

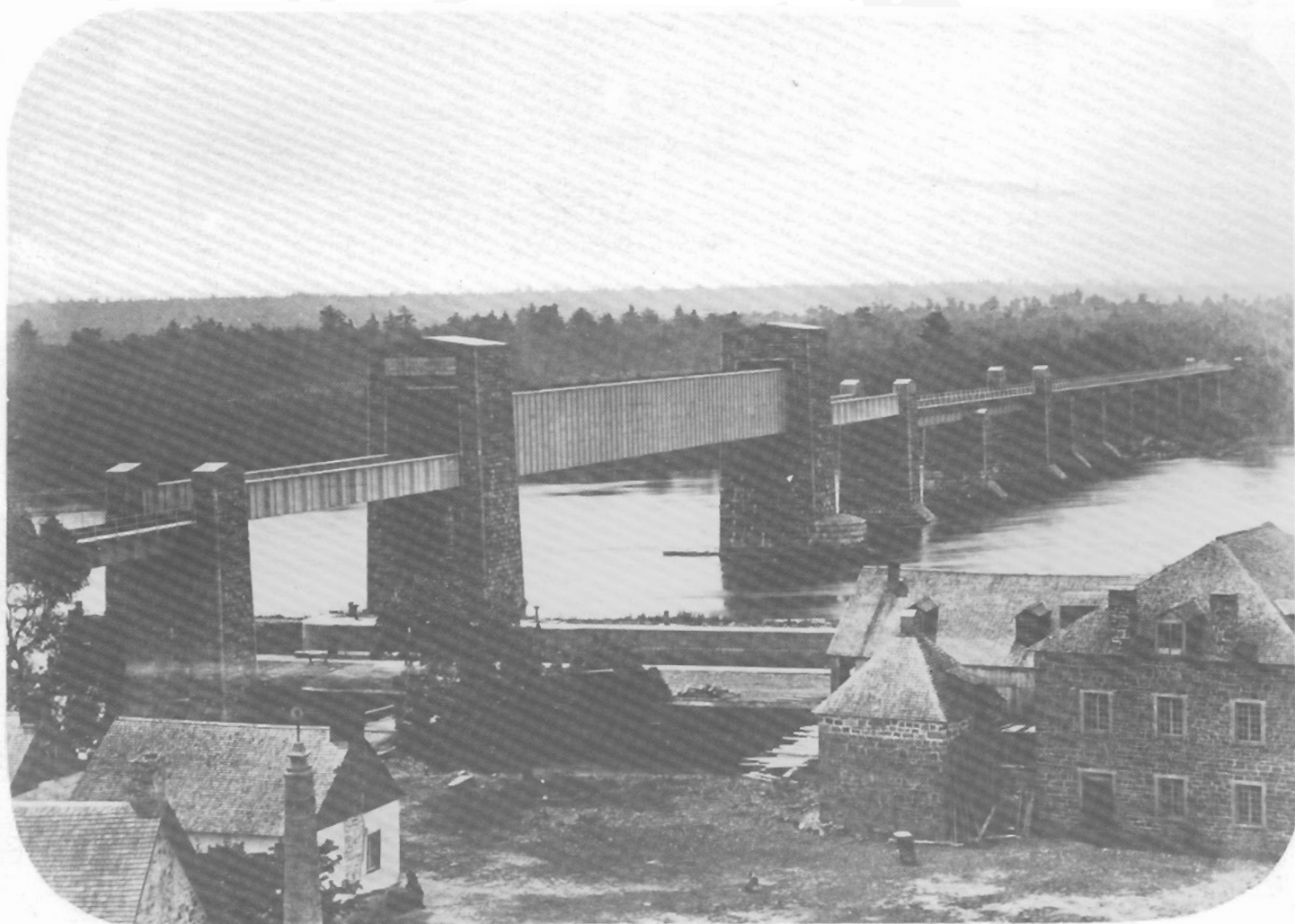
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Canadian Rail is continually in need of news, stories, historical data, photos, maps and other material. Please send all contributions to the editor: Fred F. Angus, 3021 Trafalgar Ave. Montreal, P.Q. H3Y 1H3. No payment can be made for contributions, but the contributor will be given credit for material submitted. Material will be returned to the contributor if requested. Remember "Knowledge is of little value unless it is shared with others".

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FRONT COVER: The tubular bridge of the Grand Trunk Railway at Ste. Annes, Canada East (now Ste. Anne de Bellevue P.Q.) as photographed in 1860. This bridge was built in 1855 as part of the GTR line between Montreal and Toronto, and it stood until 1899 when it was replaced by a more modern structure.

Notman Photographic Archives, McCord Museum. Photo No. 7542 View.

As part of its activities, the CRHA operates the Canadian Railway Museum at Delson / St. Constant, Que. which is about 14 miles (23 Km.) from downtown Montreal. It is open from late May to early October (daily until Labour Day). Members, and their immediate families, are admitted free of charge.

The St. Clair Tunnel 100th Anniversary

By Douglas N.W. Smith

(With some additional research by Fred Angus)

In September 1991, special events were held in Sarnia, Ontario and Port Huron, Michigan to mark the one hundredth anniversary of the opening, by the Grand Trunk Railway, of the St Clair Tunnel between the two communities. The engineering solutions to the difficulties imposed by the soils in the area brought this project into world-wide prominence.

To mark this major accomplishment, Canadian Rail takes pleasure in presenting a history of this major engineering accomplishment including a detailed account of the early history and construction of the tunnel as written by an anonymous correspondent of the Toronto Mail in 1890. This article captures the flavour of the time and the attitudes of the Victorians towards the progress of technology. Supplementary material brings the history of the tunnel up to the present time.

THE ACCOUNT FROM THE TORONTO MAIL, SEPTEMBER 9, 1890

ST CLAIR TUNNEL:

SUCCESS OF A GREAT ENGINEERING UNDERTAKING

From Our Own Correspondent.

The St Clair tunnel is an accomplished fact, and is now numbered among the great engineering wonders of the world. After overcoming almost insurmountable obstacles the gigantic iron tubes have been driven from each side of the river and have met, and nothing now remains but to lay the track in the tunnel and excavate and grade the approaches. Thus the greatest problem of subaqueous tunnelling has been satisfactorily solved.

The credit for this undertaking is due more particularly to two men, Sir Henry Tyler, president of the Grand Trunk (GT), and Sir Joseph Hickson, general manager of the railway . . .

[Here it is necessary to interject material from other sources into this account so as not to perpetuate an error made by the reporter which attributed the St Clair Tunnel project to Sir Joseph Hickson, when in reality it was the brain child of Sir Henry Tyler. Those places in the article where the reporter attributes the tunnel to Hickson have been excised - DNWS.]

On November 18, 1879 Sir Henry Tyler wrote to Mr Hickson: "When shall we be in running order to Chicago? As soon as the route is, if it become, a proved success, we shall have seriously to consider the question of a tunnel at Sarnia, or a tube at the bottom of the St Clair river, perhaps slightly below the bottom, worked from a heading with a water-tight face . . ."

On January 31, 1880, Hickson wrote to Sir Henry Tyler: "In a note you wrote me some time ago, you referred to the matter of making a tunnel beneath the River at Sarnia. I asked Mr Hannaford to tell me if any project of the kind had ever been to his knowledge, considered and reported upon. I enclose you copy of a short note he has written me on the subject.

I doubt very much if any bridges will ever be put across either the Detroit or St Clair Rivers. The shipping in these waters is immense, and the shipping interest extremely powerful in the State of Michigan.

The difficulties in the way of sinking tubes are certainly quite as great as Mr Hannaford describes them . . ."

In a letter dated January 7, 1880, Hannaford stated that the physical difficulties were such as to place a tunnel practically out of the question and that if a crossing was ever required other than the car ferry, a bridge would be the practical and least costly way².

After the fusion of the GT and Great Western railways in 1882, the matter was taken up again, as the line of the Great Western on the one side and that of the Chicago and Grand Trunk on the other side of the river were so situated as to favour direct connection by a tunnel or otherwise. Mr Walter Shanly was requested by Sir Joseph in 1883 to make an examination of the river, which he did, reporting very much in favour of a tunnel being attempted near the site which was subsequently adopted³.

[The text now returns to the account of the Toronto Mail's correspondent - DNWS.]

ORIGIN OF THE WORK

In 1874, Sir Joseph Hickson became General Manager of the GT. With that shrewdness and perception which has proved such a powerful factor in placing the road in its present proud position as one of the greatest of the trunk line systems on the continent . . . He at once set to work to consolidate the scattered and moribund railway systems and interests of the province and amalgamate them into a quickened and harmonious whole. The fusion of the Great Western and other roads followed, and the railway interests were benefited accordingly . . . The acquisition of lines of railway on the American side of the St Clair River and of the Great Western line on the Canadian side placed the means of carrying out the projected tunnel within the realm of possibilities⁴. The GT now has its most important lines converging on both sides of the St Clair River at about the only point where the building of a tunnel could be undertaken with a reasonable hope of success.

NEED FOR THE TUNNEL

The traffic over the GT system, which embraces the Grand Trunk Railway of Canada with its various leased and acquired lines and connections, the Chicago and Grand Trunk, the Detroit, Grand Haven and Milwaukee, the Toledo, Saginaw and Muskegon, and the Flint and Pere Marquette Railroads, has been increasing so steadily and rapidly every year that it became obvious . . . that a ferry transit would soon be inadequate for the work. The two large steam car ferries at present employed are worked to their full capacity. Besides this, the cost of ferrying annually is very large and the method unreliable. The ferries are operated at a point on

the river where the current is swift, running from 6 to 8 miles an hour. In this way danger from the river's freezing over is avoided, but ice jams are frequent, and a powerful tug has to be kept in constant readiness all winter to give assistance when necessary to the ferries, which occasionally get caught in a field of floating ice and are carried rapidly down the river. To reach this point where the current is so swift the railway has to deviate about six miles, making the haul so much longer, which annually is a large expense, owing to time lost and the cost of running the trains so many more miles.

There remained two ways out of the present difficulty: either to build a bridge or make a tunnel. The marine interests were a unit against a bridge. The surrounding country is very level, and it would be almost impossible to build a bridge of height sufficient to give a free and uninterrupted passage to vessels underneath. A swinging bridge was out of the question as hundreds of craft of all description pass through the river daily. Steam barges with five or six vessels in tow follow each other in rapid succession through this, the great waterway of the continent. This would interrupt railway traffic, and then again, the current, which is very swift, would be liable to carry vessels against the bridge unless it were operated rapidly and much faster than any large bridge could be swung. All these questions were considered, and it was decided to take the other horn of the dilemma, the tunnel.

A DIFFICULT SCHEME

This project was not at all promising. Subaqueous tunnels are not very plentiful on this continent, and the road to success along this path of engineering science is strewn with failures. At Detroit, an attempt had been made to build a tunnel, but it had to be abandoned after thousands of dollars had been expended on the work. The Hudson River tunnel is still in progress, and the prospects of its success are not at all assuring⁶. Experienced workmen in this department of engineering were not to be had. There were plenty of contractors and engineers acquainted with tunnelling on dry land; there were successful rock tunnellers by the score; but at tunnelling through clay and quicksand under water they drew the line. True it was that several small tunnels had been carried under rivers and lakes, but to guarantee success was another thing. [In short, the decision to tunnel was a real "Hobson's Choice", literally as well as figuratively. Ed.]

Of subaqueous tunnels it might be said that the Thames tunnel was the first. This great work had "failure" written on its plans for years. It was projected and begun in 1807, and had to be abandoned. It was resumed again in 1825 under Sir M. T. Brunel, the celebrated engineer, and completed eighteen years later, in 1843. This tunnel is only 1,200 feet long, and it cost the enormous sum of 1,200 pounds per linear yard or about \$7,200,000.

In America a subaqueous tunnel was first built in connection with the water works system of Chicago in 1864, and was completed in 1867. A crib was sunk two miles out in the lake and into the bottom to a depth of fifty-eight feet. A drift was then started towards the city nine feet in diameter. The object was to secure a pipe for fresh water. The work was successfully carried out at a cost of some \$457,844. Another under Lake Erie was built at Cleveland in 1867-74, which was successful. These number about all the successes on this continent, with the exception of the tunnels

under the Chicago river, which are only minor undertakings, so that it can be seen that the task undertaken by Mr Hobson was not a cheerful or an easy one by any means.

PRELIMINARY EFFORTS

As already stated, an unsuccessful attempt had been made to tunnel under the Detroit River under conditions to a large extent similar to those that exist at the St Clair River. Away back in 1867, Mr James F. Joy, at that time president of the Michigan Central Railway, asked Mr Chesborough, a well-known engineer, to make a survey of the Detroit River, and to report as to the possibility of building a tunnel in the vicinity of Detroit.

Mr Chesborough presented a report in 1869 which outlined a tunnel under the Detroit River 8,600 feet in length, 3,000 feet of which would be under the bed of the river. The idea was to build two single track tunnels one alongside the other. One was to be completed before operations were commenced on the second. The cost of the work was estimated at \$2,650,000. Operations were begun in 1872, and 250 feet tunnelled from the Windsor side and 1,200 feet from the American shore.

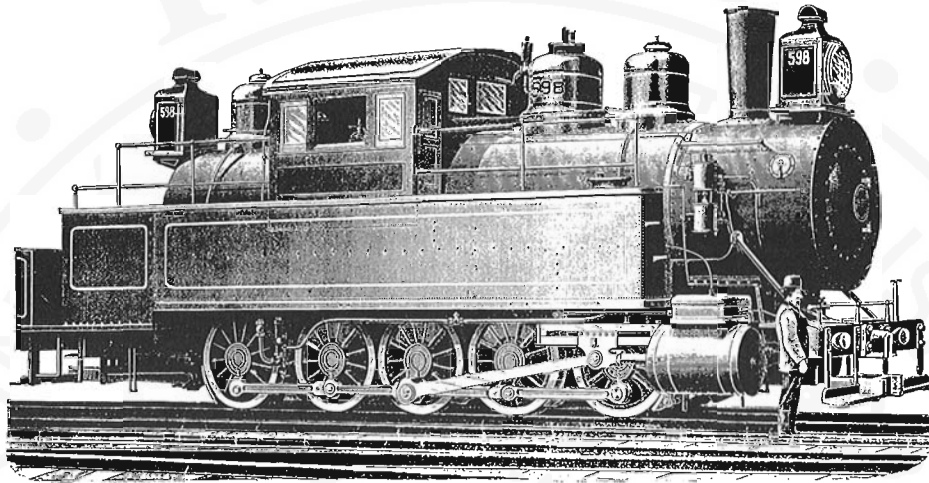
Quicksand, water and natural gas, which abound in the vicinity, interrupted the work, and the task had to be abandoned as hopeless. This in itself would have been sufficient to deter less sanguine men than Sir Joseph Hickson and his confreres from the gigantic undertaking. But Sir Joseph and those associated with him are built of sterner stuff. No such a word as "failure" is included in their vocabulary . . .

AN INTERESTING SURVEY

In 1884, Mr Hobson, with his able and enthusiastic young lieutenant, Mr Hillman, made a survey of the St Clair River with a view of ascertaining the best place for the proposed tunnel. After taking soundings of the bed of the river a spot was selected about a mile lower down the river than Sarnia, near the Indian reserve, now in the suburbs of the town.

Borings were then made close to the proposed line, and as deep down as the rock, to ascertain the depth of the clay and the strata. It was found that the strata consisted first of about two feet of the common yellow sand, such as is found on the sea shore. Then came a mixture of quicksand and blue clay, averaging about 12 feet in thickness, and underlying this and down to the rock, a depth of a hundred feet from the surface, a strata [sic] of adhesive blue clay of the consistency of putty and increasing in tenacity according to depth. Drawings and plans of the tunnel were then made, and these plans have been adhered to.

The St Clair Tunnel Company was then formed with the following officers⁶: President, Mr Joseph Hickson, general manager of the GTR⁷; Vice-President, Mr L. J. Seargeant, traffic manager of the GTR; Directors, Hon Alexander Vidal, Sarnia; Mr J. Bell, Belleville; Mr Charles Mackenzie, Sarnia; Mr E. W. Meddaugh, Detroit; and Mr J. W. Spicer, manager of the Chicago and Grand Trunk Railway; Secretary-Treasurer, Mr R. Wright; Solicitors, Mr J. Bell, Belleville, and Mr E. W. Meddaugh, Detroit; Chief Engineer, Mr Joseph Hobson, Hamilton; Second Assistant Engineer, Mr M. S. Blaiklock; Mechanical Superintendent, Mr J. T. Eames; Superintendent of Excavation, Mr T. H. Murphy.



One of the locomotives specially built for the St. Clair tunnel service. This engraving shows the engine as built. At that time they were said to be the largest in the world (note the figure of the man by comparison).

COMMENCING OPERATIONS

In the fall of 1886, operations were commenced by sinking test shafts on both sides of the river to a depth of 92 feet on the American side and 98 feet on the Canadian side. The shafts were four by eight feet, and were built of pine timbers, one foot square, with a solid stay across the centre. At the bottom, drifts were extended under the river at right angles to the shafts, on the Canadian side to a distance of some 150 feet and on the American side about 30 feet. Water and gas prevented operations being carried on any further. These horizontal shafts were six feet diameter, and were made for experimental purposes. These tests were completed in the summer of 1887.

It was then decided to go on with the main project. The company concluded to build under the river first from gigantic shafts on each shore, and once this, the more difficult section, was finished to complete the end borings. Later on they discovered they had fallen into the same error as many other tunnel builders, and that there is nothing like beginning at the beginning.

Work on the shafts began in the summer of 1888. These shafts are twenty-three feet in diameter with brick walls two feet six inches in thickness. The walls were built upon a cast-iron circular shoe with a knife edge, which kept sinking as the excavation was going on below and the bricks were built above. In this way, the whole mass of brick was to sink gradually with its own weight

into the excavation. For the first thirty feet the work on the American shaft progressed favourably. Then the brick wall refused to sink any further. The stiff clay closed on the walls and stopped further progress. Dynamite bombs were exploded at the bottom to release the pressure, but it was of no use. The shaft sank about four inches and then became fixed. All that could be done then was to proceed with the excavation and build the brick downward. This method of working proved very unsatisfactory. Each section as it was built cracked away from the upper layer of bricks, and the task seemed almost hopeless.

In sinking the Canadian shaft less difficulty was experienced. The brick walls gradually sank to the depth of 98 feet, but when this was reached a general settling in of the ground all around the shaft set in, and at the same time the soft blue clay began rising in the bottom of the shaft. To make matters worse, the shaft began to lose its circular form, the great pressure of the walls from the outside was proving too much for it. When the ground began to sink the machinery and plant were hurriedly removed to a place of safety.

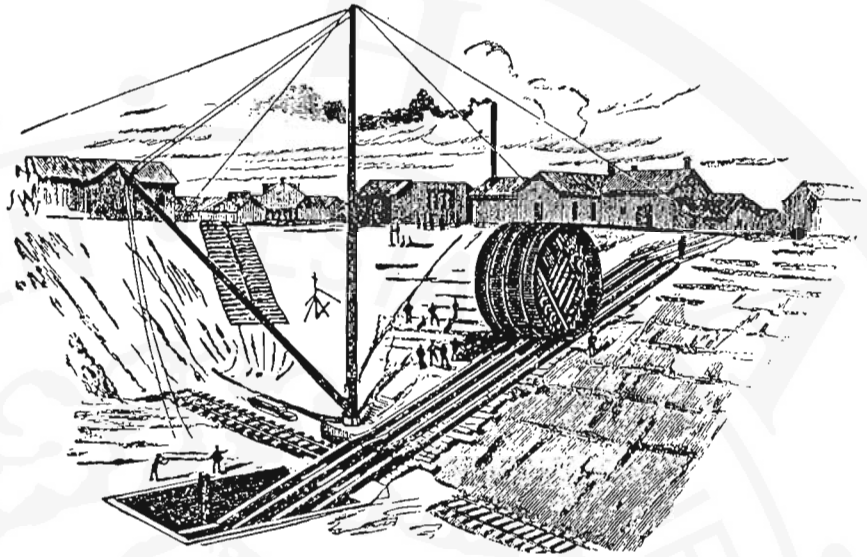
Fearing an entire collapse of the shaft, beams were hastily placed across it at intervals. But the beams did not serve the purpose required, and the shaft had to be hurriedly filled with sand to relieve the pressure and save the walls. Since then the company have decided to fill the shaft with clay and leave it to its fate. The American shaft was carried to a depth of 58 feet, and then operations ceased. It is now decided to use it as a ventilator. It will be lined with cast iron similar to that used in the tunnel.

So far the results were not very satisfactory. Sir Henry Tyler came out from England that year, and after the disastrous work on the shafts, it was decided to begin right at the beginning and drive the tubes through from the extremities. The machinery, plant, and equipment were moved 1,800 feet inland on the American side, and some 1,900 feet inland on the Canadian shore.

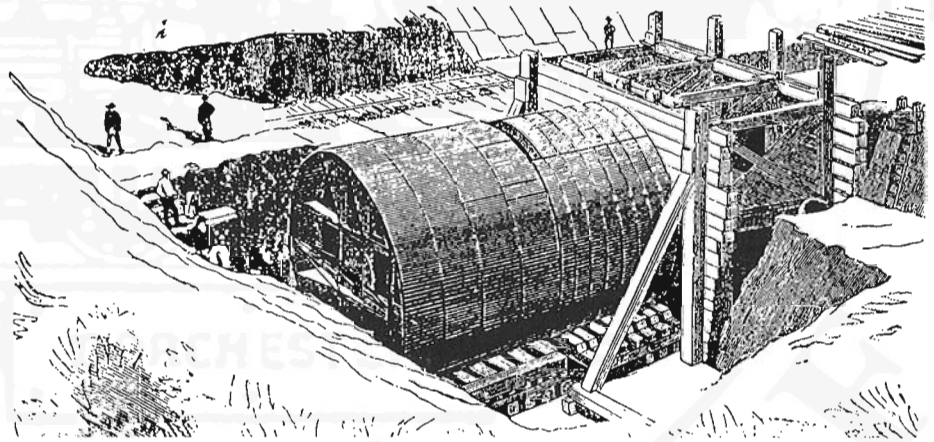
Two great spoon-shaped excavations were made, one at each shore. Operations on these cuttings began in January 1889. The cutting on the Canadian side was carried to a depth of 58 feet. The soil appeared to be firm, and the cutting was not made very wide. It was soon found necessary to widen the cut, however, as a landslide happened which sent thousands of tons of loose earth and clay into the cut, filling it to the depth of 16 feet. The slide was so extensive that it threatened to undermine the foundation of the workshops and it was decided to begin the tunnel 158 feet further back.

On the American side, owing to the existence of quicksand to a depth of eight or nine feet, and the shifting nature of the blue clay underneath it, the cutting was made larger and wider. The depth of the cut is about 56 feet and 200 feet wide at its deepest part. An incline was given, just slight enough to enable an engine to pull out the soil. The tunnel proper was then commenced, and after a pit had been dug on both sides of the river, the huge excavating shields were rolled down the bank and placed in position. A strong backing of wood was placed behind the shield, a ring of the tunnel lining bolted together, and the shield then started upon its mission across underneath the river. The engraving (a) shows the shield as it is lowered into the heading. Engraving (b) shows it resting in its place on the grade ready to enter the heading. The cutting edges of the shield are shown in front. In the rear of the shield can be seen a portion of the iron lining of the tunnel pushed up against the temporary timber backings . . .

A description of this shield is not out of place. The credit for the invention is claimed by Mr Beach, the well-known American engineer, although similar shields have been used in England and elsewhere. The shield consists of a strong cylinder of steel like a gigantic section of stovepipe. The front end of the cylinder is sharpened so as to have a cutting edge for entering the earth. The



ENGRAVING "A". The shield being lowered into the heading.



ENGRAVING "B". The shield resting in place on the grade ready to enter the heading.

rear end for about three feet is made thin and is called the hood. Arranged around the internal main walls of the hood are 24 hydraulic jacks all operated by the one pump, each jack provided with a cock by which the pressure can be relieved or increased on any one pump as desired. In this way, the shield can be directed to the fractional part of an inch. When at work, the iron plates of which the walls are composed are built up in a segment within the hood of the shield. The hydraulic jacks are then made to press against the end of the tunnel plates or tube, and it is in this way the shield is forced ahead through the clay about two feet, the length of the pistons of the jacks.

As the shield advances, the men employed in the front cut away the soil, and another gang carry it off. Each shield has an external diameter of 21 feet 7 inches, is sixteen feet long, and of steel plated one inch thick. They are divided into twelve compartments by means of two horizontal and three vertical stays or shelves two inches thick with cutting edges, and extend back six feet. There is a heading or bulkhead, with two heavy doors almost flush with the hydraulic rams. This is a precaution that in case of flooding or accident in the shield, the doors of the bulkhead can be closed, cutting off the danger. These doors did not have to be closed once during the work.

The hydraulic rams, as already stated, are 24 in number, and eight inches in diameter. The power is supplied by a Worthington pump capable of producing a pressure of 8,000 pounds to the square inch, which would amount to about 125 tons per ram, or 3,000 tons on the whole shield. The greatest pressure yet used was only 1,700 pounds per square inch, about 40 tons per ram, or 1,080 tons on the shield.

The shields weigh about 80 tons each, and were built by the Hamilton Tool Manufacturing Company. They were brought to the tunnel in sections and erected in the shops adjoining the works. The walls of the tunnel are constructed of cast-iron segments, thirteen of which and a key form a circle. The dimensions of each cast-iron segment are, length 4 feet 10 inches, width 18 inches, thickness 2 inches, with flanges inside 6 inches deep and 1 3/4 inches in thickness. These segments are cast with 32 holes in them, 12 on each side and four on each end. The edges are planed in the workshops at the works. They are then heated and dipped in coal tar, from which they come out black and shining. They are bolted together with 7/8 [of an inch] steel bolts, and the external diameter of the tunnel is 21 feet and the inside 20 feet. These segments are placed in position by means of a circular crane, which revolves on a spindle in the centre of the rear of the shield, and is provided with a vise jaw at one end and a counterpoise at the other. When a casting is secured in the jaws, the arm of the crane rises about 9 inches, thus lengthening the counterpoise arm. This gives the arm a clear space to travel around in the circle. When the spot required is reached, the sliding motion of the arm is reversed and the iron placed in its position. This crane was designed by Mr Teiper, manager of the Hamilton Tool Manufacturing Company.

COMMENCING SHIELD WORK

The shield on the American side was started on July 11, 1889, and on September 21st on the Canadian side. On the American side, little trouble was encountered. The work was continued without interruption day and night, and each shield advanced at an average rate of about 10 feet per day. The largest day's work was 27 feet 10 inches.

At first, the clay was cut out with long thin spades known as the English tiling tool. A workman employed in the shield, a cooper by trade, thought he could devise a scheme whereby the rate of progress could be materially increased. He took an old saw and bent it in the shape of a horseshoe or like the crooked knife used by coopers for shaving out the insides of barrels. When he started to work with this new tool, he could do the work of three men. The knives were then adopted. They are made for two men to operate, with a handle at each end. The men grasp the handles, and reaching up slice out slabs of the putty-like blue clay, three and four feet long and four and five inches thick. These slabs are loaded upon cars by a gang called the "muckers", and the cars are drawn out of the tunnel by horses and mules.

There are two tracks for these cars. On one track the cars are drawn

out, and upon the other the empty cars are sent back. Since the invention of the crooked knife, the excavators have been enabled to keep easily ahead of the gang that lay the cast-iron segments.

The idea of these excavating knives shows how man's inventive genius is stimulated by necessity. Another example is in the japping of the cast-iron segments. At first the japan was heated, and the cold iron segments dipped in the boiling liquid. It was found that the tar would not dry soon enough for the progress of the work and that it was constantly dripping in the tunnel. Some one suggested that the segments be heated. This plan was adopted, and now works admirably. The japan is kept cold in a large vat. The heated iron segments are dipped into it and absorb the japan much better than in the old way. There is a great saving in the amount of japan used, and besides, before the iron is cool the japan is dry, and the segments can be handled without any trouble.

**TABLE SHOWING AMOUNT OF WORK
ACCOMPLISHED EACH MONTH
(IN FEET)**

MONTH	CANADIAN	AMERICAN
-----	-----	-----
July, 1889	0.00	53.00
August, 1889	0.00	144.50
September, 1889	73.30	153.70
October, 1889	169.45	126.75
November, 1889	187.50	225.50
December, 1889	217.40	266.91
January, 1890	292.35	277.59
February, 1890	306.08	273.67
March, 1890	292.50	203.63
April, 1890	281.31	182.20
May, 1890	97.00	355.54
June, 1890	236.83	354.46
July, 1890	201.30	382.30
August, 1890	331.05	314.10
TOTAL	2686.07	3313.85

INTELLIGENT WORKMEN

The men employed on the work are of a far more intelligence than the average navvy, and were all scheming and devising plans for to surmount the difficulties. In the tunnel, they work eight hours per day.

When the tunnel on the Canadian side reached the river bed, great trouble was experienced with quicksand and water. It was almost feared that the work would have to be abandoned; but Sir Joseph Hickson visited the works, and the men say he never seemed so cheerful and confident as he did them. His happy and sanguine manner did much to cheer them. The work was continued in spite of every obstacle.

When the line of the river was reached on both sides, air-tight bulkheads of brick and cement were erected right across the tunnel. Each side of these bulkheads contains two large air chambers 17 feet long and 7 feet in diameter, with air-tight doors at each end. These chambers are built one over each car track. Then the work in the section next [to] the shield was commenced under an air pressure of 10 pounds to the square inch, which was gradually increased as the work progressed.

When a gang of men or an empty car is to be admitted into the compressed air chamber, the outside door of the air lock is opened, and they are admitted. The iron door is then closed, and the air valve is opened into the chamber until the pressure in the lock is equal to that in the tunnel under the river. The door leading in can then be opened without any trouble. Latterly, the men have been working under an artificial pressure of 22 pounds per square inch, or a total atmospheric pressure of 37 pounds per square inch, or about 2 1/2 atmospheres.

The benefit of this compressed air is that its pressure is such that water and quicksand will not flow into the tunnel - a leak will not show itself at all. The air pressure equalizes the pressure of the clay and sand so that it overcomes all tendency to gush into the shield and endanger lives of the workmen. Three gangs of 75 men are employed in the compressed air, and about 700 men are employed altogether on the work.

STRONG CONSTITUTIONS NEEDED

Only mules can be used in the compressed air sections. Horses upon being taken out of the compressed air lose the power of their limbs, and bleed at the mouth, eyes, and nose. The men before being admitted must all be examined by the company's physician, Dr Johnston.

In the air lock, the air pressure must be increased or reduced gradually on a man, it requiring about five minutes for the process. Three accidents occurred owing to the recklessness of one of the workmen, who let the air off too fast. If the air is let off too fast, when a man emerges into the outer atmosphere he finds that has what is called the "benders", that is, his knees wobble under him and he bleeds at the nose, mouth and ears.

The foreman in charge of the excavation is Mr Murphy, as daring a man as can be found in America. He is a born leader, and adored by all the workmen under him, and under his leadership the men worked cheerfully and with confidence. He has had experience in tunnelling before, having been employed in a like capacity in the Hudson River tunnel.

On the American side, they began using compressed air on April 7th, 1890, and on the Canadian side on May 20th. The total length of the tunnel is 6,000 feet, of which 2,290 feet are under the river and remainder under dry land. The maximum depth of the river is 40 feet. The length of the tunnel under dry land on the Canadian side is 1,994 feet, on the American side 1,716 feet. The length of the open cutting and approaches on the Canadian side will be 3,100 feet, on the American side 2,500 feet, making the tunnel and approaches a total length of 11,600 feet.

The cast-iron lining will weigh 55,963,600 pounds, secured by 2,000,000 steel bolts seven-eighths of an inch in diameter. Two-thirds of the cast-iron segments were furnished by the Michigan Car Company and one-third by the GT Company's foundry in Hamilton.

On each side of the river is the following plant: One pair of winding or hoisting engines, one ventilating engine, with a capacity of 10,000 cubic feet per minute, a Worthington hydraulic pump for operating the rams, on the American side an Edison electric plant, and on the Canadian side a Ball electric light plant, a drill, a planer with double tables, and two Ingersoll air compressors with boilers capable of generating 300 horse-power.

The tunnel at its lowest point is 94 feet below the surface of the river. The grades on the shore are one foot to fifty; in the portion underneath the river 1 1/6th foot to the 1,000 towards the Canadian side, where a drainage shaft has been placed, which will drain the tunnel.

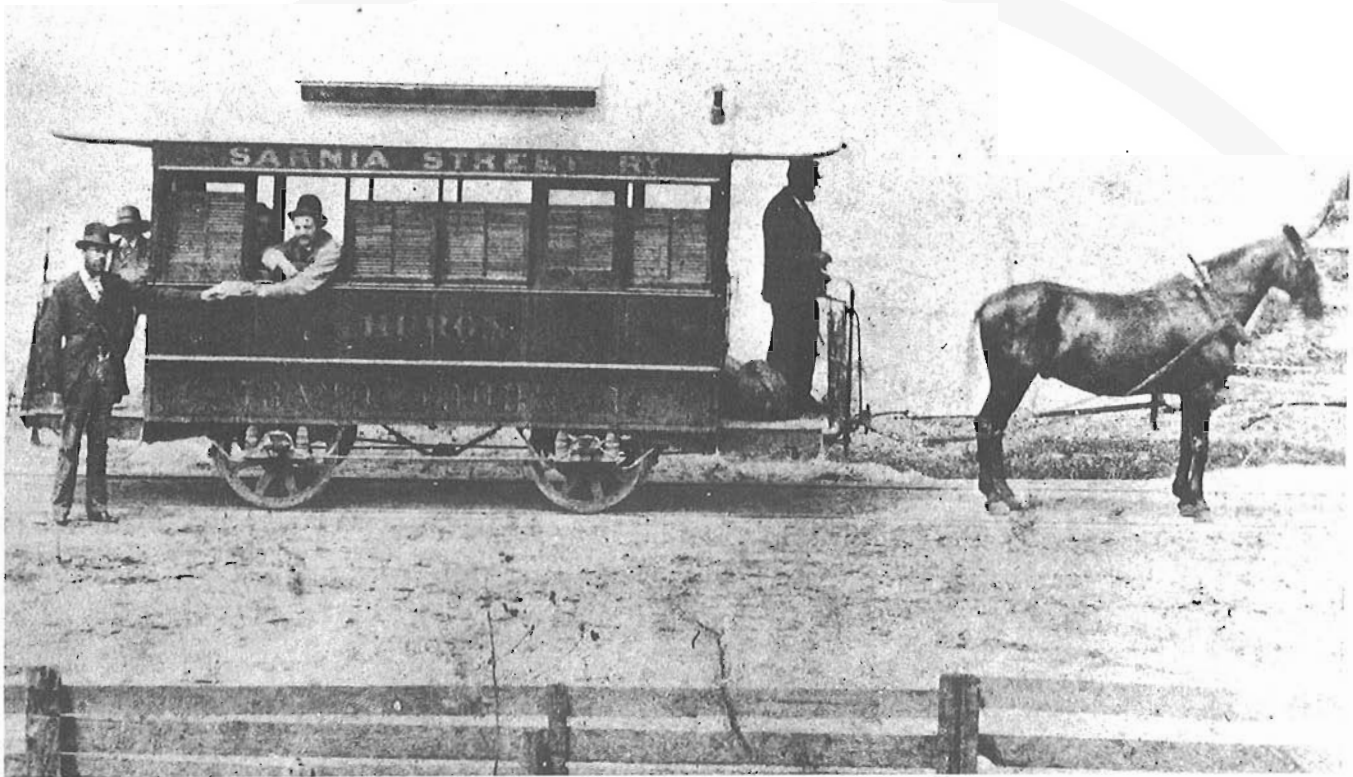
A VISIT TO THE TUNNEL

It was a bright sunny morning when I left Sarnia and took the street car for Point Edward. . . . At Point Edward, I met Sir Henry Tyler, Sir Joseph Hickson, Mr Hobson, Superintendent Stiff, and a number of other GT officials, and we boarded the official car and started for the tunnel.

An inspection of the new freight yard site was first made. Here men and horses were hard at work levelling the ground and filling in a broad stretch with the material excavated from the tunnel, and making the spot as level as a billiard table. The new yard will have accommodation for 20 miles of siding. On the American side a similar yard is being fitted up. The beginning of the cutting for the approach was also inspected, and then we set out on hand cars, as they are called "jiggers" for the tunnel.

When we arrived there, we were joined by Mr Hillman and his staff, who were taking an observation of the shield. The observations are taken from a small house in the line of the tunnel. Here Mr Hillman's pet, the transit used on the Canadian side, is set on a masonry foundation. It is a very fine instrument, made especially for the work by Messrs Troughton & Simms of London, England.

Every morning observations are taken down into the tunnel. A series of discs and a tube with cross wires, which passes through the air-tight bulkheads, and having heavy plate-glass openings at each end, enables the engineer to ascertain to the smallest fractional part of an inch any deviation in the direction of the shield. This deviation is marked in a diagram and one diagram is sent to Mr Hobson's Hamilton office, while another is kept at the work. The man in charge of the hydraulic rams is notified of the variation and deviation of the shield, and he adjusts the jacks so as



A Sarnia street car about 1890. This is the kind of car on which the "Mail" reporter would have ridden on his way to visit the St. Clair tunnel construction site. Sarnia operated the last horse cars to run in Canada; they lasted until 1902.

National Archives of Canada, Merrilees Collection. Photo PA-166522

to correct the error. The deviation is rarely more than one-fourth of an inch. When the auger passed through the drift on August 25th and both shields were sighted, they were found to be exactly in line without any deviation whatever, which speaks volumes for the work of the engineers.

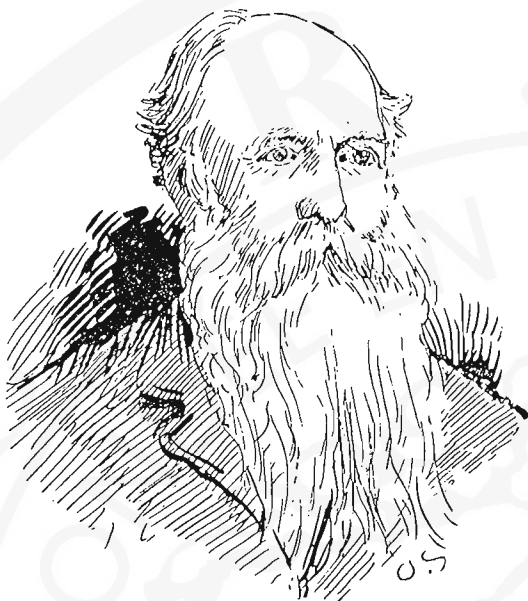
After examining the pumping or drainage shaft, which is being put down to drain the portals and approaches, we examined the engines, the pump, air compressors, and planers. Then we descended to the mouth of the tunnel. Once inside the tube lines of incandescent lamps, shining like stars, could be seen extending as far as the eye could reach into the bowels of the earth. A little boy, perched like a cat on top of huge horse, stood near the entrance, where he had just brought up a couple of cars loaded with the material excavated from the tunnel. A roar like the escape pipes of a locomotive is heard from the interior, and sounded very suggestive of the infernal regions. We were told that this was the compressed air which was being let off one of the air locks. The walls on all sides looked like the gigantic ribs of a ship, and are as dry as cork.

The party takes seats on two cars, and we are soon shooting down the incline deeper and deeper, while the roar of the escaping air becomes louder and louder every moment . . . After an almost endless period Mr Murphy who is conducting our car, set the brake, and we find ourselves at the mouth of the air-lock . . . The men are

hard at work in the shield, and when Sir Henry Tyler is recognized, a shout is raised which is almost deafening. A short passage through the drift and the American shield is reached . . . At the American side, Sir Henry Tyler stood at the opening while the camera winked . . . On the American side, the ground has settled about two inches over the tunnel, but no damage is done beyond the cracking of the walls of a house which belongs to the company. The sun never looked brighter than it did after leaving the tunnel. The air inside, however, in the portion outside the bulkheads is very pure and there will be no trouble about ventilation. The shields have not met, and the interior machinery and shelves will be removed and the shells allowed to remain their place. They have served their purpose well. The iron walls will be built up inside the shells.

COST OF THE WORK

The original cost of the tunnel was estimated at \$2,600,000. This included the cost of plant, material and labour. The actual cost will not fall far short of this. There is this, however: since the present tunnel has been demonstrated a success, a second one will probably be put through close by, and in the case of a second a certain amount can be saved by having the plant and possessing the experience derived from some of the slight [sic] indulged in the first case.



SIR HENRY TYLER as he looked in 1891.

SIR HENRY TYLER

A description of the tunnel would be incomplete without saying something about the projectors and those most closely interested. Sir Henry Tyler, as president of the GT, took considerable interest in the undertaking. Sir Henry is a man of about sixty years, with bright blue eyes, aquiline features, and a profusion of wavy hair and beard as white as the driven snow. He is as active as a boy of sixteen, being spare and athletic in figure. In Merrie England, his home and native land, he has since his youth been closely connected with great railway and engineering undertakings. He was a member of the commission that reported in favour of the Brindisi route to India. His name can be found in the encyclopedias as having reported on the advisability of building a tunnel across the Straits of Dover, connecting France with England. He has still plenty of confidence in the undertaking, and says it would not be half as difficult to cut through the blue chalk strata underlying the straits as the blue clay of the St Clair River. The foolish fears of the military authorities have kept this great undertaking from being carried through . . . Sir Henry is a captain of the Royal Engineers, and has for a number of years been a member of the Royal Railway Commission. He was knighted for his distinguished services, and is altogether a remarkable man . . .

SIR JOSEPH HICKSON

Sir Joseph Hickson is a man who has risen to his present position through sheer strength of character and ability. He is a railway man to the manor born, and his experience is so varied that there is not the slightest detail about the road he has charge of, or about railroads and railroad matters generally, that he has not at his fingers' end. The construction of locomotives and cars, the



MR. JOSEPH HOBSON In 1891.

intricacies of switches and sidings, the details of bridges and crossings, the management of freight and passenger traffic, the minutiae of railway auditing and finance, and the broader field of railroad politics and the relations of his road with other competitors are all matters upon which Sir Joseph Hickson can bring rare ability and the good judgment born of long and practical experience.

He began life believing that anything that is worth doing is worth doing well, and the St Clair Tunnel is only one example of his genius for carrying out gigantic enterprises. He was born in 1830, in the County of Northumberlandshire, England, and began railway life as a boy in the offices of the York, Newcastle and Berwick Railway. Subsequently, he went to the Maryport and Carlisle Railway, and worked his way steadily up to the position of agent at Carlisle. In 1851 he joined the Manchester, Sheffield and Lincolnshire Railway and became assistant general manager. It was then he was appointed to the position of chief accountant of the GT in 1861, and he subsequently became secretary-treasurer. In 1874 he became general manager, a position which he has ever since held.

His services in the present position have been and are of inestimable value to the road. He changed the gauge to make it uniform with the American systems. He sold to the Government the unremunerative line from Quebec to Riviere du Loup, and secured control of a line from Sarnia to Chicago. He is now president of the Great Western of Canada; the Detroit, Grand Haven and Milwaukee; Toledo, Saginaw, and Muskegon; the Michigan Air Line; the Montreal and Champlain Railway; the International Bridge Company, of Buffalo; the St Clair Tunnel Company; and a director of the Central Vermont Railway. He controls over 5,000 miles of road, and is the hardest working railway manager in America.

Few men are so well liked by the employees as Sir Joseph. He can call almost all the old employees of the road by name, and his manner makes them all feel that they have a personal interest in the railway. In 1881, the directors of the road expressed their appreciation of his services by presenting him with gold and silver plate to the amount of 2,500 pounds sterling . . . No man in Canada was more deserving of the knighthood conferred upon him this year than Sir Joseph Hickson.

MR JOSEPH HOBSON

Mr Jos. Hobson, the engineer who planned the St Clair River undertaking, is a Canadian. He was born in Guelph in March 1834. He engaged in engineering in the construction of the GT west of Toronto. After various engineering experiences on railroads in the United States and the Maritime Provinces, he engaged on the Wellington, Grey and Bruce in 1869. Early in 1870, he was appointed resident engineer of the International Bridge which was opened in November 1873⁸. He then entered the employ of the Great Western Railway Company, and became Chief Engineer in 1875, a position he has occupied ever since, although the road has been fused in the GT. He is a member of the Institute of Civil Engineers of England, of the American Society of Civil Engineers, and the Canadian Society of Civil Engineers. The tunnel, which is a monument to his genius, is sufficient glory for any engineer in a lifetime . . .

This concludes the colourful account of the tunnel's construction which appeared in the Toronto Mail.

ANOTHER ACCOUNT

The following article appeared in the Saint John Daily Sun (Saint John, New Brunswick) on Tuesday, May 5, 1891. It is written in a rather charming style, quite different from that of the "Mail" article, and contains some information not found in the latter. Accordingly, we have reprinted portions, consisting of about half, of the "Sun" article. Original spelling and punctuation have been retained. The portions which duplicate the "Mail" article have been deleted.

THE ST. CLAIR TUNNEL

DIFFICULTIES IN THE WAY OF ACCOMPLISHING THIS ENGINEERING FEAT

PUSHING IRON RINGS 6,000 FEET THROUGH CLAY UNDER A BROAD, DEEP AND RAPID RIVER.

Of all engineering work that which is least certain is what is called subaqueous tunnelling - that is, driving tunnels under rivers or other bodies of water. Usually the tunnel must be driven in clay, or river silt, or sand and gravel, with, in any case, more or less loose rock and boulders [sic]. The trouble is to keep a tight roof, and, if the material is very soft, to keep the tunnel itself in shape. There is great danger that the water will break through the roof and flood the work, or that the sides of the tunnel may be crushed in by the pressure of the water and the half fluid material beneath it. . . . The work was done by an almost untried method. When it is completed it will have cost about \$3,000,000.

The Grand Trunk Railway crosses the St. Clair river from Sarnia, Ont., to Port Huron, Mich. About sixty trains crosses [sic] there now by ferry, and at least seventy will go through the tunnel every day when it is completed. On the St. Clair river there is a shipping commerce five times as great as that which passes through the Suez canal. The river is from half to three-quarters of a mile wide, and the current flows from six to eight miles an hour.

For many years trains have been taken across on ferry boats. This is comfortable enough for passengers, but it takes up precious time, the boats are expensive to keep up and to operate, and in winter, when the river is full of floating ice, the delays and cost are serious.

To carry the tunnel, which it was decided to build here, through clay with occasional pockets of gravel and quicksand, and with a great river flowing only fifteen feet overhead, was a difficult problem.

It was decided to do the work inside of steel tubes, called shields, which should be pushed ahead as the work advanced, and to line the tunnel with rings of cast iron as fast as the shield went forward. In this way the danger of collapse of the tunnel would be avoided, and it would be practically finished as fast as it was dug.

But to keep the water or soft material from flowing in at the open front of the tube was another thing. How that was done will be told later.

One shield was started in from the Michigan side and one from the Canadian side. . . . As fast as the shield went forward the tunnel was lined with rings of cast iron. Each of these rings was twenty-one feet in diameter and eighteen inches long, measured in the direction of the length of the tunnel. [Except the last ring, which was made up of segments specially cast, since it was of a different width than all the others in order to close the final gap]. The ring being of less diameter than the shield could enter the rear of it; and so there was always a complete tube of steel and iron from the face of the clay where the men were digging to the entrance of the tunnel. . . .

This was all very simple so long as the work was under the dry land, but when it reached out under the river it was necessary to find some way to keep the water out. Otherwise, when seams of loose material were struck, water would have poured in and flooded the tunnel, and that would have ended the matter. To prevent this compressed air was used.

Every one knows that he can hold up a column of water with a column of air. Let him fill a U - shaped glass tube half full of water, hold it upright, with the open ends upward, and blow into one end of it. The water will rise in the other leg of the tube, and the harder he blows the higher the water will rise and the longer will be the part of the tube free from water.

Now, if one could put a fly in the dry leg of the tube and stop the end of it, the water would be held in the other leg, and the fly could move about at his pleasure, dry-shod. This is the principle on which compressed air has long been used in deep foundations and other sub-aqueous work. At the St. Clair tunnel the dry leg of the tube was the tunnel, the wet leg was the river, and the workmen were the flies. . . . It will be understood that the deeper one goes, and the higher the column of water, the greater the air pressure that must be carried.

The men, mules, and clay cars went in and out of that part of the tunnel, which was filled with compressed air by means of an air lock..... The painful part of the journey is in the air lock at the time the pressure is changing. There people often suffer severe pain in the ears from the unequal pressure on the two sides of the eardrum, and sometimes the suffering is so great that they can not go on.

After one has been a little while in the compressed air the pain ceases, but there is a trouble which is peculiar to working in compressed air, and which disables a good many men and kills a few. The men call it "the bends". It is paralysis, more or less complete, of the muscles, and especially of the legs. Sometimes it is not painful, but more often it is so, and sometimes very painful indeed. At the St. Clair tunnel there were three deaths from this cause. Horses could not work in the compressed air, but mules stood it well, though occasionally one of them was visited with the "bends".

The pressure of the air carried was ten pounds per square inch at first and twenty-three pounds when the middle of the river was reached. At times it was run up to forty pounds. Of course these pressures are in addition to the normal atmospheric pressure of fourteen pounds per square inch, which is always present on everybody and every surface in the open air.

The air pressure was kept up by pumps, and to guard against accident there were two sets of air compressors at each end of the tunnel. If the supply of air had failed for a moment, the water would have rushed in and drowned the men.

Besides the air-compressing plant, machinery had to be provided for pumping out any water that drained into the tunnel during the work, and other machinery for lighting it by electricity. There were hoisting engines and derricks with which to lift to the surface the dump cars as they came out loaded with clay.

It happened repeatedly that the shields, as they were forced forward, entered pockets of gravel or quicksand going deep down into the blue clay. Then the air would escape through the loose material and the water would begin to flow in. Generally this could be stopped soon by increasing the quantity of air pumped in, but not always. Sometimes the air blew out through the bottom of the river so fast that the air pumps could not keep up pressure enough to stop the flow of water.

More than once it seemed that the tunnel would be flooded in spite of all that could be done, but luckily the engineers were always able, by plastering over the face of the gravel with clay, and by working the air-compressors up to a pressure of as much as forty pounds to the square inch, to hold back the water long enough to get the shield through the loose gravel into the clay beyond.

The 30th day of August, 1890, the shield from the United States shore met that from Canada under the middle of the river. This was just one year after they had started on their strange journeys; and I do not believe that Meade, the 4th of July, 1863, was happier or more thankful than was the chief engineer of the St. Clair tunnel on this August day.

[Editor's note: This ends the "Sun" account. The final reference is to General George Gordon Meade, Civil War general and commander of the Union troops at Gettysburg, who had won this critical battle on July 3, 1863.]

COMPLETING THE TUNNEL

While the two bores under the St Clair River were joined with a pilot drift on August 25, 1890, and they actually met on August 30, it was to be more than a year before the tunnel would be opened for regular service.

While the tunnel itself was completed, it remained to excavate the approaches to the tunnel. This was a major undertaking. The Port Huron tunnel portal would be 60 feet below the land surface in a cut which would be 400 feet wide across its top. The open approach on the Port Huron side is slightly more than 2,500 feet long while that on the Sarnia side is nearly 3,300 feet long. The unstable clay soil caused considerable delays in completing the tunnel due to land slides⁹. The most serious land slide occurred on July 1st when some 300 feet of embankment came loose burying the American approach to the tunnel to a depth of 15 feet. The clay excavated from the approaches was used as fill for the new Port Huron and Sarnia yards built near the tunnel¹⁰.

While work on the approaches was underway, workmen were busy finishing the tunnel. By January 16, 1891, rails had been laid through the tunnel and workmen were plastering the brickwork in it with cement¹¹.

The first trial trip through the tunnel was made using yard locomotive 253 on April 9th. The locomotive, which carried Hobson, Charles Percy, the Assistant to the General Manager of the GT, and other officials, travelled from Sarnia to Port Huron. Driver William Owens, Fireman William McNeish and Conductor Nelson McKee comprised the first crew to take a locomotive through the tunnel¹².

Following a meeting of the directors of the St Clair Tunnel Company at Point Edward in August 1891, an ebullient Sir Henry Tyler stated that he expected a second tunnel would without a doubt be built. The prospects were that it would be started as soon as the present tunnel was placed in regular service and its capacity tested¹³.

The tunnel proved to be an important factor in securing freight for the GT, particularly in the competitive market between Chicago and the coastal cities of New York, Boston and Philadelphia. In June 1891, it was announced that the GT would shortly begin to haul Swift dressed meat from Chicago to the major cities of the Northeastern United States. The GT had lost this business two years earlier to the Canada Southern/New York Central which promised more expeditious handling of Swift's shipments. The tunnel allowed the GT to eliminate the time-consuming ferry operation across the St Clair River and reclaim this traffic¹⁴.

Service through the tunnel was formally inaugurated on September 19, 1891. The Mayor of Sarnia presented an address to Sir Henry Tyler which stated: "The municipal council and citizens of Sarnia desire to extend through me, their official head and chief magistrate, their hearty congratulations on the successful completion of the St Clair tunnel, a work of vast commercial importance to the two great nations on this continent, and an engineering achievement that will stand for all time as a monument of the enterprise, foresight and skill of its designers and builders." After the address, the invited guests boarded a special train which proceeded from Sarnia to Port Huron. The reporter for the local newspaper recorded his impressions, presaging a factor which would bedevil the operations of the tunnel during its first sixteen years: smoke.

SCIENTIFIC AMERICAN

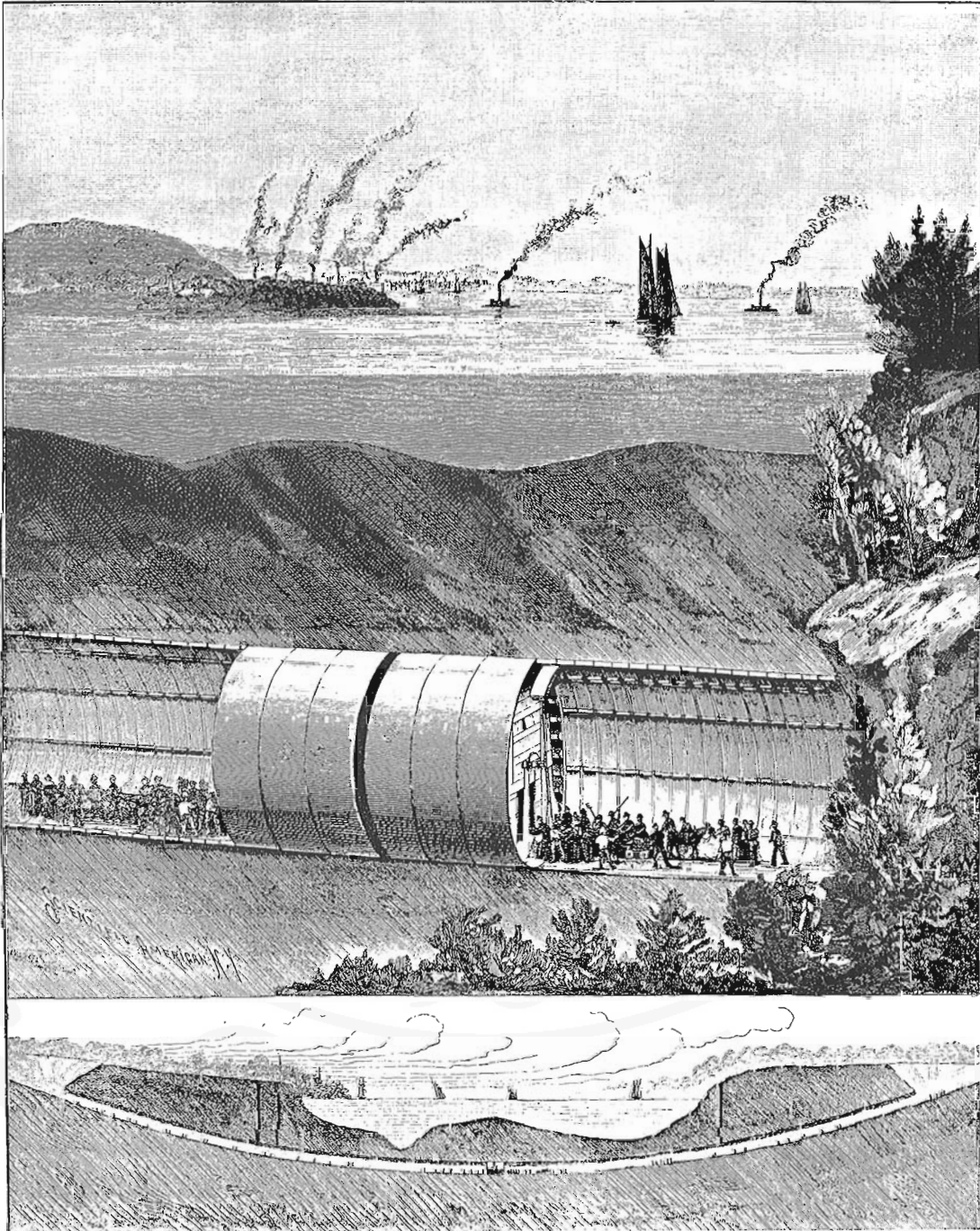
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyrighted, 1891, by Moon & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

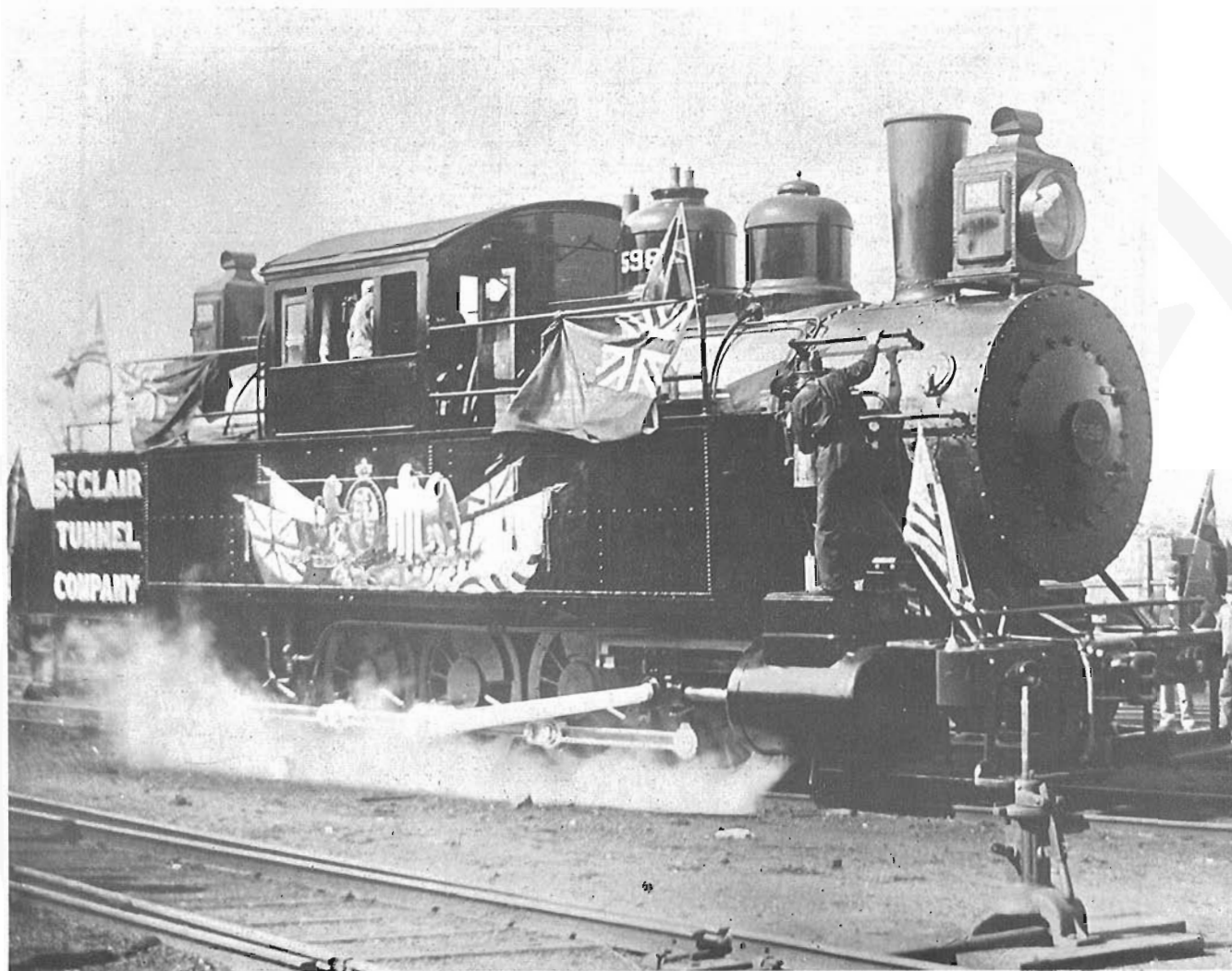
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WEEKLY.



THE MEETING OF THE GREAT SHIELDS OF THE ST. CLAIR RIVER RAILWAY TUNNEL.—[See page 164.]



Highly polished and decorated for a special occasion with the royal cypher, the British lion, the American eagle, and flags of the two nations served by the tunnel, 0-10-OT 598 presents a festive appearance. Unfortunately, neither the reason for these special efforts or the date of the photograph has been recorded. This picture predates 1898 as the 598 was renumbered 1301 in that year.

National Archives of Canada/PA175912

"In a few moments the special train was in motion towards the portal. Carefully it picked its way down the incline. The banks on each side were lined with a cheering crowd of spectators, and on the sides of the cutting stood rows of clay begrimed workmen, with pick and shovel, resting from their labours to greet with cheers the appearance of the official train that marked the successful completion of the most important part of the great work in which they had borne so laborious and dangerous a part."

"The trip through the tunnel, brief though it was, occupying barely four minutes, was entered upon with mingled feelings of awe, wonder and trepidation by many; on the train. The plunge from brilliant sunshine into the dense darkness of the great tube was swift and startling. The inky blackness was so heavy that the lamps burning in the cars appeared to have no effect upon the impenetrable gloom. The electric lights set at intervals through the

tunnel, flashed brief gleams as they were passed, but these as a result of the accumulating smoke and dust grew dimmer and hazier as the train progressed until at length they seemed enshrouded in fog. With closed windows and doors, the heat was getting to be oppressive and the passengers were beginning to wonder how much longer they would have to endure the heat and oppressiveness when with the suddenness of a lightning flash, the broad glare of day burst upon them."

"The tunnel had been safely navigated, and the pent up feelings of those who had made the trip found vent in a prolonged cheer. From the banks on the Michigan side responsive cheers swelled upwards and rolled along as the train went gallantly up the grade. At the summit, a sight was obtained of one of the mammoth special engines built to convey trains through the tunnel . . .¹⁵"



The modification of the tunnel locomotives from tank to tender equipped locomotives did not improve their aesthetics. This view, which was taken in 1908, shows the large firebox which challenged the fireman. Originally numbered 598 to 601, the quartet of tunnel locomotives were renumbered 1301 to 1304 in 1898. These units remained in yard service after being displaced from tunnel service. The first unit was retired in 1916 and the other three in 1920.

National Archives of Canada/PA-60703.

Following the passage of the official train, the tunnel was thrown open to inspection by the public who were invited to walk through it. Train operation, however, did not begin for several weeks. The delay was due to the incomplete state of the retaining walls along the approaches to the tunnel on both sides of the river. The last date the public were able to inspect the tunnel was Saturday, October 25th. Interest in the new technological wonder of the age was so great that the GT ran seven excursion trains from Detroit to Port Huron to accommodate the sightseers. By day's end, it was estimated that 7,000 had walked through the tunnel¹⁶.

Initially, four large 0-10-0T type steam locomotives built by the Baldwin Locomotive Works in Philadelphia were used to haul trains through the tunnel. Baldwin guaranteed that the engines would haul 760 gross tons, the equivalent of 25-30 loaded cars, up the 2 per cent gradients. At the time of their construction, these 97.5 ton engines were the largest steam locomotives in the world. Locomotive 598 was the first one to be shipped. In a completed state, the locomotives were too heavy for some bridges along the route to Port Huron. Consequently, the cab, tanks, side roads and other parts were taken off and shipped separately¹⁷. Sometime after placing the engines in service, the GT equipped the engines with conventional tenders in order to minimize the number of trips to servicing facilities during each shift.

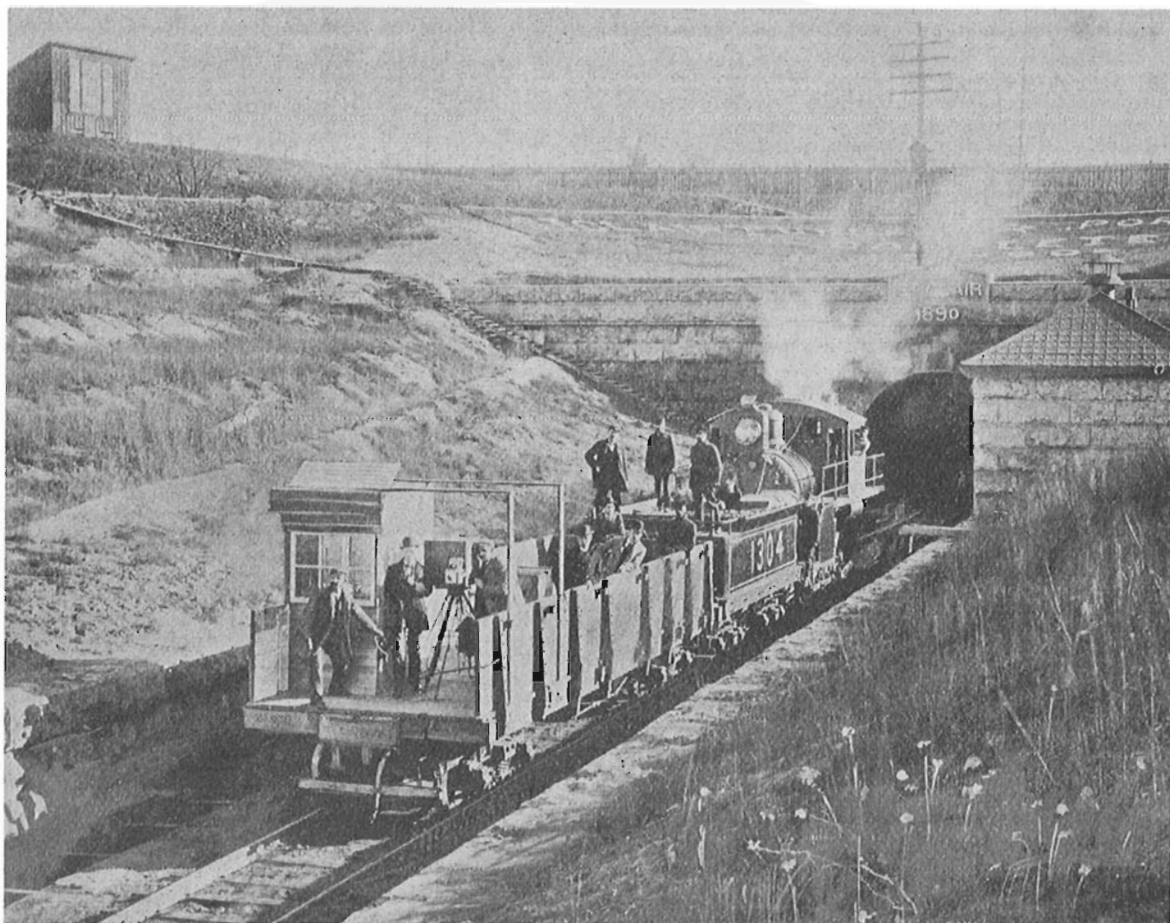
On October 23rd, the first freight cars passed through the tunnel. The first through freight train, consisting of 11 cars, left

Port Huron shortly after 1800 on October 25th. Initially, only eastbound freight trains used the tunnel. Westbound freight and all passenger trains continued to use the car ferries. The passenger trains could not use the tunnel as the new stations along the tunnel trackage at Sarnia and Port Huron had not been completed. So remote was the tunnel that the GT inaugurated special trains to convey staff from Point Edward to the Sarnia tunnel and from Fort Gratiot to the Port Huron tunnel¹⁸.

Effective November 23rd, the GT began operating westbound freight trains through the tunnel. By the end of December, traffic through the tunnel amounted to 450 freight cars each way per day. The GT's car ferries "International" and "Huron" were put up for sale in January 1892¹⁹.

Passenger trains began using the tunnel on December 7th following the completion of the new station at Sarnia. The new station at Port Huron, however, was not ready for use until February 1, 1892²⁰.

While the GT was hauling increasing freight traffic through the tunnel, all was not completely satisfactory. The "Observer" noted that to cope with the traffic, the GT was employing double crews on the trains in the tunnel and had installed an automatic signal. It was having trouble securing men for the work even though it was paying brakemen \$2.50 a day²¹. The dangers of working in the dark, smoky bore probably accounted for this difficulty.



*The outfit used, in 1899, to take flashlight photographs of the interior of the St. Clair tunnel
Railway and Shipping World, January, 1900.*

PHOTOGRAPHING THE ST. CLAIR TUNNEL

By its very nature, a tunnel is very difficult to photograph in a way which depicts clearly its engineering features. The best a railway enthusiast can do is to photograph a train emerging from the tunnel portal or, perhaps, take a flash photo looking into the mouth of the tunnel.

It is possible, however, to do better as we can see from this remarkable story of how the Grand Trunk Railway arranged for a movie of the entire interior of the tunnel to be taken in the summer of 1899, a time when motion-picture photography was in its infancy, and film speeds were very slow. This would be a formidable job even with modern video cameras, and in 1899 these were not even thought of in science fiction.

The following account is taken from the *Railway and Shipping World*, issue No. 23, January 1900. One wonders if this film has survived, and, if so, where it is. The method is definitely not recommended for present-day railway enthusiasts!

"Officials of the GTR have recently succeeded in obtaining a flashlight photograph of the interior of the Sarnia tunnel from portal to portal. Numerous photographers from different parts of America have repeatedly tried to take one, but hitherto without

success, and in the recent instance some half dozen experiments had to be made before the view was obtained. A set of large flashlight lamps were made in New York for the purpose, and a car arranged with the taking machine and flashlight apparatus was brought into requisition, from which the experiments were made. In the history of moving pictures this was the first attempt to obtain a flashlight picture of a tunnel through which an engine and car were flying at the rate of 30 miles an hour. The experiment was only by way of trial for the first few trips, to see what could be done, and the results demonstrated the possibility of perfect pictures on a complete scale such as is required for the biograph. The gondola car on which the working machines were placed was fitted up with a specially arranged outfit. A small house was built on the right, in front of the car in which were arranged the four powerful flashlight machines. The machines were connected with the compressed air on the locomotive, with attachments on the tubing to regulate the air which forced the magnesium powder from the powder chambers of the flashlight apparatus, out through an aperture, across a flame of alcohol, where it ignited and gave forth a light of pure white and brilliancy, and with parabolic reflectors placed behind the flame, the light was thrown for a distance of more than 1000 ft., illuminating the tunnel to the smallest detail, and producing the desired effect for a sharp and good negative. The experiments were



This flash-illuminated view of the interior of the St. Clair tunnel was taken, in 1899, as part of the successful project to photograph, by motion picture camera, the entire bore of the tunnel from portal to portal. Since the view was taken only eight years after the tunnel went into service, it shows it essentially as built.

Railway and Shipping World, January, 1900.

novel and exciting, as can be imagined - the engine running like a huge bullet through what practically looked like an immense gun barrel, illuminated with a light that could not be faced, and which necessitated the operators and those who took part in the experiments wearing blue glasses, and rushing through this hollow tube at a 30 mile pace. The mutograph or machine used by the biograph company for taking the pictures was placed on the left of the flashlight cabin, the electric motor used for running the machine being connected with 4 storage batteries that were carried on the car. Illustrations of the outfit used and of the interior of the tunnel are given."

THE ELECTRIC ERA

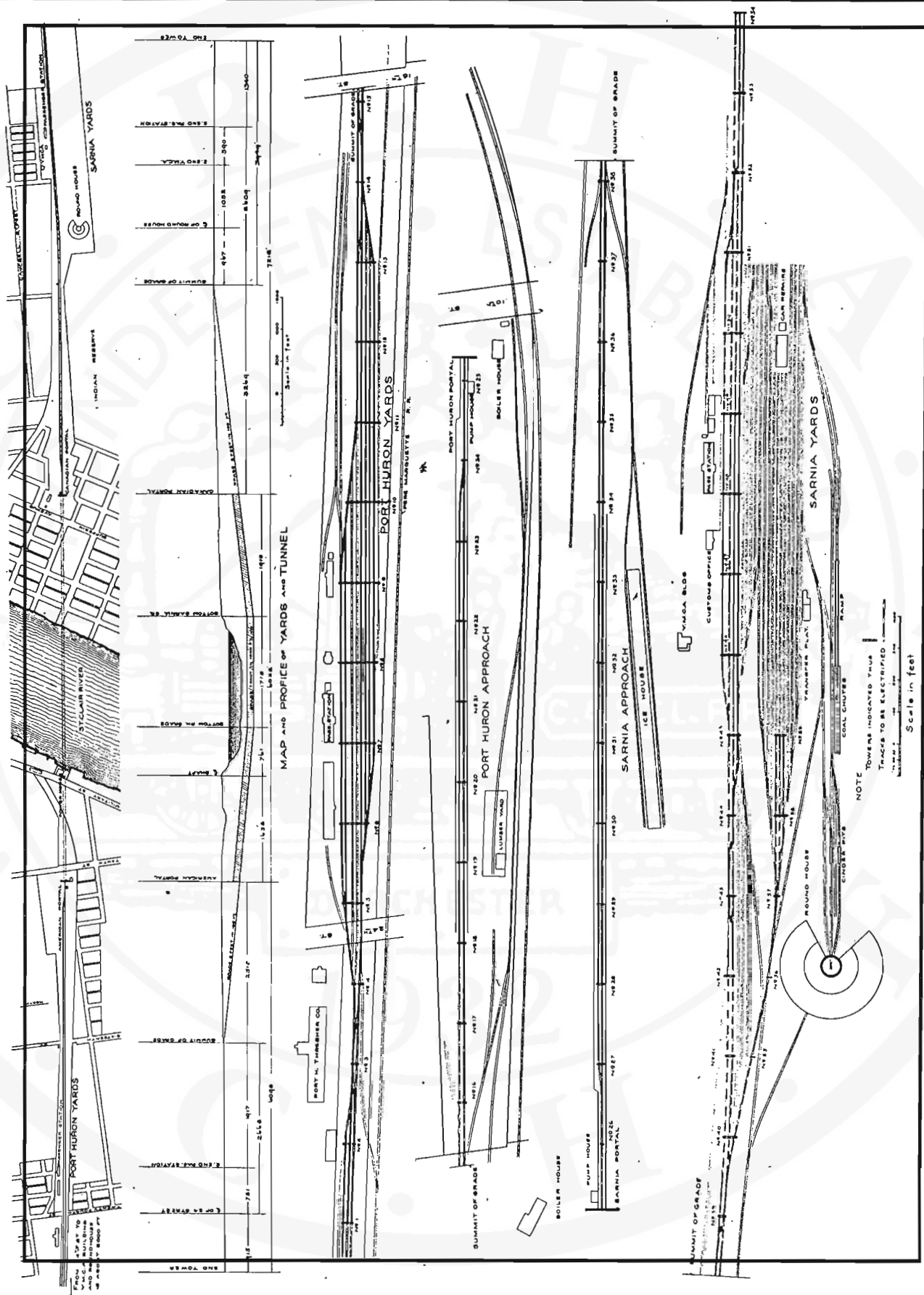
By 1900, the tunnel had become an impediment. Increased traffic levels and heavier freight cars were taxing the capacity of the single track tunnel and the abilities of the tunnel locomotives. In 1901, Third Vice President Frank Morse wrote Hobson seeking information on a possible solution to the problem:

"On account of the increased tare in freight cars, the capacity of the St Clair Tunnel is being reduced, figuring on the number of cars it is possible to put through it per day."

"The only easy way to overcome this would be to substitute for our present locomotives, others of greatly increased weight."

"Will you kindly advise if the condition of the bed of the Tunnel would cause any restriction being placed on the locomotives we may wish to run through?"

While Hobson's reply has not been found, it would have stated that the tunnel locomotives were about the biggest engines which the bore could accommodate. Then matters came to a head as the result of a tragic and fatal accident. On October 9, 1904, a freight train broke in two in the tunnel. By the time the equipment had been moved from the tunnel, five trainmen were overcome by smoke. This accident spurred the decision to electrify the tunnel. Not only would this eliminate the smoke hazard, but the electric locomotives would be able to handle greater tonnage at higher speeds.



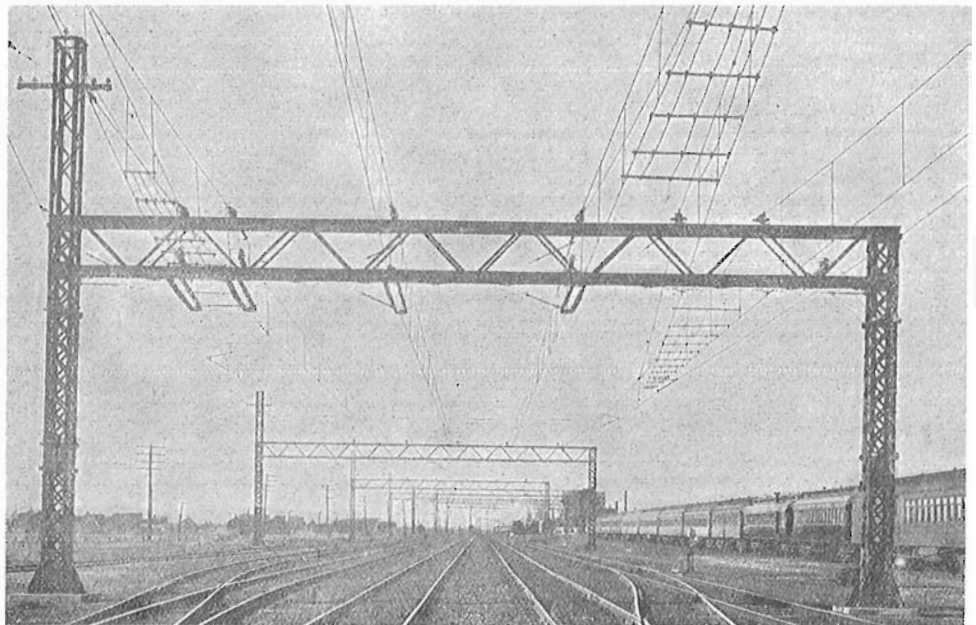
The GT developed a set of specifications requiring that the installation should be capable of hauling a 1,000 ton train through the tunnel from terminal to terminal in 15 minutes and that in so doing the maximum speed should not exceed 25 miles per hour and the minimum speed when ascending the 2 per cent grade should not be less than 10 miles per hour.

Based upon these specifications, the GT invited tenders from electrical firms. The GT selected Westinghouse Electric & Manufacturing Company to construct a 3300 volt, single phase 25 cycle A.C. system. This would be the first application of single-phase system to heavy steam railway service. Under the terms of the "turn key" contract, Westinghouse installed the catenary, built the power house, trained the crews, and was responsible for the successful operation of the entire equipment.

The locomotives were designed to exert the maximum practicable tractive effort thereby increasing the capacity of the tunnel. The capacity limit was determined by the maximum pull which could be exerted on the draw bars of the rolling stock without breaking trains in two. On the basis of this criterion, the locomotives were specified to be of sufficient capacity to develop a drawbar pull of 50,000 pounds when operating at a speed of 10 miles per hour. It was estimated that such a locomotive would be able to make a complete trip through the tunnel from terminal to terminal with a 1,000 ton train in 15 minutes permitting each locomotive to make four trips per hour. This would provide a capacity approximately three times larger than actual traffic demands in 1905.

Six pantograph equipped electric locomotives were built at the Baldwin Locomotive Works during 1907 and 1908. Each unit was rated at 750 horsepower. When tested with a dynamometer car, it was found that the unit developed 43,000 pounds of drawbar pull before slipping its wheels. As the GT decided to operate the units in pairs, each train would have 86,000 pounds of draw bar pull²³.

On January 31, 1908, work was sufficiently advanced that an electric locomotive was hauled through the tunnel from Port Huron to test the newly erected catenary in the Sarnia yards. Progress, however, was slowed by severe snow storms which blocked the main line. In order to clear up the backlog of traffic, work on the electrification of the tunnel was temporarily suspended in early February²⁴.



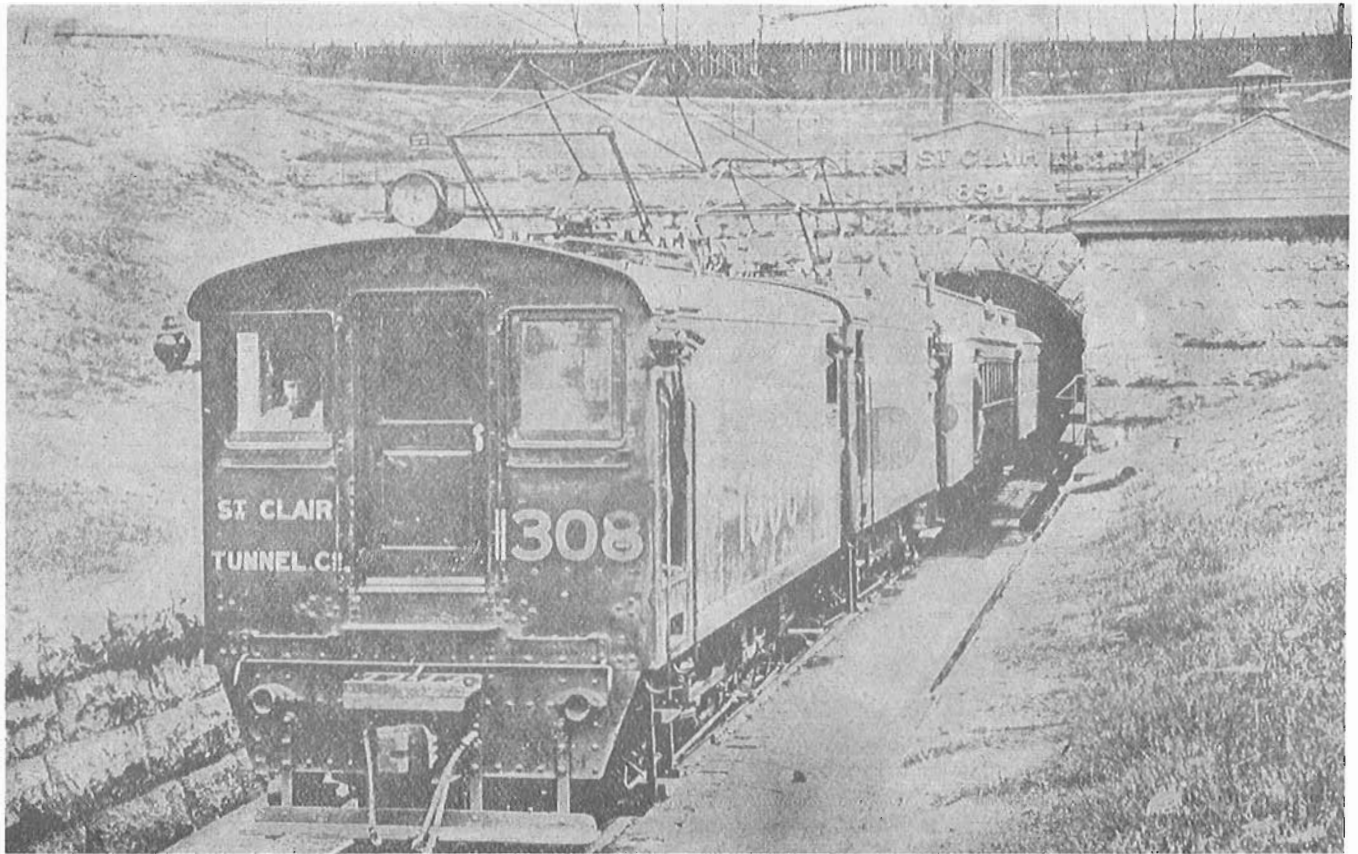
*Some of the overhead work in the St. Clair tunnel electrification.
Railway and Marine World, December 1908.*

An unofficial run was made from Sarnia to the portal of the tunnel on the Port Huron side shortly before February 19th. The reason for not running the electric locomotive through to Port Huron was to meet the wish of several GT officials who wished to be part of the historic event. On February 20th at 11:00, electric locomotives 1308 and 1309 ran light from Sarnia to Port Huron. Upon the arrival at Port Huron, the two engines were attached to a 700 ton freight train composed of 19 loaded cars. The eastbound trip passed the western summit of the tunnel at 12:28 and the eastern summit at 12:37. The crew on the first run consisted of conductor Walter Hanson and brakemen A. Boody and M. Falconer. The locomotives were operated by Terminal Superintendent Jones under the direction of H. H. Rushbridge of the Westinghouse Electric Company²⁵.

On February 20th, the electrics hauled their first passenger train through the tunnel. This trip inaugurated the regular use of the electrics on passenger trains during the 12 hour day shift. Steam remained in use on the freight trains and on the passenger trains at night²⁶. In March, electric lights were installed the length of the tunnel. On May 17th, steam operation through the tunnel ended²⁷.

Westinghouse turned over the tunnel operation to the Grand Trunk on November 12, 1908. The GT invited approximately 100 guests to ride the "official" first train. At 1300, a special tunnel inspection train pulled into the Port Huron station to load the guests onto flat cars which had been equipped with upholstered seats for

*OPPOSITE PAGE: A general map and profile of the yards and tunnel at Sarnia and Port Huron in 1906, just before the electrification.
The Railway Age, January 19, 1906.*



*An electric locomotive and passenger train emerging from the St. Clair tunnel.
Railway and Marine World, December 1908.*

the occasion. On arrival at the Sarnia station, the guests boarded a steam locomotive hauled train of conventional day coaches which took the party to Sarnia's downtown station on Crowell Street. After the obligatory luncheon and speeches, the party rode the coaches back to Port Huron where they inspected the power house²⁸.

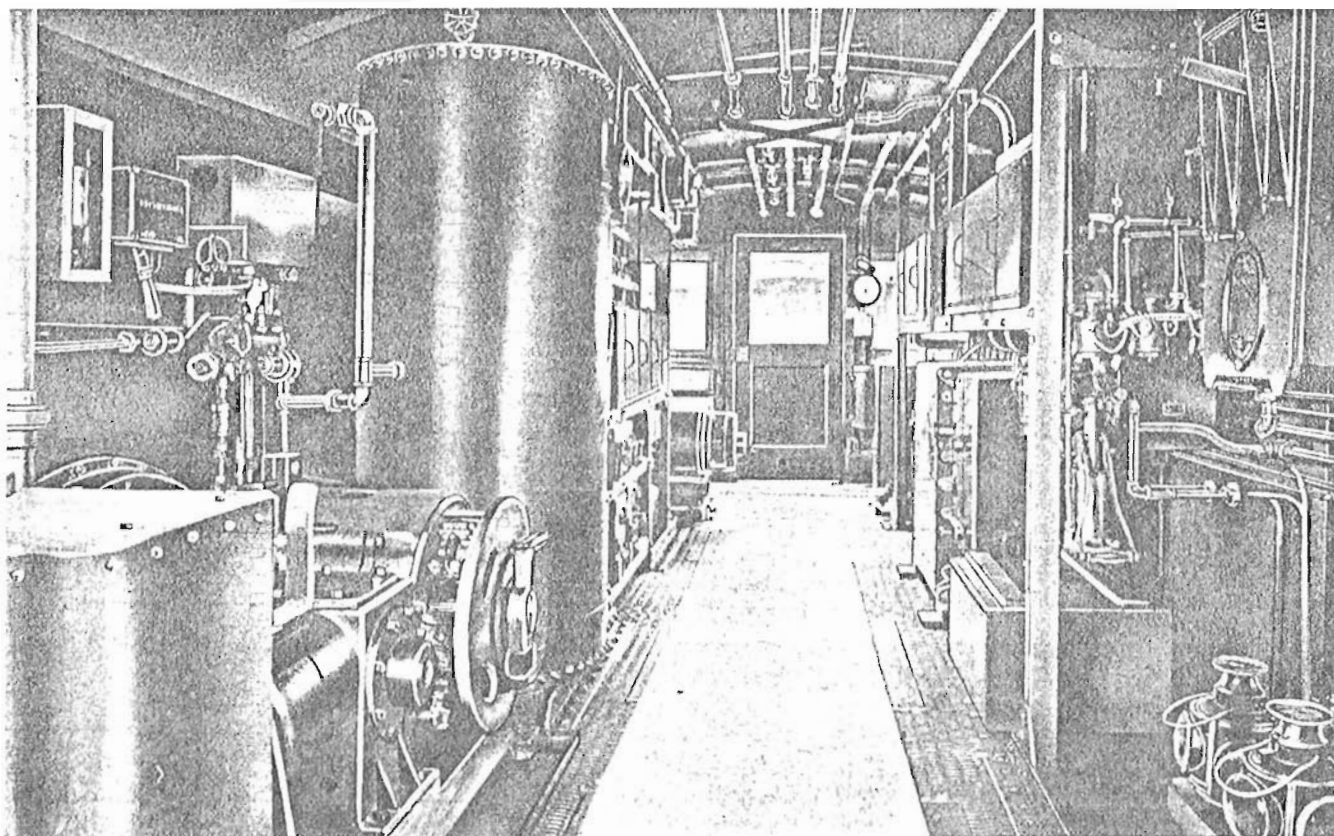
The electrification met all the expectations of the GT. Train weight increased by 25 percent and trip times through the tunnel decreased by 33%. Due to these factors, the average cost of handling a freight car through the tunnel fell from 26.6 to 17.2 cents. It is estimated that the half million dollar investment in the electrification was repaid after the first five years of operation.

In 1910, it was reported that the entire traffic through the tunnel was being handled by 2 pairs of locomotives. Comparing the last year of steam locomotive operation to the first year of electric operation, the "Electric Railway Journal" reported fuel costs had fallen by 61 per cent and maintenance and repair costs by 45 per cent. The average mileage for each unit was approximately 2,700 miles per month the equivalent of 10 round trips per day. To service the units, a two-track section of the roundhouse in Sarnia was equipped as an inspection shed²⁹.

In order to qualify for the electric service, the men who had operated the steam locomotives had to attend instruction classes every afternoon for two months when off-duty. After completing the classroom work, the steam locomotive engineers operated the electric units under the supervision of instructors. The locomotive crew was made up of an engineer and assistant. Under electric operation, the number of brakemen was reduced from two to one due to the smooth operation of trains through the tunnel³⁰.

The electric operation endured for fifty years. In order to accommodate increasing freight traffic, CN purchased two electric engines from the Chicago, South Shore & South Bend Railroad in 1927. The ten electric units soldiered on until 1958. With dieselization, the need to change motive power was eliminated and the electrification was decommissioned on September 28, 1958 at 08:00. For some time prior to this date, however, passenger trains had been hauled through the tunnel behind diesel locomotives of the Grand Trunk Western thereby eliminating the time consuming process of changing locomotives at both ends of the tunnel³¹.

The St Clair Tunnel Company was amalgamated with CN in 1958. Unlike many of the small railway companies which formed a part of CN, the St Clair Tunnel Company retained a



*Lithograph of the interior of St Clair Tunnel box car units 1305 to 1310.
Electric Railway Journal, Volume XXXV, No 14, April 2, 1910.*

public presence up to that time as its name had been proudly displayed on the four steam locomotives and eight electric engines assigned to tunnel service.

THE TUNNEL TODAY AND TOMORROW

Today, the tunnel continues to serve as a critical link in the movement of freight and passenger traffic between Central Canada and the American Midwest. For those wishing to experience a passage through the tunnel, VIA and Amtrak operate the "International", a Chicago-Toronto train, each day.

On December 5, 1991, CN announced that it will build a new \$155 million tunnel between Sarnia and Port Huron adjacent to the existing tunnel. CN expects to have the 1.2 mile long tunnel completed in 1994. The new tunnel will allow CN to improve its service to trans-border shippers. Traffic between Canada and the U.S. has increased by 12 to 15 per cent over the last two or three years while domestic traffic growth has been flat.

The new tunnel is being built to accommodate double stack container cars and multi-level automobile cars. These cars, which are too high to pass through the old tunnel, currently are being

ferried across the St. Clair River. It is expected that the new tunnel will reduce transit time for these shipments by up to 12 hours and permit CN to eliminate the costly ferry service. As well, freight trains when passing through the tunnel must slow to a crawl in order to prevent today's large freight cars from hitting the side of the tunnel. It is expected that trains will be able to pass through the new tunnel at speeds of 55 miles per hour.

In its issue for September 13, 1890, Scientific American made the prophetic statement: "Should another tunnel be put through, as now expected, we shall have a much fairer chance to compare the certain and marked advantages which the cast iron tunnel possesses over the old style brick and cement tunnels". It then seemed as if traffic would require a second tunnel within a very few years. Little did they know that it would be a century before another tunnel was built at that location, but now, after 100 years, the prediction will come true.

The fate of the existing tunnel has not been decided. It could become a utility corridor, a back-up for the new tunnel or continue in its current role³². With this new investment, trains will continue to operate under the St. Clair River for many years to come.

NOTES

¹ National Archives of Canada: MG29 A29 - Sir Joseph Hickson Papers

² Ibid.

³ Amendment published in Toronto Mail, September 12, 1890.

⁴ The Great Western was amalgamated with the GT in 1882. One of the Great Western's lines extended from Toronto to Sarnia via Woodstock and Strathroy. The GT's Toronto-Sarnia line, which terminated in the Sarnia suburb of Point Edward, passed through Guelph and Thetford. Today, the Great Western line forms CN's main route for traffic moving through to Chicago. The section of the original GT line from St Mary's Junction to a point near Sarnia has been abandoned.

The GT's line between Port Huron and Chicago was opened to traffic in February 1880. This trackage was operated by a GT subsidiary, the Chicago and Grand Trunk Railway. In 1900, the Chicago and Grand Trunk was amalgamated with other railways owned by the GT in the Midwest to form the Grand Trunk Western Railroad.

⁵ This project was abandoned in 1891. In 1902, the scheme was revived. The partially completed tunnels became part of the Hudson & Manhattan Railroad linking Hoboken, New Jersey to New York City. See Diehl, L. B., *The Late Great Pennsylvania Station*, American Heritage, New York, 1985.

⁶ The St Clair Tunnel Company was formed in 1886 when the St. Clair Frontier Tunnel Company amalgamated with the Port Huron Tunnel Company. The St Clair Frontier Tunnel Company was chartered by the Dominion Parliament in 1884.

⁷ Hickson received his title from Queen Victoria in 1890.

⁸ The International Bridge linked Fort Erie, Ontario to Black Rock, New York, a suburb of Buffalo.

⁹ "Observer", Sarnia, February 6, June 19 and July 3, 1891.

¹⁰ Ibid, March 13, 1891.

¹¹ Ibid, January 16, 1891.

¹² Ibid, April 10, 1891.

¹³ Ibid, August 21, 1891.

¹⁴ Ibid, June 19, 1891. The Canada Southern and Michigan Central continued to use a car ferry to link Detroit and Windsor until July 22, 1910.

¹⁵ Ibid, September 25, 1891.

¹⁶ Ibid, October 31, 1891.

¹⁷ Ibid, March 6, 1891.

¹⁸ Ibid, October 31, 1891.

¹⁹ Ibid, November 20, December 25, 1891 and January 22, 1892.

²⁰ Ibid, December 11, 1891 and January 22, 1892.

²¹ Ibid, January 22, 1892.

²² National Archives of Canada. RG30, Volume 1783: Car Letter Book.

²³ "Electric Railway Journal", Volume XXXII, No 24, November 14, 1908.

²⁴ "Observer", Sarnia, February 7, 1908.

²⁵ Ibid. February 19 and 20, 1908.

²⁶ Ibid. February 24 and 28, 1908.

²⁷ Middleton, W. D. "When The Steam Railroads Electrified", Kalmbach Books, Milwaukee, 1974 (Page 137) and "Observer", Sarnia, November 13, 1908.

²⁸ "Observer", November 13, 1908.

²⁹ "Electric Railway Journal", Volume XXXV, No. 14, April 2, 1910.

³⁰ Ibid.

³¹ Upper Canada Railway Society "Newsletter", October 1958.

³² "The Gazette", Montreal and "Windsor Star", December 6, 1991.

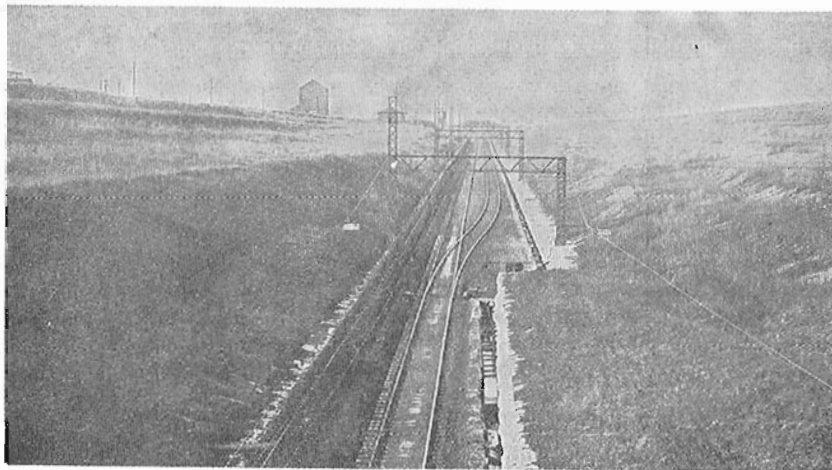


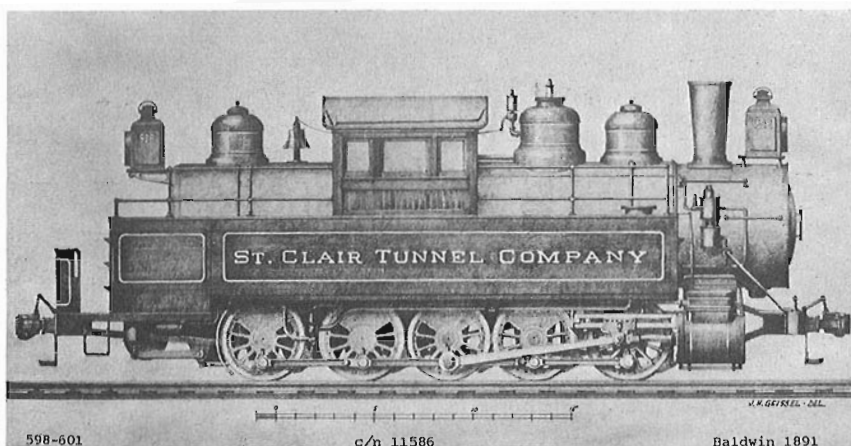
ABOVE. On November 9, 1908, photographer John Boyd recorded this view of the renovated interior of the tunnel. This view which looks toward Port Huron, Michigan shows the heavy catenary supports adopted by the GT for this pioneer electrification.

John Boyd Collection, National Archives of Canada/PA-60727

RIGHT. The approach to the St. Clair tunnel from Sarnia.

Railway and Marine World, December 1908.

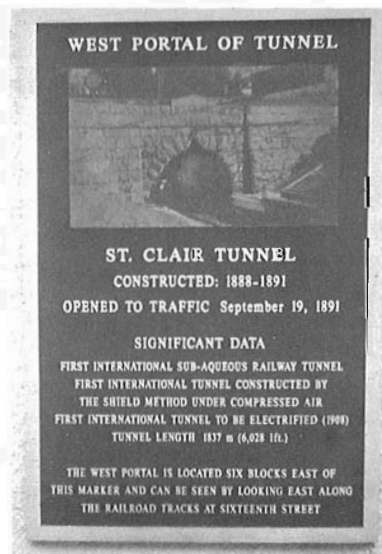
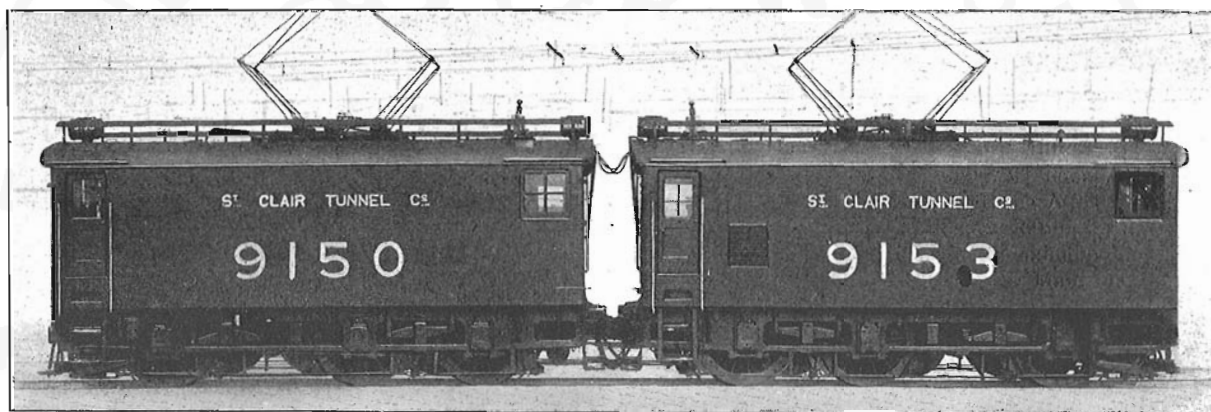




TWO ERAS OF ST. CLAIR TUNNEL LOCOMOTIVES.


LEFT: One of the original locomotives of the St. Clair Tunnel Company as built. Originally numbered 598 - 601, they were later numbered 1301 - 1304, and still later, 2650 - 2653.

BELOW: The original electric locomotives were numbered 1305 - 1310. In 1910 they became 2655 - 2660, then in 1923 they were renumbered 9150 - 9155. Finally, in 1949, they received numbers 150 - 155. This broadside view was taken in the 1920's.



On September 19, 1991 the St. Clair tunnel completed 100 years of service, and a large-scale celebration was held. Above, and on the opposite page we show some significant photos dealing with this anniversary. Above left is the monument at Sarnia consisting of an arch made from original segments of the tunnel structure; these pieces were left over when the tunnel was completed in 1890. Above right is the commemorative plaque at Port Huron.

On the opposite page we see the special ticket used on the special trains, as well as a selection of photos by Walter Bedbrook and Fred Angus showing the special train which made several trips between Sarnia and Port Huron that day. The train was operated in push-pull fashion, with a CN unit on one end and a GT one on the other.



**The
St. Clair River Tunnel
Centennial Committee**

in association with
CN, GTW, VIA Rail and Amtrak
celebrate the
100th anniversary
of this Great International Route
The inaugural train traversed this historic
passage 100 years ago to this day

Thursday, September 19, 1991

Return ticket from stations at
Sarnia, Ontario & Port Huron, Michigan

Single Coach Fare

	Regular Fare	
Adult	\$15.00 Can.	\$13.00 U.S.
Child (12 & under)	\$7.50 Can.	\$6.50 U.S.

Advance Fare (up to Sept. 18, 1991)

Adult	\$10.00 Can.	\$8.50 U.S.
Child (12 & under)	\$5.00 Can.	\$4.25 U.S.

ADVANCE TICKET ONLY.
Subject to terms and conditions on reverse.

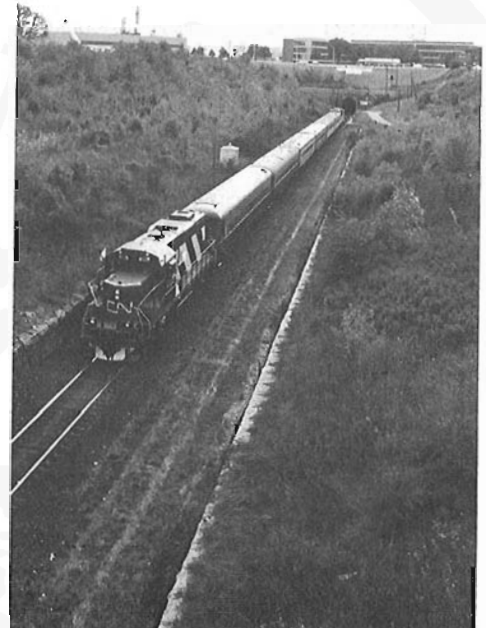
Good for one passage from
Port Huron to Sarnia
Train departs at 1730 hours

Good for one passage from
Sarnia to Port Huron
Train departs at 1700 hours



Approaching the tunnel from the Sarnia end. GT locomotive 5729 is leading.

Photo by Walter Bedbrook.



The special train going into the Sarnia portal of the tunnel. The trailing unit is CN 4135.

Photo by Walter Bedbrook.



This historic view shows the special train at Sarnia, beside the Amtrak train the "International". The latter was the first passenger train of the second century of tunnel service.

Photo by Walter Bedbrook.



The special train approaching the station at Port Huron.

Photo by Fred Angus.

The Ste. Annes Bridges - Then and Now

By A. Stephen Walbridge

On their way to the sea, the waters of the Ottawa River flow eastward along the Ontario-Quebec border into the Lake of Two Mountains. Before joining the St. Lawrence River at Ste. Anne de Bellevue, the waters draining the Lake of Two Mountains divide, to form Ile Perrot; with the main stream separating Ste. Annes from Ile Perrot; and the other separating Ile Perrot from the mainland at Vaudreuil.

While not being major bodies of water, the two streams presented the first sizable problem to the builders of the Grand Trunk Railway of Canada new line from Montreal to Toronto.

The Grand Trunk had been incorporated in 1852 "To construct a railway, on a designated route, from Toronto to Montreal" a distance estimated at 345 miles. At about the same time, the GTR became involved in the Canadian portion of the line from Montreal to Portland, Maine; and the construction of the Victoria Bridge, to connect Montreal to the mainland railway to Portland. As the main source of funds was British capital, the noted British railway construction firm of Peto, Brassey, Betts and Jackson were hired on

March 23rd., 1853 "for the construction of the line between Montreal and Toronto"; and on March 3rd., 1853 "for the construction of the Victoria railway bridge at Montreal". Designed by "Mr. Stephenson and Mr. Ross", Alexander M. Ross' name appears as the engineer.

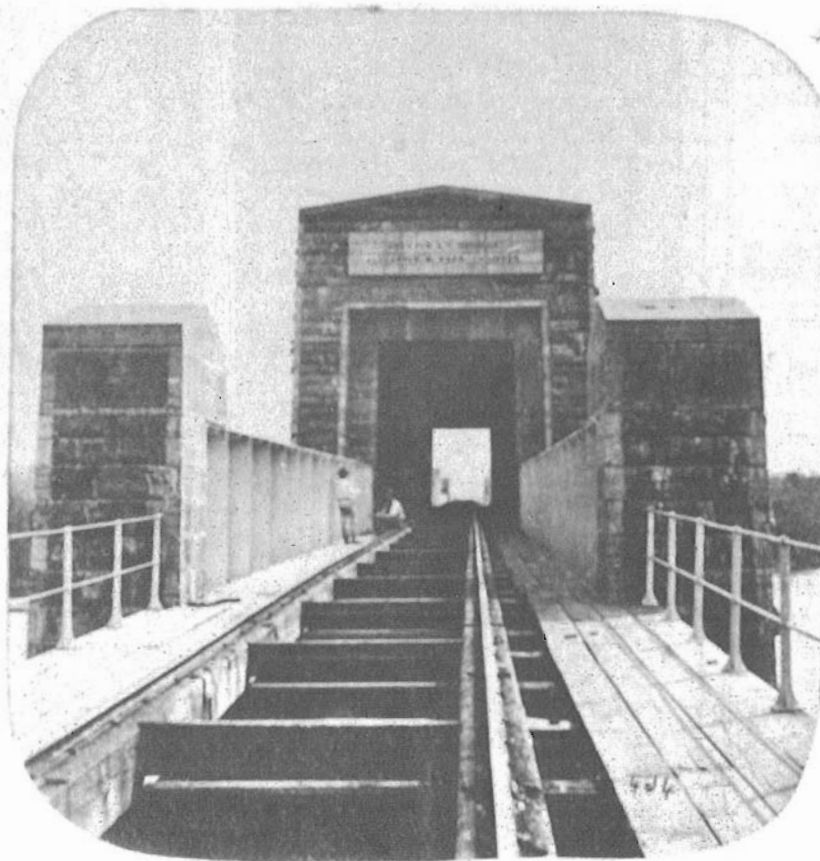
Available documentation on the history of Canadian railways is rich in the details of charters, subsidies, political pressures and scandals; but, except for some major engineering accomplishments, is rather short on the details of construction. In the present case, the fact that Mr. Ross was the engineer for both the Victoria

Bridge, and the Ste. Annes bridge (see photo) and that the construction of the Victoria Bridge is so well documented by literature and by photos, we appear to be permitted to make a number of assumptions concerning the Ste. Annes bridge as well.

The line from Montreal to Toronto was built through unremarkable terrain, which followed the descent of the St. Lawrence Valley from Lake Ontario - mainly wooded country, with few towns of great size in 1854. The rivers at Ste. Annes and Trenton had to be bridged; but the main construction problems, as described in "Thomas Brassey: Railway Builder", concerned severe winter weather, to which Mr. Brassey was not accustomed. The line is described in Trout's *The Railways of Canada* as "Gauge of track 5ft. 6 inches, weight of rails 60 to 75 lbs to the yard." It opened for traffic on October 26, 1856, single track only, until 1900.

Now, let's turn our attention to the Ste. Annes bridges. The Grand Trunk Railway Act of 1852, sec. 21 reads in part. "The Company shall be

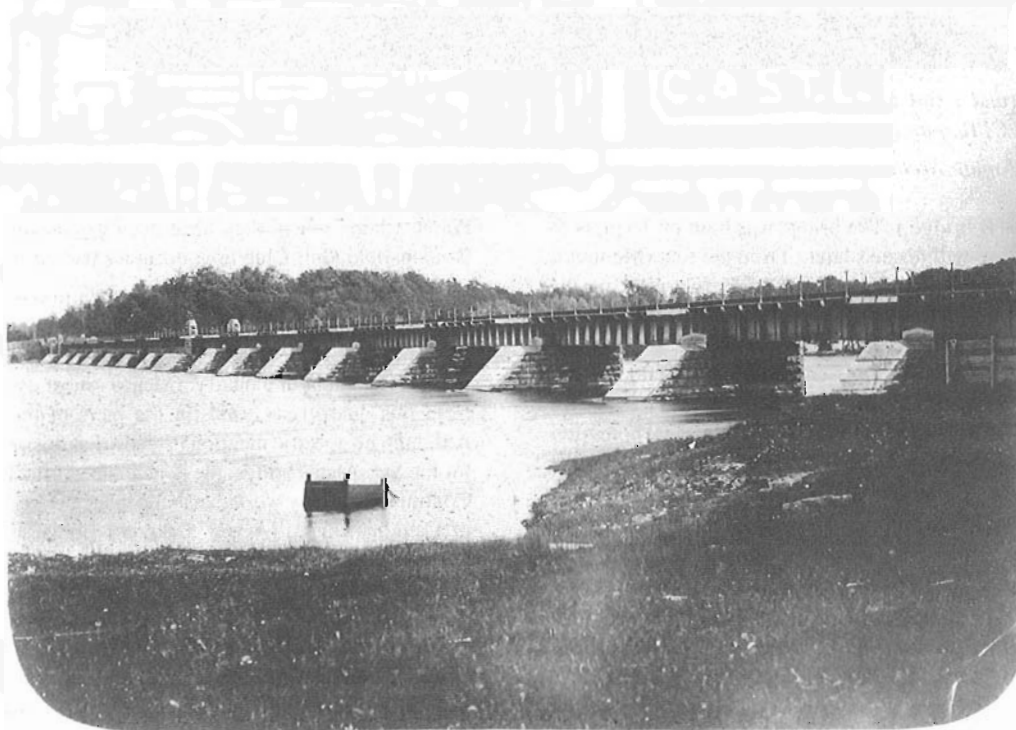
authorized, if they see fit, so to construct such bridge or bridges as to provide for the passage of all ordinary vehicles, animals and foot passengers over the same... on payment of such tolls etc." William Notman, the noted Montreal photographer of the time, shows a footpath on each side of the track; but its extensive use by the public was unlikely. Notman's excellent photograph (Front cover photo) of the finished bridge was taken in 1860 from the upstream side; and judging from the height compared with the surrounding land, was taken from the tower of the Roman Catholic Church in Ste. Annes. (A note of interest: The Canadian Pacific bridge was built to cross the same body of water in the mid-1800's immediately



The portal of the GTR Ste. Annes bridge as it was when built. This photo was taken by Notman in 1860. Note engineer Ross's name and the date carved over the portal. Notman Photograph Archives, Mc.Cord Museum. Photo No. 7464 View.

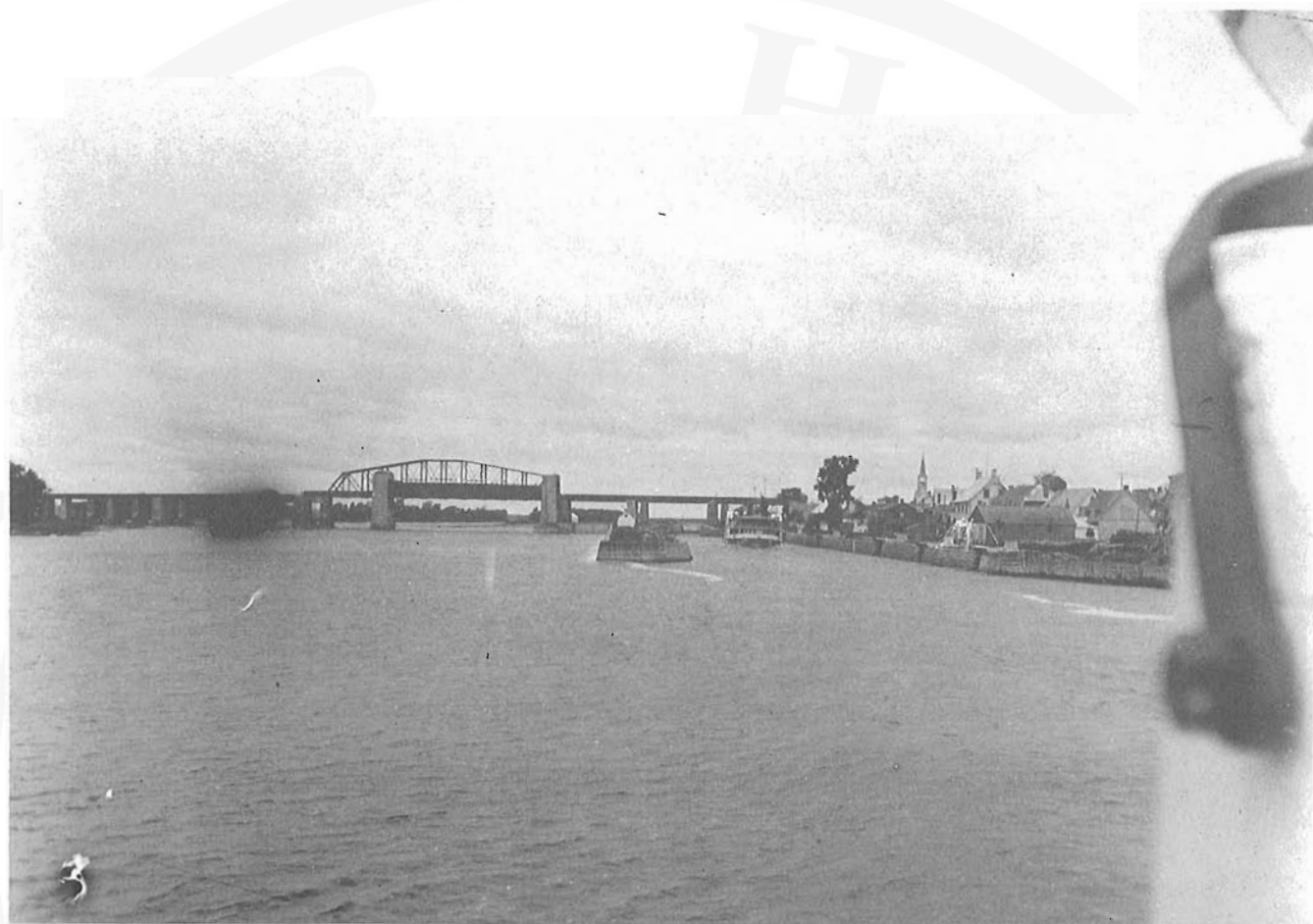


*The Ste. Annes bridge photographed from Ile Perrot in the early 1860's. The church in the photo still stands.
Notman Photographic Archives, McCord Museum. Photo No. MP2142.*



The bridge from Ile Perrot to the mainland at Vaudreuil (Dorion) did not have a tubular span as it did not cross a navigable channel. This photo was taken about 1860.

Notman Photograph Archives, McCord Museum. Photo No. 7541-View.



A view of the Grand Trunk bridge at Ste. Annes, with the Canadian Pacific bridge behind it, taken on September 2, 1896. Notice how the much newer CPR span dwarfs the old GTR one. Within three years the latter would be replaced.

Notman Photographic Archives, Mc.Cord Museum. Photo No. MP 076/77(7).

upstream of the GTR bridge.) The bridge was built on 16 piers of limestone, which we will discuss later. From the east (Montreal) side, the tracks are supported between the first two piers on the deck plate girders of rivetted construction; followed one section of thru plate girders, and the balance of the deck plate girders. All of the steel was fabricated in the Canada Works at Birkenhead, England, ready for erection. The statement was made about the steel for the Victoria Bridge that of the thousands of rivet holes pre-drilled for erection on the site, not one had to be reworked on the job. With only one section of tubular construction, it is unlikely that smoke from the locomotive presented any great problems of ventilation.

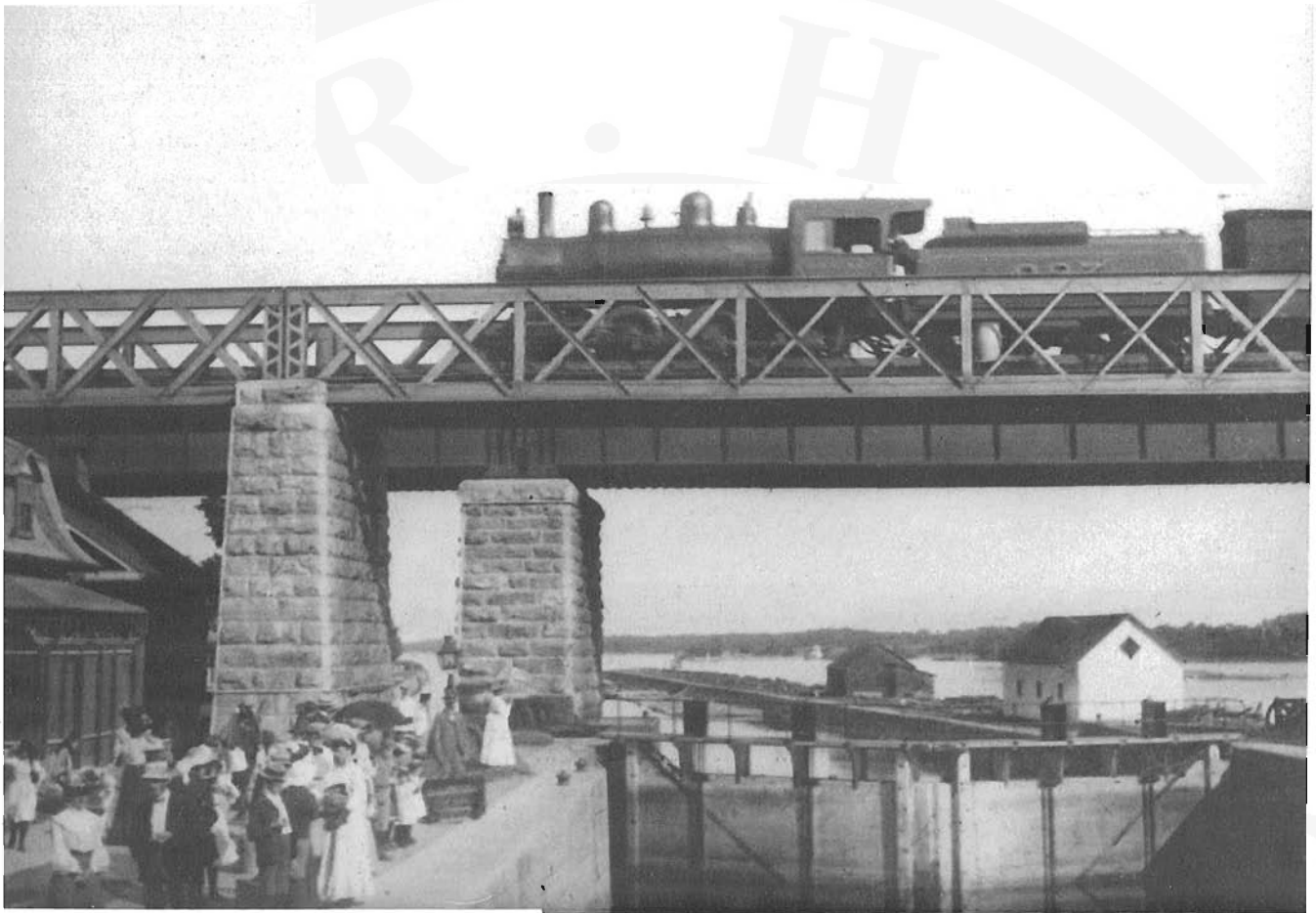
Let us consider the piers. The normal water level at this point is not deep; so, although no photos have come to hand, it is unlikely that the caissons were as elaborate as those that were essential to the construction of the Victoria Bridge. Each pier in the water had a cutwater on the upstream edge. Some photos give the impression that the tracks peak in the tubular section; but this is not borne out by the side view.

The stone used in the piers is described in Dresser's "Geology of Quebec" as "the Black River group of limestones, first seen at

Pointe Claire, where they have been extensively quarried." (The Beaconsfield Golf Club now occupies part of the former quarry).

Bryan Matthew's A History of Pointe Claire states, "On March 20, 1854, the Grand Trunk acquired four arpents of land from Eustache Brunet dit L'Etang, which was assigned to Peto and Company for the establishment of a quarry. (Memo - most of the stone quarried from this quarry was used for the piers of the Victoria Bridge. Although no specific mention is made that this stone was also used for the Ste. Annes bridge, the appearance of the latter is identical.) Continuing, "Many workmen at the quarry were Indians who lived in Caughnawaga. (Across Lake St. Louis several miles from Pointe Claire). Each morning, shortly before dawn, a convoy of canoes would arrive at the docks on the barge quay at the foot of Cartier Avenue (Station Road) and at the point, and each evening before sunset, the flotilla would push off to paddle back across the river"... "To house itinerant workers, a stone house was constructed near the perimeter of the quarry. It served as a dormitory until the end of the century, and in 1904 became the original club house for the Beaconsfield Golf Club" (1990, still in use for storage).

Steven's History of the Canadian National Railways states "Hodge found suitable stone for his piers (for Victoria Bridge) on the

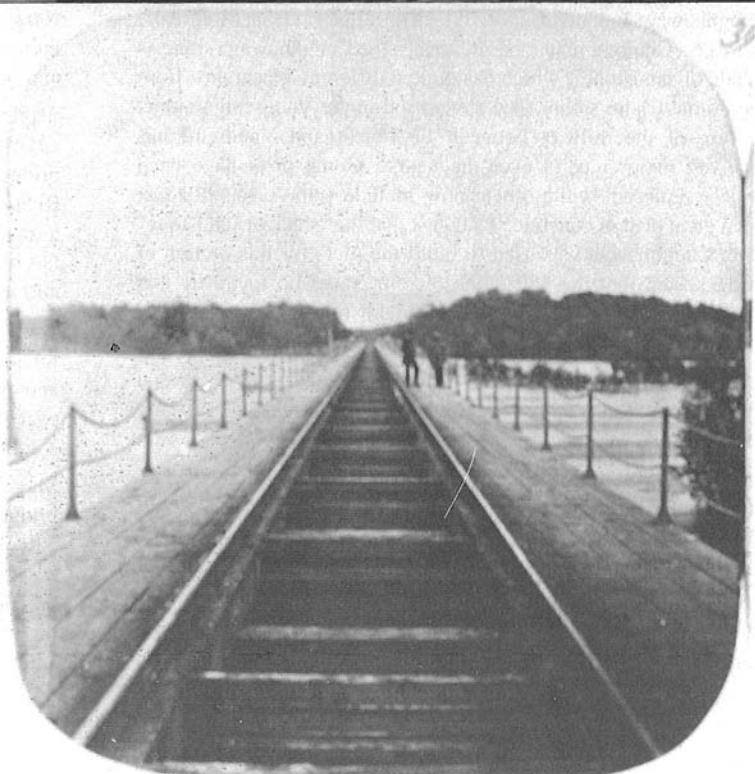


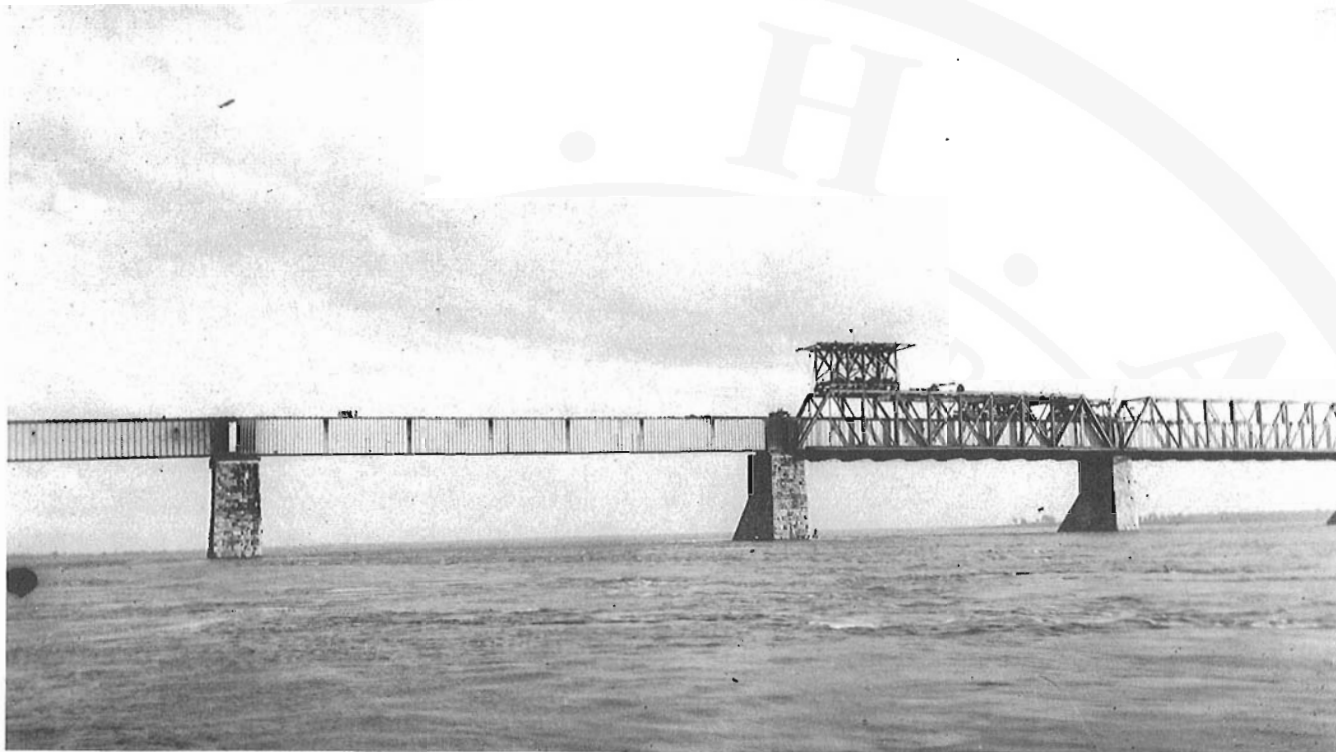
ABOVE: The Ste. Annes lock with the two railway bridges in 1904. The train in the foreground is a Montreal-bound CPR freight, while in the background we see the GTR bridge. This is the one which replaced the old tubular span in 1899.

Notman Photographic Archives, McCord Museum.
Photo No. MP 022/79 (328).

RIGHT: Looking along the track on the original bridge at Vaudreuil about 1860. Note the walkways which must have been rather dangerous when a train was passing.

Notman Photographic Archives, McCord Museum.
Photo No. 7391-View.





While no photo of the rebuilding of the Ste. Annes bridge has so far come to light, the method was likely similar to the way the Victoria Bridge was rebuilt at about the same time. This photo, taken from a boat on July 2, 1898, shows the new steelwork being built around the old tube. The latter was then removed with minimal interruption to traffic.

Notman Photographic Archives, McCord Museum. Photo No. MP-076/77(77).

Caughnawaga Indian Reserve, sixteen mile upriver from Montreal". Dresser's Geology in Quebec describes the Caughnawaga stone as "shale or sandstone", which has quite a different appearance from the Pointe Claire stone. The stone used in the Vaudreuil Viaduct section of the railway between Ile Perrot and Vaudreuil has received major repairs over the years. Some piers have been largely replaced; while others now include some original stone, but a great deal of concrete. I suggest that the "shale or sandstone" from Caughnawaga was used to build the piers for this section of bridges, and that the soft stone did not stand up to traffic and weather and current; and hence the major repairs.

The Ste. Annes bridges built in 1854-55 were single track, as was the entire line from Montreal to Toronto; until 1899. Several quotes from "Railway and Shipping World" of 1899 and 1900 are of interest.

June 1899: "Owing to the height of the locomotives recently constructed and the lowness of the tubular span over the Ottawa River at Ste. Annes, the Company (Grand Trunk) is unable to use them on the Western Section. The difficulty will be remedied by the demolition of the tube and the erection of an open span bridge similar in height to the Victoria Bridge."

July 1899: "Work is in progress to complete the double track between Montreal and Toronto...including four miles between St. Annes and Vaudreuil".

August 1899: "Good progress is being made on the double tracking between St. Annes and Vaudreuil. A steam shovel, two

work trains and 75 men are employed...Improved stations are to be built at St. Annes and Vaudreuil. They will be built of limestone and pressed brick, and will cost \$14,000 to \$15,000 each".

September 1899: "The last relic of the first epoch of railway engineering in Canada is passing away in the form of the tubular bridge at St. Annes. This old bridge, which spanned the Ottawa River near its junction with the St. Lawrence, is being removed and a truss bridge erected in its place. This old bridge is not only the last of the tubular bridges in Canada, but the last on this continent, and its removal is a historic event".

April 1900: "Excepting across the bridges, which are unfinished for want of steel, a 2nd. main track has been laid between St. Annes and Vaudreuil, 3.70 miles...The bridging and earthwork were exceptionally heavy. New stations have been built at St. Annes and Vaudreuil".

May 1900: "The enlargement of the St. Annes and Vaudreuil bridges and duplication of the track on these structures is about completed, and the trains will soon be running over the second track. When this improvement is finished, the G.T. will have a double track between Montreal and Toronto, with the exception of the 46 miles between Port Union and Port Hope".

November 1900: "Fast track-laying. Eight miles of rails between Dorval and Ste. Anne de Bellevue, Que. were laid on a Sunday recently without the slightest interruption of traffic, by a force of 120 men working from 7 a.m. to a little before 6 p.m."

Let's turn from the "THEN" to the "NOW".

Bridges, like any other part of a railway, need rebuilding for a variety of reasons. The second rebuilding of the St. Annes main span took place in 1931. Today, in 1990, a plate is rivetted to the end of the bridge: "Built by The Pennsylvania Steel Co., Steelton, Pa. 1931"

Due to fatigue, changing load factors, and technology, among other reasons, the past three years have witnessed the replacement of the deck girders of rivetted construction on most of the St. Annes bridge, and the Vaudreuil Viaduct. The new girders are fabricated of Corten steel, welded. There is no need to paint this steel as a thin layer of oxidation protects the steel from further weathering.

The method of replacing the sections of girder is interesting, as it was devised due to the need not to interfere with the traffic on the adjacent track. The girders were manufactured by Dominion Bridge, some in Montreal, and some in Toronto. The selection of photos taken on September 3rd, 1990 include one of the gantry crane used, which is longer than the span of the girder. The old rivetted section of the girder is raised from its bearing point on each pier; then moved until one end overlaps the track. This end is then lowered onto a dolly on the railway track; pulled until the other end is over a second dolly above the pier, then pulled away for loading on a set of flat cars for disposal. The new girder is then shunted on its flat car into place at the end-of-steel. The end under the gantry crane is then raised; and advanced over the space between the piers, when the second end is raised and positioned between the piers. The girder is then lowered into place upon the piers. One of the slides shows on the left, one end of a new girder; then open space between two piers; then on the right, the end of one of the old girders awaiting its turn for replacement.

The roadbed on the new girders consists of sections of pre-cast concrete, which are lowered onto the new girder to await the replacement of the track. Maintenance on the new type of roadbed should be a rare requirement.

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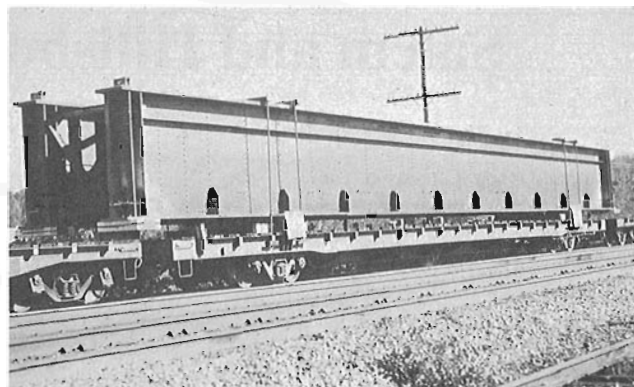
"Canadian National Railway" - G.R. Stevens

"Geology in Quebec" - Dresser

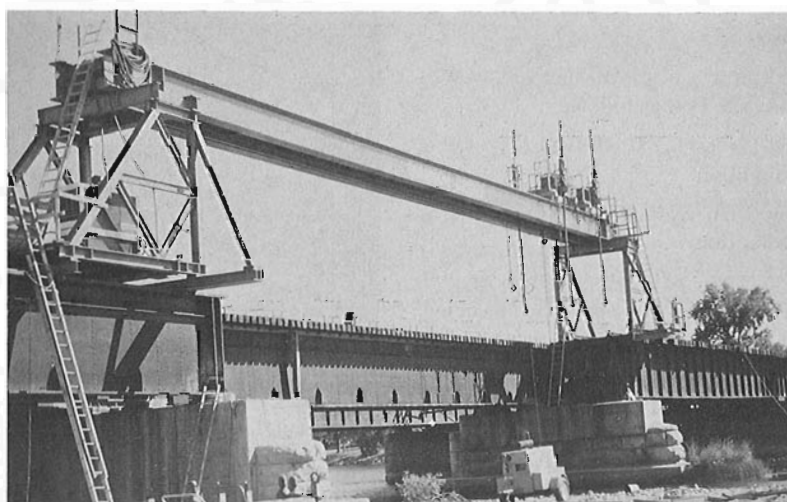
Photos by William Notman, courtesy of The McCord Museum of Canadian History, McGill University, Montreal. Additional photos by the author

A History of Pointe Claire

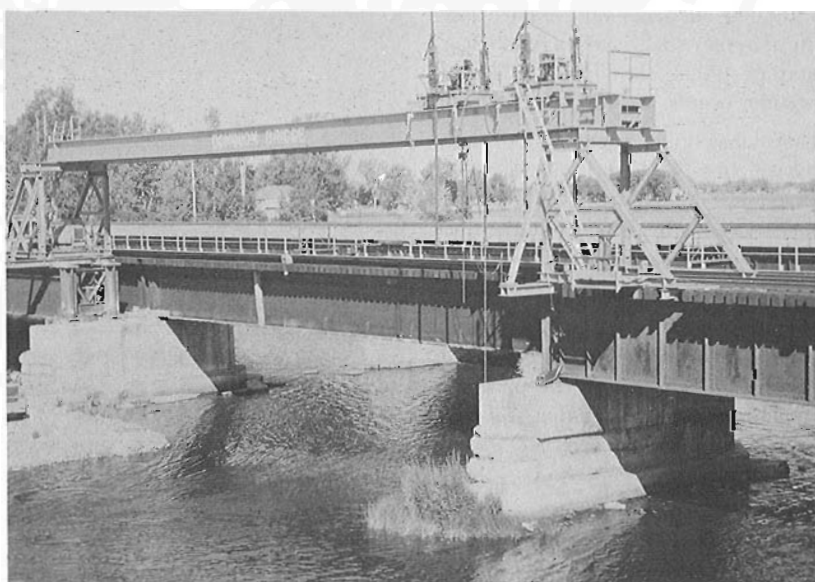
Railway and Shipping World, 1899, 1900



New beam on flat car.



Gantry crane for removing old beam and lifting new beam into place.



Installing new beam.

Salem and Hillsborough Activities

Our member Dyson Thomas of Saint John New Brunswick has sent these interesting photos of recent activities on the Salem and Hillsborough Railroad in New Brunswick.

Passenger operation resumed on the S & H in 1991, and the railroad had a successful year. Most of the trains were diesel-hauled, but on at least two occasions former CN steam locomotive 1009 (on loan from the CRHA) was used.

At present the diesel motive power of the S & H is as follows;

RS1 No. 208, Ex - DEVCO. In operating condition.

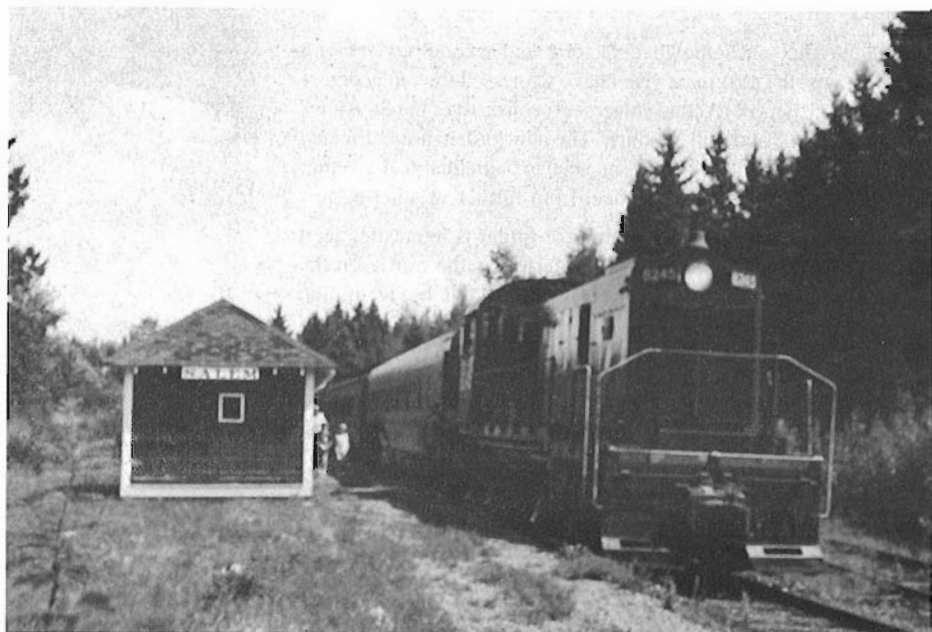
S-12 No. 8245, Ex - CN. In operating condition.

RS1 No. 8209, Ex - DEVCO 209. Acquired for spare parts; not operating.

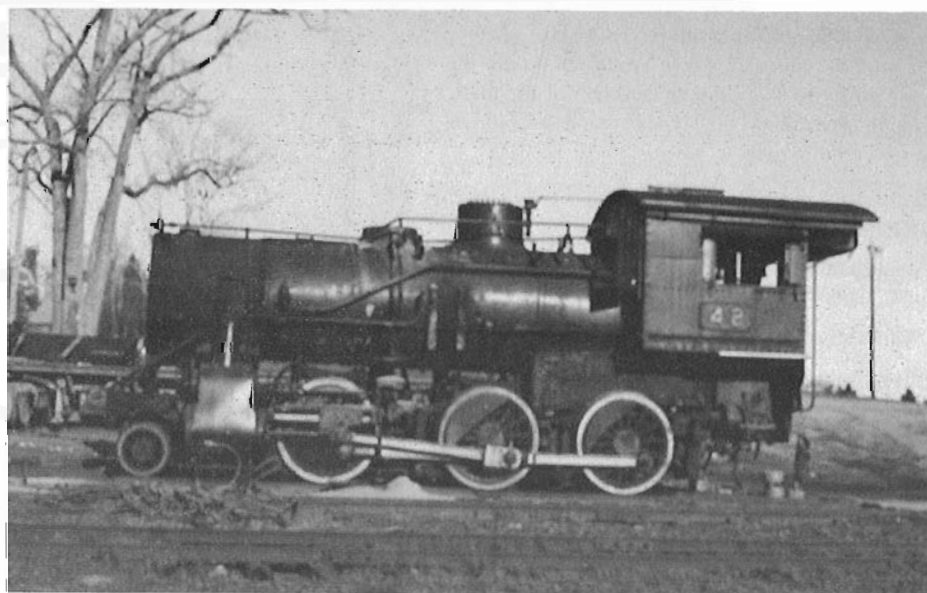
One of the most interesting events on the S & H in 1991 was the loading of locomotive 42 (built in 1899) which is being returned to Nova Scotia. On November 19, 1991 three large flatbeds and one crane truck arrived in Hillsborough. The tender was separated from the locomotive and all the trucks were secured to the flatbed. While this was going on, others were removing as much as they could, such as headlights, marker lights, smokestack, domes, running boards, cow-catcher etc.

Unfortunately the crane could not handle the weight of No. 42, so it was necessary to remove more parts to lighten the load. Eventually this was done, the locomotive was loaded and all left Hillsborough around 10 o'clock on November 20.

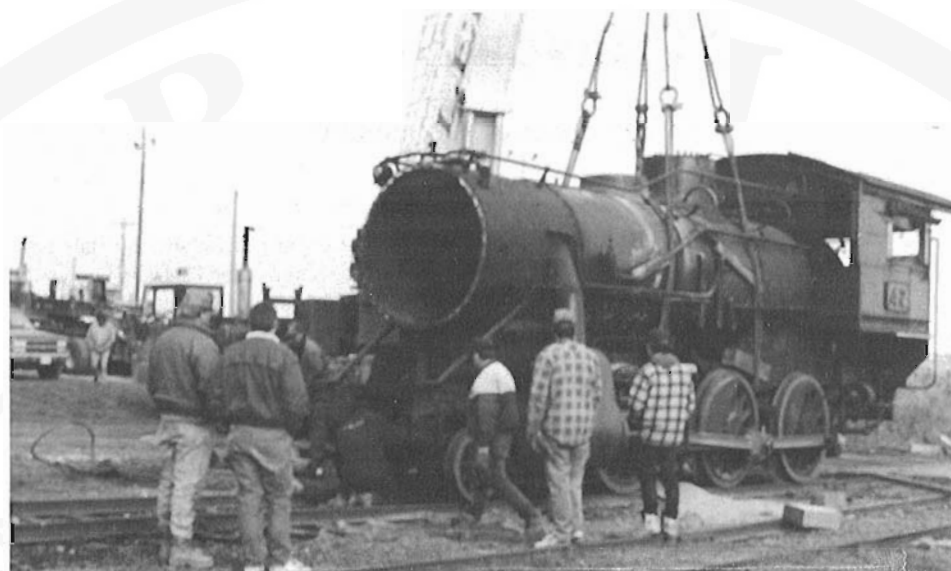
The S & H is looking forward to a successful season in 1992, and CRHA members and others should enjoy seeing and riding this interesting and scenic New Brunswick railway.



S & H 8245 and train at Salem on August 20, 1991.



ABOVE AND OPPOSITE: The move of locomotive 42. November 19, 1991.



Rail Canada Decisions

By Douglas N.W. Smith

SECTION OF ORIGINAL CP TRANSCONTINENTAL LINE TO VANISH

On October 7, 1991, the National Transportation Agency (NTA) gave CP permission to abandon 37.2 miles of trackage lying to the east of Calgary, Alberta. This trackage consists of the portion of the Langdon Subdivision from Langdon (Mile 0) to Irricana (Mile 25.7) which was placed in operation in 1910.

The remaining 14.5 miles is the remaining portion of the Strathmore Subdivision between Langdon (mile 33.6) and Shepard (Mile 45.1). This line, which formed part of the CP transcontinental line between Medicine Hat and Calgary, was built by the construction firm of Langdon, Shepard & Company in August 1883. It was officially opened to traffic on December 2, 1883. The completion of the Gleichen Subdivision between Gleichen and Shepard in 1914 gave CP an alternate route between these points. During the 1960's, CP downgraded the Strathmore Subdivision to branch line status.

SHAMROCK SUBDIVISION NOT SO LUCKY

On December 19, 1991, the NTA authorized CP to abandon the portion of the Shamrock Subdivision from Tyson (Mile 70.3) to McMahon (Mile 95.2), a distance of 24.9 miles. This portion of the Shamrock Subdivision was opened to traffic in July 1924.

The Shamrock Subdivision lies approximately 25 miles south of the section of the CP transcontinental line between Moose Jaw and Swift Current. Reflecting the small population base along the line, regular service over the Shamrock Subdivision consisted of only a twice weekly mixed train running between Moose Jaw and Swift Current.

ABANDONMENTS OVERTURNED BY GOVERNMENT

The federal government has exercised its authority to overturn rail line abandonment decisions by the NTA. An Order in Council were passed in October 1991 by the Governor General in Council reversing the NTA's order requiring the abandonment of the Taschereau Subdivision between La Sarre, Quebec and Cochrane, Ontario. On November 21, 1991, the order to abandon the Chandler Subdivision between Sainte Adelaide and Gaspé, Quebec was rescinded. The reason for this action was to preserve the rail passenger service operated over these two lines by VIA Rail.

Due to the deteriorated condition of the trackage between La Sarre and Cochrane, VIA's once per week Senneterre-Cochrane passenger service was suspended for several weeks last fall while emergency repairs were made to the line.

One Hundred Years Ago

A century ago the use of electric power for railways was becoming more and more practical. Already electricity was being successfully applied to street railways, and the horse car systems were facing extinction. It appeared to be only a matter of time before main-line railways also would be electrified, and the steam locomotive would go the way of the horse when this prophetic observation was published in 1891.

THE LOCOMOTIVE TO GO

The enormous amount of dead weight due to the carrying of the boiler, fuel and water in the old locomotive, will be entirely unnecessary in the railways of the future, which will be propelled electrically. Unquestionably the future electro-locomotion will

show a motor on every axle, or, at any rate, upon two axles of each car, and every car running as a unit, in which case they can run coupled together in a train or not, as may be convenient.

Saint John (N.B.) Daily Telegraph, May 8, 1891.

The prediction was, however, remarkably accurate in some respects. The concept of multiple-unit electric cars has found much use, especially on urban and suburban lines. However for main-line railways the prediction was only half right. The motive power is indeed electric, but the locomotive (either electric or diesel-electric) is still very much with us and is likely to remain so. Furthermore the steam locomotive remained in general use for more than 60 years after this prediction was made; far longer than the writer of 1891 could have realized.

The Business Car

TUNNEL CONSTRUCTION CHIEF NAMED

Duncan MacLennan, the CN engineer who set up Toronto's GO Transit commuter rail network and oversaw the laying of track through the Rocky Mountains, now has a new challenge. CN North America named MacLennan its chief of construction for the new \$155-million underwater rail tunnel between Sarnia, Ontario and Port Huron Michigan.

The tunnel, which CN hopes will speed up rail freight traffic and cut into the freight business handled by truckers, is expected to open in 1994. CN will be hiring tunnelling experts from around the world to work under MacLennan.

Source: Montreal Gazette, January 10, 1992.

[Note: See pages 3 to 25 of this issue to see how the present tunnel at this site was built].

A QUIET DEATH FOR ANGUS SHOPS

An 87-year-old institution in Montreal's east end is dying quietly. The Angus Shops, Canadian Pacific's locomotive and freight car repair facility, officially closed Friday January 3, but it will have some workers on site for another month to wind down operations. CP spokesman Tim Humphreys said.

"There will be nothing major going on, mostly cleanup and moving of machinery and finishing up small contracts" Humphreys said in a telephone interview. The last full day of operations was December 13. The plant has been shut down the past two weeks for the Christmas holidays.

Humphreys noted, however, that a deal reached in November between CP and nine unions representing 924 Angus workers allowed for most of the employees to continue working past the Friday shutdown. In each of five weeks - the week of December 16 - 20 and the four weeks starting January 6 - a different 20 percent of the approximately 820 unionized employees will be called in.

Only 57 members of the total work force will be laid off by the end of January; the balance will have the right to "bump" into other positions at the Cote St. Luc yard. Workers have the right to begin exercising their seniority and bump into other positions as of February 3. If there is no work there, Angus employees will continue to be paid until their retirement. They can also transfer to CP Rail's heavy repair shops in Winnipeg and Calgary.

Both sides now are negotiating for additional options to offer the workers who will be displaced.

Source: Montreal Gazette, January 5, 1992.

BACK COVER:

On November 9, 1908, John Boyd photographed the GT Train #1 standing at the Sarnia Station. The GT elected to operate the electric units in pairs. The specifications for each unit were as follows:

Length over all 23 feet 6 inches. Height from rail to top of roof 13 feet. Width of cab over all 9 feet 8 inches.

Total weight of locomotive fully equipped 67.5 tons. Length of rigid wheel base 16 feet. Diameter of driving wheels 62 inches.

Unlike steam locomotives, these units were equipped with speedometers linked to a recorder whose tape allowed officials to ensure crews adhered to the prescribed speed limits.

National Archives of Canada. Photo No. PA-60727.

WHAT IS THIS? SOMEONE REINVENTED TRAIN TRAVEL!

By Charles Lynch.

It took five holiday trips to the Ottawa railway station to realize what was happening - the trains are back. People kept arriving by train and needed to be picked up, and people kept wanting to leave by train and had to be taken to the station. The very word "station" needed getting used to again: time was when it had only one meaning in every city and town, and that was for the place the trains came in and departed. The word is back in the vocabulary now, with a vengeance. (we're talking Canada here, not the rest of the world, where trains never faded).

I had come to associate travel with the bustle that goes with airports, never user-friendly at the best of times and a nightmare at the worst, surpassed only by bus terminals. Yet here was a lineup of 40 taxicabs at the Ottawa station, and announcements about trains arriving and leaving, in a voice that could be understood. Here were people lining up to board amid good-natured banter, many sitting on their luggage. Arriving passengers came in smiling from the platforms pushing their stuff in carts courtesy of the management. People do not smile at airports and bus terminals. On two visits to the station the restaurant was closed and VIA was providing free coffee and cookies to all comers. When was the last time the public got anything free at airports?

Pricewise, compared to the train, air travel is no contest. Even first class train travel (with use of the VIP lounge at the station, and free meals and booze aboard) is cheaper than economy travel aloft. The return air fare from Ottawa to Toronto, 50 minutes each way, is something like \$450 if you count taxis at each end. The train fare is a quarter of that, and the trip is almost as fast in elapsed time. It is a sign of the times that VIA is putting on more trains where the traffic is thickest - between Montreal, Ottawa and Toronto. These are the same trains they took away when traffic was thin and most people seemed resigned to the closing down of the passenger rail business altogether. I have always said that if the train were a new invention it would be hailed as the marvel of the time, and here we are reinventing it, and getting "All Aboard".

Just a bit of good news amid the prevailing gloom.

Source: Montreal Gazette, January 4, 1992.

LONDON TO SELL OFF BRITISH RAIL

British Secretary of State for Transportation, Malcolm Rifkind, will announce plans next month for the government's privatization of British Rail, the Observer newspaper reported on December 29. The sell-off is expected to fetch up to the equivalent of \$4 billion.

Source: Montreal Gazette, December 30, 1991.

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