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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

CANADIAN SOCIETY OF CIVIL ENGINEERS

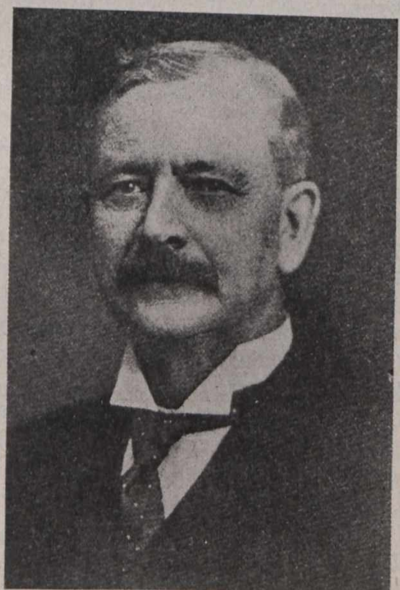
GROWTH AND ACTIVITIES DURING 1914—A VERY PROGRESSIVE YEAR —REPORT OF THE COUNCIL—PROGRAMME OF THE TWENTY-NINTH ANNUAL MEETING, MONTREAL, JANUARY 26TH, 27TH AND 28TH, 1915

SOME weeks ago we announced that the twenty-ninth annual meeting of the Canadian Society of Civil Engineers was to be held on January 26th, 27th and 28th, in Montreal. The programme of the meeting has just been received. The sessions will be held in the rooms of the Society, 176 Mansfield Street, Montreal.

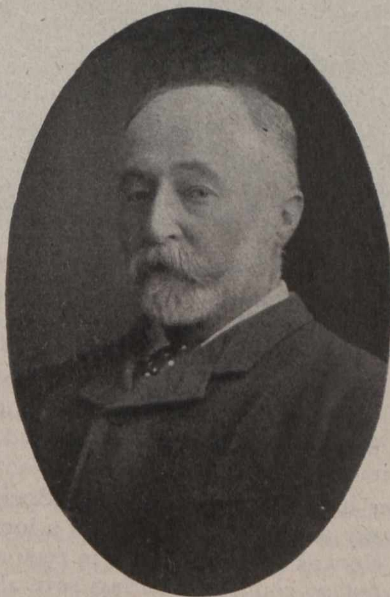
The address of the retiring president will be delivered on Tuesday afternoon.

In the evening members will participate in a smoker to be held in the Society's club rooms.

Wednesday morning is to be devoted to visitation of works at the new development of the Cedars Rapids Power



M. J. BUTLER, C.M.G.
Retiring President.



F. C. GAMBLE, C.E.
President-Elect.

Presidential Men at the Twenty-ninth Annual Meeting of the Canadian Society of Civil Engineers, to be held in Montreal, January 26th, 27th and 28th, 1915.

The programme gives every indication of a busy convention from beginning to end. The first session, on Tuesday morning, will include the appointment of scrutineers, the reports of Council, treasurer, and of the various branches of the Society. The members resident in Montreal are inviting the out-of-town members to a luncheon to be held in the Windsor Hotel at 1 p.m. Tuesday. Following it, one of the most important committee reports will be received and discussed, *viz.*, the report of the committee on reinforced concrete.

and Manufacturing Co. on the St. Lawrence River, and the Angus shops of the Canadian Pacific Railway Co. Some notes respecting these works, notes that may be of assistance to engineers who will take part in the trips, appear elsewhere in this issue.

On Wednesday afternoon the reports of various committees will be taken up, including that on rails, track, and general clauses for specifications. On the evening of Wednesday, January 27th, the annual dinner will be held.

The dinner this year is expected to be of unusual interest as four of the leading members of the Dominion Cabinet have signified their intention of being present.

Thursday will be closing day. The first official duties of the newly elected president will be an interesting part of the proceeding, while in the afternoon the new Council for 1915 will hold its inaugural meeting.

The annual meeting will mark the retirement from the presidency of the Society of one of its most distinguished and efficient members in the person of Matthew Joseph Butler, C.M.G. His experiences in the engineering profession have been wide, and little doubt is there that every member of the Society is familiar with many of his distinguishable attainments. In 1878 Mr. Butler was a Provincial land surveyor in Ontario and later became connected with railway work as buildings and water service engineer for the Atcheson, Topeka and Santa Fe Railway Co. in Colorado and Kansas. After five years he became chief engineer of the Bay of Quinte Railway and Navigation Co. He also spent three years in the wood pulp industry. In 1903 he was appointed superintendent of construction for the Locomotive and Machine Co., Montreal. Mr. Butler's prowess in engineering work gained for him the position of deputy minister and chief engineer of the Department of Railways and Canals, Ottawa. He resigned in 1910 to become associated with the Dominion Iron and Steel Co. as general manager. Since 1912 Mr. Butler has accomplished a great deal for Canada in establishing at Longueuil, Que., the immense Canadian plant, known as Armstrong, Whitworth of Canada, Limited, of which company he is general manager.

Mr. Butler is 58 years of age. He was educated at De La Salle Institute and the University of Toronto, and took up surveying, engineering and architecture. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institute of Civil Engineers of Great Britain, the American Society for the Advancement of Science, the Geographical Society, and of a number of clubs, including the Mount Royal Club, Montreal, the Rideau Club, Ottawa, and the University Club of Montreal. For some years Mr. Butler was chairman of the board of management of the Canadian Government Railways. For distinguished engineering services, his Majesty, the late King Edward VII., conferred upon him the order of C.M.G.

Mr. Butler has served the Canadian Society of Civil Engineers loyally and faithfully through a long period of membership. He was a vice-president in 1906 and in 1907. He has officiated as councillor during several terms and his name has appeared frequently on various committees. His unanimous election to the presidency last year was greeted with many evidences of genuine approval on the part of the engineering profession of Canada.

As president of the Society, Mr. Butler will be succeeded by Francis Clarke Gamble, chief engineer of the Department of Railways for the Province of British Columbia. Mr. Gamble, like Mr. Butler, is a native born Canadian. He was born in Toronto in 1848, being the son of Clarke Gamble, Q.C. He was educated at Upper Canada College, Toronto, and at Rensselear Polytechnic Institute, Troy, N.Y. He began his engineering career on the staff of the Intercolonial Railway in 1869. Two years after he joined the staff of the Great Western Railway as assistant engineer. In 1873 he became resident engineer for the contractors on the construction of the Prince Edward Island Railway. He again entered the employ of the Intercolonial Railway in 1876, as assistant engineer, and later, in the same capacity, he served the Q. N. & N. Railway until 1878. Part of the following year was spent in private practice, but in 1879 he became first assistant engineer of construction for the Canadian Pacific Railway at Rat Portage, afterwards Kenora, Ont. In 1880 the company sent him to British Columbia as principal assistant engineer, where he later became connected with government work as assistant engineer near Yale. He was transferred to the Department of Public Works in British Columbia, where he served as assistant engineer from 1881 to 1887. He was then appointed resident engineer and government agent for the Department of Public Works, which position he held until 1897, when he again resumed private practice for a short time. His ability in engineering and constructional work of large order had been well recognized, however, by the British Columbia government, and from 1898 until 1911 he served the province as public works engineer and inspector of dykes. Since that time he has been chief engineer and inspecting engineer of railways for the province, with headquarters at Victoria, B.C.

Mr. Gamble was elected a member of the Canadian Society of Civil Engineers in 1887. Since that time he has been of great service to the organization and its members. This is particularly true in connection with the engineering development of British Columbia and of the growth and activity of the Victoria and Vancouver branches of the Society. Mr. Gamble was chairman of the Victoria Branch last year.

Mr. Gamble was elected a member of the Institution of Civil Engineers of Great Britain in 1891, and a member of the American Society of Civil Engineers in the same year.

Nominees for vice-president of the Society for the term of three years are Mr. A. E. Doucet, district engineer, Transcontinental Railway, Quebec, and Mr. A. St. Laurent, Department of Public Works, Ottawa. For vice-president for one year Prof. E. E. Brydone-Jack, Department of Civil Engineering, University of Manitoba, and Mr. Gordon Grant, chief engineer, National Transcontinental Railway, Ottawa, have been nominated. For councillors, the following are the nominations: District 1, S. P. Brown, chief engineer, Montreal Tunnel and Terminal Co., Canadian Northern Railway; H. R. Safford, chief engineer, G.T.R.; A. Surveyer, consulting engineer, Montreal; R. M. Wilson, Montreal. District 2, C. B. Brown, chief engineer, Canadian Government Railways, Moncton, N.B.; F. W. W. Doane, city engineer, Halifax, N.S. District 3, A. Amos, Quebec; T. A. J. Forrester, Quebec. District 4, G. J. Desbarats, Deputy Minister Naval Service, Ottawa; A. J. Grant, superintending engineer, Trent Canal, Peterborough, Peterborough, Ont. District 5, S. B. Clement, chief engineer, T. and N. O. Railway, North Bay, Ont.; J. L. Weller, engineer in charge, Welland Ship Canal, St. Catharines, Ont. District 6, W. G. Chace, Winnipeg; F. H. Peters, Calgary, Alta. District 7, N. J. Ker, Vancouver; D. O. Lewis, district engineer, Canadian Northern Pacific Railway, Victoria, B.C.

Membership.—The report for 1914 of the Council of the Canadian Society of Civil Engineers, indicates a membership of 3,059, a notable increase of 265 members over the record of the previous year. A diagram on another page of this issue illustrates the growth in membership since the inception of the Society. The 1914 increase is distinctly one of note, compared with other years, and considering also the effect of the war upon like organizations and their activities. The increase in membership included 38 members, 46 associate members, 1 associate, 43 juniors and 169 students. Transfers comprised 29 from associate member to member, 21 from junior to associate member, 26 from student to associate member, 48 from student to junior and 1 from student to member. A total of 19 were removed from the membership by death. The following is a summary as recorded at the close of 1914:—

Honorary members	10
Members	674
Associate members	1,372
Associates	26
Juniors	352
Students	315
	3,059

At the monthly meetings of the Society, held in Montreal, the following papers were read and discussed during the year:—

St. Lawrence River Bridge.—Mr. P. B. Motley.

Building Superstructures, Built by the Pneumatic Method.—Mr. John W. Doty.

Pulp and Newspaper Manufacture.—Mr. J. Stadler.

Subaqueous Tunneling.—Mr. P. A. N. Suerot.

Road Improvement in the Province of Quebec.—Mr. G. Henry.

Fire Control in Relation to Military Rifle Fire.—Mr. A. C. Geddes.

The System of Unit Construction in the Concrete Power House at Cedars, Que.—Mr. John E. Conzelman.

Mushroom Construction.—Mr. C. A. P. Turner.

An Integrating Weighing Machine for Materials in Motion.—Prof. H. E. T. Haultain.

The Wielder of the Weapon.—Prof. H. E. T. Haultain.

Methods of Treatment of Sewage Sludge.—Prof. P. Gillespie.

The following papers were read and discussed before meetings of the electrical section in Montreal:—

Performance of Electrical Insulators.—Mr. Julian C. Smith.

Making Our Water Powers Valuable.—Mr. Arthur Surveyer.

Before the meetings of the mechanical section in Montreal, the following papers were read:—

Steel Car Shops at Angus, Que.—Mr. L. C. Ord.

Steel Passenger Car Frame Construction.—Mr. C. Brady.

Heavy Artillery.—Lieut. S. T. Layton.

To the mining section were presented the following papers:—

The Electrical Driving of Winding Engines and Roller Mills.—Mr. C. A. Ablett and Mr. H. M. Lyons.

The Evolution of Stoping Methods in Mining During the Last Decade.—Mr. C. A. Macaulay.

Top Slicing System of Mining, as Practised at the Mines of the Detroit Copper Co., Morenci, Ariz.—Mr. J. R. McLean.

Modern Artillery in the Field.—Lieut. S. L. Brunton.

At meetings of the junior section papers were read and discussed as follows:—

Contracts and Costs of Brick Veneer Building Construction.—Mr. J. H. Norris.

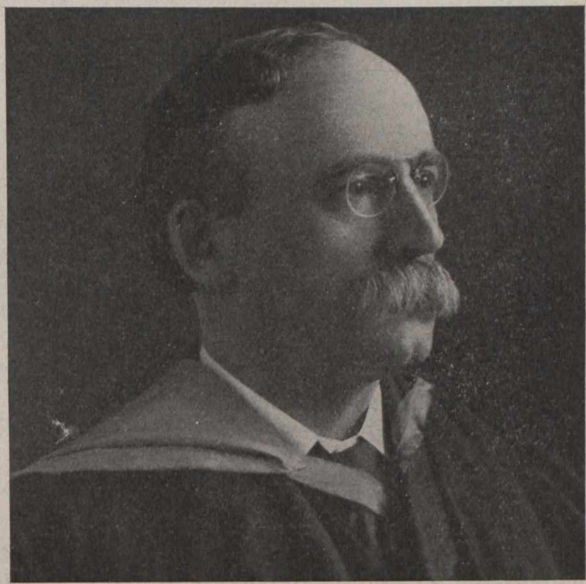
Movable Bridges.—Mr. J. Robertson.

The Moose Jaw Water Supply.—Mr. R. M. Walker.

The Sub-Structure of the Fraser River Bridge at Fort George.—Mr. H. L. Bodwell.

Extracts from Report of Council.—In its report the Council mentions the resolution adopted at the last annual meeting in regard to the co-ordination of surveys. It is stated that the resolution had been transmitted to the Dominion Government, but that no advance seemed to have been made by the latter up to the close of the year.

The Council acted in conjunction with the Institution of Naval Architects, the Institution of Civil Engineers and other associations in connection with the establishing of a memorial to the late Sir William Whyte, an honorary member of the Society.



PROF. C. H. McLEOD.
Secretary, Canadian Society of Civil Engineers.

In view of the resolution of the annual meeting regarding the question of datum planes, to which the attention of the Society had been called by the British Columbia branches, the Council, after some consideration, placed itself on record as of the opinion that the same plane of reference should, if at all practicable, be employed throughout the whole North American continent. As this would involve consultation with the United States Coast and Geodetic Survey, the Secretary was instructed to seek the co-operation of Dr. W. F. King as the officer in charge of Geodetic Surveys of Canada.

On account of the unsettled conditions arising from the war no definite plans have been made for the proposed summer convention of 1915, to be held in British Columbia. The Vancouver and Victoria branches suggest June as the most suitable time, and Victoria as the most suitable place, the proposal being to visit Vancouver and surrounding engineering works at the close of the convention.

In calling the attention of members to the importance of contributing papers for the Transactions of the Society, the Council emphasizes the present as a most opportune time for the preparation of papers, dealing with the important works upon which many of them have been engaged. The papers presented during the past year have been of the highest interest and the audiences have been the largest in the history of the Society.

Reference is made in the report to the establishment during the past summer of a new branch of the Society in Edmonton, under the chairmanship of Professor W. Muir Edwards.

A notable advance in the interests of the members was made by the British Columbia branches. As a result of representations to the Government of the Province the members have, under the Provincial Water Act, been specially recognized. It is understood that efforts are being made to secure a similar recognition by the Government of Saskatchewan.

The Council reports the sending of delegates to several congresses, prominent among which were the International Conference on City Planning, held in Toronto; the Western Canadian Irrigation Association, convened in Calgary, and the Good Roads Congress in Chicago.

It is reported that the members of the various grades of the Society who enlisted during 1914 for active service are: Members, 11; Associate Members, 46; Juniors, 29, and Students, 31, making a total of 117. A special fund has been established, from which the families of members who have gone to the war can be assisted in directions to which the resources of general funds may not be applicable. The fund has amounted to $2,033.75, and is under the direction of a special committee.

An engineering corps for war service has received considerable attention. The Council reports that the Minister of Militia and Defence has been communicated with, expressing a desire to co-operate in this connection, but at the close of the year no official acceptance had been made. The Toronto branch has suggested that a special railway corps should be organized directly under the British War Office and this matter is now under consideration.

During the year a special resolution was adopted providing for the remittance of dues to members of the Society actively engaged at the front during the term of their enlistment.

Report of the Library and House Committee.—This committee, under the chairmanship of Mr. H. M. MacKay, reports the consideration of proposals for improving the acoustics of the lecture hall. No action was decided upon for the present. Owing to the large attendance at most of the meetings during the year the acoustical defects were less noticeable than on previous occasions.

The committee presents a lengthy list of additions to the library, a notable unit of which is the Encyclopaedia Britannica, 11th Edition. A complete list of periodicals, magazines, transactions, etc., regularly received and on file is also included. Donations to the library were made by Messrs. F. W. Cowie, H. E. Harcourt, J. B. Harvey, S. E. Junkins, F. C. Kunz, G. A. Mountain, W. A. Plant, W. F. Richardson, R. M. Roy, A. Surveyer and Sir Wm. Van Horne.

[Notes on the reports of other committees, *viz.*: the committee on rails; on track; on general clauses and specifications, and on concrete and reinforced concrete appeared in our issue of December 31st, 1914, page 818. —EDITOR.]

RAPID WATER MAIN CONSTRUCTION, MEDICINE HAT, ALBERTA.

In connection with the mobilization of the Alberta cavalry it was decided to locate a squadron at the Agricultural Society's buildings, Medicine Hat, to which it was necessary to extend the public utilities of the city.

This entailed an extension of some 3,600 feet of water main. As the season was late, it was decided to push the work day and night and thus avoid, if possible, the extra expense due to frost, which would seriously hamper the progress of the trenching machine.

The trenching machine owned by the city is a No. 00 Austin gasoline-driven machine and has been in service for a year. It is capable of digging a trench 40 inches in width and a depth of 12 feet. This year the machine has dug approximately 8½ miles of water, domestic sewer and surface sewer ditch, representing approximately 50,000 yards.

On the work under discussion 81 gallons of gasoline were used, or approximately 1 gallon per 47½ cubic yards. In normal digging the machine can be operated by two men, but in caving material extra men are required to slice in the sides of the ditch in order to have the material removed by the machine. In some cases, however, where the tendency to cave is very bad it is preferable to install cribbing, in which case the progress of the machine is retarded in keeping with the rate at which the cribbing can be installed. The amount of material to be sliced in depends on the danger from caving and must be decided by the foreman in charge.

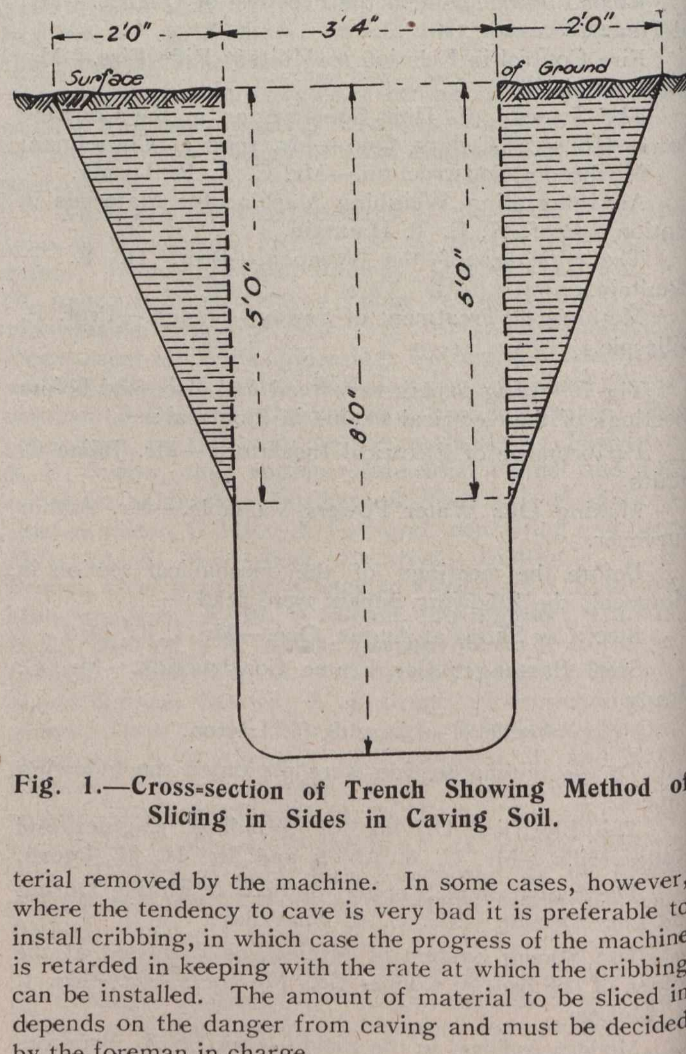


Fig. 1.—Cross-section of Trench Showing Method of Slicing in Sides in Caving Soil.

The formation in and around Medicine Hat is particularly favorable for ditcher operations. In the first place, practically no water is encountered at a lesser depth than 12 feet and the stratas overlying this are almost invariably "bone dry." The material in the same varies from a hard gumbo, approaching a soft shale, to fine running sand. In some instances boulders and stones are embedded in the stratas, but these do not cover extensive areas, or prevent the use of the ditcher, although they increase the cost of excavation. With regard to the work in question, the first 500 feet of ditch consisted of a very hard, dry, tough gumbo containing stratas of stone which varied in size from 3 inches diameter to 3 cubic feet volume. The next 2,000 feet consisted of a very much lighter material and was ideal for the operation of the machine. The remainder of the ditch was very sandy and caved so that the sides were sliced in (as shown in Fig. 1) and the material removed by the excavator. This extra material is included in the yardage shown.

Excavation.—The excavator started operation at 7 a.m. on Wednesday, November 25th, 1914, and at 6 p,m.

Fig. 2.—Excavated Ditch, Showing Some of the Boulders Moved by Machine.

had completed 650 feet of ditch, this being the hard material previously referred to. In Fig. 2 it will be noted two large rocks have been removed on the left-hand side of the ditch. These rocks were removed from the ditch by the excavator, but would not pass out over the conveyer and had to be removed by hand. The material in this section contained about 10 per cent. of stone. Between 6 p.m. on the 25th and 7 a.m. on the 26th, the trencher excavated 850 feet of trench, the material being easier for it to handle. From 7 a.m. to 5 p.m. the excavator travelled 1,150 feet, at which time a link in the caterpillar broke in making the only turn on the line, causing a delay of three hours. This material was ideal for the machine, resulting in the large increase in speed. From 8 p.m., the time of completion of repairs, to 8.30 a.m. on the 27th the excavator travelled 940 feet through a very sandy formation, which caved badly and was sliced in as previously referred to. This run completed the excavation.

From the time the machine was put in operation until the completion of the work, the excavator was only stopped four times and only for adjustment and repairs. During the first day one of the buckets became badly twisted and had to be removed, causing a loss of an hour and a half, and on the last run a loss of 3 hours occurred to repair the link in the caterpillar, in addition to which two hours were lost on the adjustment of the contact points on the engine. The total length of time that the machine was in operation was 49½ hours, deducting lost time the actual time was 44 hours, in which period the excavator travelled 3,590 feet, or an average speed of excavation of 81 6/10 feet per hour while in operation, including lost time, the average speed was 72½ feet per hour. The minimum speed was during the first day, when the average was 59 1/10 feet per hour and the maximum speed attained was 115 feet per hour. The minimum depth of ditch was 8 feet and width (exclusive of extra material sliced in) was 40 inches. This width allowed the installation of crosses without any handwork in the way of excavation.

Cost Data.

Number of cubic yards excavation	3,852.0
" " lineal feet pipe laid	3,590.0
" " tons of pipe (hauled 10,500 ft.)	63.2
" " pounds lead used per joint	12.3
" " gallons gasoline used	81.0
" " gallons gasoline per 1,000 cu. yd.	21.0
" " cubic yards per gallon gasoline	47.5

	Total expenditure.	Cost per lin. ft. (cents).	Cost per cu. yd. (cents).	Percentage of cost.
Engineering and timekeeping	$63.73	1.75	1.65	1.7%
Excavation*	150.41	4.16	3.9	4.1%
Backfilling	134.80	3.73	3.5	3.7%
Pipe laying†	158.15	4.37	..	4.3%
Materials	3,171.66	87.80	..	86.1%
Total	$3,678.75	101.81		99.9%

*Excavation cost does not include interest and depreciation on excavator. If $30 is allowed per day, the excavation would cost 5.4 cents per cubic yard.

†This item includes the cost of hauling pipe ($41.30 or 65.3 cents per ton), if this be deducted from total cost the cost of laying is 3 cents per lineal foot.

The following are the unit prices paid for labor, teams, and material:

Foreman	$ 4.50	per day
Engineer	4.50	" "
Assistant engineer	3.50	" "
Teams	6.00	" "
Labor	2.50	" "
Pipe layers	2.75	" "
Cast iron pipe	40.00	" ton
Specials	70.00	" "
6 inch valves	11.20	each
Valve box	8.75	"
Lead	5.29	per cwt.
Gasoline	.30	" gal.

We are indebted to Mr. A. K. Grimmer, the city engineer of Medicine Hat, for the foregoing information and illustrations.

CANADIAN RAILWAY DEVELOPMENT IN 1914.

Canada did not maintain the increasing rate of railway construction during the past year that had featured her transportation development in 1913 over 1912. Although over 1,000 miles short of the mileage attained in the previous year, the results of 1914 construction are nevertheless somewhat surprising in view of the financial difficulties which have attended development on every side. Over 2,000 miles of single track and over 150 miles of double track are the returns for 1914, in comparison with about 3,086 miles of single track and 467 miles of double track construction in 1913. During the past year the United States constructed a somewhat lower mileage than did Canada, the latter thereby creating for itself a new record—that of leading the world in railroad building.

By far the greater part of this Canadian construction was effected in Western Canada. The efforts of the Grand Trunk Pacific and of the Canadian Northern to complete their transcontinental lines, and the furtherance of the policy of the Canadian Pacific Railway to net the western provinces with a system of branch lines, are largely responsible for the extensive figures. The Grand Trunk Pacific built 450 miles of new track; the Canadian Northern built 515 miles, and the Canadian Pacific returns show 620 miles of new line. At the present time over 450 miles of new first track are under construction, for the most part in the West. About 2,100 miles of new line has been surveyed and 80 miles projected.

G.T.R. Construction.—The Grand Trunk Railway System, with its total mileage of 4,786.06 miles, reports no additions thereto, although 3 miles of line were constructed between Merritton, Ont., and Thorold, Ont., as a diversion necessitated by the location of the new Welland ship canal. No second, third or fourth track was built in 1914. About 9 miles of Company sidings and about 13 miles of traders' sidings were constructed. Of the former, 2 miles were embraced in two side tracks extending from Montreal terminal station to St. Henri. The G. T. R. erected new bridges at Brock Ave. subway and Sunnyside, Toronto; Thompson Road subway, Fort Erie; L. E. & N. Ry. crossing, Paris; in addition to several bridges in Detroit. Numerous other bridge structures throughout the system were replaced by new ones. New rails were laid, replacing those of lighter weight, as follows: 100-pound rails on 94.10 miles of track and 90-pound rails on 60.12 miles of track.

Stations were built by this company at the following places: Pembroke, Dalkeith, Lacolle, St. Polycarpe, Aubrey, Seagrave, Inglewood, Thedford, Hepworth, Ekfrid, Norwich, Wixom, Vickeryville and Capac. New freight sheds were erected at Sidney, Smithfield, West Toronto, Prairie Sidings, Jarvis, Helena, Welland, Ovid and Lapeer. A Y.M.C.A. building was put up at Southwark (St. Lambert), and water tanks, coal chutes, stock pens, etc., as well as minor buildings of various descriptions were erected at a number of points.

During the year the Grand Trunk Railway System installed automatic block signals on a double track line from Point St. Charles to St. Lambert in the province of Quebec, a distance of 3½ miles. This brings the aggregate mileage of automatic block signals on this company's line up to 85 miles of double track and 6.5 miles of single track. There were no non-automatic block signals established during the year.

G.T.P. Activities.—At the beginning of 1914 the Grand Trunk Pacific Railway Co. had laid steel from Winnipeg for a distance of 1,260 miles to the second crossing of the Fraser River, 75 miles east of Prince George, B.C. From the west, steel was laid from Prince Rupert 300 miles east to Rose Lake. At the close of the year 1913 there was a gap of 170 miles without steel and 256 miles where trains were not in operation. The main line was being rapidly completed, however, and on February 1st, 1914, the railway was connected up and through trains began operation, although considerable ballasting had still to be done. During the year 218 miles were completed in British Columbia. On the Calgary-Tofield branch of the G.T.P., steel was some 40 miles from Calgary on January 1st, 1914. This line was completed to Edmonton and service established during the summer. In addition, 16 miles of track have been laid on the Prince Albert branch and 26 miles on the Moose Jaw northwestern branch from Mawer to Riverhurst.

C.P.R. Construction.—Data relating to track extensions on the eastern lines of the Canadian Pacific Railway (that is, lines east of Fort William, Ont.) is not extensive, the only track laid during the year which has added to the mileage of the line being 0.64 miles known as the Forsythe St. branch, Montreal; 1.11 miles, being a freight spur at Trenton, Ont., on the Campbellford, Lake Ontario and Western Railway (C.P.R.); and 2.37 miles on the Interprovincial and James Bay Railway (mile 7.5 to mile 9.87, Kipawa north).

The double track mileage of eastern lines was increased by 38.5 miles, there being 21.0 miles of double track diversion and 17.5 miles of second track completed on the Lake Superior division.

During the year, the Canadian Pacific Railway took over the Lake Erie and Northern Railway upon which about 19 miles of steel were laid between Galt and Port Dower, Ont., in 1914. Another Ontario line absorbed by the C.P.R. is the Glengarry and Stormont Railway, which built about 27 miles of track between Cornwall and St. Polycarpe Junction, Ont.

As already stated, the C.P.R. has done very extensive work on its western lines. In addition to branch lines and general maintenance, a great deal of main line double tracking has been completed. In fact, nearly 300 miles of double tracking was done in British Columbia, Alberta, Saskatchewan and Manitoba during 1914.

The Esquimalt and Nanaimo Railway, a subsidiary of the C.P.R., on Vancouver Island, built about 36 miles of track between Courtenay and Qualicum.

The province of Alberta was the scene of greatest activity in C.P.R. construction. Here four branch lines, Bassano, east toward Swift Current, 135.5 miles; Alberta Central, 64.5 miles; Monitor-Kerrobert line, 72 miles; Gleichen-Shepard line, 13 miles, were completed and regular trains put into operation. Work was commenced on the Suffield south-west line and 27 miles completed; also on the Coronation north-west branch and 25 miles completed. In all, about 508.5 miles of ballasting were completed in this province.

In Saskatchewan 87 miles of new track were laid and 110 miles ballasted on the Weyburn-Sterling extension. This line is now 436 miles long. About 15 miles of line was completed during the year on the branch south-west from Expanse, and 7 miles on a branch from Assiniboia north. The Swift Current north-west branch was also completed. In British Columbia the Kootenay Central, from Edgewater to Skookumchuk, a distance of 67 miles, was completed, as was also the Kaslo-Three Forks branch.

The large terminal station and wharf at Vancouver have been practically completed.

Manitoba work on the Canadian Pacific consisted only of a branch 26 miles in length from Gimli to Riverton, and the reconstruction of the terminals at Winnipeg, not yet completed.

The year 1914 was marked by some interesting events on the Canadian Pacific Railway, one of which was the opening of the line between Glen Tay and Agincourt, thereby doubling the track between Montreal and Toronto. This stretch of 184 miles was open to traffic on June 29th. The construction was carried out by Messrs. Foley Bros., Welch and Stewart, under the supervision of engineer of construction Ramsay for the C.P.R. There have also been additions to the Angus shops at Montreal, curtailed, however, in their magnitude by the war. New shops have been built at Sherbrooke, and new offices constructed for the Quebec Central Railway, a subsidiary line.

Double tracking by the C.P.R. in 1914 was as follows: In Ontario, between Azilda and Cartier, 17 miles; Chapleau and Nemegos, 7.2 miles; Bolkow and Healy, 6 miles; White River and King, 9.3 miles; Salim and Pays Plat, 9.5 miles. In Manitoba a stretch of ten miles from Kemnay to Broadview was double tracked. Some 41 miles of second track was laid between Broadview and Swift Current in Saskatchewan, while in British Columbia double tracking amounted to 52.5 miles between Revelstoke and Tranquille.

This extensive development throughout the country has called for the construction of many bridges, chief among which is a large steel structure, the foundations for which have already been completed, across the Fraser River at Hope. Another important undertaking is the now famous Roger's Pass tunnel, well under way, and already described in these columns.

C.N.R. Development.—The Canadian Northern Railway and its subsidiary companies have, during 1914, put into operation many miles of track, particularly in the West. The progress has been such that before the end of this month the last link of the transcontinental line will have been joined.

The following is the mileage of track laid during the year 1914 on lines west of Port Arthur:—

Canadian Northern—Birds Hill to Pt. Grand Marais, 50.77 miles; Chatfield northerly, 27.08 miles; Laird northerly, 8.67 miles. Canadian Northern Alberta—Yellowhead easterly, 2.48 miles. Canadian Northern Western—Stolberg to Brazeau, 17.44 miles. Canadian Northern Pacific—Waterfall to Lytton, 13.5 miles; McAbee's to Kamloops, 33.8 miles; Irvine to Hell Gate, 30.8 miles; Pyramid Creek to Yellowhead, 94.39 miles. Total, 278.93 miles.

No double tracking was done in 1914 on western lines.

In Ontario the Canadian Northern Ontario Railway constructed about 130 miles of track between Capreol and Ottawa and in the Province of Quebec about 39 miles between Hawkesbury and Montreal, making a total of 169 miles of single track laid on lines east of Port Arthur. No double tracking was done during the year.

Besides the activities of these more widely known companies, a great deal of construction has been completed during the year by other and newer concerns. Between Edmonton and Lac la Biche, Alberta, about 137 miles of line were completed by the Alberta and Great Waterways Railway. In the same province the Edmonton, Dunvegan and British Columbia Railway built 124 miles of line between Smoky River and Sawridge, Alberta. The Intercolonial Railway constructed 2.69 miles between Nelson and Nelson Junction in British Columbia, and 4.3 miles between North Sydney and Leitches Creek in Nova Scotia. The St. John and Quebec Railway constructed over 30 miles of track on various branches in New Brunswick. The Quebec Central Railway built about 5 miles of track on a line to St. Sabine. The Dominion Government Hudson Bay Railway, between Le Pas, Man., and Port Nelson, added to the previous year's construction by 120 miles. The Greater Winnipeg Water District completed and put into operation about 95 miles of track between St. Boniface and Indian Bay, Shoal Lake, Ont. The Toronto, Hamilton and Buffalo Railway constructed a line in Ontario from Smithville to Dunnville, adding 14.9 miles to its trackage. The Department of Railways and Canals, Ottawa, constructed about 6 miles of track along the line of the new Welland Ship Canal for a distance of about 6 miles. Although built for construction purposes, it is a double-track, standard gauge line of permanent construction, equipped with a complete interlocking plant and block signal system. In the town of Sandwich, Ont., the Essex Terminal Railway constructed 1.1 miles of track.

Between Coalmont and Brooks, B.C., the Vancouver, Victoria and Eastern Railway, a subsidiary of the Great Northern Railway, built about 26 miles.

While dealing with railway construction in the Dominion of Canada, it is of interest also to note that the Reid Newfoundland Company constructed about 33 miles of single track in Newfoundland.

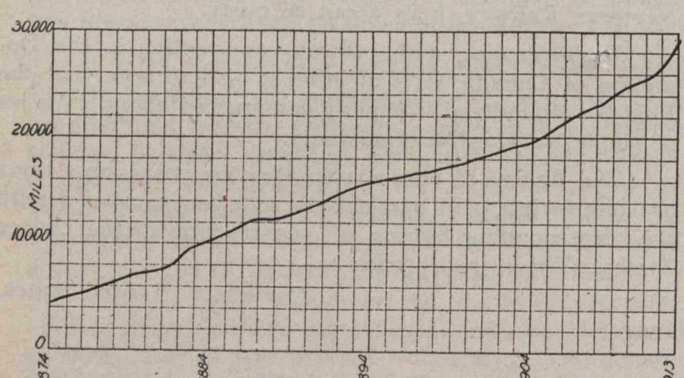
The figures of new construction by years since 1901 are interesting, and particularly so when paralleled with the corresponding figures of construction in the United States. These are as follow:—

Year.	Canada.	United States.
1901	658	5,368
1902	342	6,026
1903	687	5,652
1904	316	3,832
1905	1,181	4,388
1906	1,007	5,623
1907	976	5,212
1908	1,249	3,214
1909	1,488	3,748
1910	1,844	4,122
1911	1,898	3,066
1912	2,232	2,997
1913	3,086	3,071
1914	2,017	1,532

In Canadian railway construction during 1914 it is impossible to state, until complete returns are in, whether British Columbia or Alberta occupied the premier position. According to figures in hand, British Columbia completed, in round numbers, about 625 miles of trackage, while Alberta's returns show approximately 630 miles. Manitoba returns show about 330 miles of construction. The province of Ontario comes next with some 260 miles of track. Saskatchewan constructed close to 200 miles. Quebec's mileage is in the neighborhood of 50, that of New Brunswick 35 and of Nova Scotia 10.

Rate of Canadian Railroad Growth and Its Effect Upon Future Development.—In the thirties and forties, Canada had from 16 to 66 miles of railroad in operation. Between 1851 and 1856, the mileage grew from 159 to 1,414. In the year of confederation, it was 2,278, and ten years later, or in 1877, 5,782. By 1884, it had reached 10,273 and by 1904 had nearly doubled again, 19,431 miles of track being in operation. At the end of 1913, there were 29,304 miles. An examination of the figures regarding Canadian railways, prepared by Mr. J. L. Payne, comptroller of statistics for the Dominion Government, shows that every year since 1835 there had been a gradual increase in the construction of railway mileage, the figures changing from 0 in 1835 to 29,304 in 1913.

At the present time there is a disposition to accept with credulity the observations of many that Canada is nearing the end of a period of remarkable railroad construction. Now that the Grand Trunk Pacific and Canadian Northern transcontinentals are practical realities there is a decided tendency to believe that such is the case. Still, the Canadian Pacific Railway, an old-established transcontinental route, has not fallen behind in the immense track-laying campaign. The necessity of branch lines and of double tracking on main lines has evidenced itself in the operation of the road to such a degree that, in 1914, for instance, C.P.R. mileage of new line was considerably in advance of that of the other railroads. Granting, however, that the completion of three transcontinental routes will affect mileage statistics, there is nothing to regret. As Mr. Fred. W. Field affirms



Growth of Canada's Railroad Mileage.

in a recent issue of The Monetary Times, it should stimulate greater energy in efforts to settle the lands which are served by nearly 30,000 miles of railroad track, in order to produce more from the soil, the fisheries, the mines, the forests and the factories. What is needed, states Mr. Field, is more population, more production, more freight, more exports.

The railroads and the governments of Canada have done their part to furnish transportation. Efforts must now be made to concentrate energy upon production. When the legal representatives of the railroads were deep in their arguments before the Dominion Railway Commission a few months ago, they expressed, or at least one of them did, a doubt as to whether the Canadian railroads would be able to earn dividends. As the hearing was to consider the proposed reduction of Canadian freight rates in the west, and as lawyers have a knack of using much pitch when the picture is to be painted black, the contention must not be taken too seriously. The figures then quoted are of interest, however, in that they reveal partly the extent to which we must encourage production and consequently freight.

The statement then presented showed the capital invested and to be invested to complete transcontinental lines as follows:—

Capital Investment.

Canadian Pacific Railway, $635,229,094; Grand Trunk Pacific, $175,000,000; National Transcontinental, $200,000,000; Canadian Northern Pacific Railway, 600 miles at $80,000 per mile, $48,000,000; Canadian Northern Ontario Railway, north of Lake Superior, 900 miles at $50,000 per mile, $45,000,000; additional equipment for Grand Trunk Pacific and National Transcontinental Railway, $40,000,000; additional equipment for Canadian Northern Railway, $35,000,000. These figures give a total cost of $1,178,229,094. The statement of earnings showed: Net earnings of Canadian Pacific Railway, $42,403,340; net earnings of Grand Trunk Pacific, $2,691,402; total earnings, $45,094,742, less Canadian Pacific Railway taxes of $1,382,420, giving a balance of $43,712,322. To this is added the surplus net earnings of the Canadian Northern Railway, $400,651, leaving the total net earnings available to pay interest on capital investments as $44,112,973. That the Canadian Northern Railway's surplus net earnings are only $400,651 was shown by the following statement: Canadian Northern Railway's gross earnings, 1912, $20,860,093, less operating expenses of $14,979,047, leaving a balance of $5,881,046. This, less fixed charges of $5,480,395, leaving a total available surplus from all sources of $400,651.

"Mr. J. P. Muller" (the government expert), said the statement, "allowed six per cent. on outstanding obligations as necessary to maintain the credit of the railway. Six per cent. on $1,178,229,094 amounts to $70,693,745, for which there is available only total net earnings as shown of $44,112,973, leaving a deficit of $26,580,772.

"Assuming interest on $200,000,000 capital invested in the National Transcontinental to be a direct charge and to be assumed by the government, this would leave a deficit of $14,580,772. An average earning of 4 per cent. on the amount of capital invested as above amounts to $47,139,160, or $3,026,187 more than total earnings by the roads. If Mr. Muller's standard of six per cent. is to be adopted, there should be added to the above deficit of $26,580,772 an additional $2,500,000, representing two per cent. of the outstanding obligations of the Canadian Northern Railway. In this estimate the outstanding stock of the Canadian Northern Railway Company has been omitted, the fixed charges on outstanding obligations only being taken into consideration.

"Even allowing for the growth of the country, not more than 300,000 people would come into Canada in a year. Adding ten per cent. for this number to Canadian traffic would simply mean reducing the deficit from twenty-six to twenty-two millions odd. With the wheat out of the country and a general drop in other traffic owing to business depression, what would the earnings of Canadian roads be in the next five months? Even if bonds were guaranteed by governments, they would not sell unless the road offering them could show a remunerative business."

This statement was described by counsel for the western provinces as "raising the hospital cross in one hand and the crossbones and black flag in the other." While there is considerable elasticity of meaning in the figures, they are good enough to remind us that workers must gird their loins for production and that governments having helped the railroads must encourage freight, the railroads helping too.

Mileage by Provinces.

It is interesting to see how the provinces share the total mileage. Ontario has almost one-fourth. Saskatchewan comes next, which is a somewhat remarkable fact. That province has 4,650 miles, which is considerably more than any of the other Western provinces, and larger than any of the Eastern provinces, with the exception of Ontario. The following table gives the figures, which are still more clearly illustrated in the accompanying chart:—

Province.	Miles of railroad.
Nova Scotia	1,359.97
Prince Edward Island	279.23
New Brunswick	1,544.67
Quebec	3,986.03
Ontario	8,999.76
Manitoba	3,993.28
Saskatchewan	4,650.96
Alberta	2,212.22
British Columbia	1,950.92
Yukon	101.71
In United States	224.78
	29,303.53

The 224 miles of track in the United States relate to lines which cross United States territory in passing from one point in Canada to another, as for example, the Canadian Pacific and the Canadian Northern. Such lines are operated wholly for the purposes of Canadian traffic. There is a large additional mileage in the United States owned and operated by Canadian railways, of which no account is taken in the above statistics. The small mileage included constitutes a case in which actual, rather than geographical, conditions have governed. During 1913 70 per cent. of the increase in operating mileage was in provinces west of Ontario.

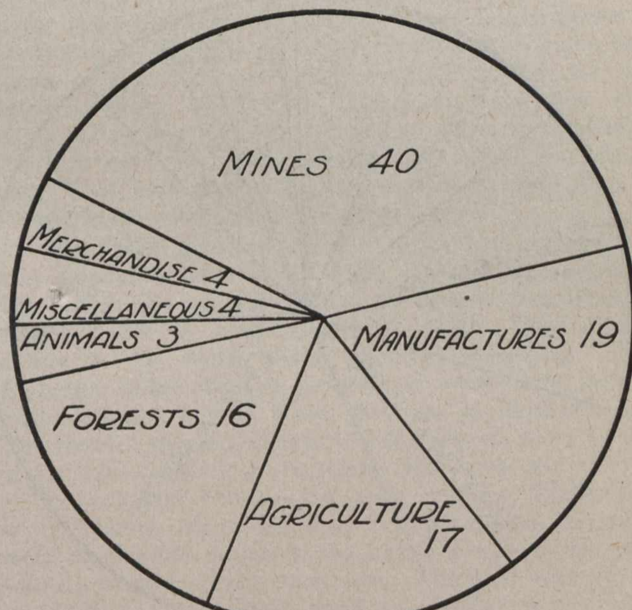
Operation Statistics.

For the year ended June 30th, 1913, Canada's railways carried 46,230,765 passengers and 106,992,710 tons of freight, an increase as compared with 1912 of 5,000,000 passengers and 17,000,000 tons of freight. Thirty-nine years ago, our railroads carried 5,000,000 passengers and 5,000,000 tons of freight. That was one ton of freight to every passenger. To-day the railroads are carrying about two and a half tons of freight to every passenger, and in a few years they should be carrying five or ten tons to each passenger. The earnings from freight service last year were $177,000,000, and from passenger traffic, $45,000,000. Here are statistics regarding the freight of Canada's railroads in 1913:—

The 106,992,710 tons of freight hauled in 1913 represented an increase over 1912 of 19.3 per cent. The largest increase in any preceding year occurred in 1912, when it was 11.9 per cent. The number of tons hauled one mile was 23,032,951,596—a growth of 3,469,480,069 as compared with 1912. Density of freight traffic was shown in 785,820 tons hauled one mile per mile of line, which was a betterment of 54,044 over the previous year. The average freight revenue per ton per mile was .758 cent, as against .757 in 1912. Freight by itself yielded a revenue of $174,684,640.28—an increase over 1912 of $26,653,741.68. The total earnings from freight service including switching, etc., were $177,089,372.78. This was larger by $27,128,232.65 than the aggregate of 1912. Gross earnings from freight service were equal to $6,040.03 per mile of line, showing a gain of $429.18 over 1912. The aggregate revenue from freight per ton was $1.636—a decline of .019 as compared with the preceding year.

The average number of loaded cars per freight train was 18—a decline of .19 as against the record for 1912. This falling off is partly due to the influence of new line mileage. The average number of empty cars per train was 5.66, as against 5.17 in 1912. The average number of tons per train was 342—a gain of 17 tons over 1912. The average number of tons per loaded freight car was 19.01, as against 17.87 in 1912. This gain of 1.14 tons per loaded car reflects the use of larger carrying units and better loading. The mileage of revenue freight trains and mixed trains was 67,320,090—an increase of 7,145,402 over 1912. The mileage of loaded freight cars was 1,211,708,492, as against 1,102,719,543 in the preceding year.

The average freight haul has increased from 183 miles in 1907 to 216 miles in 1913, which was two miles less than in 1912, and sixteen miles more than in 1911. Six years ago 63,000,000 tons were hauled, and last year, 107,000,000 tons. A problem of Canadian railroad economics is evidently presented in the fact that empty freight cars had a mileage of 381,048,160, caboose cars making a similar wasteful journey of 63,653,643 miles during the year.



Sources of Freight Carried by Canada's Railroads.

One is naturally interested to know from whence the railroads derive their freight. The following table shows this:—

Source of freight.	1913. Tons.
Products of agriculture	17,196,802
Products of animals	3,173,562
Products of mines	40,230,542
Products of forest	16,609,100
Manufactures	19,694,240
Merchandise	4,365,852
Miscellaneous	4,161,154
Totals	106,992,710

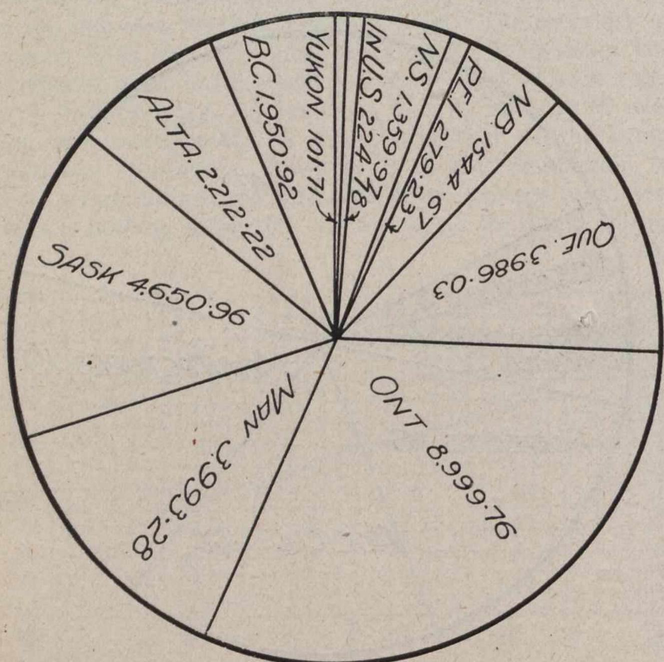
Total contains 1,561,457 tons not distributed.

Last year mining tonnage accounted for 38.16 per cent. of the total freight. Manufactures came second with 18.68 per cent.; agricultural products, 16.31 per cent.; and forest products, 15.75. Mining tonnage has been the heaviest item every year since 1907, and probably before that. With properly directed development, agricultural, forest, mineral and factory tonnage all should increase considerably during the next ten years.

Considerable traffic comes into Canada by United States lines which cross the boundary, and much tonnage is delivered at the border to roads operating in Canada, under which definition comes the connecting road. The following is the division of the traffic last year:—

	Tons.
Originating in Canada	56,829,297
Received from connecting roads	21,284,742
Received from United States roads	27,317,214
Undistributed (Grand Trunk Pacific)	1,561,457
Total	106,992,710

It may be assumed from the foregoing summary that the net tonnage for the year was 85,707,968.



Distribution of Canadian Railroad Mileage.

While the Canadian railroads earned $256,000,000 in 1913, their operating expenses were $182,000,000, the percentage of expenses to earnings being 70.9. This is better than in the seventies, when the percentage was 81, but not as good as in 1912, when the percentage was only 68.7.

SURFACE EARTHING IN MINES.

At a meeting of the Association of Mining Electrical Engineers held in Glasgow, a practical paper was read by Mr. Percy S. Glover, on "Surface Earthing of Scottish Mines." The author emphasized the point that it was of little use having an elaborate earthing system unless the paramount importance of obtaining and keeping an efficient earth was appreciated by the management and acted upon. If this was not done the endeavor to ensure safety in working by earthing became largely impaired if not altogether neutralized. The best way to secure an efficient earth was to install two or more plates and then to take steps for carrying out periodical tests to ensure that the efficiency was always maintained.

THE TRANSPORTATION PROBLEM ON SURVEYS IN THE CANADIAN NORTH.

By J. A. MacDonald.

In our new, and yet comparatively undeveloped country, where our Canadian surveyors are operating continuously on various kinds of work, not only on railway lines, but more particularly base line surveys, township subdivision surveys, exploration and topographical surveys, the surveying of quartz and placer mining claims, water powers, harbors, millsites, timber limits, etc., calls for much varied work. When one considers that many of these surveyors are operating as far north as 600 miles from Edmonton, the Peace River country, of which so much is expected, and in Northern British Columbia, hundreds of miles from civilization, railways or steam communication, the question of the transportation of the outfit for the survey party becomes problematical. North of Lake Winnipeg, in Northern Manitoba and Ontario, the county is known as a "lake country," being densely dotted with lakes, large and small, involving water transportation in summer almost entirely, while the north-western country, known as the Peace River country, with its few lakes, involves transportation almost wholly by means of pack horses. In winter, the problem of transportation is approximately similar, east and west, involving the use of both horses and dogs, supplemented by human packers with the "Tupp-line," or the toboggan. Many surveyors have obtained considerable experience in working out this problem while engaged in railway and other exploration work in the north country, which experience is of signal value to those now at various kinds of work much farther north and west.

At a convention in Ottawa a few months ago, four surveyors discussed this problem of transportation, Messrs. G. H. Blanchet, A. H. Hawkins, G. H. Herriot and J. R. Akins, and contributed valuable information on this all-important subject. The opinions and viewpoints of these men is incorporated in this article.

Base Lines versus Railway Lines.—While both base lines and railway lines are run on the same general principles, they differ considerably in detail. A base line is really a parallel of latitude run, of course, astronomically. A railway line is usually a crooked line and consequently contains many angles. A base line has only one angle in six miles, while in a given stretch of country there may have to be several railway lines run to ascertain which is the most suitable for the final location of the railroad. In base line surveying only the one line is run, but so carefully and precisely must it be run, geodetically, that progress is necessarily slow. The ground is chained twice, first with a Gunter's chain and next with a 100-ft. chain, two sets of chainmen being required. The work is of a very precise nature, allowances being made for temperature, and clinometer readings are made over rough ground. As to progress, it is difficult to say which party can cover the most ground, so that the matter of caches will be about the same.

The most vexing questions with which the surveyors have to deal in surveying their lines are those in connection with transportation. So little is known of the north country before the lines have been run, and its features vary so much, that, to a very large extent, difficulties can only be overcome as they are encountered. Experience gained during the survey of other lines is, however, of great assistance in pointing out certain broad rules, which should be followed in most cases.

The main object, according to Mr. Akins (who operates this year 600 miles north of Edmonton) to be kept in view when figuring on the transportation is to keep the supplies in camp and the camp moved along the line without interfering with the organization of the line party. This is a prime factor in getting a good total of miles run by the end of the season, and thereby reducing the cost per mile. The cheapest method of doing this is the next consideration.

The means which should be used for transportation differ greatly for the different seasons of the year. They are, therefore, best classified with reference to the periods of the year considered. Taking these periods in the order of time in which they usually occur, we have to consider (1) location of caches; (2) spring transportation; (3) summer transportation; (4) late fall and winter transportation.

The consensus of opinion among surveyors is that the smaller caches should be arranged on such a basis that, as the actual survey of the line is being carried on, not more than two or three trips of the transport outfit shall be needed to carry everything forward from each cache. There is then sufficient time between successive moves of the main camp to allow everything to be kept up with the camp. This avoids the necessity of having an extra supply train working independently of the camp to bring up supplies. Such an extra supply train generally gets into difficulties caused by deep snow or floods, or the break-up of ice in rivers or lakes, or the thawing of the ground in the muskegs.

If the surveying work is to be of large dimensions there should advantageously be erected one or more base or central caches at some convenient point from which the smaller ones might be replenished. This cache should be kept well stocked at all times.

It is the experience of one surveyor, Mr. Blanchet, who worked on base line surveys in the Peace River country, that two or three trips of the outfit should be able to carry supplies for two months. The location of the caches should result, under ordinary conditions, in enabling the surveyor to utilize their advantages to the best account. Thirty miles apart is not too far, and in some lines of work they may economically be fifty miles apart. While on such surveys as mining claims, millsites, timber limits, townsites, etc., one cache may conveniently be situated at some convenient point in the district where the work is being carried on.

As regards the number of horses, where pack horses are used for transportation, the present standard pack train of 31 horses forms an efficient mean between shortage and the trouble of handling too many. In a well-cared-for pack train of 31 horses, there should seldom be more than one or two incapacitated from work, but usually six or seven may have to be favored with lighter loads.

All surveyors admit that the load a pack horse can carry depends more on the trail than on the horse. It is considered good policy, in the long run, to make a good trail. A pack horse should carry from 120 to 200 pounds on an average survey trail. The whole train of 31 horses should handle about 4,000 pounds of the bulky freight of a camp, and about 5,000 of cache supplies, the latter being much more compact and much easier on a horse, weight for weight, than camp outfit. One trip of the whole pack train can handle the tents, beds, dunnage, cook outfit, and in addition enough supplies to last for some days. Two men can handle the train, with the help on moving-days of the cook, cookee, and one other man, who should be the trail cutter. As the supplies get lighter, and the whole train is not needed for second and third trips, the packers can assist with the work of fixing trail. In bad muskeg the trail will often require repairing after one trip. While the horses are going back light to the cache, a couple of axemen can put it in shape.

Mr. Blanchet is strongly in favor of keeping all the horses in camp, and not having a separate train working exclusively on the trail. When the horses are divided into camp and supply train, many objectionable features arise. Two more packers are needed. This means taking two men off the line, resulting in a decided loss of efficiency of the whole party. Camp cannot be moved in one trip. The first section must be cut down to necessities, with the result that if bad weather prevents the horses going back next day for the remainder, great inconvenience may result. Then again, a pack train working back on the trail may get into serious difficulties from being so short-handed. A specific example is the case of a muskeg sufficiently frozen to allow the camp outfit to cross, but which might be thawed out later in the season when the supply train would have to cross. In general, it is infinitely more satisfactory for the surveyor to have everything in camp where he can personally supervise it. Supplies in a cache represent so many horse loads, and in whatever way it may be handled, the same total transport will occur. It is true that when there is no train back on the trail, heavy work is entailed for the first moves forward from a new cache, but this is more than balanced by the comparatively easy time the horses have when the load gets lighter.

Expenses incurred in placing caches, though they may appear in themselves high, are usually justified if the caches are so placed that no time is lost when the survey party is subsequently at work The value of a day in the Peace River country, according to Mr. Blanchet, when the full party is at work, may fairly be estimated as running from $100.00 to $150.00; while Mr. Herriot places the cost of full party of 20 to 25 men, in the lake country of Northern Manitoba and Ontario, at $150.00 and $200.00 per day, for if a day is spent in advancing transportation, instead of on the actual work on the line, it means the loss of a mile of line which would otherwise have been run. The true way to estimate the loss of a day's work on the line in the middle of the season is not by considering only the actual day's wages and board account, but by dividing the total cost of the whole season by the number of days which are spent on the actual survey of the line. Time travelling from town to the locality and back again, Sundays and days of bad weather, all these must first be deducted before we get the number of days which are available at best for doing the real work we set out to do. It is not one of those days which could not have been utilized on the line which are used up in forwarding transportation in the middle of the season, but it is one of those days (much less numerous than the total) on which we could have advanced the line itself.

For similar reasons, namely, to save the party when actually on the ground for doing the survey work itself, it will generally be advisable to hire outside help and outside means of transportation to move up supplies, whenever a chance offers.

The Location of the Caches.—This must depend, to a certain extent, on the topography of the country, especially on the nature and course of any large rivers. Where a summer water route is available it usually affords the easiest means of reaching the line. If, however, such a route is not available, supplies are best transported either as soon as there is enough snow to use sleighs, or else towards the end of winter when the snow is becoming light. Early in December or early in March, is the best time from Mr. Blanchet's viewpoint, preferably the former as there is always more risk in spring. It is an absolute necessity when sending supplies out to be cached in an unknown country to send a responsible man in charge to see to the location, building of the caches and storing of the goods.

The chief dangers to which a cache is exposed in the Canadian North are water from rain or floods, large animals such as bears, and small ones such as squirrels and mice, and in recent years there has been the added danger of burglars. It is impracticable to make the roof and side of the cache proof against rain, so this is generally provided for by hanging tarpaulins from poles placed lengthwise inside the cache and close to the roof. With a pole under the middle and two poles under the sides of the roof, and two more about half way down the walls, a complete curtain can be formed to keep off any rain which comes through the roof or splashes in at the sides.

It is comparatively easy to make a cache safe from larger animals, but it seems almost impossible to keep the small ones out. It is not possible to make a cache burglar proof, and the only way to protect caches is by the determined prosecution of any offender. Cases of robbery are becoming more numerous each year in the Canadian North, but no prosecutions have yet been made. The serious part of such robberies is the inconvenience and sometimes danger which an unexpected shortage causes, apart from the financial loss. It is a fact which is not creditable to white men that such robberies only occur where they travel. Indians are usually scrupulously honest in this regard.

Experience proves that a good floor of poles should be provided in a cache to keep the supplies off the ground, and to prevent animals from digging their way in. The meat should be hung if it is intended to have the cache remain during the warm weather, and especial care should be taken about the way sugar and dried fruits are stored. A trench should be dug round the cache, whenever possible to keep the bottom dry, and a certain amount of clearing away of the surrounding bush, and sand placed on the roof will decrease the danger from fires.

When the party is at work on the line, time and trouble will often be saved if someone is sent ahead, as the line approaches the locality of a cache, to find out its exact location and decide on the best means of cutting out trails to it.

Horse Feed.—In localities, like northern Alberta, where pack horses are universally used instead of Indians and canoes, a serious item in this arrangement is the getting of horse feed. This has to be transported long distances. It is almost impossible to keep horses on oats along in spring. The swamp grass has hardly any nourishment, and the horses are exhausted in digging down below the deep snow to reach it, such as it is. Fifteen to twenty pounds of hay, or even less, with seven or eight pounds of oats per day is enough to keep a horse in good condition, if he has a chance to rustle. Enough hay should be provided by some means to last till early in April, and enough oats to last till the middle of May.

It will generally happen that the loads will be getting light at the time when feed is poorest.

Good horses are a necessity for winter and early spring transportation, not necessarily big ones, but hardy ones and good fighters.

Towards spring the transportation is very difficult during the period which comes after the sleighing has become poor, and before there is enough grass to use the pack train. During this period the outfit should be cut down to necessities, the remainder being cached in some suitable place. For moving camp during this period, two schemes are suggested by Mr. Blanchet. One is to take the rear bobs off the sleighs and shorten the rack, securing it in front to the roller. Although this is an awkward looking contrivance it is pulled fairly easily, and will carry a good load. The other scheme is to give up using the sleighs altogether, and to use the team horses as pack horses. With this last arrangement camp should only be moved so far each time that two trips can be made in a day.

About the beginning of June the frost beneath the surface finally goes out altogether in the tamarac swamps, and it has become weak in the spruce swamps. The laborious and disagreeable work of brushing the muskegs has then to be begun. The duration of frost in the muskegs depends on the depth of moss on top, on the amount of surface water, and on the protection from the sun offered by timber. The effect of the moss is much the same as that of the sawdust used in ice houses.

Placing brush on muskegs is work that no one likes, but which, in many parts of the north, is part of the daily programme. Two rules apply to brushing. The first is to avoid it altogether, if it is at all possible to go round the muskeg, even at a considerable increase in distance. The second rule is, when it cannot be avoided, to do it well. A poor piece of brushing causes subsequent trouble and delay, and serious damage to goods often results when a pack horse breaks through the brush.

The feed for horses begins to get poor about September 15th, and a small quantity of oats will benefit the horses considerably, especially those intended for winter work which should be saved as much as possible.

Those of the pack horses which will not be retained for winter work with sleighs should be sent out in the latter part of October or early in November, the exact date depending on the kind of season, and the distance they must travel to get out. It is advisable to have them move a cache ahead, before they leave, if there is not one placed ahead already.

Through the early part of winter the tamarac grass with the addition of oats will keep horses in good condition if the snow is not deep.

Winter Horse Tents.—The question of having a tent for team horses in winter is a very debatable one among surveyors. If there is a constant supply of hay available so that the horses will always be tied up, and if moves are not too frequent, a tent is unquestionably an advantage. When, however, the horses have to rustle for themselves part of the time, as is nearly always the case, the change from the steaming warm air of the tent to very low temperature outside would have a serious effect. Apart from this the chief objections to a tent are the way the moisture keeps it frozen and it would probably be destroyed in a short time by the frequent handling and by the restlessness of the horses.

A dog train is always a valuable auxiliary to have in camp in winter. As freight carriers, dogs are not efficient, but they have three valuable advantages in the comparative ease with which they can be fed, their speed and the small amount of work required to make a trail for them. They are not recommended for main transport in a thickly timbered country, but are valuable for auxiliary work such as supplying a shortage from a distant cache or trading post, getting and sending mail and for moving a flying camp. A dog must consume a large proportion of his own load. One hundred pounds per dog is a high average load, and of this he will eat four pounds a day of fish or meat. The use of dogs requires extra work in caching meat for them. Mr. R. W. Cautley reports that a dog's ration in the Yukon is 2 pounds of bacon and 1 pound of rice per day. Rolled oats and grease, according to Mr. J. N. Wallace, form another good ration. In the Yukon a dog team is composed of seven dogs, and a full load on a light sled, is 1,000 pounds. Big huskies are used.

Summer Transportation.—The method followed by Mr. Herriot in northern Manitoba, has been to have an equipment of about one small and five large canoes. The chief purpose of the small canoe was for exploratory work and for packing along the line in case any fair sized inland lakes are met, where walking around would mean lost time. The large canoes consisted of one 18-foot Peterboro, suitable for quick trips, which could be fairly easily portaged and yet was sufficiently large to carry about 1,000 pounds of freight; and four 19-foot Chestnut canoes. The latter are used entirely for freighting and moving camp. They are an excellent canoe standing rough usage in rapids, rough weather on the lakes, and hard handling on the portages. The one objection to their use by the surveyors is the heavy weight on the portages, and the difficulty of handling them in swift waters. A Chestnut canoe is a canvas-covered canoe. According to Mr. Herriot, a 40-inch beam best meets the requirements. With this number of canoes enough supplies for the surveying outfit to last three weeks can be carried from Norway House, for example, to the scene of work. In the surveying of railway lines in northern Ontario, canoes were used exclusively for summer transportation. We used no pack horses on account of the absence of roads and trails through the wilderness country.

In order to get the greatest benefit from the existing waterways it is advisable to have a thoroughly reliable guide who is familiar with the country and knows every possible creek and river that may be utilized for canoe transportation. For such a guide one must turn to the Indians of the country; but, as stated before, it is a difficult matter to secure the Indians. They have to be hired at least in pairs, as one Indian will not remain alone with a party. Neither do they care to stay longer than a few weeks at a time, unless they are given a chance to return to their homes at occasional intervals.

Winter Work.—In winter, where snow is very deep in northern Manitoba, horse transport is out of the question. Dogs, on the other hand, can be used in practically any depth of snow, since a couple of men may be sent ahead on snow shoes to open the trail, and after a day has elapsed their tracks will be sufficiently hard to carry dogs. In a comparatively open country the trail, crossing as it naturally will, different lakes and open swamps, will (in the case of dog transport) soon build up so as to produce an excellent one. If horses are used, the trail drifts full of snow each time, and has to be broken afresh at each trip. For these reasons dogs are to be preferred in open country where snow is deep, while horses will probably be found more satisfactory in bush country. If the country is very wet and much broken by muskegs and lakes, there is little doubt but that dogs should be used, since the swamps and muskegs and some of the rivers do not freeze hard enough to carry horses until about the first of December. On the other hand, dogs can be brought into the country in canoes and located at a convenient point, so as to be available as a means of transportation as soon as there is sufficient snow for toboggans. In the season of 1913-14, in northern Manitoba, owing to a heavy fall of snow which came about October 10th, and remained, the muskegs were prevented from freezing until about the end of November. The waterways began to close up as early as October 12th, and by October 20th many of the larger lakes were passable for dog trains. It is evident, therefore, that a surveyor using horses would have been compelled to either "man pack" throughout the last 15 days of October and practically all of November, or else "lay up" until such time as he could use his horses. With dogs, however, it was possible to go ahead with the survey. One trip across the swamps on snow shoes, to pack the snow and spoil it as a non-conductor of heat, followed by one or two cold nights, produced a trail that the dogs and toboggans could travel over in safety.

A second important factor in the choice of transport is the question of feed. In the northern country, where there are numerous lakes teeming with whitefish, tulebee, jackfish and suckers, the problem of dog feed is not difficult. Horse feed is difficult to obtain, since hay is found only in very widely separated spots in this northern area. This means that all the hay and oats for horse feed would have to be brought into the country, thus increasing the regular transport.

In regard to the efficiency of a good dog transport, Mr. Herriot, B.L.S., states a few facts relative to his work in 1913 and 1914. "From October 28th, to January 5th, sixty miles of line were surveyed. The transport consisted of 28 dogs, which were made up into five five-dog trains, and one three-dog train for the first six weeks. For the balance of the time just five trains were used. Supplies were drawn from a single cache located about seven miles from the commencement of the line and on Setting Lake, at a distance of about 12 miles from this point, was located a single fish cache from which the dog feed was hauled. Four dog drivers handled the transport, using the spare dogs in turn with the dogs of their regular teams, except on moving days when the explorer and the cookee drove the spare dogs as extra teams."

However, if the survey is organized in the early winter, horses might be found to be more economical and more satisfactory than dogs. Mr. E. W. Robinson, D.L.S., after using a combined transport of dogs and horses, during the winter of 1912 and 113, on the survey of the Second Meridian, favors horse transport. There is, however, a serious objection, which is that the scarcity of feed in the country makes it necessary for the horses to be sent out before the spring break-up. This arrangement leaves a very short season, or necessitates considerable man packing before canoes can be used as means of transport. Dogs on the other hand can be used much later in the spring, as there is no need to send them out until after the break-up.

Mail Service.—A matter as vexing to the surveyors as to the Department of the Interior, is the question of mail. The Indians who stay around the posts are, as a rule, lazy and unreliable and it is often impossible for the postmaster to get anyone to bring the mail to camp. The alternative is for the surveyor to go himself or to send some member of the party. Throughout most of the north the mail service is monthly. The only suggestion which can be made is to attach an additional man to the party in the capacity of assistant explorer, such a man would be useful in many other ways. In this connection it may be said that the efficiency of the whole party would be increased by the addition of two such men over the total of 21 now allowed.

Summer Versus Winter Work.—Much could be said on the subject of the relative advantages of summer and winter work. It is advisable not to draw too hasty conclusions. Arguments excellently supported by the experience of one winter, or one section of country, might not apply elsewhere. For a muskeg country in general the conditions in spring average the best, that is from about March 15th to June 15th. From June 15th to October 15th, the chief difficulties are making trails over muskegs, the flies, excessive rainfall and heat waves interfering with instrumental work. The advantages are long days, and good horse feed. In the period proceeding March 15th mounding is difficult, the snow retards progress to a certain extent and horse feed must be provided. On the other hand, during this time trail work is generally easy and the working conditions for the men are good. Probably the varying conditions can be used to best advantage by going out to the work in the late winter, after the worst of the cold weather is over, and the days have commenced to lengthen, but while the ice on the lakes and rivers is still good.

Moving Camp.—Mr. Hawkins, who is engaged in general survey work in the far north, favors moving every five or six days as a rule, and once the line is advanced as far as the camp, the explorer starts off to locate the next camping ground. With a good explorer and fair ground the trail can be located near the line so that the party may stop work on line an hour earlier and cut trail back to camp. If this procedure is followed for a couple of days it is not a difficult matter on moving day to complete the trail and still have a fair force on the line. This has been our own practice on topographical and preliminary railway surveying in the north.

The crossing of a stream or river is always a more or less serious problem for the pack train. It is recommended that all small streams be bridged if at all practicable, dry timber being used. After construction, notches should be cut in the logs and if any gravel is available, it should be thrown on the logs to prevent the shoeless horses from slipping. If there is no gravel a good coating of spruce limbs, held firmly down by logs placed along the ends of the brush, gives the horses good footing. A railing placed on both sides of the approaches and along both sides of the bridge, is very desirable.

When fixing a trail over soft ground spruce boughs or willows should be used but, if at all possible, the trail should go round all such obstructions. It is easier, both on horses and men. Mr. Hawkins does not favor the use of corduroy if it can be avoided. If it must be laid down, see that the logs are well notched and brushed, as it is most trying on horses to walk with unshod feet on the top of small round logs laid none too closely.

A fairly generous equipment should be carried for repairs to the outfit, and for the medical treatment of the horses. Mr. Hawkins recommends the following:—latigo leather for repairing or for making new cinches, thread and wax, copper rivets, leather, baling-wire, punch for buckle holes, leather needles, a palming needle and shield. These last are required to quickly repair a ripped bag, mantle or blanket and are extremely useful. The head packer should always have them at hand. Other articles required are a syringe, a horse float, a hoof knife, pinchers and a rasp to keep the horses' feet in good shape, bluestone, gall cure, sweet nitre, carbolic acid, aconite and about one and a half pounds of grease or oil per horse for fly protection.

The importance of the transport question cannot be too strongly urged on the minds of surveying parties, operating in our Canadian North. An efficient commissariat service is the *sine qua non* of successful work. The importance of this branch of the service was indelibly impressed upon the writer the first year he worked in the Canadian North country, as transitman on Railway exploration survey in 1904-5. We were eight days (about 200 miles) from the C.P.R. tracks, and from civilization, so that the matter of transportation of supplies was important as none were obtainable en route. But, by the foresight and efficiency of our chief engineer, in the matter of transportation and supplies, we were never, during the whole season's work, a single day deprived of any article of food on our "bill of fare," or of other needed supplies and equipment. This branch of the work took almost the whole time of the chief, as it should do working in such country, while the actual survey work was performed by the staff of assistants. In other camps not far away they—some of them—were continually running out of this and that necessity, while in some camps the men were stricken with disease from short rations and from being forced to eat innutritious food. As a result of this evidence of inefficiency of the chief surveyor of such party, with regard to his transport service, very little work was accomplished. The health of the party and individual efficiency depends to a very large extent on the ability of the chief surveyor to solve the transportation problem.

LEGAL CASE ARISING FROM ROGER'S PASS TUNNEL CONSTRUCTION.

An important civil case is being heard in the Vancouver courts, action having been brought against Messrs. Foley Bros., Welch and Stewart, railway contractors, now engaged in boring the 5-mile Roger's Pass tunnel for the Canadian Pacific Railway under Mount Macdonald in the Selkirk Mountains. The plaintiffs are Messrs. James McIlwee & Sons, sub-contractors. The latter state that they contracted to bore the 7 x 8 ft. pioneer tunnel, which is being constructed alongside the main tunnel to enable the work to be pushed ahead on the latter at various intervals made by cutting transverse tunnels to the main bore. They were not to bore the main tunnel, but only the main tunnel core 8 x 11 ft., which the defendants were to enlarge to the required size of the completed tunnel. Both the pioneer tunnel and the centre heading are in solid rock. For the former they were to receive $20 per ft., and for the centre heading bore, $22.50 per ft., with a bonus of $1,000 per ft. for every ft. bored over 900 ft. per month.

On September 24th, the contract was cancelled by the defendants. Prior to its cancellation the plaintiffs had earned, they allege $250,000 in bonuses, having in one month made a record of 1,115 ft. of boring.

The defendants claim that the cancellation of contract arose from the action of the defendants in depriving other contractors of their share of the supply of compressed air, by overusing the ventilating fans after each shooting.

The plaintiffs claim that there was no valid reason to cancel the contract. They claim that their profits were $30,000 per month apart from the bonus, and are suing for profits due under the contract and for the bonus. The defendants allege that the bonus cannot be claimed till the work is completed, and that the farther the bore is pushed into the mountain, the more difficult the work becomes, resulting in much slower progress.

Well known experts are in Vancouver to give evidence. Records and systems as made and applied in Alpine and other tunnel construction, are being submitted. The question of tunnel ventilation in use on such works, is being carefully investigated. In all, the case is a most interesting one, and should be closely followed by the tunnel engineer and contractor.

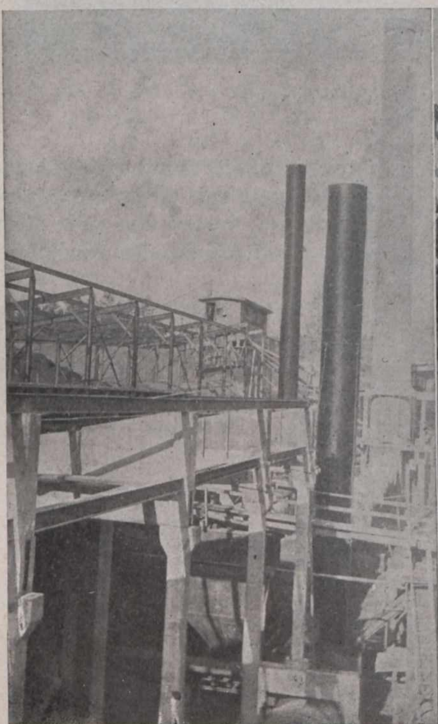
UNIT CONSTRUCTION IN CONCRETE MILL BUILDING.

THAT there are instances where the newly developed system of unit construction displays considerable superiority over the old method of formwork and casting in position, has been demonstrated on several notable pieces of construction during recent months. Mention is made elsewhere in this issue of the system adopted for the construction of the power and transformer buildings of the Cedars Rapids Manufacturing and Power Company in connection with their new 100,000-h.p. development. To this particular instance we devoted a little space in our issue of December 24th, 1914. The system of unit construction as applied there is the subject of a paper of some length, read before the Canadian Society of Civil Engineers on October 22nd, 1914, by Mr. John E. Conzelman, chief engineer of the Unit Construction Company of Montreal.

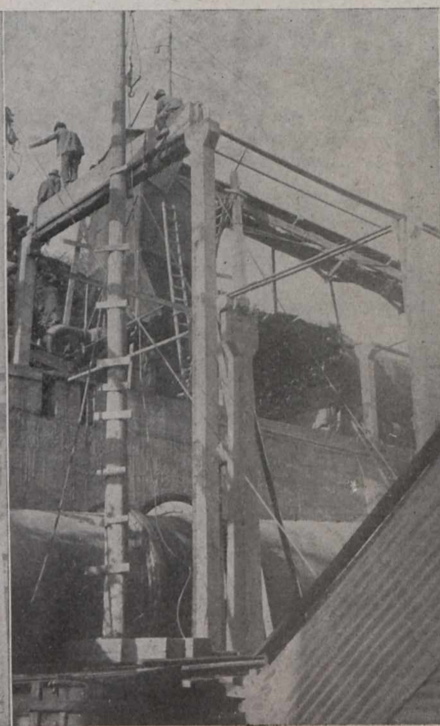
The following information relates to an application of the "unit cast" type of construction used on a mill building in the vicinity of Vancouver, B.C. It is a type designed to overcome several serious difficulties that stood in the way of using ordinary methods of concrete construction. The building, as built, is of the "saw-tooth" type.

Referring to the accompanying sectional elevation, it will be noted that the total height from floor to bottom of beam is 27 ft. 3 in., which height alone would require rigid posts to support the forms, providing the ordinary method had been adopted. An additional handicap to ordinary construction would have been that presented by a railway track in the space between two rotary coolers, shown in section. This track had to be kept clear at all times as it was in steady use. Perhaps the most pronounced factor peculiar to the structure is that it was absolutely necessary to keep these two rotary coolers in continuous operation. They handle clinkers from the rotary kilns at a temperature of about 1,500 degrees F. This great heat would have prevented the use of any timber forms close to the shell.

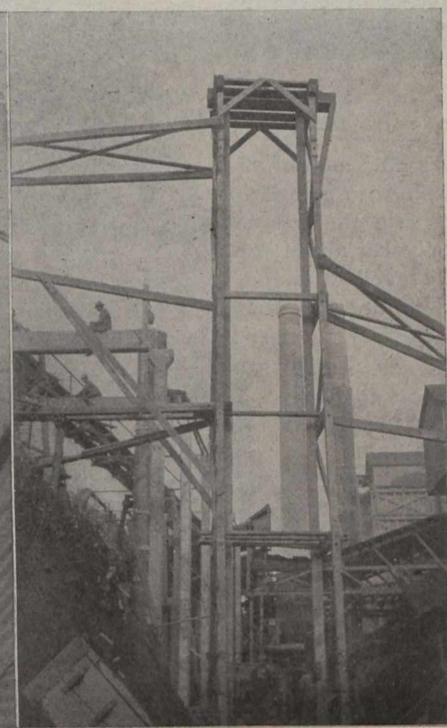
For these reasons it was decided to cast the various



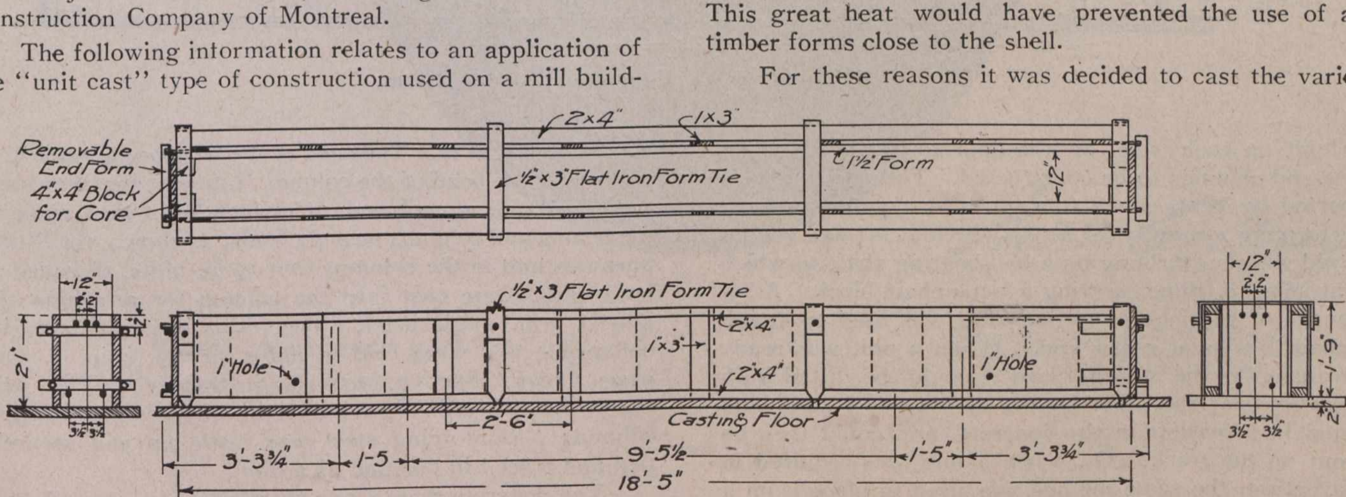
Roof Truss and Purlins.



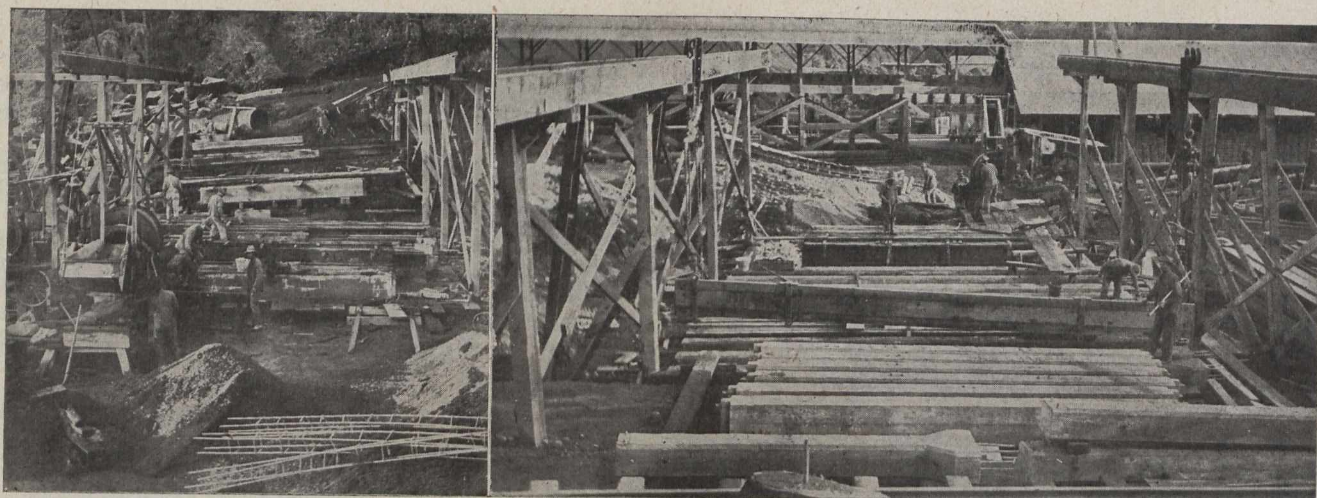
Erecting Unit Cast Beam with Gin Pole.



Hoist Tower, and "Units" Under Erection.

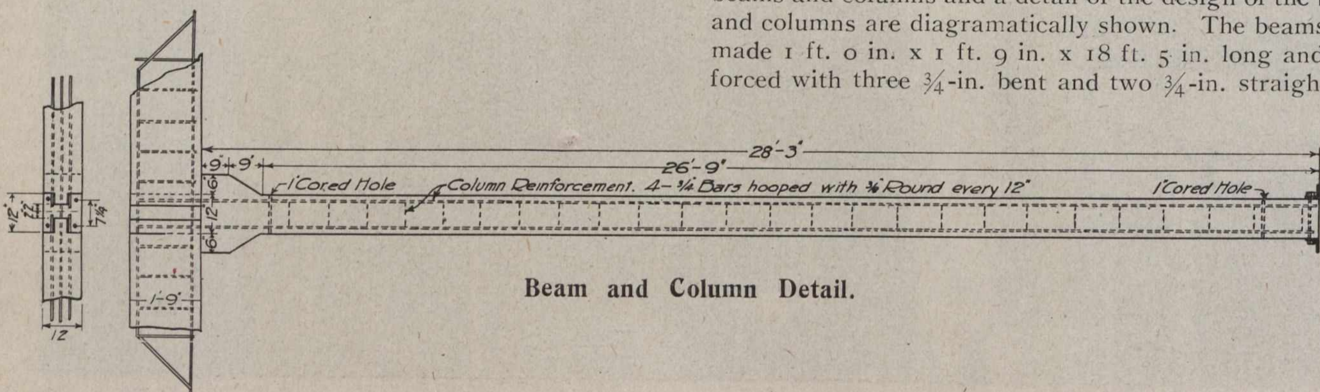


Plan, Elevations and Section of Concrete Girder Forms.

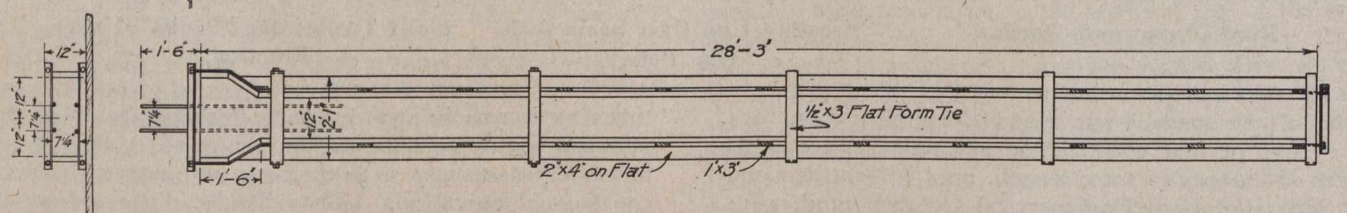


Views of Casting Floor Showing Concrete Mixer and Telpher Track.

members on a casting floor outside of the building, and to erect them into position in a manner somewhat similar to that used in the erection of square timber. A casting floor, or yard, about 100 ft. in length and 30 ft. wide was carefully levelled up and floored with tongued and grooved dressed lumber 2 in. thick. A special type of telpher track



Beam and Column Detail.

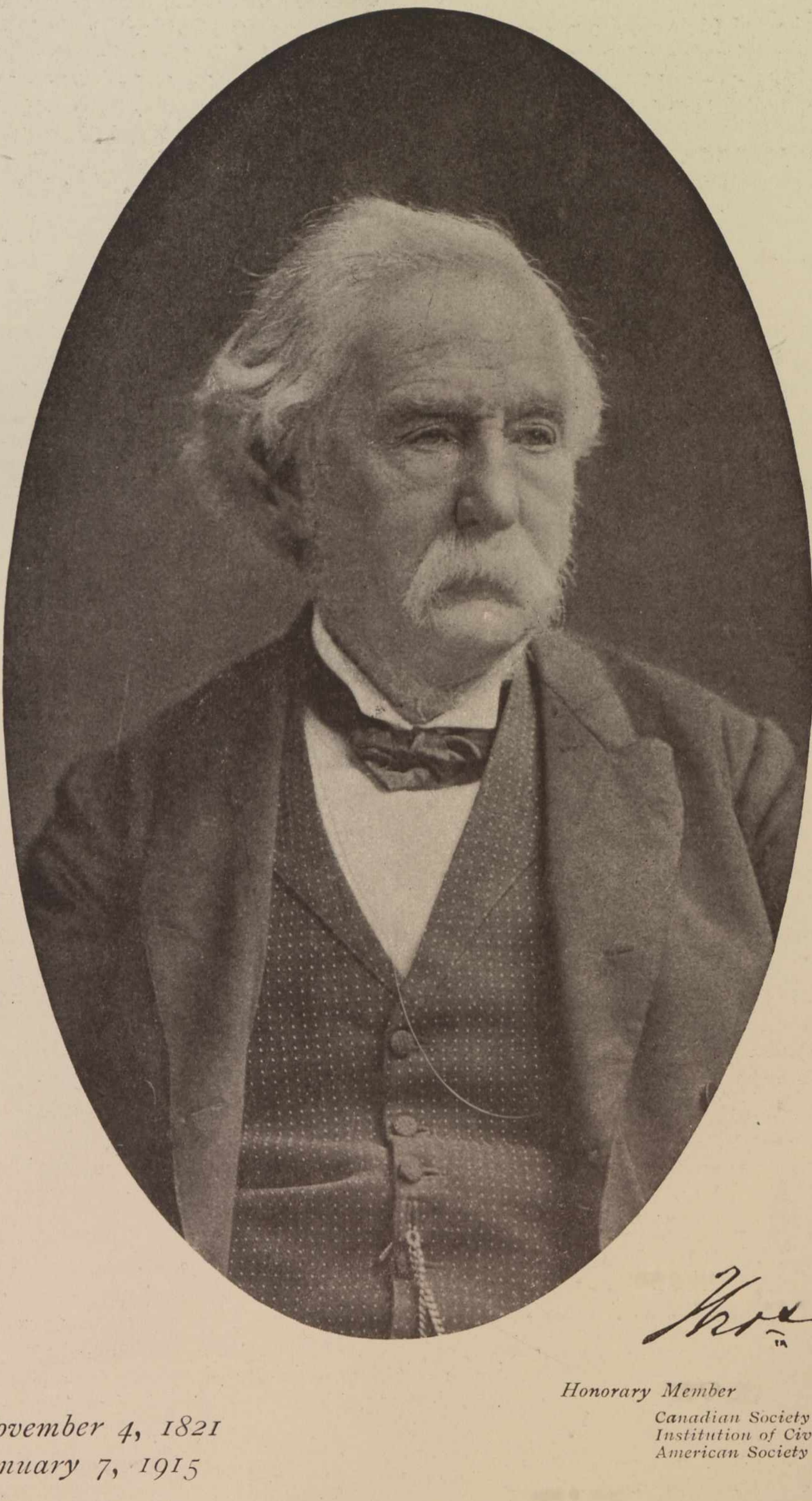


Plan and Elevation of Concrete Column Form.

was built on each side of the floor to handle the long beams and columns to be constructed. These tracks were supported by bents at 18 ft. centres, carrying 20-pound rails, forming a runway for a two-wheeled carriage having grooved wheels overhung on a ball-bearing shaft to which was attached a frame carrying a 5-ton chain block. A 29-ft. length of 7⅛-inch H-section steel was used to attach the chain blocks at either end. When a unit was ready for transfer to the storage yard it could be lifted high enough to clear the other forms, by means of steel bars inserted in holes left in the concrete, and could then be run out on the track. Or, when a unit was required in the structure, the same method was used to place it on a flat car on a track which crossed under the runway. A motor-driven ½-yard Ransome concrete mixer was located at one end of the floor high enough to allow the concrete "buggies" to run on plank on top of the unit forms. Sand and gravel was scraped off scows and deposited at the mixer.

The details of the removable forms for casting the beams and columns and a detail of the design of the beams and columns are diagramatically shown. The beams were made 1 ft. 0 in. x 1 ft. 9 in. x 18 ft. 5 in. long and reinforced with three ¾-in. bent and two ¾-in. straight bars hooped every 12 in. The ends of the bars projected 1 ft. 6 in. beyond the head of the column. Likewise the beam steel projected 2 in. at each end. One-inch holes were made in the beams and columns near the ends, as shown, for lifting purposes and in the columns two ¾-in. bolts, threaded at both ends, were cast into the column for attaching the 4-in. x 4-in. angle irons. The forms were made easily collapsible and were held in place by the ½-in. x 3-in. irons shown, slipping into holes in the floor. This held the forms always in rigid alignment and ensured straight columns. Reinforcing steel was made up and securely tied and placed in position as a unit.

The concrete was a 1:2:3 mixture for the columns and beams. By casting the units in a horizontal position



Thos. C. Keefer.

Honorary Member

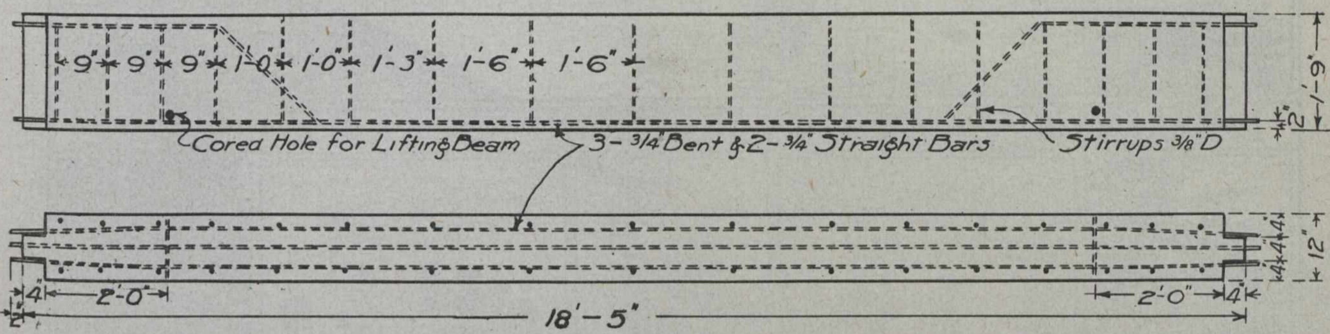
Canadian Society of Civil Engineers
Institution of Civil Engineers of Great Britain
American Society of Civil Engineers

Born, November 4, 1821
Died, January 7, 1915

careful tamping of the concrete was assured and the finished unit was very free from defects. The concrete was allowed to set 7 days on an average and then was moved into the storage pile where it remained till ready to be erected. The footings for the columns were excavated and concrete poured in place to 1 ft. below floor grade. Four ¾-in. bolts were set for attaching the 4 x 4-in. angle irons. The columns were erected by means of a gin pole and hand winch, as the site was too crowded to allow of using a derrick. Likewise the gin pole picked the beam up by the middle, and set it on the top of the columns. Before landing in position a thin layer of mortar was placed on the head of the column to form a uniform seat, and a form was placed around the joints. The projecting column and beam steel and the dovetailed ends of the beams were then grouted in with a wet 1 : 3 mixture.

After the beam was in place, a collapsible form was set up on top of the same and the roof truss was poured in place. Details of this are also shown. This consists of 3 buttresses 10 in. x 12 in. connected by a 3-in. reinforced wall. Anchor bolts are set for attaching the 8-in. I-beam purlins to carry the roof slab. These buttresses were bonded to the beam by ¾-in. dowels grouted into holes cored in the beam.

The forms for the roof slab were made in sections and were carried by the bottom flanges of the I-beams. By bevelling the ends, the web of the I-beam was encased, leaving only the bottom flange exposed. The concrete for the roof slab was mixed by the mixer at the casting floor and the 1-yd. Koppel side dump cars were hauled by an electric winch to a tower at the edge of the building. A second winch picked the car and a section of track up bodily and elevated it about 35 ft. to the level of a track on the roof where the concrete was dumped into a box and distributed by wheelbarrows. An illustration shows this tower and track. Another shows the method of erecting the unit cast beam with the gin pole, and another the hoist tower and units under construction.

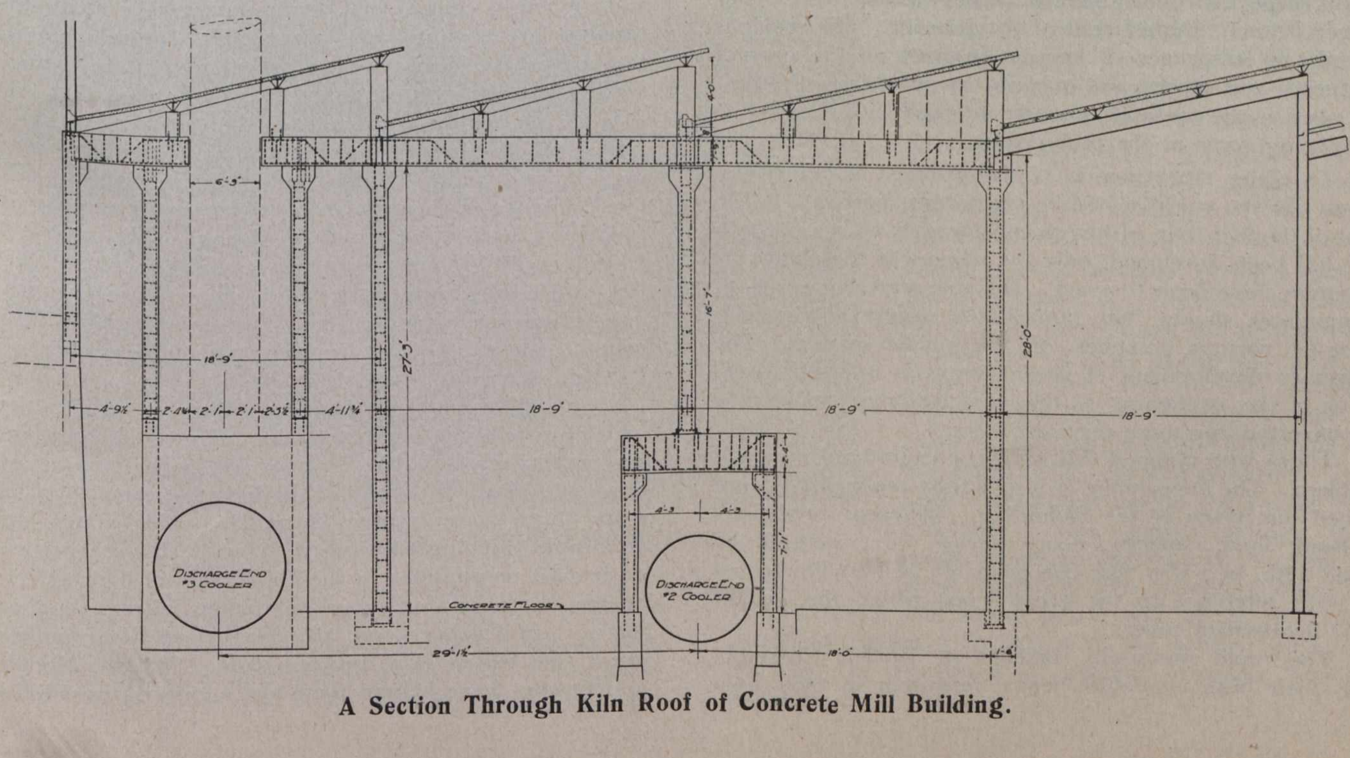


Plan and Elevation of Concrete Beam.

The roof slab was 3½ in. thick and was finished with ½ in. of 1 : 2 mixture and trowelled smooth. A concrete rain gutter was moulded in place, with a slope towards the edge of the building to run off the water.

This type of construction eliminates practically all the form work and waste of lumber, as the beam and column forms were used over repeatedly, as were the forms for the roof truss and the collapsible roof slab forms. Attention is called to the method of carrying the columns affected by the cooler. Excellent results were obtained at a cost of about 70 per cent. of the estimate of a similar job built in place.

The work was designed and erected under the direction of D. C. Findlay, C.E., for the Vancouver Portland Cement Company, Victoria, B.C.



A Section Through Kiln Roof of Concrete Mill Building.

Entrance to the Exhibit of the Water Power Branch, Department of the Interior, at the Panama-Pacific Exposition.

THE enormous water power possibilities of the Dominion of Canada will be depicted at the Panama-Pacific Exposition in a manner that cannot fail to attract the interest of engineers and manufacturers to the place she holds among the water power countries of the world. An exhibit has been prepared that, for originality and forcefulness of illustration, will undoubtedly do justice to its aims and to the possibilities it represents.

The task of presenting in the most practicable and in the nearest adequate way the resources of the country in this respect was delegated to the engineers of the Water Power Branch, Department of the Interior. The result is already an assurance of keenest interest on the part of engineers and others, not only in the power possibilities, but also in the methods already adopted or proposed in developing some of the power sites.

To claim that Canada is the greatest water power country in the world would be premature, perhaps, in the light of the fact that, although considerably over 1,000,000 h.p. has been developed, only the fringes of the country's resources have been touched. Reliable water power data accumulates slowly, but remarkable progress has been made by various branches of the public service. The enormous development of recent years is in itself a criterion of the awakening to this vast resource, waiting to be converted into more serviceable form.

Those who planned this exhibit encountered no small problem. The importance of it was fully realized. It concerned the whole of the Dominion. Different conditions of head, flow, capacity, cost, service, etc., were to be coped with, in a way that can probably be best illustrated by light reference to the great scope which the exhibit must necessarily cover.

The rapid mountain torrents of British Columbia with their high available heads represent in their own picturesque way, power possibilities as enormous as the larger and slower rivers of Central and Eastern Canada, with large volumes of water and comparatively low heads. The majority of the mountain streams, too, are capable of regulation so as to make use of all the water flowing in them. Such rivers as the Winnipeg and St. Lawrence are noteworthy for their extremely constant flow under natural conditions, coupled with the possibilities particularly in the case of the Winnipeg and the Ottawa of greatly improving this by artificial means.

It is especially fortunate that all the large commercial and industrial centres of Canada have power possibilities capable of meeting any conceivable future demands. Vancouver is already well supplied and future demands may be met by extensions in almost any direction. The Bow River not only caters to the aesthetic tastes of visitors to the famous mountain resorts traversed by it, but supplies energy for the whole Calgary district. With the Winnipeg River capable of supplying as much power as is perhaps feasible from the Canadian Niagara Falls, the City of Winnipeg is in an enviable position. The Hydro-Electric Commission of Ontario is performing a unique and invaluable service to the agricultural and commercial centres of that province, with Niagara Falls as its main source of energy.

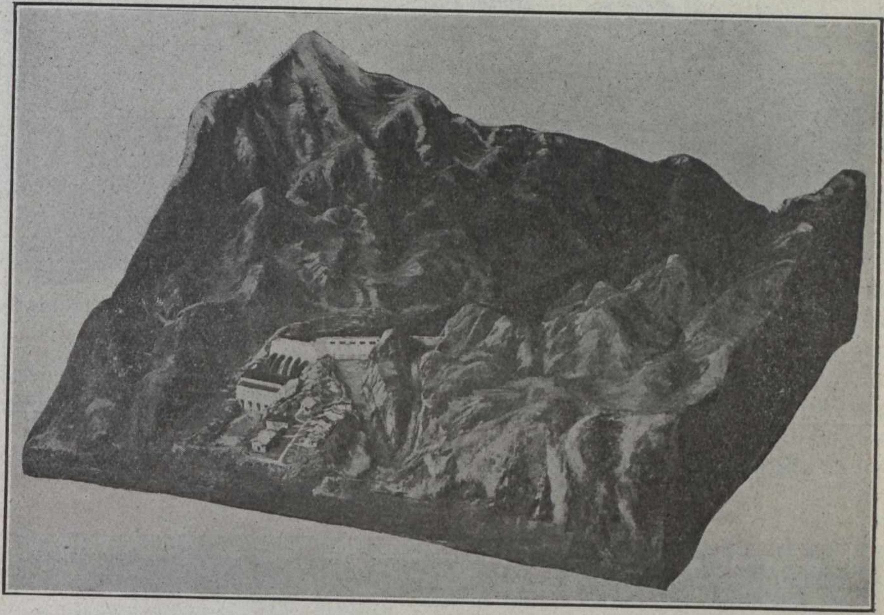
Canada is particularly rich in water power sites, which by their location in the midst of vast timbered areas are particularly suitable for pulp and paper making purposes. Along the coast of British Columbia, too, are many large water powers situated at tide water, with admirable shipping facilities at hand. This at once suggests vast possibilities in the application of hydro-electric energy to the manufacture of various nitrogenous products. In Quebec, too, the Saguenay River presents great possibilities of a similar nature. Ottawa, Montreal and Quebec have behind them the enormous possibilities of the Ottawa, the St. Lawrence and the St. Maurice, not to mention many smaller streams, in which the province of Quebec abounds.

The Maritime Provinces also have their supply of water power, Nova Scotia particularly having many small water powers, whose value is relatively as great to this district as larger powers are to sections of the country with greater demands. The rainfall is comparatively large and in many cases natural storage basins sufficient to enable complete regulation of the various streams are available at small cost.

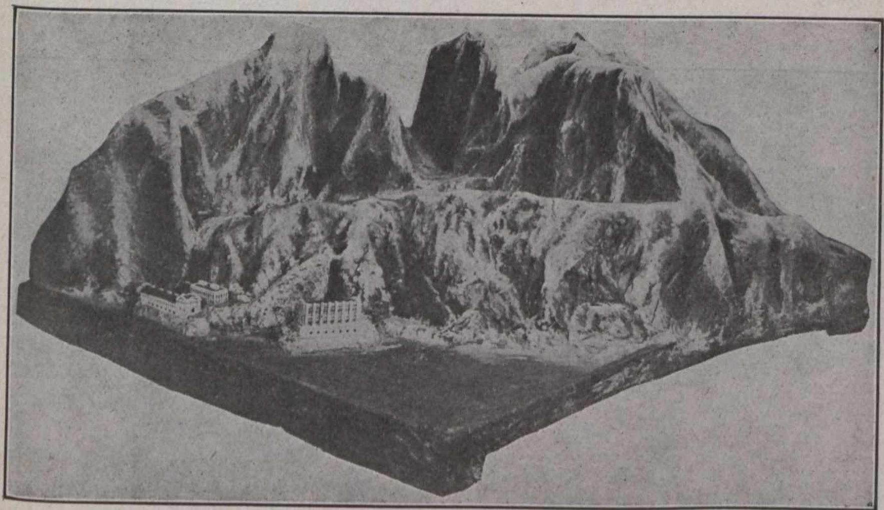
The exhibit consists essentially of a 70-foot painting of Canada and a number of models of power plants supplying the main commercial centres from coast to coast. These main centres are shown on the large map; red buttons indicate the locations of some of the larger developed water powers and green buttons are used to show some of the larger power sites as yet undeveloped.

A brief description with illustrations of each of the plants shown follows herewith:

Coquitlam-Buntzen Plant.—This plant of the British Columbia Electric Railway Company, of which Mr. G. R. G. Conway is chief engineer, is one of two main developments supplying Vancouver and the surrounding country. The first installation of 12,000 h.p. was put in operation December, 1904, and successive enlargements and expansions have been made until now there are two power houses with a total of 84,000 h.p. available. A large hydraulic-fill dam gives a storage in Coquitlam Lake of about 175,000 acre-feet, while a tunnel some 12,650 feet in length leads from this lake to Lake Buntzen, which acts as a local reservoir and regulating basin. From Lake Buntzen, steel pipe lines lead to the original power house, the second power house being supplied from the same source by a combination of rock tunnel and steel penstock. About 1,700 feet of tunnel leads to a reinforced concrete surge tank, from the base of which three steel penstocks lead directly to the power house. The mean head is 400 feet and power is transmitted to Vancouver, some 15 miles distant, at 60,000 volts. The hydraulic features of the developments are exceedingly interesting, particularly the long tunnel connecting Lake Coquitlam with Lake Buntzen. Great pains have been taken to make the new power house as well as all gate-houses and control structures, attractive from an architectural standpoint. It is also interesting to note that the power houses are situated on the north arm of Burrard Inlet, a tidal body of water affording direct water communication with Vancouver, from which they are some 15 miles distant.



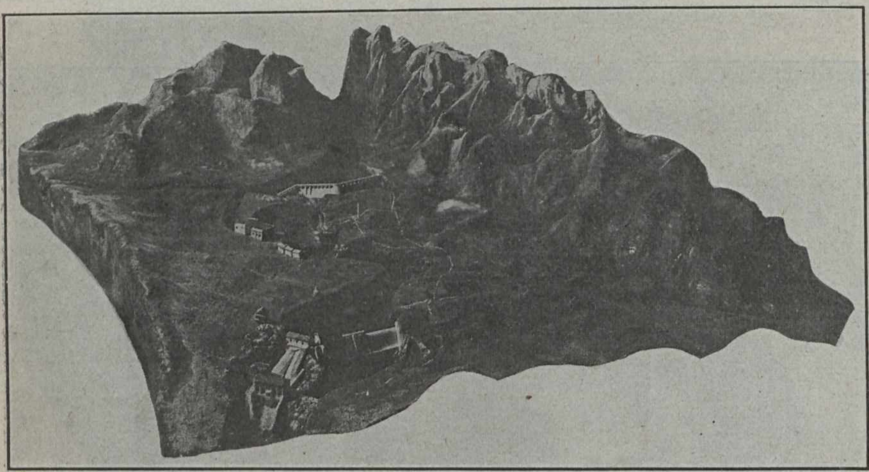
Stave Falls Development. Western Canada Power Company.



Coquitlam-Buntzen Development. Vancouver Power Company.

Stave Falls Development.—This plant, owned and operated by the Western Canada Power Co., and first operated early in 1912, is a remarkably efficient and compact development, with the power dam serving at the same time as a storage and regulation structure, giving when completed, ample storage to utilize the total run-off of the drainage basin. It is situated on the Stave River, about 6 miles from the main line of the C.P.R. at a point 36 miles from Vancouver. Connection is made with the C.P.R. by a standard gauge railway operated by the company. The present operating head is about 105 feet and there are three units installed, giving a total output of 40,500 h.p. Provision is made for an ultimate head of 115 feet with a total of 4 units, giving in all 54,000 h.p. The company has a fine steel tower, 60,000-volt transmission line to Vancouver, and sells power in bulk to the British Columbia Electric Railway Co., as well as locally. It also sells some power across the United States boundary. The interior fittings of the power house are particularly complete. The same company also controls other sites further down the river, which will admit of a future development equal in output to the present installation. Mr. R. F. Hayward is general manager and chief engineer.

Calgary Power Developments on the Bow River.—The Calgary Power Company has two power plants on the Bow River, about 50 miles from Calgary, and supplies energy in bulk to the City of Calgary and to the Canada Cement Company. These two plants are less than two miles apart and the headwater of the lower one is practically the tailwater of the upper. The combination of vertical setting with pressure tunnels and tail-race tunnels in rock is interesting. The lower plant or Horseshoe Falls development was first operated in the early part of 1911, while the Kananaskis plant was put into service in December, 1913. There is installed in the two power houses machinery with a total capacity of 31,000 h.p. Energy is transmitted to Calgary over two wooden pole transmission lines at 55,000 volts. The operating head is about 70 feet at each plant.

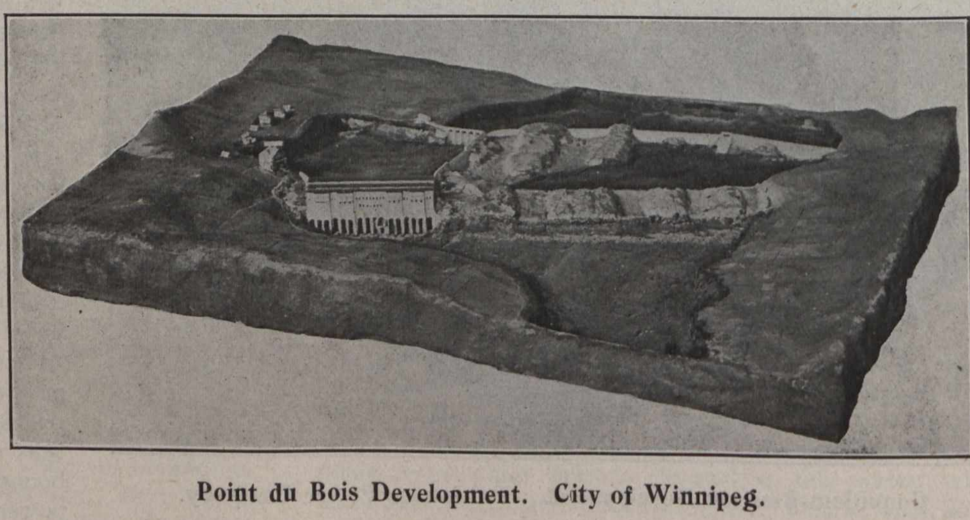


Bow River Developments—Kananaskis and Horseshoe Falls. Calgary Power Company.

The company already has 44,000 acre-feet storage on the upper waters of the river, while there is an excellent opportunity of providing 175,000 acre-feet further storage as well as large local regulation reservoir adjoining the headwater of the Kananaskis plant. There are besides, several other possible sites on this stretch of the Bow River, capable of economic development as occasion demands.

Messrs. Smith, Kerry and Chace were the engineers of the first development, while Mr. H. A. Moore was general manager and chief engineer of the Calgary Power Company, during the construction of the second plant.

Point du Bois, City of Winnipeg Plant.—This is a plant owned and operated by the City of Winnipeg and represents a fine type of hydraulic layout, from an operating standpoint. It has been in continuous operation since the latter part of 1911.



Point du Bois Development. City of Winnipeg.

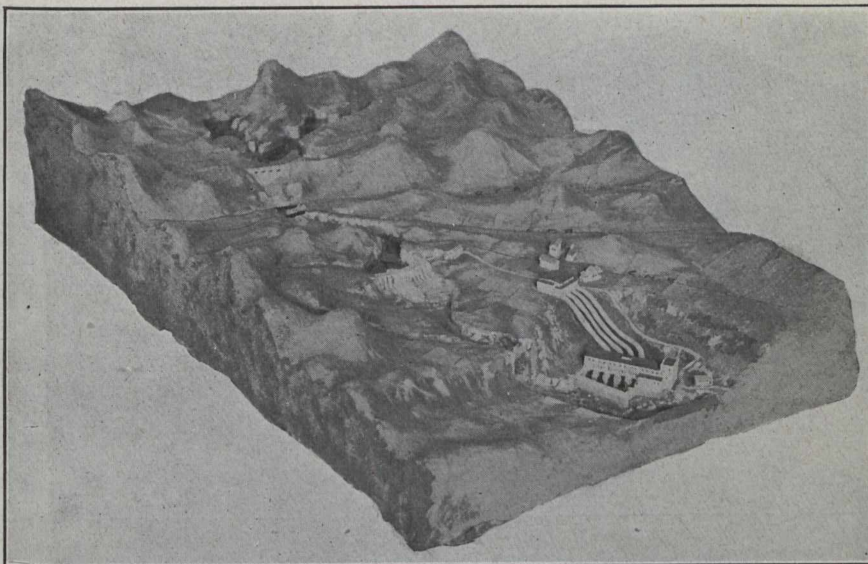
The location of the development is on the Winnipeg River about 75 miles from Winnipeg, and communication is by C.P.R. and a city tramway of about 20 miles. Energy is transmitted to Winnipeg at 60,000 volts over a substantial steel tower line 77 miles long and distributed there by the municipality in competition with a privately owned development also on the Winnipeg River.

The present installed capacity of the plant is 26,000 h.p. at 45 feet head with a contemplated enlargement to 88,000 h.p. The model shows the installation complete. Messrs. Smith, Kerry and Chace were the original engineers.

The Kaministiquia Power Development.—This plant is situated at Kakabeka Falls on the Kaministiquia River, about 20 miles from Fort William, and is reached by the main line of the Canadian Northern Railway. It has been in operation about seven years and its record of service for that period is an average yearly interruption from all causes, mostly transmission, of 20 minutes.

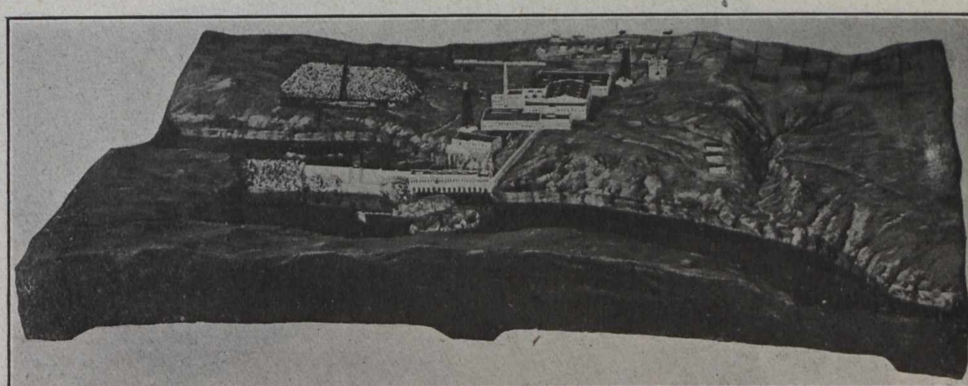
It has about 35,000 h.p. installed with a head of 180 feet, and sells energy in bulk to the municipal plant at Fort William and to the Port Arthur system of the Ontario Hydro-Electric Power Commission, as well as to the various grain elevators in Fort William. Partial regulation of the river is accomplished by storage on Dog Lake, some 18 miles from the plant. Mr. W. L. Bird is the general manager at Fort William and Mr. R. S. Kelsch, of Montreal, is consulting engineer.

Iroquois Falls Development.—All the plants so far mentioned have been hydro-electric developments proper with the usual market of lighting and small motors loads at some distance from the plant. The energy derived from the Iroquois Falls plant of the Abitibi Power and Paper Company, on the Abitibi River in Northern Ontario, some 450 miles from Toronto, is used entirely at the point of development for the manufacture of pulp and paper. It is a particularly complete and well arranged plant, representing the best present day practice in developments of this kind and has been shipping pulp since July, 1914. It is expected that the paper mill will be completed by May 1st, 1915, when the output of the entire plant will be 200 tons of mechanical pulp and 60 tons of sulphite pulp, giving an average of 225 tons of news print per day.



Kakabeka Falls Development. Kaministiquia Power Company.

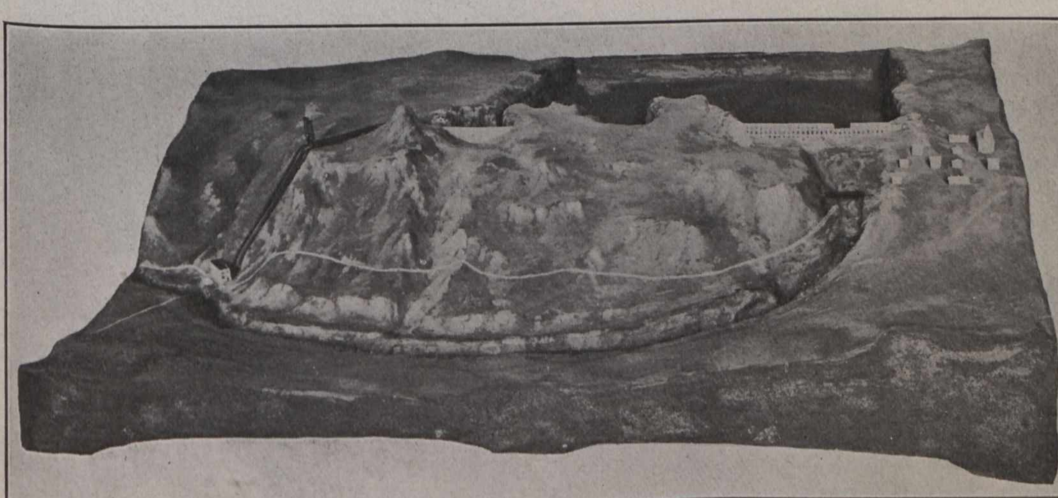
The total operating head is 44 feet. There are 10 turbines aggregating 17,000 h.p. direct connected to pulp grinders and four units aggregating 6,800 h.p. connected to electrical generators supplying power for driving machinery throughout the various parts of the plant. Storage is provided on Lake Abitibi some 35 miles above the development, which has an area of about 550 square miles. Another power site is also available between Iroquois Falls and Lake Abitibi. Mr. Geo. F. Hardy, architect and engineer, New York, is responsible for the design and construction of this plant.



Iroquois Falls Development. Abitibi Power and Paper Company.

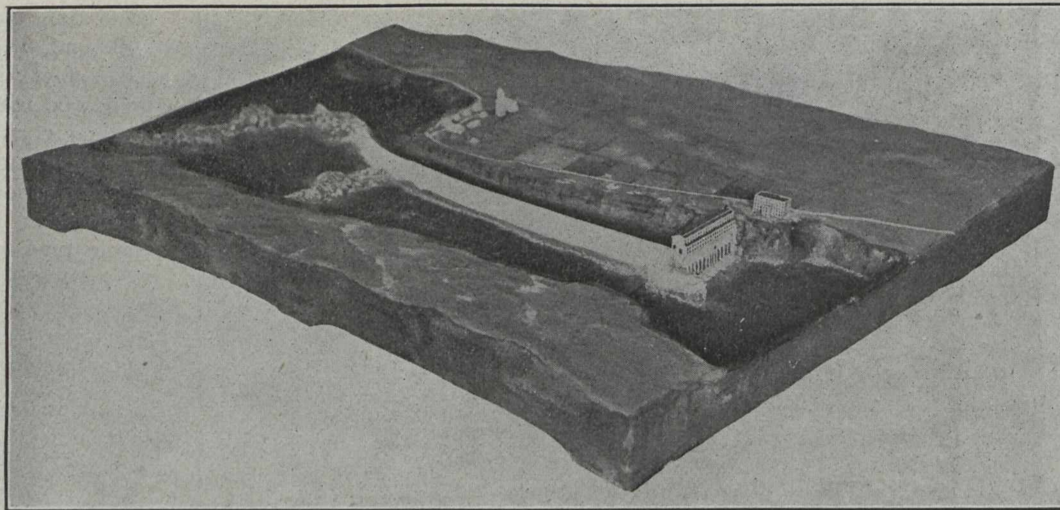
Eugenia Falls Development.—At Eugenia Falls, on the Beaver River, the Hydro-Electric Power Commission of Ontario has established a development to supply power and light to a number of municipalities in the district. The plant has a total head of 550 feet, the highest east of the Rockies. The storage basin comprises an area of 1,700 acres. The installation necessitated the construction of a large concrete dam 45 feet high with a 1,260-foot bulkhead, 105-foot spillway and measuring 1,820 feet, including end fills. Another dam, 960 feet long and 30 feet high, is of earthen construction. A 5,000-foot canal leads to the gate-house, and two 3,350-foot 46-inch wood stave pipes will lead to a surge tank 100 feet high, also of wood stave pipe. A 1,550-foot 52-inch riveted steel penstock leads to the power house. At present the generating installation consists of two 2,250-h.p. Francis reaction water turbines running at 900 r.p.m.

Cedars Rapids Power Plant.—This plant, so far as the first installation goes, was completed at the close of 1914. It is being built by the Cedars Rapids Manufacturing and Power Company at a site on the St. Lawrence River about 30 miles above Montreal. Its principal market is Montreal and Messina, N.Y. Its chief interest lies in its huge proportions, the large 10,800-h.p. turbines being the largest in the world from the point of physical magnitude. They operate under an average head of 31 feet and are of the now well-recognized single-runner, vertical section type with Kingsbury bearings supported above the generator. The first installation consists of 10 units, aggregating 108,000 h.p., with provision for a further extension to a total of 194,000 h.p. Mr. Julien C. Smith is hydraulic engineer of the Cedars Rapids Manufacturing and Power Company, with whom is associated Mr. R. M. Wilson, as electrical engineer.



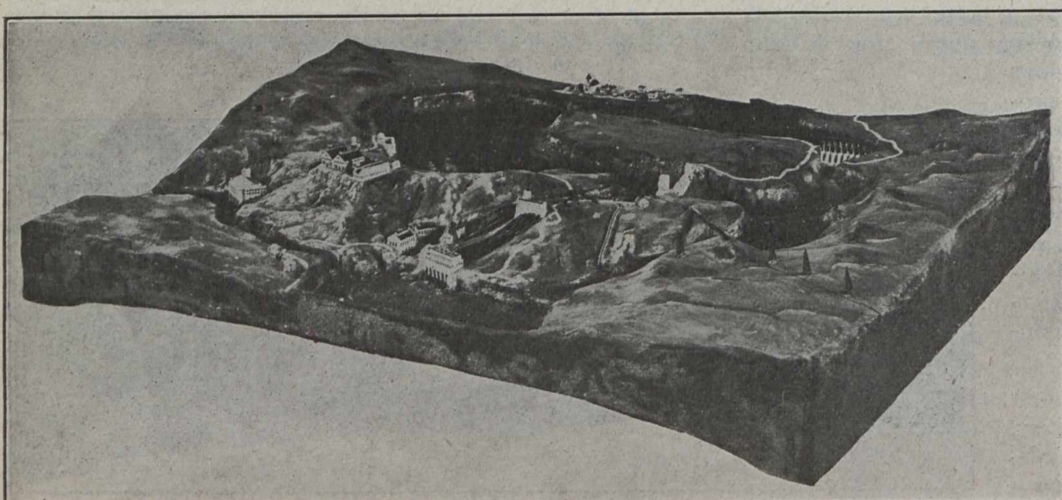
Eugenia Falls Development. Hydro-Electric Power Commission of Ontario.

Shawinigan Water and Power Company.—This development is the largest and most important supplying the western part of the Province of Quebec. It is situated on the St. Maurice River at the town of Shawinigan, about 100 miles east of Montreal. The Shawinigan Water and Power Company not only owns and operates two power houses, but also supplies water to two power houses of the Aluminum Company and one power house of the Belgo-Canadian Pulp Company. They have given particular attention to ice prevention, long distance transmission and general arrangement of plant to secure continuity of operation. Apart from local use, as indicated above, the company sells power to the Montreal Light, Heat and Power Company, for distribution in Montreal. The history of the various enlargements in connection with this entire development now aggregating some 180,000 h.p. with a head of 140 feet is the history of hydro-electric progress during the last decade or more, and practically all phases of this progress are represented in the various parts of the plant as it stands to-day. The application of hydro-electric energy to large industrial projects such as the manufacture of aluminum, as well as to lighting and small motor loads, is also illustrated by a study of this development in its entirety. In short, perhaps no other large scheme in Canada is more worthy of careful study than this one with its various allied ramifications. Mr. Julien C. Smith is chief engineer with Mr. F. T. Kaelin as assistant engineer.



Cedars Rapids Development. Cedars Rapids Manufacturing and Power Company.

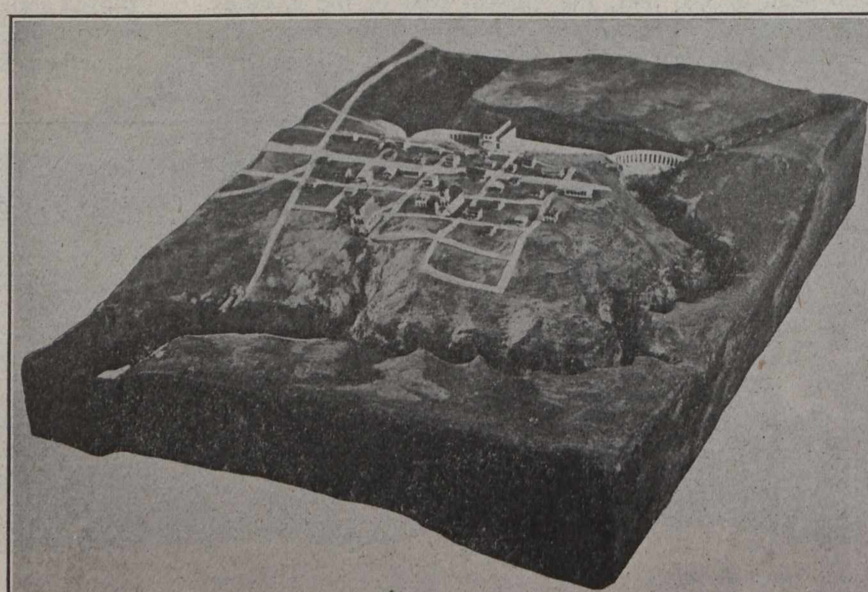
An extremely unique feature in connection with it is the design of the tail-race and log chute. Both are to be of tunnel construction. The illustration shows clearly the location of each.



Shawinigan Falls Development. Shawinigan Water and Power Company.

St. Margaret's Bay Development.—This is a proposed scheme to supply electrical energy to the City of Halifax and the site is situated on the south shore of Nova Scotia, about 20 miles from Halifax. It is not a large scheme, but offers the advantage of complete storage and regulation in a number of lakes throughout the drainage basin on which it depends. It is estimated that 2,160 continuous h.p., with 3,210 h.p. 12 hours daily, might be obtained.

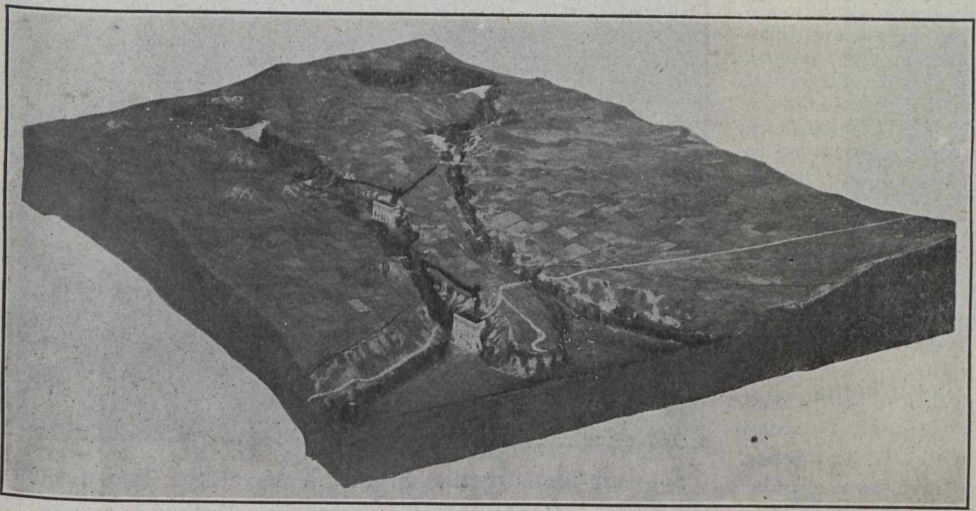
Grand Falls Development (Proposed).—The development has been under consideration since 1909. It is to be situated at Grand Falls, on the St. John River, about 200 miles above St. John. A 140-foot head is here available, and the design provides for a capacity of 80,000 h.p. This energy will be consigned to various uses, both municipal and industrial. Mr. John B. McRae, Ottawa, originated the design.



Grand Falls Development (proposed). St. John River.

The scheme, for which Messrs C. H. and P. H. Mitchell, consulting engineers to the Water Power Branch, Department of the Interior, Canada, are responsible, is particularly ingenious and interesting. It involves the diverting of one river to a site on another where the two are combined at different heads, 150 feet and 88 feet respectively, in a single power house. A second power house is situated at tidewater, utilizing the combined flow of the two rivers under a head of 92 feet.

The Halifax Power Company has this development in hand and has already broken some ground.



St. Margaret's Bay Development (proposed). Halifax Power Company.

The extensive exhibit which this article is an endeavor to describe has been, as stated, worked out by the engineers of the Water Power Branch, Department of the Interior, under the supervision of J. B. Challies, M. Can. Soc. C.E., Superintendent of Water Powers. K. H. Smith, B.A., A.M.Can.Soc.C.E., has been engineer in charge of the collection of data, the construction of models, and the general working out of the scheme.

[NOTE—For more complete descriptions of the engineering features of the plants herein described as being completed and in operation, the reader is referred to previous issues of *The Canadian Engineer* as follows: Coquitlam-Buntzen development of the British Columbia Electric Railway Co., January 12, 1914; Stave Falls plant of the Western Canada Power Co., March 20, 1913; Bow River developments of the Calgary Power Co., August 6, 1914; Point du Bois plant for the City of Winnipeg, January 19, 1911; Kaministiquia plant of the Kaministiquia Power Co., July 31, 1913; Cedars Rapids plant of the Cedars Rapids Manufacturing and Power Co., January 1, 1914; Eugenia Falls plant of the Hydro-Electric Power Commission of Ontario (preliminary), April 16, 1914; and others.—EDITOR.]

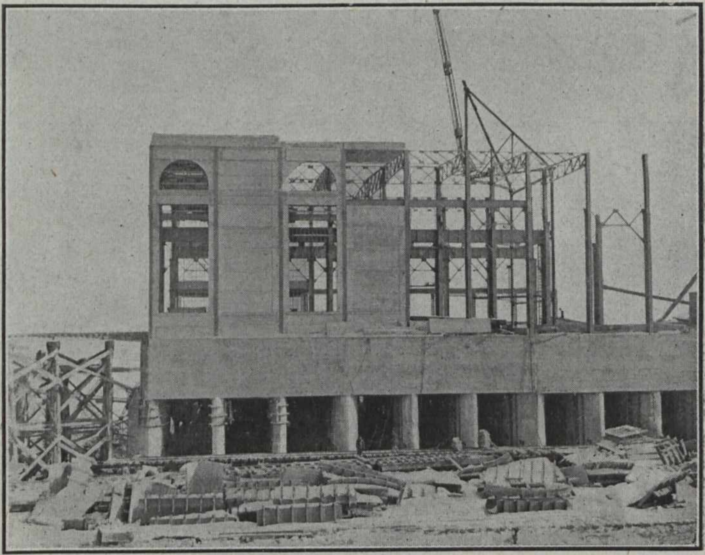
Sketch of Large Painting and of Models of Power Plants as They Will Appear.

HYDRO-ELECTRIC POWER DEVELOPMENT AT CEDARS RAPIDS, QUE.

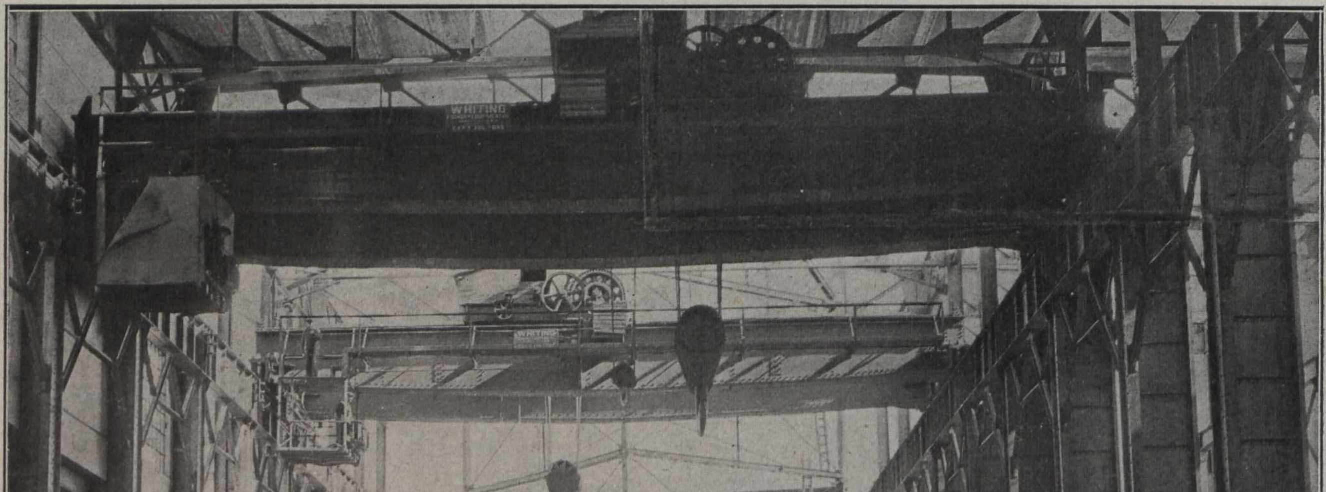
[NOTE:—The coming convention of the Canadian Society of Civil Engineers will afford the members an opportunity of visiting the recently constructed plant of the Cedars Rapids Manufacturing and Power Company. The development is one of the largest in the Dominion, and is in many respects one of the most interesting, both from hydraulic and electrical points of view. While several articles descriptive of the design and construction of this development have already appeared in *The Canadian Engineer*, we feel that the appropriateness at this time of concisely outlining the general features of the scheme will more than offset the danger of any repetition of information that has already appeared in these columns. For fuller descriptions of the development, both as to design and construction, the reader is referred to our issues of January 1st, 1914; July 9th, 1914, and December 24th, 1914.—EDITOR].

THE Cedars Rapids Manufacturing and Power Co. have under construction a power station that, for the present, will produce 100,000 h.p., but, when fully constructed, will develop 160,000 h.p. This gigantic installation, which developed its first power about a month ago and which is now in operation to the full extent of its present requirements, is situated between Lake St. Louis and Lake St. Francis on the St. Lawrence River. Between these two lakes there are three rapids, *viz.*, the Coteau, the Cedars and the Cascade. Together they aggregate a fall of 80 ft. The Cedars themselves have a fall of 32 ft., and are situated about 30 miles distant from the city of Montreal. The company has the permission of the International Waterways Commission to develop 160,000 electrical h.p., requiring about 56,000 ft. per second of the river flow.

In order to concentrate the total fall of Cedars Rapids, which is distributed over a length of about 2 miles, a canal is being constructed along the north bank of the river. This canal is about 12,000 ft. in length and approximately 1,000 ft. in width. It is formed by the construction of a water-tight wall of rock and earth embankment, built up from material excavated from the canal section itself. During its construction water was excluded by an earth bank serving as a cofferdam at its head.



Showing Construction of the Walls of the Transformer House. (Unit Construction Method.)

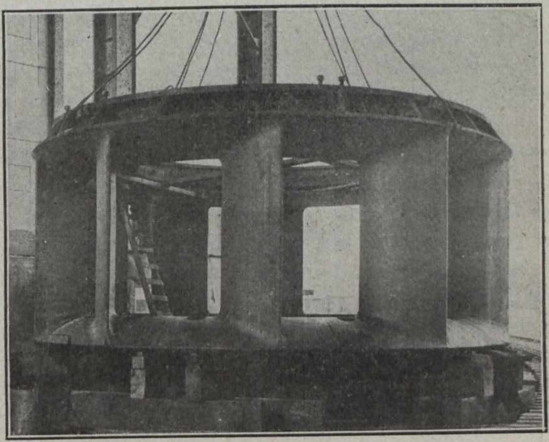


Interior View of Power House During its Construction, Showing Crane Service for the Installation of Machinery.

This latter embankment has since been removed, the canal water entering the canal between the Isle-aux-Baches and the main land. From this island to the power house the canal wall is practically a straight line, while the shore wall consists of a similar bank located on the natural flow of the river.

To divert floating ice from Lake St. Francis, an ice fender, equipped with a number of submerged openings five or six ft. below the surface, has been constructed at the upper end of the canal. The fender is given the same general direction as the main current of the river, produced by a curve farther up. The design is such that ice will be carried along by the current without interrupting the flow of water into the canal or causing heavy impact upon the fender. The momentum of the ice blocks will at best produce but a glancing blow.

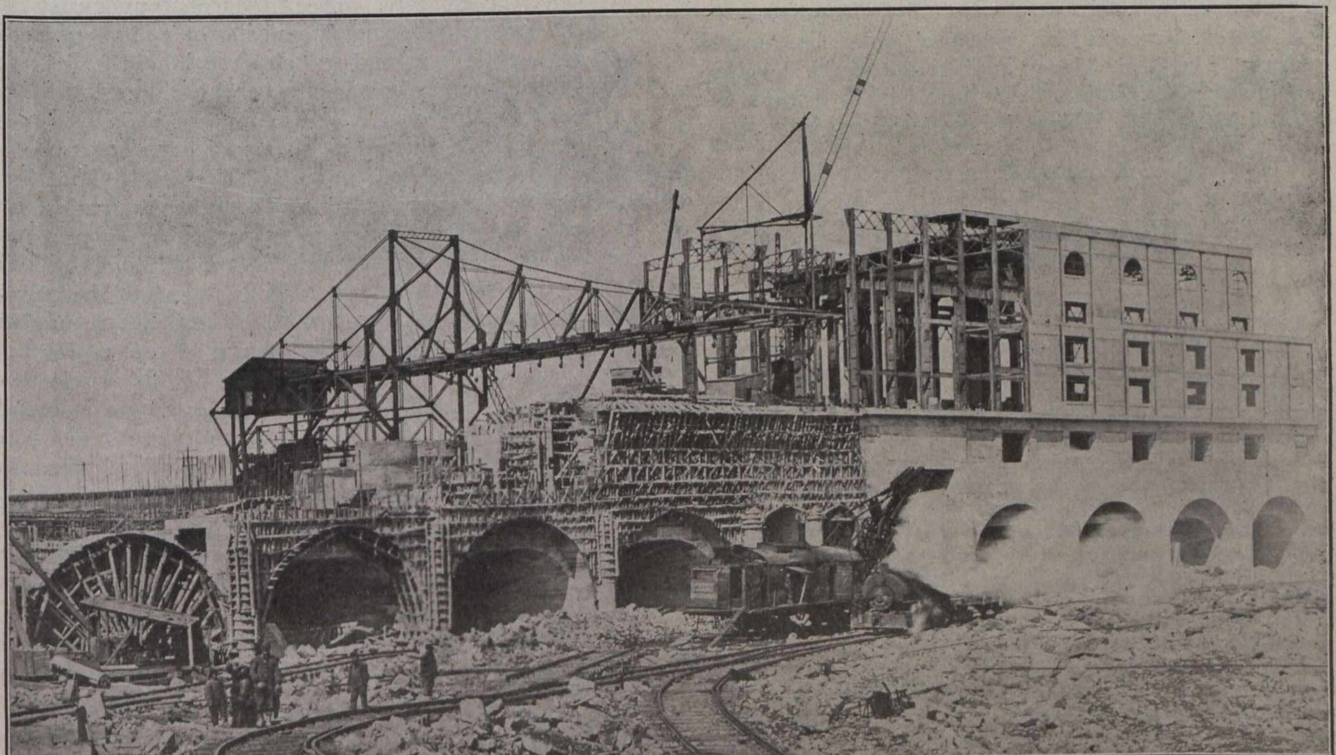
The lower end of the canal is formed by the power house itself, connecting the south and north banks, with its foundation work forming the dam giving the desired fall of 32 ft. The structure is 663 ft. in length and 140 ft. wide. The foundations extend to rock and are about 50 ft. in depth. Both the foundation and superstructure of the power house are built of reinforced concrete. The design and method of construction has created much interest, a system of unit concrete construction having been employed. The building, above the foundations, is of essentially structural steel frame construction, while the floors, walls and roof are all of reinforced concrete. The steel work was erected by the Phœnix Bridge and Iron Works Company, Montreal, and the concrete work by the Unit Construction Company, Montreal. This form of construction, by unit method, was specially adapted to the structure under consideration. The concrete units were constructed in a casting yard close by and brought to the site on flat cars. The advantages of this system are claimed to lie in the fact that the units are made under "factory" conditions, providing for easy inspection and test, assuring proper placing of reinforcing, and accurate and uniform adjustment of concrete forms. The walls of the building include some 35 bays, 16 ft. 8 ins. long with 3 special bays, 18 ft. 4 ins. long. The exterior walls consist of two independent concrete slabs 4 ins.



Speed Ring of One of the Twelve 10,800-h.p. Water Wheels Now in Operation.

thick, with a 4-inch air space between. The steel columns are provided with slots to receive the slabs, which are lowered down from the top of the columns, which are afterwards grouted in place. The roof construction consists of similar units 3 ins. thick, and cast integral with the beam. These units are 3 ft. 6½ ins. long and are so dimensioned that a 1½-inch space is left for grouting.

The transformer house is also of reinforced concrete, and is a 4-story building with basement. It is 228 ft. long and 88 ft. wide. The floor calls for specially heavy construction to support the transformer, and the handling equipment necessary for their installation. The upper



Down-stream Face of Cedars Rapids Power House, Showing Method of Construction, and the 84-foot Boom.

floors are designed to carry a live load of 250 pounds per square foot, and the roof is designed for a load of 100 pounds per square foot. The exterior walls of the transformer house are of concrete slabs 10 ins. thick, having a 2-inch air space between. The basement walls are of reinforced concrete 12 ins. thick.

The generating equipment of the present installation consists of twelve 10,000 h.p. water wheels of the single-runner vertical-shaft type, the plan for the final development calling for 18 of these. They operate under a head of 30 ft. at a speed of 56 r.p.m. There are three 1,500 h.p. exciter units operating under the same head at 150 r.p.m. Water enters by the racks through the up-stream face of the power house into intakes of the scroll or involute type, constructed of reinforced concrete. The wheel chambers, formed in the concrete foundation of the building, are spiral in shape. After discharging through the wheel the water leaves by a centre draft-tube into the tailrace.

The design possesses a distinguishing feature in that practically all the equipment is on the main floor and not, as in the commoner types of vertical water-wheel installation, where the governor and thrust-bearing pumps, etc., are located below the generator floor where they are liable to be inaccessible for close supervision and repair.

The generators are situated immediately below the turbine and mounted on a shaft 20 ins. in diameter, supported by a thrust bearing.

The development was practically completed in December, and power is now being delivered under two contracts, one with the Aluminum Co., amounting to 60,000 h.p. for use at Messina Falls, N.Y., and the other with the Montreal Light, Heat and Power Co., amounting to 20,000 h.p.

The Cedars Rapids Manufacturing and Power Co. awarded the contracts for the water wheels to the I. P. Morris Co., Philadelphia, and Wellman-Seaver-Morgan Co., Cleveland. The electrical equipment was supplied by the Canadian General Electric Co., Schenectady, N.Y. Messrs. Fraser, Brace & Co., Montreal, were the general contractors. Mr. J. E. Aldred is president of the development company; Mr. Julien C. Smith is its hydraulic engineer, and Mr. R. M. Wilson its electrical engineer.

PLASTIC DEFORMATION OF STEEL BY OVERSTRAIN.

In a recent issue of the Bulletin of the American Institute of Mining Engineers, Messrs. H. M. Rowe and A. G. Levy describe a microscopic study they have made of the deformation of 0.2, 0.4, 0.75, and 1.45 per cent. carbon steels during the processes of cylindrical and conical punching, tensile testing, and wire-drawing. There are four aspects of flow in the plastic deformation of steel by overstrain: (1) The relative movements of the grains as a whole; (2) the relative movements of the cementite and pearlite within the grains; (3) the relative movements of the ferrite and cementite in the pearlite; and (4) the crystal unit slipping giving rise to the slip-bands of Ewing and Rosenhain. Intergranular movements are best shown by the uplifting of the grains on the upper surface of the plate polished previous to punching. The displacements are greater in cylindrical than in conical punching, but are confined to a narrower ring in the former case. Study of intrapearlitic deformation shows that elongation or compression parallel to the stratification results in drawing out the cementite lines into squads and rearranging them *en echelon.* Sometimes the cementite lamellæ curve greatly, but cementite islands resulting from divorce annealing are shattered.

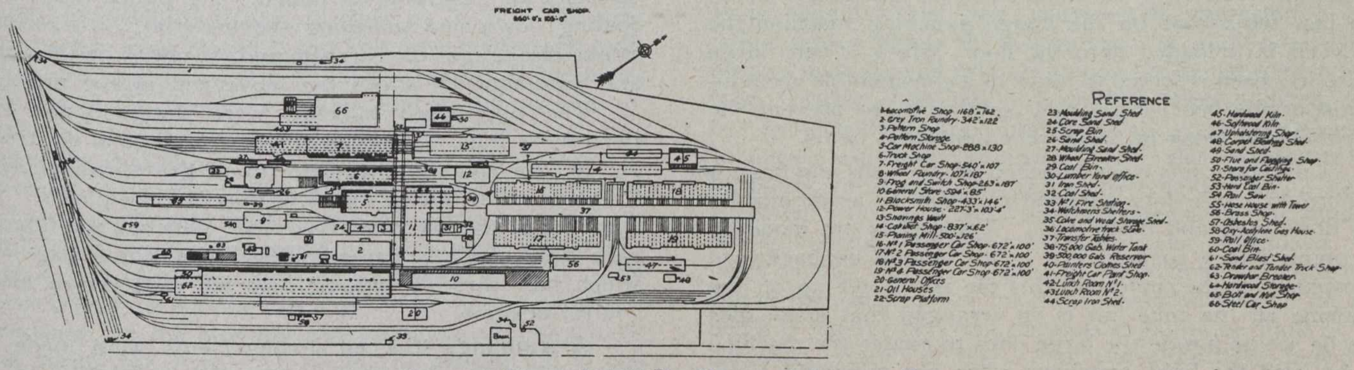
THE ANGUS SHOPS OF THE CANADIAN PACIFIC RAILWAY, MONTREAL.

[The members attending the annual meeting of the Canadian Society of Civil Engineers will be given an opportunity of spending a few hours at the Angus shops of the C.P.R. This is one of the most interesting visits that could have been arranged, as the shops present a number of features that will attract the attention, in one way or another, of men following many varied branches of engineering. In view of the wide range of methods and plant arrangement to be inspected there, some of the more notable are enumerated in the following paragraphs—not with the idea of presenting, in a few pages, a detailed description, adequate for a satisfying conception of the magnitude and management of the shops, but rather a brief summary that will assist in a better understanding of the works, on the part of those who avail themselves of the opportunity to visit them, and create a desire for a more intimate knowledge on the part of those who may not be in attendance.—EDITOR.]

On a plateau about 175 feet above the St. Lawrence River, and just east of Montreal, the Angus shops of the Canadian Pacific Railway cover an area of about 200 acres. The location is an admirable one and the plant arrangement is deserving of careful study and admiration. Particularly interesting at this time are the new car shops, for the construction of steel passenger and freight cars. These shops have been in operation but a comparatively short time. The older part of the plant was devoted to the manufacture, maintenance and repair of rolling stock, and its various parts are, in themselves, well worthy of the comment and descriptions that are to be found in the engineering and technical press. The locomotive, boiler, machine, and erecting shops are in a building 1,335 ft. long by 163 ft. wide, and divided into three bays. The forging and smiths' shops are in a building 435 ft. long by 300 ft. wide with added wings 230 ft. wide and 146 ft. wide, respectively. The grey iron foundry is 342 ft. long by 122 ft. wide with a capacity of 35 tons of castings per day. The frog and switch shop is 265 ft. by 120 ft. The wheel foundry occupies several buildings, the largest being 140 ft. by 110 ft. The pattern shop is a 2-story building 232 ft. by 50 ft. The old car department machine shop is 288 ft. by 130 ft. The truck shop, for the building of both passenger and freight car trucks, is 434 ft. by 82 ft. The old freight car erecting shop is 107 ft. by 640 ft. The planing mill is 500 ft. long by 126 ft. wide. The passenger car erecting shop (not the new steel car shop) is 672 ft. by 100 ft. There are a number of other buildings, such as the general offices, power house, store house, etc. It is the purpose of this article to deal with the recent additions, and the foregoing is merely a summary of the older established and already well-known portions. The equipment of each and all of these buildings, and the shop methods, even including the fire and police protection, the courses of instruction to apprentices, the dining hall, library and recreation facilities are all matters that have been worked out to a scientific and sound business basis.

The New Steel Car Shops.—The new shops were designed to turn out 10 passenger cars per month and 8 freight cars per day. Since then it has been found that this output may be readily increased, especially in the passenger shop. Owing to the similarity that exists in both shops in the matter of handling material, arrangement of machines, and features of assembling and erection, the layout of the freight car shop only will be described.

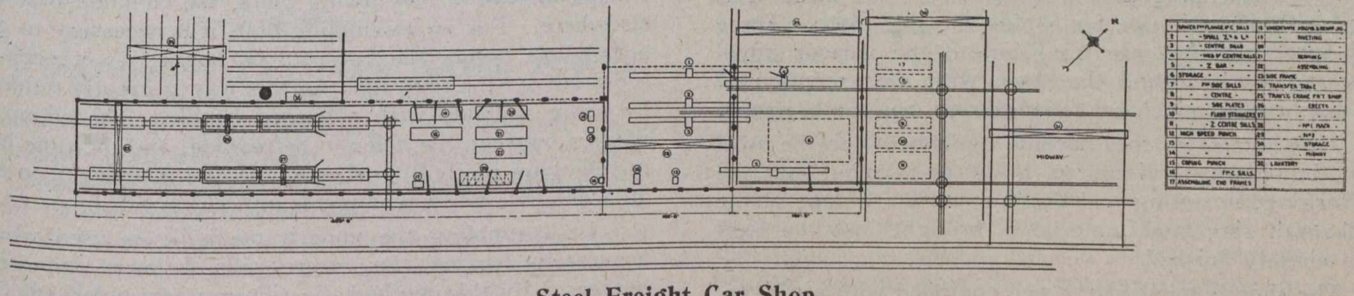
The floor area for this shop is 41,785 sq. ft., the area of the machine shop being 22,069 sq. ft. less 7,265 sq. ft. which was set apart for machining and assembling steel centre sills for repair work, giving a total area of 14,795 sq. ft. available for machines. The area of the assembling portion of the freight shop was 9,170 sq. ft., while the erecting area was 17,820 sq. ft. The building is steel with brick walls, steel sash being used, and care has been taken to provide a large amount of light, the area of light to the total wall space being approximately thirty per cent.



General Plan of C.P.R. Shops at Angus, Que.

The steel shop proper consists of two 100-ft. bays running parallel with the front of the shop, and at right angles to this one 72-ft. bay 405 ft. long. The passenger shop erecting section is composed of four 27½-ft. bays 202½ ft. long, running at right angles to the 100-ft. bays and parallel to the freight section.

The crane service comprises a 10-ton travelling crane 96 ft. 3 in. span on a runway 309 ft. long in front of the shop covering the material section and parallel to the cranes in the shop and of the same height and span. Inside the shop there is a 10-ton crane 96 ft 3 in. in each of the 100-ft. bays. These cranes all have a head room of 27 ft.



Steel Freight Car Shop.

In the erecting section on the freight side there is a crane of 10-ton capacity, 67 ft. 7 in. span with a head room of 35 ft. 6 in. In the passenger shop 4 travelling cranes 24 ft. 10 in. span of 2-ton capacity with 20 ft. headroom are used. They are for the handling of material for the passenger car work and are operated from the ground.

The floor in the shop is mastic throughout and is an asphalt composition in two ⅝-in. coats, the top being a wearing and the bottom a cushion coat on a concrete base 4 in. thick.

In the front portion of the steel shop are two long bays 100 ft. wide. The first bay is 209 ft. 6 in. and the second 182 ft. in length, one bay being longer than the other in order to allow for unloading directly into the shop any material which it was necessary to keep under cover. The arrangement of the two bays with travelling cranes running crosswise to the tracks in the shop was particularly suited to the spacing tables and types of machines installed. The crane in the front section was used to supply the material to the machines through which it was carried automatically into the next bay, where the second crane distributed it from the machines to the various points in the shop requiring it.

An effort was made in the layout of the shop to use machines with a relatively small capacity, but sufficient in number to prevent the expense and delay of changing dies and setting up, and the big accumulation of material necessary to feed the shop without delay, when one large machine is used for several purposes.

In the freight shop four spacing punches are used. One of these is fitted specially for punching 6-in. Z bars for steel centre sills for repairs on the line, and is not concerned in any way with the steel car work. This machine is fed by an independent lorry track. The Z bars require to be punched twice, once for the flanges and once for the webs. Specially arranged air jacks are used for lifting the Z bars to place on the rollers which feed the machine and also for unloading the punched Z bars from the machine. One spacing table is used for punching the webs of channels (centre sills 15 in. and side sills 8 in.) while another machine punches the flanges of these same channels. An additional punch for the flanges has been installed and the foundations for the spacing table laid out so that without disarranging the handling of the material, by adding a spacing table to the existing punch, it will be possible to double the output of these machines, the spare punch being used for hand work at the present time.

In the event of a break-down of any of the punches employed on this spacing table work, serious delay to the output could not possibly be avoided. As additional heavy punches for coping, slotting, etc., were necessary, it was arranged to purchase machines which are duplicates of those used on the spacing tables. On all the machines used in the shops the interchange of punches, gags and other jigs have been closely considered to prevent delay, or the necessity of large stocks being carried.

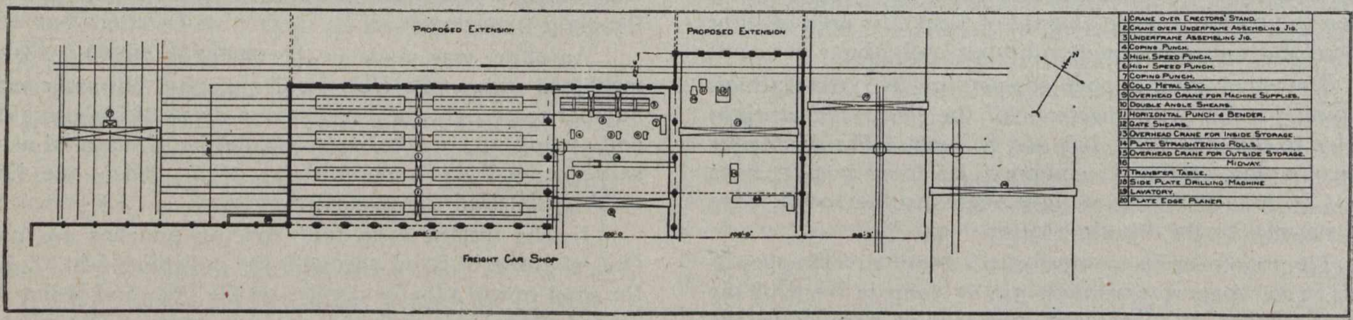
The design of the spacing tables is particularly convenient as each of the templates has two lines of gauge points and, therefore, the punching of both pairs of flanges is done on a sill from the same template. From the last movement on the flange punching machine the material is unloaded onto the floor, where a very large space has been reserved to allow of a considerable accumulation of finished centre and side sills, to prevent the possibility of delay on these very important items.

The centre sills when punched on the webs and flanges require to have slots punched in them to accommodate the draft gear and brake pipe. These slots are made on a coping punch so arranged as to require no backward movement of the material; this die is left set up on the machine all the time but is so arranged that small dies can be set up beside the large ones to enable the machine to be used for light punching when not punching slots. One other coping punch is fitted up with dies for making

The Thomas spacing tables are of the semi-automatic type. The movement of the carriage is controlled automatically, while that of the gags for bringing one or more punches into play at each stroke is controlled by hand. The tables are electrically operated, their movement being controlled by two templates ⅞ in. by 3 in. having a double row of steel pins. They are so arranged that when the trip on the moving portion of the table engages the pin it automatically stops and locks the material to be punched and at the same time, by means of an electric magnet, operates the clutch on the punch. The punch head, after coming down and punching the material, on its return stroke disengages the carriage and the clutch on the punch and automatically starts the movement of the material.

The high-speed punches were designed by John Bertram & Sons. They run at the high speed of 60 strokes per minute and are entirely without gears, being belted from the motor direct to the flywheel of the punch. The clutch is of the six-point type; two punches are fitted in each head, both being controlled by a single gag lever which has three positions, one for each punch and a neutral position.

Assembling.—Special arrangements were made for the storing and handling of material in relation to the assembling to reduce the labor to a minimum. With un-



Steel Passenger Car Shop.

the various mitered cuts and coping the side posts and braces. The coping punch beside the Z bar machine is fitted with a special die for coping the side plate. Three high-speed punches are used for all the various small punching work around the shop, with the exception of the diaphragms which are punched on a horizontal punch.

This completes the machine equipment for the steel shop, but it must, of course, be borne in mind that the hot forging, upsetting and bending work are done in the blacksmith shop and material is brought into the steel shop already finished.

The shop is particularly well equipped with air jacks, skids, overhead fixed hoists, travelling hoists on runways and swinging jib cranes. To reduce the labor and the cost of handling and of repairing, ball bearings and roller bearings are used throughout on jibs, hoists, hand travelling cranes and material rollers. Special care has been taken to have definite room allowed for the piling of material outside the shop, for the storage of material around the various machines and the storage and accommodation of the finished material. Specially constructed racks are used throughout the shop. To maintain the orderly handling of the material, painted lines are used to define the boundaries of these piles and mark the passageways, which are always kept clean of material. These boundary lines are repainted at the end of every week, at which time an absolute clean-up is made of any material which would otherwise tend to occumulate.

derframes an important gain was made by the use of clamps instead of assembling bolts, the common practice elsewhere. For an assembling bolt, it is necessary to get a full hole before the bolt can be applied; a wrench is required and the time spent in this way is greatly reduced by using a clamp with a hinged handle. The clamp is applied between the holes to be reamed, and the time lost in removing the bolt from one hole and applying it in the adjacent hole when reaming is entirely avoided.

In assembling the underframe a jig is used which accurately locates the centre sills, bolsters and cross bearers. By this method the sills are assembled square, reamed in the same position and then transferred to the underframe riveting jig. This jig consists of a number of cast columns supported on I-beams bolted on a concrete foundation and securely holds the underframe in position while being riveted, so that the underframe is constructed accurately and square in every way. A great deal of time is thus saved in the assembling and the line of the car when finished is very greatly improved. To rivet the underframe on the jig by compression riveters without turning it over, it was necessary to have a special type of riveter designed with a thin nose to permit the top row of rivets to be driven and to allow sufficient clearance for the bottom row, particularly on the bolsters, to be driven without moving the underframe.

The movement of the steel sills from the point of as-

(Continued on page 179.)

Editorial

ANNUAL MEETING OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The twenty-ninth annual meeting of the Canadian Society of Civil Engineers is close at hand. The programme has been received and has presented every indication of a most successful meeting. Indeed, if the usual progress of the Society is maintained it will necessarily be one of the best that the Society has ever held, for, despite the disturbing influences of the war, the Society has made very active and substantial progress. A review of the 1914 activities shows not only a large increase in membership, but an admirable list of papers, full of important data of keenest interest to members. It is to be expected that the coming meeting will exhibit an increased attendance, as the monthly and sectional meetings have done during the year. No doubt the present lull in engineering work will be instrumental in permitting the attendance of many engineers whose lot it has been to be too closely tied to professional duties to have been able to be present at recent annual meetings.

The programme gives promise of an annual dinner that will play a very important part in the proceedings of the meeting. Five Dominion cabinet ministers have signified their intention of being present. These are Hon. Sir George E. Foster, Minister of Trade and Commerce; Hon. Robt. Rogers, Minister of Public Works; Hon. John D. Hazen, Minister of Marine and Fisheries, and also Minister of the Naval Service; Hon. T. Chase Casgrain, Postmaster-General, and Hon. Chas. J. Doherty, Minister of Justice. In consideration of such a notable representation of the Government, in the list of speakers, a great deal of good will undoubtedly ensue for the followers of the engineering profession.

UTILIZATION OF CANADIAN WATER POWER.

Considerable space is devoted in this issue to a description of an exhibit which is to appear in the interests of Canada at the Panama-Pacific Exposition and to the great natural resource which this exhibit is made to represent. There has been a long period of uninterrupted prosperity in water power development, and the present lull affords an opportunity of looking forward.

As Arthur Surveyer, M.Can.Soc.C.E., brought out in his paper read some time ago before a meeting of the Canadian Society of Civil Engineers, by far the greater part of the developed water power in Canada is used for motive power, traction and lighting. A very small percentage of it is consumed in electro-chemistry, electro-metallurgy, and electro-siderurgy. But a small percentage is thus consumed, nevertheless, and, considering the condition of affairs in a young country like this, the most urgent power requirements are those that naturally have first to be met. In this respect Canada has made a name for herself, and no people in the world has realized greater benefit from the advantages of hydro-electric power for domestic, municipal and manufacturing purposes than have the people of the province of Ontario.

Considering the question of future development from the viewpoint of utility, it is hardly possible to logically conceive of any other manner of growth than that which actually obtains with respect to the requirements of these two classes of consumers, motive power, traction and lighting versus electro-chemistry and electro-metallurgy. It is obvious that any considerable extension of existing power plants or development of additional water powers must depend primarily upon the demand for power from traction, lighting, and motive power sources, and but secondarily on the possible use of power for electro-chemical, electro-metallurgical, and electro-siderurgical purposes, the use of power for pulp-making being alone excepted. For any considerable increase in our present power demand, with the exception just mentioned, we must depend largely on proving the commercial possibilities of the use of power for these newer purposes. To this end it is vitally important that investigation be made of the successful results of the use of power for these purposes in foreign countries. This involves exhaustive, expensive research, but with the assistance of electro-chemical research departments of our universities, the co-operation of power producing companies, and the active financial backing of the Canadian Government, permanent and substantial results of far-reaching importance should be early realized. The responsibility of initiating such co-operation between the universities, the interested power companies, and the industries dependent upon chemical science looking to the adaptation in Canada of the successful results realized in foreign countries in the use of power for industrial purposes, rests with the Dominion Government, because the movement must be national in scope and will necessarily require government backing and independent, resourceful leadership.

Consider alone the question of electrical fixation of nitrogen, the carrying out of which in Canada will some day be a commercial success, and offer tremendous advantages of almost incalculable value. Military requirements alone indicate the necessity for having at some convenient location well within our borders, a satisfactory source of nitrate manufacture. The day will ultimately come when the western farmer will no longer scorn the use of fertilizer, and once this time arrives, there will be an enormous demand for nitrate of lime. The necessity of these two contrarient purposes, the sinews of war and the support of agriculture, so different and yet so dependent, require that the Canadian Government should seriously consider the advisability of encouraging the possible use of some of our great sources of hydro-electric energy for this and other allied purposes. Some form of Governmental assistance may even be found to be necessary before the use of our power under present economic conditions for these purposes can be realized.

CAN EXECUTIVE ABILITY BE TRAINED?

The power to accomplish is, after all is said and done, the most essential qualification of the successful engineer. It even surpasses in importance the requisite training in principles and methods which underlies the solution of the problems he encounters. The value of fundamental principles has long been recognized by our schools and colleges. The result is a direct training, more accurate, and of broader scope, than few during past generations ever aspired to. But, the results do not stand out as prominently as the development of the institutions warrant. The reason probably lies in the fact that there is not provided in the curriculum, a corresponding training of executive ability and power to accomplish.

There are two ways in which people are disposed to size up executive ability. One is an assumption that it is a characteristic of all men, and that any one, properly trained in the principles underlying the accomplishment of an undertaking, has as good a chance as anyone else of bringing it to a successful completion. The other is that it is a rare gift from nature, and that the proud possessor succeeds, of necessity, in a position of responsibility.

In a sense, both are right, and both wrong. Executive potentiality is a gift from nature, but it is also possessed by every man. It requires, however, a training to bring it to a proper stage of usefulness, the same as does an aptitude for mathematics, drawing or music.

One curious feature about methods in our training schools is that there is no direct attempt to exercise and develop this executive talent, as has been, for ages, the custom in early education, when there is recognition of a natural gift for such attainments. Because of this, the young college graduate knows very little of business ability, what it is, or in what measure, small or large, he possesses it. In the case of the engineer, especially, he is not prepared for the work expected of him.

In an article entitled "Training for Action," published in a recent issue of *Popular Science Monthly*, Mr. H. W. Farwell, of Columbia University, refers to the claim of many schools and colleges that ample opportunity is given the student for the development of executive ability, both in the curriculum and in outside activities, and that there is every chance in college for a training in the management of affairs and in the handling of men, as required in later life. The writer points out that the real situation is different, and emphasizes the need for a revision of the courses to the end that the students may, before they graduate, ascertain some knowledge of their own potentialities as executives.

Referring, by way of illustration, to a young civil engineer of his acquaintance, he writes: "He could make long computations of stresses in girders for steel work, he could lay out beautiful curves for a railway line; but all his years of college had not trained him in the very practical problem of keeping busy and happy a party of sixty additions to the melting pot, knights of the pick and shovel. Where do the textbooks state that a young engineer should never allow such an occasion to arise that one of his dusky foremen calls him by a short and ugly name, or that, the occasion having arisen, he should promptly apply a sedative by means of a convenient pickaxe handle if he wishes to maintain his self-respect and his job?"

A FAVOR TO THE NEW MAYOR—"BOUNCE" THE ENGINEER."

The scene is laid in the municipal council chamber at Brockville, Ontario. The inaugural meeting of the new council is being staged. Enter his worship, the Mayor! His trusties follow. "Gentlemen, be seated." The daily press has it about as concisely as it can be put:—

Brockville, Jan. 11.—The new municipal council at its inaugural meeting to-night discharged the city engineer, G. H. Bryson, on the casting vote of Mayor Donaldson. The latter, during his term last year, found considerable fault with the work of the official, and the new council, still two members short on account of the disqualification of the south ward representatives elected by acclamation, gave him the desired support, upon which he acted to bounce Mr. Bryson.

Question: Why bother with a vote in the case of such trivial matters?

PEAT BY-PRODUCT INDUSTRIES SUITABLE TO CANADA.

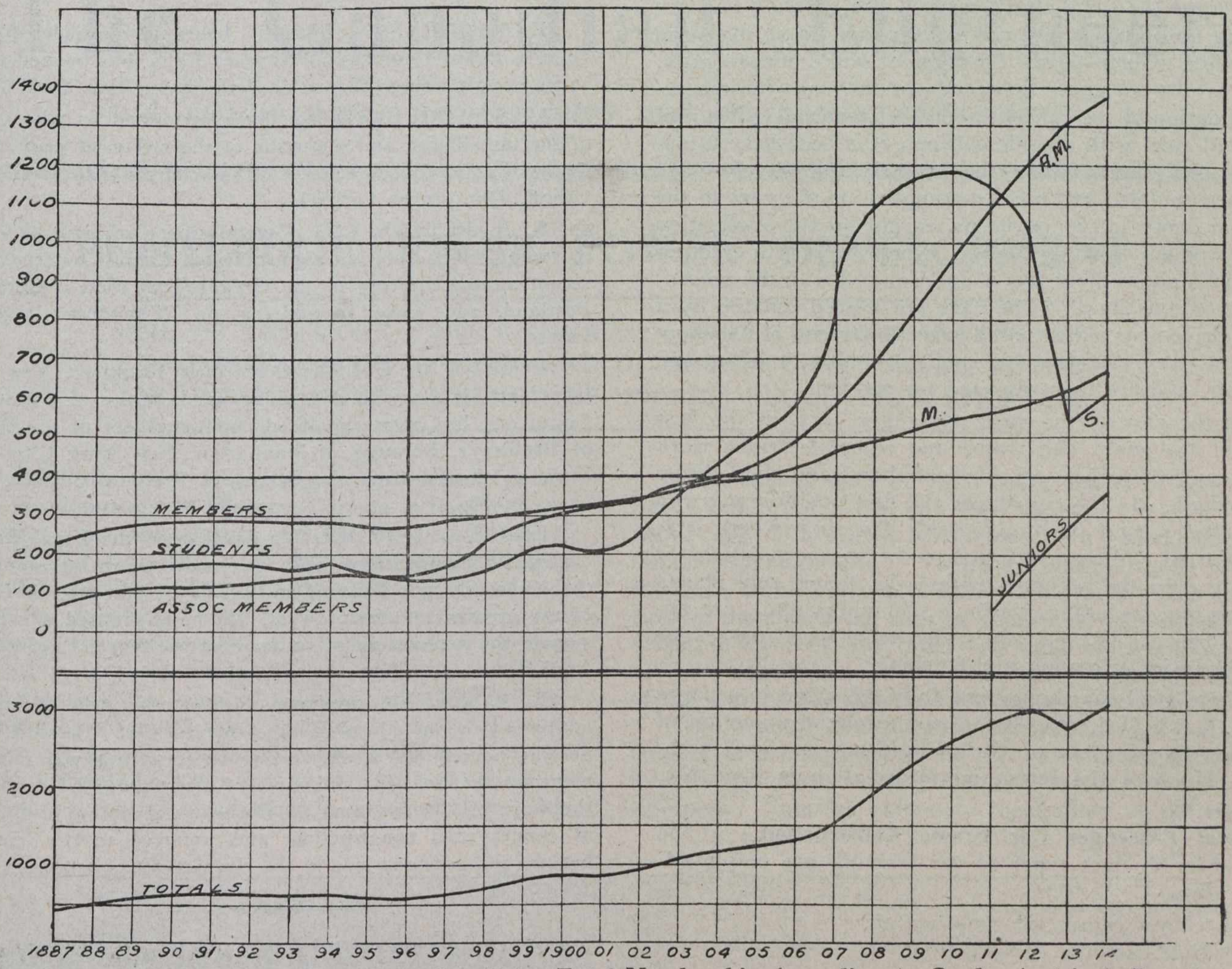
In a recent issue of the journal of the Canadian Peat Society, attention is drawn to the importance which development of the latent resources of Canadian peat bogs might readily assume if full advantage were taken of the new conditions arising from the war. The article refers to the world's production last year of sulphate of ammonia, estimated at 1,365,000 tons, worth about $80,000,000. This is a chief by-product of European peat plants, and is a valuable fertilizer worth about $60 per ton. Figures are given to emphasize the existence of extensive markets which might be supplied, in part at least, by Canada, and of the opportunity to capture some share of the trade of Germany and Austria in this product. It is stated that these two countries export over 120,000 tons annually. Canadian peat bogs are suitable for this industry, being rich in nitrogen, and British capitalists are already inquiring relative to the feasibility of establishing chemical works in Canada, providing a sufficient supply of peat can be guaranteed.

Apart from the potential value of our peat bogs, as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products such as alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries giving employment to many people.

CAST IRON TEST-BAR DIMENSIONS.

In a paper read before the Iron and Steel Institute (Great Britain) Mr. Geo. S. Hailstone describes some interesting investigations into the relation of the size of a cast iron test-bar to its strength. A number of test-bars were cast from mixtures of very weak to strong cast iron, 2⅛ by 1⅛ in. section, 42 in. long, and machined to 2 by 1 in. and tested on 36-in. centres. One of the broken halves of each bar was then machined to 1 by 1 in. and tested on 12-in. centres. The breaking load of the 2 by 1 in. bars ranged from 2,576 to 3,920 lb., and that on the 1-in. bars ranged from 2,240 to 3,416 lb. The ratio of the breaking loads of the two sizes of bars ranged from 1.142 to 1.166 for the whole series of 26 bars of each size, averaging 1.153. Another series of bars were cast to size, 2 by 1 in. and 1 by 1 in.; 15 bars of each were tested without machining, giving breaking loads ranging from 2,548 to 4,116 lb. for the 2-in. bars, and from 2,184 to 3,584 lb. for the 1-in. bars, the ratio of strengths ranging from 1.117 to 1.166, averaging 1.146. Mr. Hailstone concludes that the best standard cast iron test-bar, to give the most consistent and comparable results, both in breaking load and deflection, is one cast 2⅛ by 1⅛ in. 42 in. long, machined down to 2 in. by 1 in. section, and tested on 36-in. centres.

GROWTH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.



Curve Illustrating Growth by Years, and Classifying Total Membership According to Grades (not including that of Honorary Member).

THE ANGUS SHOPS OF THE CANADIAN PACIFIC RAILWAY, MONTREAL.

(Continued from page 176.)

sembling to the jig where they are riveted together is handled entirely by small air jacks running on trucks on narrow gauge rails which move the underframe from position to position without requiring the use of the overhead crane. This, of course, saves a considerable amount of time and enables the movements to occur simultaneously, which could not possibly be done if it were necessary for the crane to move them all, as the crane can only handle one at a time. The only portion of this output which is fixed is that of riveting the underframe with the compression riveters, and the capacity is about 14 or 15 cars per day. Provision is, therefore, made for the installation of an additional position for riveting the underframe along the side wall of the building where the jib cranes for handling compression riveters can easily be located. The other positions can easily handle 25 cars a day, by the addition of more help where required.

For assembling the side frame a jig was designed by which a considerable improvement has been attained over former practice. The side frames for as many cars as are required are built on one jig, all the parts being placed in templates, giving them a fixed location. The riveting on the lower side sill is handled by two suspended compression riveters, the balance of the riveting being done by hand. The parts are at present clamped together by hand clamps, which will shortly be replaced by fixed pneumatic clamps in order to hold them more rigidly and avoid the time lost in applying and removing the hand clamps. Special attention has been paid to the loss of time in locating and applying clamps, and pockets are arranged in the frame so that everything is as close as possible to the point where it is to be used. Even more care is taken in the racks for the material, as each post and brace is piled directly opposite to where it will be used in the frame. A small gantry crane is being constructed to handle this material from the jig to the piling space. The same arrangement is made for the end frames.

Erecting.—The erecting is commenced at a point where the trucks are brought in from the supply tracks at the side of the shop and handled across turntables into proper position. The underframe is then brought down by the travelling crane and placed on the trucks. In the first position the floor stringers are riveted in place and one end frame is lifted on by a jib crane specially constructed for that purpose. When this is done the underframe is moved down to the second position, and the side frames are lifted up by two special hoists from the convenient piles where they have been placed by the overhead crane, and the other end frame is lifted to place by a jib crane. In the third position the carlines and the riveting up on top of the car is completed on an overhead scaffolding which allows the men to work conveniently. There is also an upper floor and special racks for the accommodation of the carlines and other material. The roof being all steel with outside carlines, it is necessary to apply the roof sheets before the carlines, and therefore the roof is assembled and erected complete on the cars in the steel car shops in two positions, except for the application of the wooden running boards. Room for a fifth erecting position is allowed but this is not required with the present output of the shop. The cars are moved outside by a motor-driven car pull situated in the lower end of the shop, are sent over to the wood shop for lining, roofing and painting, and are then reported for service.

In the case of the steel passenger cars, in the first position the posts, end frame and complete frame work of the car are erected and side roof sheets and hood sheets are applied. As the car leaves the first position it is run on by the second position outside the shop where it is sand blasted and then returned to the second position for finishing. In the second position the centre roof sheets and flooring, including vestibule trimmings, etc., are applied. The car is then sent over to the wood passenger shop for inside trimming and finishing.

These steel car shops were fully described in a paper by Mr. L. C. Ord, read before the mechanical section of the Canadian Society of Civil Engineers on April 30th, 1914. Much of the foregoing information is from Mr. Ord's paper.

Steel Passenger Car Frame Construction.—At the shops, four distinct types of car framing are employed. These are:—

(1) Heavy centre sill construction.
(2) Side carrying construction.
(3) Underframe construction.
(4) Combination construction.

These types, with the exception of the first, were described and compared by Mr. C. Brady, in his paper presented on December 3rd, 1914, and abstracted in our issue of December 10th, to which the reader is referred.

L. & P. S. RAILWAY COMMISSION.

The personnel of the London & Port Stanley Railway Commission is as follows:—Sir Adam Beck, chairman; Philip Pocock, M. D. Fraser, K.C., and Major William Spittal.

GOOD ROADS CONVENTION.

The Second Canadian and International Good Roads Convention will be held in Toronto, March 22 to 26. The sessions will be presided over by Mr. W. A. McLean, M.Can.Soc.C.E., Provincial Highway Engineer of Ontario.

FAREWELL DINNER TO ENGINEERS.

On January 14th, the Ottawa branch of the Engineering Alumni Association of the University of Toronto gave a farewell dinner to twenty members who are leaving shortly with the corps of Canadian Engineers. There was an exceedingly large attendance. Letters and telegrams were received from friends in various parts of the country.

PERSONAL.

R. D. JOHNSON, formerly hydraulic engineer for the Ontario Power Company at Niagara Falls, has opened a consulting engineering office at 60 Wall Street, New York City.

M. S. WOOLLARD has been appointed to take charge of the installation and operation of the electrical plant of the Ontario Stone Corporation, in the company's quarries at Uthoff, Ont., (near Orillia).

F. H. PETERS, C.E., Commissioner of Irrigation, Department of the Interior, with office at Calgary, attended the recent annual meeting of the Oregon Irrigation Congress in Portland, and gave an address on "Canadian Irrigation Laws."

EUGENE W. STERN, Consulting Engineer, New York City, and secretary of the American Institute of Consulting Engineers, has been appointed chief engineer of the Bureau of Highways, Borough of Manhattan, New York City. Mr. Stern graduated from the School of Practical Science, Toronto, in 1884.

LIEUT. G. L. RIDOUT, a graduate of the Royal Military College, Kingston, 1907, and for some time in the employ of the Hydro-Electric Power Commission of Ontario, in charge of the erection of steel towers, has been granted a commission in the department of railways of the Royal Engineers of Lord Kitchener's Army.

W. A. McLEAN, provincial highway engineer of Ontario, addressed the members of the University of Toronto Engineering Society last week, on the subject of highway improvement in Ontario. In the course of his remarks he dealt with the work the Department of Highways is doing in the way of county road construction, and referred to the comprehensive recommendations of the Highways Commission.

ANNUAL MEETING, TORONTO BRANCH CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Toronto branch is being held at 8 p.m., on Thursday, January 21st, in the Engineers' Club, 90 King Street West. The reports of the committees for the past year will be read and the election of officers for this year's committees will take place.. Mr. A. F. Stewart is chairman, and Mr. John S. Galbraith, secretary-treasurer.

VANCOUVER BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the Vancouver Branch, Canadian Society of Civil Engineers, was held on Thursday, January 7th, 1915. An illustrated paper on Vancouver Joint Sewerage Scheme was presented by A. D. Creer, M.Can.Soc.C.E. Mr. G. R. G. Conway presided.

MINING SECTION, CANADIAN SOCIETY OF CIVIL ENGINEERS.

On January 14th, a meeting of the Mining Section was addressed by Mr. C. A. Macaulay, his subject being, "Evolution of Stoping Methods in Mining during the last Decade." A paper was also presented by Mr. J. R. McLean on the "Top Slicing System of Mining as practised at the Mines of the Detroit Copper Company, Morenci, Arizona." Both papers were illustrated by lantern slides. Following the reading and discussion of these papers there was an illustrated address by Lieut. S. L. Brunton on "Modern Artillery in the Field."