CANADIAN NORTHERN QUEBEC RAILWAY

MOUNT ROYAL TUNNEL

C. H. RIFF

Canadian Northern Montreal Tunnel and Terminal Co.—It is expected that the boring of the Mount Royal tunnel will be completed Dec. 15. A contract for the electrification of the tunnel and the connecting lines has been let to the Canadian General Electric Co.

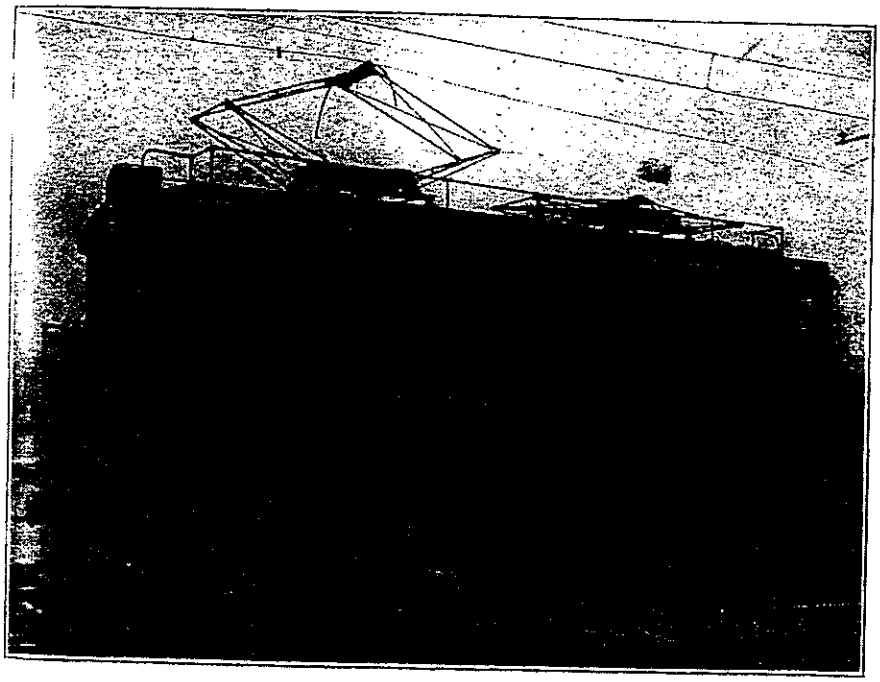
Press reports state that plans for the station on Dorchester St. are being prepared by Warren and Wetmore, New York.

J. P. Mullarkey, who is building a section of the line westerly from Rideau Jct., is reported to have stated, Nov. 17, that he expected to have his contract completed by the end of 1914. The Board of Railway Commissioners has authorized the making of a connection with the C.P.R. at Pembroke, Ont., in order to get in construction material. Tracklaying is being gone on with easterly from Pembroke, and it is expected to lay 35 miles this year. Sir Donald Mann, in an interview Nov. 10, is reported to have stated there were about 60 miles of track to be laid to complete the line from Port Arthur to Ruel, 545 miles. It is expected to have this laid by the end of the year.

December
1913

Electric Locomotives for Mount Royal Tunnel, Canadian Northern Railway.

Some general information in regard to the principal electrification features of the Mount Royal Tunnel, Montreal, supplied by W. C. Lancaster, Electrical and Mechanical Engineer, Canadian Northern Montreal Tunnel and Terminal Co., was published in Canadian Railway and Marine World for November. The following fuller details in regard to the electric locomotives, six of which have been ordered, has since been received. As before stated they will be designed for an operating potential of 2,400 volts direct current, with vertical trolley construction. Two of them, operated and controlled as a single unit, will have ample capacity and suitable speed requirements for handling the heavy transcontinental pas-



Electric Locomotive of Similar Type to those ordered for Mount Royal Tunnel.

senger trains—1,130 tons trailing load—with the Montreal terminal zone. A single locomotive will successfully handle the freight trains—1,000 tons trailing—and the local passenger service—550 tons trailing.

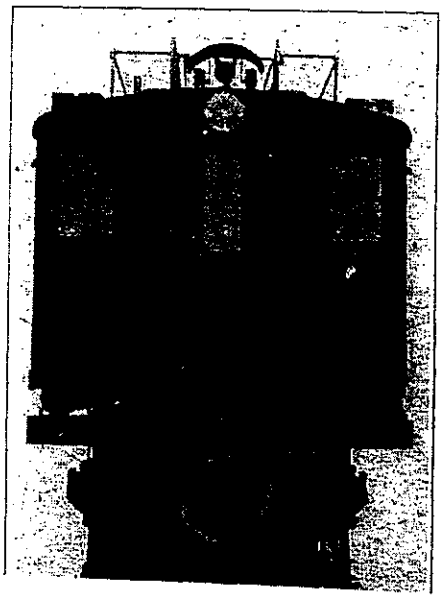
The general type of locomotives to be used is that known as the box cab articulated running gear. The estimated weight of the complete locomotive is 83 tons. The locomotive will have four axles, with all of the weight of the locomotive upon the [illegible] thus securing the effect of severe shocks.

Both the box cab and platform will be built of plates, sheets, angles and heavy channels, and will be thoroughly reinforced throughout. The box cab will be divided into three compartments; the apparatus compartment in the centre and the two operators' compartments at the ends. Each operator's compartment will have a full complement of apparatus, consisting of controller, control switches, meter, air brake control apparatus, air gauges, pantagraph control and heaters, thus providing the locomotive with a complete double end control. All apparatus subject to 2,400 volt potential will be located in the centre apparatus compartment and screened to protect against accidental contact. The location and general arrangement of this apparatus will be such as to provide easy access from all sides for inspection, cleaning and repairs.

The Sprague-General Electric type M multiple unit double end control equipment is proposed for the locomotives, all the control points being proportioned and adjusted so as to secure a smooth and even acceleration, at all times, corresponding to a current consumption near the slipping point 2,400 volts, so that two may be connected permanently in series and operated on a 2,400 volt circuit. These motors will be geared to the axles through twin gears, there being one pinion on each end of the armature shafts. These motors are especially designed for locomotive service and will be provided with forced ventilation by a blower located in the apparatus compartment. The locomotives will be geared for a free running speed on tangent, level track of approximately 45 miles an hour, and will be operated as two speed machines with ten points in series and nine points series parallel.

The air brake equipment will be the straight air and automatic type, so as to combine the desirable features for train operation through an equalizing reservoir and the independent operation of the brakes upon the locomotive. Provision will be made for the multiple operation of the compressors upon all locomotives when operating in multiple, so as to distribute the duty upon all the compressors in the train.

The motors will be operated in series and series-parallel by the Sprague-General Electric type M two speed control. The external regulating resistance will be divided into two parts, each part being directly connected to a pair of motors permanently connected in series. The two pairs of motors, with their resistances, will all be connected in series on the first point of the control, the resistance being varied through the first nine points on the controller and finally short circuited on the tenth, or running point. The two pairs of motors will then be similarly operated in series parallel and all resistances cut out on the



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CANADIAN PACIFIC RAILWAY NORTH BAY TERMINAL

Canadian Railway and Marine World.

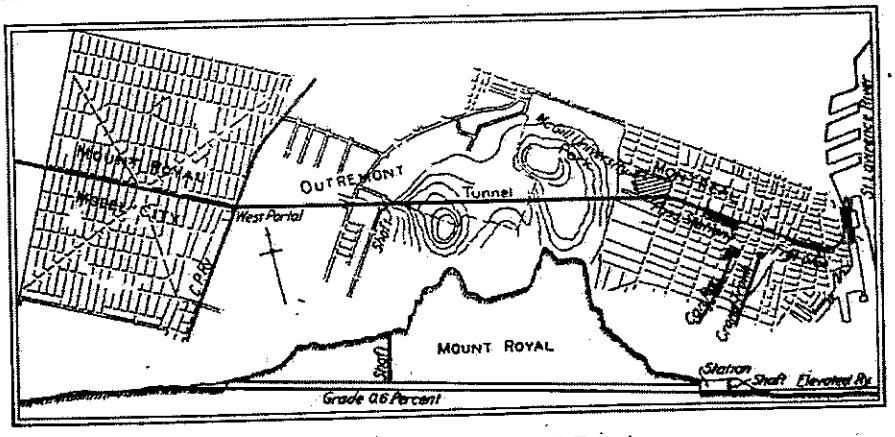
August, 1913.

Canadian Northern Railway Mount Royal Tunnel:

By S. P. Brown, M. Am. Soc. C.E., Chief Engineer, Canadian Northern Montreal Tunnel and Terminal Co., Ltd.

The C.N.R. is now operating about 5,000 miles of track in Manitoba, Saskatchewan and Alberta, besides its Eastern lines. It also has about 2,500 miles under construction that when completed in 1914 will make it a transcontinental system, with Vancouver, on the Pacific, and Montreal as its main eastern distributing point. When this work is finished it will be important to have proper terminal facilities already prepared in the main eastern point, and, with this in view, the Canadian Northern Montreal Tunnel & Terminal Co., Ltd., was incorporated to make the necessary developments in and about the city of Montreal.

Montreal has a population of about 600,000 and is the main eastern seaport during the busiest part of the year. The business and financial part of the city is largely concentrated in a narrow strip of land between the St. Lawrence River and Mount Royal, which is already so congested that the resident section is gradually spreading up and down the river and around the mountain into Westmount and Outremont. Mount Royal forms a very positive barrier between the people living back of the mountain and the business portion of the city.



Plan and Profile of Mount Royal Tunnel.

General Features of Project.

The natural location of the business centre of Montreal, between Mount Royal and the river, made the problem of entry at first appear complicated. To enter from either end of this strip meant a detour that was undesirable, and might have resulted in two separate stations for the eastbound and westbound traffic. A study of the topography and economic distribution of the city and island showed that a tunnel was the logical, as well as the economical, method of entry. It was found that the railways coming from the west could be brought from a convenient site for yards, shops, etc., near the Back bridge across the St. Lawrence River. Such an extension would also include in the commercial part of the town an elaborate freight distributing depot, a department to which the C.N.R. is giving most serious thought at present. In connection with this freight department, large sorting and transfer yards are being developed back of the mountain and east of the city, where most of its shunting and mechanical part of the freight transference will be accomplished.

Back of the mountain, in the broad, gently sloping country, including some of the most fertile farms in Eastern Canada, the C.N.R. saw an opportunity for the site of a new city. With this in view, the Canadian Northern Montreal Land Company, Ltd., was incorporated to purchase this farming country and develop it as part of the general scheme of financing.

The New Model City.

The city of Mount Royal, or as it is locally termed, the "model city," is laid out on a rectangular plan, with four diagonal boulevards radiating from the railway station, which forms the centre of the town site. There is also a meandering boulevard connecting a series of parks and playgrounds distributed over the city, in general midway between the central park and the station site and the city limits. The land, consisting of a gently sloping plane, makes the situation ideal for drainage and sanitation. The streets will be paved principally with [illegible] stone for the tunnel will bring the Mount Royal station within a very few minutes of the main passenger terminal in the city proper and trolley cars will tie the street car lines of the "model city" with those of Outremont and Montreal. A small freight yard near the west portal of the tunnel will serve for the delivery of local freight and express and for the manipulation of multiple unit trains during the rush hours. The entire terminal scheme is to be utilitarian from the Back River to the waterfront. The idea is to produce structures and developments that will be attractive to the eye and so designed and disposed as to be self supporting in themselves without the assistance of the ordinary railroad traffic.

Tunnel History.

To the writer the most interesting part of the study of tunnels is its history. From the days of the cave man, through those of the Egyptians, Chaldeans, Romans and Europeans of modern times, the evolution has continued. The changes in the tunnel itself are small but the methods of excavation and construction have changed beyond recognition. The Lake Fucinus tunnel driven in the Abruzzi, during the reign of Claudius, was 6 ft. high, 10 ft. wide, and 3½ miles long. It took 11 years to build, and employed 30,000 men. To expedite this work some 40 shafts and inclines were sunk, some over 400 ft. deep.

As a comparison the present Mount Royal tunnel is practically the same length; the heading, however, is about 9 ft. high by 12 ft. wide, over 50% larger than the Lake Fucinus tunnel. It has one intermediate shaft about 240 ft. deep and another about 50 ft. deep at Dorchester St., which is at present acting as the eastern portal. The first heading was started on July 8, 1912, and since that time the shafts have been sunk and over 2 miles of heading driven on the tunnel line, besides more than ¼ mile at the shafts and in the terminal sites.

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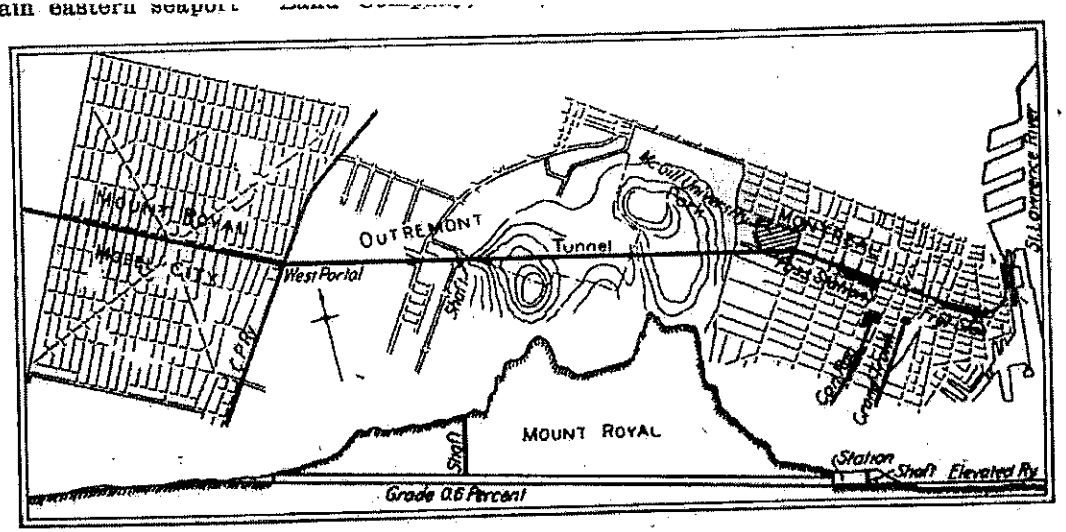

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From the main passenger terminal the tracks may be extended across to the lower town on a viaduct at a level grade to connect with a viaduct along the harbor front, proposed by the Harbor Commissioners of Montreal, and a possible to purchase this farming country and develop it as part of the general scheme of financing.

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In the Lake Fucinus tunnel they used crowbars, chisels, picks, shovels, and possibly drills and saws with cutting edges of corundum. Most of the progress, however, was made by "fire setting," i.e., by building fires against the face of the heading until the rock was highly heated and then dashing cold water or acid, such as vinegar, on it to break the ground. Condemned criminals and prisoners were used in this work, as the death rate was terrific.

Compare this with modern tunnel prac-

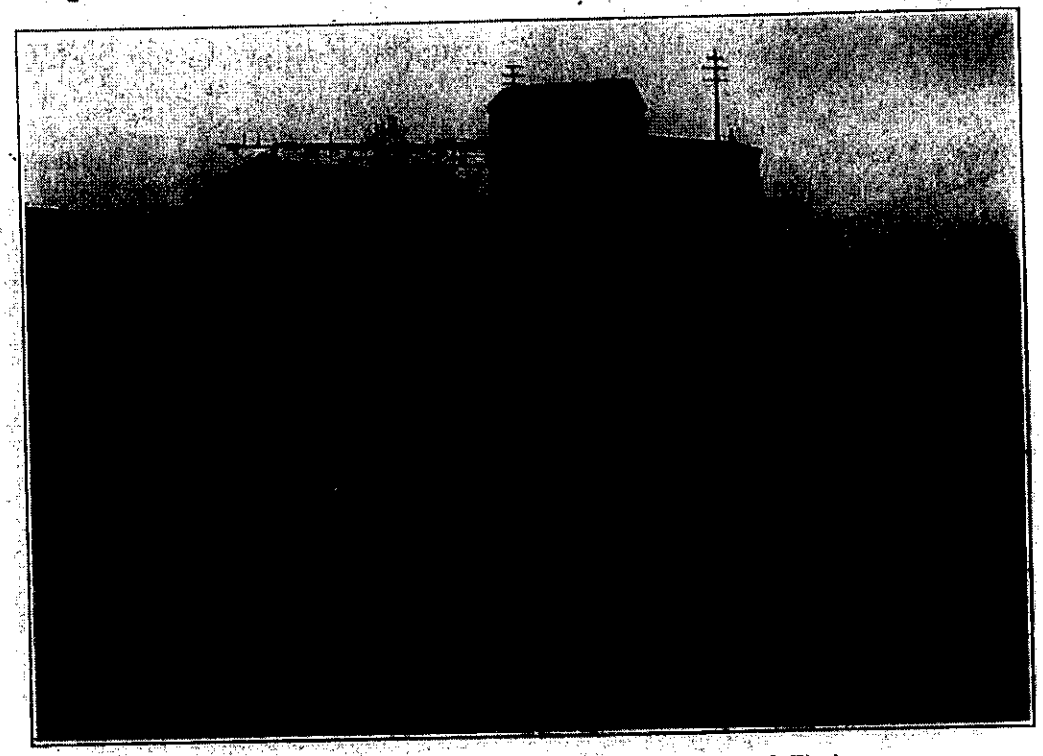
sylvania Lines East of Pittsburgh, including the through lines between New York and Pittsburgh. Underneath the walkway is a continuous refuge niche, except at splicing chambers, where trackmen may sit on the duct bench at the bottom of the dividing wall and be absolutely protected from passing trains.

Excavation.

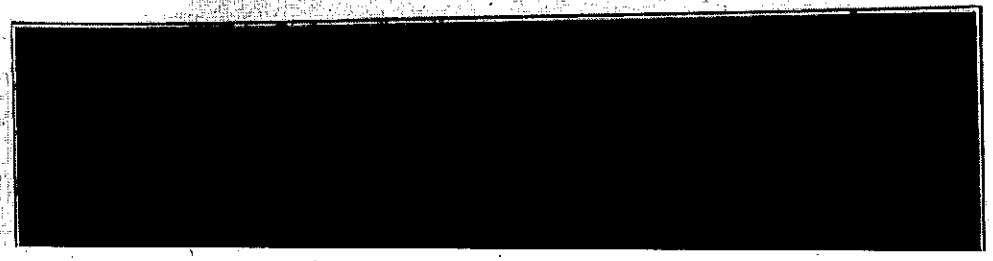
The method of excavation adopted is perhaps more European than American, although a close analysis would show it to be the resultant of several systems. In modern tunnel practice, lines of demarcation and sectionalism that were quite distinct only a comparatively few years ago are gradually becoming lost, so that an engineer is apt to select a combination of several systems which he considers wisest for his ground and structure. The things that stand out most sharply in all tunnels where great progress has been made and which are principally European in origin are: First, the opening heading is always comparatively small and usually in the bottom of the section; second, a horizontal bar is used to support the drills instead of columns; and, third, short rounds are drilled and shots are fired often. Every little economy in time is practised, and all delays, no matter how trifling, are analyzed and corrected, when possible. Workmen are given a bonus for extra progress above the specified minimum, and machinery, such as drill carriages, is used where it is found advantageous.

European engineers, like our Western miners, like to get under the muck, so that much of it falls into the cars by gravity instead of having to be lifted in. Sometimes this is accomplished by stoping, and sometimes by driving a top heading directly above the bottom heading. The one important point is to rock, for by this method the heading can be driven on rapidly and the timbering work and full sized section developed with care and without hurry in many places simultaneously along the line.

A great many mechanical drilling, excavating and mucking apparatus have been devised, and in some cases they were found to work advantageously, but where the space is confined and delays serious, the laborer, with his pick and shovel, is usually employed. One man



Mount Royal Tunnel—West Portal, Crushing Plant and Tipple.



centre heading with break ups at intervals where the full sized tunnel section is developed. The heading is driven by the horizontal bar method. In one heading, where very hard rock is encountered, requiring extra heavy drills, a drill carriage is used with a mechanical muck carrier for loading the cars. In this drill carriage the drill bar is supported on a beam which can be extended 20 ft. ahead of the carriage over the muck pile and has also a vertical and lateral movement to accommodate the heading.

On the city end outside conditions are very disadvantageous. The city of Montreal has never had any previous experience in underground excavation, so that blasting that would be hardly noticeable in New York, for instance, is considered quite serious. For this reason under the city proper, where the cover was light, no blasting was allowed between 11 p.m. and 7 a.m.; the holes in

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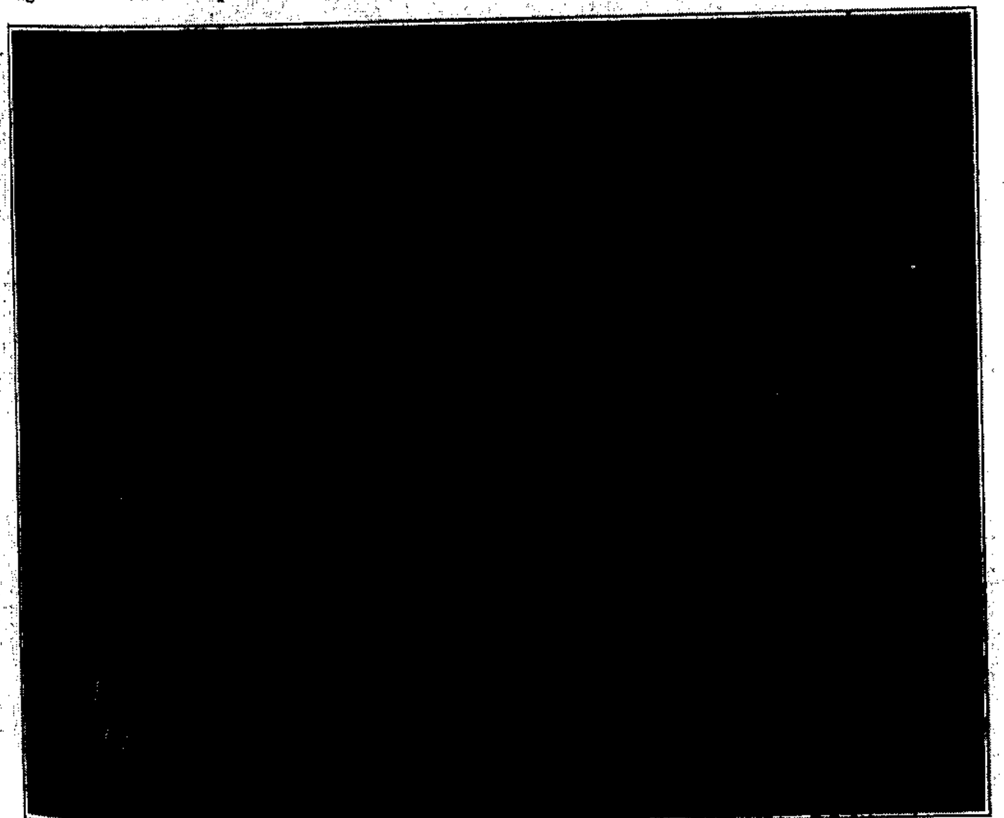
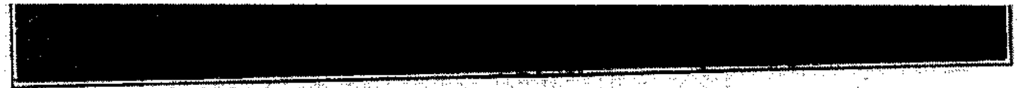


Mount Royal Tunnel—Heading. Observe Drills on Horizontal Bar and Water Attachment to Drills.

keep the bottom heading open for traffic at all times, so that the heading progress is never materially affected. The full size excavation can be carried on over jumbo timbers at as many places as necessary to keep up with the heading.

A bottom heading in bad ground, if possible, is even more desirable than in



Mount Royal Tunnel—West Portal, Crushing Plant and Tipple.

cavating and mucking apparatus have been devised, and in some cases they were found to work advantageously, but where the space is confined and delays serious, the laborer, with his pick and shovel, is usually employed. One man can handle a good deal of muck in his shift, shoveling off slick sheets into low cars. At present muckers in the Mount Royal tunnel heading are handling 15 cu. yd. of muck per man per eight hour shift.

Bottom Heading Method.

The method of excavation adopted in the Mount Royal tunnel is a bottom

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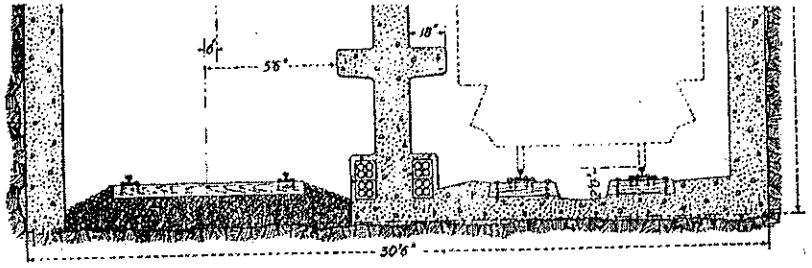
The effect of all this on heading progress was not so serious as might have been expected. While the holes were short, the rounds were fired so often that an average progress of about 17 ft. a day was maintained. In approaching the mountain, where 5 ft. cut holes could be used, the average progress was about 20 ft. per day.

Record Tunnel Progress.

During the month of May, just ended at this writing, as the rock cover had very much increased, shooting was allowed at night, which very much improved the heading progress. In this way, a total of 810 ft. of 8 x 12 ft. heading were driven in the 31 working days immediately following May 1. This, the writer believes, is the best tunneling record yet made in a hard rock heading.

A greater record than the above was made in the Loetschberg tunnel in Switzerland, where 1,013 ft. of 6.5 x 10 ft. heading were driven in one month through soft triassic limestone. An excellent record was also made last year in Arizona, where 799 ft. of 8 x 8 ft. heading were driven in 31 working days through granite porphyry sufficiently hard to drill well and in general stand without timbering. Neither of these



Cross Section of Twin Tubes, Mount Royal Tunnel.

and one realizes how the usages have changed.

When the obstacles confronting those early tunnel diggers, however, are considered, we can but be filled with the sincerest admiration for the confidence, courage and perseverance that made the accomplishment of such great works possible. Their immature systems, methods and appliances required genius to produce success, and the stories of their early struggles form far more thrilling romances that one can find in the most visionary novel of today.

Mount Royal Geology.

Mount Royal is an intrusion of igneous rock forced upward through the original bed of Trenton limstone. There have evidently been several stages of eruption or intrusion, as both the limestone and main igneous bodies are broken and cut by a multitude of dikes and sheets of different and varied character, and evidently of later origin.

The two principal rocks to be encountered on the present line are Trenton limestone, slightly tilted upward toward the mountain, and essexite, which is the main intrusion of igneous rock. The Trenton limestone, at a considerable depth, is quite hard and crystalline, and except where silicious or too much cut up by dikes is a very good tunneling rock. At the city end the limestone was very soft and rather blocky for the first 2,000 ft., with occasionally earth in the heading roof. As the cover increased the rock became harder and more cut by dikes. At present it is quite hard and becoming slightly crystalline, the dikes causing the only difficulty in the tunneling. The essexite is very hard, but aside from this as a good tunneling rock. The most difficult tunnel rock is a volcanic breccia, which when cut by dikes is so badly broken and blocky that it is extremely hard to drill, does not shoot well, and will require almost continuous masonry lining. This is especially common near the junction of the limestone back of the mountain. It was, of course, known that the heart of the mountain was of hard, igneous essexite, as above described, which, with breccia, also showed outcroppings in a ridge near the western portal. While this lower ridge of hard rock and breccia could not have been avoided without seriously affecting the layout of the model city, a portion of the hard rock in the centres of the mountain could have been avoided had it been considered expedient.

The line finally adopted is the shortest case of accident or derailment. The outside wall clearance is coincident with the clearance for new structures in the New York Central terminal work in New York and in excess of the clearance of the Pennsylvania Lines East of Pittsburgh.

A high headroom, almost the same as that of the Detroit River tunnel, was adopted, on account of the probability of a high voltage overhead contact circuit. The flattened three centred arch was adopted to allow for the sway of the pantograph and on account of the stratification of the rock where much of the lining will occur.

The walkway is made narrow, so that people will be forced to pass along it in single file, thus avoiding the danger of crushing and panic. The normal clearance at the walkway edge is 2 in. greater than that of the normal high passenger platform adopted in the terminal, which is somewhat greater than that allowed on the New York Central and Pennsylvania lines about New York. The walkway edge also coincides with clearance lines (outside of the platform) of the Penn-

Mount Royal Tunnel—Breakup, Showing Jumbo Timbers in Heading.

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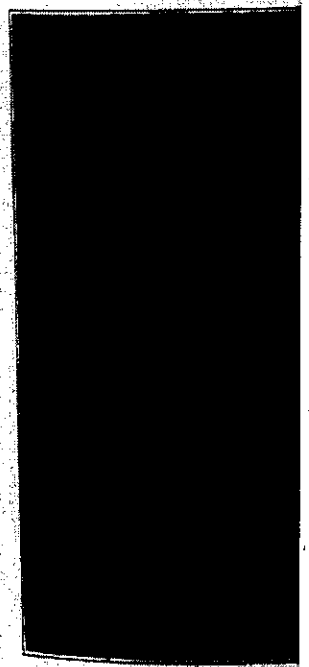

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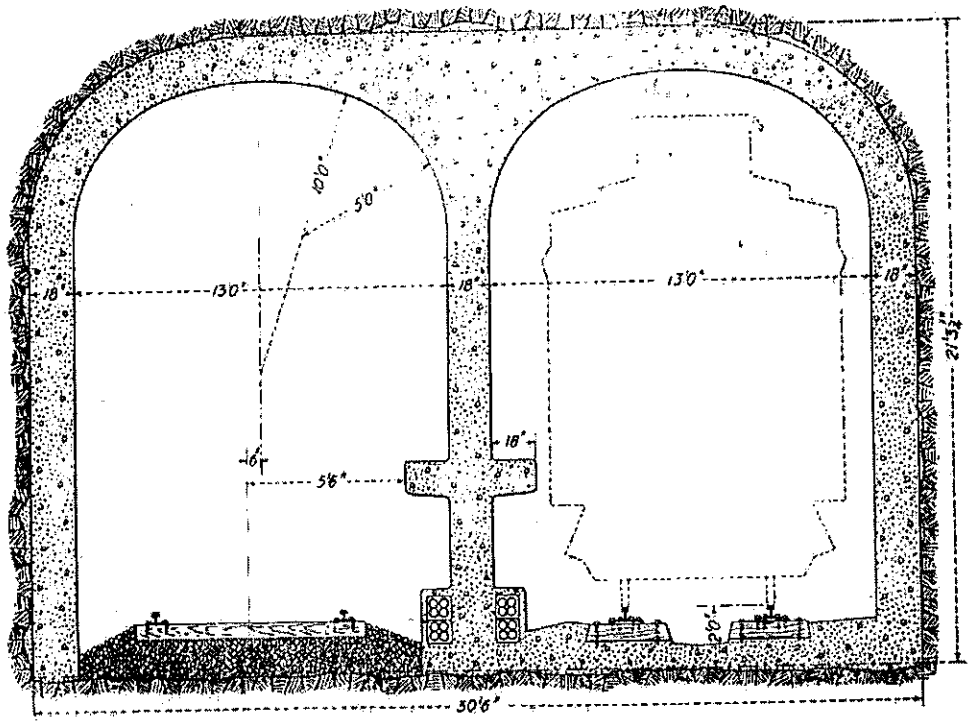
tice using electricity, compressed air and high explosives, which, combined with highly perfected machinery and carefully systematized forces, produce speed and economy that would have seemed incredible even a couple of generations ago.



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Mount Royal Geology.

Mount Royal is an intrusion of igneous and the main volcanic intrusions.

Tunnel Location.

The location of the tunnel under Mount Royal was more or less established by the location of the passenger terminal in Montreal and the model city at the back of the mountain. It was, of course, known that the heart of the mountain was of hard, igneous essexite, as above described, which, with breccia, also showed outcroppings in a ridge near the western portal. While this lower ridge one possible between the two main objective points that could be devised to avoid surface obstructions and take advantage of the geological formation, as far as it is able to be anticipated. It is believed that while much of the breccia and part of the limestone will require masonry lining similar to that required in soft ground, much of the limestone, inclined as it is to the present tunnel line, will require only a centre wall for safe support; in the essexite no centre wall will be required except for ventilation and purposes of safety in case of derailment or accident. This gives, economically, an extremely good tunnel line, which, with the exception of one curve under the McGill University grounds, is all on a tangent and at only sufficient grade to insure proper drainage.

Tunnel Cross Section.

A twin tunnel cross section has been adopted for three main reasons—economy in excavation and construction, ease and economy in ventilation, and safety in case of accident or derailment. The outside wall clearance is coincident with the clearance for new structures in the New York Central terminal work in New York and in excess of the clearance of the Pennsylvania Lines East of Pittsburgh.

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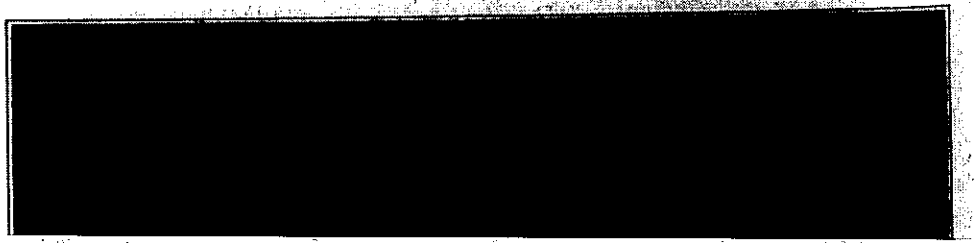
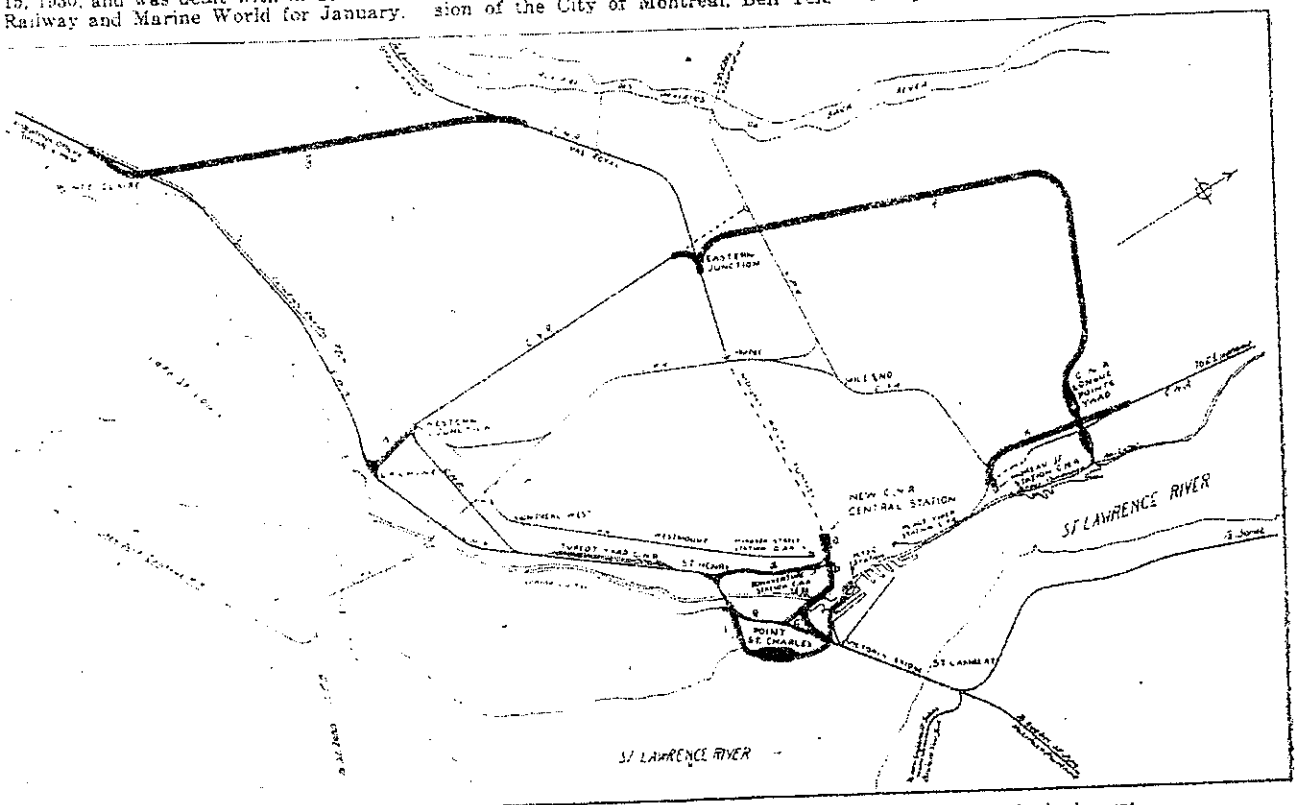


Montreal Terminals Development, Canadian National Rys.

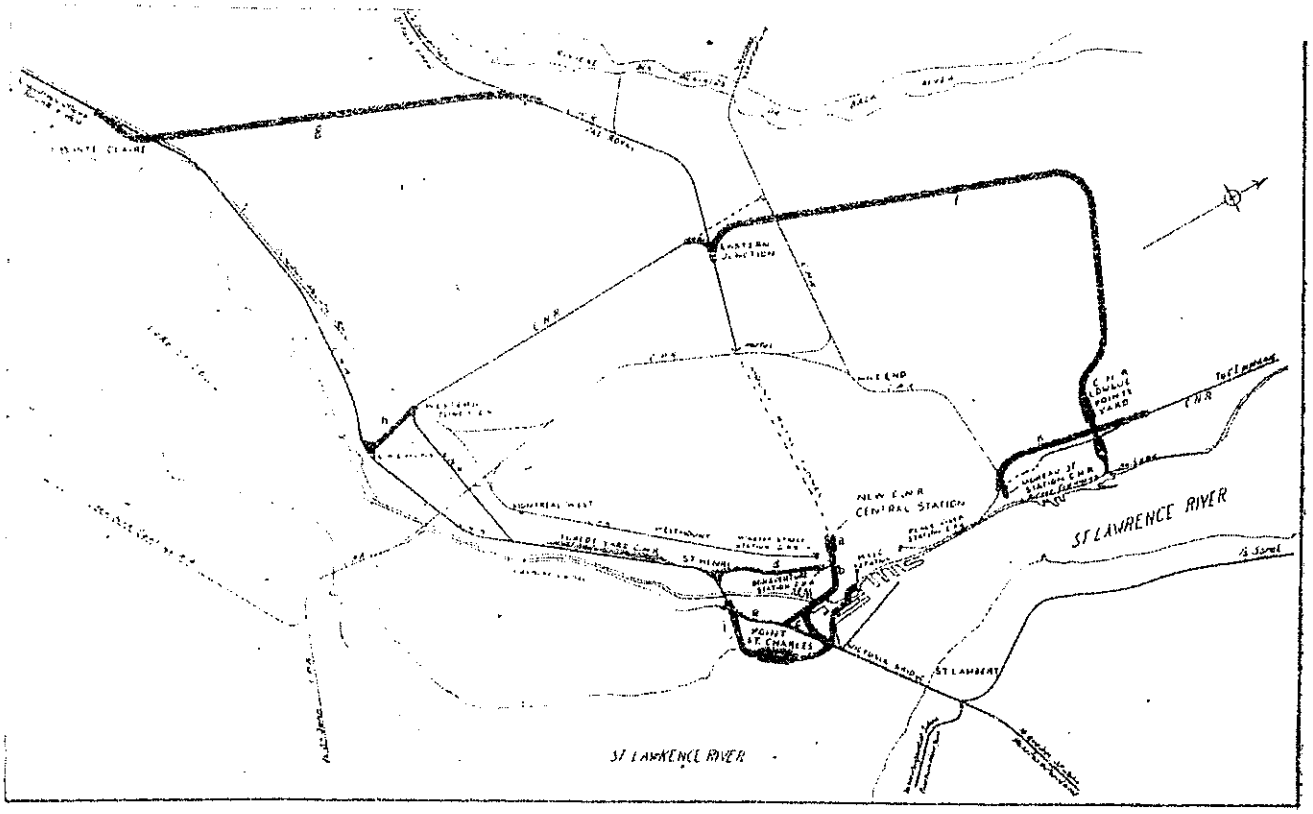
The Board of Railway Commissioners passed order 46,203, Feb. 2, granting an application made by Canadian National Rys. under the Railway Act, secs. 252 and 256, for authority to cross certain highways and road allowances with the line to extend from Longue Pointe to Eastern Jct., the crossings to be in the City of Montreal, and the towns of St. Leonard de Port Maurice, Montreal North, St. Michel de Laval, and St. Laurent, and for authority to cross the Canadian Pacific Ry. between Bremner and Stewart Sts., and to cross the Montreal Tramways Co. line on Stanley Bagg Ave. The Board's hearing on the application was held in Montreal, Dec. 15, 1930, and was dealt with in Canadian Railway and Marine World for January, pg. 36, where it was mentioned that the application was opposed vigorously by Montreal interests allied with Mayor Houde and his followers in the city council. A report on the situation, favoring the granting of the application, [illegible] the question of appointment of costs of separations are to be carried out at Rockland Ave., Racine St., St. Lawrence Blvd., St. Denis Street, Berri Street, Lajeunesse Street, Stanley Bagg Ave., St. Hubert Street, Christopher Columbus Street, Papineau Ave., Delorimier Ave., Lille Street, St. Michel Road, St. Vital Street, Pie Neuf Blvd., Rosemont Ave. and Sherbrooke Street, subways to be provided at all but the last two, where overhead bridges are to be built; that a large number of streets are to be crossed and diverted; that detail plans of the proposed grade separation structures are to be filed for the approval of an engineer of the Board; that the City of Montreal, Montreal Light, Heat and Power Consolidated, Electrical Commission of the City of Montreal, Bell Telephone Co., Montreal Tramways Commission and Montreal Tramways Co. are to move such of their utilities as may be affected by the grade separations as and when requested by the C.N.R. Chief Engineer, Operating Department; that C.N.R. in Aug., 1930, to pay for all grade separations on the line, present and future, should have been accepted. On Feb. 11; the city gave notice, through Chief City Attorney St. Pierre, that it would, on Feb. 20, apply to the Supreme Court of Canada for leave to appeal from the Board's order, on the ground that the Board did not give the city opportunity to further present its views, following the hearing on Dec. 15, Mr. St. Pierre having stated:—"The Board did not give the city an opportunity to appear before it previous to its judgment. It first sat in open court in Montreal, on which occasion the city was represented. The matter was referred to the Board's Chief Engineer for further study. The city then made a request to appear before the Board again, but this was not granted".

The city's application for leave to appeal from the order was heard by Mr. Justice Rinfret, Feb. 20. Judgment was reserved.

A statement issued by S. J. Hunger- [illegible] President, Operation and Con-



Longue Pointe-Eastern Jct. Line's location in relation to other units of C.N.R. Montreal terminals development.



Longue Pointe-Eastern Jct. Line's location in relation to other units of C.N.R. Montreal terminals development.

pg. 36, where it was mentioned that the application was opposed vigorously by Montreal interests allied with Mayor Houde and his followers in the city council. A report on the situation, favoring the granting of the application, was prepared by the Board's Chief Engineer, and was summarized in our February issue, pg. 99. The C.N.R. management considers the line necessary as a part of its Montreal terminals development scheme, to connect its facilities in the east and west ends of Montreal and environs, the situation as it now exists being that cars cannot be handled via C.N.R. from the east side of Montreal to the west except by a roundabout route from Longue Pointe to Turcot via Joliette, Rinfret and Eastern Jct., 108.4 miles.

The Board's order specifies that detail plans of the bridge by which the line is to be carried over the Canadian Pacific Ry. should be filed for approval by an engineer of the Board; that grade

phone Co., Montreal Tramways Commission and Montreal Tramways Co. are to move such of their utilities as may be affected by the grade separations as and when requested by the C.N.R. Chief Engineer, Operating Department; that the question of appointment of costs of constructing and maintaining the grade separation works is reserved for further consideration by the Board. The Longue Pointe-Eastern Jct. line's location is shown on the accompanying sketch map.

Soon after the Board's order was made public in Montreal, Alderman Bray, chairman of the city council's executive committee, and other members of the Houde administration, stated that the matter was not settled finally by the order, and that attempts to prevent an elevated line being built would be continued. The Houde administration's political opponents claimed that under the order the city may have to pay a part of the grade separation costs, and that an offer said to have been made by the

to appear before the Board again, but this was not granted".

The city's application for leave to appeal from the order was heard by Mr. Justice Rinfret, Feb. 20. Judgment was reserved.

A statement issued by S. J. Hungerford, Vice President, Operation and Construction Departments, C.N.R., immediately following publication of the Board's order, called attention to the great need of the Longue Pointe-Eastern Jct. line, to the fact that its construction was approved by the Dominion Parliament, to the statement by the Board of Railway Commissioners' Chief Engineer, T. L. Simmons, saying that the line's construction would be more likely to increase land values in the vicinity than to decrease them, and to the fact that no real valid objection to the line's construction had been produced. He said that a contract had been awarded Kennedy Construction Co. for building substructures for the grade separation

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Montreal Terminal Developments, Canadian National Railways.

Developments in connection with the Canadian National Rys. terminal work in Montreal were dealt with in Canadian Railway and Marine World for March to the point where the city's application to the Supreme Court of Canada for leave to appeal from the Board of Railway Commissioners' order 46,203, Feb. 2, approving construction of the proposed elevated line between Longue Pointe and Eastern Jct., had been heard before Mr. Justice Rinfret, on Feb. 20, judgment having been reserved. The Board's order, and a description of the proposed line, with a map showing its location in relation to other parts of the terminal scheme, were given in the article. A major point in the city's desire to appeal from the Board's order was the city's claim that the Board had refused the city the right to make further representations before the order was issued. The Bell Telephone Co., and Montreal Light, Heat and Power Consolidated had also applied for leave to appeal from the Board's order as it affected them individually. Mr. Justice Rinfret gave judgment, Feb. 22, on the applications for leave to appeal, granting the applications of the two public utilities mentioned, but refusing the city's. The judgment stated, in regard to the city's application, that the Board's jurisdiction to deal with the matters covered by the order was not questioned, the city's complaint having been alleged lack of opportunity to present its case. After quoting at length from the Railway Act, secs. 19 and 33, in an effort to derive the exact meaning of the word "complaint" as used in the act, the judgment stated that the city had no legitimate basis for complaint, and said:—"It cannot be said the Board exercised its powers otherwise than in a legal manner, or that the City of Montreal was condemned unheard. The maxim 'audi alteram partem' means that the party must be given an opportunity to be heard. The City of Montreal had that opportunity".

On March 3, it was announced in Montreal that the city council executive committee had decided to appeal to the Governor in council from the Board's order. The appeal was prepared by St. Pierre, Parent, Damphousse, Butler, Menard and Choquette, attorneys for the city, and was made public on March 12. It gave in full the C.N.R. application for authority to build the Longue Pointe-Eastern Jct. line and cross specified streets and street lines, and also the Board's order; it traced the developments prior to issuance of the order, and gave a description of the proposed line as it would be built in compliance with the Board's order. It called attention to a communication sent by the city to the Board on Jan. 20, giving in detail the city's objections to the construction of the line as provided by the order, expressing its desire to have the line built as a depressed one, and presenting argument as to why a depressed line should be provided. In that communication it was stated in part:—"Any operating difficulties that may be apprehended in connection with a depressed line, such as "from snow or ice, are just as must be "experienced in the existing cut or "trench forming the approach to the "company's tunnel under Mount Royal "and forming also part of the railway "terminal station of the company at Dorchester St. and Lagauchetiere St., and "any such difficulties resolve themselves "in the last analysis into a question of "cost, which, it is submitted, should be "borne by the railway company rather "than that any damage caused by the "building of an elevated line should be "borne by the city and the property owners in the vicinity of the proposed railway line." The city also stated in its communication to the Board that land values along the line, if built in accordance with the order, will depreciate to a great extent and will not appreciate in future to the same extent as land values beyond the railway belt, and that building of the line in accordance with the order will retard the development of the district through which it will pass. The appeal then stated that the order was wrong because it did not require a large number of grade separations in addition to those provided for, and concluded with the plea proper, as follows:—A. That the proposed line, instead of elevated, be depressed and constructed in an open cut or trench between miles 5.2 and 11.0, i.e. from a point opposite cadastral lot 395, in the Town of St. Leonard de Port Maurice to Eastern Jct., and that the profile of the line be modified accordingly. B. That in addition to the grade separations directed in the order, 8 additional grade separations be provided in Montreal, 3 additional in Montreal North, and 2 additional in St. Lenoard de Port Maurice. (The names of the streets at which the additional grade separations are desired were given.) C. That grade separations at 6 streets (which were specified) be constructed when the line is built, and not when required, as directed in the order. D. That the company provide at its expense grade separations at all the streets which may be opened on both sides of the railway after its construction. E. That paragraph 3 of the order, in so far as it authorizes the diversion of the streets mentioned therein, be struck from the order. F. That the company operate the line only by electricity and by means of electric locomotives.

The appeal was sent to Ottawa, and on March 18 a delegation, composed of Alderman Bray, chairman of the city council executive committee, Alderman Biggar, the council leader, Norman Holland, chairman, Montreal Industrial Commission on Unemployment, and civic officials, proceeded to Ottawa, being joined there by Mayor Houde, and by W. H. Butler and C. Laurendeau, counsel for the city. The appeal was presented before Prime Minster Bennett and other members of the Dominion Government on March 21, the Canadian National Rys. being represented by Sir Henry Thornton, Chairman and President, E. E. Fairweather, Director, Bureau of Economics, C. B. Brown, Chief Engineer, Operation Department, and Alistair Fraser, K.C., and L. E. Beaulieu, as counsel. The Montreal Tramways Commission was represented by F. Beique, and the Montreal Tramways Co. by Thos. Vien, and ratepayers in the northeast part of Montreal, and those of the other places through which the Longue Pointe-Eastern Jct. line would pass, were also represented. Following presentation of the city's case by Mr. Laurendeau, and of the C.N.R.'s by Mr. Beaulieu, in the morning, the members of the government held a brief private discussion, and shortly after noon Mr. Bennett announced that the city would be given further opportunity to place its views and desires before the Board of Railway Commissioners.

Alderman Bray was quoted in a Montreal press report of March 23 as having stated, upon his return to that city, that the city council's executive committee would pass a resolution calling upon the C.N.R. to stop work in connection with the Longue Pointe-Eastern Jct. line, and to have also said that the city council would like to see a union terminal, adding:—"What I would like to see would be to bring the Canadian National and the Canadian Pacific Rys. together and have the C.P.R. pay 50% of the cost and save the country about $75,000,000.

Naturally, the Longue Pointe-Eastern Jct. line matter being such a controversial one, it has been the subject of much discussion and many addresses and resolutions in Montreal. Following the passing of a resolution by the Montreal Trades and Labor Council, Feb. 20, criticizing Mayor Houde and his administration for trying to prevent building of the line in accordance with the Board's order, the Mayor, in addresses on Feb. 20, Feb. 23 and March 16, defended the city administration's action in regard to the line, and stated emphatically that the C.N.R. plans for an elevated line are very undesirable from the city's viewpoint. On Feb. 20 he said:—"I am not fighting the Canadian National Rys. because it is the Canadian National Rys. I would be

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ready to fight the Canadian Pacific Ry. the same way if they tried to do the same thing". On Feb. 23 he said:—"You have heard, no doubt, that in opposing the C.N.R. terminal plans I am merely a C.P.R. agent. Let Sir Henry Thornton, or any opponent, bring proof that I am so interested, and if their charges are substained in fact, I will not remain any longer Mayor of Montreal".

On March 16, it was reported that the Dominion Minister of Marine, Mr. Duranleau, had asked the Montreal Harbor Commission to appoint a board of three engineers to enquire into the scheme for use by the C.N.R. of trackage along the St. Lawrence River waterfront to provide a connection between its east and west Montreal terminals, in place of the proposed Longue Pointe-Eastern Jct. line, a scheme which had received some support from the city administration, but which the C.N.R. branded as wholly impracticable. However, on March 18, a Montreal newspaper reported that it had been authorized by J. H. Rainville, Chairman, Montreal Harbor Commission, to deny that the Minister had requested the Commission to appoint a board of engineers for the purpose mentioned.

The Montreal Chambre de Commerce passed a resolution Feb. 25, which called upon the Dominion Goverment, "not to "listen to the propaganda going on "against the construction of the C.N.R. "terminals." The Montreal Board of Trade issued a statement, March 13, which said that it had considered the Longue Pointe-Eastern Jct. line question at its preceding three meetings, and had decided to urge that construction be proceeded with without delay, according to C.N.R. plans, as approved by the Board of Railway Commissioners

Expenditures on Terminal Work.—A report from the C.N.R. management showing the work done and expenditures made in connection with the Montreal terminals development work, as authorized by the Canadian National Montreal Terminals Act, Dominion Statutes of 1929, chap. 12, was tabled in the House of Commons shortly after the opening of the current session, together with an estimate of the expenditure for 1931. The expenditures were classified in accordance with the schedules to the act, each schedule covering a definite portion of the work, as explained in our July, 1929, issue, where the act was given. The expenditures under the various schedules have been as follows, the amount first stated being that spent to Dec. 31, 1929, the second amount being the expenditure in 1930, and the third being the total expenditure to Dec. 31, 1930, in each case:—Schedule A, $798,396.58; $4,232,940.31; $5,031,336.89. Schedule B, $302,506.91; $989,004.73; $1,291,511.64. Schedule C, $10,966.38; $70,126.97; $81,093.35. Schedule D, $107,512.96; $436,500.80; $544,013.75. taxes, repairs and other expen 407.09; $3,366.66 debit amount; 43. Total net expenditure, $1 44; $6,818,632.87; $8,614,497.31

The report also contained a of expenditures to Dec. 31, 193 lows:—Land, 1929, $1,464,053. $5,237,238.28; total to Dec. 31, 701,292.22. Construction, 19; 251.81; 1930, $996,309.87; tota 561.68. Preliminary surveys architects' fees, supervision, $55,820.54; 1930, $190,884.6 $246,705.15. General supervisi counting, 1929, $112,917.18; 19 137.22; total, $285,054.40. Int ing construction, 1929, $37,228 $218,696.23; total, $255,924.2 rentals on property, after dedu es, repairs, etc., as given in t ing. Total expenditure, 1929 864.44; 1930, $6,818,632.87; tot 31, 1930, $8,614,497.31.

The estimate of expenditu made during the calendar ye as follows:—Land, property a es, $1,820,500; main terminal 853,500; grade separations, inc erhead bridges, subways an structures, $1,881,000; other $370,000; new lines, $898,000; struction, $327,000; general ex gineering, surveys, etc., $850. $8,000,000.

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tion and other work at the site of the central terminal, at the present tunnel terminal. Dorchester Street West was closed between St. Genevieve and Mansfield Streets, Feb. 16. On notice being given that the street was to be closed, Theodore Morgan, President, Montreal Tourist and Convention Bureau, issued a statement in which he claimed that the C.N.R. had no right to cause the closing of such an important street without providing some means of handling the traffic on it, such as a bridge over the excavation for the terminal. He claimed that the heavy traffic ordinarily carried on Dorchester St. will be thrown into St. Catherine and Sherbrooke Streets, causing great congestion. Mr. Hungerford issued a statement in reply, stating that the matter had been gone into thoroughly with the city authorities and the Montreal Tramways Co.; that it had been decided, in view of the heavy rock work involved, that the maintenance of a temporary bridge would be very difficult; that the railway, with the interests of the city at heart, is doing its best to secure speedy construction of the permanent supports for the roadway of the new Dorchester Street, which will be 104 ft. wide at the terminal, in place of the 66 ft. width existing before, and that provision of the new roadway is to have precedence over all other work at the terminal site. At the time of writing, Feb. 17, the terminal development work is being prosecuted vigorously at several points, and large numbers of men are employed.

The Board of Railway Commissioners has passed the following orders relating to the Montreal terminal work:—46,134, Jan. 20, approving plans and specifications for the fruit warehouse for the construction of which Atlas Construction Co. has been awarded a contract; 46,204, Jan. 30, authorizing the C.N.R. to open for traffic the portion of its high level tracks from just east of D'Argenson Street to just west of Wellington Street, between Turcot and Point St. Charles; 46,205, Jan. 30, authorizing the C.N.R. to place the St. Remi Street subway in operation; 46,206, Jan. 30, authorizing the C.N.R. to place the Charlevoix Street subway in operation; 46,215, Jan. 30, authorizing the C.N.R. to place the subway at Hibernia Street in operation; 46,203, Feb. 2, as summarized in the foregoing.

For complete description of all work incidental to terminal development in Montreal and vicinity, see Canadian Railway and Marine World for July, 1929, pg. 415-418.

rocks can be creditably compared in hardness with the diked Trenton limestone now being excavated in the Mount Royal tunnel. However, as the rock encountered in the Loetschberg tunnel was sufficiently hard to require the use of air drills, that progress of 1,013 ft. will undoubtedly stand as a world's record for a long time, and certainly stands as a monument to good tools, good management, and good men.

The rock in the Dorchester St. heading of the Mount Royal tunnel, while not so hard as it is back of the mountain, is a very good Trenton limestone, which makes an excellent concrete stone, being sharp and not too high in lime. All stone coming from the tunnel is being crushed and what is not used by the company is being sold for massive and reinforced concrete, principally in Montreal.

The break ups, as they are called, where the full sized tunnel is excavated, are opened at as many intervals as desired. This excavation is extremely cheap and rapid. In one break up about 200 cu. yds. are now being excavated per day with two shifts of drillers. Jumbo timbers are framed into the headings at the break ups, so that the heading traffic is never interfered with, and the bulk of the break up muck drops into the cars by gravity. It is to permit the use of a fairly broad gauge double track at these break ups that the Mount Royal headings are driven 8 to 10 ft. high by 12 ft. wide.

While so large a cross-section very materially reduces the progress of the headings driven each month, it very greatly increases the economy of further excavation and construction. Back of the mountain, where the very hard rock is encountered and the drill carriage is in use, the heading averages about 10 x 12.5 ft., and the May progress was 510 ft. in 27 working days. At the city end, where the record was made, it was permitted to reduce this to about 8 x 12 ft. in order to assist the progress. It is expected to remove most of the benches below the level of the jumbo timbers with a steam shovel.

consists of R. Byers, General Superintendent, West; E. Duffy, General Superintendent, East; W. C. Lancaster, Electrical and Mechanical Engineer; H. T. Fisher, Tunnel Engineer; H. D. Robinson, Engineer of Design, and J. C. K. Stuart, First Assistant Engineer. The writer is managing engineer for Mackenzie, Mann & Co., Ltd., and Chief Engineer of the Canadian Northern Montreal Tunnel & Terminal Company, Ltd.—Engineering Record.

August 1913

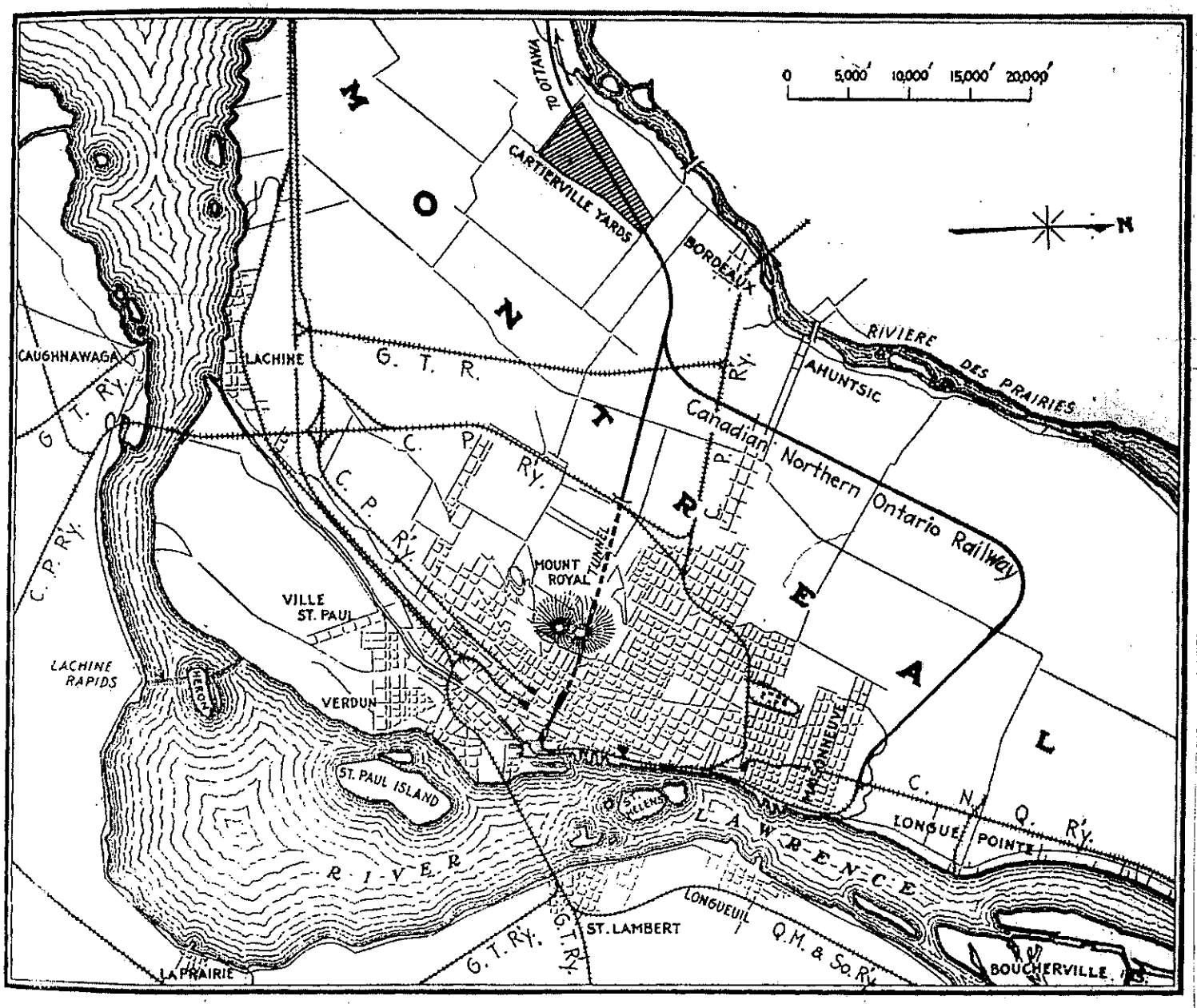

Fig. 3.—Canadian Northern Railway Terminal Lines in Montreal, with Tunnel under Mount Royal to Central Passenger Station.

Sturgeon River at mile 870, the line makes for the valley of a parallel stream, the Blackwater, which it follows to mile 900. Leaving the Blackwater about five miles above its mouth, the line turns abruptly south, and at mile 908 comes out on the immediate shore of Lake Nipigon at Sand Point. For the next 50 miles the work is generally heavy and on side hill. The line follows the bold shore of Orient Bay, and from its head follows a curious valley between lofty trap mountains, partially filled in with glacial drift, once forming the outlet of the lake. At mile 912 is the only tunnel since leaving Montreal, 1,100 ft. in length through a bold trap bluff.

200 ft. to the dividing ridge between it and Thunder Bay. Immediately after crossing this divide is the heaviest piece of permanent trestle on the line, the crossing of Blende River at mile 998. This is 1,400 ft. long and 140 ft. maximum height. From this point into Port Arthur, at mile 1,023, there is a long descent on fairly easy ground to within two miles of the city, whence it is being arranged to use the C.P.R. line to a junction with the C.N.R. line already in operation from Port Arthur westward.

Exploration and Surveys.

The surveys for this long stretch of line (1,023 miles) have extended over eight years, although most of the work

established supply routes, elevations of lakes and rivers, direction of drainage, and the character of the surface geology.

From the information gained, a general route was laid down through governing points, only one or two of which have been abandoned as the result of fuller information. This being done, the regular survey was started and carried continuously forward from either end. The methods were rather different from, and it is believed an improvement on, the usual practice. The district was divided into two parts under as many experienced division engineers, probably the very best men for the task to be found in the country. To each of these was as-