal compound engine, developing about 500 I.H.P. at a speed of 60 revolutions per minute. The air pump, vertical and single-acting, 2-ft. diameter by 2-ft. stroke, was driven by bell-crank lever and links from the piston rod crosshead. The vacuum in the condenser varied from 9.8 lbs. to 10.3 lbs. per square inch.



The temperature of the injection and discharge were 108° and 136° respectively. The pressure in the condenser was, therefore, from 2.3 lbs. to 1.8 lbs. higher than the pressure of saturated steam at the temperature of the discharge. This variation, as well as the great difference between the observed and saturation pressures, naturally suggested leakage of air into the condenser, but no leak could be found, nor were more air bubbles than usual visible in the discharge. The foot and delivery valves were in order, and the bucket valve, though not seen by the writer, was said by the engineman to be in order. Some other cause, therefore, had to be sought for. A drawing of the pump (see Fig. 1) supplied the clue. The bucket, to use words inserted in many modern specifications, was "a plain cast-iron bucket of great depth," with the valve on the upper surface, which, when the bucket was in its lowest position, was 11-in. above the bottom of the barrel.

Moreover, the clearance space between the delivery valve and the bucket valve when the latter was in its highest position was very large, containing sufficient water to fill the barrel of the pump to a height of 12-in. The lowest level of the water surface in the pump, and in the condenser, unless the pressure in the latter exceeded that in the pump, was therefore 23-in. above the bottom of the pump, and the condenser was water-sealed.

Now, it is well-known that even when all glands, joints, and drain taps are absolutely tight, air is carried into condensers with the injection water. If the condenser be water-sealed, how can this air escape? Some of it is entangled in the water in the form of bubbles, and is carried through the foot valve with the water, but the rest must remain in the condenser until its pressure becomes sufficient to force the water seal. If in the case referred to the depth of the seal had been only 23-in., the seal would have been forced and the air would have escaped as soon as the pressure in the condenser exceeded the pressure in the pump by an amount equal to this head, or, in other words, the vacuum would only have been 0.83 lbs. per square inch worse in the condenser than in the air pump. Unfortunately, the depth of the seal was limited to 23-in. only when the engine was standing. When it was working the pump had to discharge 1.43 cubic ft. of water every up-stroke, a quantity sufficient to raise the water surface in the pump 5.7-in. above its lowest level, or to 28.78-in. above the bottom of the barrel. And this is not all. To force water through a foot valve the head of water, or the pressure on the condenser, must exceed that in the pump by an amount depending on the resistance of the passages and the rate of flow required. In the pump shown by the figure the net area through the foot-valve grid was 0.67 sq. ft. The effective area, allowing for contraction caused by the sharp edges of the holes, would probably be about 0.4 sq. ft. The time of one revolution was one second. Assuming for the moment the foot valve to have been open, and the velocity through it to have been uniform for two-thirds of this period, that velocity would be 5.4 ft. per second, and the head required to impart it 5.5-in.

But it is quite certain that the velocity was not uniform, for the flow was greater while the bucket was ascending than while it was descending, and ceased altogether while the foot valve was shut. The maximum velocity was probably not far from double the mean, and therefore the head required to give it four times as great as that required to give the mean, that is to say, about 22-in., instead of 5.5-in. So that, roughly, the conclusion seemed to be that if the pressures in the condenser and air pump could have been kept equal, the water surface in the latter would have stood approximately from 28.7 + 5.5 = 34.2-in. and 28.7 + 22 = 50.7-in. above the bottom of the air-pump barrel.

The pressures required to force water seals of these depths would be 1.22 lbs. and 1.8 lbs. per square inch. Under such conditions the vacuum would naturally vary, rising whenever the water seal was broken and falling as the water and air pressure in the condenser rose. The argument shows the influence of the relative levels of the bucket valves and foot valves, and the areas through the latter upon the vacuum in the condenser.

As regards the former, it may be asked, Why not put the bucket valve at the bottom instead of the top of the bucket? The answer is because the change would increase the clearance space between the bucket and delivery valves, and therefore the volume of air bubbles left in the upper part of the pump at the beginning of the down-stroke of the bucket. It would also reduce the ratio of expansion, and therefore the vacuum obtainable in the pump.

Suppose the bucket valve were placed at the same level as the bottom of the bucket shown in the figure. The volume above the bucket at the beginning of the down-stroke, or the

*From the report of M. Longridge, M.A., Chief Engineer British Engine, Boiler and Electrical Insurance Company, England.

clearance space, would then be about 5.5 cubic ft. At the end of the down-stroke this space would be increased by the displacement of the bucket 6.2 cubic ft., and diminished by the volume of water flowing through the bucket valve per stroke, 1.43 cubic ft., giving a net increase of 4.85 cubic ft., which, added to the clearance, gives a total volume of 10.35 cubic ft. Suppose the water left in the clearance when the bucket begins its down-stroke to contain 5 per cent. of air bubbles. Then the clearance, 5.5 cubic ft., will contain 5.2 cubic ft. of water and 0.3 cub. ft. of air at atmospheric pressure. When the bucket has completed its down-stroke, the 0.3 cubic ft. of air will have been increased to 10.35 — 5.2 = 5.15 cubic ft., and since the expansion will be isothermal, the pressure will have fallen from 15 lbs. to $15 \times \frac{0.3}{5.15} = 0.875$ lbs. per square inch. If, however, the clearance, instead of being 5.5 cubic ft., were reduced to 1 cubic ft., and the final volume 4.85 + 1 = 5.85 cubic ft., then the volumes of air and water in the clearance at the beginning of the down-stroke would have been 0.05 and 0.95 cubic ft., and the pressure at the end of the down-stroke $15 \times \frac{0.5}{5.85—95} = 0.153$ lbs. per square inch.

That is to say, by reducing the clearance from 5.5 cubic ft. to 1 cubic ft., the vacuum produced by the air pump would be improved by nearly 0.73 lbs. per square in. In neither of these calculations has account been taken of the air brought into the pump with the 1.43 cubic ft. of water which passes through the bucket valve during the latter part of each down-stroke, as this, being the same in each case, would not alter the difference between the calculated final pressures.

As the vacuum in the upper part of the air pump is the limit to which the vacuum in the condenser can approach more or less nearly, but never reach, this speculation indicates the importance of keeping down the clearance, especially when the injection water contains much air or gas. It also suggests the reason why an air pump running few revolutions per minute produces a better vacuum than one running many, for the fewer the revolutions the less the quantity of air that must be let into the top part of the pump to prevent or to mitigate the shock when the water strikes the delivery valve.

Even in this pump the vacuum ought to be improved by leading a 3-in. or 4-in. pipe from the top of the condenser to enter the air-pump barrel at about the highest water-level, as shown in dotted lines on the figure, but the better plan would be to design the pump somewhat as shown in Fig. 24.

There is no urgent reason for making buckets without packing rings of great depth for vertical pumps, for it is not necessary that they should be absolutely tight. There must be a certain depth at the central boss in which the rod is fixed, in order to give depth and strength to the ribs or arms, but at the circumference a depth of 2-in. or 3-in. would probably be found sufficient.

The pistons of horizontal air pumps not being water-sealed are more efficient with packing rings to prevent air passing from one end of the pump to the other when the pistons wear down.

EARTH ROADS.*

By Maurice O. Eldridge, of the United States Office of Public Roads.

The cost of hauling over country roads is largely determined by the size of the load that can be hauled, the number of trips that can be made in a day and the wear and tear on teams and equipment. Steep grades as well as ruts and mud holes serve to decrease both the speed and the load. On the principal that a chain is no stronger than its weakest link, the maximum load that a team can draw is the load that it can draw up the steepest hill or through the deepest mud hole on that road.

Wherever possible roads should be located on straight lines between terminal points. In hilly or mountainous country, however, the attempts to keep roads straight between terminals often leads to the serious error of heavy grades. Straightness and grade must therefore be handled together. The best location is one which is straight in general direction, is free from steep grades, is located on solid ground and serves the largest possible number of people.

Roads should be located for the benefit of the people and not the private land owner. If county officials would apply to each badly located road some simple formula like the following they would be justified in relocating many roads. For example: The diagonal road on a 160-acre tract is .70 mile and saves .30 mile in going around it. Assuming 3,000 tons of traffic and a cost of 25c. per ton per mile, the public would save $225 by the short route. This is enough to pay the interest and sinking fund on at least $4,000, which would be sufficient to pay for the whole farm at $25 per acre. The $225 alone would in most cases pay the damage and in many other cases there would be no damage. If the short road is on a better grade than the long one the saving would be still greater.

The elimination of one or two steep hills on a line of road will frequently enable horses to draw three or four times as much as they could draw on the old road. It takes approximately four times as much power to draw loads up 10 per cent. grades (10′ vertical in 100′ horizontal) as on a level, but on a 4 per cent. or 5 per cent. grade a horse can usually draw (for a short time) as much as he can draw on a level. A 4 per cent. or 5 per cent. grade is, therefore, considered the maximum on roads subject to heavy hauling. Many steep grades may be avoided by locating the road around instead of over the hill, and it is often no further around than a hill than over it—the bail of the bucket is no longer when held in a horizontal position than in a vertical. By going around we avoid two steep hills.

If the road must pass up a steep hill or mountain side the steepness of the grade may be decreased by increasing the length of the road. In other words, eliminate steep grades by locating the road on curved or zig-zag lines, and not in a straight line from the bottom to the top of the hill. These curves should be carefully plotted and the straight stretches located with an instrument. This improves the looks of the road and does not add materially to its cost.

In studying the relation of grade to distance the following calculation is interesting: To lift a ton one foot high requires 2,000 foot pounds of energy; on a road the surface of which offers 100 pounds of tractive resistance per ton the same energy would roll the ton a horizontal distance of 20 feet. To save one foot of grade the road may therefore be lengthened 20 feet.

Roads should never be located so close to stream beds as to be subject to overflow, or on ground which is constantly damp and marshy.

The earth road should have at least six hours of sunshine each day. This can be secured either by locating the road with southern or western exposure, or by having such brush and trees as impede the drying action of the sun and wind removed. With gravel and stone roads, this is not so necessary, as a certain amount of moisture is needed on such roads, especially in the summer time.

Re-locating roads is not an engineering problem alone. One must also consider the effect of the road on those who now live upon it. Many farmers dislike to have the road placed back of their houses or out of sight of it. It requires tact and good judgment to secure a suitable location without arousing harsh antagonism.

As soils differ for agricultural purposes, so they differ for roads. Clays or soils of fine texture usually make poor

* From a paper read at the First American Congress of Road Builders, Seattle, Wash., July 4-8, 1909.

roads, especially if they contain much vegetable matter. The coarser soils, however, which contain some sand or gravel, will often make very satisfactory roads for light traffic provided they are kept in proper repair.

If the road is composed of fine clay or soil it will sometimes pay to resurface it with top soil from an adjacent field which has sand or gravel mixed with it. This method, called the top soil method, is now in successful use in Clarke County, Georgia.

The earth road can best be crowned and ditched with a road machine, and not with picks and shovels, scoops and plows. One road machine, with suitable power and operator, will do the work of many men with picks and shovels, and do it better.

The road machine should be used when the soil is damp, so as to make the soil bake, when it dries out. If it is worked dry, it takes more power to draw the machine, and, besides, dry earth and dust retain moisture and quickly rut after rains. The use of clods, sods, weeds or vegetable matter in building earth roads should be avoided because they retain moisture.

It is a great mistake to put the working of the earth road off until August or September. The surface is then baked dry and hard. It is not only difficult to work, but is unsatisfactory work when done. Earth which is loose and dry will remain dusty as long as the dry weather lasts and then turn to mud as soon as the rain begins.

By using the road machine in the spring of the year while the soil is soft and damp the surface is more easily shaped and soon packs down into a dry, hard crust which is less liable to become dusty in summer or muddy in winter.

Storm water should be disposed of quickly before it has time to penetrate deeply into the surface. This can be done by giving the road a crown or slope from the centre to the sides. For an earth road which is 24 feet wide the centre should be not less than six inches nor more than twelve inches higher than the outer edges of the shoulders. A narrow earth road which is high in the middle will become rutted almost as quickly as one which is too flat, for the reason that on the narrow road all the traffic is forced to use only a narrow strip.

Shoulders are often formed on both sides of the road which prevent storm water from flowing into side ditches, retaining it in the ruts and softening the roadway. These ruts and shoulders can be entirely eliminated with the road machine or split-log drag.

Ordinarily, the only ditches needed are those made with the road machine, which are wide and shallow. Deep, narrow ditches wash rapidly, especially on steep slopes, which is another good reason for decreasing the steepness of the grades. It is difficult to maintain an earth, or any kind of road for that matter, on a steep grade.

The width of the earth road will depend on the traffic. As a rule, 25 or 30 feet from ditch to ditch is sufficient, if the road is properly crowned. A road that is narrower than 25 feet is difficult to maintain for the above stated reason that on narrow roads the teams are more apt to track than on a wider road, causing it to rut if subjected to heavy hauling.

We should not loosen, dig up, or plow up any more of the surface of an eath road than is absolutely necessary. The road should be gradually raised, not lowered; hardened, not softened.

On flat lands, where water moves slowly, grading material should be taken from the lower ditch, and culverts supplied where waterways occur. A shallow ditch on the upper side makes it possible to give culverts a good fall. Two or more small pipes, instead of one large one of equal capacity, may be used for culverts, especially if the large pipe necessitates much grading or raising of the roadway. At least six inches of space should be left between the pipes, and earth should be tamped around them thoroughly so as to prevent a wash-out.

To prevent washing on steep roads, the water should be carried under the surface at frequent intervals from the upper to the lower side, and from the lower side away from the road. Five 12-inch pipes in a mile of roadway is about as cheap and far better than one 24-inch pipe. The water must be disposed of before it gains force or headway, or has time to damage the road.

If culvert pipes have a fall of one inch to 100 feet, the water passing through them has a velocity of about four miles an hour, but if the fall is 36 inches to 100 feet, the velocity is about 20 miles per hour, hence, a pipe laid upon a fall of 36 inches to 100 feet will have five times the capacity of a pipe of equal diameter laid on a grade of one inch to 100 feet. A 24-inch pipe, having a fall of one inch to 100 feet, will have a capacity of 3,296 gallons per minute, whereas a 12-inch pipe, having a fall of 36 inches to 100 feet, will have a capacity of 2,554 gallons per minute.

By increasing the fall, we increase the capacity of the pipe; decrease the size of the pipe necessary, and therefore decrease the cost of the culverts. Furthermore, culverts laid flat will soon fill up, but if given a good fall, they will keep themselves clear.

If much fall is obtained in a culvert pipe, the spillway should be paved. Earth should be tamped under and around the pipe in layers, and should be of sufficient depth to prevent the pipe from being broken by traffic; but under no circumstances should a ridge over the culvert be allowed, for it not only endangers the life of the culvert, but is a menace to traffic.

An attempt to drain mud holes with culvert pipe will fail in most cases. The water should be drained off by means of open ditches; the soft mud then thrown out and replaced with just enough good firm earth to make it level, after consolidation, with the surrounding surface. If mud holes in earth roads are filled with brush or stone, it usually results in two mud holes, one at each end.

Repairs should be made when needed, and not once a year after the crops are "laid by." One hundred days' labor, judiciously distributed throughout the year, will accomplish more and better work in the maintenance of an earth road than the same amount of labor expended in six days, especially if the six days are in August, September or October, when the ground is hard and dry.

Because of its simplicity, its efficiency and cheapness, the split-log drag, or some similar device, is destined to come into more and more general use. With the drag properly built and its use well understood, the maintenance of earth and gravel roads becomes a simple and inexpensive matter. Care should be taken to make the log so light that one man can lift it with ease, as a light drag responds more readily to various methods of hitching and the shifting positions of the operator than a heavier one.

The best material for the drag is a dry cedar log, though elm, walnut, box elder or soft maple are excellent. Oak, hickory, or ash are too heavy. The log should be from seven to ten feet long, and from eight to ten inches in diameter at the butt end. It should be split carefully as near the centre as possible and the heaviest and best slab chosen for the front. Holes are then bored perpendicular and at right angles to the split faces and in such a way that one end of the back slab when fastened in position will be about sixteen inches nearer the centre of the road than the front one. This gives the "set back" so that the logs will track when drawn along the road at an angle of about 45 degrees. The two halves of the logs are fastened together by stakes, these being mortised into the holes above mentioned. A cleated board is placed between the slabs for the driver to stand on.

A strip of iron placed along the lower face of the front slab will prevent the drag from wearing. The drag may be fastened to the double tree by means of a trace chain. The chain should be wrapped around the left hand or rear stake and passed over the front slab. Raising the chain at this end of the slab permits the earth to drift past the face of the drag. The other end of the chain should be passed through a hole in the opposite end of the front slab and held by a pin passed through a link.

For ordinary purposes the hitch should be so made that the unloaded drag will follow the team at an angle of about 45 degrees. The team should be driven with one horse on either side of the right hand wheel track or rut the full length of the portion to be dragged and made to return in the same manner over the other half of the roadway. Such treatment will move the earth toward the centre of the roadway and raise it gradually above the surrounding level.

The best results have been obtained by dragging roads once each way after each heavy rain. In some cases, however, one dragging every three or four weeks has been found sufficient to keep a road in good condition.

When the soil is moist but not sticky the drag does its best work. As the soil in the field will bake if plowed wet, so the road will bake if the drag is used on it when it is wet. If the roadway is full of holes or badly rutted, the drag should be used once when the road is soft and slushy. This is particularly applicable before a cold spell in winter, when it is possible to so prepare the surface that it will freeze smooth.

Not infrequently conditions are met which may be overcome by a slight change in the manner of hitching. Shortening the chain tends to lift the front slab and make the cutting slight, while a longer hitch causes the front slab to sink more deeply into the earth and act on the principle of a plow.

TAR AND ITS USES IN MODERN ROAD CONSTRUCTION.*

By E. Purnell Hooley, M. Inst., C. E., County Surveyor of Nottinghamshire, Eng.

The question, How to construct roads at the minimum of present and future expense, will be best answered by a paper entitled "Tar and Its Uses in Modern Road Construction."

It is not here proposed to enter into any detail of general road construction. Other writers will, and have, doubtless dealt as specialists in the many branches of the road question, but there is little doubt all will unite in agreeing that good roads are absolute necessities in the advancement and development of a progressive country, and that without good roads it is impossible to advance.

By roads in this case all roads, be it waterways, railways, horseways, are embraced, but for internal development and progress the ordinary highways must be the actual nerves that bring in touch the general internal public with with the outside world.

In England the maintenance of highways has become of such importance that hardly a day passes without some new proposal being made for dealing with the cost of management of the same.

Broadly, at present, all the existing English main roads are vested in the county councils. The urban and rural councils have the care of the branch of district roads. New roads have to be made by private individuals, and have to be thoroughly well constructed and properly dedicated before they are taken over by the local public authorities.

This paper is to deal with ordinary country roads, not town streets.

The question now is, how best to repair the existing roads, and America has the experience of England to guide her in the matter of expense, trouble, and very possibly avoid defeat, by carrying out modern ideas in laying out and constructing new roads on the very best and up-to-date systems, rather than having to patch up and undo the failures and disasters that the ratepayers of England are so loudly grumbling about, in the present high rates they are called upon to pay.

* Paper read at First American Congress of Road Builders, Seattle, Wash., slightly abbreviated.

Roads without proper foundations are the most expensive and disappointing to deal with, but to re-form the foundations of all the roads, 27,600 miles of main and possibly 92,300 miles of district roads of England, say one hundred and twenty thousand, would cost a sum so large that it is outside the bounds of possibility to even think of.

The general practice of all thinking road engineers now seems to be, to treat the present roads as the foundations upon which to build roads of a permanent character.

In America it surely must be the only wise course to thoroughly construct new roads for the sake of the present and future road users.

Leaving all questions of foundations to be dealt with by other writers with the general proviso that all roads should or must have foundations, the writer will turn his remarks to surfacing.

Where roads have a first-class face, and it is possible to tar-wash that face at least once every four months at a cost of about 3 cents per square yard, tar as a surface binder will undoubtedly be a success in temporarily holding the surface of an ordinary macadam road together, but there its help and benefit ends. It will not make a weak road, subject to disintegration from below, a strong one; it will not hold material together when subject to disintegration from frost and thaw, for it certainly will not hold a road together in any part which mere surface treatment does not reach.

But a road composed throughout of thoroughly tarred material will do all that it has here been stated surfac treatment only will not do.

Tar macadam has been in use for many years in England; often it has been a success where least expected, and more often it has been a failure (and when a failure has to be faced it is by far the best plan to go to the root of the trouble and endeavor to ascertain its cause, rather than attempt to continue the failure on the chance of success later).

The failure of tar macadam has been due to the inability to secure the adherence of the tar to the material that was to be tarred. The slightest moisture on the material or chilling of the tar means failure of adherence, and the use of a soft material that would allow of adherence means a failure through the road giving way as a whole.

No material can be used for the manufacture of tar-macadam that is not hot or heated, and the more the material is heated so as to allow the centre of the material to be the hottest part, the better will be the tarring, but the weaker the material.

The materials that have previously proved the most satisfactory in tar macadam work have been limestones from varying neighborhoods, but if limestone has been subjected to a temperature sufficient to heat the stone throughout, the very nature will have been burnt or dried out of the stone, and the fact that tar is afterwards applied will not secure a road material that will stand anything but foot-passenger traffic for any length of time. The difficulty also arises that to heat sufficiently a large quantity of material, a drying and store place of such dimensions is necessitated as to make the cost almost prohibitive, apart from the large amount of manual labor required in so many times handling the material.

In the neighborhood of large iron works slag has been successfully used as a road material, and when it was possible to convert that slag into tar macadam a fair result has been obtained.

Those who know anything of iron as made in England know of the large heaps of refuse which surround the big blast furnaces, and also know the disposal of the slag has long been a source of anxiety to the iron work owners.

While watching the slag pouring out of a furnace one day, it struck the author that the whole trouble of heating the slag for the manufacture of tar macadam was unnecessary, for here was the material that later would be in an ideal condition ready, and of such a nature that the very best results in road construction could be obtained.

He had a breaking and tar mixing plant constructed. The hot slag was brought from the furnaces in large caldrons, each containing about four tons, and allowed to stand for about twenty-four hours until consolidated. It was then tipped onto a cooling ground, and about twelve hours later, when the outside temperature of the slag was about 160° F., broken up either by hand or by means of a dumping hammer, and conveyed, while the outside was still warm, to the breaker. It was then passed through breakers and screened to form varying gauges.

The centre portion of the material, which was still the hottest, was passed into a steam-heated cylinder constructed to keep the material in motion, heated tar, pitch, and other compounds being poured into the same cylinder so as to form a perfect bath, and the whole turned and churned up. From the cylinder it was deposited into the railway trucks and was ready for use.

The material is delivered onto the roads in the county can be produced at the works in a most remunerative manner for eight shillings and six pence, or say, two dollars per ton, to which, of course, must be added railway freights when conveyed to a distance.

The material is delivered onto the roads in the country of Nottinghamshire, with a railway journey of thirty miles, and up to three miles of road cartage, allowing for a thickness of three inches when consolidated, of road crust, at a cost of from 60 to 70 cents per yard super.

This material has been in use for seven winters on a road with a waterlogged, roundstone foundation, that previously had to be coated with 2½ inches of Leicestershire syenite each year, and is now in good and perfect condition with practically no surface dust—and absolutely no dust, as previously was the case, from attrition and disintegration.

The scavenging is reduced to the removal of horse droppings and earth brought from the adjoining fields.

This material has been registered under the name of "tarmac," to keep it from being confused with the old-fashioned tar macadam, and it is different from the latter inasmuch as in its use, the road surface is composed of a good wearing material 1½ inches in gauge, with a minimum of tar to waterproof it and form its proper adherence, instead of, as previously was the case in tar macadam, being composed of very fine particles of softer stone, with a large amount of tar only partially adhering to it.

To construct a good tarmac road it is necessary to have an ordinary road as a bottom, or as good a foundation as is possible; if a waterproof one is desired, then it must be of tarmac. The bottom layer of tarmac can be of four-inch gauge material laid securely and rolled with the interstices filled up with finer tarmac and the whole steam rolled. The next layer should be about ¾ of an inch in thickness of ⅜-inch tarmac and left unrolled; on this should be supplied a 2¼-inch gauge tarmac, rolled into the ⅜-inch, and when rolled, ⅜-inch tarmac should be swept with a brush into every crevice or open joint. Then a further layer of ⅜-inch tarmac should be applied as before, unrolled, and, as a last coating, a perfect layer of 1½-inch tarmac should be applied, and after the roller has passed twice each way over its face, ⅜-inch tarmac should again be swept into each crevice so that a perfect face is presented. The whole must again be steam rolled by a steam roller being passed over three or four times, and the road is at once fit for traffic.

If the traffic will not allow of the whole width of the road surface being stopped at one time, the work can be carried on by taking half the width at a time, but care must be shown in leaving each layer of material to form a Greek key lap.

It is bad work to attempt to feather the edges or thin down a tarmac road. When a patch is applied or a coating ended, it should be finished with a square or butt joint; if otherwise dealt with, the edges will fray or waste away.

The camber, or cross fall, of a tarmac road should not be greater than 1 in 50 from the centre to the sides and a perfect formation should be carried throughout from the foundation so that the whole thickness should be complete.

There is no need for pitched gutter courses in tarmac roads, but in lieu a final washing of boiling tar to a width of 18 inches or 2 feet from the curbing to form a gutter prevents scouring and assists sweeping up in cities and populous places.

In the maintenance of ordinary macadam roads great difficulty is experienced in patching holes and depressions.

A most satisfactory patch can be carried out by means of tarmac; and the practice is followed on all the main roads of Nottingham, either for ordinary wear in water-bound roads or to repair disturbances in tarmac roads.

It is necessary to cut out to the required depth any portion of the road surface that is loose, worn, thin or disturbed, so as to leave a sharp cleanly defined edge. This must be swept clean from any sign of dust in dry weather, then a thin coat of ⅝-inch tarmac should be applied with the greatest thickness at the edges. The necessary material for the patch filling is then applied, well and carefully rammed with a hand rammer, and when rammed any interstices filled with ⅝-inch tarmac, rammed again, and when nearly dry the whole should be swept over with dust from the adjoining road surface. A perfectly level neat patch is thus formed.

A length of tarmac road adjoining a level crossing immediately outside the town of Newark, Notts, and adjoining the Midland railway station, previous to treatment with tarmac in 1898, was annually repaired by the use of 2¼-inch gauge water-bound Leicestershire syenite, the best available road stone of the neighborhood. When first laid the tarmac cost two shillings four pence per yard super. This portion has once been refaced by the application of a 1¼-inch coat of tarmac, in 1905, and to-day is in perfect condition.

A main road a mile and a half outside the city of Nottingham (population 300,000) is greatly used by farm carts, motors and motor lorries, as well as ordinary vehicular traffic of all kinds. It has been laid four winters and has had no other material applied to it. It is practically free from dust and is absolutely an ideal road for all types of self-propelled and other traffic.

RETAINING AND REVETMENT WALLS.*

Richard M. Garrett.**

The revetment put in by the Missouri, Kansas & Texas Railway, along the Missouri River for shore protection is built similar to those along the Missouri River, which have been made by the Missouri River Commission, and averages about 60 feet in width. The first work put in by this company was during 1897, and extends from the east city limits of St. Charles down the river for 9,000 feet. A rock dike was first built out into the river, and a boom made of heavy timbers was anchored to lower side of dike, and laid parallel with it. From this boom the mat was started, having its full width at the beginning. The mat was first woven and sunk, and then the bank was graded by hydraulics to a slope of 2 to 1, and then paved from the top down.

In 1903, work was extended 3,000 feet down the river, and was done in the same way as the first section, with the exception that the mat was anchored at the starting point with piles instead of the boom.

In 1906, revetment was again extended 7,200 feet. On this last section the bank was graded to a slope of 2½ to 1 in advance of weaving the mat, as considerable trouble had been experienced on former works, on account of material from the bank covering the mat, so that a connection between paving and mat could not be properly made.

Grading on this section was done with a small hoisting engine on a barge, as follows:—A derrick was erected on barge, having a boom long enough to reach the top of the

*Abstract from Bulletin No. 108 of the American Railway Engineering and Maintenance of Way Association.

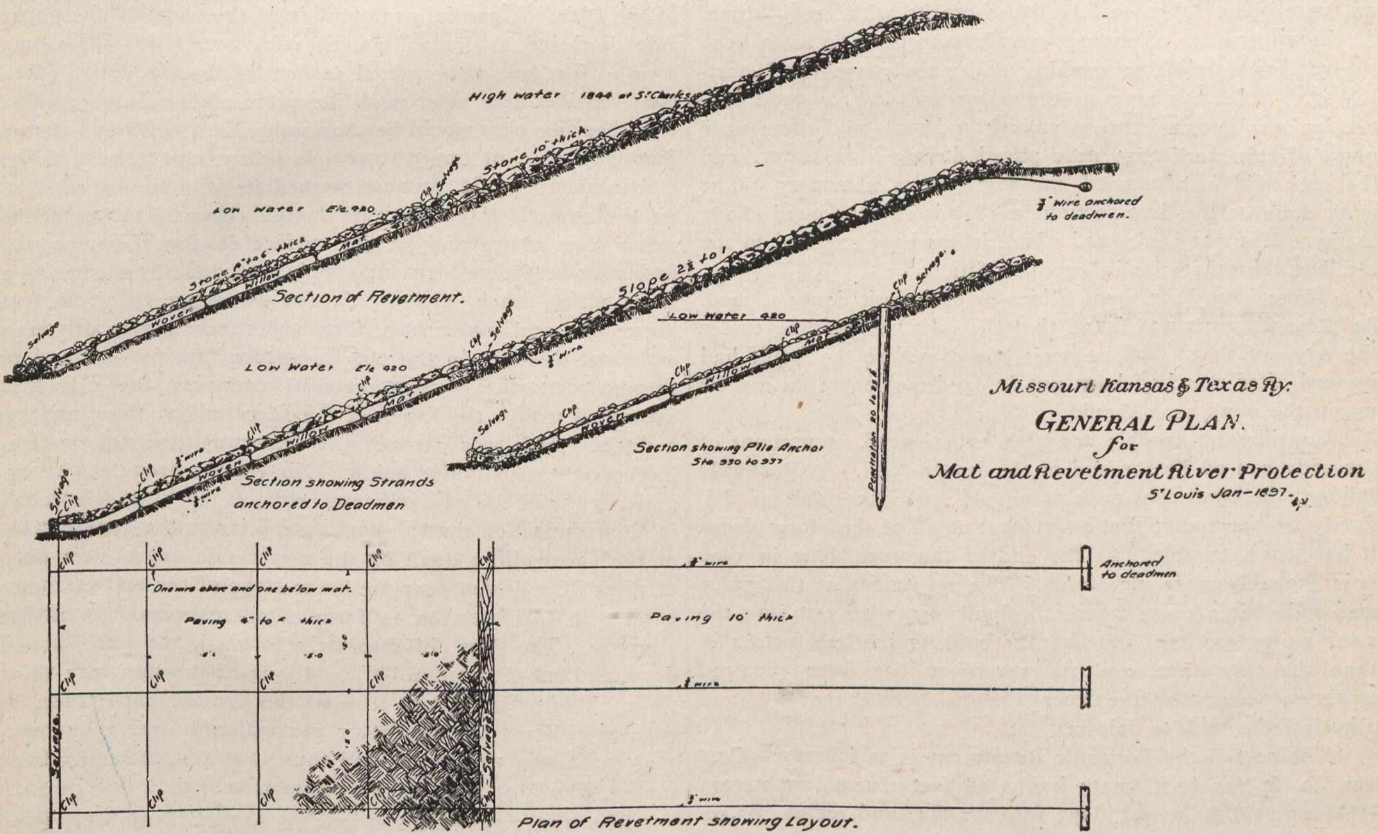
**Resident Engineer, Missouri, Kansas, and Texas Railway.

bank to be graded, a No. 3 wheeler scraper pan was pulled along this boom from the barge to the top of bank, by a mule on the bank, and was held in place by two men and filled, and then dragged down the bank by the hoisting engine. The beginning of mat was anchored to deadmen on top of bank about 200 feet up stream, and weaving was begun about 100 feet back on the old mat, so that full width of new mat was gotten where the unprotected bank commenced.

In 1908, 4,000 feet of revetment was put in on north side of river just above Boonville Bridge. At Kingsbury, there is a siding on the west side of main line, and out of the south end of this track the spur was built to the river; this required a main track of 6,500 feet in length, and a spur track 900 feet in length. Track was laid about 5 to 20 feet from top of bank all along where revetment was to go in, so that rock could be unloaded and used with as little handling as possible. The bank was first graded to a slope of 2½ to 1 by teams; the mat was then woven and sunk, and the slope paved from bottom up. It is the description of this last section that will be given, as the only differences between this and other works are those mentioned.

as the natural surface. Grading was never carried further than 200 feet in advance of weaving, as the barges from which the mat was being woven would protect the bank from the current for this distance.

The mat was woven 60 feet wide with a selvage edge on out-stream side, and sunk parallel with shore with the inner edge about 3 feet above the average low water. The mat was strengthened with five double rows of ⅜-in. galvanized steel cable (7 strands No. 11 wire) laid longitudinally one above and one below, and anchored with a double row of similar cable laid transversely every 15 feet and fastened to deadmen, buried 3 feet deep and located 15 feet back from the upper edge of slope. At every intersection of the longitudinal with the transverse rows, the four cables are fastened together with a ⅝-in. "U" clip. The transverse rows are fastened to deadmen by wrapping one cable around the deadmen twice and then fastening it to the other cable with two ⅜-in. "U" clips. The deadmen are pile butts about 3 feet long, and the object in fastening the cable to them, as mentioned, is to allow the cables to slip when loaded, so that the same strain will be on both the under and upper cables.



The bank was about 18 feet higher than what was taken as the average low water; the soil is mostly a very fine sand and very little gumbo; the bank was clear of timber and brush, but there were several large snags along where mat was to lie that were taken out by sawing, blowing-out and using teams and line.

Shovelers first dug along the top of the bank and shoveled down all the perpendicular and overhanging points, so as to make it safe for a mule to walk along close to the edge; then a two-mule team plowed two or three furrows as close to the edge of the bank as team could be gotten. The mules were then hitched to a "Go-Devil," constructed of two 2 x 10-in. plank 8 feet long, fastened together at the front end and flared to about 4 feet at the back end; it required one man to drive the mules and one man to weight the drag. This was then run along the back side of furrows, and the loose earth shoved toward the river. After the bank began to slope, two or three slips were put on, and the bank brought to the desired slope.

It will be seen that only about half of the material in slope is moved, as the excavation makes the fill and does not wash away, as it does when grading by hydraulics. It was found that with this material the filled portion was as solid

The willows were cut from bank of river about one mile above mat, and were hauled by wagons, hauling about 1.6 cords to the load. The road was bad at times, and it required a snap team to pull out of the mudholes, but most of the time the road was in good shape. It required 0.6 cord of brush to 100 sq. ft. of mat; average thickness of mat, about 18 in.

Weaving was started at a point at upper end and gradually widened out to full width, anchors being placed for longitudinal cables in top of bank about 100 feet above upper end. The mat was woven with four small barges fastened together, so as to make the desired width. Fingers of skids were built on barges out of 3 x 12-in. plank, 24 feet long, and spaced 5 feet apart, extending from the water level on up-stream side to an elevation of 3 feet above floor of barge at a point about 3 feet back from down-stream side. Spools of cable were set under the down-stream ends of fingers at the proper position for the under longitudinal cables, so that cable would unwind as the barge was let down stream. Barge was anchored at the shore end to the track, and at the upper end to the mat that had been woven. Mat was woven on the barge as high as the fingers would permit, and cable and clip men would pull the under cables through the mat by means of an iron hook about 2 feet long, and the top longitudinal cables were run under these, and all were fastened together with a ⅝-in. clamp. Barge was then pulled from under the mat with a team, and anchor ropes slacked just enough so that about 3 feet of mat would be left on fingers. Top longitudinal cables were cut off the reel on shore in lengths of about 100 feet, and spliced together with a square knot on mat, as the work proceeded.

Mat was sunk and held down with stone weighing from 30 to 50 lbs. An average of 1.5 cu. yards of stone being used to the 100 sq. ft. of mat. Rock for sinking was unloaded from cars onto shoulder of slope and wheeled in wheelbarrows out onto the barge, anchored lengthwise across the mat, and dumped along the edge of barge. Mat was sunk from shore side out, so that it would settle away from shore and the transverse cables would tighten up. Sinking was kept at least 100 feet back from weaving barge to prevent pulling the mat off the barge. When the water was higher than the proper elevation for the shore side of mat, it was sparred out, so that in sinking it would settle to its proper position.

The rock for paving slope was unloaded from cars onto slope and rolled down to the bottom, where paving was begun. Paving is 10-in. thick, and was paved from the bottom up, care being taken to fill all the cracks with small stone. At the upper edge of paving, spawls were piled so as to keep the surface water from washing under the paving and starting it to roll. As long as the water was low, a good connection was gotten between paving and mat, and there were parts of this work that were paved during high water, and the rock slid in afterward, making repairs necessary. The work done on the first section in 1897 is in very good shape to-day. The mat has rotted where it has been exposed to the air, but the paving is in good condition.

There have been some slides on the work done in 1906. At these places it was found that the rock was settling under the edge of mat. These were places where the bank had washed after mat had been put in, and the mat does not lie up on the bank as it should.

Considerable trouble has been experienced on account of the eddy caused by the end of the revetment. At Boonville Bridge, the revetment ends at an old rock dike, and no difficulty is expected at that point; but at all of the other places it has given trouble. At the end of the work done in 1906 it is probably more noticeable. The revetment at this place was ended at a place where the bank extended out into the river 400 or 500 feet, and now the bank is 100 feet further in than the revetment, and the revetment has been repaired twice on account of the river washing behind the end, and allowing the rock to fall in.

The cost of the Boonville Revetment is as follows:—Cost per lin. ft. for 60-ft. mat; banks 18 feet above low water; laborers paid $1.50 per day; foremen $4, and teams, $3.50. This does not include interest on investment or make allowances for rainy days and moving, but is the actual cost. The contractors' profit is included in the track work only:—

			c.
Grading bank per lin. ft.			.13
Weaving mat			.410
Sinking mat			.110
Paving slope			.230
Willows, including cutting, hauling and unloading, and price paid landowner			.340
Rock, at 0.75, delivered on site (2.3 cu. yds. to the lin. ft.)			1.730
Unloading rock			.120
Spotting cars with teams			.004
Hauling deadmen and cable			.018
Taking out snags			.030
Cable and Clips:			
1260—⅝-in. clips @ .06	75.60		
746—⅜-in. clips @ .035	26.16		
107150—⅜-in. cable @ 1.00	1071.50	1173.26	.300
Deadmen, 270 @ 50 = $135.00			.035
Track, 7,500 lin. ft.			
Labor, grading, including contractors' profit.			
Labor, laying	$1493.20		
Taking up	1000.00		
	4075.10		
Bridge across draw	460.00		
	4535.10		1.140
Grading spur to quarry, $393.50			.074
Total cost per lin. ft.			$4.67

W. S. Kinnear (Assistant General Manager, Michigan Central Railroad), in a written discussion on slides adds the following:—The writer has had quite a little experience with embankment slides, under various conditions, and recalls a sidehill embankment which gave us endless trouble from the first heavy rainfall after its construction until slide was finally checked, which will be explained hereafter. As mentioned, the embankment was on a sidehill, and initial steps to remedy the trouble consisted in hauling material by train and filling as rapidly as bank would go out below. It was found after a short time this would be practically an endless performance, and measures were taken to ascertain the cause of the slide. A careful examination of the slope on the upper side disclosed a sloping waterbearing strata of clay, some 8 or 10 feet below the actual surface of the side-hill. For a considerable time after each heavy rainfall the top of this waterbearing clay would be thoroughly saturated, and it was found, in case of any disturbance below, the weight of the embankment would produce immediate slipping or sliding on the smooth clay. It was thought best to intercept the water from above and let the surface of clay, carrying the embankment below, dry out. This was done by means of a sheet piling ditch, about 3 feet wide, some 15 or 20 feet above the embankment. The sheet piling was driven a sufficient distance in the clay to secure firm footing and to prevent distortion. The material overlying the clay was excavated within the limits of the sheet piling, thus forming a ditch, which was carried to a waterway through the embankment to an outlet below. No further trouble was experienced, and the embankment held. It might be mentioned in this connection that a short time prior to the construction of the sheet piling ditch on the upper side one or two rows of piles were driven near the lower slope of the embankment, hoping in this manner to form some resistance to further slipping. The piles did absolutely no good, and were carried down and out of position by the slipping bank in a very short time. The writer thinks it is of the utmost importance, in case of either embankment or excavation slides, to immediately ascertain the cause, and thus save a great many false moves, which, at best, are very expensive.

The writer has also had trouble a great many times from old embankments, and has in mind one or two cases where high banks some 20 or 30 years old gave considerable trouble after periods of ordinary rainfall, due to conditions which we could not discover. We found the best treatment under such circumstances was to build perpendicular blind drains down the slopes, connecting with a similar blind drain parallel to the foot of the embankment. These drains were placed from 50 to 100 feet apart, as conditions seemed to demand, and consisted of an excavated trench some 3 or 4 feet deep, filled with one-man stones. These were carried entirely down the slope and brought up against a similar trench filled with stone carried along the foot of the slope throughout the length of the slide. We have not found one single instance where his method was not effective in stopping trouble.

It has been the writer's experience that slides in old embankments were likely to occur after the construction of a second track roadbed. This was undoubtedly due to an interpretation of the drainage and pressure of the new bank upon the old. Our method of treatment in such cases was similar to that described immediately above.

The writer has found from experience that landslides are very difficult to contend with, and in the majority of cases about the only remedy which can be applied is to keep the track as near grade as possible and wait for a new and permanent condition of the slope to become established. A study of the possibility of diverting certain surface water is always advisable under such conditions, and, in some cases, may prove of benefit, although we have always found, where a mountain side or steep sidehill is disturbed by the construction of a line of railroad, trouble will undoubtedly be experienced, which it will take years to overcome. The writer is not a believer in driving piles either in embankments or excavation to hold sliding masses.

INTERNATIONAL CONFERENCE OF ELECTRICAL UNITS AND STANDARDS, 1908.

The "blue-book" report of the International Conference on Electrical Units and Standards, held in London, England, in October 1908, has just been distributed—eleven months after the conference closed.

The resolutions are of considerable interest, and we give them in full. Two of the specifications prepared are also re-published, as they may be taken to represent the most recent decisions on these matters.

Schedule B.—Resolutions.

The conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electro-magnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass and the seconds as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimetre, gramme, and second; (3) the volt, unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimetre, the gramme, and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions:

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.5421 grammes in mass, of a constant cross sectional area and of a length of 106.300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification I. attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II. attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electrical pressure of one international volt.

Specification I.—Specification Relating to Mercury Standards of Resistance.

The glass tubes used for mercury standards of resistance must be made of glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millmetre. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed 5 parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0°C as possible. The measurements are to be corrected to 0°C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimetres) and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula.

$$A = \frac{0.80}{1063\pi}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) \text{ ohm.}$$

where r_1 and r_2 are the radii in millimetres of the end sections of the bore of the tube.

The mean of the calculated resistance of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

Specification II.—Specification Relating to the Deposition of Silver.

The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that no more than 30 per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the kathode of platinum. The current density at the anode shall not exceed one-fifth ampere per square centimetre and at the kathode 1-50 ampere per square centimetre.

Not less than 100 cubic centimetres of electrolyte shall be used in a voltmeter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the kathode.

Before weighing, any traces of solution adhering to the kathode must be removed, and the kathode dried.

Schedule C.—Weston Normal Cell.

The Weston Normal Cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification may be taken, provisionally,

(Continued on Page 360).

ENGINEERING SOCIETIES.

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

QUEBEC BRANCH—

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

TORONTO BRANCH—

96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—

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

VANCOUVER BRANCH—

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

OTTAWA BRANCH—

Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

MUNICIPAL ASSOCIATIONS

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

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

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

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

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

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

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

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, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

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

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

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

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

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

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

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

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

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

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

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

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

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, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Rd., Halifax, N.S.

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

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

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

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

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

COMING MEETINGS.

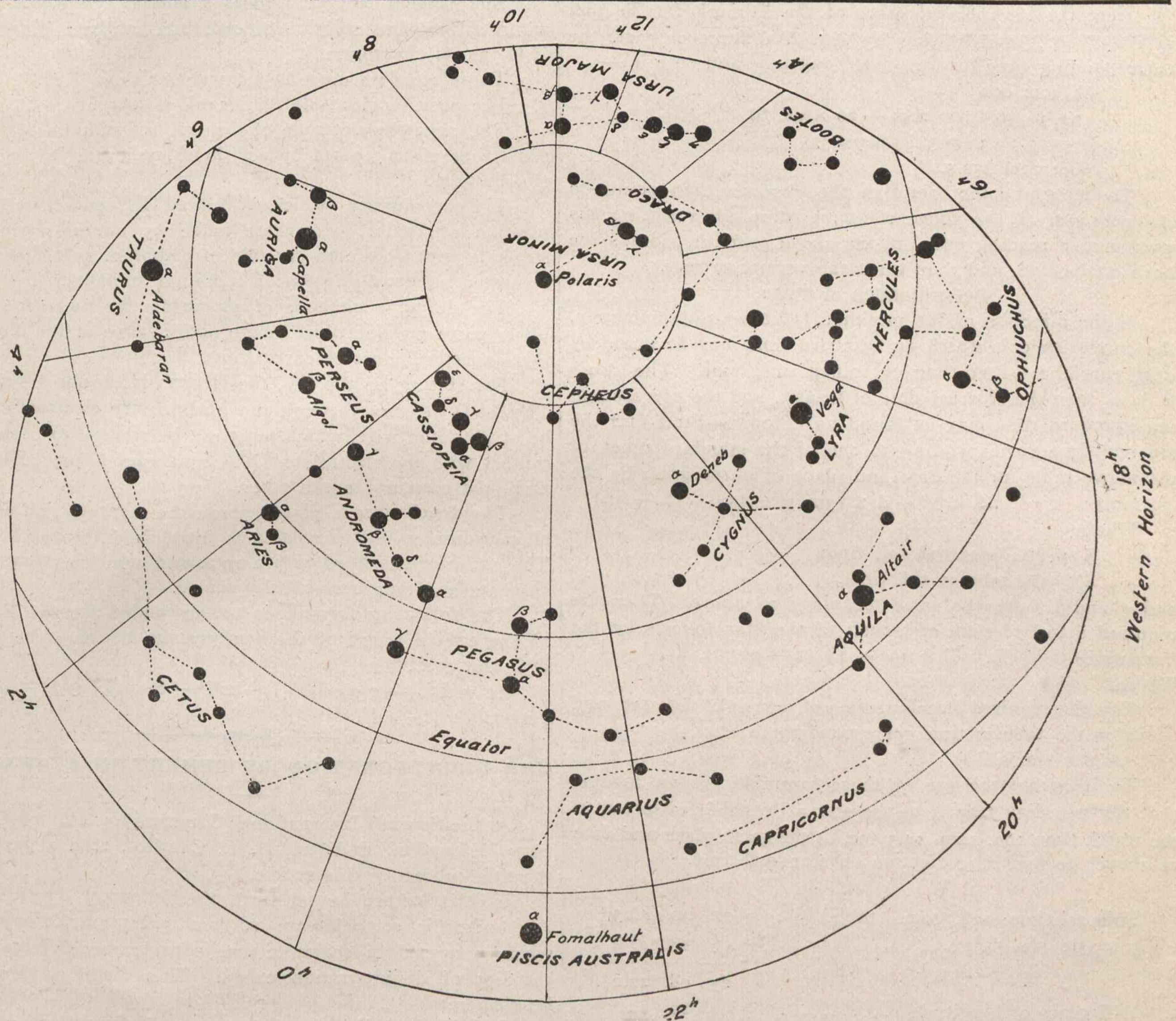
American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

American Society of Municipal Improvements.—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

Royal Architectural Institute of Canada.—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

National Gas and Gasoline Engine Trades Association. Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

ASTRONOMICAL PAGE



Star Map for October 1st, 1909, 10 p.m.

CUT HERE FOR REFERENCE.

STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., OCTOBER 1st, IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for October 15th at transit across the meridian of 5h W. of Greenwich.

Star	Mag.	R. A. h. m. s.	Decl. ° ′ ″
α Andromedœ	2.1	0 03 43.5	+ 28 35 36
β Cassiop..............	2.4	0 04 22.3	+ 58 39 12
α Cassiop..............	2.5	0 35 23.5	+ 56 02 36
γ Cassiop..............	2.3	0 51 16.2	+ 60 13 43
α Ursæ Min. (Polaris) ..	2.1	1 27 31.5	+ 88 49 26
α Arietis	2.2	2 02 05.2	+ 23 02 13
α Tauri (Aldebaran)....	1.1	4 30 44.3	+ 16 19 47
α Aurigæ (Capella)	0.2	5 10 00.9	+ 45 54 22
β Ursæ Maj.	2.4	10 56 21.7	+ 56 52 00
α Ursæ Maj.	2.0	10 58 07.3	+ 62 14 16
γ Ursæ Maj.	2.5	11 49 02 8	+ 54 11 49
δ Ursæ Maj.	3.4	12 10 55.3	+ 57 32 07
ε Ursæ Maj.	1.8	12 50 01.1	+ 56 27 04
ζ Ursæ Maj.	2.1	13 20 15.1	+ 55 23 05
η Ursæ Maj.	1.9	13 43 56.8	+ 49 45 58
α Lyræ (Vega)	0.1	18 33 51.9	+ 38 42 10
α Aquilœ (Altair)	0.9	19 46 22.0	+ 8 37 50
α Cygni................	1.3	20 38 21.0	+ 44 57 38
β Pegasi	2.4	22 59 24.0	+ 27 35 40
α Pegasi	2.6	23 00 15 9	+ 14 43 14

Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on October 1st, 1909, for places in longitude 5th (= 75° W.) and at certain standard times T:

T	Sid. Time	Lat. = 44°		Lat. = 48°		Lat. = 52°	
P.M. h. m.	h. m. s.	A ° ′ ″	a ″	A ° ′ ″	a ″	A ° ′ ″	a ″
8 00	20 40 26.6	1 33 46	— 8	1 40 53	— 9	1 49 45	— 9
8 30	21 10 31.5	1 29 07	—11	1 35 56	—12	1 44 25	—13
9 00	21 40 36.4	1 22 55	—14	1 29 17	—15	1 37 13	—16
9 30	22 10 41.4	1 15 14	—17	1 21 02	—18	1 28 16	—20
10 00	22 40 46.3	1 06 13	—19	1 11 20	—21	1 17 44	—22
10 30	23 10 51.2	0 56 00	—21	1 00 21	—23	1 05 47	—25
11 00	23 40 56.2	0 44 47	—23	0 48 16	—25	0 52 37	—27
11 30	0 11 01.1	0 32 45	—24	0 35 18	—26	0 38 30	—28
12 00	0 41 06.0	0 20 07	—25	0 21 42	—27	0 23 40	—29

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.

T = the time for October 1st.

L = the longitude.

d = number of days elapsed since October 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on October 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 38′ 34″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: S = S′ + d × (3m 56s.555) — (L — 5h).

Where

S = the required sid. time.
S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— T = T′ + (α — S) (1 — 0s.16).

Where

T = the required standard time of transit of the star, and
T′ = the tabular time corresponding to S′.
α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star α Pegasi is observed at the watch time 10h. 12m. 14.5 sec. at the same place and date as above; to find its correction on standard time.

		h.	m.	s.
Sidereal time, 10h. 00m. (table) ...	=	22	40	46.3
7 × (3m 56s. 555)	=		27	35.9
		23	08	22.2
Difference of longitude	=		20	00
S	=	22	48	22.2
R.A. of star	=	23	00	15.9
α — S	=		11	53.7
11.9 × 0s.16	=			1.9
Equivalent mean time interval	=		11	51.8
T′	=	10	00	00
T	=	10	11	51.8
Watch	=	10	12	14.5
Watch fast	=			22.7

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

In a paper on steam turbines read before the Incorporated Municipal Association, at Manchester, by Alfred S. Blackman, borough electrical engineer and manager at Sunderland, the author estimated that the maintenance of a steam turbine plant, consisting of turbine, alternator and condensing plant, should not exceed $500 per year per 10,-000,000 generated, and in many cases would be less than this.. He quoted some figures on the consumption of his 2000-kw turbine, as follows: Steam with 27½-in. vacuum, 17.07 lb. per kw-hour on one test and 17.1 lb. on another. The cost of oil per turbine, generating 9,000,000 kw-hours during the year, was $64, and for the auxiliaries $88.12 for the year.

INTERNATIONAL CONFERENCE.

(Continued from Page 357).

as having, at a temperature of 20°C., an E.M.F. of 1.0184 volts.

Specification Relating to the Weston Normal Cell.

The Weston Normal Cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8-3 H_2O) as its electrolyte.

The electrolyte must be neutral to Congo Red.

The positive electrode of the cell is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam.

The depolarizer, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqeuous solution of cadmium sulphate.

The different methods of preparing the mercurous sulphate paste are described in the notes. One of the methods there specified must be carried out.

For setting up the cell, the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolarizer is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits O°C and 40°C.

$E_t = E_{20} — 0.0000406\ (t - 20°) — 0.00000095\ (t - 20°)^2 + 0.00000001\ (t - 20)^3$.

THE DISINTEGRATION OF CEMENT IN SEAWATER.

At the Seventh International Congress for Applied Chemistry in London, England, H. L. Chatlier, read a paper on the title subject of this article.

In this lecture he set forth the following conclusions: All hydraulic cements are without exception disintegrate when immersed in seawater, but considerable difference in rapidity of disintegration exists. This disintegration will be slower:

(1) The smaller the percentage of aluminum, a comparatively small amount of aluminum, in fact, 2% is sufficient to bring forth all disadvantages of the cement.

(2) The greater the coefficient, at least with the common Portland cements. Of course it is a fact that under the usual conditions an increase of the coefficient will bring about a crumbling to powder cooling off, which influences the mechanical resistance in an undesirable quick time.

(3) The quick setting cements containing a high percentage of calcium sulphate and high coefficient can produce very satisfactory results. The reduction of the resistance with a simultaneous increase of the coefficient is less than is experienced with Portland cements, because the existence of calcium-sulphate, as found by Candlat, will tend to counteract the crumbling of cement when cooling off.

(4) An addition of Puzzolan, especially of burned clay and doubtless a good quality of trass will aid all hydraulic products to a high degree of chemical resistance.

Through binding of the calcium in insoluble combinations an edulcoration will be counteracted, as well as an increased porosity of the mortar.

(5) The density of the mortar which has been known a long time is still the chief factor for the conservation of mortar in seawater. In this respect the addition of puzzolan regardless of any direct chemical action, adds considerably to obtain a more dense concrete. This at least is the conviction of the author from extensive experiments.

In a discussion on the above Feret stated that in some details the above does not correspond with experiments conducted by him.

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.

Quebec.

COMO.—Tenders will be received up to Thursday, September 30th for macadamizing eight miles of road. A. W. Mullan, Secretary-treasurer, Hudson Heights, Que.

MONTREAL.—Tenders will be received up to Wednesday, the 29th September, for the supplying and installing of a complete Heating Plant in the Corporation Shops on Grand Trunk street. L. O. David, City Clerk.

QUEBEC.—Tenders will be received until Thursday, October 7, for the construction of a dam on Kipawa River, County of Pontiac. Plans may be seen at the offices of J. G. Sing, resident engineer, Toronto; J. L. Michaud, Merchants Bank Building, St. James Street, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

Ontario.

BARRIE.—Tenders for the construction of the sewage outfall works in connection with the Allandale sewers, now under construction, were opened this week, but in the judgement of the committee and engineer were not acceptable; the town is advertising again in these columns calling for tenders to be in on September 30th, 1909. C. H. & P. H. Mitchell, consulting engineers, Toronto.

CORNWALL.—Tenders for extension of wall above Lock 18, Cornwall Canal, will be received until Monday, October 4th. Plans can be seen at the Department of Railways and Canals, Ottawa, and at the office of C. D. Sargent, Resident Engineer, Ontario, St. Lawrence Canals, Cornwall, Ont.

GUELPH.—Tenders will be shortly invited by the Radial Railway Board for a new steel bridge over the river Speed at Dundas Road. Plans are in course of preparation for a structure to cost from two to three thousand dollars.

OTTAWA.—Tenders for Postoffice Boxes and Drawers will be received until Friday, October 1st. By order, Napoleon Tessier, Secretary, Department of Public Works.

RAINY RIVER.—Tenders will be received until Saturday, September 25, for the erection of a frame fire hall and council chamber on concrete foundation. Specifications may be seen at the office of the town clerk, Rainy River, or at Pratt & Ross, Architects, Winnipeg.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until 5th October by the City of Toronto for 16-inch cast iron pipe and valves. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

TORONTO.—Tenders will be received until Monday, October 4th for the erection of a reinforced concrete bridge over the river Don at Wilton Avenue. Joseph Oliver, (Mayor) Chairman, Board of Control. (Advertised in The Canadian Engineer.)

Manitoba.

PORTAGE LA PRAIRIE.—Tenders will be received until Thursday, September 30th, for the construction of a needle dam. Smith, Kerry & Chace, Consulting Engineers, Library Building, Winnipeg.

WINNIPEG.—Tenders for supply of cast iron water pipe of the following quantities and sizes, delivered f.o.b. cars, Winnipeg, namely, 20,000 feet of 8-in. pipe, 6,000 feet of 10-in. pipe, 6,000 feet of 18-in. pipe, will be received up to September 29. M. Peterson, Secretary Board of Control.

WINNIPEG.—Tenders will be received up to Monday, November 1, for supply of one motor hose wagon for the Fire Department capable of carrying 2,000 feet of 2½-in. cotton, rubber lined, fire hose, approximate weight, 2,200 lbs., and six men, approximate weight, 1,020 lbs. M. Peterson, Secretary Board of Control.

Saskatchewan.

SASKATOON.—The time for receiving tenders for the construction of a subway under the C.N.R. tracks has been extended to Wednesday, October 6th. J. H. Trusdale, City Clerk. (Advertisement in the Canadian Engineer.)

YORKTON.—Tenders will be received until Tuesday, September 28th, for cast iron pipe and laying of mains. F. T. McArthur, B. Sc., Town Engineer. (Advertised in the Canadian Engineer).

British Columbia.

VANCOUVER.—Tenders will be received until September 27th for the erection of five sub-stations for power distribution on the New Westminster-Chilliwack line of the British Columbia Electric Railway.

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

CONTRACTS AWARDED.

Nova Scotia.

HALIFAX.—At a recent meeting of the Works Board, tenders for supplying 20,000 brick were opened. Black and Flinn tendered at $8.60 per thousand, General Contractors Supply Co., $7.65 and J. Simmonds & Co., $7.25. The latter being the lowest was accepted.

Quebec.

MONTREAL.—The contract for concreting the Lafontaine Park pond has been given to the Artificial Marble Company of this city. Contract price, $3,650.

Ontario.

ORILLIA.—Sewer construction tenders were awarded on Tuesday, September 14, as follows:—Laying fifteen thousand feet of sewers, and providing tile pipe therefor, Jas. A. McIlwraith, of Collingwood, $11,815. Mr. McIlwraith was also awarded contract for laying the iron pipe for sewer force main, at $3,825. Supplying 7,000 feet of iron pipe, Canada Foundry Co., at $31.95 per ton, a total of $3,295. Building the pumping station, Timothy Clement, $6,175. Machinery for this building will be furnished by the John McDougall Caledonian Iron Works, of Montreal, at $4,166. Mr. Willis Chipman, consulting engineer, of Toronto, has charge of the work.

GUELPH.—The contract for laying Westrumite on Paisley Street was let to the Westrumite Company at $5,232.40.

PETERBORO.—Messrs. E. & F. Conroy, of Peterboro, will build the new reinforced concrete bridge on Smith St., for $28,457, which is $1,700 higher than the tender of Geo. A. Begy & Co., of St. Catharines, Ont., who were originally given the contract.

Manitoba.

WINNIPEG.—The contract for the construction of a pipe line from the Red river to the National Transcontinental railway shops at St. Boniface has been awarded to the Western Construction company of Winnipeg, the lowest tenderers. The contract price is 34½ cents per yard.

WINNIPEG.—The Board of Control have accepted the tenders of the Western Coal Company, for screenings at $7.25 a ton.

British Columbia

VICTORIA.—Mr. H. W. Kent of the British Welding company and the Jens Orten-Boving Company of London, has been awarded the contract for 55,000 feet of 30-inch welded steel pipe for the Esquimalt Waterworks company. The pipe is to be laid from the company's plant at Goldstream to the city limits at Victoria. These old country firms are famous manufacturers and the pipe which is to be supplied to the Esquimalt Waterworks company is manufactured at Motherwell, Scotland. The first consignment will be sent on the Holt steamship line and is to arrive next March.

VICTORIA.—Luny Brothers have been given a contract for the erection of a branch of the Royal Bank on Government Street here. Their price, about $50,000, includes a British Columbia granite front and considerable reinforced concrete work.

RAILWAYS—STEAM AND ELECTRIC.

Nova Scotia.

SYDNEY.—The Cape Breton Electric Company have been asked by the city council to make numerous extensions.

New Brunswick

ST. JOHN.—It is expected that the International Railway will be completed this fall. Eight miles of the line are yet under construction.

ST. JOHN.—Mr. C. O. Foss, chief engineer of District A of the Transcontinental, has returned to St. John, from a trip of inspection over the construction work in Victoria County. Mr. Foss examined the Salmon River viaduct, which he says is the largest piece of bridge work on the Transcontinental, and probably the largest of the kind in Canada. The viaduct is built of steel trestle work, with the uprights sunk in concrete pedestals, and crossed by heavy steel girders at the top. In all, the viaduct will be 4,800 feet in length and its completion requires the exercise of very careful engineering skill. The substructure is nearly finished, and work has begun on the superstructure.

Quebec.

MONTREAL.—Mr. M. J. O'Brien has accepted the presidency of the Matane and Gaspe Railway. The line begins at St. Flavie Station and runs down the shore of the St. Lawrence to Matane, about forty miles. The work of construction is to be rushed, and it is expected that trains will be running over the line by next August.

Ontario.

BARRIE.—Mr. John W. Moyes, of Toronto, has roughly outlined a proposition by which Barrie would have a street railway. He proposed to connect the C.P.R. and C.N.R. at Atherley with the C.P.R. at the thirteenth concession of Essa by an electric line.

BRANTFORD.—The street railway company are asking permission of the council to extend their system. They propose to lay a second track on Brant Avenue.

COBOURG.—The Canadian Northern Railway are rushing the survey of their new line in this vicinity. One party in charge of Mr. Con. O'Gorman, with headquarters at Cobourg, is making a survey from Cobourg east. Another party, with Mr. Armstrong in charge, is surveying between Cobourg and Port Hope.

OTTAWA.—Tenders closed on Thursday with Mr. M. J. Butler, chairman of the Government Railways Managing Board, for construction of a six stall addition to the engine house at Riviere du Loup, Que.

PORT ARTHUR.—Work commenced on Monday on the Arthur Street extension of the street railway, the first of a series of branch lines to serve part of the city not reached by the main line.

STURGEON POINT.—Mr. S. Anderson, who is now operating 40 miles of electric railway is said to be looking into the possibility of a street railway system from Fenelon Falls to Bobcaygeon, passing through Sturgeon Point.

WELLAND.—Mr. B. Corey has applied for a franchise to operate an electric railway on the streets of Welland. It is expected to run from Port Colborne to Niagara Falls. The N., St. C. & T. Railway will at once start extending the line from Welland to Port Colborne, and it is expected to be in running operation this fall. The survey has been completed and a lot of the material ordered.

WINDSOR.—The last section of the subaqueous tunnel connecting Windsor and Detroit was laid on Tuesday morning, September 14th, and it is expected that trains will be running through by the first of the year.

Manitoba.

BRANDON.—Sir Thomas Shaughnessy is reported to have said that the double-tracking of the C.P.R. between here and Portage la Prairie would be undertaken in the near future.

WINNIPEG.—Steel laying on the Superior Junction to Winnipeg Section of the G.T.P. is practically completed.

WINNIPEG.—On Wednesday, the 22nd, Mr. Frank Lee, Division Engineer of the C.P.R., received tenders for some grading work near Schwitzer, Man.

Saskatchewan.

SASKATOON.—Laying steel on the line of the Canadian Pacific between Saskatoon and Wetaskiwin will be completed next month. Several hundred men have been sent by the Canadian Pacific from Montreal during the past few weeks to assist in this work. Two steel gangs have been working up to the present, but the work is now centred on the west end. Three weeks will complete the laying of steel, after which as much ballasting as possible will be done before the freeze up. This line will constitute the main line of the Canadian Pacific between Winnipeg and Edmonton, and much traffic which now goes by way of Calgary will be delivered to it as soon as it is completed. Trains will be operated over the line this fall.

Alberta.

EDMONTON.—The G.T.P. track between Edmonton and Pembina River will be opened for general traffic within two months. The big tracklaying machines on G.T.P. construction west of Edmonton have been removed to Melville, where they are now being used on the branch line north from Melville to Yorkton and the branch south from Melville to Balcarres on the Regina extension. It is expected that both branches will be ready to handle grain within two weeks.

British Columbia.

VANCOUVER.—Tenders have been called for the construction of five sub-stations along the line of the British Columbia Electric Railway Company from New Westminster to Chilliwack. The buildings are to be of concrete, and in general similar to those now in operation on the lines of the New Westminster and Lulu Island interurban extensions. They will be used for the distribution of light and power to the surrounding districts as well as in connection with the operation of the tram system.

VANCOUVER.—The Great Northern Railway Company are buying property on the waterfront here. They already have ninety thousand dollars' worth, and if they purchase the entire property at the same price per foot—four hundred dollars—it will require an outlay of nearly a million and a half.

VANCOUVER.—The Eburne branch of the British Columbia Electric Railway which provides a new route between New Westminster and Vancouver, and opens up undeveloped territory along the north arm of the Fraser River, was opened last week.

VANCOUVER.—Officials of the G.T.P. are having trouble with the Indians at Kitsumkalum. The railway company want to build their line through an Indian grave-yard and the Siwashes refuse to accept their terms of compensation. The Dominion Government is inclined to think the proposition of the company is quite fair and the Indian Department have sent a man out with a view to a settlement being reached.

VICTORIA.—The contract for the mountain section of the Mill Bay Road has been awarded to M. J. Carlin by the Provincial Government. The cost will be $130,000 for the ten miles of road necessary to link up the six-mile and two-mile sections, work upon which has been underway for the past eight months. By the terms of the contract the road is to be completed by January next, and for the first time the upper portion of the island will be in communication with Victoria by a feasible and practicable trunk road. The construction of this section involves heavy rock cuts.

Foreign.

DETROIT, MICH.—The Michigan Central will build a new two-million dollar station at Detroit.

LIGHT, HEAT, AND POWER

Ontario.

GALT.—Galt town council recently considered a proposition to buy the local electric lighting plant and referred the matter of an estimate of its value to Mr. E. B. Merrill, C.E., of Toronto. The price asked by the Galt Gas Light Company, which owns the existing plant, is $67,000. This does not include the water power at the dam, an auxiliary property, earning $1,474 a year in rentals, and the value of which is unstated in the offer.

NIAGARA FALLS.—The Commissioners of Queen Victoria (Niagara Falls) Park have given permission for another undertaking by the Ontario Power Company. The company will spend over a million dollars in laying another pipe from the gate-house to the power house. The new pipe is to be the same diameter as the old, eighteen feet. but instead of being steel, encased in concrete, it will be wholly of reinforced concrete.

PETERBORO.—The Otonabee Power Company, who have asked the city for a twenty-year franchise, propose to spend $250,000 in uniting their two dams.

Manitoba.

WINNIPEG.—In accordance with the recommendation of Professor Herdt, of McGill University, Montreal, the Winnipeg Street Railway has opened the first of three sub-power stations. It is hoped by these and by bonding the rails, to reduce the danger to water mains and gas pipes from electrolysis.

British Columbia

VICTORIA.—The work of installing the $1,500,000 power plant which the B. C. Electric company will construct at Jordan river will be under the direct supervision of Edward Carpenter, who will be engineer in charge. Wynn Meredith, the chief engineer of the B. C. Electric company, who prepared the plans of the Lake Buntzen power plant and other large works for the same corporation, will supervise the work and prepare all necessary plans. The company intends to complete the work as soon as possible.

SEWERAGE AND WATERWORKS.

Ontario.

GUELPH.—The formal opening of the new waterworks by the Hon. J. M. Gibson, lieutenant-governor of Ontario, took place on Thursday, September 23rd. The new system provides a supply of pure, spring water, unsurpassed in quality, while the quantity is practically unlimited. The old plant was installed in 1879, at a cost of $173,948, and over a hundred thousand dollars have been expended during the past year in laying a pipe line some few miles from the city to tap large springs. A board of three commissioners, who gave their services gratuitously, had charge of the work. To the ordinary householder, the cost of water under the new arrangement will be less than nine dollars a year.

The city of Guelph is one of the most progressive of Canadian municipalities. Its population of 14,060 enjoys all the privileges of a modern city.

LONDON.—The city of London is having trouble with its system of sewage disposal, which is thought to be too small to carry away all the sewage. In some sections the sewers are practically choked up, and Mr. Willis Chipman, consulting sanitary engineer, of Toronto, has been called in to make recommendations.

OTTAWA.—Sewer extensions, to cost $1,500, made necessary by the proposed new G. T. R. station, will be built at an early date.

PORT ARTHUR.—The city will lay an intake pipe in connection with the waterworks system at a cost of $30,000 The pipe will go 3,500 feet out into Lake Superior, into thirty feet of water, where the supply is always pure, even on the surface, and where the depth makes the presence of impurities impossible. Mr. John Galt, C. E., of Toronto, has been consulted by the municipality.

STRATFORD.—The City of Stratford has been allowed three months in which to complete the enlargement of the sewage disposal works. Until the expiry of that time William E. Bean, a farmer, will not be able to press his motion for sequestration. Bean desires to place the sheriff in possession, alleging that the city has been guilty of contempt in ignoring the court's order of ten years ago. This order restrained the city from polluting the waters of the River Avon, which flows through Bean's farm. Mr. M. Ferguson is the city engineer.

CEMENT—CONCRETE.

Quebec.

MONTREAL.—The Artificial Marble Company will receive a contract for concrete work in connection with the Lafontaine Park Road amounting to $3,650.

Ontario.

COLLINGWOOD.—At a recent council meeting, the town engineer recommended the erection of a cement arch over the canal on Fifth Street at a cost of $500. The Board of Works will report.

GUELPH.—On September 15th, the first sod was turned in connection with the Niagara power station. The building will be of concrete and brick.

NIAGARA FALLS.—The Ontario Power Company have just been granted permission to lay a reinforced concrete pipe from the gate-house to the power house at an estimated cost of one million dollars.

PETERBORO.—Messrs. Geo. A. Begy & Company, of St. Catharines, Ont., who were to build the new reinforced concrete bridge here, on Smith Street, have withdrawn their tender and the contract has now been given to Messrs. E. and F. Conroy, a local firm. Contract price, $28,457.

TORONTO.—A reinforced concrete bridge with a span of 120 feet clear and two spans of 100 feet may be erected by the city of Toronto across the River Don at Wilton Avenue. Until Monday, October 4th, Mr. Joseph Oliver, (Mayor), Chairman of the Board of Control, will receive tenders for its construction. A few weeks ago, tenders were called for a steel structure, and it looks as if the tenders for both steel and concrete structures will be compared before a decision is arrived at. Further particulars appear in our advertising columns.

British Columbia.

VANCOUVER.—Five sub-stations of concrete will be erected on the New Westminster-Chilliwack line of the British Columbia Electric Railway, and tenders are now invited for the work of erection.

VICTORIA.—The cost of paving Fort Street is estimated at $27,000. Concrete will be used for the foundation.

VICTORIA.—A reinforced concrete building with a British Columbia granite front will be erected here on Government Street, by Luney Bros., for the Royal Bank. Estimated cost, $50,000.

FINANCING PUBLIC WORKS.

Ontario.

BRUCE MINES.—This municipality has recently sold $10,000 debentures to Messrs. Brent, Noxon & Co., Toronto.

COLDWATER.—At a recent public meeting of ratepayers it was unanimously resolved that council be asked to have a by-law submitted to the people at once to decide whether the village will install a system of fire protection alone at an approximate cost of $10,000 or a complete waterworks system at an approximate cost of $29,000.

HAMILTON.—Mr. S. H. Kent, city clerk, offers for sale $80,000 school debentures.

NEWMARKET.—Mr. J. E. Hughes, clerk and treasurer of this municipality, offers for sale $20,000 debentures until September 29th inst.

Manitoba.

BRANDON.—At the earliest possible date a by-law, to obtain permission for borrowing $13,000 for winter fair buildings, will be submitted to the ratepayers. It is intended to erect the buildings this fall.

Saskatchewan.

WYNYARD.—This municipality has sold to Messrs. Nay & James of Regina local improvements debentures amounting to $3,407.65.

British Columbia.

VANCOUVER.—The district of Peachland, B.C., sold to Messrs. Wood, Gundy & Co. $20,800 debentures. The money is required for waterworks, electric light, road improvements and fire protection.

VANCOUVER.—The civic finance committee have recommended to the council money by-laws aggregating $325,000 for the purchase of land at Kitsalano beach and English Bay.

VANCOUVER.—A draft for the Columbia St. Bridge by-law, recently prepared by the Bridge Committee of the City Council, calls for $675,000. The total cost of the bridge, approaches, compensation, and bond shrinkage will be $907,500.

TELEPHONY.

Saskatchewan.

REGINA.—On Wednesday, Sept. 22nd, tenders closed with Mr. S. P. Porter, deputy commissioner of Railways and Telephones, for the construction of 'phone systems in Hanley and Melville.

The world's production of nickel last year is estimated at 12,800 metric tons, as compared with 14,100 metric tons in the previous year. The maximum recorded production was 14,300 metric tons in 1906. Of the total rather more than half is produced in Europe and the remainder in America.

MARKET CONDITIONS.

Montreal, 22nd September, 1909.

The pig-iron markets of the United States show an advance of 50 cents per ton. Bessemer pig is selling as high as $17.50 per ton, and it is very difficult to obtain any at less, a few sales being, however, reported at $17 as well as at the higher figure. It would appear that none can be had for next year's delivery at less than $18. Basic pig is quoted in the vicinity of $16, but once the advance in bessemer is established, basic will also advance. Foundry iron is also selling at $16, but it is stated that sales have been made at 50 cents higher than that, and $17 is being demanded for next year. Another fact of much importance in the situation is the firmness in the price of coke. This, during the past two months, has advanced very considerably, and it seems to be the impression that by the beginning of next year $3 will be the regular price. Sellers are not looking for long time contracts. Good grades of foundry coke are quoted at $2.65 to $2.75 for immediate delivery. The buying of pig-iron is quite heavy at present though steel-making iron is not very active as far as the actual closing of contracts is concerned.

In Great Britain, the market is improving and prices are gradually advancing. Montreal interests state that the latest reports are certainly the best which have been received for at least 18 months past. Replies to cables show that the market is in a very firm position and that the tendency is upwards, no concessions being now obtainable on inquiries even for large lots. In fact, quotations are given subject to immediate acceptance.

The situation in Canada is unusually encouraging. The output of the Dominion Iron and Nova Scotia Steel plants is practically not available for the general market, the requirements of these institutions for steel-making purposes absorbing almost all the iron they produce. Londonderry is out of blast and is likely to remain so until about the end of this year. The Radnor furnace of the Canada Iron Corporation is working on charcoal iron, as is also the Deseronto furnace. The Hamilton furnaces of the Hamilton Steel and Iron Company have been out of blast for some time and are under repairs, and deliveries with this concern are in arrears. The Midland furnace of the Canada Iron Corporation is now occupied with orders which will keep it operating for five or six months to come, so that the company is not anxious to make further contracts at to-day's prices. The Atikoken furnace, of the Atikoken Iron Company, is now in blast, but the grade of metal produced is not suitable for ordinary small foundries, being sold particularly to the large concerns as a mixture for other grades. The output of these furnaces is also contracted for for some months ahead. The situation in Canada, therefore, is that furnaces are well occupied, and there are absolutely no stocks of metal on hand. It would consequently seem that the furnaces would very shortly take advantage of the upward movement in the United States and Great Britain and ask higher prices for such deliveries as they are able to make.

Regarding the hope that Nova Scotia and Dominion Iron companies would reap very considerable advantages from the lowering of the import duty from 40 to 15 cents per ton on import iron entering the United States, it transpires that the contracts for the coming year were made with the understanding that the purchasers should receive the benefit of any reduction which might take place. Hence the Canadian companies will not be able to get the advantage of the 25 cent. reduction, at the present time. There is, however, an indication that the volume of the orders in the United States will be greatly increased. American foundries have recently contracted for about 250,000 tons of Wabana ore for delivery as quickly as possible.

Although merchants handling different lines of finished and semi-finished products of iron and steel report few or no changes, this week, they are uniformly of the opinion that advances in the near future are in order, the present tone of the market being unusually firm, throughout. Quotations are:—

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

Bar Iron and Steel.—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

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

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

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

Chain.—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

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

Copper.—Prices are strong at 14½ to 14¾c.

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

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.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $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 strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.50 to $3.60.

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

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

Nails.—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

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

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

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50;

STRUCTURAL STEEL

ANGLES BEAMS PLATES
BARS CHANNELS TEES

LET US QUOTE ON YOUR SPECIFICATION

A. C. LESLIE & CO., Limited
MONTREAL

5

1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

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

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

Railway Ties.—See lumber, etc.

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

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

Spikes.—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Telegraph Poles.—See lumber, etc.

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

Tin.—Prices are unchanged, at 33¾ to 34c.

Zinc.—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, September 23rd, 1909.

Advices from the Old Country indicate improved conditions in iron and steel. Demand, both domestic and external, is better, and the labor troubles, long so threatening, have pretty well subsided. In the United States, prices of iron and steel are firm and higher, with production stimulated by an active demand from railways. Canadian furnaces are well employed and have orders ahead for some months.

Wholesale business in Toronto is fairly active in various lines, iron and steel and other metals not the least so. Building continues in the city, of dwellings especially, at a rate which causes prudent observers alarm lest overdoing in this direction may cause a reaction which must seriously affect real estate dealers and speculative builders. A better feeling begins to appear in cement, while bricks appear to be as active as ever. Lumber is firm in tone. Roofing material active and steady.

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

Antimony.—Demand inactive, market unchanged at $9 per 100 lbs.

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

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

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

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

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

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

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Shipments are fairly heavy, mainly on existing contracts, and not much new business is offering. An indication of a disposition towards greater stiffness in the market is afforded by the following quotation made to-day by a large producing company:—"Our price to-day for Portland cement, f.o.b. Toronto, is $1.70 net cash including cotton bags, for acceptance within 10 days from date of quotation, and for shipment within 30 days from date of acceptance." According to stories in the newspapers, the cement merger is assuming shape. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

Coal.—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is laregly used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

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

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

Roofing Felt.—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

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

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

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—gauge, $4.50; 20-gauge, $4.25; per 100 lbs. This downward change is the result of dissolution of an agreement between British and United States makers.

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

Iron Pipe.—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, per 100 feet. Talk is still heard of an advance, but nothing definite.

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

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

Lumber.—Although prices are stiffening generally, there is no freedom in buying shown by country dealers in Ontario, who continue to order "from hand to mouth." It is the city trade building being still active, which still absorbs the attention of producers or large merchants. Some sizes of native pine, for example, 2-inch good and 10 x 12 inch stock, are becoming scarce. British Columbia shingles are easier; everything else on the list appears to be on the upward trend according to outside advices. The almost wonderful demand from builders in the city, however, continues, and the keen competition to fill it makes the market almost a buyers' one. We quote dressing pine $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3 per keg of 100 lbs.

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

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

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

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

Ready Roofing.—An improved request is noted lately, at catalogue prices before quoted.

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

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

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

Steel Beams and Channels.—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; 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-inch, $2.40 per 100 lbs.

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

Tin.—The feeling in tin is firm, and the price unchanged at 31½ to 32c.

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

Zinc Spelter.—A very active movement continues, and the market is very firm at $5.75 to $6 per 100 lbs.

CAMP SUPPLIES.

Beans.—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked. $1.90 to $2.

Butter.—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

Canned Goods.—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

Cheese.—No old cheese on hand; new cheese, large, 13c.; twins, 13¼c.

Coffee.—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

Dried Fruits.—Raisins, Valencia, 6 to 6½c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6¼ to 7c.; Vostizzas, 8¼ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

Eggs.—New laid, 24 to 25c. per dozen, in case lots.

Lard.—Scarce and higher. Tierces, 15¼c.; tub, 15½c.; pails, 15¾c. per lb.

Molasses.—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

Pork.—Still advancing. Short cut, $27.50 per barrel; mess, $26.

Rice.—B grade, 3¾c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¾ to 6c.

Salmon.—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

Smoked and Dry Salt Meats.—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

Spices.—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

Sugar.—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

Syrup.—Corn syrup, special bright, 3½c. per lb.

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, September 21st, 1909.

There is no let up in the amount of work being done in Winnipeg, and the prospects for an exceptionally busy fall are very bright. The carpenter's strike is reported to be over, and every available man is being put to work. The demand for all lines of builders' supplies is still strong, and dealers have no cause for complaint at the season's business. The hardware trade is possibly a little quiet just now, particularly in the country, as farmers are in the midst of threshing and getting their grain marketed. Country merchants, however, have laid in large stock, and their business in the near future will be decidedly more brisk.

The commercial condition in the West was never better than it is now, and people are in better shape financially, and more able to invest in new buildings and improvement work than they have been for some time. There has been a sharp advance in Winnipeg in the price of pork, which will be felt by railroad contractors and those having to feed large gangs of men. The retail price of bacon has gone up, at the rate of from 5c. to 8c. per lb., and the price of hogs, which for some years has averaged 6½c. per lb. live weight off the cars, has advanced to 9c. per lb. All quotations on builders' material remain steady, and the demand continues to be strong.

Winnipeg prices are as follows:—

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

Axes.—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

Barbed Wire.—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

Bar Iron.—$2.50 to $2.60.

Bars.—Crow, $4 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch.

Boards.—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

Bricks.—$10, $11, $12 per M, three grades.

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

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

Copper Wire.—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

Copper.—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

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.—Plasterers', 80 to 90c. 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.

Galvanized Iron.—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

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.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

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

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

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, 6¾c. 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.

Rope.—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 10½c.

Spikes.—Basis as follows:—1¼ 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 abse; cast tool steel, lb., 9 to 12½c.

Staples.—Fence, $3.40 per 190 lbs.

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.

Tool Steel.—8½ to 15c. per pound.

Wire.—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 aguge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

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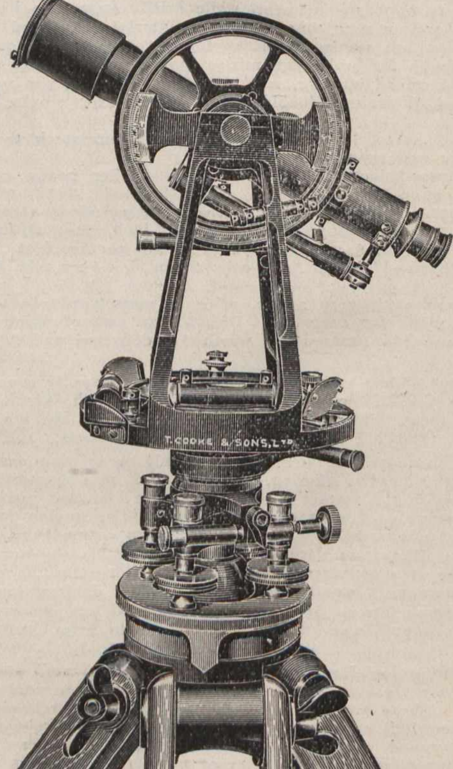

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