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Volume 28 Toronto, February 4, 1915 Contents of this issue on page 5

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

DEVELOPMENT OF CANADIAN TRANSPORTATION AND TRADE

SOME FEATURES THAT PARTICULARLY INTEREST THE ENGINEER—ANNUAL PRESIDENTIAL ADDRESS TO THE CANADIAN SOCIETY OF CIVIL ENGINEERS, MONTREAL, JANUARY 26th, 1915.

By M. J. BUTLER, C.E., C.M.G.

WE meet under unusual world-wide depression of business conditions. Our Empire is at war, not of our seeking, but forced upon us, for the preservation of good faith, and in pursuance of treaty obligations, by one of the signatories to the treaty. It is worth while to know that we are part and parcel of an Empire which regards treaty obligations as something more than a "scrap of paper."

The European war has upset all the business affairs of the world, and marks a stop in the progress of Canada. It seems to me that we may profitably consider where we are and to what we may look forward.

I propose, as briefly as possible, to review our progress for the past decade, in transportation, trade and population, with such comments as may elucidate probable future developments.

Transportation.—In 1904 we had 19,431 miles of railway in operation; in 1913 we had 29,304 miles in operation. The railway statistics of Canada prior to 1907 failed to supply any detailed information, hence for the purpose of comparison I shall confine myself to the period from 1907 to 1913.

The mileage of track in 1907 was 27,967. In 1913 it was 38,223. The mileage of railway in 1907 was 22,452, and in 1913 it was 29,304. The tonnage hauled one mile in 1907 was 11,687,711,830, in 1913 it was 23,032,951,596. The tonnage hauled per mile of line in 1907 was 518,486, and in 1913, 785,820. The freight train mileage in 1907 amounted to 38,923,890. In 1913 it had increased to 67,320,090. The number of average tons per train in 1907 was 260; the corresponding figure for 1913 was 342. The average tons per car in 1907 was 15.37, and in 1913, 19.01.

The average receipt per ton mileage was 0.815 in 1907 and 0.758 in 1913. The revenue from freight in 1907 was $94,995,087, which had increased to $174,684,640 in 1913. The gross earnings per mile in 1907 amounted to $6,535.64, and in 1913 to $8,750.50. The earnings per train-mile in 1907 were $1,953, and $2.263 in 1913. The expenses per train-mile in 1900 were $0.864; in 1904, $1.216; in 1907, $1.381; in 1913, $1.604.

It will be observed that the cost of running trains per mile since 1904 has increased 31 per cent., and that in the past 13 years the increase has been 85 per cent., the percentages for the period from 1899 to 1913 being for earnings an increase of 89.8 per cent., and for expenses 105.9 per cent.

In 1907, 124,012 men were in the employ of the railways, earning $58,719,493 or 56.7 per cent. of the operating cost. In 1913, 178,652 men earning $115,749,825, making 63.59 per cent. of the operating expenses.

Nominally there are 193 railways in Canada. Actually they may be considered as being included in a few great systems in order of magnitude, the Canadian Pacific, the Grand Trunk and Grand Trunk Pacific, the Canadian Northern, the Government Railways, the Great Northern, and one province-owned railway. The Timiskaming Northern Ontario, the Algoma Central and the Sydney and Louisburg, owing to being allied with great industrial undertakings, may remain independent. All of the remaining lines are in due course to be absorbed by these great corporations.

It is proper to remark that we in Canada have the greatest railway mileage per head of population of any country in the world. These great transcontinental railways have their terminals at tide water on the Atlantic and Pacific.

As might have been expected, the engineering profession has profited by such an extensive railway-building programme. It is now near an end and the conditions for the employment of engineers on railway construction is bad. Hence, as intelligent men, some other field of occupation must be sought.

A close study of the statistics discloses that good service is rendered at reasonable cost. The traffic density is increasing, and hence the railways may look forward to prosperity as soon as business resumes its normal condition. Fundamentally, Canada is an agricultural country, with reserves in mines, forests and manufacturing, and the inter-relationship of all kinds of employment is essential to the well being of the country. Not every man is suited to a farmer's life—sons and daughters seek the work for which they are naturally adapted; hence sectional appeals to the Government should be frowned upon, and such action taken by wise adjustments of the tariffs as will insure to us a well-rounded life work.

Nevertheless, the greatest problem before the country is the transportation question. Insofar as I am aware, Canada is unique in this regard. It is the only country I know of where, politically and otherwise, we must, to preserve our independent action, fight against geography. It is a well-known physical law, that forces all tend to move along the lines of least resistance. We have, as a nation, undertaken the task of forcing our outlets against the line of least resistance. The Atlantic seaboard is the outlet for the products of the prairies, situated some 1,500 miles inland, and one effort in building railways, with easy curves and grades, in the enlargement of our canal system, and in the improvement of rivers, particularly the St. Lawrence route, has been with the one object of putting a few cents more per bushel into the pockets of our farmers. The enlargement of the Welland Canal will allow the larger type of ship, of 300,000 bushels capacity, to pass down Lake Ontario and the River St. Lawrence to within 120 miles of Montreal. Great storage elevators will be erected at or near Prescott and 1,000-ton barges will be towed through the present canal system to Montreal. Each incoming ship is known for days ahead, and the exact cargo of grain required can be in waiting for transfer by floating elevators. Ultimately, however, the larger ship will come through to Montreal, as it is quite practicable and within the resources of the country to convert the St. Lawrence River into block-water navigation by the building of eight dams, with duplicate locks; and as an incident thereof, to develop the greatest water powers in the world, aggregating over four million horse-power, eliminate the ice-jams, and make practicable the navigation of the river in winter by the aid of powerful ice-breakers.

It is a duty our Government may well undertake at the earliest possible moment, to secure a hydrographic and topographic survey of the St. Lawrence, so that accurate estimates of cost may be made, and that proper regulations drawn to so regulate proposed power developments owned by private corporations that each may be brought into a component part of the completed whole.

It would be difficult to place a limit on the possibilities on such power development, situated on the greatest transportation route in the world. Cheap and abundant power means so much to a country.

Trade.—Our trade has grown by leaps and bounds during the period under review.

Exports

Year.	To United Kingdom.	To United States.	To other countries.	Total.
1900	96,562,875	52,534,977	14,412,938	163,510,790
1914	215,253,954	163,372,690	52,961,795	431,588,439

Our imports for the same period were:—

1900	44,279,983	102,080,177	26,146,718	172,506,787
1914	131,942,249	395,565,328	90,821,277	618,324,874

A feature which concerns us closely is the growth of manufacturing and the development of mining products:

Statistics of Manufacture—1900 to 1910.

	1900.	1910.	Increase, per cent.
Establishments ..	14,650	19,218	31.18
Capital	$446,916,487	$1,247,583,609	179.15
Employees on salaries	30,691	44,077	43.61
Salaries	$23,676,146	$43,779,715	84.91
Employees on wages	308,482	471,126	52.72
Wages	$89,573,204	$197,228,701	120.19
Raw and partly mfgd. materials.	$226,527,858	$601,509,018	125.68
Products	$481,053,375	$1,165,975,639	142.38

Mineral Production.

	1900.	1910.	Increase, per cent.
Mines and works..	1,373	2,222	61.84
Value of buildings and plant	$42,771,803	$108,506,051	153.68
Employees on salaries	1,527	2,284	89.86
Salaries	$1,512,821	$3,317,030	119.26
Employees on wages	37,065	67,150	81.16
Wages	$16,336,273	$39,129,941	139.053
Value of products.	$47,956,862	$122,004,932	153.40

A marked feature of our trade is the importation of steel products and manufactures of which steel is the important constituent. During the year 1911 we brought in $85,319,541 worth of such, of which $11,448,428 worth was on the free list. We also imported fire clay and fire brick to the value of $994,193, all of which was on the free list. I have no desire to infringe upon the boundary line of politics, but I may be permitted to point out that such a tremendous balance of trade against us is one concerning which thoughtful men may well ask, how is it to be dealt with? I venture to say that by careful readjustment of the tariff quite 50 per cent. of the importations may be profitably dispensed with by manufacture in Canada.

We have been large borrowers in the world's markets, spending money lavishly and, on the whole, wisely. Here and there over-capitalized, ill-considered industrials will be found, but the time has arrived when we must economize—pay our way—write down inflated capital and show the loaning world that Canada is solvent and worthy of the trust and confidence shown us.

I have no doubt of the ultimate result. Our resources of unworked land, our mines, forests and fisheries, will afford homes and opportunities for millions of men. In 1901 our population was 7,206,643, of which 3,925,679 was rural and 3,280,964 was urban. It will be noted that barely 600,000 additional was made to the rural population, whereas the great increase flocked to the cities and towns. This is not satisfactory, and efforts will be needed to bring more people to our land.

The Province of Quebec spent $4,000,000 on good roads last year.

Mr. H. N. Munro, in a paper recently read before the Junior Institution of Engineers, of Great Britain, said the commercial possibilities of aluminium became evident in 1887, when Hall in America and Héroult in France produced the metal by electrical means. For electrical purposes aluminium was fast becoming common. Overhead transmission lines constructed in aluminium showed a great saving over equivalent copper lines, a saving of as much as 10 to 25 per cent. being effected, depending on the size and nature of the system erected.

A test is being conducted by the mechanical engineering department of Purdue University, Lafayette, Ind., to determine the effect of the impact resulting from flat wheels. These tests cover flat spots of various sizes on wheels carrying definite loads and running at definite speeds. It has been found that an imperfect wheel with a 3-in. flat spot strikes the track with an impact of 104,000 lb. when the car is going 16 miles per hour and is carrying a load of 20,000 lb. It was also found that under similar conditions a flat spot only 1½-in. in length produced a blow of 20,000 lb., and the impact for spots 2-in. long was 25,000 lb. A standard goods car was mounted in the test laboratory and special apparatus including an instrument which photographed the magnitude of the blows, was employed to collect test data.

ANNUAL MEETING, CANADIAN SOCIETY OF CIVIL ENGINEERS.

As forecasted in our issue of last week, the twenty-ninth annual meeting of the Canadian Society of Civil Engineers took the place that was to have been expected of it. It established itself very prominently in the history of the Society. Business-like, crisp, up-to-the-minute sessions, resourceful and energetic speakers, educative and unevasive committee reports, recreative and enlightening excursions, and an enthusiastic and well-attended dinner, combined with keen interest and active endorsation of progressive proceedings, marked the affair with the stamp of genuine success.

Tuesday Morning.—The first session opened at 10.15 with Mr. Butler presiding. Telegrams of greeting and good wishes were read,—one from Lieut.-Col. C. H. Mitchell, C.E., Staff Headquarters, Salisbury Plain, England, and one from the youngest of the Society's offspring, the Edmonton Branch. The minutes of the last annual meeting were received and certified correct. The appointment of scrutineers for amendments to by-laws and also for officers and members of Council, occupied but a few minutes, whereupon the Report of Council was brought before the members. (This report was published in abstract form in our issue of January 21st, page 151.)

The report of the Library Committee (also summarized in our issue of last week) was then received and adopted without discussion.

The treasurer's report and auditor's statement created a little extra interest in virtue of the rather large amount of dues outstanding, and it was suggested that the incoming Council be instructed to exercise such measures as they deemed appropriate in order to lessen the amount outstanding.

Reports of Branches.—The annual reports from the various branches were then read, either by representatives or by the secretary, Professor McLeod.

Vancouver branch reported a membership consisting of 48 members, 74 associate members, 15 juniors, 10 students and 4 associates. Fourteen meetings had been held during the year and many instructive and important papers presented. The branch reported the death of two of its prominent members in the persons of Mr. G. H. Webster and Mr. R. M. Horton.

Manitoba branch had a membership of 297, consisting of 46 members, 103 associate members, 58 juniors, 25 students and 65 associates. Besides its general meetings, other meetings had been held by its electrical and mechanical sections and a lengthy list of papers had been presented. During the year a change of by-laws had been effected whereby the officers, who were elected at the annual meeting in December, took office in the following May. The branch was quite sound financially, reporting a very healthy bank balance.

The report of the Toronto branch was received with much applause, the members evidently having in mind the comments, lightly expressive of inactivity, which characterized the adoption of the report of this branch a year ago. During 1914 the membership had increased from 215 to 295, an advance of 37 per cent. The meetings had been largely attended, a varied programme of meetings having been arranged and a selection of notable speakers made. The average attendance of meetings, including luncheons and excursions, had been 116. The energetic work of the library committee in its recataloging the volumes and materially adding thereto, deserved special mention. Identification passes had been issued to members to enable them to visit plants and works of interest. The report observed that an important feature of the work of the incoming executive of the branch would be an arrangement for permanent quarters, in view of the fact that the Engineers' Club of Toronto had under consideration the building of a new home. Deep regret was expressed at the loss suffered by the Society and the branch in the death of Dean Galbraith, and also of Mr. J. T. M. Burnside and Mr. J. McD. Parke.

The membership of the Ottawa branch was also increased during the year, although a large number of the members are absent, having offered themselves for service in the first or second Canadian contingents. At its annual meeting the by-laws were revised to extend the term of office of the managing committee from one year to two. Besides monthly luncheons the branch held eight meetings, the attendance at which varied from a minimum of 35 to a maximum of 325. The report showed considerable betterment in the finances of the branch and indicated the steps that were being taken to acquire better quarters and library facilities.

The Kingston branch also reported quite a number of its most active members as being absent on overseas service. The loss of Professor A. Kirkpatrick was considered a severe loss to the branch, as he had been one of its most enthusiastic workers. Some very interesting gatherings had been held and instructive papers presented, although no meetings had taken place since the outbreak of the war.

Two very important papers had been presented and discussed before the Quebec branch, namely, Mr. Arthur Surveyer's paper on "Making Our Water Powers Valuable," and Mr. A. J. Forester's paper on "Cast Iron and Steel Mains for Water Supply." The membership, at the close of the year, was composed of 20 members, 41 associate members, 2 associates, 14 juniors and 21 students.

The Victoria branch held eight regular meetings during the year, at which very instructive papers were read, dealing chiefly with engineering work in British Columbia. The branch had adopted a procedure of alternating its monthly meetings with evening receptions, seven of which were held. The total membership of 80 had not changed since the last annual report, there having been 17 new members enrolled and 17 removals. Mention was made of the third annual convention of British Columbia members, held in Victoria in December and participated in by the Victoria and Vancouver branches.

The report of the Calgary branch showed a present membership of 62, with an average attendance of 45 at meetings. Fifteen papers had been presented in 1914, and 11 branch dinners held. A very substantial bank balance was reported. The branch expressed itself as eager for a western convention of the Society.

The establishment of the Edmonton branch of the Society, during the summer, had been a result of the united endeavors of a large number of members resident in Edmonton and vicinity. Since its formation three splendid papers had been read and a good programme had been arranged for the present season. Alternate meetings of the Society took the form of luncheons and dinners.

In bringing to a close the presentation of annual reports of the branches, Mr. Butler expressed genuine satisfaction respecting their work during the year.

According to the report of the Society's board of examiners, 18 candidates had presented themselves for examination during the year. Fifteen were successful.

With respect to the Committee on Cement Specifications, no report was presented. The meeting expressed itself in favor of requesting the incoming Council to continue the committee and a number of names were suggested for consideration.

No report was received from the Committee on Improved Engineering Service, and it was decided to discontinue this committee. The progress report of the Committee on Educational Requirements was read by its chairman, Mr. Marceau. It was decided by motion to continue the Committee on Sewage Disposal. No report had been presented, although a letter from Mr. Willis Chipman called attention to Mr. W. S. Lea's absence in Europe, and referred to the valuable work that was being accomplished by the International Waterways Commission. Mr. John Kennedy briefly reviewed the committee's work and suggested its continuance.

In his report, as chairman of the Committee on Steel Bridge Specifications, Mr. Monsarrat drew attention to the great value of the specifications of the American Railway Engineering Association, pointing out that since the ground had been well and fully covered by that association there was little use in continuing the present committee of the Society. He recommended the adoption of the above-mentioned specifications. It was the opinion of the meeting that the specifications for steel highway bridges, upon which the committee had done considerable work, should be finished, and with that in view the committee will be continued.

Mr. James White, chairman of the Committee on Conservation, presented a voluminous report. One matter dealt with during the year had been the question of the collection and publication of gauge records. This had been touched in a preliminary way only. Forest protection had been greatly ensured by legislation empowering the Dominion Board of Railway Commissioners to prescribe regulations for the operation of locomotives during the dry season. Other investigations of the Commission of Conservation were dwelt upon. The report had incorporated into it a number of contributed suggestions and discussions from members of the committee. Mr. W. H. Breithaupt reported on the situation in the Grand River Valley. Mr. J. Chalmers dealt with reforestation. Mr. C. R. Coutlee presented several suggestions as follows: Combining hydro-electric powers; keeping swamp areas; cutting fire guards; curtailment of fire losses by more restricted use of soft lumber in floors, walls and roofs of dwelling houses; preventing farmers from settling on unarable lands. Mr. C. E. W. Dodwell dealt with the importance of cheap alcohol for industrial and domestic use; cultivation of the beet sugar industry; furtherance of the good roads movement; encouragement for the peat industry; prevention of coal waste, and importance of fostering coal tar distillation in Canada.

Mr. Jas. B. Hegan related to the necessity of protection of the remaining tracts of growing timber on Prince Edward Island and also to the need of improved wardenship in the fishing industry of the province.

Mr. J. B. Challies suggested the advisability of having the committee confine its attention to matters of immediate professional importance and reasonably possible of solution through, or largely by, the action of the members of the Society. He intimated that, while such questions as Indian welfare, lobster conservation, improved English, etc., were of general interest, there was an urgent necessity for some central governmental information bureau for all survey and general engineering information gathered by the various departments of the Government. Some uniform method of publication of such information, especially hydraulic or hydrographic data, including stream flow, was of pressing importance and deserved the serious and active attention of the committee.

Major R. W. Leonard suggested that the committee discuss the economic aspect of the proposed Georgian Bay Canal and the enlargement of the Welland and St. Lawrence ship canals, compared with rail transportation from Georgian Bay to Montreal. He also referred to the suggestion of Mr. J. B. Challies to the effect that a central bureau or clearing house of general engineering information be established.

Mr. P. M. Sauder suggested again that the Dominion Government be urged by the Society to co-ordinate and extend its hydrographic surveys.

Prof. R. O. Sweezey contributed a communication relating to Indians and forestry. Concerning the latter, he referred to negligence on the part of railway contractors, railway operators and settlers.

The closing section of the report related to the establishment and operation of the Forest Products Laboratories of Canada.

In discussing the report, the question of datum planes was discussed, after which the report was adopted.

The report of the Committee of the Electro-Technical Commission referred to the issuance of several publications, and to proposed participation in the coming International Engineering Congress.

The report of the Committee on Cast Iron Water Pipes and Specials was read by Mr. F. H. Pitcher, chairman. It stated that the committee was coping with a considerable handicap in the matter of insufficient unanimity of opinion among manufacturers, but that considerable progress had been made. His suggestion that the committee be continued was adopted.

The Gzowski Medal Committee recommended the award of the Gzowski medal to Mr. P. A. N. Seurot for his very excellent paper on "Subaqueous Tunneling." The recommendation was adopted amid hearty applause.

This closed the session.

Tuesday Afternoon.—The greater part of the second session was occupied by a discussion of the report of the Committee on Concrete and Reinforced Concrete, presented by Walter J. Francis, C.E., chairman. Mr. Francis reviewed briefly the proceedings of the last annual meeting with respect to the draft presented thereat, and commented upon the broad, general and comprehensive scope which such a specification must necessarily possess. He pronounced it "a general specification on a general subject for the general use of engineers in general practice." (Mr. Francis' letter of transmittal was summarized in our issue of December 30th, 1914.)

The discussion following the presentation centered chiefly around Clause 74, which reads: "There shall be constant competent inspection throughout the whole of the work." Several members thought that it should read, "the work shall be open to inspection at any time." This suggestion was stoutly over-ruled, however, by many speakers, who emphasized the necessity of "constant competent inspection."

Another point that arose was that of clean sand, and some interesting experiences were told by several respecting the relative qualities of various grades of sand.

The report was adopted with applause, Mr. Butler remarking that it had been a laborious task exceedingly well carried out.

Next followed a report from the Junior Section of the Society. Good progress had been made; four very acceptable papers had been read, the average attendance at meetings being 25.

Then followed the address of the President. It appears elsewhere in this issue. Mr. Butler greatly impressed the members with his clear presentation of Canada's development along lines of transportation, trade and population. In closing, he paid high tribute to the two great engineers whose careers had terminated since the last annual meeting. He referred to Messrs. T. C. Keefer and John Galbraith with greatest esteem and mourned the dire loss which the Society had experienced.

The session closed with Mr. Butler's address.

Tuesday Evening.—The smoker at Society headquarters on Tuesday evening was so largely attended that the house was filled to capacity. During the course of the entertainment Mr. H. F. V. Meurling gave an illustrated talk on submarine mining for coast defence. He explained open coast and protected coast stretches and cited examples from the present war to clearly demonstrate the nature and value of such manoeuvres. Methods of construction, provision for the protection of friendly and neutral ships, absolute control from shore headquarters were all explained. He described the type of mine used and how they were laid. Mr. Meurling, as an officer in the Swedish navy, spent several years in directing such operations as those which formed the subject of his lecture.

Wednesday Morning.—An official visit, limited to fifty members owing to transportation facilities, was paid to the newly constructed hydro-electric plant of the Cedars Rapids Manufacturing and Power Company, at Cedars, about 32 miles from Montreal. Another body of members, about 100 strong, visited the Angus shops of the Canadian Pacific Railway. As brief descriptions of these interesting plants appeared in our issue of January 21st, nothing further will be noted at this time, except to state that the trips were both exceedingly interesting, every facility possible having been granted by the respective companies.

Wednesday Afternoon.—The greatest volume of discussion of any report was that which followed the presentation of the report of the Committee on General Clauses for Specifications, by Mr. Holgate, chairman. Mr. Duggan regarded the proposed general clauses as somewhat loose in places, with a frequent occurrence of implied obligations and a certain degree of unfairness to the contractor in a number of clauses. He read, as suggestions, several drafts of clauses eliminating the difficulties he had pointed out. He took the stand that the best specifications were those which gave an assurance of fairness to the contractor, thereby inviting lower prices and better workmanship.

Mr. Francis pointed out the extreme difficulty of using such clauses in varied classes of work. While they might serve the purpose admirably in some instances, their practicable application would be almost impossible in others.

Mr. Macallum expressed his belief that the personality of the engineer was an important factor in the framing and carrying out of such clauses.

Mr. Oliver emphasized the necessity of wording all specifications so that they would stand the sand blast of the courts, Mr. McNab adding that the more specifications fall short of that requirement the more costly is the work. Messrs. McPherson, Brown, Safford and others expressed themselves in accordance, in whole or part, with these observations. In concluding the discussion the president drew attention to the magnanimity of the task before the committee, and to the wide consideration that was being given the question of general clauses all over the continent. He claimed that a set of such clauses, well prepared and well written, ought to be of material assistance to engineers. He drew attention to several things in the proposed draft, of which he was not in favor. He suggested the continuance of the committee, and it was accordingly continued, the draft being referred back for further consideration. The committee was empowered to add to its number Mr. G. H. Duggan and Mr. H. R. Safford.

The Committee on Rails, of which Mr. Howard G. Kelley is chairman, referred to the vast amount of work that had been done toward the improvement and standardization of rail specifications, both individually and through the American Railway Engineering Association. The specifications of the A.E.R.A. were strongly recommended for adoption by the Society. This was done, the committee to be continued to embody any changes that may be made. Mr. H. R. Safford was added to the personnel of the committee.

The report of the Committee on Track was submitted by Mr. Safford, chairman. Two subjects had been selected, with the approval of the Council, and investigations during the year were confined to these subjects. The one was "Specifications for Size and Spacing of Ties," and the other "Study of Economics of Track Labor." Programs of study had been drawn up and members were requested to assist the committee by giving these subjects their careful consideration, as a broad discussion was extremely desirable.

The report was adopted and the committee continued.

Wednesday Evening—29th Annual Dinner.—The banquet was held at the Engineers' Club, Beaver Hall Square, and was attended by about 120 of the members, Mr. Butler presiding. There were five toasts observed, *viz.*, The King, The Empire, Sister Professions, The Press and The Retiring President and Council. The speeches were interspersed by patriotic vocalisms from several well-known Montreal singers.

In proposing the toast to The Empire, Professor H. E. T. Haultain referred to the obligations of engineers to think outside of their own profession, as men of the Province, the Dominion and the Empire of which they were a part and in which they did their work. This thought was dwelt upon by Sir George Foster, Minister of Trade and Commerce, who emphasized the necessity of recognizing that it was a finer thing to be a good citizen than a good professional man. The mistake a man made who fixed himself definitely within the limits of his own work and disassociated himself from the work of the world was strongly brought out.

In passing from the establishment of the idea of profession to the idea of Empire, which idea had become such a tangible factor in the minds of men, Sir George declared the present to be a time of test for the calibre of the men of the country. He contrived to show that the European struggle was not a war of machinery and missiles so much as it was a struggle of ideals, the British ideal being men first and a government for the benefit of men, the German ideal being the government first and men for the purposes of the government.

The speaker referred in glowing terms to the heroism of the Belgian and of the great transformation during the past generation of the Russian.

"Sister Professions" was proposed by Mr. H. R. Safford, who referred particularly to the legal profession, remarking, "When I see a good lawyer the thought occurs to me that the engineering profession is short a good man." Mr. Geo. G. Foster responded on behalf of the law, bringing out the similarity of the principles upon which law and engineering were based, and jocularly observing, "If it wasn't for the engineer what would there be for the lawyer to do?"

Mr. Walter J. Francis proposed the toast "The Press," remarking in his introductory sentence that this did not mean the press of business. He presented a few enlightening figures respecting the constitution of the Canadian press, and referred to the existing representation therein of the engineering profession.

The toast was responded to by Hon. W. S. Fielding, who eulogized the unanimity of the press at the present time, party dissensions having been dropped with phenomenal haste when the crisis demanded of it the cementing of empire that has been so prominent since the outbreak of the war.

Mr. John Kennedy, in proposing the toast to the retiring president and Council, praised the year's good work for the advancement of the Society and the engineering profession. Mr. Butler, in replying, spoke a few words of appreciation, and went on to announce the establishment of two gold medals; one the J. H. Plummer medal, donated by Mr. J. H. Plummer, of the Dominion Steel Corporation, for metallurgical research, and the other the R. W. Leonard medal, given by Major R. W. Leonard, of the Coniagas Smelters, Limited, for the best paper on mining, to be open to members of the Canadian Society of Civil Engineers, and to members of the Canadian Mining Institute.

Thursday Morning.—The closing session of the meeting was marked by an unusually large attendance compared with the closing sessions of other years. A part of the morning's business consisted in a discussion of amendments of by-laws as proposed by Council and submitted to the members some time ago, for their consideration. These amendments were all carried. The incoming Council was instructed to appoint a committee in whose hands would be placed the drafting of a memorial to the late Mr. T. C. Keefer. The Council was also instructed to approach the Dominion and Provincial Governments with a view to having the term "civil engineer" more fittingly defined on the Government statutes.

The following reply was sent to Lieut.-Col. C. H. Mitchell: "The members of the Canadian Society of Civil Engineers assembled at the annual meeting appreciate your greeting, and, by resolution, extend to you and to our other gallant members now with the overseas expeditionary force our very best wishes." The Council was also instructed to convey by letter the good wishes of the Society to its members now serving on the battle line in France and Belgium.

Votes of thanks were tendered to the retiring president and Council for their very excellent work during the year, to the reception and introducing committee for its efficient services, to the Canadian Pacific and Grand Trunk railways for their co-operation and assistance, and to others who similarly tendered their services toward adding to the success of the meeting.

An interesting feature of the morning's proceedings was the award of the Gzowski medal to Mr. P. A. N. Seurot.

Mr. M. J. Butler retired from the presidential chair in favor of the newly elected president, Mr. F. C. Gamble. The latter's remarks were brief but most appropriate to the occasion.

The nominating committee for 1916 was elected as follows:—

District No. 1—C. N. Monsarrat.
District No. 2—G. A. Hendry.
District No. 3—S. E. Oliver.
District No. 4—L. W. Gill.
District No. 5—E. W. Oliver.
District No. 6—H. N. Ruttan.
District No. 7—R. W. Macintyre.

The proposed summer convention was discussed, Mr. Gamble suggesting that it be held in Victoria and extending to the Society a very cordial invitation from the Victoria and Vancouver branches. The matter was left to the incoming Council.

The Committee on Prizes for Student Papers recommended awards as follows:—

D. Bremner, "The Cost of Modern Houses."

E. E. Watts, "An Investigation Upon the Treatment of Zinc Ores."

L. A. Badgley, "Plane Table Surveying for Town Planning."

C. A. Macaulay, "The Evolution of Stoping in Mining During the Last Decade."

The following are the newly elected members of Council, replacing those who have retired at the end of their three-year periods::—

Vice-Presidents.—E. E. Brydone-Jack, Winnipeg; A. St. Laurent, Ottawa.

Councillors.—J. L. Weller, Toronto; C. B. Brown, Moncton, N.B.; S. P. Brown, Montreal; W. G. Chace, Winnipeg; A. A. Dion, Ottawa; T. A. J. Forrester, Quebec; N. J. Ker, Vancouver; A. Surveyer, Montreal.

Before adjournment an invitation was extended to the members by Mr. S. P. Brown to visit the Mount Royal tunnel that afternoon.

The meeting was adjourned by Mr. Gamble after a reminder to the members of the new Council that its first meeting would be held that afternoon.

At the close of the meeting the register showed an attendance of 279 members.

McKENZIE DRAIN.

The McKenzie drain, one of the most noted public works in Galt for several years, has been completed, and good time was made in completing the big contract. It was on October 22nd the work was commenced, and it was completed on January 16th, exactly twelve weeks later. The drain is 8,933 feet long, and the pipe was laid at an average depth of 12 feet. About 150 men were employed on the contract, eight hours a day. The drain, besides providing a long-needed service for the residents of the west end, was the means of providing work for many men.

POWER DEVELOPMENT AT KANANASKIS FALLS

FIRST OF A SERIES OF ARTICLES DESCRIPTIVE OF PRELIMINARY INVESTIGATIONS, DESIGN AND CONSTRUCTION OF THIS NEW PLANT OF THE CALGARY POWER COMPANY ON THE BOW RIVER, ALBERTA.

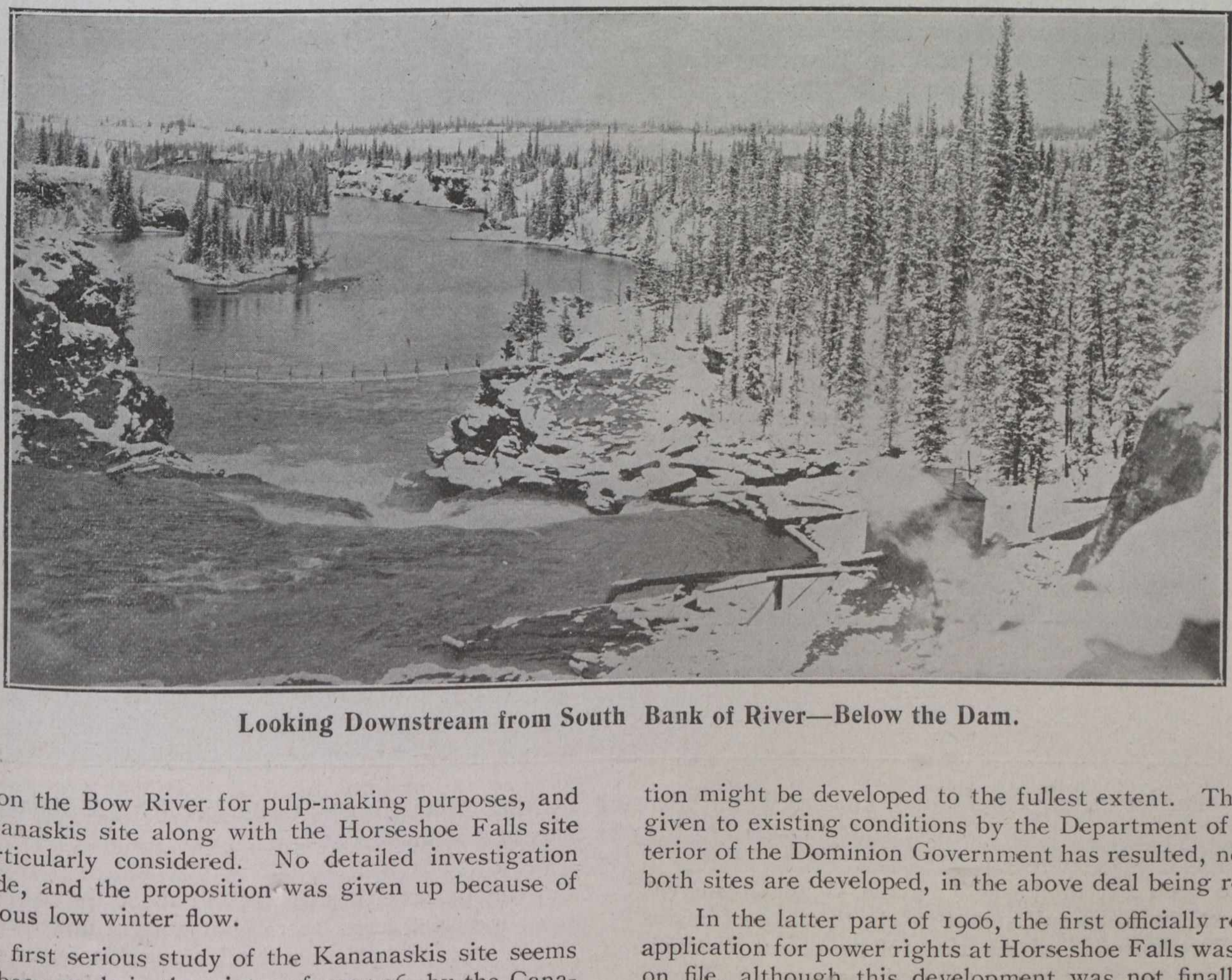
By K. H. SMITH, B.A.

[NOTE.—*The chief points of interest in the design and construction of the Kananaskis Falls Hydro-Electric Development were presented to our readers in an article which appeared in* THE CANADIAN ENGINEER *for August 6th, 1914. There are many features of the plant worthy of more detailed description, however, and it is with much pleasure that we begin, with this issue, a series of articles dealing with those features. Mr. Smith was resident engineer for the Dominion Government during the construction of the plant.*—EDITOR.]

THE earliest investigations of the Bow River for power purposes were made by Mr. Prince and his associates of the Eau Claire Lumber Company, of Calgary, about 1891. The Eau Claire Company had extensive timber limits at the head-waters of some of the tributaries of the Bow River, over much of which the timber was small and apparently well adapted for pulp purposes. Accordingly, their idea was to utilize the water-powers on the Bow River for pulp-making purposes, and the Kananaskis site along with the Horseshoe Falls site was particularly considered. No detailed investigation was made, and the proposition was given up because of the obvious low winter flow.

The first serious study of the Kananaskis site seems to have been made in the winter of 1905-06, by the Canadian Pacific Railway Company, who investigated this site in connection with a general study of the power possibilities of the Bow River in this district, and made surveys for that purpose. In the early part of 1906, application was made by officials of the Canadian Pacific Railway Company for the power rights at Kananaskis Falls. The rights asked for were never granted, and in any case the whole scheme was dropped when a current meter measurement revealed an entirely unsuspectedly low winter flow.

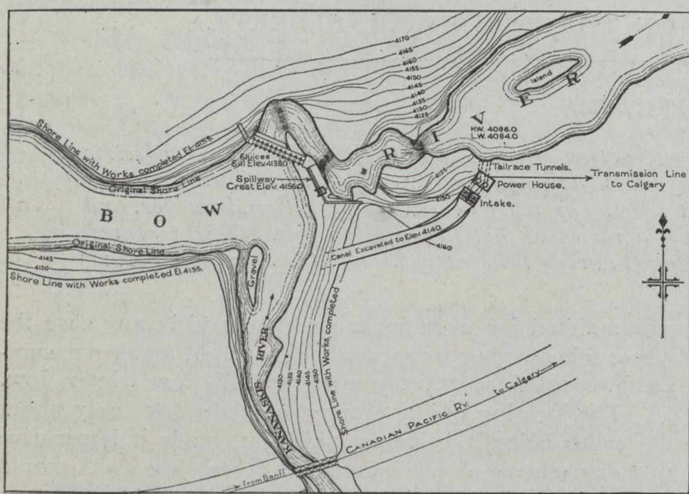
The location of the Horseshoe Falls site, only about 1½ miles below the Kananaskis site, made it imperative that any scheme of development at Horseshoe Falls should be considered in conjunction with the Kananaskis site, so that the power possibilities of the Bow River in this section might be developed to the fullest extent. The study given to existing conditions by the Department of the Interior of the Dominion Government has resulted, now that both sites are developed, in the above deal being realized.



Looking Downstream from South Bank of River—Below the Dam.

In the latter part of 1906, the first officially recorded application for power rights at Horseshoe Falls was placed on file, although this development was not finally completed until early in the year 1911. All rights at Horseshoe Falls were given with a view to preventing any interference with a possible future development at Kananaskis Falls, and at least one survey made in connection with the Horseshoe Falls development, included the Kananaskis Falls site and several miles of the Bow River above it. In the meantime, during January, 1910, the same interests, who were behind the Horseshoe Falls development, applied for rights at Kananaskis Falls.

In connection with the application referred to above, surveys at the Kananaskis site were made in February,



General Layout of the Development.

1910, by H. S. Johnston, then in the employ of Messrs. Smith, Kerry and Chace at Horseshoe Falls, and preliminary plans were submitted. In June, 1911, Mr. Johnston made a detailed survey of the Kananaskis site for the Montreal Engineering Company, acting for the Calgary Power Company, while in the meantime a party

to the future action of this Department respecting approval of plans, and terms and conditions of agreement under the water-power regulations. Preparations for construction by the company's own forces were begun immediately with Mr. H. A. Moore, as general manager and chief engineer of the Calgary Power Company; C. W. Allen, superintendent of construction, and H. S. Johnston, resident engineer. An agreement between the Government and the Calgary Power Company was executed shortly after.

Location and Water Supply.—The Kananaskis Falls development is located at the junction of the Bow and Kananaskis rivers, in such a manner that the Kananaskis River flows directly into the head-water above the dam. It is on the main line of the Canadian Pacific Railway, at mileage 52 from Calgary, and is, therefore, about 30 miles from Banff. The dam and other works are situated on the extreme westerly edge of the Stoney Indian reserve, while the headwater from the dam backs into the adjoining Rocky Mountains Park.

The mean low-water flow is in the neighborhood of 800 second-feet, with a minimum flow as low as 550 second-feet, the latter small flow being due to ice jams in the river. With storage basins at present in operation or proposed, it is expected that a mean regulated flow of about 1,500 second-feet can be obtained. This storage is made up as follows: Minnewanka, at present in use, 44,000 acre-feet; Spray Lakes, proposed, 171,000 acre-feet; Bow Lakes, proposed, 27,400 acre-feet.

These basins are all at such great distances from the Kananaskis plant (the nearest being about 35 miles distant) that local regulation by them is out of the question.

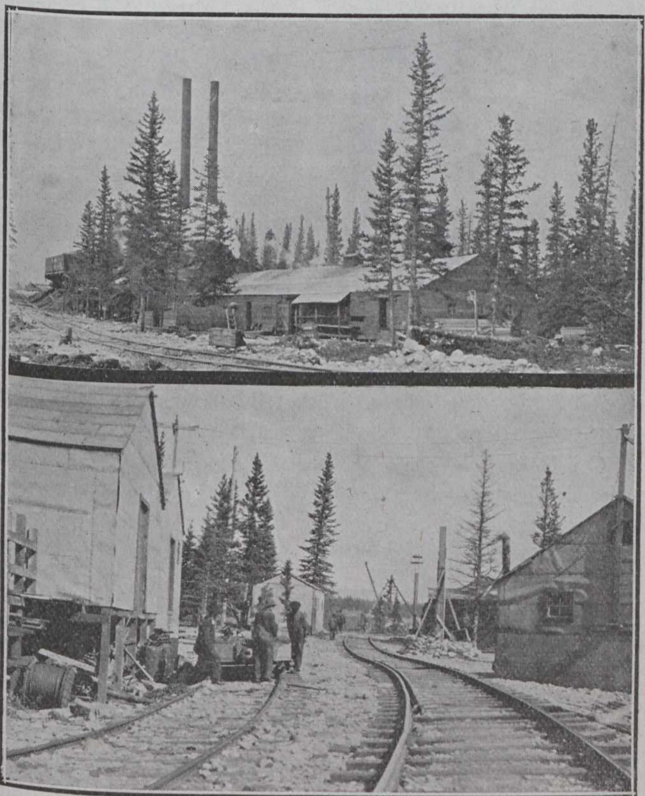
Part of Construction Camp, Looking West, Showing Location With Respect to the C.P.R. A Siding Leading to the Site May be Seen in the Background.

had also been put in the field by the Water Resources division of the Railway Lands Branch, to make extensive surveys in connection with a study of the power possibilities of the Bow River, and a detailed survey of the Kananaskis site was made by this party under Mr. M. C. Hendry in August, 1911.

On November 25, 1912, permission was given by the Department of the Interior to begin, and to proceed with, preliminary construction operations at Kananaskis Falls, provided that such work was undertaken without prejudice

For this purpose, besides a pond above the dam of about 122 superficial acres, there is at present under consideration a storage basin on the Kananaskis River near the head of the pond from the Kananaskis Falls dam. This would give a storage capacity of about 8,300 acre-feet, and would be used entirely for regulation purposes. The present idea is to take one of the small units from the Horseshoe Falls plant of the Calgary Power Company, and place it at this storage dam. This small unit could well be spared from the Horseshoe Falls plant, and such an arrangement would not only give double use of water from the Kananaskis storage but would give immediate relief to the main power plants, depending only on the time required to synchronize the smaller machine. Under normal conditions, it is thought that the auxiliary plant need be used only for short periods at a time, so that there would be no great variation in head at the Kananaskis storage dam. The advantage of this whole scheme, from the standpoint of taking care of peak loads and tiding over periods of extreme low water, is obvious.

General Scheme of Development.—The first ground in connection with the Kananaskis construction was broken on November 27, 1912, when some work was done on a road leading to the site of the development from the already existing development at Horseshoe Falls. Work was carried on continuously from that date to December 27, 1913, when power from the new plant was first delivered to the Calgary transmission lines, though even at



Boiler House, Machine Shop, and Other Camp Buildings, Also Service Track.

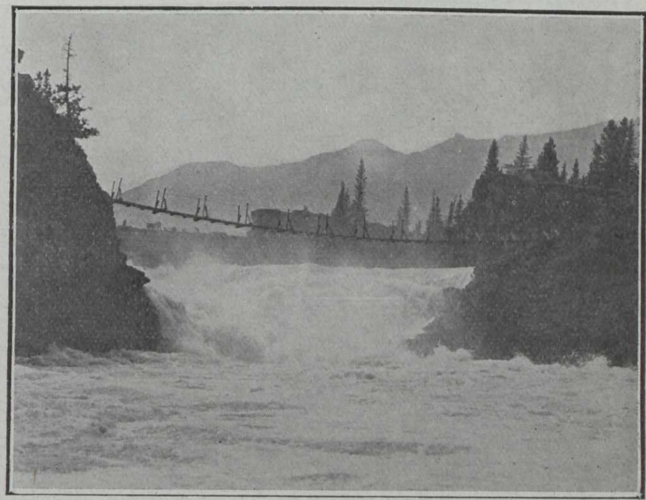
that time there was much work to be done in connection with various fittings in and about the power house and dam, and the installation of the second generator unit.

While the final plans for the development were not approved until early in the year 1913, still they were sufficiently matured in their more important essentials to allow of organization proceeding during December, 1912. This organization was carried out with the idea of meeting the requirements of a development consisting of the following main features:—

(1) A gravity section concrete dam, part free spillway and part stop-log sluiceway, extending across the Bow River immediately below its junction with the Kananaskis River.

(2) An open canal extending from the forebay along the south bank of the river for about 650 feet to a concrete intake structure.

(3) A power house situated in an excavated site about 20 feet from the intake structure, the excavation to the bottom of the draft tubes being almost 100 feet from the surface of the ground, and connected with the intake by



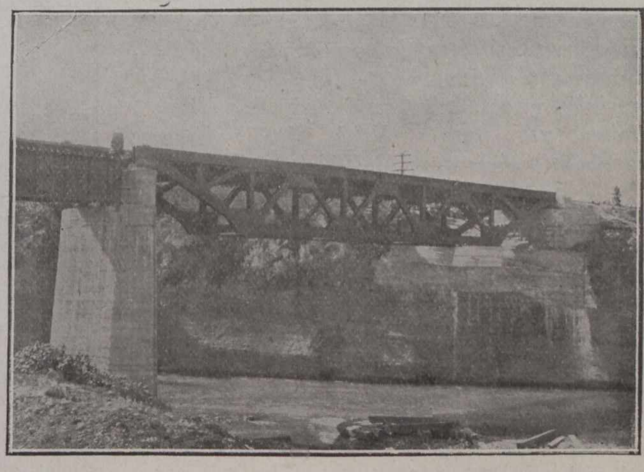
Lower Pitch of Falls at High Water.

pressure tunnels through rock leading to the scroll case of each turbine.

(4) Two tailrace tunnels leading from the power house some 120 feet to the river below the falls.

Preliminary Operations and Organization.—This general scheme, apart from the large amount of excavation and tunnel work involved, also necessitated one main coffer-dam and a smaller coffer-dam at the outlet of the tailrace tunnels. The overflow section of the dam, which rests on a long rock projection, could be built at the low-water period without any unwatering being necessary. The control of the water was then as follows:—

(1) The overflow section was begun at low-water, an opening being left at a natural low spot in the rock foundation large enough to take care of the low-water flow of the river.



C.P.R. Kananaskis Bridge After Being Raised, Showing Method of Protection at Normal Water Line.

(2) A coffer-dam was built embracing about one-half of the sluice section of the dam.

(3) After the high-water period, the coffer-dam was extended across the remaining portion of the dam.

The result of this plan was that the medium and high water was taken care of by the small opening in the overflow section, and that portion of the river beyond the first coffer-dam; low water was entirely taken care of by the opening in the overflow section. This small opening was finally closed by stop logs, for which provision had previously been made, behind which concrete was placed, the water in the meantime rising and passing through the main sluiceway openings.

Mixing Plant, as Seen from Southwest Corner of Coffer-dam.

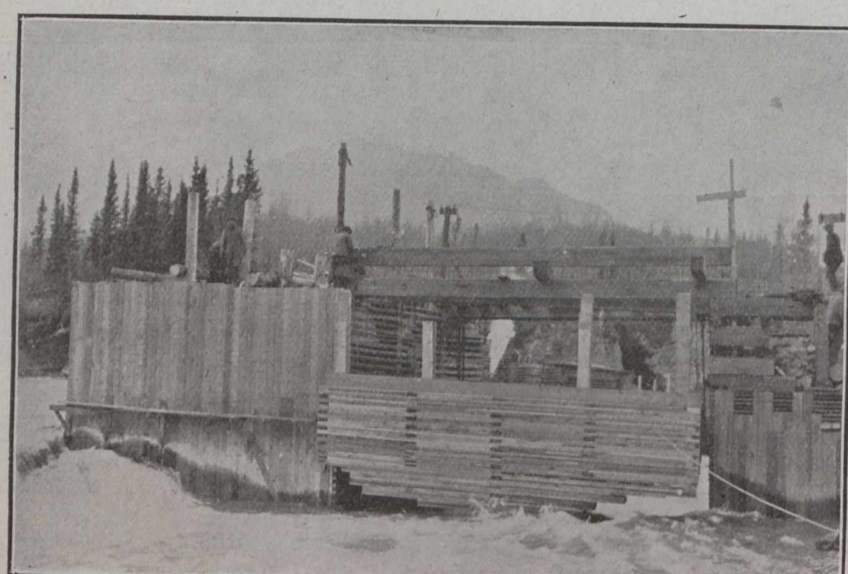
Apart from the building of the necessary camp buildings, machine shops, etc., the first necessary step was the building of a spur line of railway some three-quarters of a mile from Seebe siding on the main line of the Canadian Pacific Railway across the Kananaskis River, which involved a trestle some 40 feet maximum height and about 300 feet long. This spur line was finally connected up on December 31, 1912. With the various branches, which were shifted from time to time, it was used not only for bringing in supplies, but also for handling gravel for concrete and spoil from excavation. Coal cars were brought into the works intact as well as car loads of machinery.

A well-equipped machine-shop was set up, also a central heating, lighting and pumping plant.

A large concrete-mixing plant was built near the south end of the dam site, equipped with two Milwaukee mixers of one yard capacity each. This plant was equipped with a gravel hopper of about 126 yards capacity, feeding to the mixer by gravity. Cement was loaded directly from the cars into storehouses adjacent to the mixing plant and was delivered to the mixer hoppers by timber chutes. Suitable gravel was found on the ground some one thousand feet from the mixing plant. It was loaded in dump cars by a steam shovel, and taken directly to the mixing plant hopper. Frequent physical tests were made of this gravel, to insure its being properly graded and free from too large a quantity of loam. Regular physical tests were also made of the cement, which was supplied mostly by the local plant of the Canada Cement Company at Exshaw, some 5 miles away. This cement was often found to be too green for immediate use, and the work was, on account of this, held up for short periods on several occasions.

By December 24, 1912, the Kananaskis commissariat was in complete running order. Previous to this, meals had been supplied from a camp already existing at Horseshoe Falls. Throughout January, work proceeded on the tailrace coffer-dam which was completed on February 6, as far as the cribbing went. These rock-filled cribs were afterwards sheeted, and a wall of concrete was placed around the bottom edge of the sheeting. This concrete was placed under a slight head of water, which tended to force it under the edges of the sheeting, and the result was a coffer-dam which was practically tight.

On February 1, 1913, the first concrete was placed in the main dam, in a large hole at the site of the temporary unwatering sluiceway; this was mixed by hand. Due to precautions necessary against frost, the placing of concrete proceeded slowly.



Crib to Close Coffer-dam—Just Before Dropping.

On February 13, excavation of rock at the upper end of the canal was begun, in order to get rock for the main coffer-dam which was begun two days later. This coffer-dam consisted of rock-filled cribs made of material 2-inch by 8-inch. Rock from the canal excavation was transported in push cars to the cribs. This coffer-dam was placed on the brink of the upper pitch of the falls, so that only three slides were necessary for it. An opening was left during its construction to pass the Kananaskis flow, which opening was later closed by a wedge-shaped crib partly swung, and partly floated, into place. The first attempt to close this opening was unsuccessful as the crib buckled due to the force of the current and was carried through the opening. The next attempt was more successful, though unfortunately even in this latter case the crib jammed before it was entirely in place, and much patching had to be done to make the opening tight. There was always considerable leakage through this coffer-dam, so much so that a temporary opening was left through the bottom of the dam which was afterwards filled from the inspection tunnel of the dam and another opening on its downstream side.

During January and February, the temperature ranged mostly from zero to 35 degrees below and very little concrete was placed during this time. By March 21, the main mixing plant was ready for operation, but due to cold weather no concrete was placed.

For the lower parts of the dam, concrete was taken directly from the mixers in Hudson 1-yard dump cars. For the upper lifts Insley hoists were arranged and the push cars used as before. The capacity of the mixing plants was about 700 yards per ten-hour day, the longest haul was about 800 feet, the average haul about 250 feet, and the highest day's yardage, 312 with one mixer running.

(Part II. will deal with the construction of the dam and canal.)

ONOWAY-PEACE RIVER LINE.

The steel bridge across the Pembina at Sangudo on the Onoway-Peace river line has been completed. The grading and trestle work is already completed to Whitecamp at the crossing of the McLeod river, but as the grading was done two years ago it is somewhat out of repair and work will have to be done on it in the spring before track can be laid. No doubt, however, track will be laid to White Court next summer.

RAILROAD EARNINGS.

The following are the railroad earnings for the first two weeks of January:—

Canadian Pacific Railway

	1915.	1914.	Decrease.
January 7th	$1,316,000	$1,850,000	— $534,000
January 14th	1,321,000	1,563,000	— 242,000

Grand Trunk Railway

January 7th	$ 743,522	$ 797,268	— $ 53,746
January 14th	779,745	803,919	— 24,174

Canadian Northern Railway

January 7th	$ 205,400	$ 364,700	— $159,300
January 14th	239,000	362,800	— 123,000

The world's gold output in 1914 is estimated by the Engineering and Mining Journal of New York at $455,305,000, a decrease of $7,364 from 1913, and of $19,028,000 from 1912. The 1914 figures are based upon returns for eleven months from most of the countries of the world, and estimates for the final month of the year, together with the returns of the director of the United States Mint and the United States Geological Survey.

OPERATING SEWAGE DISPOSAL PLANTS.

THE Committee on Sewage of the Indiana Engineering Society, in its report presented January 22, devotes practically all of its attention to the subject of the proper operation and supervision of sewage disposal systems. This part of the report is given below:

Sewage disposal projects in small towns and in institutional plants are, after their installation, usually neglected. They are not, as a rule, popular and the tendency is to see that they are operated properly at first and to forget them afterwards. Many in charge of such plants have the idea that they need no attention. They are allowed often to get in such shape that later a large sum may be required to place the plant in proper condition. In numerous instances such expenditures might have been avoided had proper attention been given. A plant, even though overloaded, if well looked after, will give fair results and even better results than a well-designed plant that is neglected.

In some plants under observation it has been found that practically no attention whatever has been given the sewage disposal plant, consequently they have become inefficient and do not properly perform their function. In some instances, even with the inattention, the plant has continued to show good results, but in cases of this kind it will only be a matter of time when conditions will become serious and cause either useless expense or the plant will get in such condition as to be unable to purify the sewage.

Persons in charge of sewage disposal plants should understand the principles of operating the plant and should be thoroughly familiar with the details of the plant. Operators should understand the dosing apparatus and know how to adjust same in case it gets out or order. They should be able to tell when the sedimentation or reduction tank is operating properly, whether too much suspended matter is being carried over to the filters or whether too much sludge is in the tank. Also when contact beds are being overworked or when sand filters are clogged or need to be raked. It does not take a technical man to know these things, but it requires a man who will look after these things and the plant at regular intervals and keep track of what it is doing. At municipal or public plants the city or county engineer could direct such work, and at public institutions the chief engineer at the plant is fully capable of getting results if he will devote the necessary time.

Too little attention is usually given to the operation of sewage disposal plants and the plants are often left in charge of the poorest kind of labor. It is quite evident that instructions should be given to the operators of such plants if proper results are to be obtained and the aims of sewage disposal are to be accomplished.

The following suggestions are given toward the proper operation of the smaller plants which can not receive expert supervision:

Septic and Imhoff Tanks.—As the purpose of such tanks is mainly for the separation and retention of the suspended matter to as great a degree as possible, the tanks should be kept in such condition that this will be accomplished, otherwise the efficiency of such tank will be impaired.

To get the best results, large accumulations of septic sludge should be avoided when they cause violent ebullition and a consequent carrying over of the sludge to the filters. The sludge should be removed when necessary.

In using Imhoff tanks the sludge should not be allowed to get above the depositing slots at the bottom of the settling chamber.

Large and unusual flows through the tank, such as storm water flows, should be diverted, especially in plain septic or sedimentation tanks. The removal of suspended matter should be as complete as possible, as the less of this matter reaches the the filter beds the less trouble there will be in operation. Sludge should be blown off when possible at regular intervals, or at time of high water, unless provision is made for sludge drying.

In the event that there is no stream large enough to carry off the sludge at high water, then a sludge bed, well underdrained, should be constructed and the sludge run on to this bed, allowed to drain and then removed. Settling chambers of Imhoff tanks should be kept free of sludge, and in some cases where the slope of hopper bottom is not steep enough the sludge should be pushed down through the slots or otherwise removed.

In some Imhoff tanks sludge mats are liable to form on top surface of settling chambers and it will usually be found better to clean this mat off at intervals.

The effluent from tanks of any kind should be examined at regular intervals. If solids are carried over it is likely to cause trouble in the syphons, and in the case of contact beds the sludge, if carried over in quantities, will clog the bed in time.

Contact Filters.—The main trouble with contact beds is the tendency toward clogging. Contact beds should not be overworked and should have stated periods of rest. It is impossible not to get some matter carried over from the tank, but this can be taken care of in a way to cause the least trouble, and to catch most of the material before it works into the beds. Proper and complete underdrainage will assist greatly in getting rid of accumulations, but it is safe to say that few contact beds are very thoroughly underdrained. Too little regard is usually given to good underdrainage and proper bottom construction to contact filters.

In operating contact filters they should be filled by dosing; the sewage should then stand for several hours, usually about two hours. At the end of the contact period they should be automatically discharged and should have a suitable resting period of at least six to eight hours. Should the beds become in a clogged condition, the stone must be removed and cleaned or new stone placed.

Sand Filters.—The sand filter is not so liable to trouble as the contact bed, but it goes without saying it should be kept as free as possible from material that will clog. When ponding occurs the bed should be raked about ¾ in. deep. The bed can be allowed to dry and the top skin will peel easily and can then be raked off. Slopes around filters should be sodded so that clay or dirt will not get into the sand and clog same.

Where the sewage is discharged by distributors onto the bed it will be found advantageous to place large gravel or broken stone at such points, so that the sand will not be washed out or scoured.

Low spots on the sand area should be kept filled so that the sewage will flow level and all parts worked as uniformly as possible. In freezing weather the surface of the filter should be furrowed.

In conclusion, operators who are not getting proper results out of their plants, or if they notice unusual conditions, should notify the State Board of Health, with a view toward getting things in proper shape.

THE MECHANICAL LIFE OF TIES AS AFFECTED BY BALLAST.*

By E. Stimson,
Engineer, Maintenance of Way, Baltimore & Ohio, Baltimore, Md.

THE wooden cross tie, transmitting the heavy axle loads from the rail to the ballast, is subjected to mechanical wear not only from the action of the rail on top of the tie, but also from the action on the sides and bottom of the tie of the ballast which supports it. Tie destruction from mechanical wear of ballast seldom occurs to any appreciable extent excepting in occasional stretches of crushed stone, or other forms of hard ballasted tracks where a soft roadbed or a sink requires continual raising of track and tamping of ties in order to maintain good track surface. The wearing away of ties by ballast is the result of tamping the ballast under the tie and the action of the tamping tool striking the side and edge of the tie rather than the action of the tie bearing upon and working in the ballast under trainloads. There is but little mechanical wear due to the tie working in the ballast.

After ties are first put in the track and tamped to surface on hard ballast, the necessity for retamping to surface and consequently the wear of the ties by ballast depends largely on the nature of the sub-grade. Good surface and sub-surface drainage usually insures a solid road bed where the normal bearing value of the material qualifies it for heavy loading. Where such conditions prevail, track surface is maintained with a minimum amount of tamping and the mechanical effect of the ballast on the ties is negligible.

Ties which are removed after service in hard-ballast tracks are found to be pitted or indented on the bottom and sides from contact with the stone or other material. These indentations are a valuable factor in holding the track in line and surface as long as they are not increased by frequent tamping. The continual tamping of the ballast under the tie soon rounds off the edges of the ties, leaving little or no flat bearing surface for support. When this happens the tie acts as a wedge and tends to force the ballast out into the cribs instead of receiving full support from it. The greatest wear occurs from 6 to 8 in. either side of the rail and there is practically none directly under the rail. In track maintenance the best practice is to tamp the tie for its full bearing upon the ballast outside of the rail and for an equal distance inside. In spite of close supervision, however, this is not always done but instead, the trackman expends his efforts toward tamping solidly as near the rail as he can work with a tamping pick. This wears off the edge of the tie for some distance each side of the rail, and leaves a short unworn edge directly under the rail. When a tie becomes rounded on the bottom at the most essential tamping point and becomes difficult to maintain to surface, it is then found more economical to replace it with a new tie having a flat bottom that will necessitate less tamping. The average trackman feels little hesitancy about removing a tie for this cause when he has difficulty in keeping it tamped. Even in cases of most excessive tamping, wear from ballast does not become objectionable until the tie has been in service from 50 to 75 per cent. of its normal life. The kinds of ballast and ties used and the standard at which a track is main-

*Read at the Convention of the American Wood Preservers' Association, January 19, 20 and 21, Chicago.

tained, are all important factors. Slag and stone when crushed, form hard, sharp, angular fragments that appear from observation, to be more destructive when tamped under wooden ties than gravel, burnt clay, cinders, granulated slag or other similar forms of ballast. Ballast of the last named materials has little or no effect in wearing down the sides and bottoms of the ties nor is the tamping of this kind of ballast so destructive to the ties, as the particles are smaller, generally of softer material and rounded in form. There is a perceptible difference in the resistance offered against mechanical wear by ties made from the different kinds of wood. Hard wood ties of rough texture withstand the action of the rail cutting and of excessive tamping much longer than ties of soft wood. It has been observed that these ties which are most durable under the mechanical wear of the rail also last longer under the wear of ballast; for instance—white oak, chestnut oak, black walnut, maple and beech are more suitable than yellow pine, fir, catalpa, cedar and red wood.

It is important to mention the extent to which some forms of ballast increase the abrasive action of the rail upon the tie. Granulated slag, gravel, cinders, chatts and other forms of ballast carrying fine gritty particles contribute largely to this action between the rail and the tie or between the tie plate and the tie thus greatly accelerating the mechanical wearing away of the wood. It has been observed that the cutting of the rail into the tie is much greater where fine ballast is used than where coarse hard ballast is employed. This trouble has been largely overcome by the use of flanged bottom plates which become embedded in the tie, and by plates fastened directly to the ties by lag screws, independent of the rail spiking, thus reducing the movement between the plate and tie to a minimum. However, many ties are removed from track each year because of deterioration from rail wear and a large amount of this deterioration can be assigned to the effect of the fine particles of ballast grinding under the rail.

Regarding the use of treated ties where extraordinary wear by ballast is known to exist, the same rule might apply that is observed when the mechanical wear under the rail limits the life of the tie. Treatment to prevent decay does not give the tie increased resistance to abrasion, and ballast abrasion that is so severe as to wear out an untreated tie would preclude the possibility of any benefit from the use of treated ties at locations where such abrasion occurs.

THE BRULE, GRANDE PRAIRIE & PEACE RIVER RAILWAY COMPANY.

Application will be made to the Parliament of Canada during the coming session for an act to incorporate a railway company under the name of the Brule, Grande Prairie and Peace River Railway Company, with power to lay out, construct and operate a line of railway, telegraph and telephone lines, commencing at a point in the Province of Alberta at Brule Lake, on the main line of the Grand Trunk Pacific and Canadian Northern Railways, thence north-westerly to Grande Prairie, thence north-westerly to a point in the Province of British Columbia, connecting with the terminus of the Pacific and Great Eastern Railway at or within the Peace River Block; also commencing at Grande Prairie, in the Province of Alberta, thence northerly to the Pacific, Peace River and Athabasca Railway at or near the point where the said railway crosses the Montagneuse River, passing at or near Spirit River Settlement and crossing the Peace River at or near Dunvegan, approximately four hundred miles in all.

TYPES OF MOVABLE DAMS.

THE use of dams in the partial or complete control of flowing water involves studies of local conditions that oftentimes encounter diametrically opposed requirements at certain times. For instance, there are the conditions of low and flood stages of a stream which necessitate varied and, occasionally, quite opposed functions on the part of a projected dam. It is to cope with such an occurrence as this that the movable dam came into use.

While each particular case may possess distinct requirements of its own, auguring for a wide variation in the design of such dams, and while there has been a correspondingly great variety of designs, there are nevertheless, a comparatively few accepted and successful types of movable dams. There is much of interest in their outstanding features, and literature on the subject has been decidedly enhanced by a paper on the subject recently presented to the Canadian Society of Civil Engineers by one of its members, Mr. H. B. Muckleston, assistant chief engineer, Canadian Pacific Railway, western lines. Mr. Muckleston divides all types into two classes: (1) Automatic or semi-automatic, *i.e.*, in the sense that they do not require external power for their operation, and (2) all types which require external power, either manual or mechanical, for their operation.

Dams of the first type may either go into operation automatically with the rise and fall of the water, or operate only by human intention regardless of the stage of water. To this class belong all the many varieties of bear trap and drum dams. Of the bear traps five types have survived: The old style or sliding leaf type; the Parker or hinged leaf type; the Lang, a modification of the Parker; the Chicago, and the sector type.

All these types operate on the same principle, which is to utilize the head created by the dam itself for its operation, without intermediate machinery of any kind. As regards numbers, there are more old style bear traps than all the others put together, followed by the Parker, Lang, drum and sector types in the order named.

The principal types in the second class of dams are:

(1) Bridge dams, consisting of a permanent bridge with the openings between the piers closed by some form of gates which get their support from the piers directly.

(2) Shutter and wicket dams, consisting of a series of shutters or leaves, side by side, so arranged that they can be laid flat during floods and raised up on end when it is desired to close the dam. They vary in complexity from the simple shutter hinged at the bottom and supported by a chain or prop, to a complicated arrangement with hydraulic rams and subterranean tunnels.

(3) Roller dams, where the dam is formed by a massive cylinder having a diameter equal to the required height. When it is required to open the dam the cylinder is rolled up an inclined track out of the way of high water.

(4) Frame dams, essentially bridge dams in which the bridge itself is movable. The bridge consists of a series of framed trestles or horses which are set in place or can be removed successively from one bank of the river to the other. Usually they are arranged to lie flat on the bottom when not in use. According to the means used for filling the gap between the trestles, frame dams are classed as:

(*a*) Needle dams, when the closures are vertical and set in place successively side by side.

(*b*) Boulé or flashboard dams, when the closures are horizontal and set in place successively from the bottom up.

(*c*) A-frame, when the frames are so numerous and closely spaced that they form the dam without other closures.

5. Curtain dams, similar to bridge dams, but instead of the closures being horizontal and supported by the piers, they are vertical, and usually consist of a series of frames, hinged to the bridge at the top, which can be lowered till the other end butts against a support on the floor of the dam. The actual closure is effected by a flexible curtain which is rolled up for removal.

All the types above described have their advantages and disadvantages and a careful study and weighing of natural and imposed conditions is necessary before a choice can be made. It is impossible to outline all the possible conditions which a given problem might present, but the following are usually among them and in most cases they are the most important.

Character of Service.—When movable dams are built to aid navigation they are usually so located as to create a series of pools at low water, with locks to overcome the difference in elevation. The character of the traffic and the way it is handled will usually either dictate the type at once, or if not, will limit the field to two or three possibilities from which a choice will be made on other conditions.

When navigation is not a factor or is only a very minor one, the character of service is not usually the controlling condition. The only requirement imposed by it, is that the dam must be reasonably tight against leakage and must maintain the required head.

The Character of the Stream.—It is evident without argument that the selection of type must be influenced by the size of the stream. The weight of parts increases with the cube of their dimensions, and as movable dams must be handled and that sometimes very rapidly, it is evident that a structure suitable for a small stream can not simply be built on a larger scale for a big one.

Some streams when in flood bring down so much driftwood and debris of all kinds that certain types of movable dams would be absolutely inadmissible, and others could only be operated at great expense and with ever-present possibilities of serious damage. The various types offer a wide range in freedom from obstruction to flow when open, usually at a certain cost either for construction or working, and the choice must be made with all the facts in view.

The amount of silt brought down by a river in flood is a very variable quantity. During a rising flood the Nile is so heavily loaded with silt that it resembles gruel. On the other hand, the St. Lawrence above Lachine is practically free from silt all the year round. It is evident that the two cases would require very different treatment.

Different rivers or different sites on the same river exhibit a wide variety in the material of the bed, which may consist of rock, gravel, sand or mud. This has an influence on design, not only in the matter of foundations but also in selection of the proper type of dam. Some rivers with gravel or sand bottoms are continually changing their course because of the material rolling along and forming bars and pools, and interference with this process may be extremely dangerous. Some dams cause much more interference than others, and it is proper to select the type which reduces this interference to a minimum.

Range in stage and time factor are most important in their influence on design; the range because of its effects on first cost, and the time factor because of its effects on cost of working; and no design, simple or complicated, should be accepted unless full consideration has been given to them.

Climatic Conditions.—The destructive effects of ice are felt from "shove" due to expansion or slow movement, and from jams after the spring break-up.

In this connection there is an important difference between streams flowing north and those flowing south. In the former case the rivers commence to break up at the headwaters and the ice tends to pile up as it is carried down to the still firm ice below. In the latter case the break-up begins in the lower reaches and ice jams are less frequent, though the individual sheets are usually larger.

In tropical countries the growth of vegetation is rapid and luxuriant. Deposits of silt left uncovered are immediately converted into jungle, which remains and forms a decided obstruction to the natural flow. Obviously where such a condition can arise the design should be so chosen that silt deposits are avoided or kept well covered with water at all times.

Settlement.—The condition of the banks above as regards settlement is an important factor in choice of type. If the banks above are thickly settled it is important that the afflux caused by the dam when open should be a minimum, otherwise the cost of land condemnation may be prohibitive. The kind and degree of settlement is an indication of the character of debris which the floods may bring down. For instance, sawmills, if flooded out, would set free a great deal of the worst sort of drift.

Legal Requirements.—The effects of legal requirements and vested rights on design are real though they may not be obvious. They vary so much from place to place that it is impossible to completely enumerate them. As an example, take the case of a stream on which logging operations have been carried on for a number of years. The logging interests may have acquired a certain vested rights to use this stream for a certain purpose, and would be able to prevent the construction of a dam unless a provision was made to pass logs or perhaps even rafts and batteaux. Another legal requirement in some cases is provision for passing migratory fish.

Some types of dam lend themselves to such provisions more easily than others, and other things being equal, would have a preference on that account.

It will very seldom happen that all the conditions can be fully satisfied, and in consequence nearly every design is somewhat of a compromise between opposing requirements.

Having decided what the governing conditions are and which ones are inconsistent, the designer must give to each its proper weight in order that the final decision will be the most advantageous possible under the circumstances as they exist. He must not forget that the real cost of the structure is not its first cost, but is the sum of first cost, capitalized cost of working, and capitalized cost of maintenance, and until this sum is reduced to a minimum he is not making a dollar earn the most interest. Only after the most exhaustive surveys and careful estimates can he be sure that this end has been reached, and he should insist on having both the time and the money with which to make them.

Mr. Muckleston describes a number of typical examples, showing the particular conditions to be met and the manner of solution. These include the brush and dock dam at the head of the Ganges Canal, India; the Okla weir at the head of the Agra Canal, India; the simple bridge dam above Chaudiere Falls on the Ottawa River; the complex barrages on the Nile; the Ohio River dams; the St. Andrew's Rapids dam on the Red River below Winnipeg; and the C.P.R. irrigation dam now under construction in Calgary. Being typical of the varying requirements the examples are most interesting. Space permits mention only of those which, in meeting Canadian conditions, are of particular interest.

Stop Log Dam, Ottawa River.—This structure consists of a series of concrete piers spaced on the arc of a circle, about 24 feet apart in the clear. The openings are spanned by heavy stop logs lowered into grooves. The logs are handled by an electric crane or winch, which moves along the dam and places or removes logs as required. The purpose of the structure is two-fold; 1st, to divide the water equitably between the mills on each side of the river, and, 2nd, to maintain a nearly constant head on the turbine wheels of the power plants. In considering the design of this structure the following basic conditions were met:—

1. Absolute reliability in all sorts of weather.
2. Immunity against damage by ice.
3. Accurate and delicate control of division of water and of head.

After an examination of all types of bear traps, wicket, and frame dams, the bridge dam was selected and the stop log closure finally decided on only after thorough consideration of the advantages and disadvantages of sluice gates of all descriptions.

St. Andrew's Rapids Dam.—Another example of a movable dam built solely for navigation purposes is the St. Andrew's Rapids Dam on the Red River below Winnipeg. The traffic so far is principally cord-wood barges and excursion boats. The object of the dam is partly as an aid to navigation and partly to maintain a stable condition in the river through Winnipeg. The dam consists of six openings of 120 feet, closed by Camere curtains. The curtains are rolled up on frames hung from steel bridges and butting against castings on the floor of the dam. There is a great quantity of complex machinery in connection with the dam and its operation must be very expensive. The design has been very severely criticized on several grounds. It has done its work well, but it is very doubtful whether a far smaller initial expenditure and much less cost of operation could not have been secured by the choice of a different type.

C.P.R. Dam, Calgary.—The dam consists of three portions, numbered from the north bank:—

1. A regulating section of the sector type of bear trap, 150 feet long.
2. A stop-log dam, 555 feet long.
3. A breaching section, 200 feet long, consisting of an earthen dyke, which will be topped and carried away should either or both of the other sections become inoperative through drift, debris or ice. The design is the result of a very exhaustive study of the conditions which a dam at this site must meet, and also of the many types of dam which have been built and operated, and the difficulties which have been met with in so doing.

The following summary of the governing conditions is the result of that study.

Character of Service.—The structure is a diversion dam pure and simple. The reason for its construction is simply that without it the river is not deep enough at low water to enable full supply to be taken into the canal. At the same time, it was realized that a solid weir with scouring sluices of the usual Indian type would not do, and that a barrage of some kind was the only possible type. It is evident that navigation has no bearing.

Character of Stream.—The Bow River is a somewhat turbulent stream, with a comparatively small drainage area situated at a high altitude. Its ultimate source is in the glaciers of the mountains, but most of its catchment area is below the permanent snow line, and much of that is somewhat steep and rocky. In consequence, its discharge during the summer months fluctuates violently, and frequently without much warning. The run-off at the site varies between wide extremes. The minimum occurs during the winter and varies very little, being about 1,000 second-feet. During floods it may rise to 60,000. The bottom, which is gravel in sizes up to six or eight inches, is continually moving and rapidly piles up against any obstruction which arrests this movement. Another result of this movement is a gradual erosion below any such obstruction. It is not necessary to enlarge on the climatic conditions—it is sufficient to point out that the rapid alternation between extremes of heat and cold have their effect on the behavior of the stream.

Settlement.—Owing to the fact that the river above the dam flows through the centre of a large city, it was imperative that the regimen of the river in flood be disturbed as little as possible. This fact had a further bearing in the matter of debris and other matter brought down by the river. Those who saw the last big flood, when Calgary was less than one-tenth its present size, will realize what a repetition of such a flood would mean with the very much denser settlement which now exists.

Legal Requirements.—The only legal requirement was that the structure should be approved by the government department concerned, which it was.

Cost.—As in all other engineering constructions, the combined costs of construction, operation, and maintenance, must be a minimum. In this case, materials for concrete are relatively cheap; machinery and metal work expensive; labor for operation inefficient and expensive; power comparatively cheap. Before any work was done in the matter of design, an extensive series of surveys was made to determine in what way, if any, the dam would affect the regimen of the river above the site. The foundations of the structure vary. The stop log portion is on gravel and boulders through practically its whole length. The sector portion—or rather the well into which the sector sinks—is on shale rock. Where the structure is on gravel and the head is greatest, the cut-off walls are to consist of steel sheet piling. For the low heads either wood piling or concrete curbs are to be used.

Method of Operation.—As the dam consists of three dissimilar parts, there are three methods of operating.

The breaching section will operate of its own accord when necessary. The stop log section is to be operated by a machine which resembles the familiar traveling crane in its functions, and is worked by electric power. The operator has a station inside the machine, from which he can see all movements. Without leaving his seat he can bring the machine over any opening, lower the rams, engage the log, hoist it out of the groove, pile it on the stack, and move to the next opening; and he can do all this at the rate of one log per minute after he becomes familiar with its working. The machine has three motions like a traveling crane. The logs are hoisted by rams worked by rack and pinion like the dipper handle of a steam shovel. The machinery working the racks is mounted on a carriage moving athwart the dam; this carriage itself being mounted on a second carriage moving along the dam. Each motion has its own motor and controller, and is provided with a very complete set of automatic brakes.

The sector section is operated by hydraulic power furnished by the head which the dam creates. The sector itself is an inverted trough having one side straight and the other side curved to the radius of the straight side. The free edge of the straight side is hinged to the floor by a watertight hinge, so that the whole structure can revolve, sinking in its lowest position into a well in the floor. The curved side and the ends of the trough make watertight rubbing contacts with the masonry. Water from above the dam can be admitted to the under side of the sector under pressure due to the head or any part of it, and according as this pressure is varied the sector assumes different positions. The head inside the sector is varied at will by means of a movable weir crest in the form of a telescoping tube, or alternatively in case of trouble by manipulation of valves at inlet and outlet. The river flows over the crest and down the straight side. To a certain extent the sector is automatic in its working, for the position which it assumes is at all times the result of a balance of several forces, and if any of these change the sector will move to a new position where the forces are again in equilibrium. Suppose the dam set for the night run with a certain depth of water going over. Should the discharge increase, the depth will increase also, putting a heavier load on the back of the sector, with the result that the sector will sink until equilibrium is again established.

In connection with all dams of this type, the writer concludes, it is desirable that provision be made for access to the inside for the purpose of painting and general maintenance. In this case a series of dogs or props are set along the front of the well. These can be thrown out so as to catch under the edge of the curved face and so hold it up. After this is done and not before, a door in the abutment wall can be opened, and the valves at inlet and outlet being closed the well can be pumped out. If necessary, the whole sector portion can be isolated by emergency dams above and below for which provision is made in construction.

KETTLE VALLEY LINE IS BEING RAPIDLY RUSHED.

The contractors have practically completed the grading of the joint section of the Kettle Valley and V., V. and E. railways, and at present a large number of men are engaged in building abutments for the bridges and in preparation for track-laying, which will be started very soon from the Hope end of the line to Coquihalla Summit. Three miles of track were laid west of Coquihalla before the snow came and stopped the work. A large quantity of the steel has been delivered already for the spring operations.

Rapid progress is being made with the construction of the bridge over the Fraser river, near Hope, over which tracks will be laid to furnish communication between the main line of the C.P.R. and the Kettle Valley. The structure is expected to be completed early in March.

Russian Consul Dogoravlenski announced that the Russian Government has awarded a contract for 15,000 railroad cars to a Seattle firm, and says that this order is only the beginning of business between the Russian Government and the Pacific Northwest.

THE GROWING VALUE OF WATER SUPPLIES.

At a recent meeting of the American Water Works Association Mr. L. J. Le Conte, C.E., called the attention of the members to the fact as the population in any district increases annually and the troubles from contamination necessarily grow worse, the intrinsic value of ground water supplies increases correspondingly. The natural growing troubles due to density of population have led many large cities in Europe, as well as this country, to abandon their old surface water supplies, and they have gone back to the old original ground water supplies as being the best and safest and this conclusion has been reached after long years of sad experience.

It is true that ground water supplies are surrounded by grave doubts as to their capacity in a long season of protracted drought. The sum and substance of the whole business is this, that in all such cases the best teacher is broad experience. This teaches us that in cases where you have ample capacity of gravel beds to store up the available waters, the maximum supply possible, in any case, will be 25 to 30 per cent. of the long average rainfall. In a great many cases, however, the capacity of the gravel beds is inadequate to store up and hold all the available waters and as a final result you will only get the volume of water that the gravel beds will naturally hold and no more. Hence it is that in a great many cases you only get 8 to 10 per cent. of the average rainfall, simply because your gravel beds are not large enough to hold all the available waters.

In arriving at the volume of storage in the gravel beds a great deal of conservatism should be exercised. After you have carefully figured out the total volume of the gravel beds, then assume that half of this will be lost by reason of underground topography, then assume that the voids in the balance will be one-third, hence we have $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$ the total volume of gravel beds is available for storage of water and $\frac{1}{4}$ average rainfall is the maximum water available.

Storage reservoirs for surface waters on the Atlantic Coast catch $\frac{1}{4}$ R″ rainfall for three driest years in succession. On the Pacific Coast they only get $\frac{1}{8}$ R″ rainfall for three driest years in succession.

Catch = $\frac{1}{4}$ R″ long average rainfall. Hence the gravel bed reservoirs have naturally a much greater annual catch seteris paribus and are much less liable to contamination. Moreover, the possibilities of expansion of the supply, when needed, by artificial means are quite possible and in some cases very material. This can be done by temporary surface storage in the watershed above and distributing ditches over the gravel beds and by deep-well artesian flow in the bed of the valley.

The John S. Metcalf Company, Limited, of Montreal, is designing two elevators for the Arthur Guinness Son and Company, the famous Dublin Brewers. The new elevators are for their plant at Manchester, England, are entirely of concrete, and will cost in the neighborhood of $600,000.

H. W. Gillett, of the United States Bureau of Mines, discussing brass melting practice, says 5 per cent. of original metal is lost, that lack of technical control is shown by reports of metal losses varying from 1 to 22 per cent., and fuel efficiency from 1½ to 16 per cent. He also points out that the life of crucibles may be prolonged by employing them wherever possible in the making of alloys, having successfully diminishing melting points, as first for copper, then phosphor bronze, next brass, and finally for aluminum.

Editorial

STRUCTURAL STEEL PROTECTIVE PAINTING.

Some very useful recommendations appear in a report of the iron and steel committee of the American Railway Engineering Association, as submitted at a recent meeting. From this report the following notes on good and bad practice in the application of shop and field coats, should be found instructive.

Scientific research and numerous practical tests have demonstrated the fact that certain paint pigments, though possessing excellent moisture-repelling properties, will actually stimulate corrosion when applied directly to steel surfaces, while certain other pigments have a tendency to restrict and repress corrosion when used for primers and foundation coats. Because of this, the pigments are divided into rust retarding, and air and moisture excluding groups, using the first for priming and contact coats, and the latter for finishing and exposed outer surfaces.

A rust retarding coat may be suitably compounded from red lead mixed with pure linseed oil. The average stock mixture may consist of from 25 to 30 pounds of red lead to the gallon of oil. This mixture can then be reduced to the proper consistency at the time of application. A small amount of turpentine added to this brush coating will greatly help in its manipulation and will also provide for proper penetration. Red lead should always be mixed at the time of its application, for it settles quite readily, as it is an extremely heavy pigment.

Natural oxides have also grown to be very good for priming purposes, and very satisfactory results are recorded from their use. A number of consumers favor oxides because of their easier application and the less expert class of labor which is required to apply them. A saving of from 5 to 10 per cent., as compared with red lead paint, can thus be effected. Some concerns are using a combination of red lead and oxide and make good reports regarding it.

It appears to be a universal opinion that linseed oil is not a desirable material for the prime coating of metals when used without the addition of pigments. A foundation coat of linseed oil is very often the direct cause of peeling and blistering of the other several coatings applied over it.

Paints containing the same kinds of pigments as for shop coatings, can be successfully used for the first field coat, providing it is covered with another elastic outer coating. If that is not done, paints suitable for finishing coats should be applied, and the first field coat omitted. Red lead or oxide priming should be darkened for this coat by adding carbon or lampblack in the proportion of 90 to 95 per cent. of the reds and 5 to 10 per cent. of carbon mixed.

Carbon lampblack and graphite pigments, singly or mixtures of them, have given best satisfaction as outer surface and finishing paints. These, combined with some inert and reinforcing pigments according to special formulas, form the basis for nearly every satisfactory brand of metal paint on the market. The addition of some high-grade gum improves a finishing paint greatly, producing more elasticity, resistance and life. It is, of course, just as essential that the oils entering into the makeup and composition of the various paints are of the proper kind and quality, as that the selection and composition of pigments be properly made.

Paints containing tar, or those with a tar base, should not be used on steel structures exposed to the sun and weather, as tar-paint films rapidly check, crack and "alligator."

When for any reason it becomes necessary to repaint an iron or steel structure, the paint should never be applied in wet or freezing weather, and the surface should be freed absolutely from all scale, rust, dirt, etc. When for some reason it is not possible that the entire structure can receive a coat of some rust-retarding primer, the parts cleaned and freed from rust, and all the exposed surfaces, at least, should be touched up with either a red lead or oxide primer, before the finishing coat is given. The use of turpentine in the paint applied over the old surface is advised, as turpentine is a penetrant, provides the penetration and adhesion between the old paint film and the new coat.

Although more expensive, cleaning by sand blast is much more thorough than the hammer, chisel, scraper and wire brush method, and the greater cost is readily offset by better results in the end. The sand blast method thus far has not been very extensively used. Where the sand blast has been used and the steel has been painted promptly, it has not shown signs of corrosion again nearly as quickly as steel cleaned by hand.

Occasionally we notice defects showing up here and there on a steel structure within an unusually short time after the completion of the painting. We decide to visit the mill, and there we may notice in a remote part of the place a bunch of unskilled laborers mopping paint on some steel that has been sent along for priming, using large 6-inch or 8-inch flat brushes, and covering over mill scale, rust, dirt and other imperfections, each and every one a destructive agent to the life of steel.

Next we pay attention to the paint they are using and learn that the package, which was opened some time ago to be inspected and was left standing uncovered all this time, had contained the standard paint as specified, but now, through neglect, is no longer fit for its purpose. On examining the contents of the package closely, we also notice that the paint is scarcely stirred up, and we see that the oily substance from the top of the mixture is first used, and as the work progresses and the material is consumed, the paint becames heavier and intermixed with more or less pigment, until when the lower part of the package is reached nothing is left but a semi-dry pigment, which will no longer spread under the brush. Now, to assist in brushing, the men reach for the benzine can and reduce the paint with it, destroying what little life the paint had first contained. In this way a number of different surfaces and films are created on the same structure, and from the same package of the so-called protective coating.

The foregoing illustration may appear somewhat severely drawn, and the situation presented greatly exaggerated; nevertheless, if a number of troublesome cases were thoroughly sifted, the illustration, in part, or in whole, would be identical with the underlying cause of the trouble.

No matter how diligent and untiring an inspector may be, it is not possible for him to be in a number of places at the same time, for, in large plants, where modern methods are pursued in the manufacture and assembling of steel, the various departments are sometimes miles apart.

Of course, not all failures are due to work which was first painted at plants, for often, even among so-called intelligent mechanics, the belief still exists that anything in the way of paint is good enough for priming purposes, so long as it is going to be covered again with paint, thus entirely ignoring the fundamental principles of a correct foundation.

It may, therefore, be suggested that considerable attention be given to the education of men who supervise the erection and maintenance of steel structures, so that greater interest in the problem will be aroused, better co-operation between the various departments effected, and the proper men chosen to handle the different lines of work.

ANNUAL MEETING, DOMINION LAND SURVEYORS.

THE annual convention of the Dominion Land Surveyors' Association was held in Ottawa January 27th and 28th, Mr. C. F. Aylesworth, D.L.S., president of the association, in the chair. The morning session of the first day was devoted to the routine business of the association. It was announced that about twenty members had already offered themselves for active service, and it was expected that many more would do so in the near future. A resolution was adopted whereby all members of the Dominion Land Surveyors' Association who had offered themselves for service should be kept in good standing and all fees remitted. Another item of business was the voting of $100 to the Patriotic Fund.

The principal items during the afternoon were two addresses of more than ordinary interest to surveyors. Mr. E. M. Dennis, D.L.S., gave an address on "The History of the System of Dominion Land Surveys." Mr. Dennis showed what strides the methods and equipment in survey work had made, tracing the development of survey work from 1869 down to the present time.

A paper on "Stadia Surveys" was read by Mr. R. Neelands, D.L.S., who outlined the progress of stadia surveying in the last three years and the increasing appreciation of the stadia as a substitute for the chain in topographic work. He showed the advantages in the way of rapidity of operation, and the fewer number of men required to conduct a survey. He showed how complete and practical were the instructions compiled by Dr. Deville, head of the Canadian Topographical Surveys (which instructions were sent out to the surveyors), and how satisfactory was the work being performed by them. Mr. Thomas Nash, superintendent of the drafting division of the Topographical Surveys, attested to the satisfactory work done during the past season by the stadia surveyors working for the department.

At the evening session Mr. W. C. Murdie gave an illustrated paper on "Stereophogrammetry as Applied to Surveying." An invitation had been extended to the general public, and the meeting was largely attended. Some valuable discussion followed the presentation of this, as well as of the other papers.

The association met for the second day's session on Thursday morning, when one of the most interesting papers of the annual gathering was presented by Mr. F. H. Kitto, Director of Surveys for the Yukon Territory, entitled "Placer Surveys in the Yukon." The following is a summary of Mr. Kitto's paper:—

In 1884 there were about 250 placer claims surveyed in the Yukon in the vicinity of Forty-Mile River, 200 of which have been worked to some extent. In 1889 some changes were made in the Canadian Mining Act relating to placer mining in the Yukon, but they proved unsatisfactory. At the time of the great rush in 1897 the old act of 1889 was replaced by an act styled "Regulations Governing Placer Mining in the Yukon." This also proved unsatisfactory and a change was made in 1898; after three years' operation other changes were made in 1901. This 1901 act, while it pleased the big fellows, did not meet with favor from the miners, and consequently a radical change was made in the new act of 1906, entitled, "Yukon Placer Mining Act." Further amendments, however, have since been made.

The 1889 regulations governing quartz claims were made to apply to placer claims. There were to be erected on the end of the claim at high-water mark on both sides of the river eight posts to stake a claim, having the claimant's name with date of staking marked on each.

That these frequent and rapid changes in the mining regulations have caused endless litigation may be understood when it is considered that a bench claim of 1897, a plot 100 ft. square, has yielded $80,000; and it may be imagined that the demand on the surveyor for precise work is urgent. Some of the incongruities may be mentioned:

(1) Suppose that a creek forks; a base line is run up each fork of the creek, a miner stakes a claim on one fork a short distance up, and his claim being, as allowed, 1,000 ft. on each side of the base line, may extend across the other fork, thus giving him two lengths of pay-streak, each the length of a claim, one on each creek.

(2) A small creek runs into a large one at right angles; the larger creek has a wide valley on the side upon which the smaller creek empties and its pay-streak lies on that side; a miner stakes a claim along the smaller creek in the valley of the larger one, so that his claim of 1,000 ft. on each side of the base line along the smaller creek will include 2,000 ft. of the pay-streak of the larger creek, whereas the instructions are that such pay-streak should be staked in claims of 500 ft. only.

(3) Angles in the base line and the treatment of claims in the vicinity of such angles give rise to much discussion and puzzle the surveyor.

As regards surveys of quartz or lode mineral-claims, the instructions of the department at Ottawa specify that "in making surveys of mineral claims and mill sites, it will not be necessary to take notice of placer claims or of the monuments making such claims."

Mr. Kitto summarized these objectionable features of the placer-mining-claim regulations and offered suggestions for correcting their many incongruities and it is to be hoped the department, under whose jurisdiction these surveys are made, will act on them. The unsatisfactory conditions under which the miners labor, the endless confusion and litigation and the utter inability of the surveyor to work intelligently, all call for a drastic change.

Mr. Thomas Fawcett, a topographical surveyor, now on the international boundary survey, but a former commissioner in the Yukon, with the aid of the blackboard,

(Continued on page 228.)

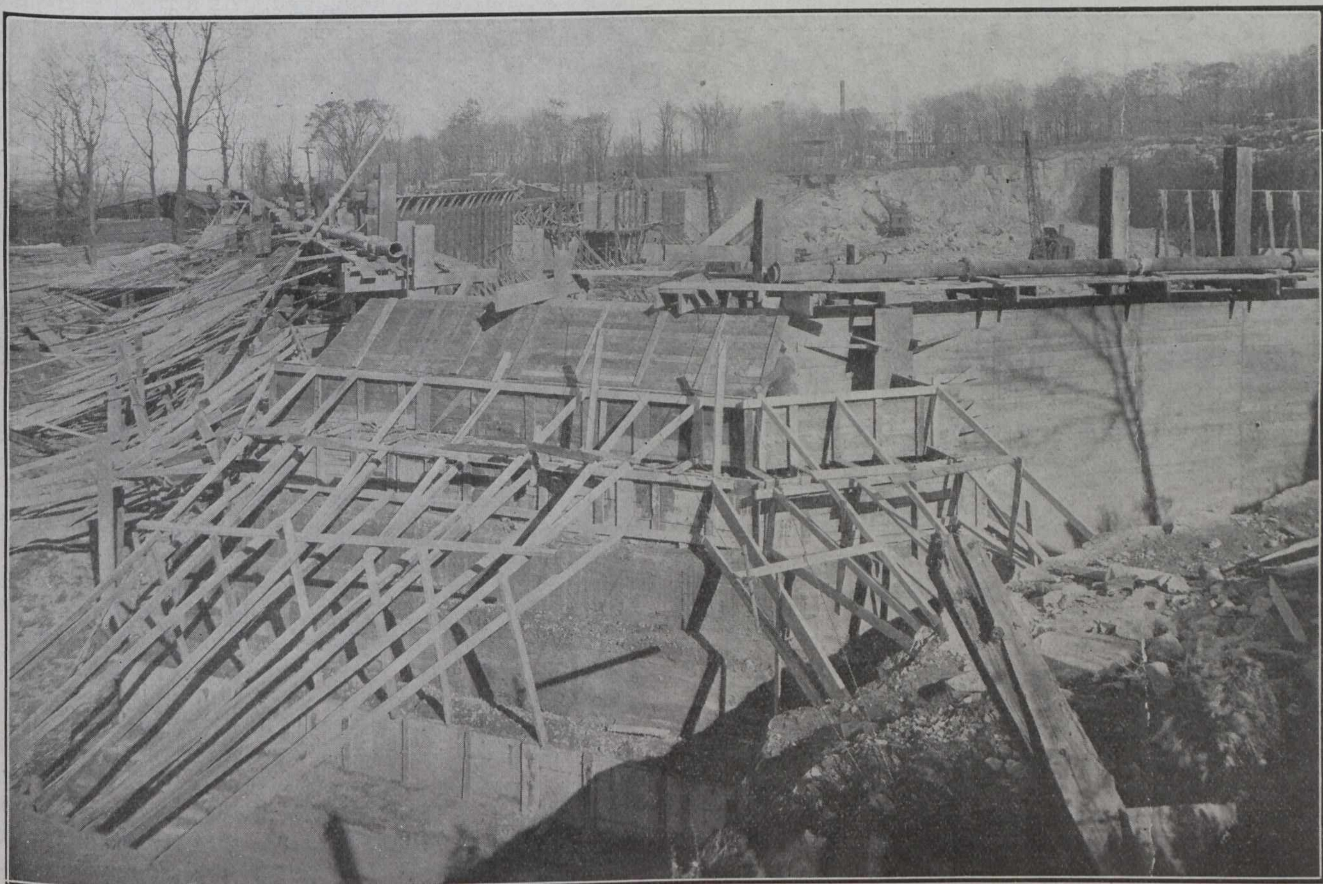
POURING CONCRETE BY COMPRESSED AIR.

AMONG recent developments in ways and means of handling construction work, none has attracted more attention than the application of compressed air to the mixing and placing of concrete. The transportation of material through a pipe by compressed air has long been an accomplished fact—this method of conveying materials being old—but the economical mixing and placing of concrete in quantity by air jet, though now a well established practice, is a comparatively recent invention.

The two most important time-consuming operations in concreting have been the mixing, and the transportation of the mixed concrete from the mixer to the forms. It has been the constant endeavor of designers to reduce the time that the concrete remains in the rotary machine to the shortest possible period consistent with the making of good concrete. According to good engineering practice, with a rotary machine, it is necessary for the concrete to be revolved for a period of not less than one minute. The transportation of the concrete from the mixer to the forms is, of course, a problem which has to be solved for each individual job, but which commonly consumes the greater part of the total concreting time and cost.

In 1913 patents were issued covering the machine and the method for mixing materials by compressed air, and their conveyance by compressed air through a pipe. The pneumatic concrete mixer consists of a steel shell of the shape of an inverted cone surmounted by a cylindrical chamber, with a 90-degree elbow at the point of the cone, and an airtight door at the top of the mixer. The door, which is for the admission of the materials, is opened and closed by a small air piston mounted on the mixer, and this is the only moving part, the interior of the mixer, except for the air inlets, being one smooth, solid surface. The pipe by which the concrete leaves the mixer and which leads to the forms, is bolted to the bottom elbow. These mixers are made in sizes to deliver ¼, ⅓, and ½ cubic yards of concrete per batch, the ½-yard size having proved of sufficient capacity for the largest work.

The conveyer pipe is 6-in. or 8 in. I.D. lap-welded steel, usually fitted with loose flanges or screwed flange joints, though ordinary screwed joints are sometimes used on pipe which is to remain in one position for some time. For pipe which is to be often shifted, the weight is of consideration, and for such cases it can be obtained in weights ranging between 15 lbs. and 25 lbs. per lineal foot. Cast iron pipe of standard weight has been used, with standard flanged joints, but on account of the weight this is not advisable when frequent shifting is necessary. The pipe of greatest utility weighs about 17 lbs. per foot, and is equipped with loose, cast-steel, male and female flanges, with gaskets of common building paper. This pipe may be obtained in convenient lengths of approximately 10 and 20 feet, with odd lengths to assist in making up the line on the job. At a test made on pipe of this weight with a joint as described, a sustained hydraulic pressure of 550 lbs. per sq. in. was applied, without a leak. The loose flanges are held on by a lip, which is turned up at each end of the pipe lengths after the flanges are slipped on,



Retaining Wall, Montreal Water and Power Company, Showing Concrete Conveyer-pipe Used in Pouring, Mixer Bins and Plant in the Background.

making a joint similar to the Van Stone type. The weight of a complete steel flange is about 30 lbs., and a cast iron flange of the same type about 40 lbs. per joint. Bolt circles and holes are made A.S.M.E. standard. The pipe of smaller diameter is used for conveying small aggregate (stone under 1 in.) and the 8-in. pipe for the larger sizes of aggregate.

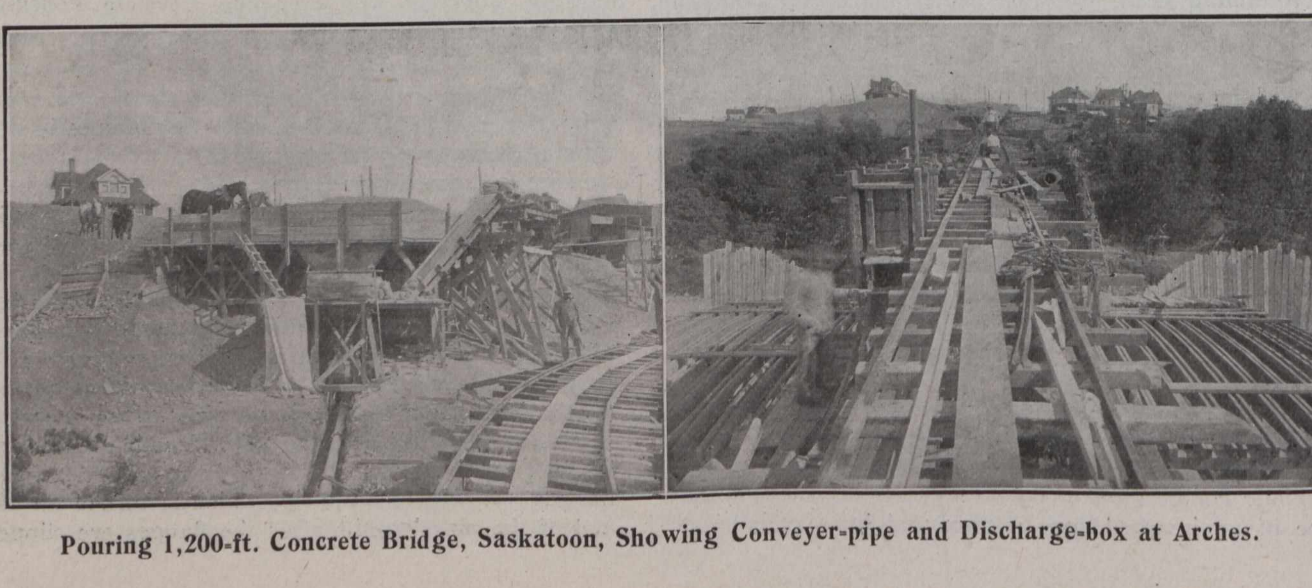
At bends, elbows of long radius are used. It is at the bends that the wearing action of the concrete stream

Pouring Dam, Montreal Water and Power Co. Length of Conveyer Stand-pipe, 47 Feet.

is most noticeable, and this has an important bearing on the design of the elbows. The wear depends a great deal on the condition of the stone used in the mix. Gravel causes very little abrasion, while freshly crushed hard stone, having sharp edges, is more active in this respect. To provide for this, elbows are used having a greater thickness on the outside of the bend where the wear is greatest, and for the most severe service these reinforced elbows are made of manganese steel. The straight pipe, under normal conditions, will convey about 20,000 cubic yards before it needs to be taken from the line for repairs. The repairs usually consist in cutting off a few inches at one end of the pipe and in turning up this end again. The elbow at the discharge end seems to show greater wear than any other, and a fair estimate of the life of this manganese steel elbow, before repairs are necessary, would be about 5,000 cu. yds. Often the worn place may be filled with new metal making it as serviceable as a new elbow. Other elbows in the pipe line have a much longer life.

Any type of compressor is applicable to this method but the one usually employed in this work is a straight line type, one or two stage, compressing to 80-100 lbs., the motive power depending on the relative economy of steam, electricity of gasoline for the work in hand. Unless the nature of the work demands a portable outfit, the capacity is decided upon from the speed of pouring desired by the contractor for the "average shot," which is the distance from the mixer to the "centre of gravity" of the mass of concrete to be poured. As a rule the compressor is installed near the mixer, to cut down air friction, but on a large job having a central boilerplant the compressor may be placed near this, and the air piped to the mixer. In considering the average shot to determine the capacity of the compressor, any vertical distance to which the concrete is to be raised in its course to the forms, will increase to a certain extent the amount of air required. Concrete has been placed in forms at elevations up to one hundred feet above the mixer. The compressor should be supplemented with one or two storage tanks to sustain the pressure during the discharge periods. If two tanks are used the larger should be placed nearer the mixer.

A standard form of air piping at the mixer is shown on page 226, and this arrangement has been found convenient and economical. One man can operate the three air valves and also control the admission of water. Storage bins for materials are provided, nearly always with the idea of handling large quantities, on account of the speed which may be attained by pouring concrete by compressed air. For a typical set-up on a mass job, the plant is arranged about as shown, a cycle of operations being as follows: Sand and stone are admitted to the measuring hopper over the mixer through hand-operated sliding gates in the bottom of the storage bins. At the same time the proper amount of cement is put in the measuring hopper, or it may be placed directly in the mixer with the other materials. The gate in the bottom of the measuring hopper is then opened, allowing the measured materials to drop into the mixer, a measured amount of water running in at the same time. The mixer now having been



Pouring 1,200-ft. Concrete Bridge, Saskatoon, Showing Conveyer-pipe and Discharge-box at Arches.

charged, the operator closes the door by turning an air valve, and then immediately opens the two valves which admit the air to the mixer. Two gauges show, respectively, the pressure of the supply and the pressure in the mixer during the discharge. When the valves are opened, the pressure in the mixer rises to about 40 lbs. per sq. in. and then steadily drops as the charge passes to the forms. The air valve controlling the mixing air-jet, is closed when the gauge indicates a pressure in the mixer of 15 to 25 lbs., the charge by that time being well out of the pipe. The air jets in the upper part of the mixer, above the charge, are solely for the purpose of creating a pressure so that there will be no tendency for the charge to remain in the machine when the mixing jet is turned on, and the valve controlling this pressure is closed first. The whole operation of charging and discharging requires from 15 to 60 seconds, and two laborers should be able to take care of the operation of all air and material valves. The mixer is located in the most convenient place for handling the unmixed materials and the conveying piping run to the forms from the set-up, under tracks and around obstructions, in a way not to interfere with other plant.

The mixing process takes place both in the mixer and in the conveyer pipe. The mixing air-jet is located in the elbow at the bottom of the mixer, the air stream being directed along the horizontal axis of the pipe. The air-jet strikes the material which, by dropping through the cone-shaped mixer, has become an intermingled mass of stone, sand, cement and water, and scatters the lighter particles through the mass with great force. This portion in front of the air-jet begins to move off, the inertia of the heavier particles having been overcome, and other material drops down from above, to go through the process just described. As it moves away, the material in the centre tends to precede that next the sides of the pipe, on account of the friction with the pipe, and thus there is a constant shifting from side to centre, which continues the mixing process. Bends in the pipe also assist in stirring the mass but they are not needed for that unless the pipe is very short. Even then a little care in charging the mixer, allowing the materials to drop in together, will overcome any trouble due to a short pipe line. A straight conveyer pipe line should be at least 50 feet long to insure proper mixing.

It is not important in what order the materials are dropped into the mixer but, when bins and measuring hoppers are used in charging, it is convenient to allow them to flow into the mixer together. The cement, if put in the measuring hopper, should be introduced with the stone to prevent its sticking in corners and pockets.

The operations of mixing and placing are performed by simply opening the two air valves, hence there is no variation in the mixing power, and each batch is identical with all the others when it has left the pipe. This is of advantage in night work or at other times when inspection is difficult.

The time for discharging a batch varies with the horizontal distance it is conveyed and the vertical distance it is lifted in its course to the forms. There should be enough air available so that, at the average length of shot, the desired speed of pouring can be maintained. If the air capacity is too small, there will be such a wait after each shot for the air pressure to pick up that the desired number of shots per minute cannot be obtained. The time of discharge is the length of time that the air valves are open. A great saving of air is made when the operator closes the valves at the right instant.

Two time-studies on one job are given herein which will serve to show, for two different distances, the speed at which the concrete was delivered. The air supply was about 600 cu. ft. per minute and the mixer was charged from overhead bins by hand-operated sliding gates immediately over the measuring hopper. Two laborers controlled the gates of the sand and stone bins, one laborer dumped the measuring hopper and operated the air valves, and one laborer operated the water valve and assisted the mixer operator. This is the result of operation by unskilled labor and does not seem to be an extraordinary performance, for the pneumatic mixer, as the time-studies were taken during the course of a regular day's run.

Time-study No. 1.—Operation of ½-yard MacMichael Pneumatic Mixer and Conveyer.

Consec. No. of shot.	Charging mixer, seconds.	Closing door, seconds,	Discharging mixer, seconds,	Wait for rise in air pressure, seconds.
1	10	4	13	23
2	10	2	13	11
3	9	3	17	15
4	8	5	14	16
5	10	5	17	20
6	11	2	20	14
7	11	6	19	20
8	9	6	15	19
9	10	5	18	..
Average	9.8	4.2	16.2	17.2

Average time per shot, 47.4 seconds.
Length of conveyer pipe line, 315 feet.
Vertical rise of pipe, 15 feet.
Bends in pipe, 270 degrees.

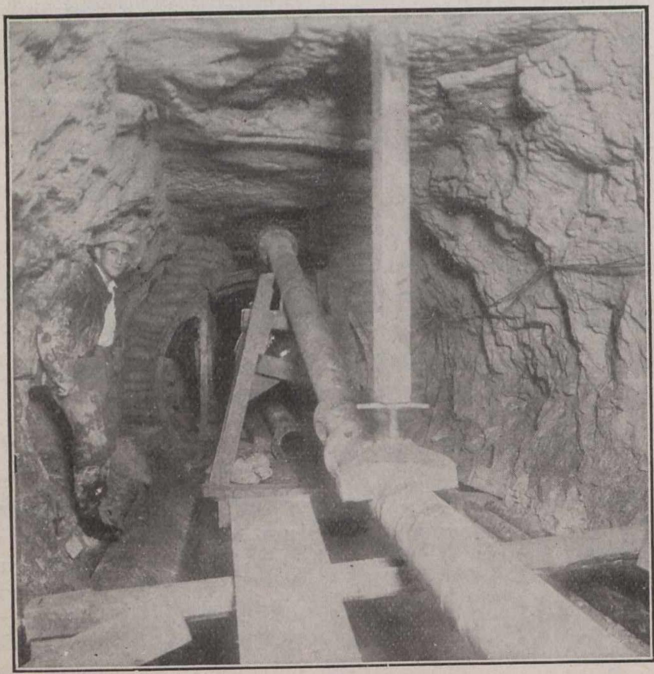
Time-study No. 2.—Operation of ½-yard MacMichael Pneumatic Mixer and Conveyer.

Consec. No. of shot.	Charging mixer, seconds.	Closing door, seconds.	Discharging mixer, seconds.
1	8	3	7
2	5	3	11
3	9	1	9
4	7	4	8
5	6	4	9
6	7	5	9
7	5	5	12
8	7	9	11
9	6	3	10
10	5	5	11
11	7	5	10
12	5	4	13
Average	8.7	4.4	10.0

Average time per shot, 23.1 seconds.
Length of conveyer pipe, 102 feet.
Vertical rise of pipe, 37 feet.
Bends in pipe line, 205 degrees.
Note: No wait for rise in air pressure.

The compressed air method was adopted by the contractors, Laurin & Leitch, for the work of pouring the heavy concrete dam and retaining walls in a new reservoir for the Montreal Water and Power Co. at Montreal. A ½-cu. yd. mixer was used, supplied with air from a compressor of 706 c.f.m., rated capacity, which was located in a central power plant about 1,100 feet from the mixer.

The long 6-in. air line contained two storage tanks of 50 and 160 cu. ft. capacity, the larger being placed at the compressor. The material-handling plant was designed for speed in pouring, the bins being of large capacity, and valves and levers easily operated. The pipe conveying the concrete to the retaining walls ran to the foot of the forms at the nearer end, rose 37 feet, and was continued along the top of the forms to the far end. At any point an elbow could be bolted on allowing the concrete to be poured in the forms at any point along the line. The concrete was allowed to drop directly into the forms, or a "bootleg" was connected to the elbow to assist the spreading over a large area. The same system was employed on the 300-ft. dam, which was poured in 42-ft. sections and in three vertical lifts of 15, 30 and 37 feet. The longest shot on the job was 600 feet and the greatest height to which the concrete was raised was about 40 feet. The average operating crew numbered eight laborers. An

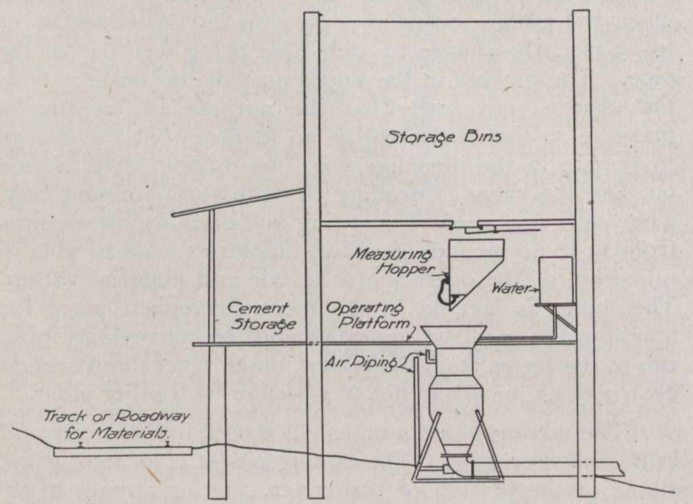


Example of Tunnel Lining Being Poured by Compressed Air.

average daily pouring speed of 250 cubic yards was maintained, the plant operation being independent of the weather conditions.

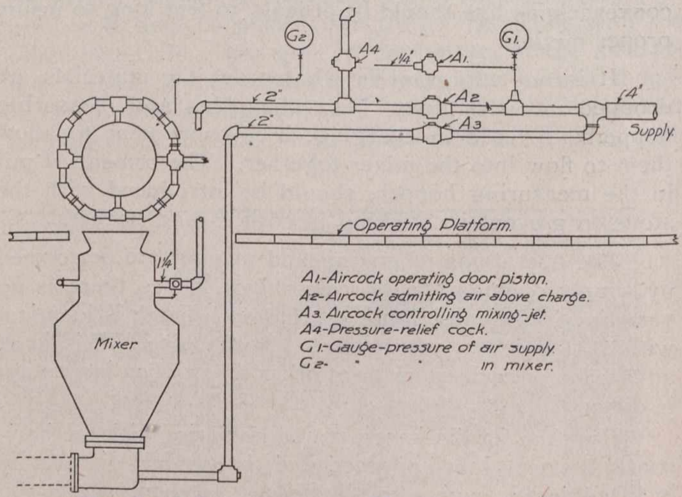
One of our illustrations shows a set-up in which the bins were filled from the adjacent gravel pile by scrapers. Here the mixer was set in a hole deep enough to bring the top of the bin on a level with the bank, and the scraper teams dumped the gravel on a screen of rails over the bins. This job is a typical application of the pneumatic method to reinforced concrete bridge construction. From the bank of the river the conveyer pipe rose on a slope of 45 degrees to a level about 20 feet above the mixer and was extended along the forms from arch to arch as each was poured. During the pouring of the piers and haunches of the arches, the concrete was discharged into a wooden box, and was then distributed by gravity chutes. With a conveyer pipe 500 feet long the speed of pouring was 30 yards per hour, an arch of 500 cu. yds. being poured in 17½ hours. The compressor plant was installed in two electrically driven units, each of 400 c.f.m. rated capacity.

The extreme convenience of the conveyer pipe for delivering the concrete is shown at its best in the usually difficult and slow work of lining tunnels. Pneumatic pouring was recently employed in lining an 8-ft. tunnel 2,800 ft. long, for the St. Louis waterworks at Chain-of-Rocks, Mo. The mixer was set up at the bottom of the shaft and the material was dropped through a pipe to the



Typical Concrete Plant for Mass Work With Pneumatic Mixer.

mixer from a measuring hopper at the surface. In filling the 36-ft. form, which was used, an 18-ft. length of pipe was inserted over the top of the form and this position was held until the rear half of the form was filled. The pipe was then withdrawn and the remaining portion of the lining was poured from the front end of the form. There was no difficulty in shooting 1,100 feet, with the air supply pressure of 95 lbs. per sq. in. The air line was run down the shaft to the mixer from the surface. The crew numbered 10 men, 6 of that number being at the surface handling material and the others below engaged as follows: 1 man operating mixer; 2 men at discharge end of the pipe, building sand-bag bulkheads; 1 foreman.



Standard Air-piping for Mixer and Conveyer.

The tunnel lining averaged about one cubic yard of concrete to the lineal foot. Records are available for some parts of this work showing that in one week, with the crew as given, in 34 hours of working time 435 cu. yds. of lining was mixed and placed at an average distance of 600 feet. This appears to be an extraordinary record in speed and economy, as the changing of pipe from form to form is included in the working time. The pouring of concrete by compressed air has gained much of its prominence from the success attending its use on tunnel work.

In applying this method to railway tunnels a concreting car has been developed on which is mounted a mixer, water tanks, and material bins of a capacity to make 25 cu. yds. of concrete without refilling. The car is a standard 40-ft. flat, material bins being placed at each end, sloping to the centre where the mixer is placed. In charging the mixer, a gate allows the material to flow by gravity from the bins to a hopper beside the mixer. The hopper is raised and dumped by an air piston and cable. The conveyer pipe runs under the car, turning up at the end to a convenient height for discharging directly into the forms. The crew of 4 men is divided as follows: 1 man operating the gates of the storage bins; 2 men on the cement; 1 mixer operator. With this crew and equipment a rate of 25 cu. yds. per hour has been commonly attained.

Following up the idea of portability, it would seem that on light construction work of considerable magnitude, such as aqueducts, sewers and light retaining walls, in which the point of operation is constantly progressing, a portable outfit could be used to good advantage.

For depositing concrete under water this method has been used successfully with good economy and, somewhat in line with this is the work, in which it has been employed, of forcing grout into slipping strata of rock or earth which are failing under heavy load.

Attention given to the distribution end of the pipe is amply repaid by the reduced cost of operation. Cost of pipe handling can be reduced to a minimum by having spare elbows ready placed at the point of pipe change, by the use of "bootlegs" and chutes to distribute over a wide area from one pipe position, and by portable "goose-necks" the arm of which can be swung in an arc to cover several adjacent separate forms. The "goose-neck" is usually mounted on a raft so that the entire stand-pipe and arm can be moved as a unit.

On first consideration, it perhaps seems that the cost of power for mixing and placing is excessive, as it amounts to more than that required by a rotary type of mixer. However, the actual cost per cubic yard is very low, on account of the large amount of concrete placed in unit time and also on account of the fact that the power used is applied most economically, both mixing and placing being done almost instantly, in one operation. Taking a figure from an installation of one 700 c.f.m. compressor located in a central power plant, which furnished air for a ½-yard pneumatic mixer pouring about 250 cu. yds. per day, the cost per cu. yd. was 3 to 3½ cents. In extreme cases with power at a high rate and by wasteful methods of operation, the power charge might double this figure. However, this latter figure should not be attained in actual work. On the other hand, in favorable circumstances, a lower figure than that here given might easily be reached.

The approximate labor cost can be well judged by a review of the typical jobs mentioned, where a list is given of the number of laborers used, with the speed of pouring. The crew rarely exceeds 10 men, who attend to all work in connection with the mixing, conveying, pipe changing, etc. This number of laborers has proven sufficient on jobs where the rate of pouring has been as high as 60 cu. yds. per hour. Except where the concrete is delivered by gravity chutes or on small reinforced concrete work, no spading or tamping is required as all air is forced out and spaces filled by the impact of the discharge. On account of the many variable quantities entering into the cost of operation for different jobs, narrow limits for the cost of pouring by this method cannot be given. However, comparison has been made of costs on a number of jobs of each type with results as follows: For work composed of small isolated quantities and for work requiring a portable outfit, the cost of labor and power ranges between 20 cents and 40 cents per cu. yd.; tunnel lining has been done for 25 cents to 50 cents; and on large mass work where full advantage of rapid operation is obtained, costs of from 6 cents to 15 cents per cu. yd. represent common limits.

The equipment to be obtained consists of the air compressor and conveyer pipe, with suitable storage or loading plant. The cost of the bins will not be more than for bins of equal size used with other methods. The first cost of the compressor might seem to be enough to force the contractor to consider other methods for small jobs, but the depreciation on that class of machinery is so small that the actual cost chargeable against any one job for the use of the compressor is very small. Conveyer pipe fitted with steel flanges can be estimated to cost, delivered, $1 to $1.25 per foot, including bends and fittings. A depreciation charge per cu. yd. to take care of the pipe can be approximately determined when the average length of shot and the total yardage is known. This figure varies from 2 cents to 5 cents, depending on the material used, and on the average shot. The mixer is leased to the contractor on a yardage basis depending on the type and size of job.

The average daily capacity of the ½-cu. yd. mixer can be taken as 300 cubic yards, when working quite steadily, but this machine has mixed and placed 60 cu. yds. per hour for long periods of time, often working at the rate of 72 cu. yds. per hour, when there is sufficient air. A record showing the capacity of this mixer to handle quantities of concrete has been taken from a job not yet finished. At a distance of 150 feet, and raising the concrete a height of 25 feet, 435 cu. yds. was mixed and placed in a working time of 7 hours.

The leasing rights in Canada for the MacMichael Pneumatic Mixer are held by the Pneumatic Concrete Placing Company of Canada, Limited, whose head offices are in Montreal.

ROAD INSTRUCTION IN MANITOBA.

It has been decided to hold a short course of instruction and convention commencing March 3rd, at the Manitoba Agricultural College, for the benefit of those interested in highway construction and maintenance in Manitoba. Hon. Dr. Montague has assured the College that the new course will have the fullest support of the Department of Public Works. The course as planned, will be made as practicable as possible, and will deal with such subjects as road drainage materials for culverts, road surveys, surfaces, repairs, and cost of building and maintaining various classes of highways. Prominent road builders from Ontario and the United States will be present to supplement the local engineers in lecturing upon and demonstrating the various subjects. Many municipal councils throughout the province have assured their co-operation, while the Manitoba Good Roads' Association has signified its intention of fully supporting this educative movement.

ANNUAL MEETING, DOMINION LAND SURVEYORS.

(Continued from page 222.)

explained some of the more important points in Mr. Kitto's paper. Mr. Brownlee also added interestingly to the discussion.

A paper entitled "Laboratories of the Dominion Land Surveys at Ottawa," by Mr. W. C. Way, a member of the staff of the Topographical Surveys, Ottawa, elicited considerable interest. This was well illustrated by numerous photographic views. A summary of this paper, illustrated by many of the views, was published in *The Canadian Engineer* for October 29th, 1914, page 586.

"Notes on Plane Table Surveying" was the subject of the discussion at the afternoon session, introduced, with a paper, by C. R. Westland, D.L.S., while Mr. J. W. Harris, city surveyor of Winnipeg, spoke on "Early Survey of Manitoba." The latter proved very popular among the members, not only because of its informative and interesting character, but because Mr. Harris is one of the best posted surveyors of the Dominion.

"The General Suitability of Boundary Posts for Survey Work" was a topic of discussion during this session. Specimens of indestructible metal posts were produced and discussed, the type being that used by United States surveyors. Their several points of advantage over posts such as are used in Canada were enumerated, with the result that a special committee was appointed to report fully on the question. It is thought probable that changes in the type of survey posts used in Canada may be made in the near future.

Then followed the nomination and election of officers for the ensuing year. They are as follows: President, Mr. A. H. Hawkins, D.L.S., Listowel, Ont.; vice-president, Mr. J. J. McArthur, D.L.S., Ottawa; secretary-treasurer, Major E. W. Hubbell, D.L.S., Ottawa, re-elected; executive committee, E. M. Dennis, D.L.S., D. F. Robertson, D.L.S., D. H. Nelles, D.L.S., all of Ottawa.

The convention was fittingly closed on Friday evening by one of the most successful banquets in the history of the association. About 60 members were present. Dr. Otto Klotz presided, while Hon. Dr. J. W. Roche, Minister of the Interior, was chief guest of honor.

Other speakers were Mr. A. E. Bradbury, M.P.; Major Rothwell; Mr. C. F. Aylesworth, of Madoc, Ont., the retiring president; Mr. A. E. Fripp, K.C., M.P.; Mr. R. H. Campbell; Major E. W. Hubbell and others. A number of those present were in uniform, which fitted in well with the patriotic speeches of the occasion. Two toasts only were proposed, *viz.*, the King, and Parliament of Canada.

The banquet was held at the Chateau Laurier, while the other sessions of the meeting were held in the Carnegie Library lecture hall.

ANNOUNCEMENT OF ANNUAL DINNER.

The executive committee of the University of Toronto Engineering Society has announced that its annual dinner will be held on Friday, February 12th. One of the speakers will be ex-Mayor Thos. R. Deacon, C.E., President of the Manitoba Bridge and Iron Works, and a graduate of 1891 of the School of Practical Science, Toronto.

Detailed arrangements will be announced next week.

PERSONAL.

J. A. BAIRD, town engineer of Leamington, Ont., is resigning.

WILLIAM PARKER has been appointed superintendent of the Hamilton Street Railway Company, Hamilton, Ont.

D. C. ARCHIBALD, city engineer of Saskatoon, has been given full charge of the city's pumping station and filtration plant.

A. KILPATRICK succeeds Mr. H. McCall as superintendent of the Edmonton-Prince George division of the Grand Trunk Pacific, with headquarters at Edson, Alta.

CHAS. DAVID MARX, Professor of Civil Engineering at Leland Stanford, Jr., University, was last week elected president of the American Society of Civil Engineers.

R. G. HARVEY, city engineer of Duncan, B.C., has resigned. Mr. Harvey has been with the city as city engineer, electrician, and water works superintendent since its incorporation, three years ago.

H. McCALL has been appointed superintendent of the Winnipeg-Watrous main line division, and of the Melville-Canora branch of the Grand Trunk Pacific, with headquarters at Melville, Sask., succeeding Mr. G. S. Cooke, resigned.

OBITUARY.

The death occurred last week in Montreal of Charles Lester, who was sales manager of the waterworks supply department of the John McDougall Caledonian Iron Works Company, Limited. Mr. Lester was born in India and educated at Edinburgh. After the completion of his training, he returned to India for several years, where he was engaged in engineering work. He came to Canada twenty years ago, and has been with the McDougall Company ever since. Mr. Lester was an expert on municipal water supply systems, and was well known throughout the country, as he travelled all over Canada for his firm. He was a charter member of the Engineers' Club of Montreal, and was one of the consulting engineers for Three Rivers, P.Q.

VANCOUVER BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the Vancouver Branch, Canadian Society of Civil Engineers, was held on Thursday, January 21st, 1915. An illustrated paper on street railway track construction was presented by Mr. H. J. Tippett, Jr., Can. Soc. C.E.

CLAY PRODUCTS CONVENTION.

At the annual meeting of the Canadian National Clay Products Association held last week in Toronto, the following officers were elected for the current year: Past President, C. A. Millar, Toronto; President, J. Edward Frid, Hamilton; Vice-Presidents, A. F. Greaves-Walker, Toronto; Thomas Kennedy, Swansea; William Burgess, Toronto; Secretary-Treasurer, Gordon Keith, Toronto; Councillors: Messrs. C. B. Lewis, Milton; D. A. Lochrie, Toronto; W. McCreadie, Lyon, Ont.; Angus German, Toronto, and John S. McCannell, Milton.

There are 32,500 electric light meters in Winnipeg, according to the annual report of the power engineer. During the year 1914, 68,762,647 kilowatts were generated, an increase over the preceding year of 22.45 per cent.