



# BUILDING CANADA

## The Canadian Society for Civil Engineering

CSCE National Office  
Bureau national de la SCGC  
300 rue St-Sacrement #521,  
Montréal, QC H2Y 1X4  
Telephone/ Téléphone: (514) 933-2634  
Website/Site web : [www.csce.ca](http://www.csce.ca)

The CSCE is a learned society created to develop and maintain high standards of civil engineering practice in Canada and to enhance the public image of the civil engineering profession.

La SCGC est une société savante dont le but est de développer et maintenir des standards élevés de la pratique du génie civil au Canada et de rehausser l'image de la profession du génie civil auprès du public.





Photo credits to: LM Wind Power

Photo credits to: LM Wind Power

# WELCOME

From Canoes, Canals, Bridges & Railways... to the Future!

CSCE History Committee

Supported by:

City of Ottawa  
University of Ottawa  
University of New Brunswick

Welcome to our display on how civil engineering helped build Canada, and design the infrastructure that ensures your health and welfare, your family home, and your environment.

Civil engineering is one of the oldest professions, and is now helping to address the challenges of the future: growing global population and climate change.

We hope to take you on a brief journey through the past, present and future of civil engineering. We begin with some of the most important projects that played a key role in creating the Canada we know today.

# Bienvenue

Des canoës, des canaux, des ponts et des chemins de fer ... du futur!

Comité histoire de la SCGC

Avec l'appui de:

La Ville d'Ottawa  
L'Université d'Ottawa  
L'Université Nouveau Brunswick

Bienvenue à notre exposition sur la façon dont le génie civil a contribué à bâtir le Canada et à concevoir les infrastructures qui assurent votre santé et bien-être, votre maison familiale et votre environnement.

Le génie civil est l'un des métiers les plus anciens. Actuellement, il participe à relever les défis de l'avenir: l'accroissement de la population mondiale et le changement climatique.

Nous espérons vous emmener faire un bref voyage dans le passé, le présent et l'avenir du génie civil. Nous commençons avec quelques-uns des projets qui ont joué un rôle clé dans la création du Canada que nous connaissons aujourd'hui.





CIVIL ENGINEERING  
Transforming Canada and the World

LE GÉNIE CIVIL  
Transformer le Canada et le monde

Before roads and bridges and canals and railways, most people lived, worked and died within 10 kilometres of where they were born. Cholera and typhoid fever raged unchecked. Life for most was short, nasty and brutal. But between about 1700 and 1914, Civil Engineers changed the world. New roads and bridges and canals enabled travel, spread new ideas, and promoted industry, economy and agriculture to support a more comfortable, educated and stimulating lifestyle. Telford, Smeaton, Brunel, Richardson, Keefer and Fleming - they changed the world with their works. And the work goes on!

This Display is about Civil Engineering in Canada's past, present and future ....

our common future!

Avant l'avènement des routes et des ponts, des canaux et du chemin de fer, la plupart des gens ont vécu, travaillé et sont décédés dans un rayon de 10 kilomètres de leur lieu de naissance. Le choléra et la fièvre typhoïde faisaient rage. La vie de la plupart des habitants était rude et pénible et leur espérance de vie était courte. Mais entre 1700 et 1914, les ingénieurs civils ont changé le monde. De nouvelles routes, des ponts et des canaux ont facilité les voyages et la propagation de nouvelles idées. Ils ont favorisé l'essor de l'industrie, de l'économie et de l'agriculture, ce qui a permis un mode de vie plus confortable et stimulant et un accès aux connaissances. Telford, Smeaton, Brunel, Richardson, Keefer et Fleming ont changé le monde avec leurs œuvres. Et le travail se poursuit !

Cette exposition porte sur le génie civil à travers le passé, le présent et l'avenir...

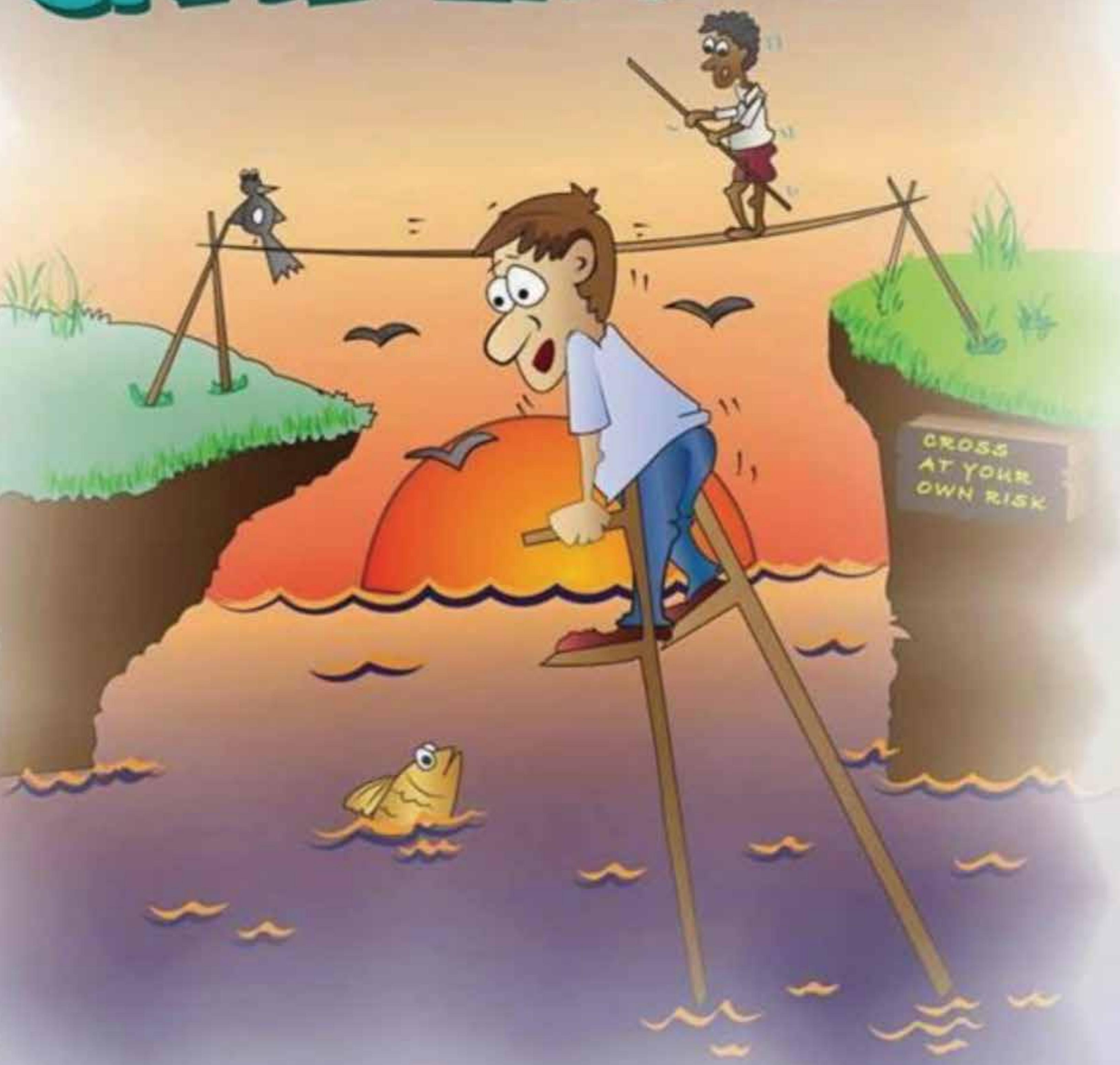
notre avenir commun!



Photo by Mike Danneman.

Used with permission

# Life without CIVIL ENGINEERS





# LE PONT DU GARDE

## the Work of Civil Engineers

The Pont du Gard is an ancient Roman aqueduct that crosses the Gardon River in southern France. It is the highest of all elevated Roman aqueducts, built halfway through the 1st century AD as part of a 50 km long aqueduct that supplied the city of Nîmes with water. Built as a three-level aqueduct standing

50 m high, this three-storey bridge measures 360 m at its longest point along the top. The Roman architects and hydraulic engineers created a technical masterpiece that stands today as a work of art.

Le Pont du Gard est un ancien aqueduc romain qui enjambe la rivière Gardon dans le sud de la France. Construit au milieu du 1er siècle après JC, il est le plus haut de tous les aqueducs romains surélevés. Il fait partie d'un aqueduc de 50 km de long qui fournissait de l'eau à la ville de Nîmes. Construit sur trois

niveaux de 50 m de haut, ce pont mesure 360 m à son point le plus long à son sommet. Les architectes et les ingénieurs hydrauliques romains ont créé un chef-d'œuvre technique qui se présente aujourd'hui comme une véritable œuvre d'art.

"Sur le Pont d'Avignon  
On y danse, On y danse  
Sur le Pont d'Avignon  
On y danse tous en rond"



# SUR LE PONT D'AVIGNON

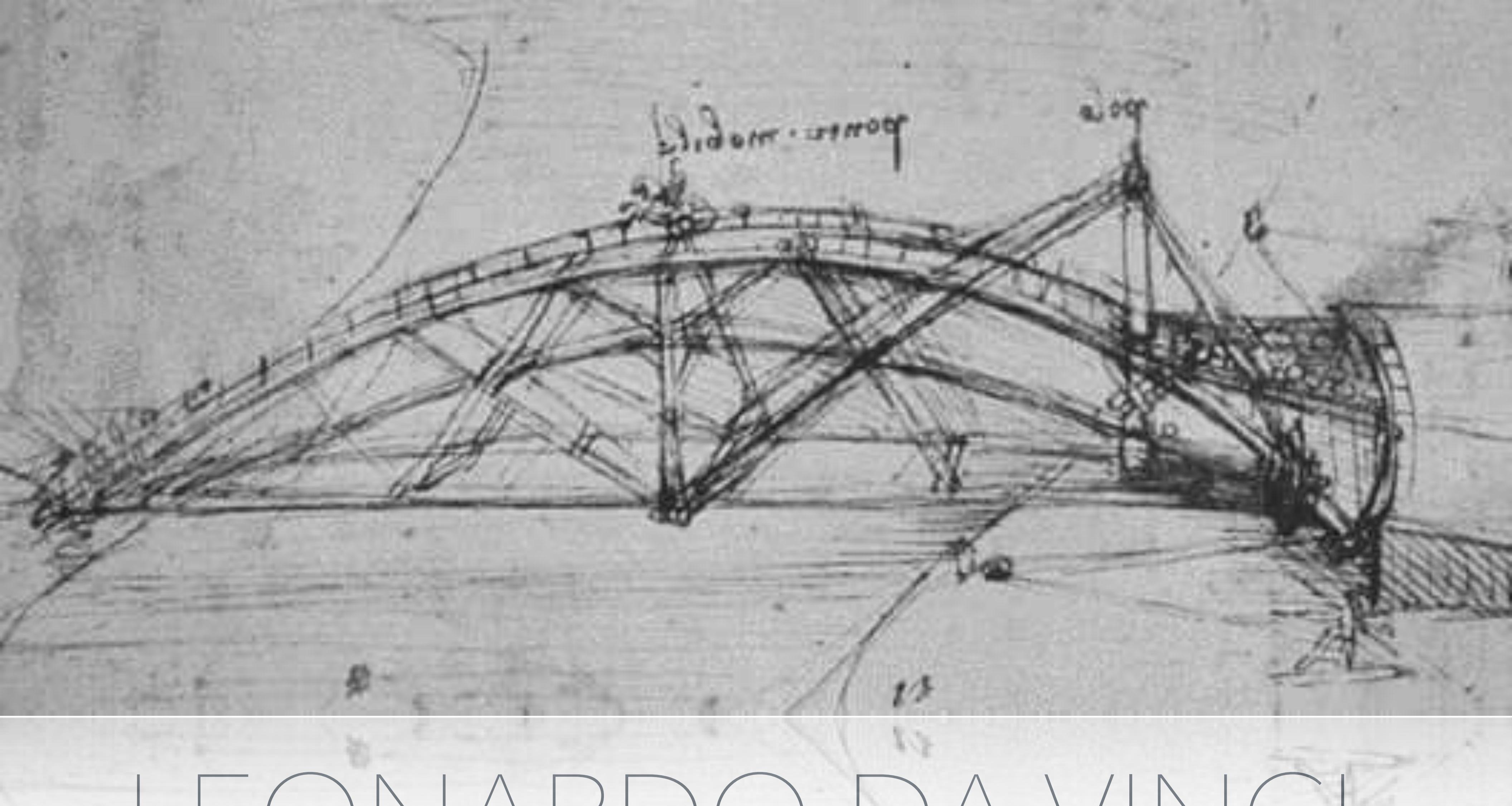
## the Work of Civil Engineers

The Pont Saint-Bénézet, also known as the Pont d'Avignon, is a famous medieval bridge in the town of Avignon, in southern France and was built between 1177 and 1185. "Sur le Pont d'Avignon" is a French folk song about the Pont d'Avignon that

dates back to the 15th century. Saint Bénézet, "Little Benedict the Bridge Builder", was a shepherd boy who saw a vision during an eclipse in 1177 to build a bridge over the Rhone River at Avignon.

Le Pont Saint-Bénézet, aussi connu sous le nom du Pont d'Avignon, est un fameux pont médiéval construit entre 1177 et 1185 dans la ville d'Avignon, dans le sud de la France. "Sur le Pont d'Avignon" est une chanson folklorique française

sur le pont datant du 15è siècle. En 1177, Saint-Bénézet, "Petit Benoît, le constructeur de pont" était un jeune berger qui a eu une vision de la construction d'un pont sur le Rhône à Avignon pendant une éclipse. .



# LEONARDO DA VINCI

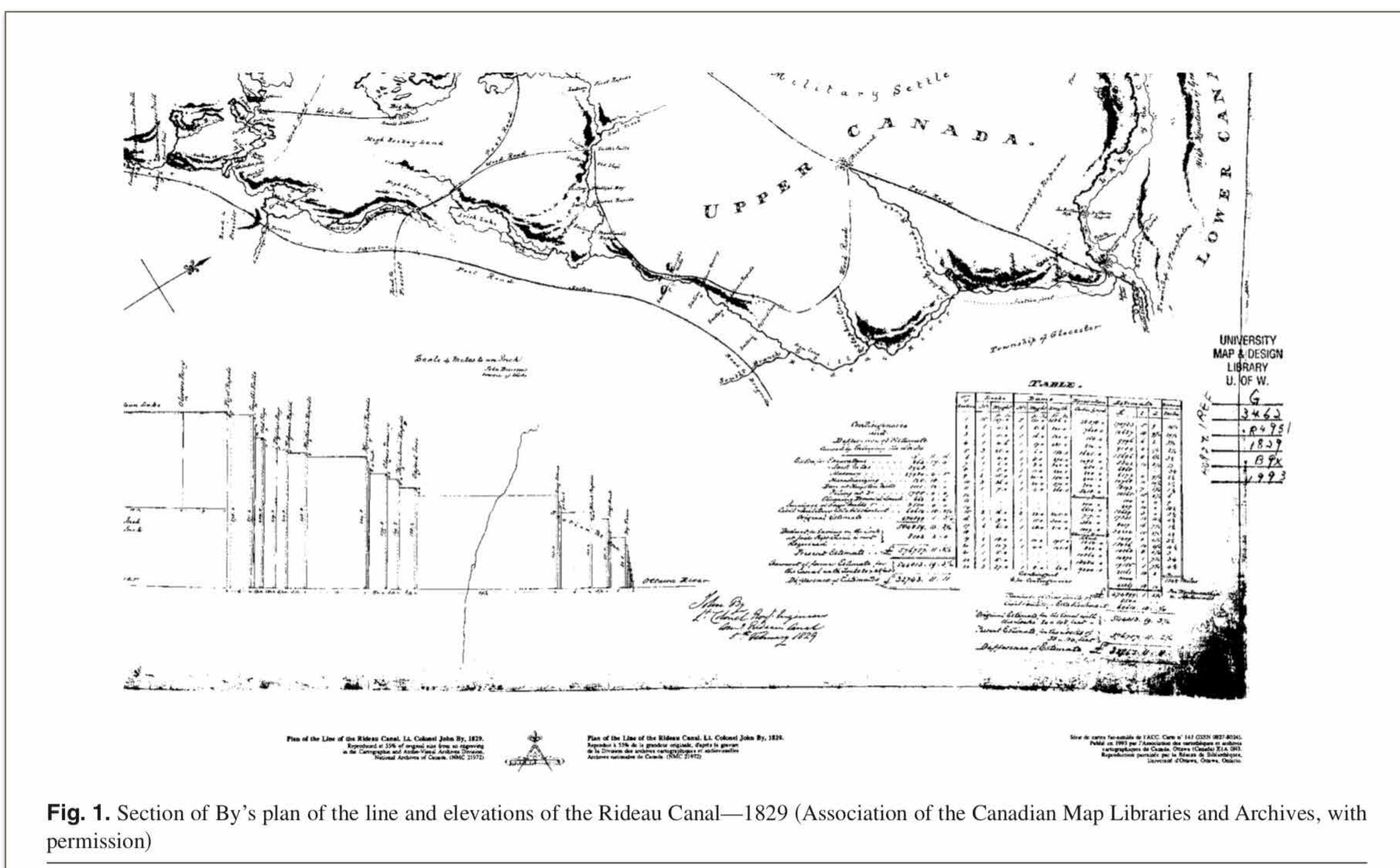
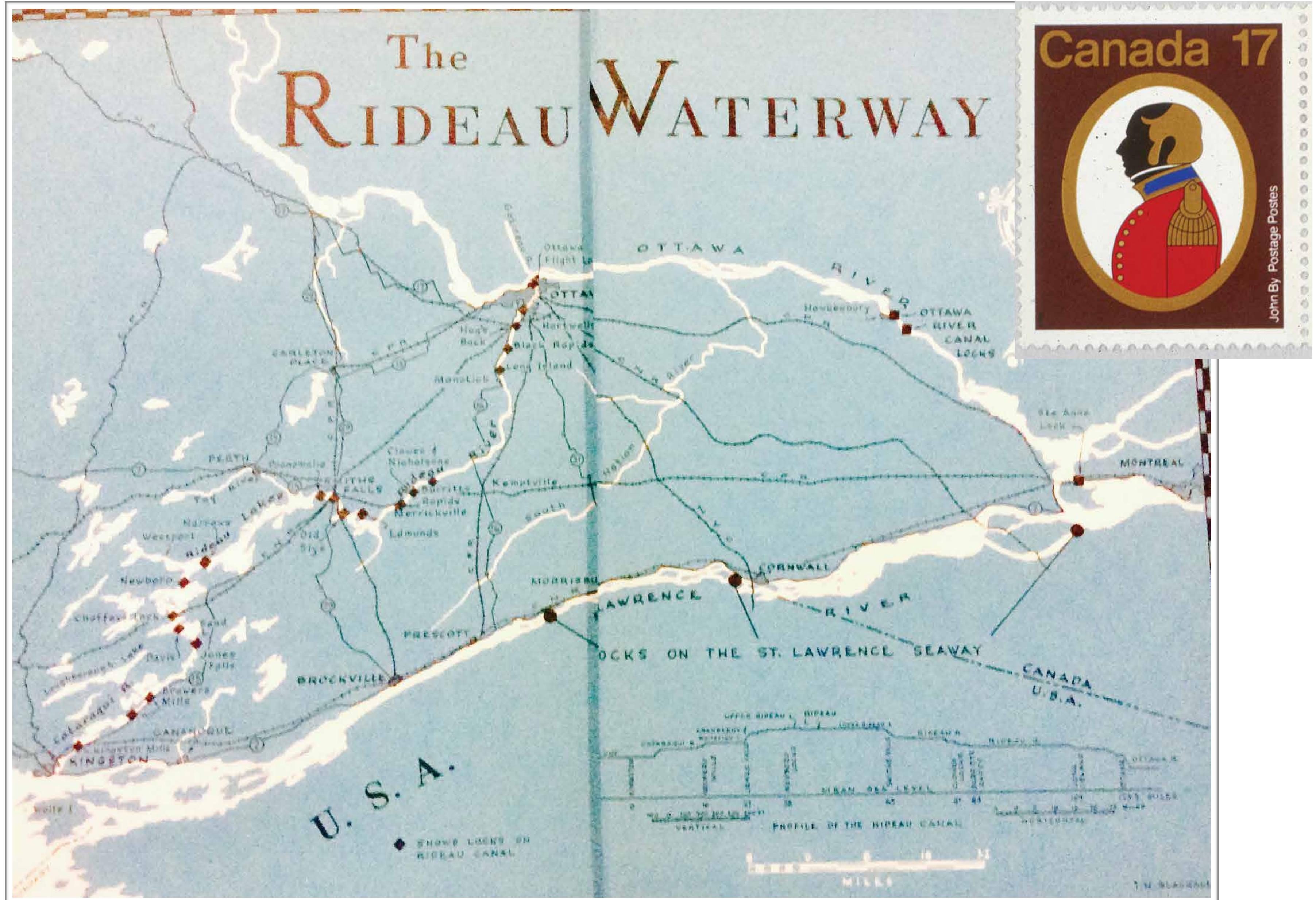
## the Work of Civil Engineers

From Leonardo's Codex Atlanticus, circa 1485, truss bridge above, swing bridge centre, and pontoon bridge (barely visible) below. For a fortified island, where a bascule

bridge would be inappropriate, he designed a swing bridge mounted on a pivot, a design now used frequently by modern bridge engineers.

Du Codex Atlantico de Léonard datant d'environ 1485, pont à treillis (haut), pont tournant (centre) et pont de bateaux (à peine visible - bas). Un pont à bascule étant inadéquat pour

une île fortifiée, il a conçu un pont tournant monté sur pivot, aujourd'hui utilisé fréquemment par les ingénieurs des ponts.



**Fig. 1.** Section of By's plan of the line and elevations of the Rideau Canal—1829 (Association of the Canadian Map Libraries and Archives, with permission)

# IN DEFENCE OF CANADA

## The Rideau Waterway - 1832

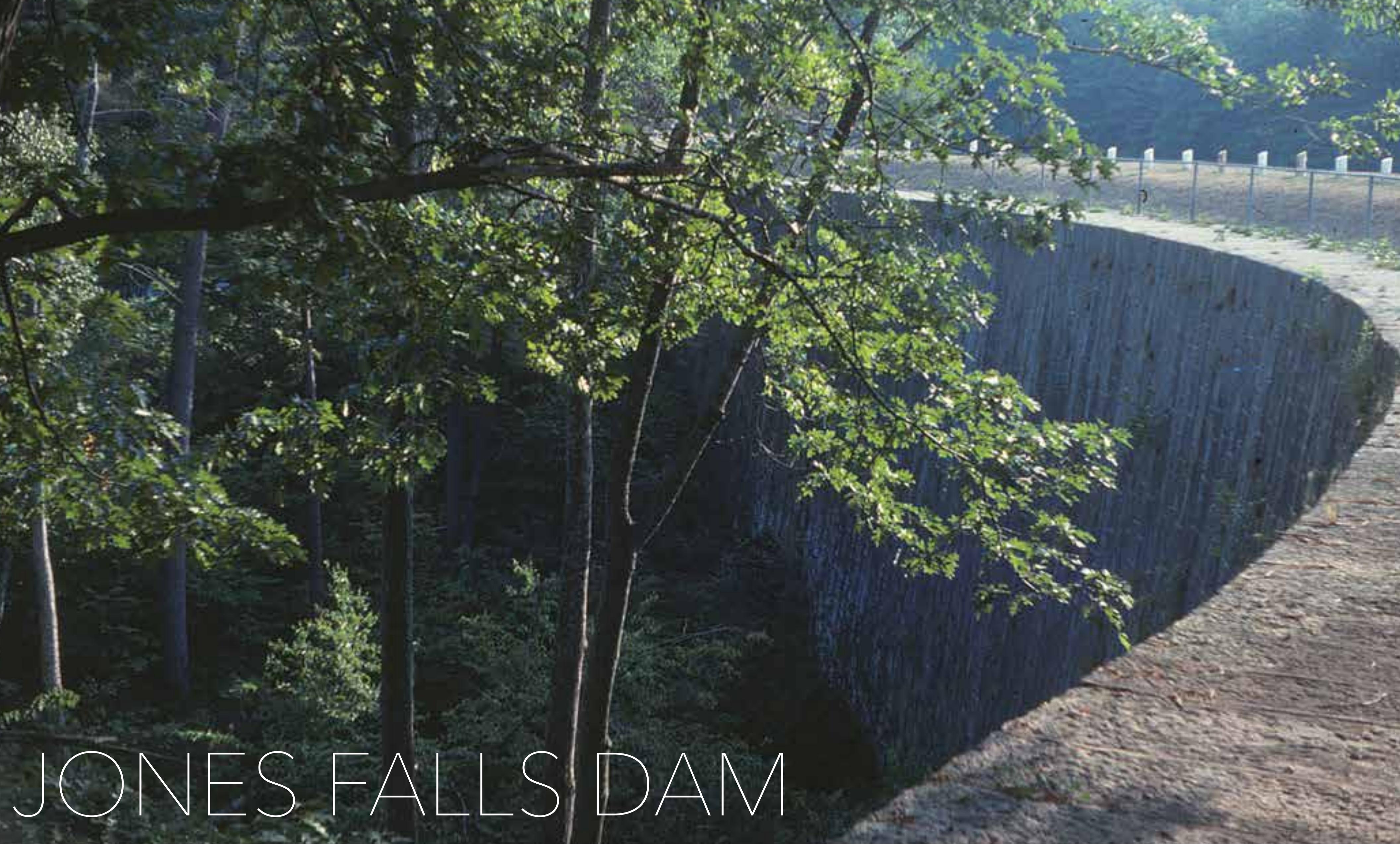
In 1814, after the War of 1812, the Rideau Canal Project was conceived as a defensive route linking Montreal and Kingston, the two key cities of Lower and Upper Canada. In 1826 construction began and Lt. Col. John By was appointed Superintending Engineer. By faced a stiff challenge to create a navigable waterway

between the Ottawa River and Kingston, through what was then a wilderness of rough bush, swamps and rock terrain. By completed the project in 1832.

Above is a map of the Rideau waterway and a plan and profile of part of the canal in Col. By's own hand.

En 1814, après la guerre de 1812, le projet du canal Rideau fut conçu comme une voie défensive reliant Montréal et Kingston, les deux villes clés du Bas-Canada et du Haut-Canada. La construction débuta en 1826, et le lieutenant-colonel John By fut nommé ingénieur-sous-intendant. By fit face à un défi de taille consistant en la

création d'une voie navigable entre la rivière Ottawa et Kingston, dans ce qui était alors une étendue sauvage de broussailles, de marais et de terrains rocheux. By acheva le projet en 1832. Dessinée de la main du Col. By, la carte ci-dessus illustre la voie navigable Rideau et un plan et profil d'une partie du canal.



# JONES FALLS DAM

Jones Falls Dam on the Rideau, constructed in 1830, was the first true arched masonry dam in North America. Constructed far from any settlement in virgin forest and malaria ridden swamp, the graceful sandstone dam marked a turning point in Canadian engineering.

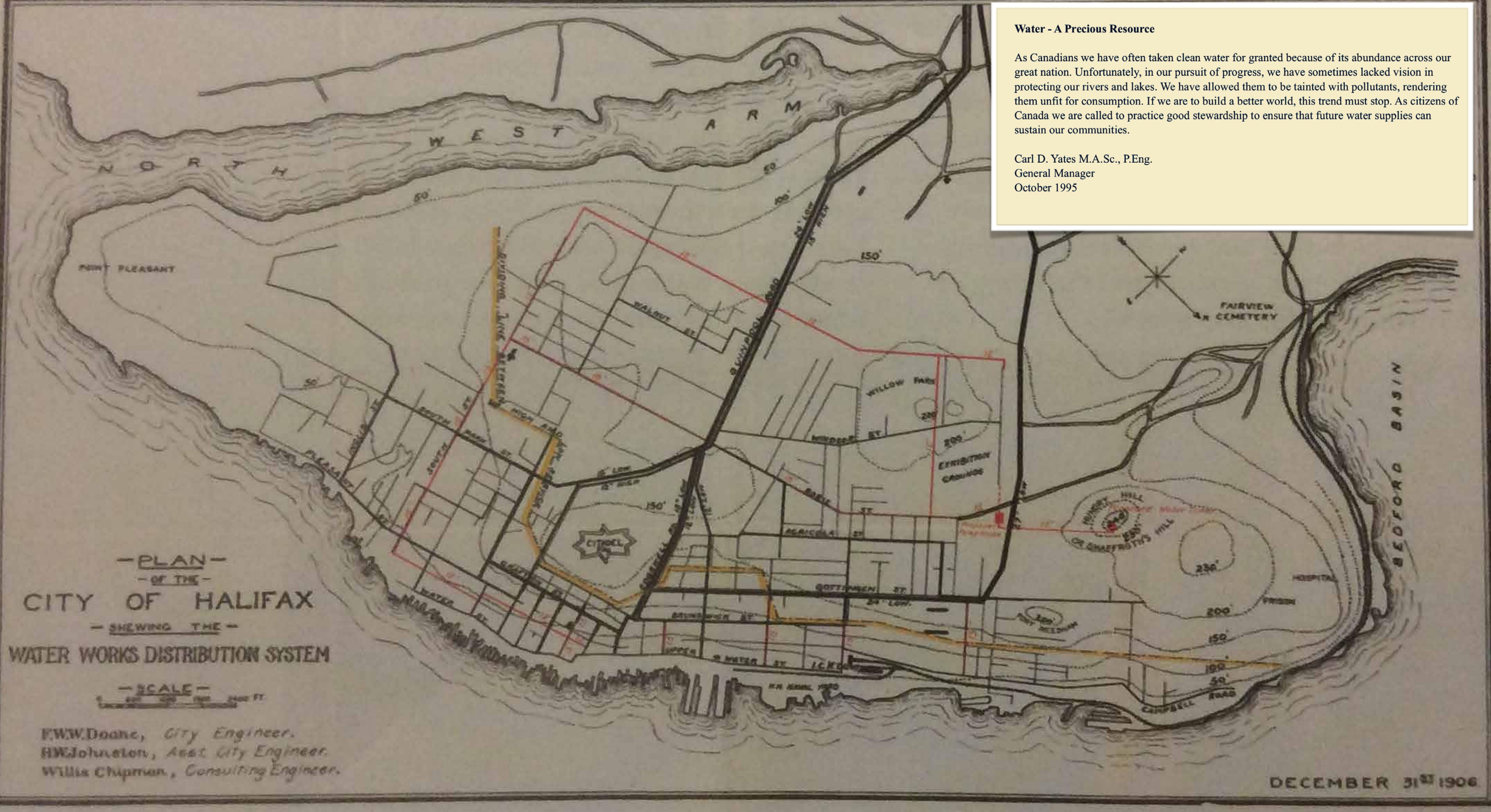
Construit en 1830 sur le canal Rideau, le barrage Jones Falls fut le premier véritable barrage à arche en maçonnerie d'Amérique du Nord. Implanté loin de tout peuplement, dans une forêt vierge et un marécage infesté de paludisme, le gracieux barrage en grès a marqué un tournant dans l'ingénierie canadienne.



#### Water - A Precious Resource

As Canadians we have often taken clean water for granted because of its abundance across our great nation. Unfortunately, in our pursuit of progress, we have sometimes lacked vision in protecting our rivers and lakes. We have allowed them to be tainted with pollutants, rendering them unfit for consumption. If we are to build a better world, this trend must stop. As citizens of Canada we are called to practice good stewardship to ensure that future water supplies can sustain our communities.

Carl D. Yates M.A.Sc., P.Eng.  
General Manager  
October 1995



After many infectious epidemics in Halifax, in 1844, civic-minded businessmen formed the Halifax Water Company. The city purchased the system in 1861 and operated it in one form or another until 1944. On January 1, 1945, the Halifax Water Commission was given a mandate

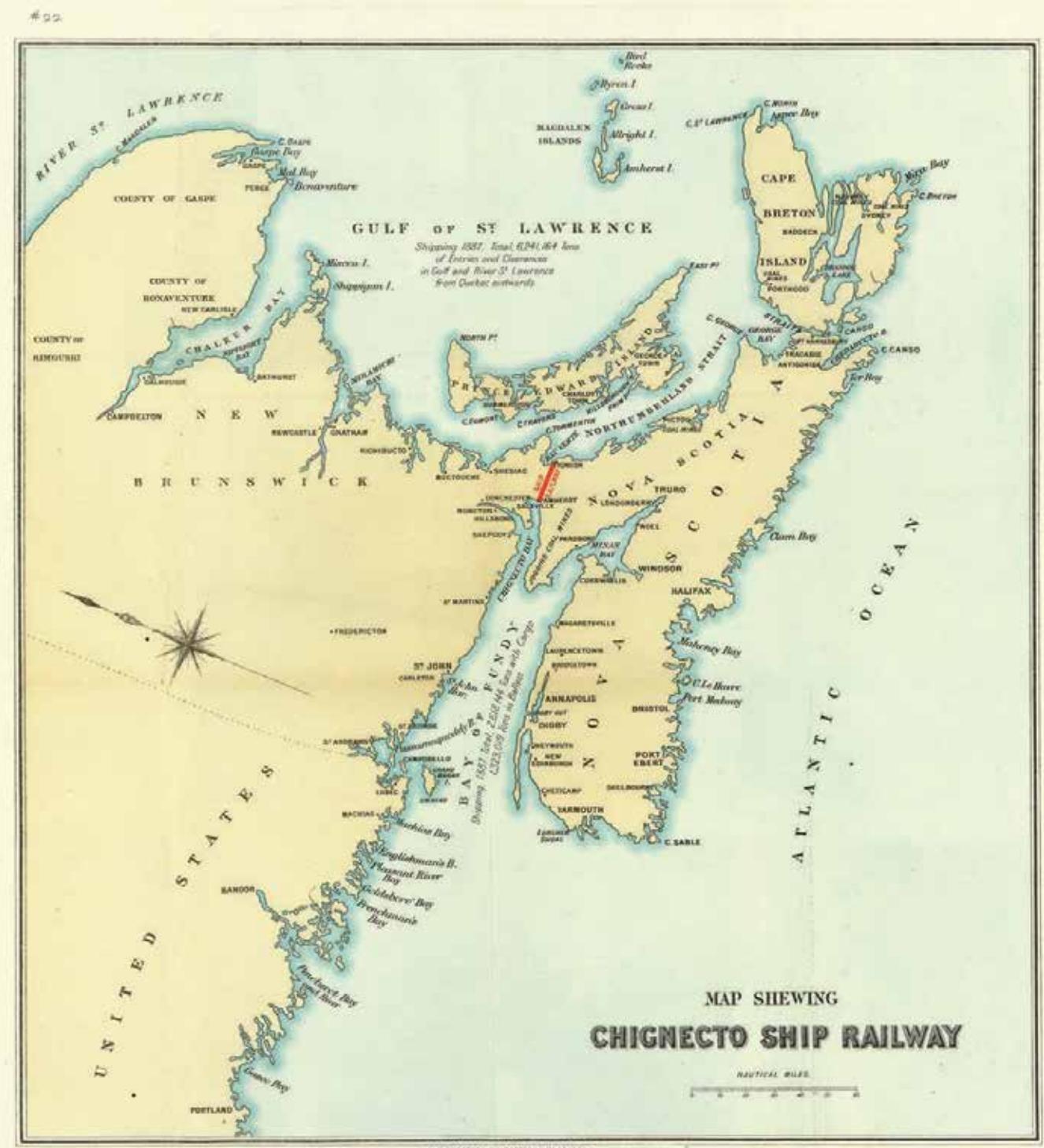
to operate and maintain the water supply system after it was ravaged by the demands of two world wars and the neglect of the depression, and is now a modern, efficient water utility serving Halifax and beyond.

À la suite des nombreuses épidémies infectieuses qu'a connues Halifax en 1844, des hommes d'affaires mus par leur civisme ont formé la Société de l'eau de Halifax. La ville a acquis la société en 1861 et l'a exploitée sous une forme ou une autre jusqu'en 1944. Le 1er janvier 1945, la Commission de l'eau d'Halifax a reçu le mandat d'exploiter et

d'entretenir le système d'approvisionnement en eau après les dommages que lui ont causé les deux guerres mondiales et le délaissé dont il fut l'objet durant la dépression. Il est actuellement un service d'eau moderne et efficace servant Halifax et ses environs.

# THE CHIGNECTO SHIP RAILWAY 1888 - 1891

## LA VOIE FERRÉE DE TRANSBORDEMENT DE CHIGNECTOU 1888 - 1891



LOCATION OF PROJECT  
SHOWING ALIGNMENT OF SHIP RAILWAY IN RED.  
Localisation du projet  
La voie ferrée de transbordement est indiquée en rouge

**"The Chignecto Ship Railway"**  
an innovative civil engineering project  
by Henry G. C. Ketchum (1888-1891)

Innovation in engineering usually comes about after a need is identified but it is often a risky enterprise. The Chignecto Ship Railway is an example. In the 1880s, it became clear that the sea route from New England to Montreal could be shortened by about 800 km if ships could travel up the Bay of Fundy, go through the isthmus between New Brunswick and Nova Scotia, and on to the Gulf of St. Lawrence.

Ketchum proposed a 27 km ship railway across the isthmus. Ships up to 1800 tonnes, with hull and cargo, would enter a holding basin at one end, be placed onto a cradle, be lifted to a railway, be pulled by two locomotives at 15 km/h across the isthmus and be placed in a holding basin at the other terminus. A canal was not adopted because of higher costs and the extreme tides in the Bay of Fundy.

Ketchum's project was supported by other well-known engineers including Thomas C. Keefer of Canada and Sir John Fowler and Sir Benjamin Baker of Britain. The construction was commenced in 1888 but work was stopped in 1891 because of financial difficulties. The ship railway was about two-thirds complete when work ceased. This innovative idea of the ship railway almost became a reality and it would have been the first of its type in the world.

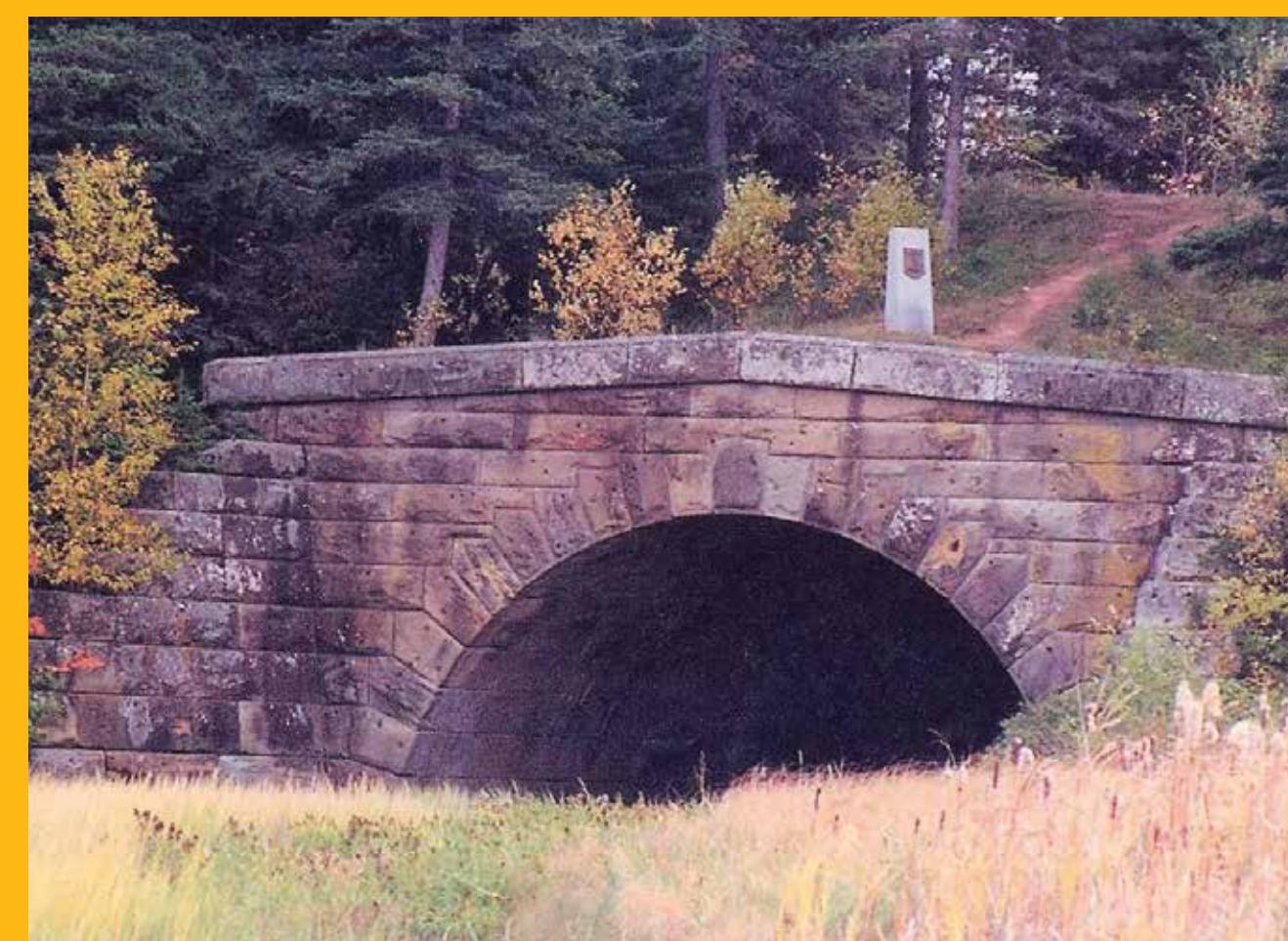
Images courtesy: Archives & Special Collections, University of New Brunswick  
\* Image courtesy: Dale I. Bray  
Created in May 2017



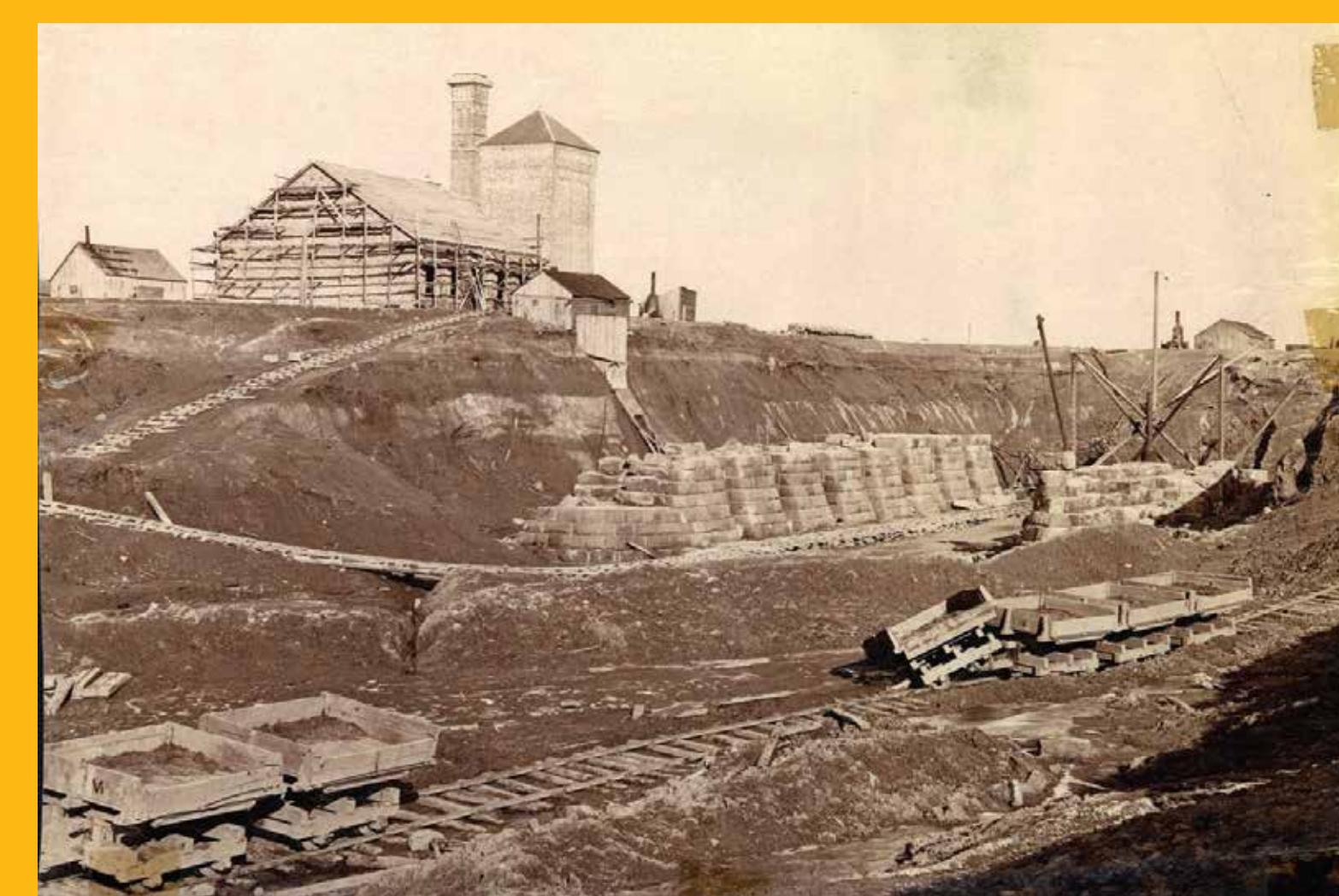
HENRY G.C. KETCHUM 1839 - 1896  
ENGINEER FOR THE PROJECT



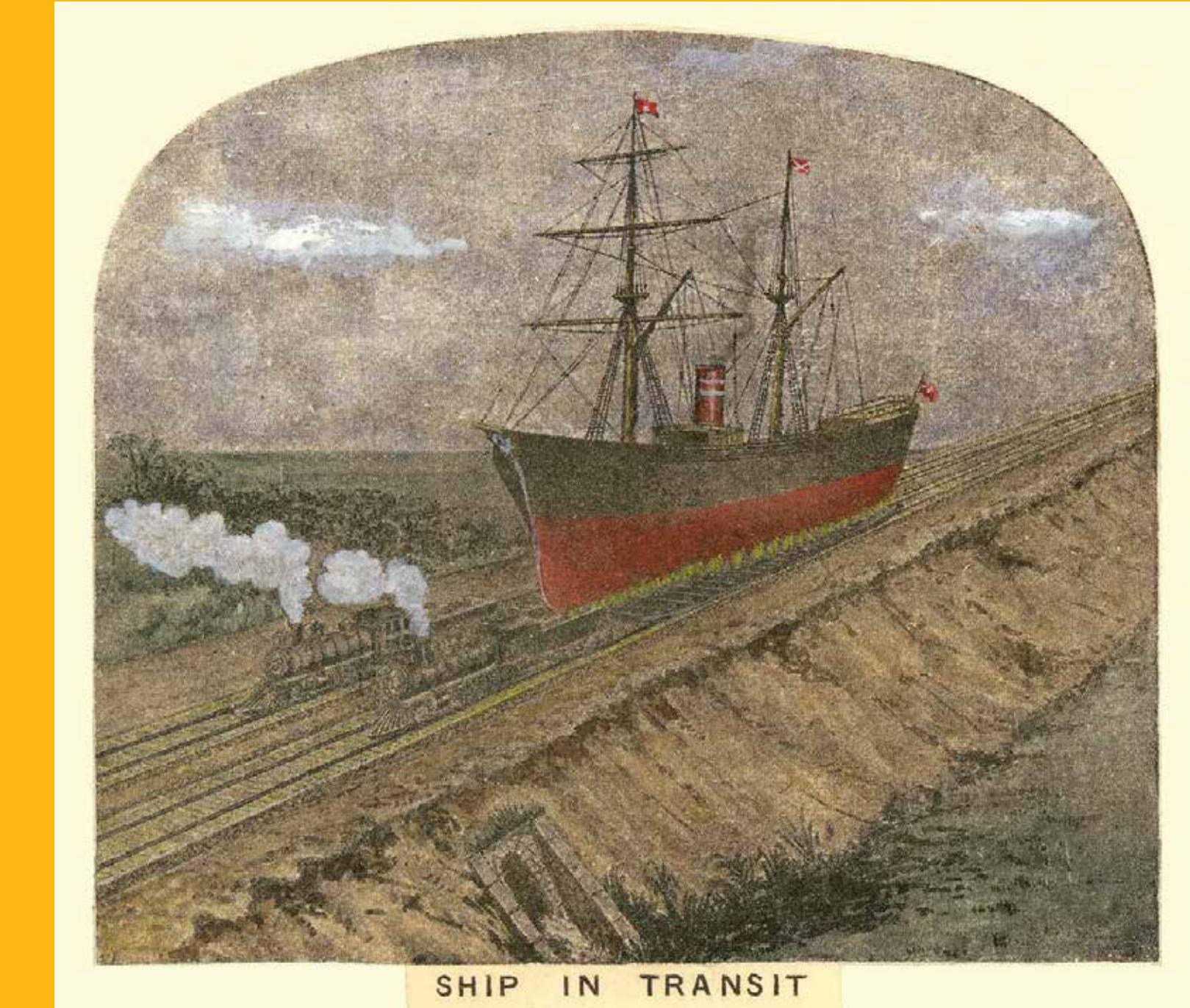
ARCH BRIDGE ON RAILWAY  
NEAR TIDNISH, NS AT EASTERN END 1890  
Pont en arc sur la voie de transbordement  
À l'extrémité est près de Tidnish, N.-É. - 1890



ARCH BRIDGE ON RAILWAY  
NEAR TIDNISH, NS AT EASTERN END 1997\*  
Pont en arc sur la voie de transbordement  
À l'extrémité est près de Tidnish, N.-É. - 1997\*



ENGINE HOUSE AND HOLDING BASIN  
AT WESTERN END NEAR AMHERST, NS c1890  
Bâtiment des machines et purot  
À l'extrémité ouest près de Amherst, N.-É., vers 1890



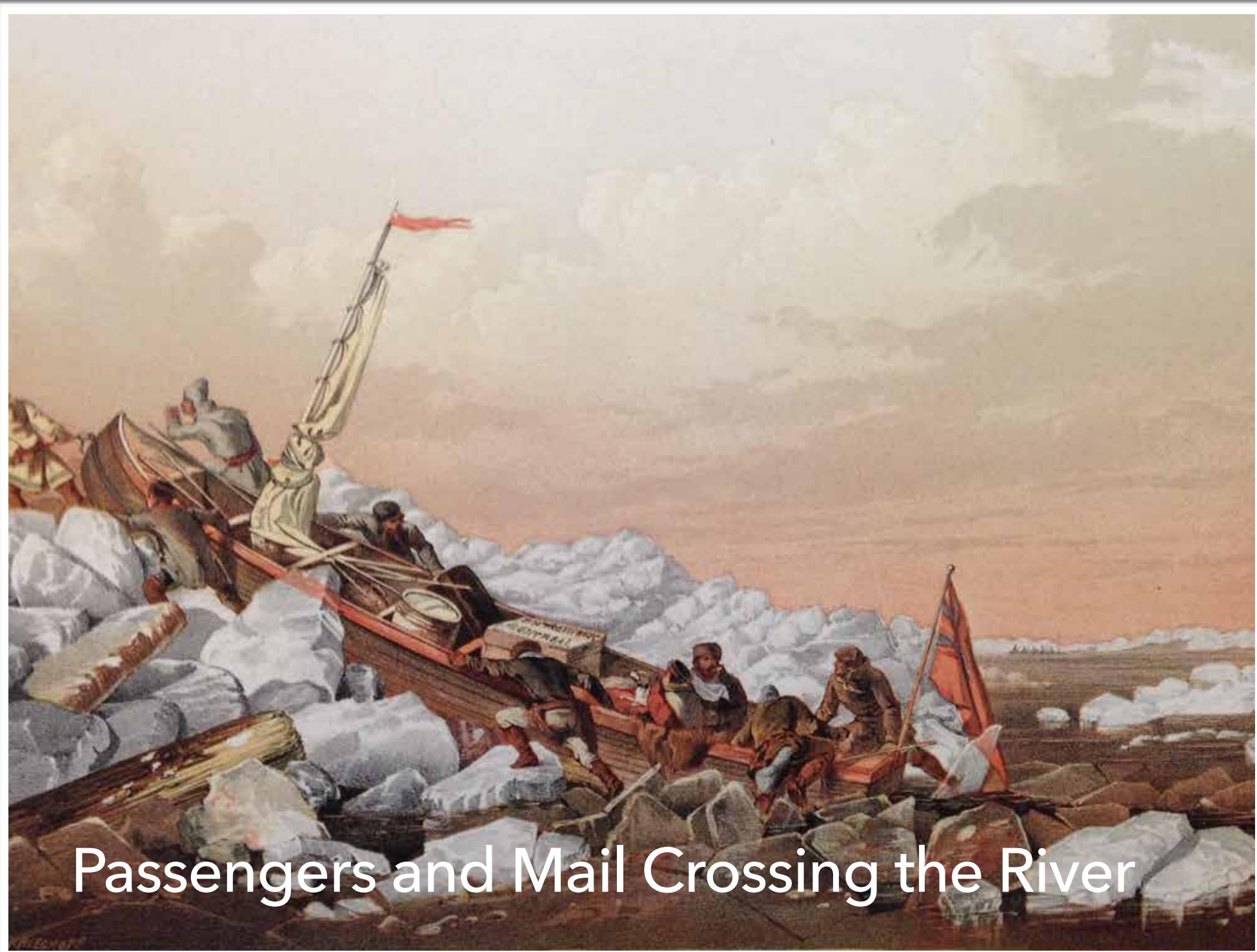
ARTIST RENDERING OF A "SHIP IN TRANSIT"  
Représentation artistique d'un "navire en transit"

**"La voie ferrée de transbordement de Chignectou"**  
Un ouvrage de génie civil innovant  
par Henry G. C. Ketchum (1888-1891)

L'innovation en ingénierie survient habituellement après qu'un besoin a été identifié, mais c'est souvent une entreprise risquée. La voie ferrée de transbordement de Chignectou en est un exemple. Dans les années 1880, il était devenu clair que la voie maritime entre la Nouvelle Angleterre et Montréal pourrait être réduite d'environ 800 km si les navires pouvaient voyager jusqu'à la baie de Fundy, par l'isthme entre le Nouveau-Brunswick et la Nouvelle-Écosse, puis le golfe du Saint-Laurent.

Ketchum a proposé une voie ferrée de transbordement de 27 km à travers l'isthme. Des navires de 1 800 tonnes avec la coque et la cargaison devaient entrer dans une retenue d'eau à une extrémité, être placés sur un berceau puis sur la voie ferrée, tirés par deux locomotives à 15 km/h sur l'isthme et placés dans une retenue d'eau à l'autre extrémité. L'idée de construire un canal n'avait pas été retenue en raison de coûts plus élevés et des marées extrêmes de la baie de Fundy.

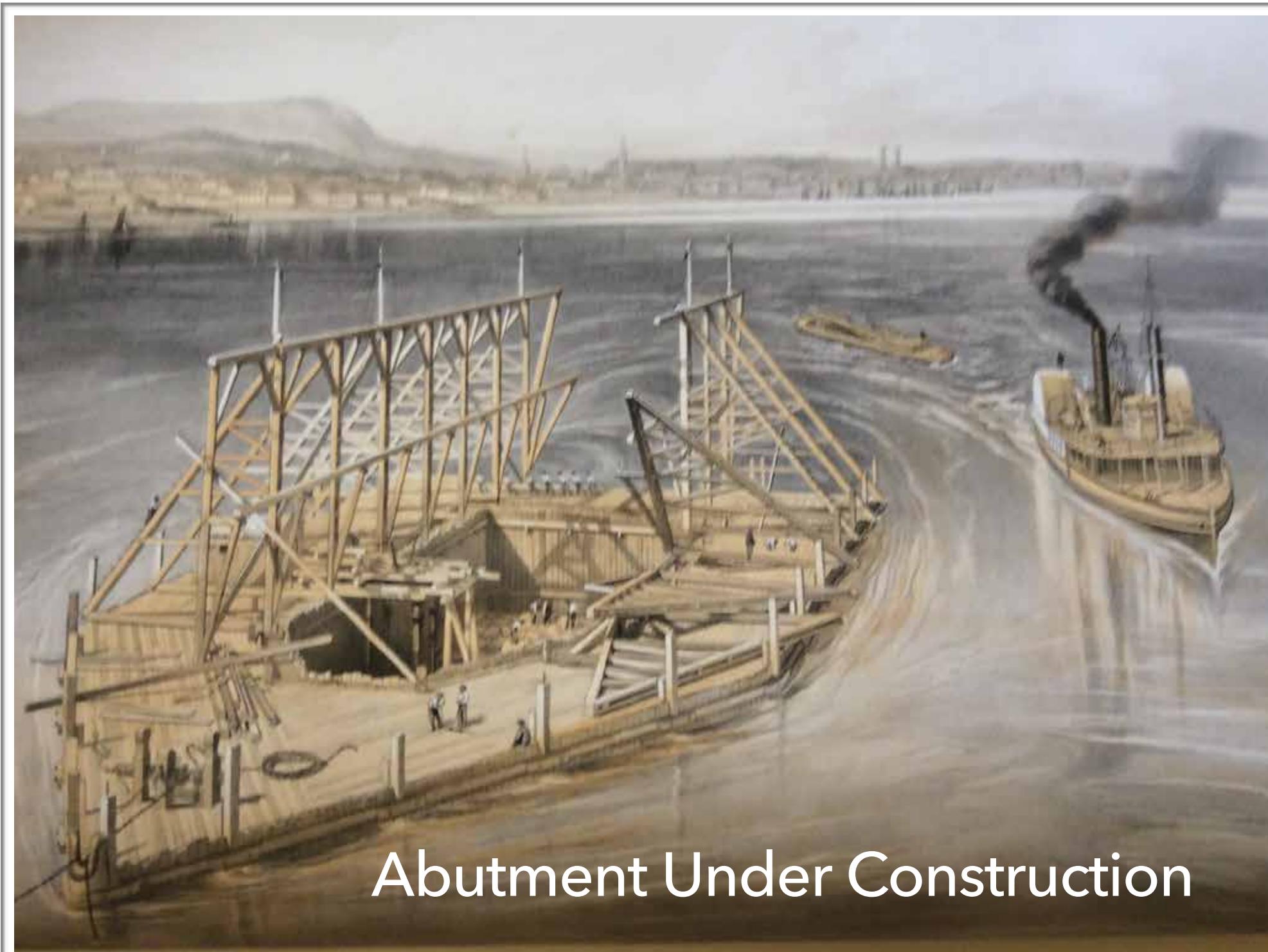
Le projet de Ketchum a reçu l'appui d'autres ingénieurs bien connus dont Thomas C. Keefer du Canada et Sir John Fowler et Sir Benjamin Baker de la Grande-Bretagne. La construction a commencé en 1888 mais les travaux furent arrêtés en 1891 en raison de difficultés financières. Environ les deux tiers du projet étaient achevés lorsque le travail a cessé. Cette idée novatrice de voie ferrée de transbordement a failli devenir une réalité et cette voie ferrée aurait été la première du genre dans le monde.



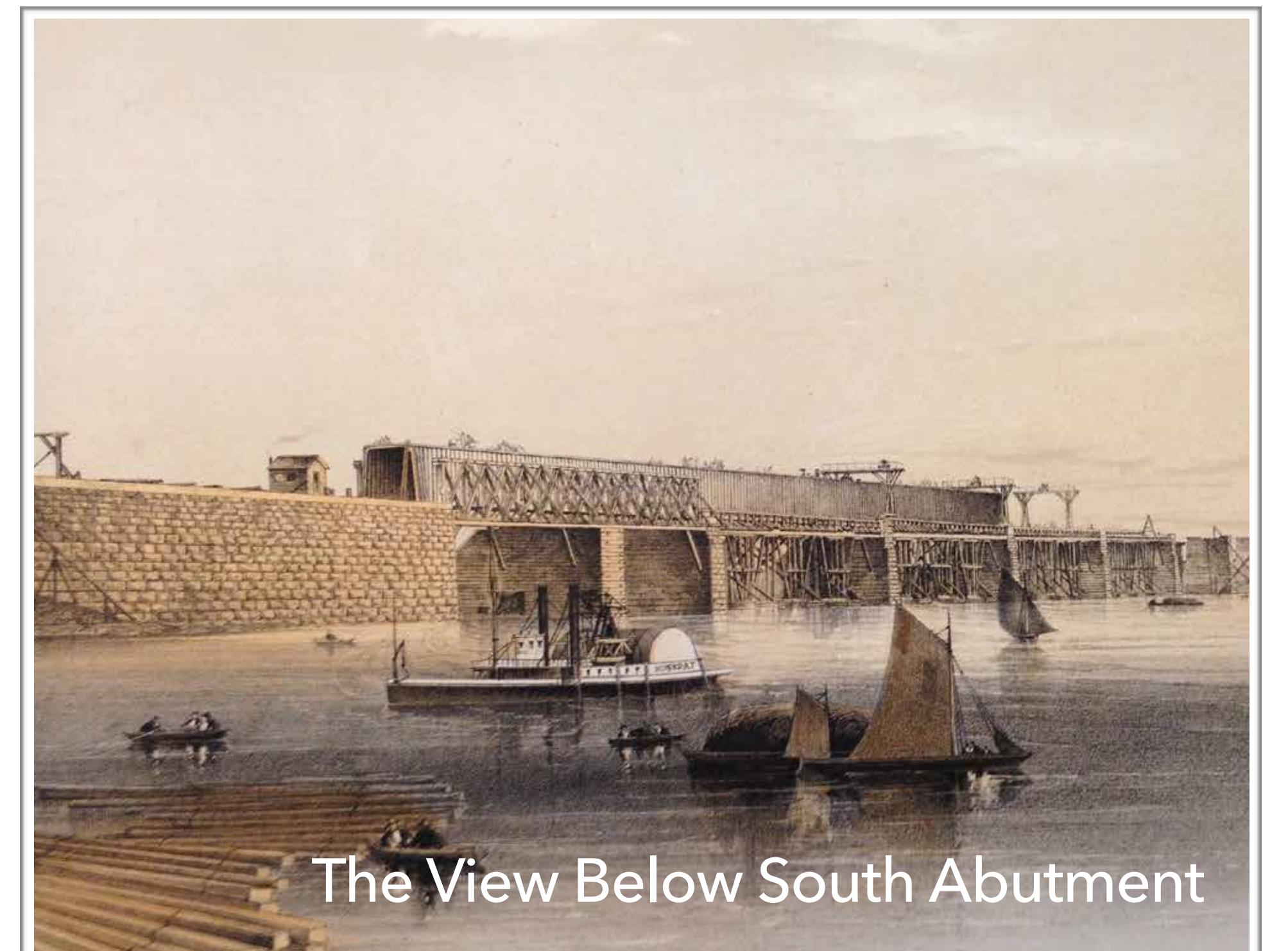
Passengers and Mail Crossing the River



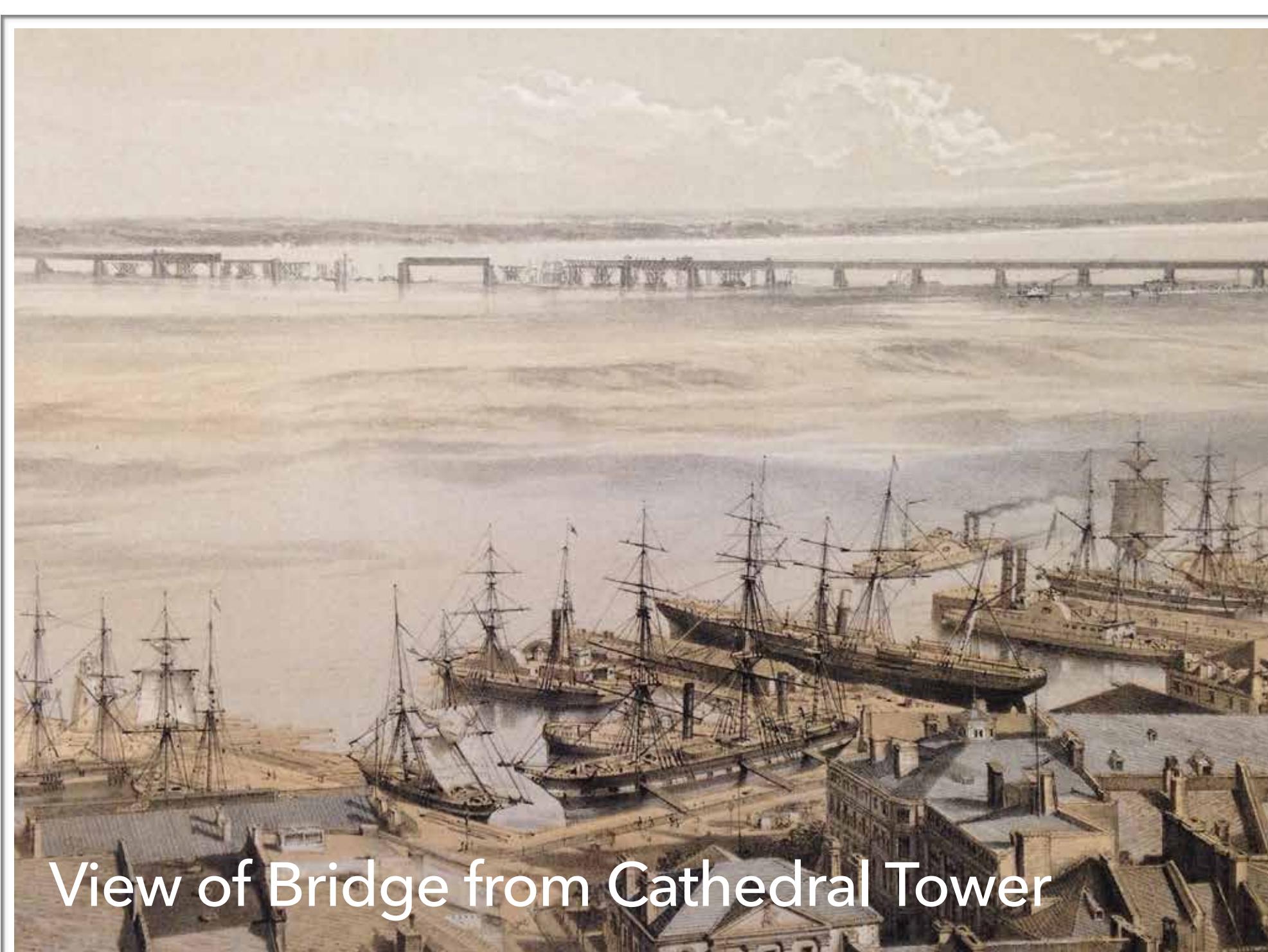
Putting Up Side Plates and Top of Tube



Abutment Under Construction



The View Below South Abutment



View of Bridge from Cathedral Tower



Victoria Bridge, Montreal & Mt Royal, 1860

## TO HRH ALBERT, PRINCE OF WALES

Who has graciously visited Canada to inaugurate the opening of the Victoria Bridge, constructed for the passage of trains of the Grand Trunk Railway across the river St. Lawrence (from folio presented by Messrs Peto, Brassy & Betts, contractors, 1860)

The Victoria Bridge was the first crossing of the St. Lawrence River, constructed as a long tubular iron bridge between 1853 and 1859. It was officially opened in 1860 by Queen Victoria's eldest son, Albert, Prince of Wales. A site for the bridge was selected by the Canadian engineer Thomas

Keefer. The structure was designed by Robert Stephenson (son of George Stephenson and the builder of the famed Rocket locomotive). Beautiful artwork from the folio presented to Prince Albert in 1860 is shown above.

Construit entre 1853 et 1859 sous forme d'un long pont en fer tubulaire, le pont Victoria fut la première voie traversant le fleuve Saint-Laurent. Il fut inauguré officiellement en 1860 par le fils aîné de la reine Victoria, Albert, Prince de Galles. Le site du pont fut sélectionné par l'ingénieur

canadien Thomas Keefer et la structure conçue par Robert Stephenson (fils de George Stephenson, constructeur de la célèbre locomotive Rocket). Une belle illustration du folio présenté au Prince Albert en 1860 est exposée ci-dessus.



# CANOT DE MAITRE

## Viscount and Lady Monck, circa 1861

On a trip by Viscount Monck (Governor General of Canada, 1861-68) and Lady Monck., by Mrs. Edward Hopkins (1838-1919). In a visit to the new capital of Ottawa in 1864, Lord Monck saw Rideau Hall,

which became the Governor General's residence. The battered condition of the roads often resulted in Lord Monck travelling to Parliament by canopied boat up the Ottawa River.

Lors d'un voyage du Vicomte Monck, Gouverneur général du Canada (1861-1868) et Lady Monck et de madame Edward Hopkins (1838-1919). Durant une visite à Ottawa, la nouvelle capitale, en 1864, Lord Monck

a vu Rideau Hall qui devint la résidence du gouverneur général. Le mauvais état des routes a souvent conduit Lord Monck à se rendre au Parlement par bateau à auvent sur la rivière des Outaouais.

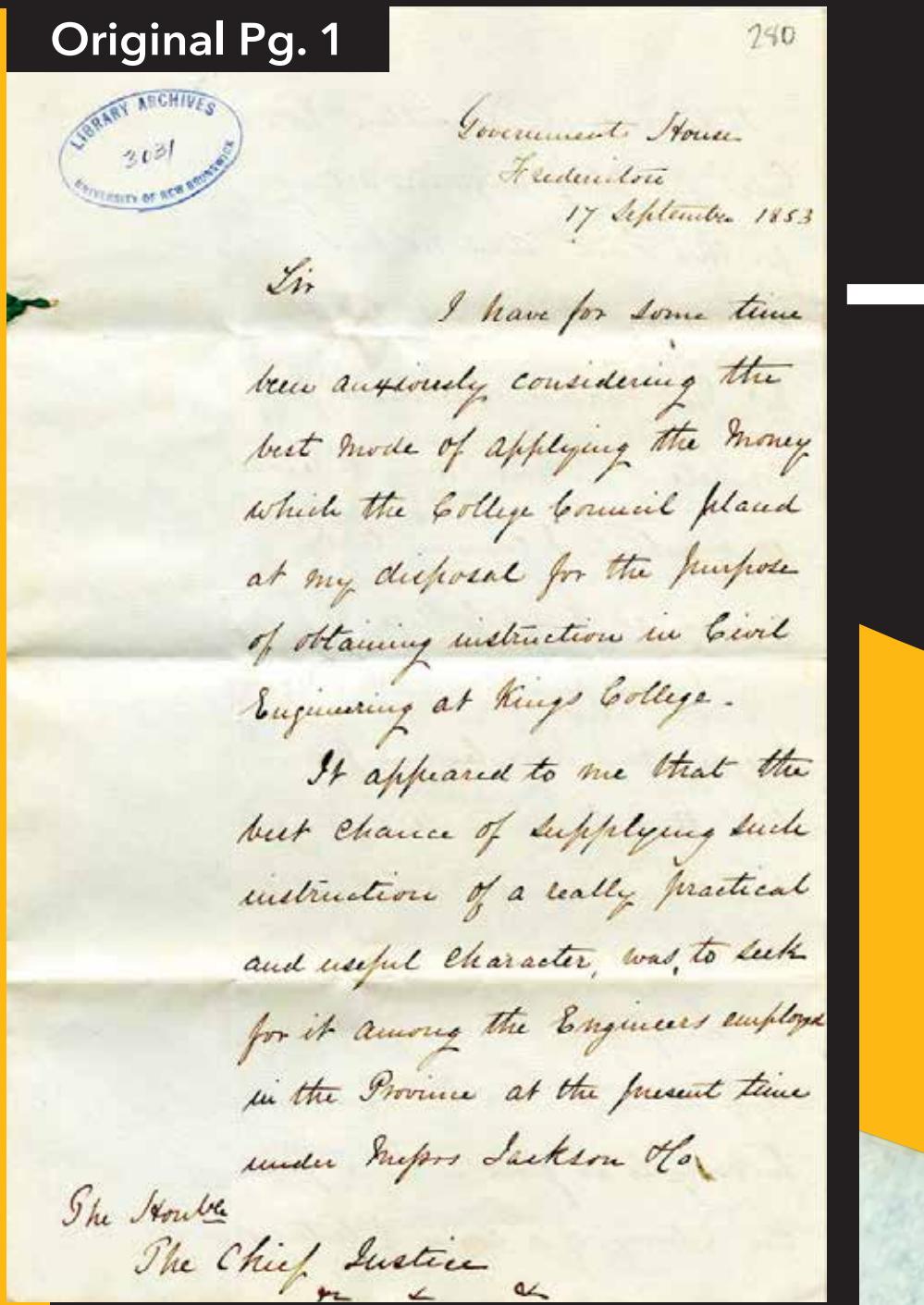
# FIRST COURSE IN CIVIL ENGINEERING IN CANADA 1854

## PREMIER COURS DE GÉNIE CIVIL AU CANADA 1854

### (KING'S COLLEGE, FREDERICTON, NB)



Sir Edmund Head  
Lieutenant-Governor of New Brunswick 1848-1854  
and proponent for the First Course.



Transcript of the letter  
to the Chief Justice of NB  
by Sir Edmund Head proposing  
the First Course

Government House  
Fredericton  
17 September 1853

I have for some time been anxiously considering the best mode of applying the money which the College Council placed at my disposal for the purpose of obtaining instruction in Civil Engineering at Kings College. It appeared to me that the best chance of supplying such instruction of a really practical and useful character, was, to seek for it among the Engineers employed in the Province at the present time under Messrs Jackson & Co. I have myself seen Mr. McMahon Cregan and have learned from him that he would be willing to lend his aid and Mr. Giles states that he could be spared during a portion of the months of January February and March. This would probably be as good a time for the delivery of a course of lectures on the elements of Civil Engineering and Surveying as could be selected. I propose, if the College Council concur with me, to offer Mr. McMahon Cregan a fixed sum of One hundred pounds currency for a course of lectures to be delivered in January February and March on the subject stated above and that a fee in addition should be paid by each pupil say Two pounds by Students not members of the College and Ten shillings by those who were matriculated. Such fees would of course belong to the lecturer. Should the Council think it expedient to carry out this scheme I would further suggest for their consideration that Professor Jack should between this time and the month of January organize a mathematical class for the purpose of imparting such special elementary knowledge as might better fit the pupils for further instruction from Mr. Cregan - Any students not members of the College should of course be called on to pay to Professor Jack such a fee as the College Council may approve. I will thank you, Sir, to take steps for obtaining the views of the College Council on these suggestions as soon as can conveniently be done. Should they concur in them it will probably be expedient to give public notice of the intended course of lectures so soon as the assent of the Council has enabled me to make the final arrangements with Mr. McMahon Cregan who expects to hear from me again. I ought to add in conclusion that I trust the Council will look upon these proposed arrangements as nothing more than the first step towards advancing the practical utility of Kings College and that another year may enable us to improve upon them.

I am  
Sir  
Yours very faithfully  
Edmund Head

University Manuscripts, UA RG 109, Box 2, no. 280

Original Pg. 2

I accordingly consulted Mr. Giles the Chief Engineer acting for this Firm and he has assured me that one of his staff Mr. McMahon Cregan is fully competent in every way to teach that which I conceive to be required at Kings College. I have myself seen Mr. McMahon Cregan and have learned from him that he would be willing to lend his aid, and Mr. Giles states that he could be spared during a portion of the months of January February and March. This would probably be as good a time for the delivery of a course of lectures

#### First civil engineering course in Canada offered at King's College, Fredericton, NB in 1854

By the mid-1800s railways were being planned and built in New Brunswick. Sir Edmond Head, Lieutenant Governor of New Brunswick saw the need for practical education in the development of the province. In September 1853, he petitioned the College Council of King's College (University of New Brunswick after 1859) to make arrangements to offer the first known course in civil engineering in Canada.

This first course was offered at King's College during the period February-April 1854 and the first lecture was given on 15 February 1854. The instructor for the course was McMahon Cregan, an engineer from England who was working with Jackson & Co. to conduct surveys in New Brunswick for the European and North American Railway. The course focused on the civil engineering aspects of the design and construction of railways with an emphasis on surveying.

Twenty six students completed the course. One of these, Henry G. C. Ketchum, became well known as a railway engineer in Brazil and Canada.

Syllabus, as published, for the first course in Civil Engineering in Canada February – April 1854

An explanation of the construction and uses of Logarithms, Sines, tangents, etc., Trigonometrical Formulae; Resolution of Plane Triangles; methods of Surveying with Theodolite, Circumferenter, etc. Construction, use and Adjustment of Instruments used by the Engineers, both for the field and office work; levelling; Method of determining best route for Railway, etc.; Computation of the quantities of land, earthwork, etc., required for the execution of the works; Horsepower and Machinery, etc.; Method of "setting out" Railway curves and side widths; Calculation of gradients and theory of inclined planes; Superelevation of rails; Composition and resolution of Forces; Calculation of strains and pressures; strength of materials; theory and practice of timber and iron framing; viaducts, bridges, etc."

Signed by Charles Foster, Registrar, King's College, Fredericton, NB on December 1, 1853 and published in the New Brunswick Courier on December 10, 1853.

The Syllabus from New Brunswick Courier. 10 December 1853

Kings College  
Fredericton May 8th 1854

I hereby certify that Henry G. C. Ketchum, has attended my course of lectures on Land Engineering, Surveying & levelling:- I have much pleasure in bearing testimony to his uniform good conduct, attention & with regard to his proficiency I beg to state that at the terminal examination he distinguished himself by a good and practical knowledge of the various subjects embraced in the course.

73

Kings College  
Fredericton  
May 8th 1854

Transcript of Certificate

I hereby certify that Henry G.C. Ketchum has attended my course of lectures on Land and Engineering Surveying & levelling:- I have much pleasure in bearing testimony to his uniform good conduct, attention with regard to his proficiency I beg to state that at the terminal examination he distinguished himself by a good and practical knowledge of the various subjects embraced in the course.

Signed MCM Cregan

Cert. Copy J. Head

signed J. Mc Mahon Cregan

Certificate from the First Course Signed by McMahon Cregan, Instructor.

#### Le premier cours de génie civil au Canada offert au King's College, Fredericton, N.-B. en 1854

Au milieu des années 1800, les chemins de fer étaient planifiés et construits au Nouveau-Brunswick. Sir Edmond Head, Lieutenant-gouverneur du Nouveau-Brunswick a vu la nécessité d'une formation pratique pour le développement de la province. En septembre 1853, il a présenté une requête au Conseil du collège de King's College (devenu Université du Nouveau-Brunswick après 1859) afin de prendre des dispositions pour offrir le premier cours de génie civil au Canada.

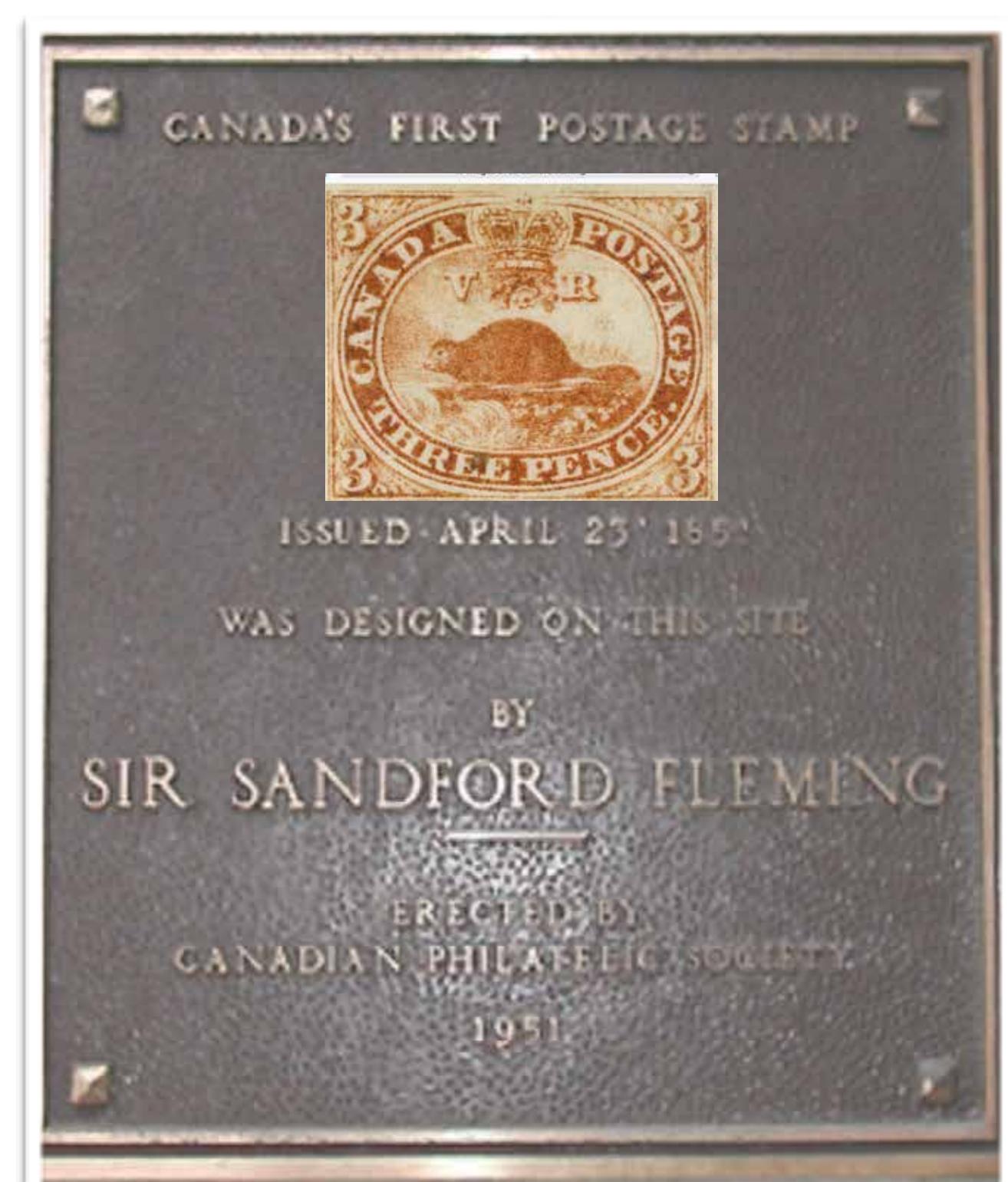
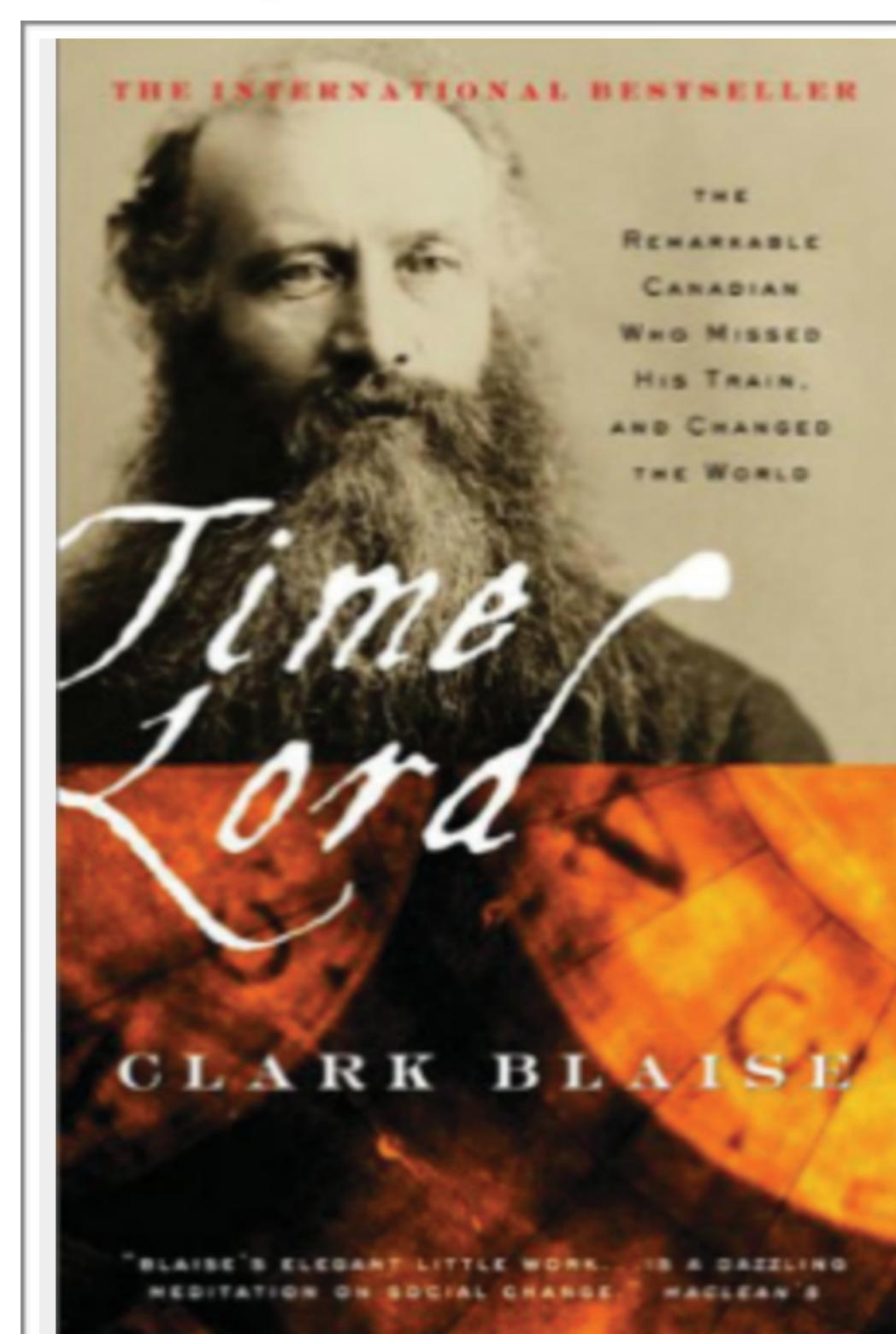
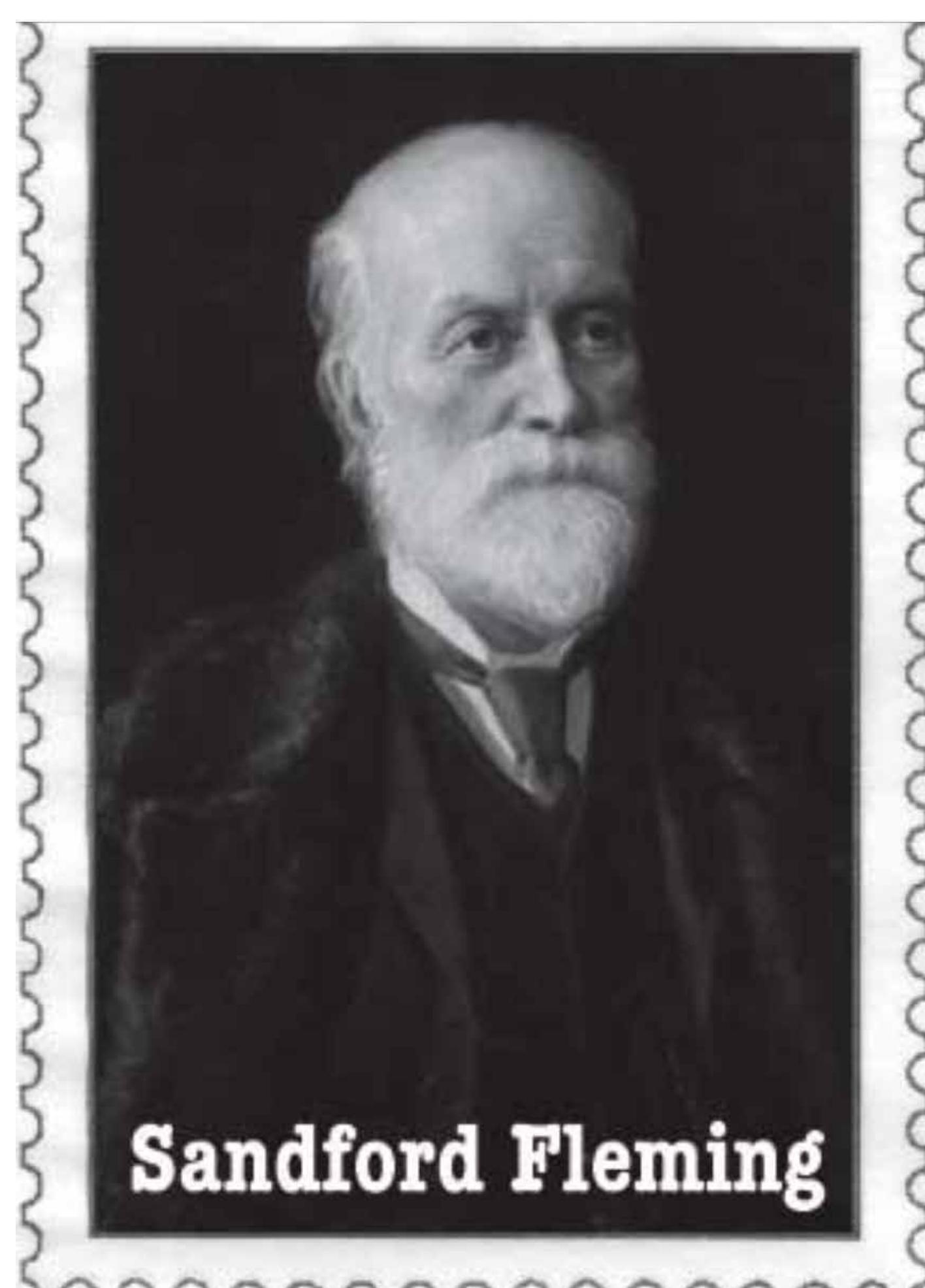
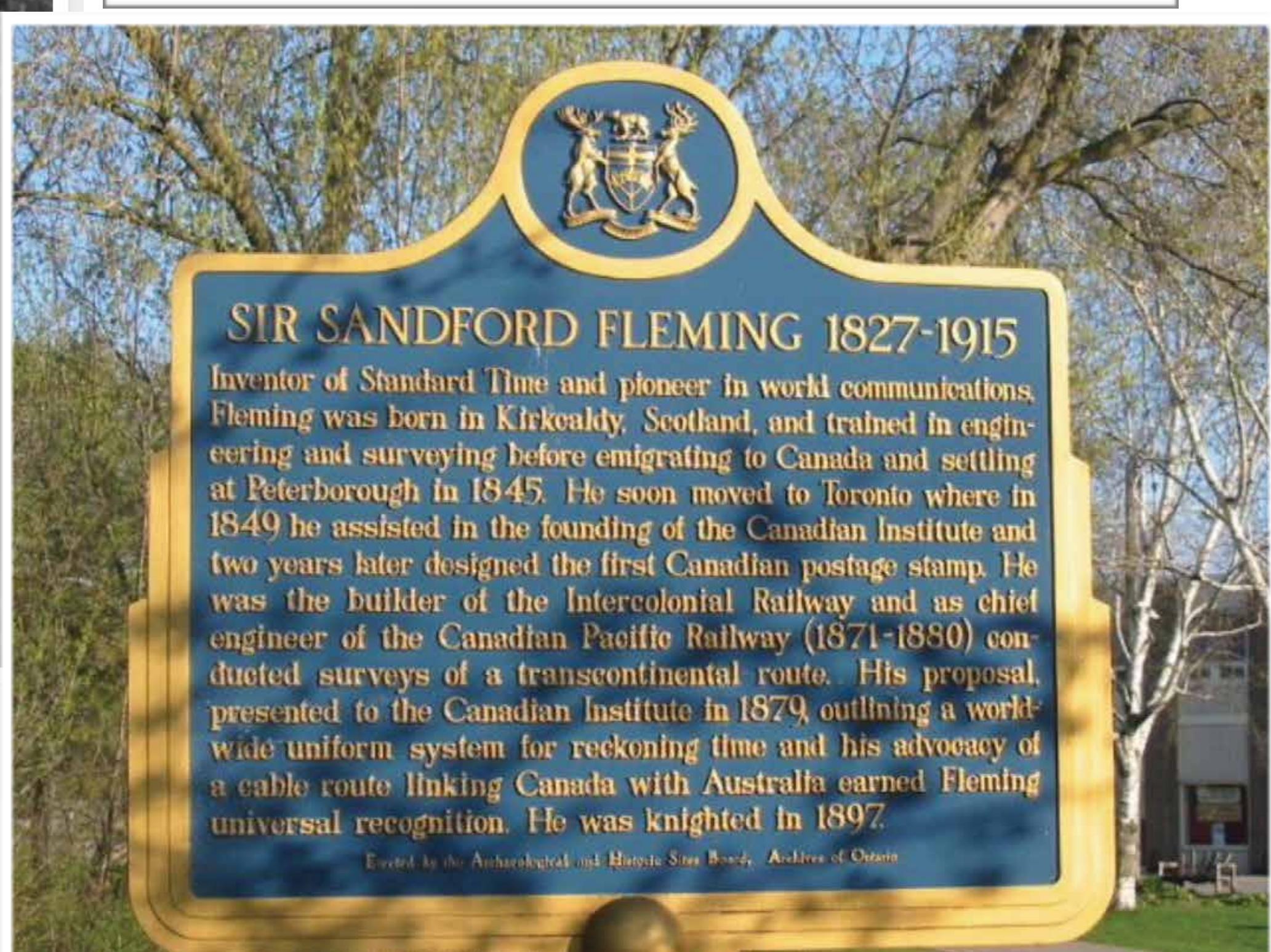
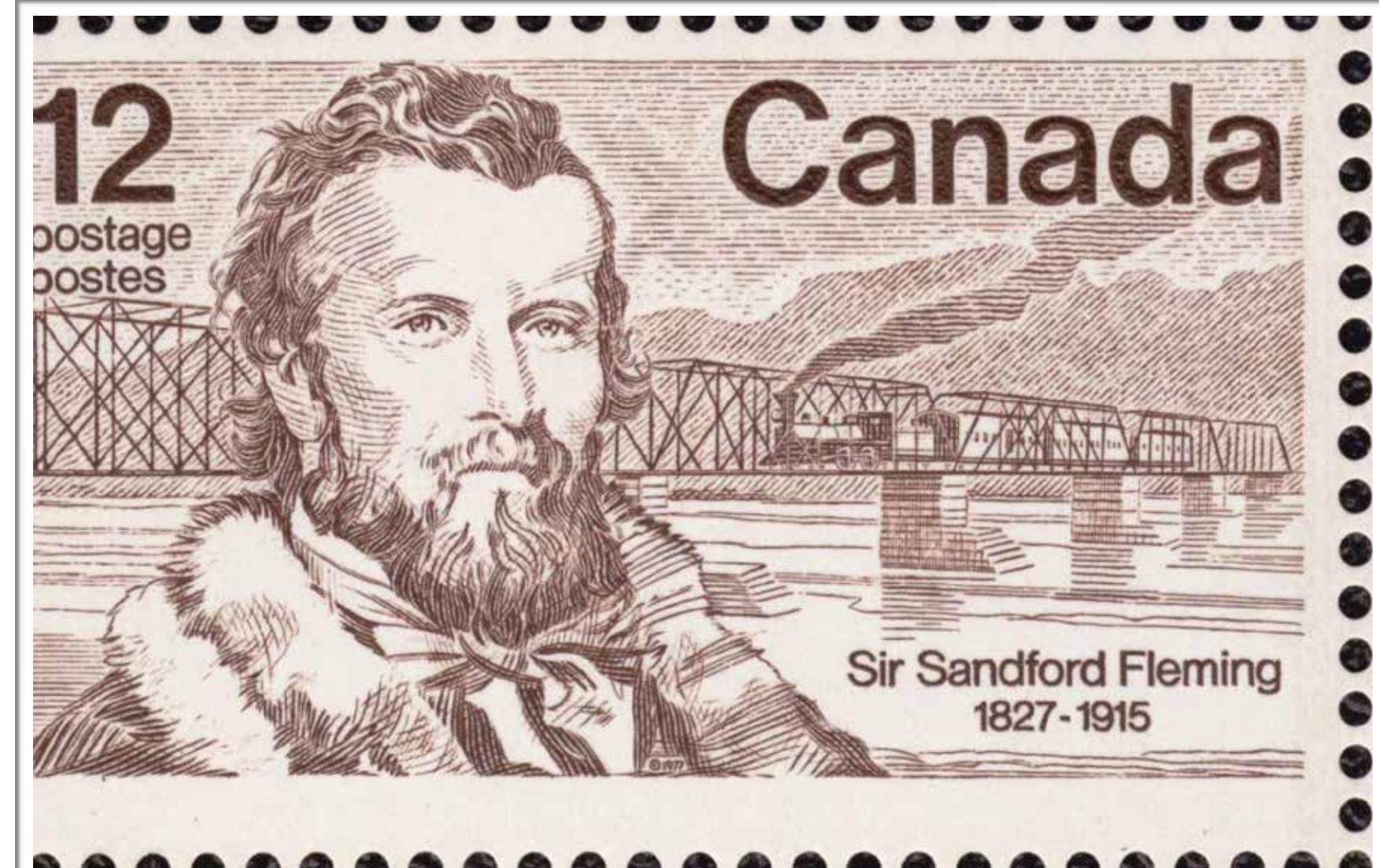
Ce premier cours fut offert au King's College du mois de février au mois d'avril 1854 et le premier cours magistral le 15 février 1854. L'instructeur était McMahon Cregan, un ingénieur d'Angleterre qui travaillait auprès de Jackson & Co. pour réaliser des enquêtes au Nouveau-Brunswick pour l'European and North American Railway. Le cours était axé sur les aspects de génie civil de la conception et de la construction des chemins de fer avec un accent sur l'arpentage.

Vingt-six étudiants ont suivi le cours. L'un d'eux, Henry G. C. Ketchum, est devenu très connu comme un ingénieur des chemins de fer au Brésil et au Canada.





Sir Sandford Fleming as a young man, 1855–1860 (MIKAN 3507406)



# SIR SANDFORD FLEMING

## Civil Engineer/ingenieur genie civil

Born in Kirkcaldy, Scotland, Fleming immigrated to Canada from Scotland in 1845. At the age of 30, in 1857. He served as chief engineer of the Ontario Northern Railway and the Intercolonial Railway (1863-76) linking Upper Canada and Lower Canada to the Maritime colonies. In 1871 Fleming was chosen as chief engineer to direct the construction of the

Canadian Pacific Railway, and undertook an expedition across Canada to survey locations. Fleming also contributed to the establishment of a telegraph system that would circle the globe, and the development of international standard time.

Né à Kirkcaldy en Ecosse, Fleming a immigré au Canada en 1845. À l'âge de 30 ans, en 1857, il était ingénieur en chef du chemin de fer du nord de l'Ontario et du chemin de fer Intercolonial (1863-76) reliant le haut et le Bas-Canada aux colonies des Maritimes. En 1871, Fleming fut nommé ingénieur en chef pour diriger la construction du chemin de

fer Canadien Pacifique, et a entrepris une expédition à travers le Canada pour une étude de sites. Fleming a également contribué à la mise en place d'un système télégraphique couvrant toute la terre ainsi que l'élaboration du temps légal international.





CANADIAN SOCIETY FOR CIVIL ENGINEERING

# Historic Civil Engineering Sites



## NEWFOUNDLAND RAILWAY, ST. JOHN'S, NF

Construction of this narrow gauge (3ft. 6in.) railway from St. John's to Port aux Basques was commenced in 1881 and completed in 1893. It was built by the Government of Newfoundland with hopes of considerable social and economic benefits. It was intended to end the winter isolation of many people, to stimulate new industries based on the island's mineral wealth, to assist the fishery industry and to generate employment in the construction and operation of the railway itself. Most of these hopes were not realized and the railway was finally abandoned in 1993.

## CHEMIN-DE-FER DE TERRE-NEUVE, ST. JOHN'S, (T.-N.-L.)

La construction de ce chemin-de-fer à voie étroite (3pi, 6po) de St. John's à Port aux Basques a commencé en 1881 et fut terminée en 1893. Il fut construit par le gouvernement de Terre-Neuve dans l'espoir d'obtenir des gains sociaux et économiques considérables. Il fut destiné à mettre fin à l'isolement hivernal de nombreuses personnes, à stimuler de nouvelles industries basées sur la richesse des minéraux de l'île, à aider l'industrie de la pêche et à créer de l'emploi dans la construction et l'exploitation du chemin-de-fer lui-même. La plupart de ces espoirs n'ont pas été réalisés et le chemin-de-fer fut finalement abandonné en 1993.



## KINGS COLLEGE (UNIVERSITY OF NB) FREDERICTON, NB

The Old Arts Building, constructed between 1826 and 1829, was the location, in 1854 of the first University level program in Civil Engineering in Canada.

## KINGS COLLÈGE (UNIVERSITÉ DU NOUVEAU-BRUNSWICK) FREDERICTON (N.-B.)

Le bâtiment de "Old Arts", construit entre 1826 et 1829, fut l'emplacement, en 1854, du premier programme universitaire en Génie Civil au Canada.



## OCEAN TERMINALS, HALIFAX, NS

The Ocean Terminals were constructed in several stages between 1912 and 1928, and have served the Port of Halifax ever since. Not only did they form the necessary infrastructure for the commercial success of the Port of Halifax, but also for many years, these terminals were the point of disembarkation for thousands of European immigrants to Canada

## TERMINAUX OCÉANIQUES, HALIFAX (N.-É.)

Les Terminaux Océaniques ont été construits en plusieurs étapes entre 1912 et 1928, et ont servi le Port de Halifax depuis lors. Non seulement ils forment l'infrastructure nécessaire au succès commercial du Port de Halifax, mais aussi pendant de nombreuses années, ces terminaux ont été le point de débarquement de milliers d'immigrants européens au Canada

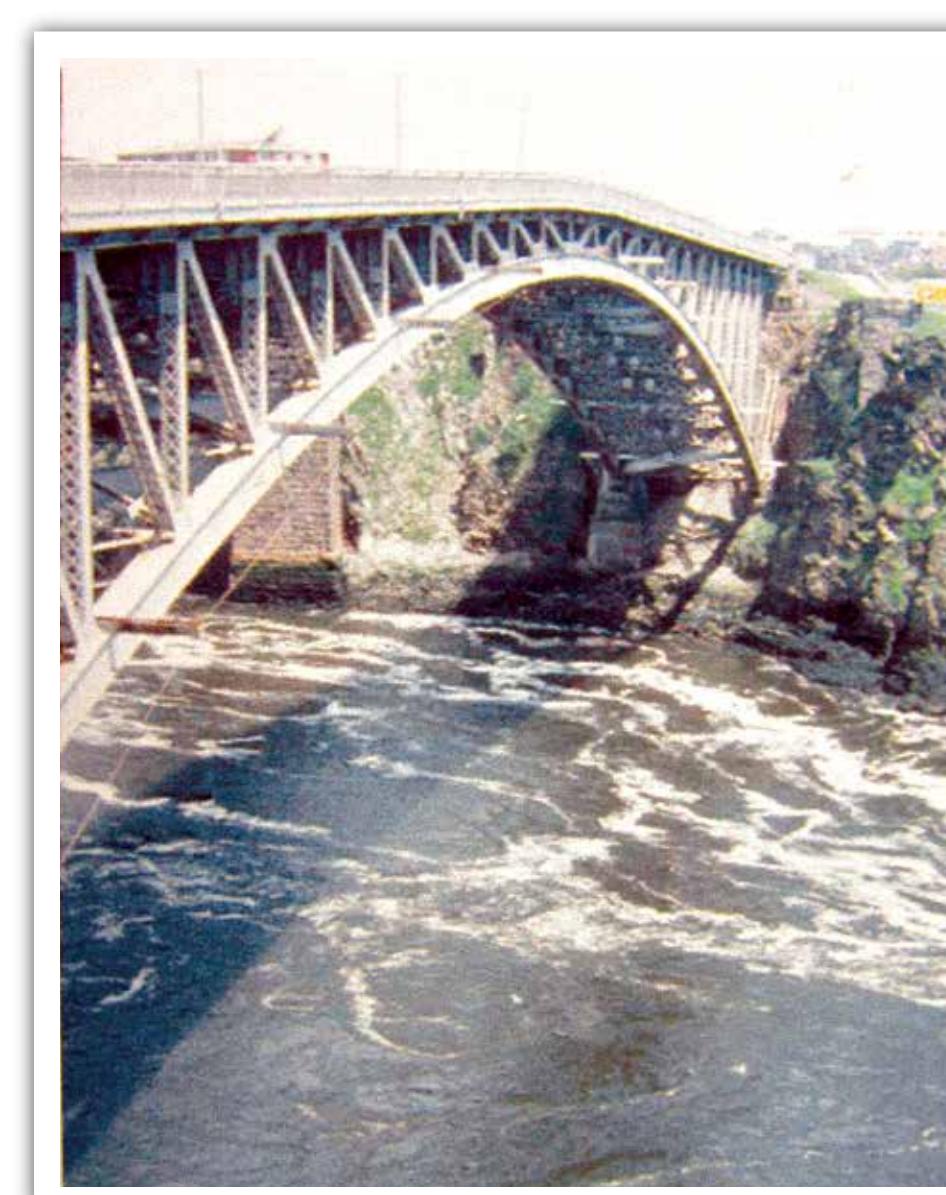


## SHUBENACADIE CANAL, DARTMOUTH, NS

Built in the 19th century between Dartmouth and the Bay of Fundy, the 86km canal included a series of locks and marine railways. It was a remarkable achievement for its day and was one of the first of Canada's major engineering projects intended for purely "civil" purpose. It continued to be used for commercial shipping until the development of competing railways.

## CANAL SHUBENACADIE, DARTMOUTH (N.-É.)

Construit au XIXème siècle entre Dartmouth et la Baie de Fundy, le canal de 86km comprenait une série d'écluses et de chemins-de-fer maritimes. Ce fut une réalisation remarquable pour son époque et l'un des premiers projets de génie civil majeurs du Canada destinés à des fins purement "civiles". Il a continué à être utilisé pour la navigation commerciale jusqu'au développement des chemins-de-fer concurrents.

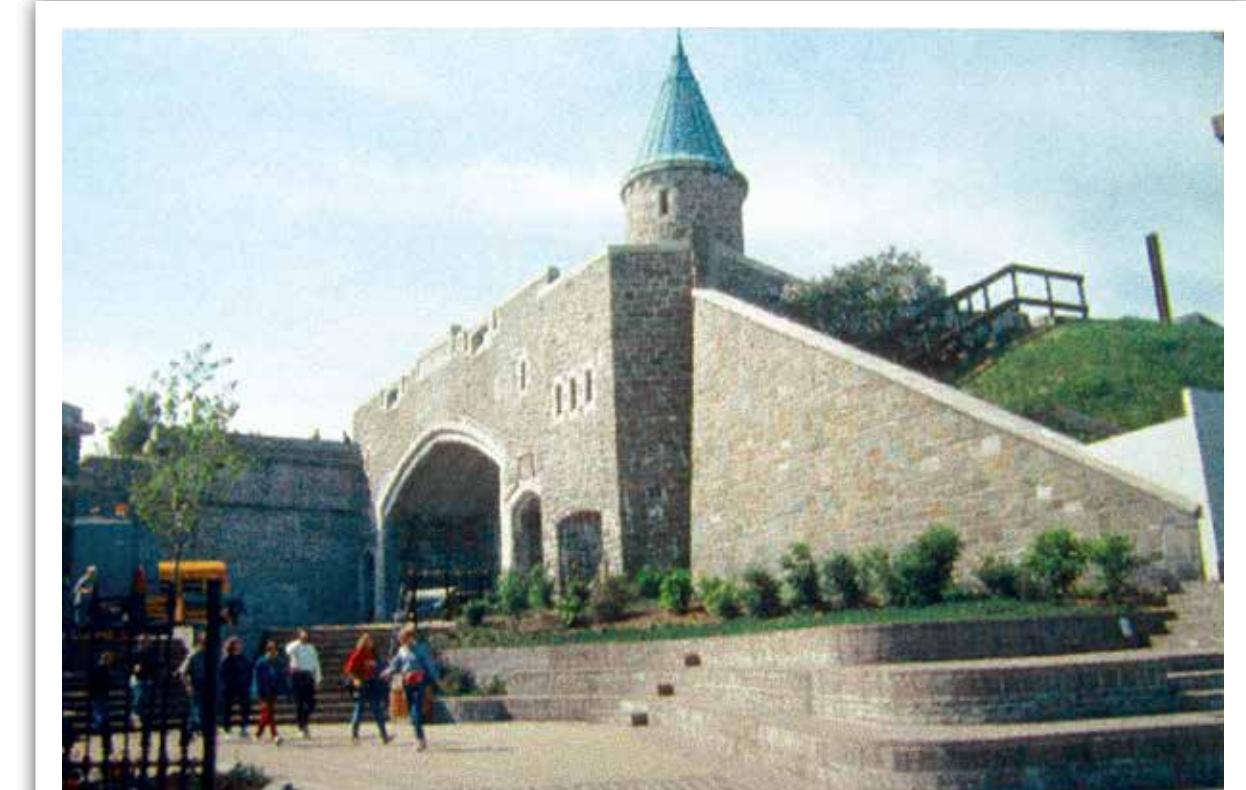


## REVERSING FALLS BRIDGE, ST. JOHN, NB

This is the location of two historic bridges. The first was a 190m span suspended bridge built in 1853 and used until 1915 when it was replaced by the present highway bridge. The second was a 372m span cantilever type railway bridge built in 1885 and used until 1921 when it was replaced by the existing railway bridge.

## REVERSING FALLS BRIDGE, ST. JOHN (N.-B.)

Ceci est l'emplacement de deux ponts historiques. Le premier était un pont suspendu de 190m de portée construit en 1853 et utilisé jusqu'en 1915 quand il fut remplacé par le pont de l'autoroute actuel. Le second était un pont ferroviaire en porte-à-faux de 372m de portée construit en 1885 et utilisé jusqu'en 1921 quand il fut remplacé par le pont de chemin-de-fer existant.



## FORTIFICATIONS OF QUEBEC CITY, QC

Construction of the City's main fortifications was commenced in 1745 under the direction of French Military engineers. Although the fortifications were later expanded by both French and the British, the initial works rank as some of the largest and most technically advanced of the French Military period.

## FORTIFICATIONS DE LA VILLE DE QUÉBEC,(PQ)

La construction des principales fortifications de la ville a débuté en 1745 sous la direction des ingénieurs militaires français. Bien que les fortifications ont été plus tard élargies par les Français et les Britanniques, les travaux initiaux se classent parmi les plus grands et les plus avancés techniquement de la période militaire française.



CANADIAN SOCIETY FOR CIVIL ENGINEERING

# Historic Civil Engineering Sites



## BROOKS AQUEDUCT, BROOKS, AB

The Brooks Aqueduct is a large elevated flume, which was built in 1914 to carry water from the Bow River to Southeast Alberta over a valley 3.2km wide and 20m deep for the irrigation of 170,00 ha of farmland. The flume is a 6.5m wide and 2.5m deep and is supported by 1030 columns. A 300mm dia. inverted siphon near the outlet of the flume was used to cross the CPR main line through the valley. All components of the structure were constructed of reinforced concrete. A canal replaced the aqueduct in 1979.

## AQUEDUC DE BROOKS, BROOKS, (ALB)

L'aqueduc de Brooks est un grand canal élevé qui a été construit en 1914 pour transporter de l'eau de la Rivière Bow au sud-est de l'Alberta par-dessus une vallée de 3.2km de large et 20m de profondeur pour l'irrigation de 170,00 ha de terres agricoles. Le canal mesure 6.5m de largeur et 2.5m de profondeur et il est soutenu par 1030 colonnes. Près de la sortie du canal un siphon inversé de 300mm diam. a été utilisé pour traverser la ligne principale de CPR à travers la vallée. Tous les composants de la structure ont été construits en béton armé. Un autre canal a remplacé l'aqueduc en 1979.

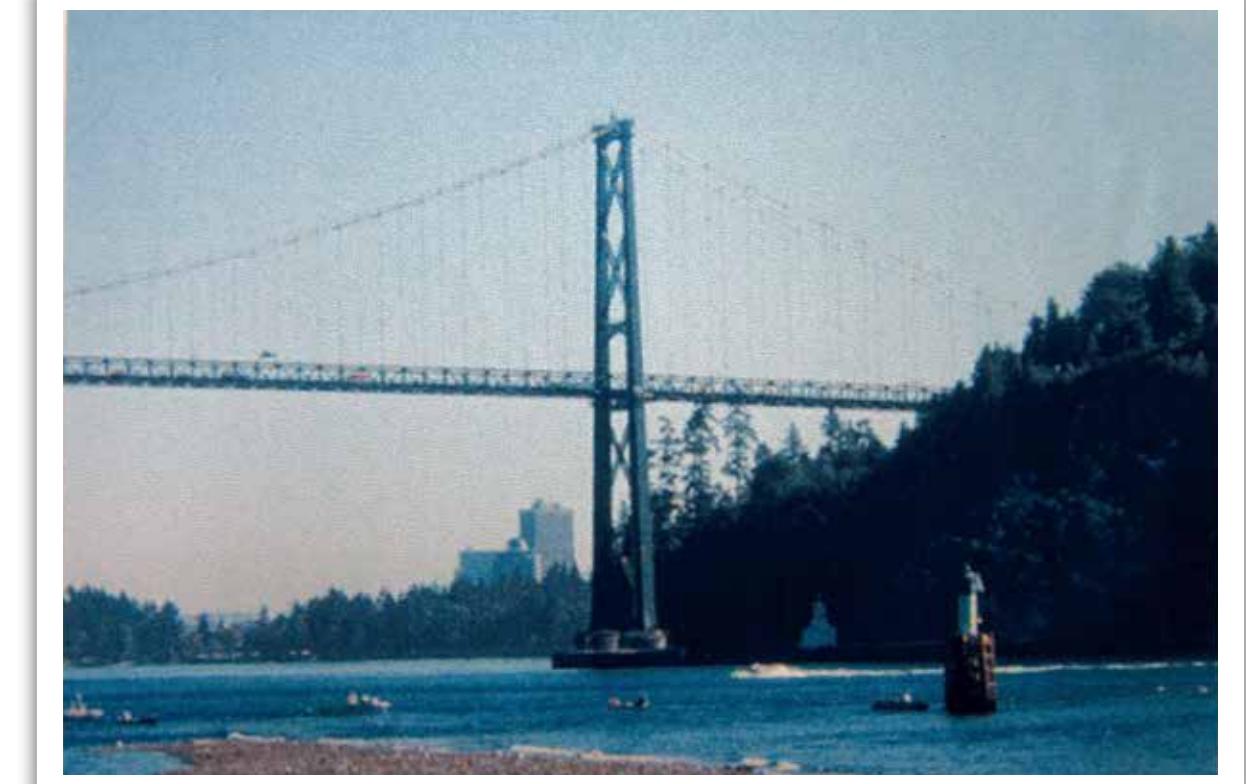


## YUKON AND PACIFIC RAILWAY, EDMONTON, AB

The most significant element of the railways is the Low Level Bridge, which was the first bridge across the North Saskatchewan River at Edmonton. There are also several timber trestle bridges typical of their era. The railway never achieved its initial objectives in reaching either the Yukon or the Pacific.

## CHEMIN-DE-FER YUKON ET PACIFIQUE, EDMONTON, (ALB)

L'élément le plus important de ce chemin-de-fer est le pont à niveau bas, qui était le premier pont à travers la rivière Saskatchewan Nord à Edmonton. On trouve aussi plusieurs ponts en cadre de bois typiques pour leur époque. Le chemin-de-fer n'a jamais atteint ses objectifs initiaux d'arriver au Yukon ou au Pacifique.



## LION'S GATE BRIDGE, VANCOUVER, BC

This bridge spans the first narrows of Burrard Inlet, is the longest suspension bridge in Western Canada. It was built between 1936 and 1938 and has been a Vancouver landmark and international icon since its opening in 1938.

## LE PONT PORTE DU LION, VANCOUVER, (C.-B.)

Ce pont s'étendant par-dessus le premier détroit des Burrard Inlet, est le plus long pont suspendu de l'Ouest Canadien. Il a été construit entre 1936 et 1938 et représente un point de repère pour Vancouver et une icône internationale depuis son ouverture en 1938.



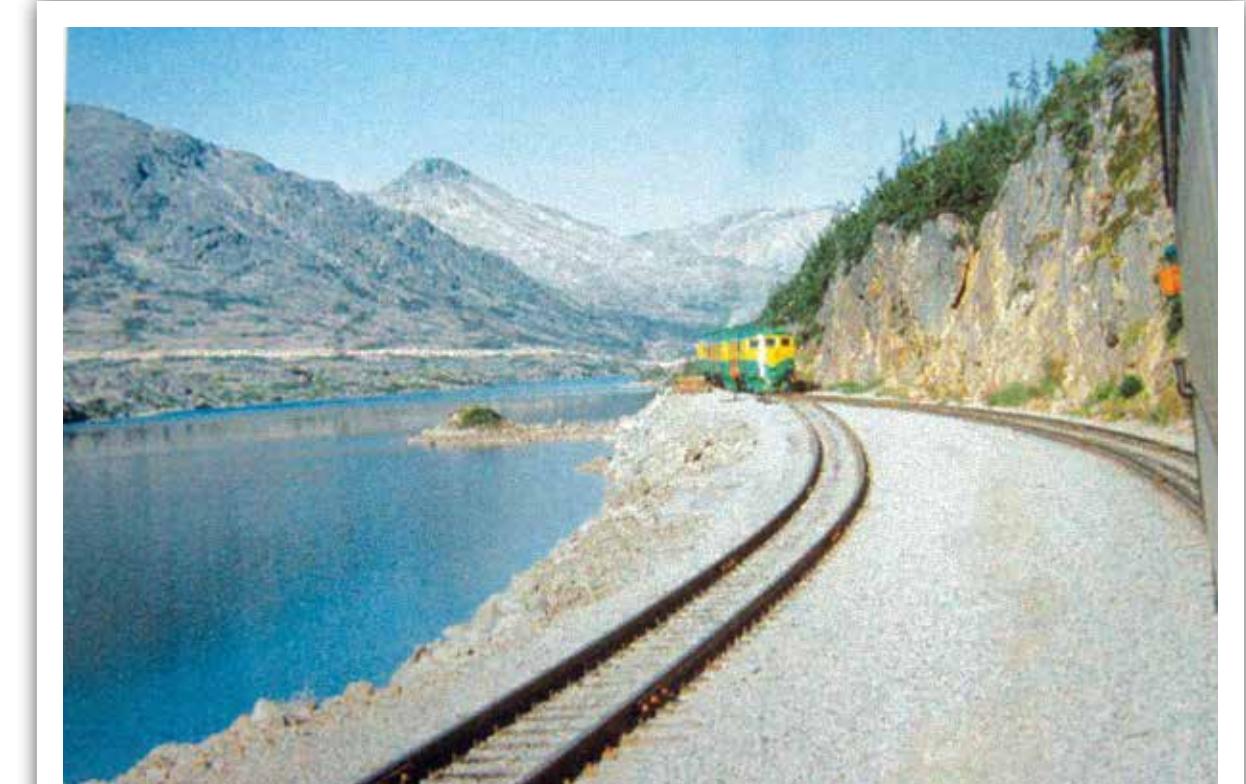
## ESQUIMALT DRY DOCK, VICTORIA, BC

Constructed as a joint venture between the British Admiralty, the Government of Canada and the Government of British Columbia, this graving dock was completed in 1887. At the time of its construction, the only dry dock available to British Admiralty vessels was in Australia and although initially required as a naval facility it has served both naval and commercial vessels ever since. Still in use it is the oldest surviving dry dock on the Pacific Rim.



## TRANS CANADA: CANADIAN PACIFIC RAILWAY

Canada is the only country in the world whose very existence depended on the successful completion of a major Civil Engineering Project. That Project, the Canadian Pacific Railway is the most widely recognized of any Canadian Civil Engineering Project and is commemorated by a plaque at Craigellachie, BC, the site of the driving of the "Last Spike".



## THE WHITE PASS AND YUKON RAILWAY, SKAGWAY, AK TO WHITEHORSE, YT

This 110 mile narrow gauge railway was conceived, designed and built by Canadian and American engineers. Completed in 1899, it initially served the Yukon Gold Rush and was later to provide a major transportation link with the Yukon.

## LE WHITE PASS ET LE CHEMIN-DE-FER DU YUKON, SKAGWAY, AK À WHITEHORSE, (YN)

Ce chemin-de-fer à voie étroite de 110 milles a été conçu et construit par des ingénieurs canadiens et américains. Achevé en 1899, il servait initialement la ruée vers l'or du Yukon et plus tard fournissait un lien important de transport pour le Yukon.

## ESQUIMALT DRY DOCK, VICTORIA, (C.-B.)

Construit comme une co-entreprise entre l'Amirauté Britannique, le Gouvernement du Canada et le Gouvernement de la Colombie-Britannique, ce quai naval a été achevé en 1887. Au moment de sa construction, le seul quai disponible pour les navires de l'Amirauté Britannique était en Australie. Même si initialement il a été requis comme un développement militaire, il a servi à la fois des navires militaires et commerciaux depuis lors. Toujours en usage, il s'agit du plus ancien quai naval dans le périmètre du Pacifique.

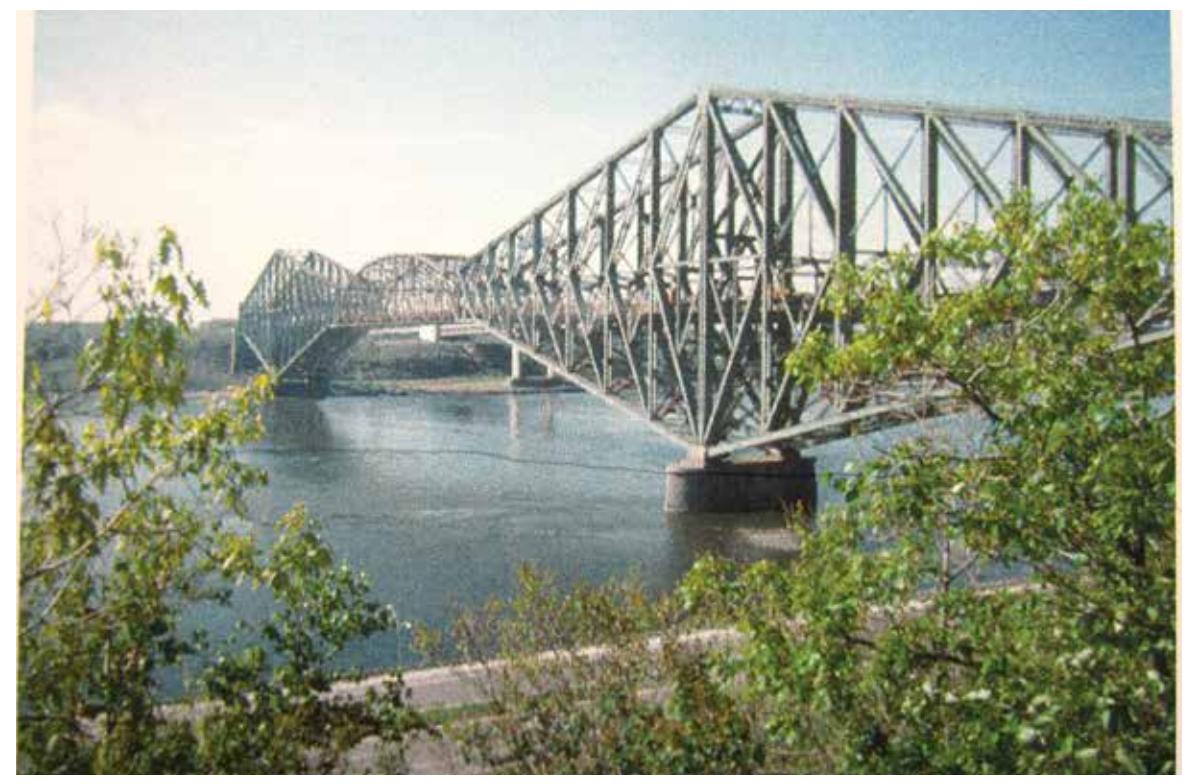
## TRANSCANADIEN: CHEMIN-DE-FER CANADIEN PACIFIQUE

Le Canada est le seul pays au monde dont l'existence même dépendait de la réussite d'un grand projet de génie civil. Ce projet, le Chemin-de-fer Canadien Pacifique, est le plus largement reconnu de tous les projets canadiens de génie civil. Il est commémoré par une plaque à Craigellachie, en C.-B., le site de l'installation du "dernier clou"



CANADIAN SOCIETY FOR CIVIL ENGINEERING

# Historic Civil Engineering Sites



## QUEBEC BRIDGE, ST. FOY, QC

The Quebec Bridge is an international Historic Civil Engineering Site commemorated by both the Canadian Society for Civil Engineering and the American Society of Civil Engineers. This cantilever bridge, which suffered two collapses during its construction, was designed by the American and Canadian engineers. Completed in 1915, its central span is still the longest bridge cantilever span in the world – 549 meters.

## PONT DE QUÉBEC, ST-FOY, (PQ)

Le Pont de Québec est un site international historique de génie civil commémoré par la Société Canadienne de Génie Civil et la Société Américaine des Ingénieurs Civils. Ce pont en porte-à-faux, qui a subi deux effondrements au cours de sa construction, a été conçu par les ingénieurs américains et canadiens. Achevé en 1915, sa travée centrale est toujours la plus longue travée de pont en porte-à-faux au monde – 549 mètres.



## VICTORIA BRIDGE, MONTREAL, QC

A vital link in the development of the Grand Trunk Railway, the Victoria Bridge was initially constructed in 1859 as the Tubular Bridge. The design was based on the British Engineer Robert Stephenson's Britannia and Conway Bridges. The superstructure was replaced in 1898 to create the Jubilee Bridge, which is still in operation for both road, and rail traffic. The St. Lambert Diversion was added in the 1960's as part of the development of the St. Lawrence Seaway.

## PONT VICTORIA, MONTRÉAL, (PQ)

Un lien vital dans le développement du Grand Tronc Ferroviaire, le Pont Victoria a été initialement construit en 1859 comme un Pont Tubulaire. La conception a été basée sur les ponts Britannia et Conway conçus par l'ingénieur britannique Robert Stephenson. La superstructure a été remplacée en 1898 pour créer le Pont Jubilée, qui est toujours en opération pour circulation routière et ferroviaire. La dérivation de St. Lambert a été ajoutée dans les années 1960 dans le cadre du développement de la Voie Maritime du Saint-Laurent.



## HAMILTON'S 1859 PUMPING STATION, HAMILTON, ON

Designed by T.C. Keefer, First President of the Canadian Society of Civil Engineers, this Pumping Station was the key element in a technically advanced water supply and treatment facility for the City of Hamilton. At a time when cholera and other diseases were being spread through insanitary water supplies this project reflected a state of the art development in sanitary engineering. The Pumping Station was equipped with two steam-powered pumps, which pumped potable water from Lake Ontario until 1910.

## HAMILTON'S 1859 PUMPING STATION, HAMILTON, (ONT)

Conçu par T.C. Keefer, premier président de la Société canadienne des ingénieurs civils, cette station de pompage était l'élément clé d'une installation techniquement avancée d'approvisionnement en eau et de traitement pour la ville de Hamilton. À une époque où le choléra et d'autres maladies étaient propagés par des approvisionnements en eau insalubres, ce projet reflétait le développement le plus avancé dans le domaine du génie sanitaire. La station de pompage était équipée de deux pompes à vapeur qui pompaient l'eau potable du lac Ontario. Elle fut utilisée jusqu'en 1910.

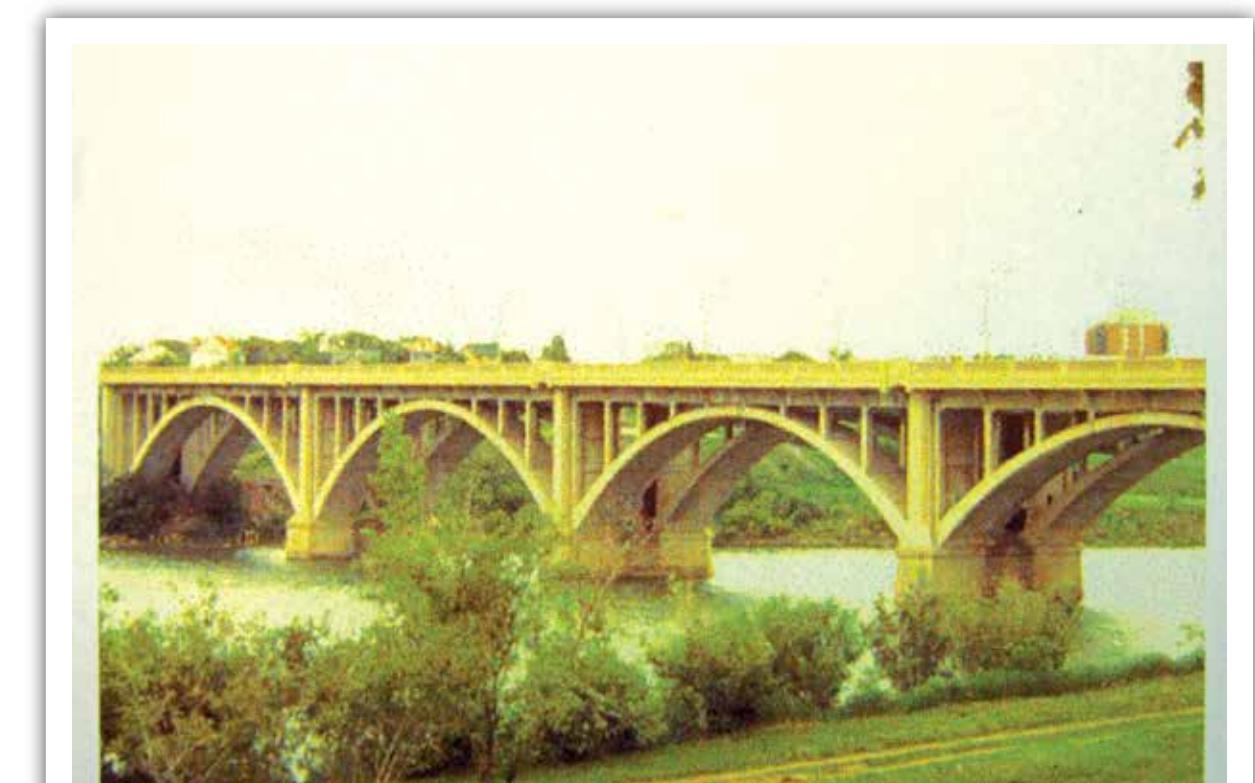


## TRENT-SEVERN WATERWAY, PETERBOROUGH, ON

With a total length of 386 km, this waterway features Liftlocks at Peterborough and Kirkfield and marine railway at Big Chute. Initial work on the waterway started in 1833 but the entire project was not completed until 1920 making it Canada's longest ever public work.

## TRENT-SEVERN WATERWAY, PETERBOROUGH (ONT)

Avec une longueur totale de 386 km, cette voie d'eau comprend Liftlocks à Peterborough et Kirkfield et le chemin de fer maritime à Big Chute. Les travaux initiaux sur le cours d'eau ont commencé en 1833, mais le projet entier n'a pas été achevé jusqu'en 1920, ce qui en fait le projet de travaux publics le plus long au Canada.



## ST. ANDREW'S LOCK AND DAM, LOCKPORT, MB

Built between 1900 and 1910, this facility controlled the flow of the Re River and by overcoming the St. Andrews Rapids, permitted boat traffic to pass to and from Lake Winnipeg. The dam is the unique feature of the site; the structure incorporates a "movable" curtain or "camere" dam, the only example of its kind in North America and one of the only three in the world. The lock is the only lock in Canada west of Sault Ste. Marie.

## ÉCLUSE ET BARRAGE DE SAINT-ANDRÉ, LOCKPORT, (MAN)

Construite entre 1900 et 1910, cette installation contrôlait le débit de la rivière Rouge et en surmontant les rapides de St. André, permettait aux bateaux de traverser le Lac Winnipeg. Le barrage est la caractéristique unique du site; la structure intègre un rideau "mobil" ou un barrage de type "camere", le seul exemple de ce genre en Amérique du Nord et l'un des trois seuls au monde. L'écluse est la seule au Canada à l'ouest de Sault Ste. Marie.

## BROADWAY BRIDGE, SASKATOON, SK

This five span sloping concrete arch bridge, one of the earliest of its type in Canada, was built in 1932 during the Great Depression to provide work for local residents. It was designed, constructed and financed entirely from within the City of Saskatoon and was the first major link between the downtown area and the growing commercial area of Broadway.

## PONT BROADWAY, SASKATOON, (SASK)

Ce pont en arc de béton à cinq travées, l'un des plus anciens de son genre au Canada, fut construit en 1932 pendant la Grande Dépression pour fournir du travail aux résidents locaux. Il a été conçu, construit et financé entièrement par la Ville de Saskatoon et fut le premier lien majeur entre le centre-ville et la zone commerciale croissante de Broadway.

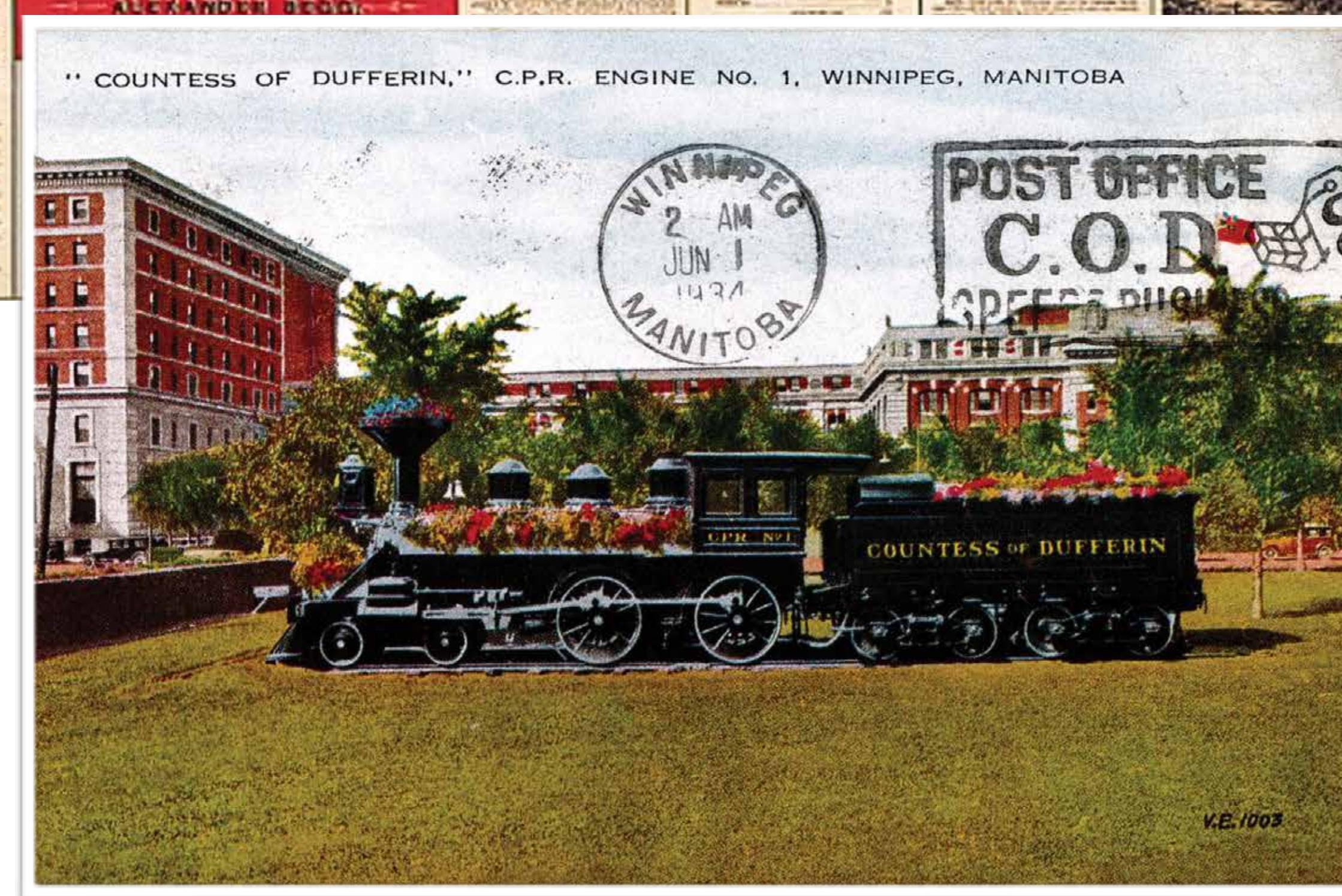


# GO WEST!

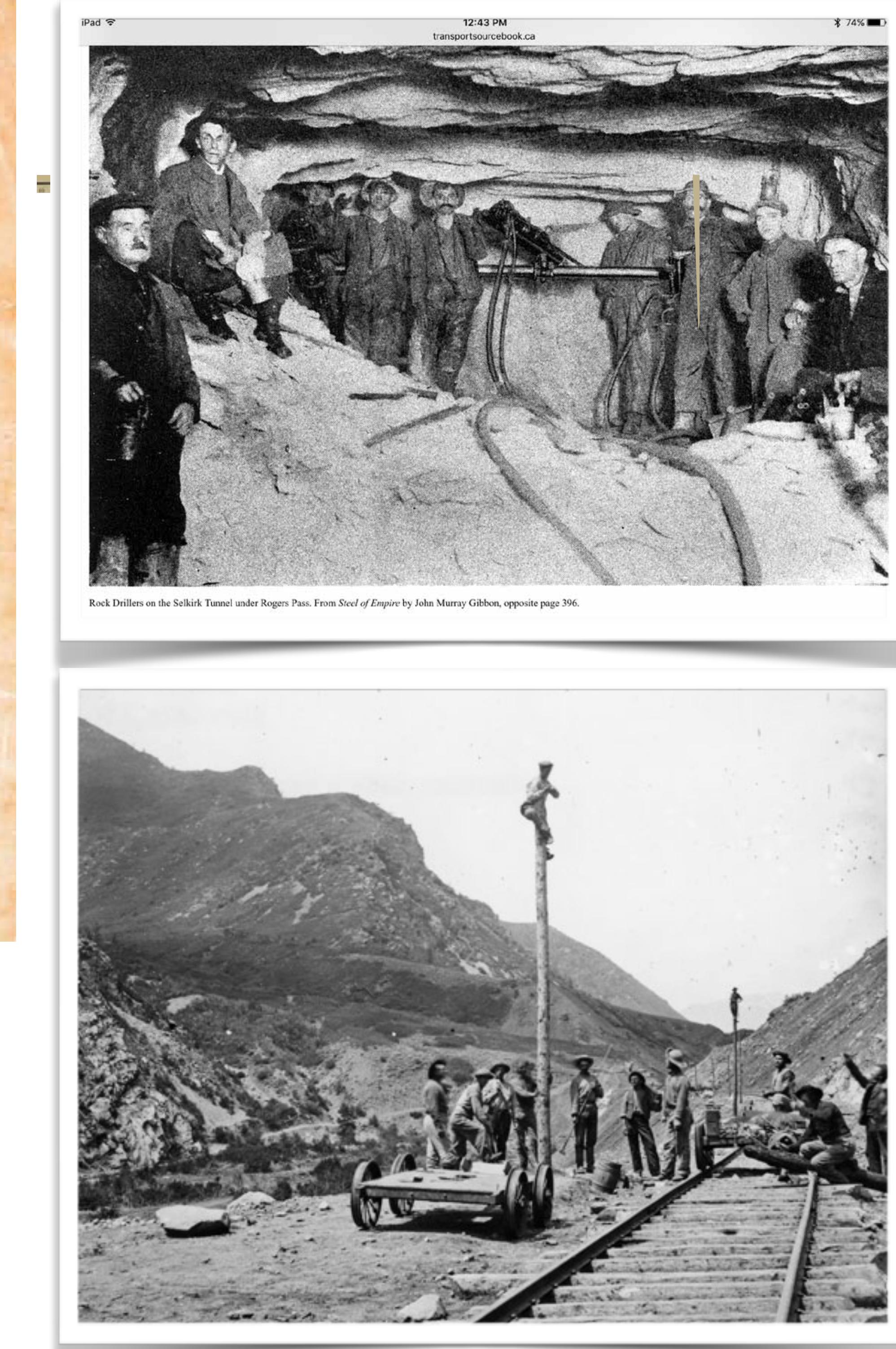
The Canadian Pacific Railway - 1885

The Canadian Pacific Railway was Canada's first transcontinental railroad, founded in 1881, originally connecting Eastern Canada and B.C. Construction began in 1881 following B.C.'s entrance into Confederation in 1871, which promised the railway would be built. The Canadian Pacific Railway was founded because of political promises to connect B.C. to Eastern Canada under Prime Minister Sir John A.

Macdonald who wanted to unify the country. The first transcontinental passenger train, to make the trip along the Canadian Pacific Railway, the Countess of Dufferin (pictured above) left Montreal, Quebec, at Dalhousie Station on June 28th, 1886 at 8 pm. It arrived in Port Moody, B.C. on July 4th, 1886 at noon.

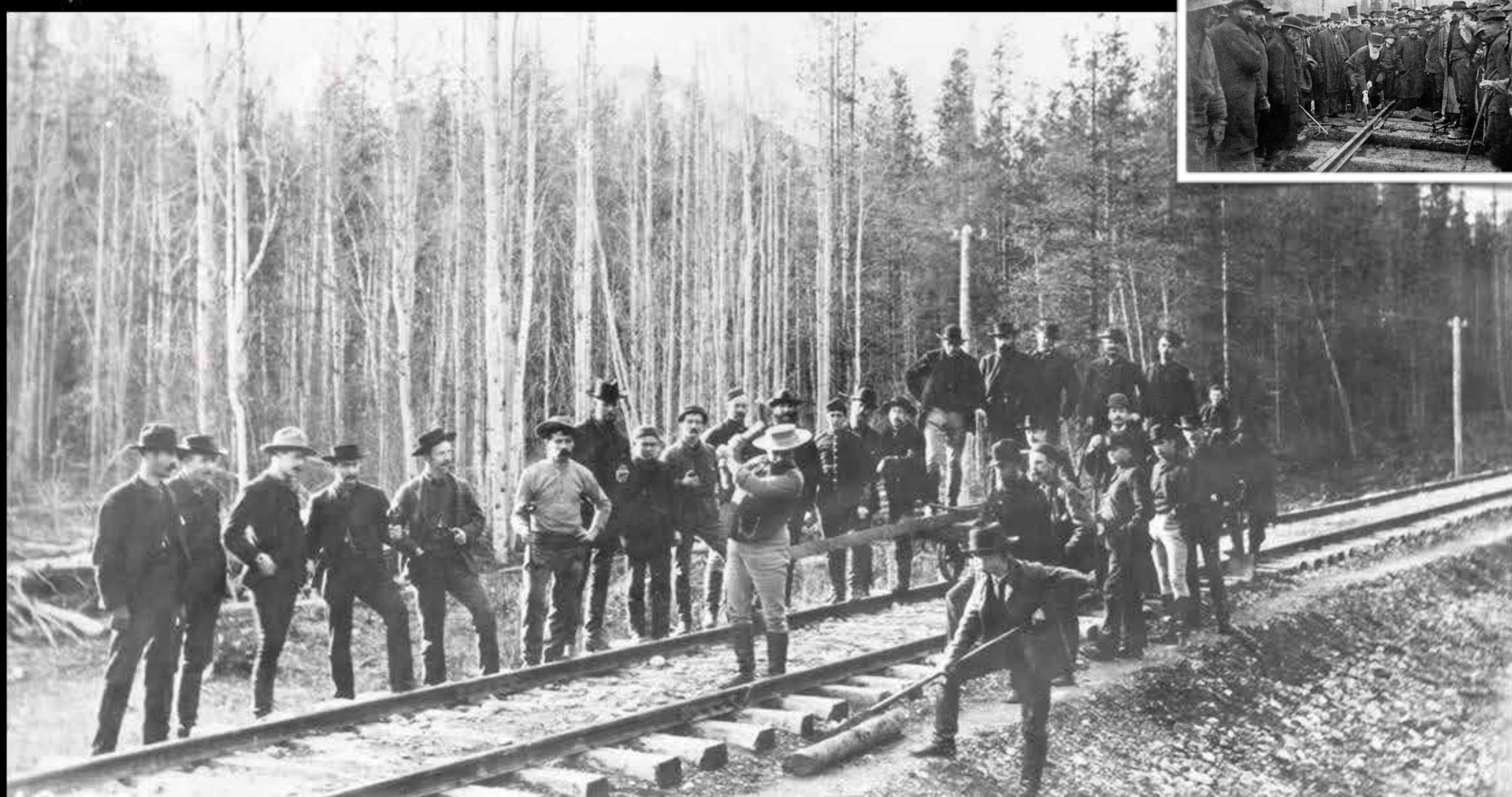
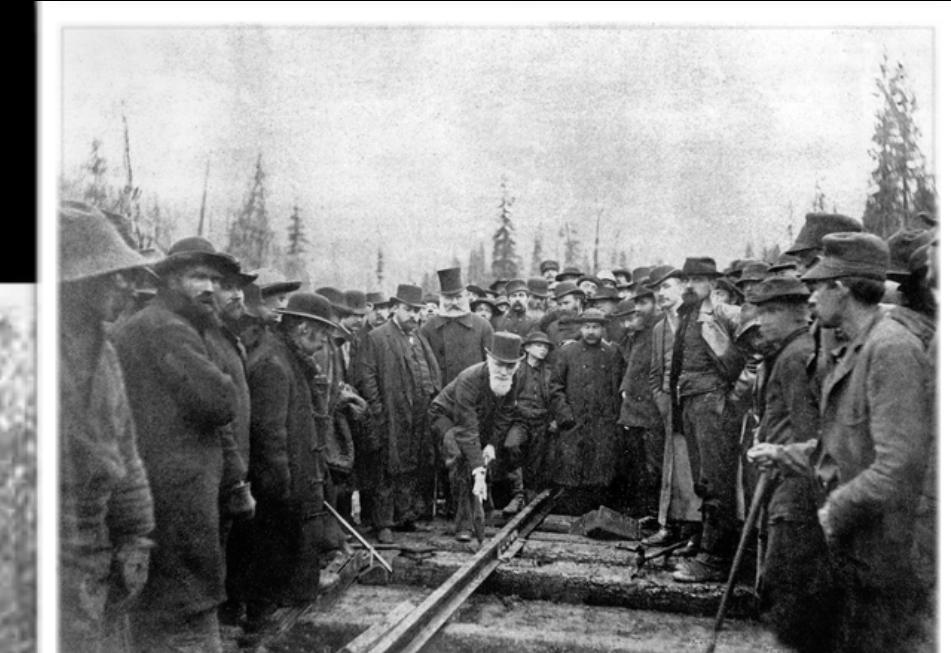


Le chemin de fer Canadien Pacifique fut le premier chemin de fer transcontinental. Il devait à l'origine relier l'est du Canada et la Colombie-Britannique. Sa construction a commencé en 1881 après l'entrée de la C.-B. dans la Confédération en 1871. Sa construction était une promesse politique de relier la C.-B. à l'Est du Canada sous le premier ministre Sir John A. Macdonald qui voulait unifier le pays. Le



# CPR EMPLOYEES RE-ENACTING THE LAST SPIKE

By an unknown photographer  
Library and Archives Canada / e004666096



# THE OTHER "LAST SPIKE"

September 25, 1885

Before the dignitaries arrived, before the famous picture of the last spike being driven by Cornelius Van Horne at Craigellachie on November 7, the workers themselves had a moment to reflect on the success of their labours, blood, sweat and tears. The difficulty in obtaining an adequate work force led to the controversial importation of thousands of Chinese workers. Around 17,000 Chinese labourers helped to build the Canadian Pacific Railway – working in harsh conditions for little pay. And so it was that they were quickly dismissed and their employment terminated on September 25.

Avant l'arrivée des dignitaires, devant la célèbre photo du dernier crampon mis en place par Cornelius Van Horne à Craigellachie le 7 novembre, les travailleurs eux-mêmes ont eu un moment pour réfléchir au succès de leurs travaux, leur sang, leur sueur et leurs larmes. La difficulté d'obtenir une main d'œuvre adéquate a entraîné l'importation controversée de milliers de travailleurs chinois. Environ 17 000 ouvriers chinois ont aidé à construire le chemin de fer du Canadien Pacifique dans des conditions difficiles et pour un bas salaire. De plus, ils furent rapidement licenciés et leur emploi s'est terminé le 25 septembre.

295

**THE LAST SPIKE**  
**NOTICE!**

YALE, B. C., SEPT. 26, 1885.

**AS OUR LAST RAIL FROM THE PACIFIC HAS BEEN LAID IN Eagle Pass to-day,**

And the balance of work undertaken by the CANADIAN PACIFIC RAILWAY COMPANY between Savona and point of junction in Eagle Pass will be Completed for the Season on WEDNESDAY,

**ALL EMPLOYEES WILL BE DISCHARGED**

On the Evening of September Thirtieth.

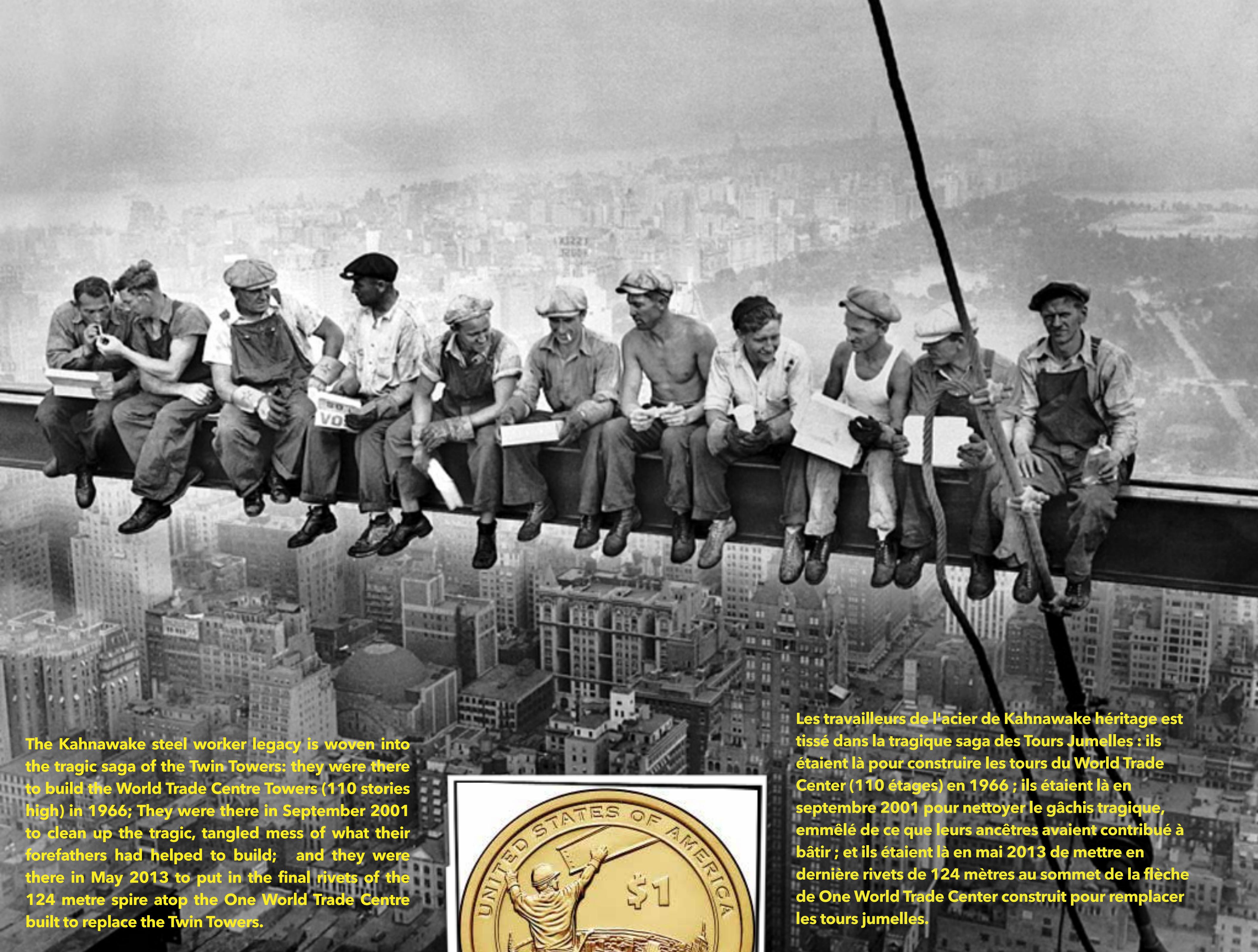
Application for position in the Operation Department for the present may be made to M. J. HANEY, but the above portion of line will not be operated until Notice is given to that effect by the VICE PRESIDENT.

**ALL ACCOUNTS**

Should be liquidated before the TENTH PROXIMO, at Yale, as the books of the Company should be closed on that day.

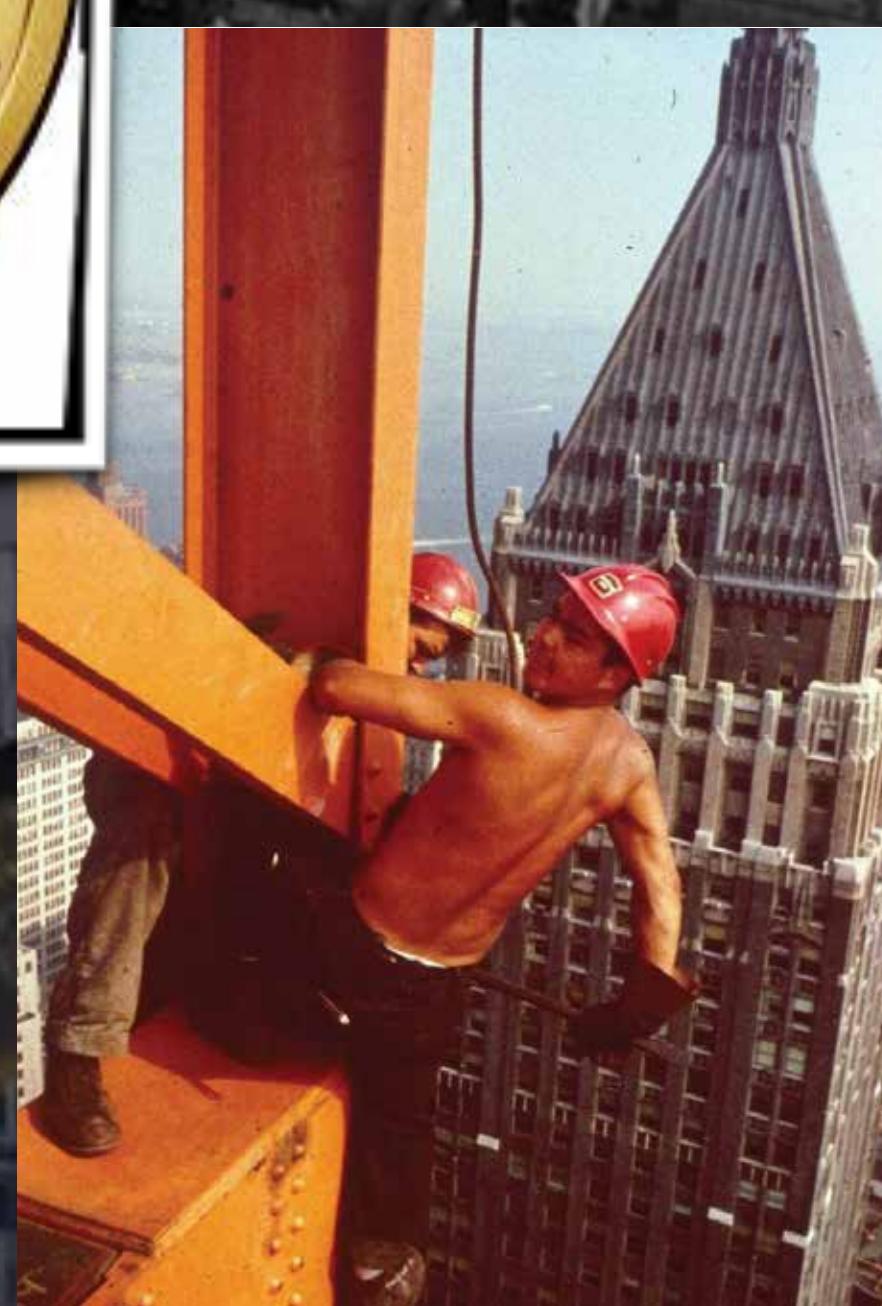
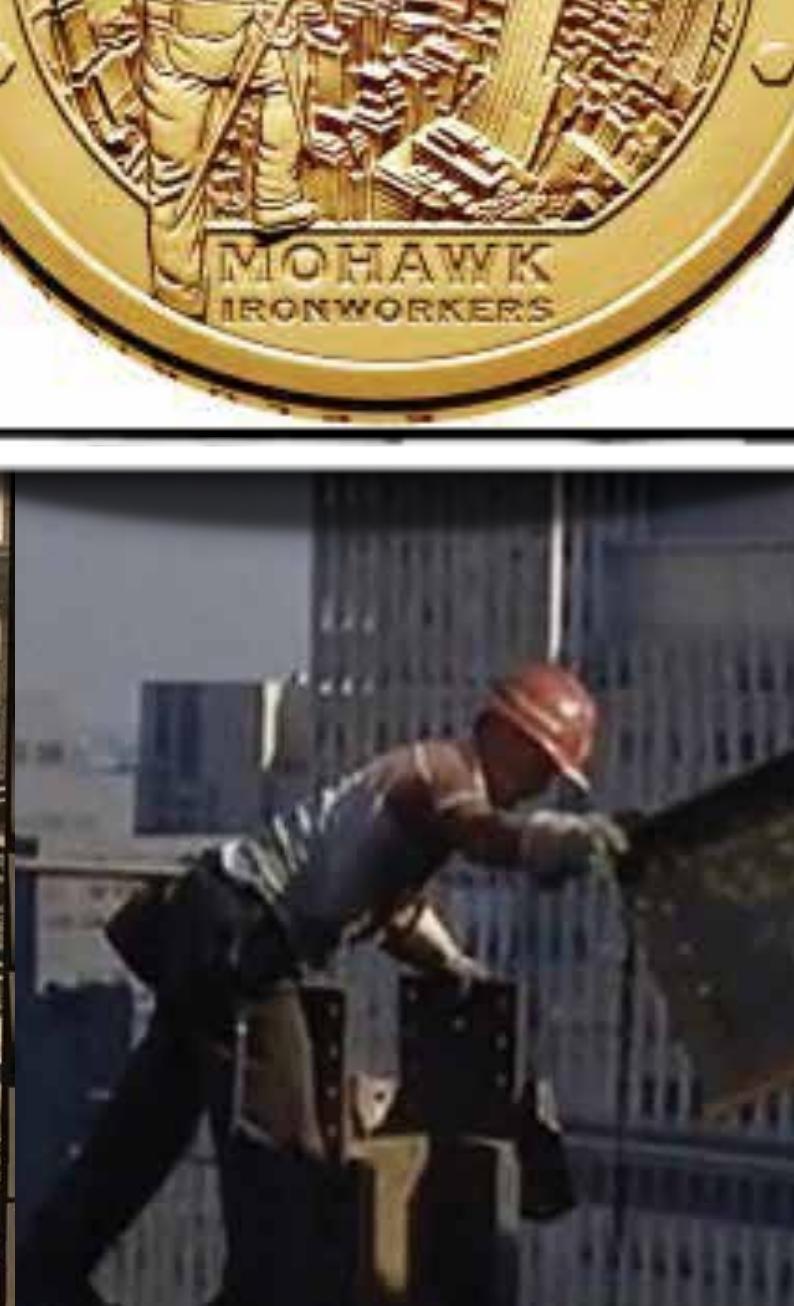
**A. Onderdonk.**

Onderdonk pays off the railway workers on construction at Eagle Pass



The Kahnawake steel worker legacy is woven into the tragic saga of the Twin Towers: they were there to build the World Trade Centre Towers (110 stories high) in 1966; They were there in September 2001 to clean up the tragic, tangled mess of what their forefathers had helped to build; and they were there in May 2013 to put in the final rivets of the 124 metre spire atop the One World Trade Centre built to replace the Twin Towers.

Les travailleurs de l'acier de Kahnawake héritage est tissé dans la tragique saga des Tours Jumelles : ils étaient là pour construire les tours du World Trade Center (110 étages) en 1966 ; ils étaient là en septembre 2001 pour nettoyer le gâchis tragique, emmêlé de ce que leurs ancêtres avaient contribué à bâtir ; et ils étaient là en mai 2013 de mettre en dernière rivets de 124 mètres au sommet de la flèche de One World Trade Center construit pour remplacer les tours jumelles.



# IT BEGAN WITH A BRIDGE

## 1886

Ironworking requires a rare combination of strength, intelligence and courage – often while thousands of feet in the air. The Mohawk steelworker tradition began in 1886 during construction of the CPR bridge across the St. Lawrence from Kahnawake to Montreal. Mohawk "Skywalkers" soon made their mark throughout the United States and Canada. They worked on the Empire State Building, the George Washington Bridge, the

Chrysler Building, the United Nations Building, the World Trade Center, the Sears Tower in Chicago, the Golden Gate Bridge, the Quebec bridge and the Lions Gate Bridge in Vancouver. Their contribution has been recognized by two NFB documentary films: High Steel (1965) and Little Caugnawaga: To Brooklyn and Back (2008), and a \$100 gold coin issued by the US Mint.

La ferronnerie nécessite une rare combinaison de force, d'intelligence et de courage, souvent à une hauteur de milliers de pieds. La tradition du métallo mohawk a commencé en 1886 pendant la construction du pont CPR sur le Saint-Laurent entre Kahnawake et Montréal. Les "Marcheurs du ciel mohawks" ont rapidement laissé leur marque à travers les États-Unis et le Canada. Ils ont travaillé sur l'Empire State Building, le

pont George Washington, le Chrysler Building, l'édifice des Nations Unies, le World Trade Center, la Sears Tower à Chicago, le Golden Gate Bridge, le pont de Québec et le pont Lions Gate à Vancouver. Leur contribution a été reconnue par deux films documentaires de l'ONF : High Steel (1965) et Petit Caugnawaga : à Brooklyn et retour (2008), ainsi qu'une pièce d'or de 100 \$ frappée par l'US Mint.

CANADA'S NATIONAL HISTORY SOCIETY

# GOVERNOR GENERAL'S AWARDS

FOR EXCELLENCE IN TEACHING CANADIAN HISTORY



## Canada's Historic Civil Engineering Sites

Much of the history of our country can be told through the works of our civil engineers. Their canals, bridges and railroads followed the routes of the explorers and opened the country for immigration. Civil engineers design, construct and maintain the communication and transportation infrastructure that holds a vast country like Canada together. Our cities flourish and our health is protected through the roads, sewers and water supply systems that civil engineers create. In 2002, The Canadian Society for Civil Engineering received the Pierre Berton Award for their efforts to recognize Canada's Civil Engineering Heritage. The award, a program of Canada's National History Society, celebrates individuals or organizations who have brought history to a wider audience.



### 1 Yukon

The White Pass and Yukon Railway, Whitehorse, YT

In late May 1898, construction of the White Pass and Yukon Railway started in Skagway. It was built to service the masses of prospectors lured to the North by the Yukon Gold Rush. This 110-mile narrow gauge railway was financed by an English syndicate and conceived, designed and built by Canadian and American engineers. Despite steep canyons, deep snow and a strike against 30 cent an hour wages, the route was completed in July 1899. The line extended as far as Bennett Lake and was later to provide a major transportation link with the Yukon.

### 2 Manitoba

St. Andrew's Lock and Dam, Lockport, MB

Built between 1900 and 1910, and opened by Prime Minister Sir Wilfrid Laurier, this facility controlled the flow of the Red River and by overcoming the St. Andrews Rapids, permitted boat traffic to pass to and from Lake Winnipeg. It was originally part of an ambitious steamboat transportation plan to link Winnipeg to Edmonton. The dam incorporates a "moveable" curtain or "couver" dam, the only example of its kind in North America and one of only three in the World. The lock is the only lock in Canada west of Sault Ste. Marie.



### 3 Trans Canada

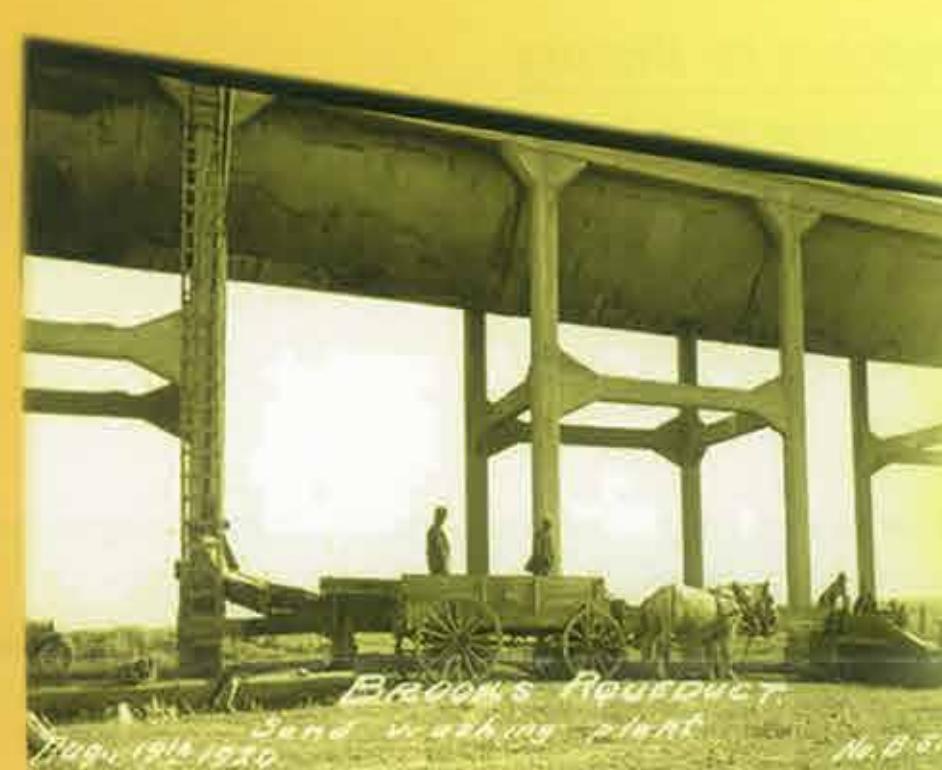
Canadian Pacific Railway

Canada is the only country in the world whose very existence depended on the successful completion of a major civil engineering project. The construction of a railroad crossing the continent in Canadian territory was one of the conditions on which British Columbia entered the confederation in 1871. The "Last Spike" in the main line from Montreal to the Pacific coast was driven by Donald Smith at Craigellachie, BC, in 1885.

### 4 Newfoundland

Newfoundland Railway, St. John's, NF

Begun in 1881 and completed in 1893, this narrow gauge (3 ft. 6 in.) railway from St. John's to Port aux Basques was built by the Government of Newfoundland, a British colony, to end the winter isolation of many people, stimulate the mining industry, assist the fishery industry and to generate employment in the construction and operation of the railway itself. It was Newfoundland's first megaproject, and perhaps the most important economic development to affect the Island until Confederation with Canada in 1949.



### 13 Alberta

Brooks Aqueduct, Brooks, AB

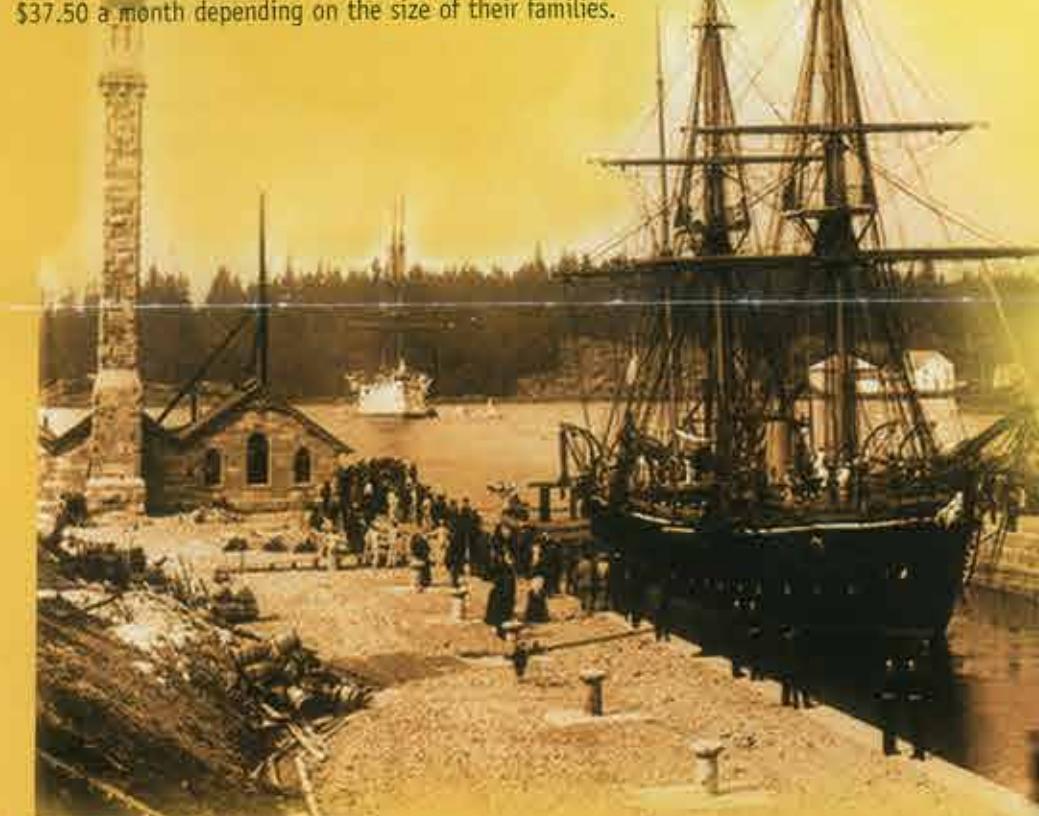
The bone-dry lands of Southern Alberta were included in the 25 million acres the Canadian Pacific Railway received to complete the transcontinental railway. To sell the land to settlers, the CPR had to irrigate the area. They had to get water from the Bow River across a shallow valley, 3.2 kilometres wide, to 170,000 ha of farmland. In 1914, they built The Brooks Aqueduct, a large flume or elevated canal, 6.5 m wide and 2.5 m deep, supported by 1030 columns. A canal replaced the aqueduct in 1979.



### 12 Saskatchewan

Broadway Bridge, Saskatoon, SK

This five span sloping concrete arch bridge crosses the South Saskatchewan River, part of the vast drainage system describing the trading monopoly granted to the Hudson's Bay Company in 1670. The Broadway Bridge was built in 1932 during the Great Depression as a relief project. It was designed, constructed and financed entirely by the City of Saskatoon to help cope with the hard times of the "Dirty Thirties". Hiring was restricted to married men, who were allowed to earn from \$25.00 to \$37.50 a month depending on the size of their families.



### 11 British Columbia

Esquimalt Dry Dock, Victoria, BC

Two of the Terms of Union proposed by BC for their inclusion in The Dominion of Canada in 1871 were the completion of the Pacific Railway and the guarantee of 5 per cent on a loan of £100,000 to build a dry-dock at Esquimalt. Constructed as a joint venture between the British Admiralty, the Government of Canada and the Government of British Columbia, this graving dock was completed in 1887. It has served both naval and commercial vessels and is the oldest surviving dry dock on the Pacific Rim.

### 10 CN Tower, Toronto

By the late 60's, Toronto's ascending skyline posed a problem for existing communications systems. The transmission towers were simply not high enough to broadcast over the new obstacles. Construction of a tower tall enough to overcome these obstacles began on February 6, 1973. On March 31, 1975, the CN Tower became the world's tallest freestanding tower. In December of 1995, the American Society of Civil Engineers acknowledged the CN Tower as one of the Seven Wonders of the Modern World.

### 9 Ontario

Hamilton's 1859 Pumping Station, Hamilton, ON

In 1850, Hamilton was recovering from outbreaks of cholera and smallpox. In 3 years, European immigrants doubled the population to 20,000 people, all using five wells provided by the city. There was no city dump, and no drains. Proposed in 1853 and completed in 1859, Hamilton's new pumping station provided clean water for citizens and also much needed water for factory processes. The system included fire hydrants and was equipped with two steam-powered pumps, which pumped potable water from Lake Ontario until 1910.

To nominate someone for the Awards, simply call

**1-800-861-1008** or visit our Web site

[www.historysociety.ca](http://www.historysociety.ca)

We'll do the rest.



HISTORICA

Disponible en français

CANADA'S  
NATIONAL  
**HISTORY**  
SOCIETY

### 5 Quebec

Quebec Bridge, St. Foy, PQ

After the coming of the railroad, the St. Lawrence River became a barrier to east-west transportation. Montreal built the Victoria Bridge in 1859. Its downriver commercial rival, the city of Quebec eagerly sought a bridge of its own. Completed in 1915, the Quebec Bridge is still the longest bridge cantilever span in the world. Despite two collapses during its construction, the bridge has stood firmly astride the St. Lawrence ever since, helping to link the Maritime Provinces and eastern Quebec with the rest of Canada.



### 6 Prince Edward Island

Confederation Bridge, Borden-Carleton, PEI

Prince Edward Island entered the Dominion of Canada under conditions that included an efficient service for the conveyance of mails and passengers between the Island and the mainland. This became part of the Canadian constitution. On May 31, 1997 the 12.9 kilometre Confederation Bridge opened a new age of transportation to Atlantic Canada. It is the longest bridge over ice covered waters in the world. The Bridge carries two lanes of traffic 24 hours a day, seven days a week and takes approximately 10 minutes to cross at normal traveling speeds.

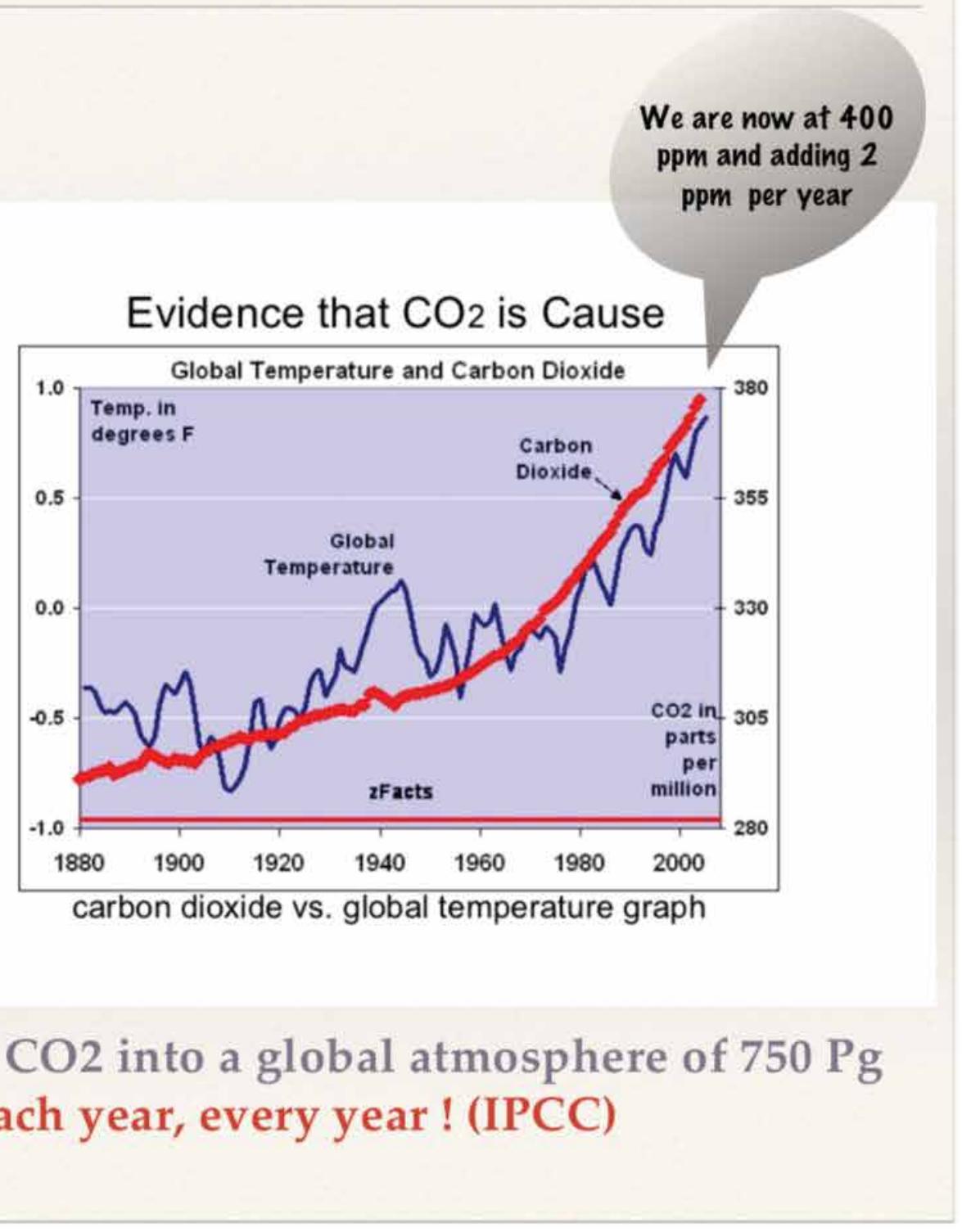
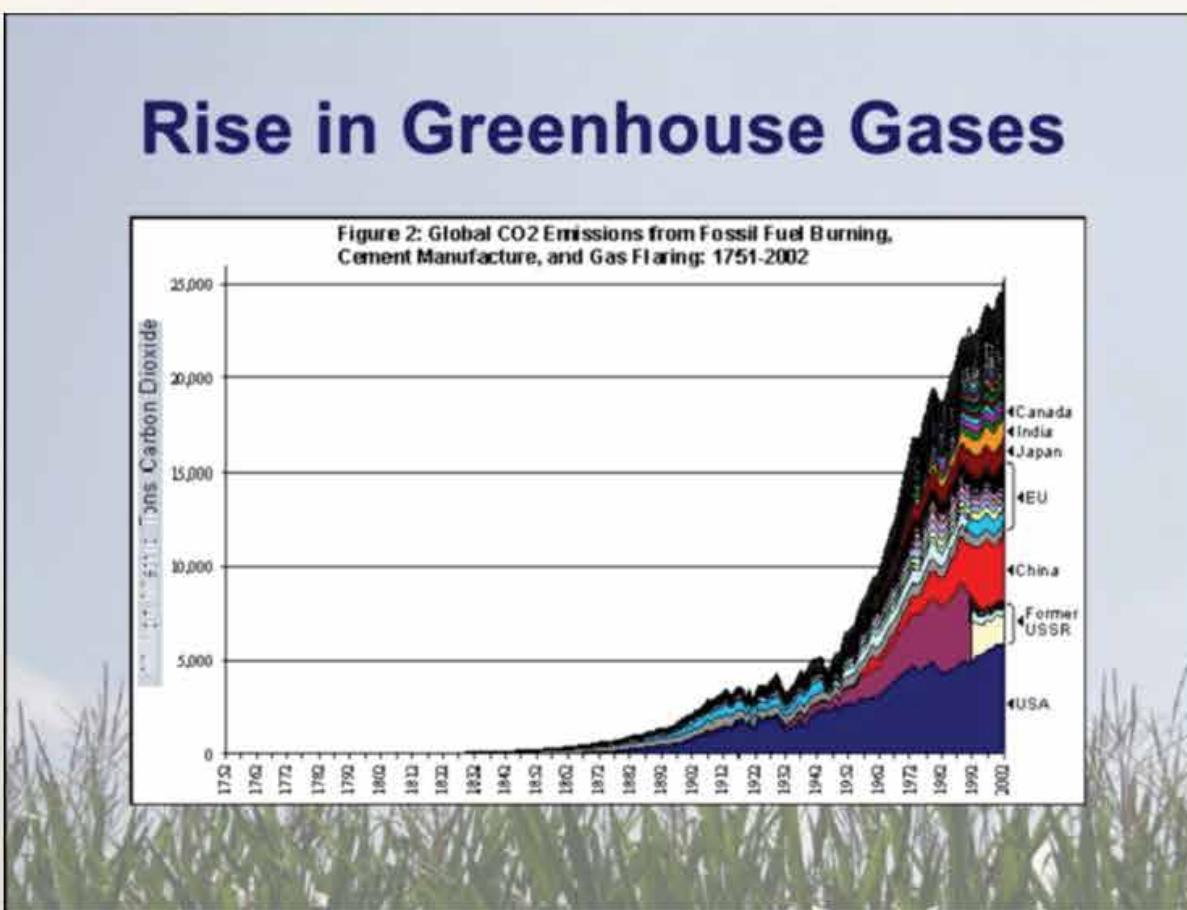
### 7 Nova Scotia

Ocean Terminals, Halifax, NS

Constructed in several stages between 1912 and 1928, the Ocean Terminals served the warships crowding Halifax harbour during WW1. On December 6, 1917 two ships collided in the harbour. The resulting blast would remain the most violent man-made explosion ever created until Hiroshima was bombed in 1945. The Ocean Terminals survived the blast and went on to form the necessary infrastructure for the commercial success of the Port of Halifax. Following the war, these terminals welcomed thousands of European immigrants to Canada.



# Why Now?? - because of the 1%



Each year we burn 6 Pg and breathe 2 Pg of CO<sub>2</sub> into a global atmosphere of 750 Pg almost 1% of the atmosphere, each year, every year! (IPCC)

11

**WHY ACT NOW?** According to NOAA and IPCC, the concentration of carbon dioxide in the atmosphere has now exceeded 400 ppm, and the annual emission of greenhouse gasses into the atmosphere is more than 1% of the entire global atmospheric envelope. As the global population rapidly increases and energy use escalates, the situation is serious, urgent and growing. Canadian infrastructure must be **sustainable infrastructure**. We have the technology and material now to build infrastructure that can operate safely and reliably for 200 years. That should be our goal. To be sustainable, future infrastructure must also provide triple bottom line benefits - social, environmental and economic benefits - for all of those 200 or more years. First Nations leaders counsel that one must consider how decisions taken now will affect people seven generations into the future. CSCE and Canadian civil engineers must have the same perspective.



## ENGINEERS AND CLIMATE CHANGE: WHAT YOU NEED TO KNOW

There's no doubt about it: Climate change is happening. But what are the implications for engineering, and how will engineers take this new dynamic into account in ways that are cost effective and protect the public?

**F**lorida experienced four hurricanes in a span of six weeks this past fall. Edmonton had two once-in-100-years storms in two weeks, followed by a hail storm that required backhoes to clear away the debris. Something is going on. But what?

The "what" behind these weather events is climate change, an emerging issue that will become an integral part of many areas of engineering practice. While the full implications are not yet known, engineers will need to consider the impact of climate change on engineering works in the interests of public health, safety and welfare—the cornerstones of professional engineering.

Factor	Temperature	Timescale
Greenhouse gases	Increase	Decades/centuries
Ozone depletion	Increase	Decades/centuries
Tropospheric aerosols/sulphur	Decrease	Weeks
Volcanic activities	Decrease	Years
Nuclear explosions/asteroids	Decrease	Immediate
Land use changes	Either	Varies
Changed solar output	Either	Varies
Ocean circulation	Either	Varies

Figure 1: Impact on global temperatures

MARCH/APRIL 2005

ENGINEERING DIMENSIONS

51

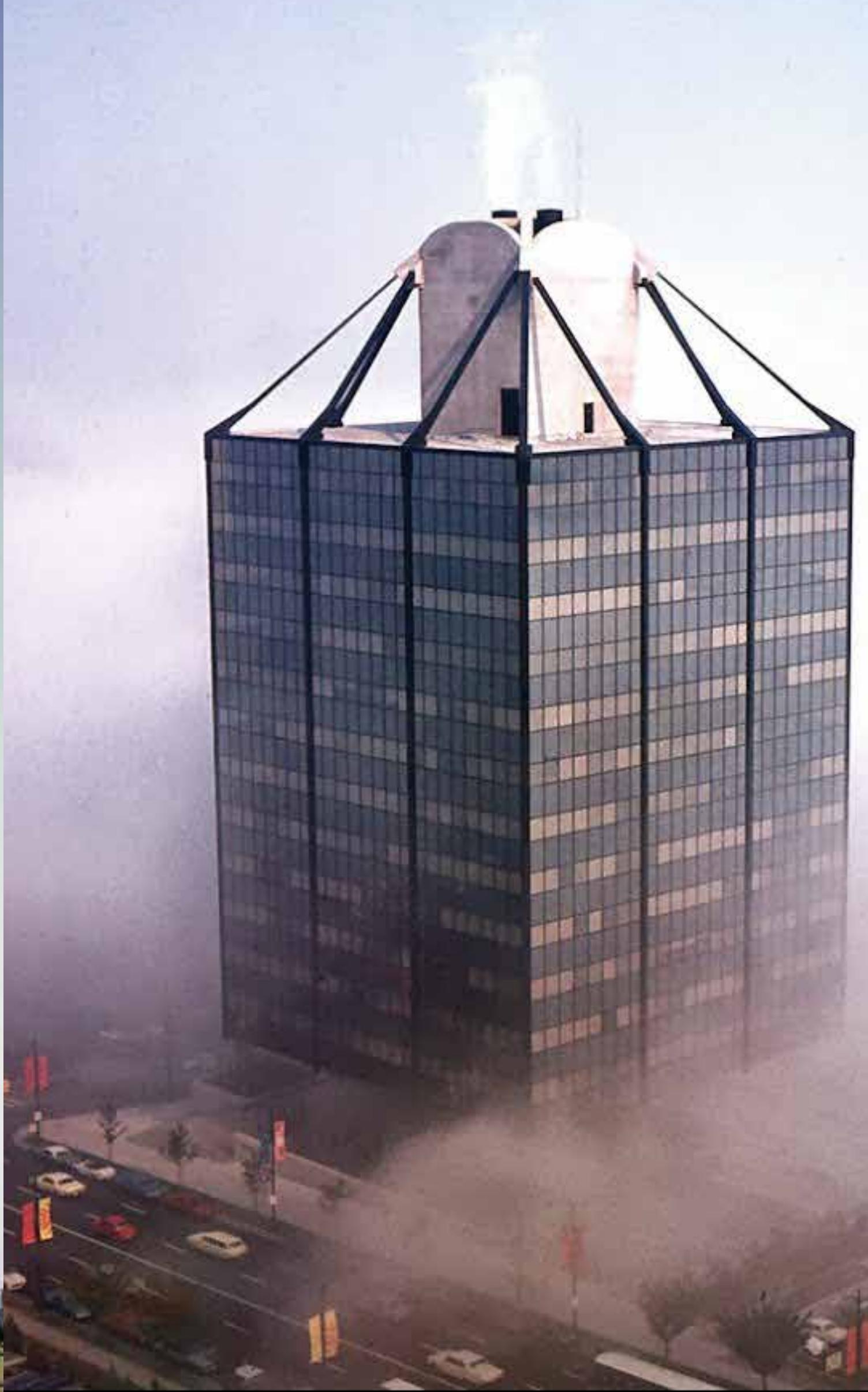
**POURQUOI AGIR MAINTENANT?** Selon la NOAA et le GIEC, la concentration de gaz carbonique dans l'atmosphère a maintenant dépassé 400 ppm, et l'émission de gaz à effet de serre dans l'atmosphère est de plus de 1 % pour l'ensemble de l'enveloppe atmosphérique de la terre. Alors que la population mondiale croît rapidement et l'utilisation de l'énergie augmente, la situation est grave, urgente et empire. L'infrastructure canadienne doit être une **infrastructure durable**. Nous avons la technologie et le matériel maintenant pour construire des infrastructures qui peuvent fonctionner de manière sûre et fiable pendant 200 ans. Ce devrait être notre but. Pour être durable, les infrastructures futures doivent également fournir des avantages - sociaux, environnementaux et économiques pendant 200 ans. Les dirigeants des Premières Nations conseillent de prendre en considération l'impact qu'auront les décisions prises aujourd'hui sur les sept prochaines générations. La SCGC et les ingénieurs civils canadiens ont la même perspective.

**What is climate change?**  
Climate change is concerned with changes in key climate variables: temperature, precipitation, atmospheric moisture, snow cover, sea level and the extent of land and sea ice. It also involves the changing patterns in atmospheric and oceanic circulation, extreme weather events and long-term climate trends.

Climate change is affected by radiation that is received or retained in the atmosphere, and the redistribution of energy within the atmosphere and among the atmosphere, land and oceans. Greenhouse gases (GHGs) have long been blamed for climate change, of course. But many other natural and human factors, such as volcanic activity and tropospheric aerosols (very fine particulate suspended in air), and the combustion of fossil fuel, have an impact on global temperatures, too. How all of these factors affect climate change varies (Figure 1).

**Is it really happening?**  
Climate change is a naturally occurring phenomenon and Earth has experienced many different climate regimes throughout geological history. The question is whether what's happening now is really different than this naturally occurring phenomenon. The answer is yes.

Ice cores tell the story. Ice cores show a direct relationship between atmospheric temperature changes and changes in GHG levels. During the past 10,000 years or so, atmospheric CO<sub>2</sub> concentrations have remained at close to the typical interglacial concentration of 280 parts per million (ppm). However, about 200 years ago things began to change. Concentrations of GHGs began to increase rapidly, primarily due to emissions from the combustion of fossilized carbon in coal, oil and natural gas and, to a lesser extent, land use change activities (Source: CDIAC website at <http://cdiac.esd.ornl.gov/trends/trends.htm>). Today, concentrations are at about 375 ppm—more than 30 percent above pre-industrial era levels. This concentration appears to be unprecedented in the 400,000-year ice-core records, and has catapulted us so far out of the known historical ranges that we're not sure what all of the impacts will be.



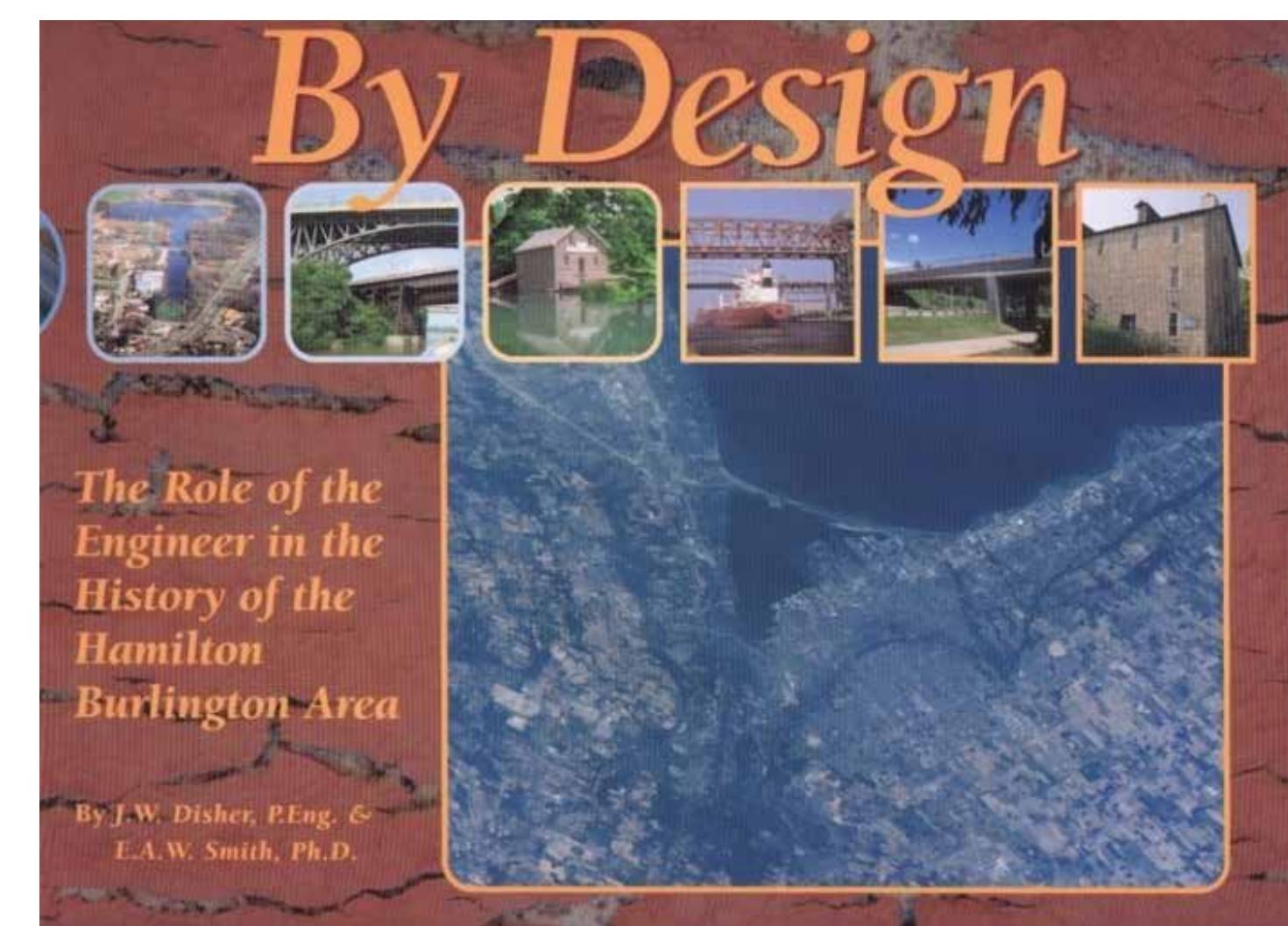
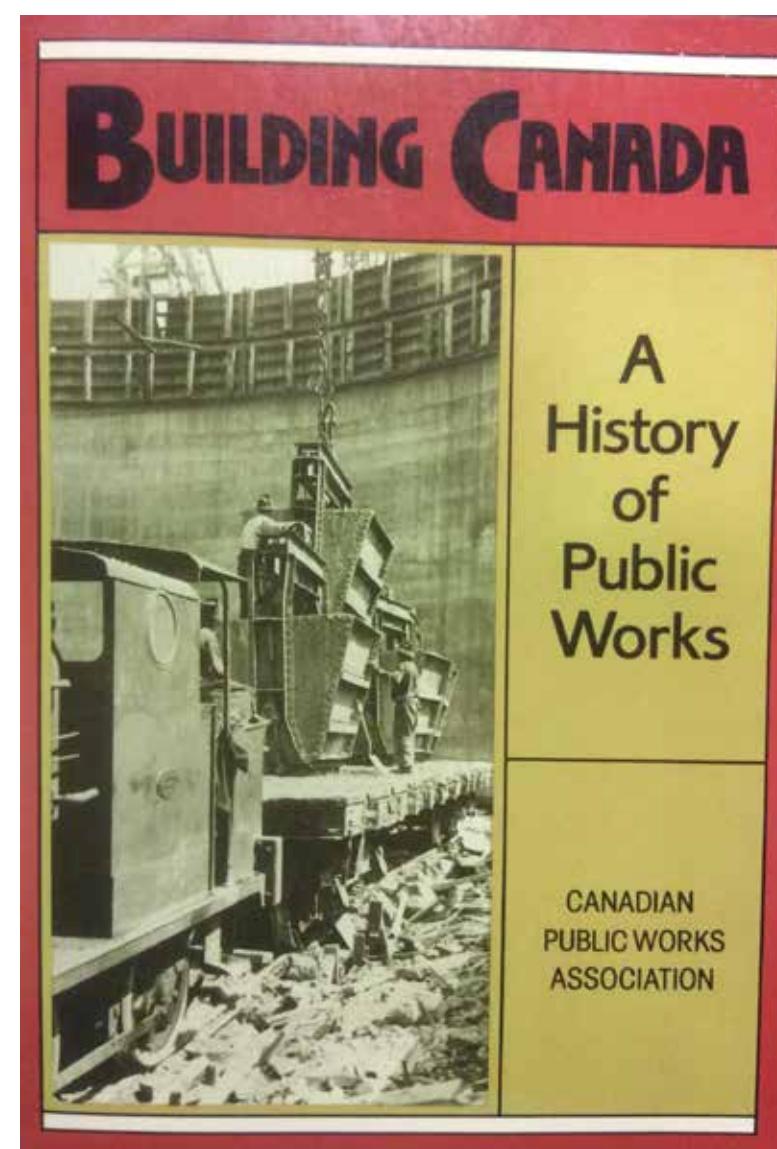
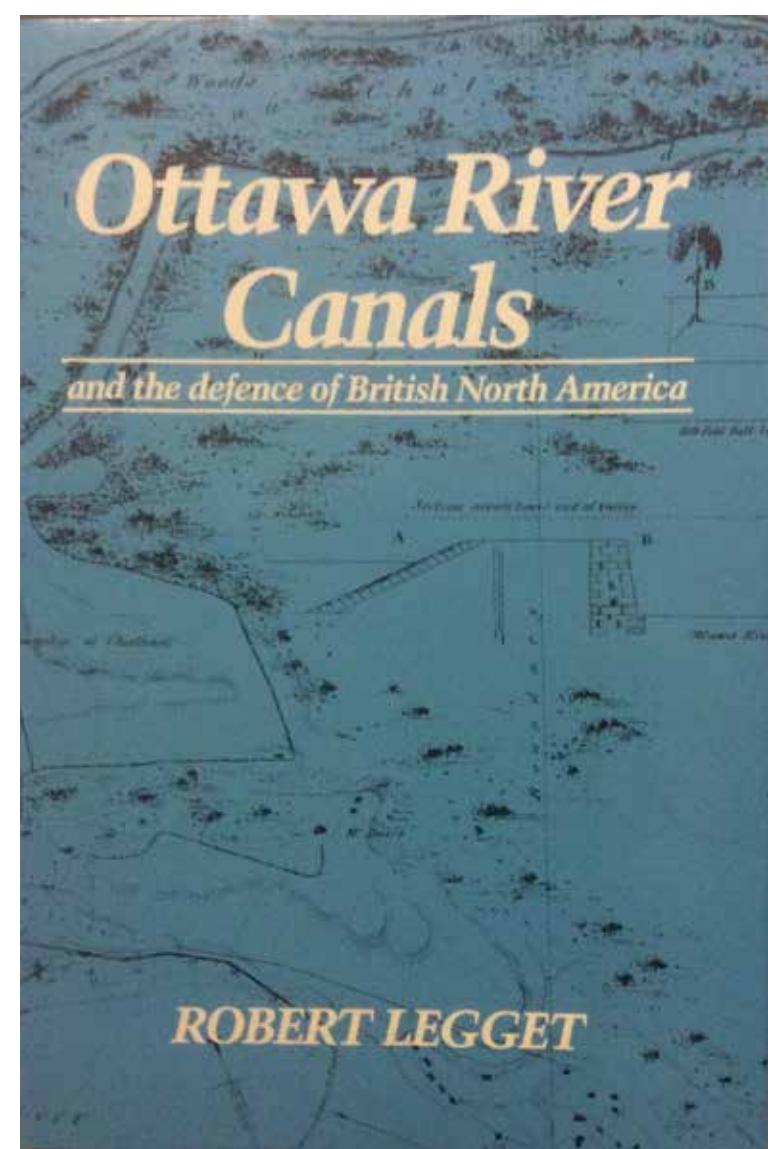
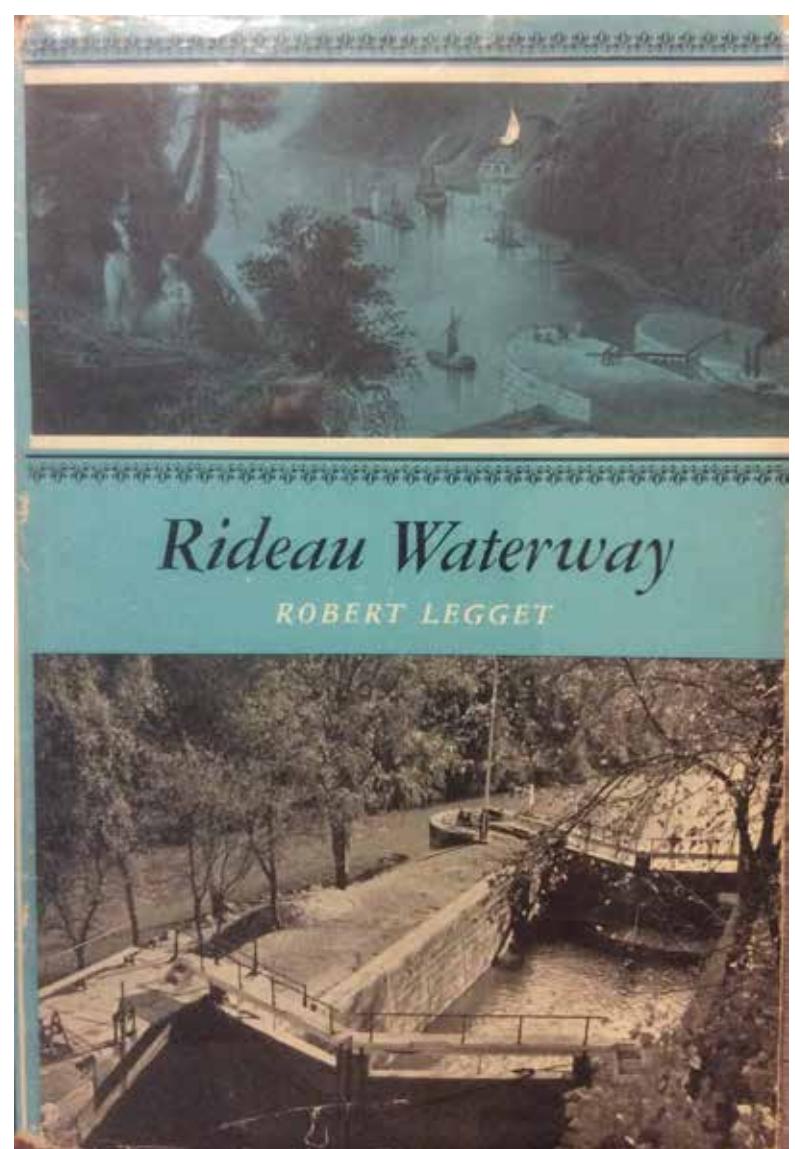
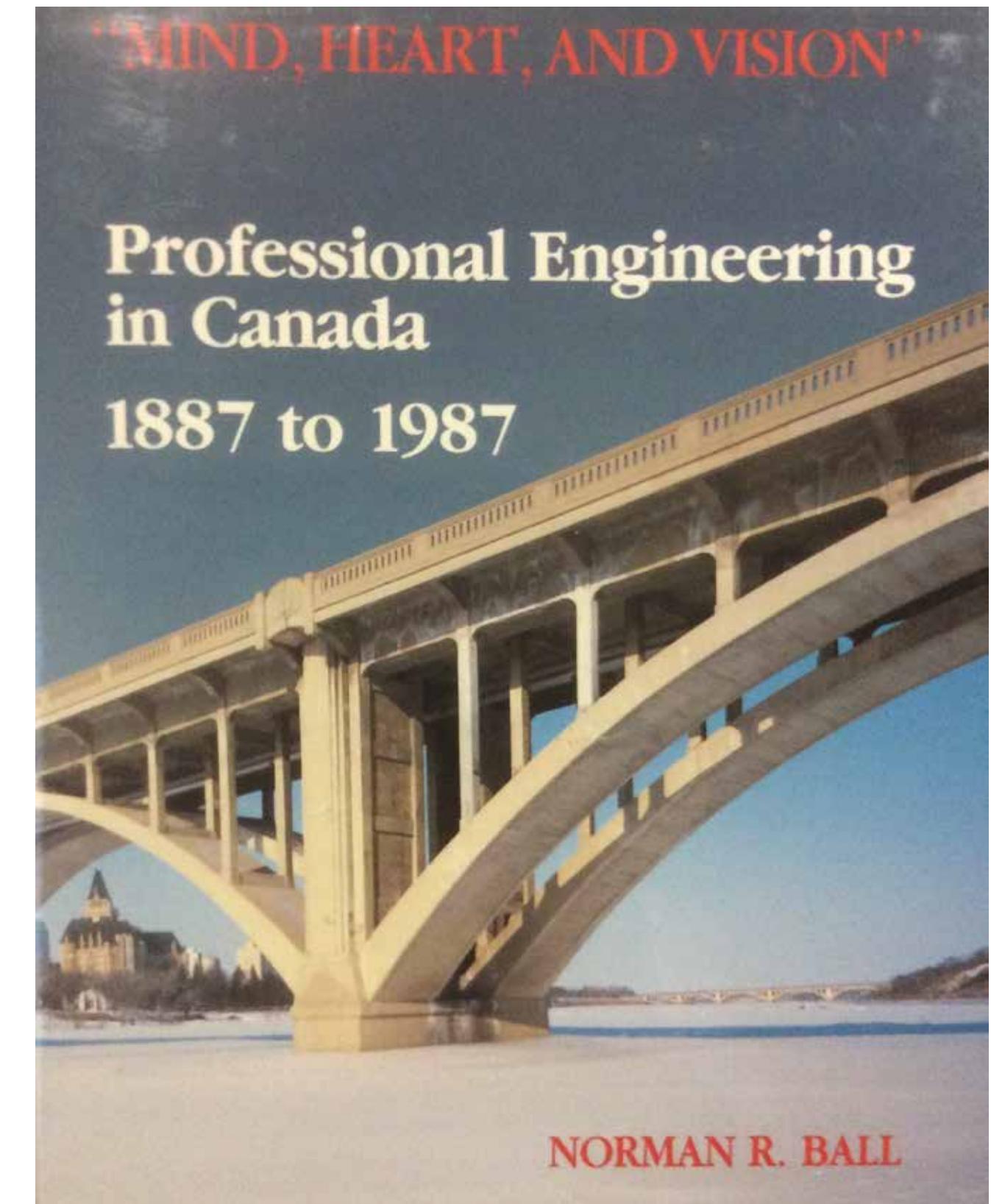
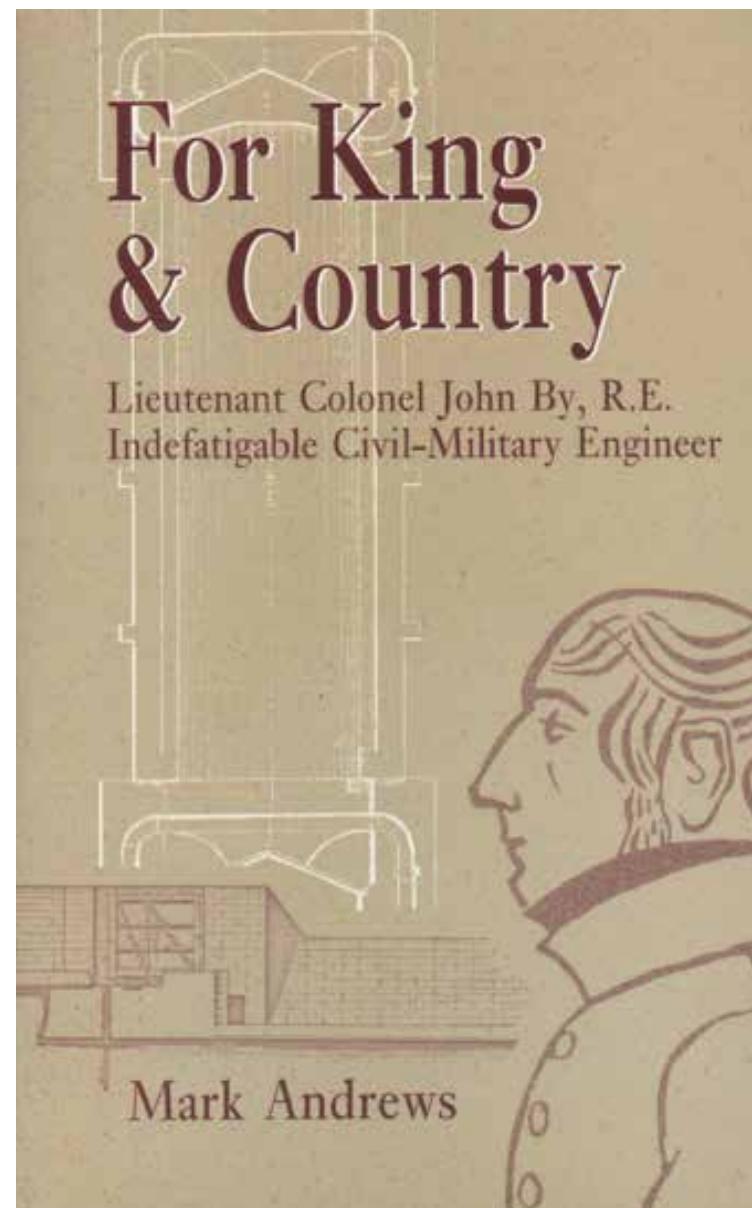
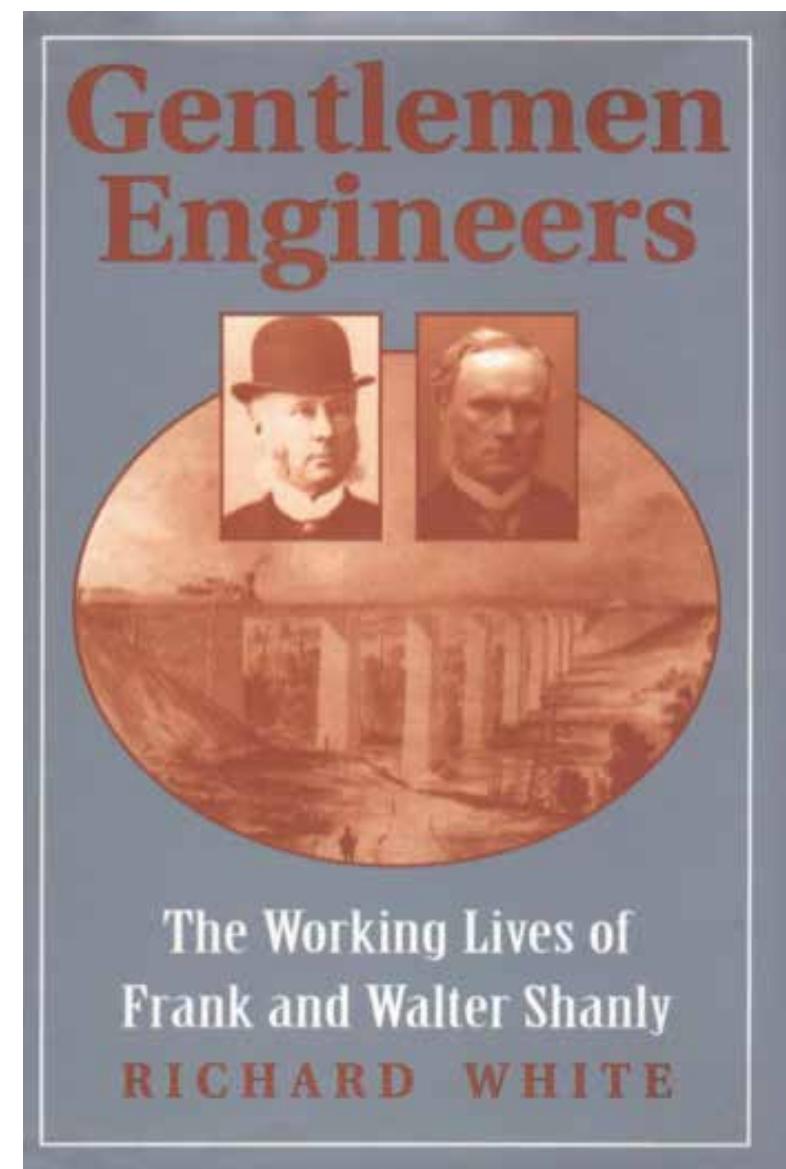
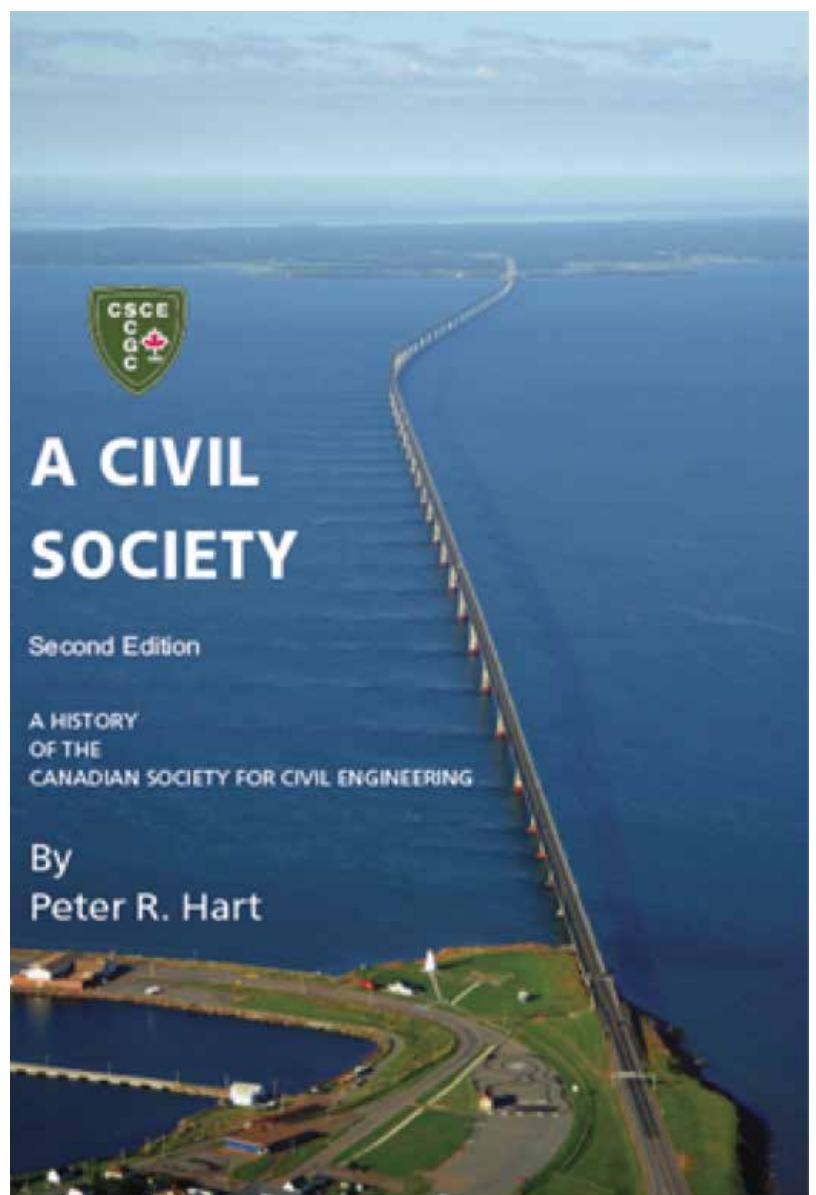
# THE QUBE

## The West Coast Transmission Building

Completed in 1970 as one of Canada's most striking highrise buildings. The floors are suspended from the central core, allowing the building to move more freely with less damage during an earthquake. It was renovated to condominiums as the Qube in 2005. It is considered to be one of Vancouver's most earthquake-resistant structures.

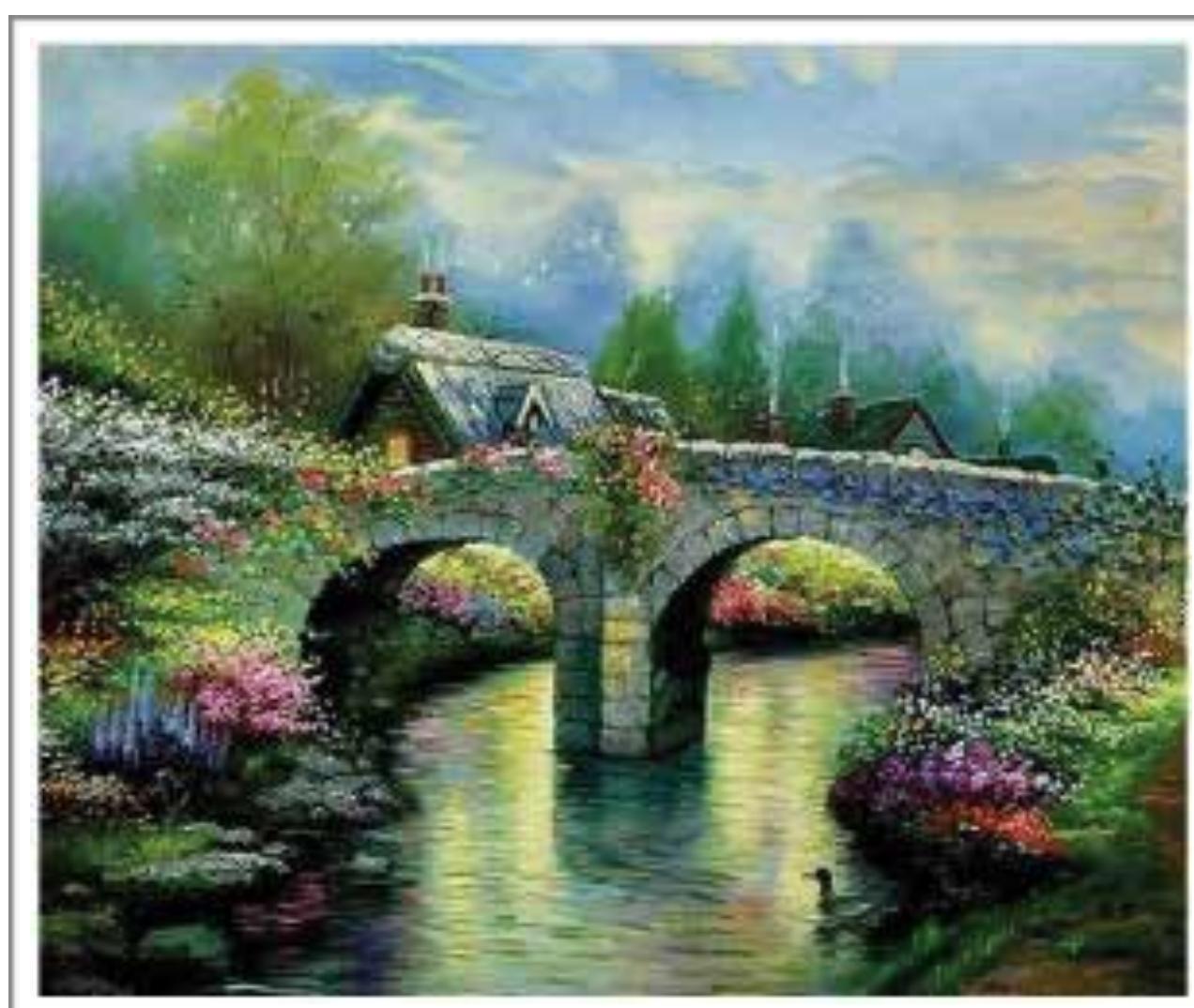
Terminé en 1970 comme l'un des plus frappant des hauts bâtiments. Les étages sont suspendus depuis le noyau central, ce qui permet à l'immeuble de se déplacer plus librement avec moins de dommages lors d'un tremblement de terre. Il a été rénové et transformé en appartements en 2005 et nommé le Qube. Il est considéré comme l'une des structures parasismiques les plus résistantes de Vancouver.



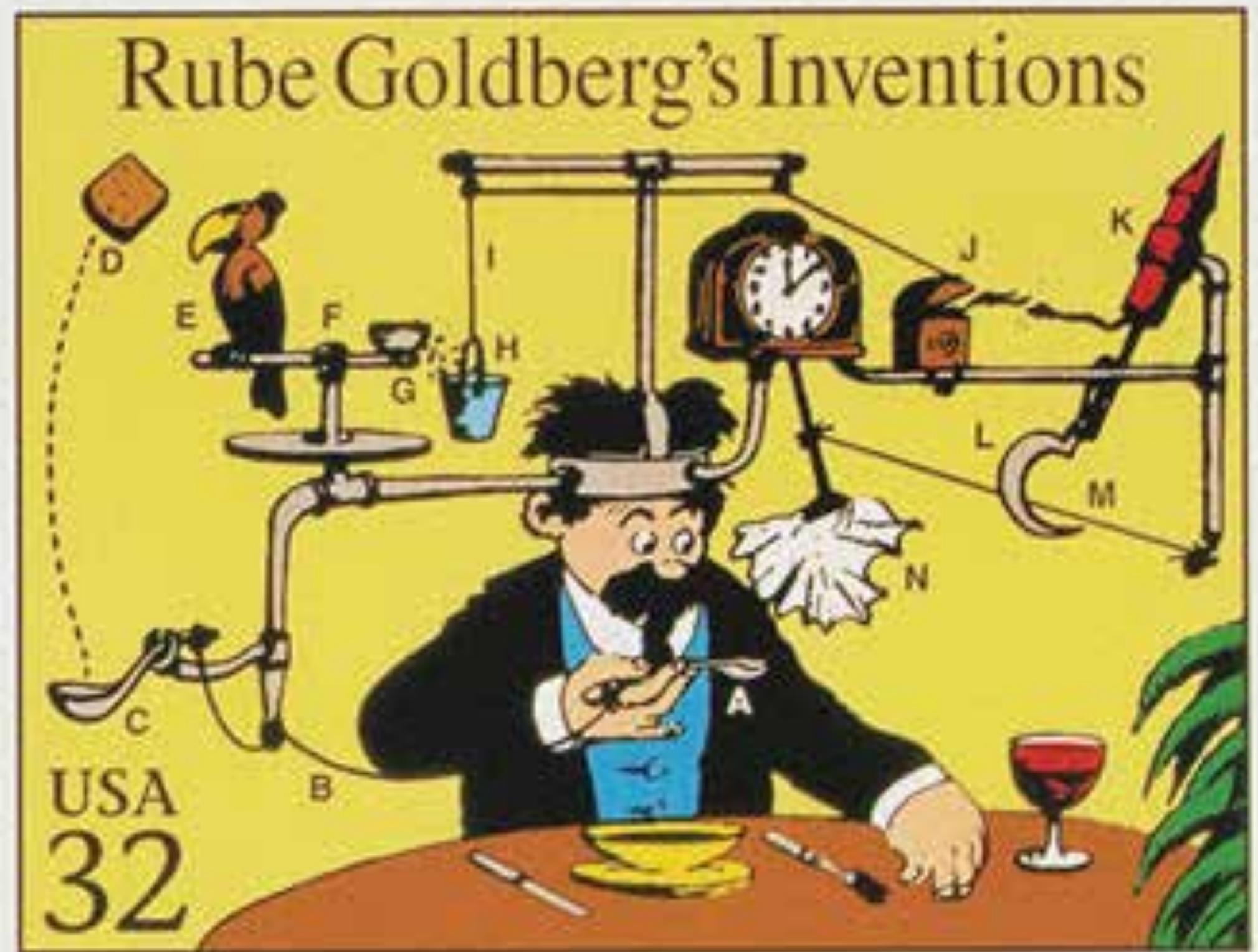


A SENSE OF HISTORY  
L'HISTOIRE DU GENIE





L'ART DE  
GENIE CIVIL



# A SENSE OF HUMOUR

## Who knew Rube was a Civil Engineer!

Rube Goldberg (1883-1970) was a Pulitzer Prize winning cartoonist best known for his zany invention cartoons. He was born in San Francisco on the 4th of July, 1883 - and graduated from U. Cal Berkeley with a degree in engineering and first worked in mining.

Working for Hearst publications as a cartoonist he became a household name. In 1995, a U.S. postage stamp honored "Rube Goldberg Inventions" and depicted his iconic self-operating napkin.

Rube Goldberg (1883-1970) était un dessinateur lauréat du prix Pulitzer, plus connu pour ses dessins loufoques. Il est né à San Francisco le 4 juillet 1883, a obtenu un diplôme en ingénierie de l'Université Cal Berkeley et a entamé sa carrière dans l'industrie

minière. Alors qu'il travaillait aux publications Hearst, il devint un nom familier. En 1995, un timbre-poste américain a honoré "Rube Goldberg Inventions" et a représenté son emblématique serviette de table automatique.



# ENTRUSTED TO OUR CARE

The Canadian Society for Civil Engineering

In 1994 CSCE President Claude Johnson wrote that if global resource and energy consumption were not reduced, the global environment "will simply collapse". CSCE's Guidelines for Sustainable Development (2007) were prepared to instil these concepts into the planning, design and operation of civil infrastructure in Canada. More recently, the 2015 Civil Engineering Triennial Summit focused on making cities "resilient" and "future proofed", or risk exponential poverty, social inequality, economic decline, terrorism and conflict. These represent urgent "calls for action", recognizing that climate change fundamentally changes the question for all of humanity. And

civil engineers, through the practice of their profession, can serve as agents of change. In order for Canadians 200 years from now to have a quality of life at least as good as our own, we must make the right infrastructure decisions now. It is our responsibility to future generations to build sustainable infrastructure now. For more information on CSCE sustainable infrastructure initiatives contact our President at [president@csce.ca](mailto:president@csce.ca)

En 1994, le président de la SCGC Claude Johnson a écrit que si la consommation mondiale des ressources et de l'énergie n'était pas réduite, l'environnement planétaire "s'effondrera". Les Directives pour le développement durable de la SCGC (2007) furent alors élaborées afin d'inclure ces concepts dans la planification, la conception et l'exploitation des infrastructures au Canada. Plus récemment, le Sommet triennal du génie civil 2015 a mis l'accent sur la nécessité de rendre les villes "résilientes" et outillées pour affronter l'avenir" sinon risquer une pauvreté exponentielle, des inégalités sociales, un déclin économique, du terrorisme et des conflits. Cela représentait un "appel à l'action"

urgent reconnaissant que le changement climatique transformait la question pour l'humanité entière. Par la pratique de leur profession, les ingénieurs civils peuvent être les agents du changement. Pour que dans 200 ans les Canadiens aient une qualité de vie au moins aussi bonne que la nôtre, il nous faut prendre les bonnes décisions sur les infrastructures maintenant. Il est de notre responsabilité envers les générations futures to construire des infrastructures durables maintenant. Pour plus d'informations sur les initiatives relatives aux infrastructures durables de la SCGC, veuillez contacter notre président à [president@csce.ca](mailto:president@csce.ca).



CANADIAN CIVIL ENGINEER  
L'INGÉNIEUR CIVIL CANADIEN

2017 | SPRING/PRINTEMPS

# RESILIENT INFRASTRUCTURE INFRASTRUCTURES RÉSILIENTES



[www.csce.ca](http://www.csce.ca)

- Rt. Hon. Herb Gray Parkway
- Barrie landfill reclamation
- Reference-free bridge damage identification
- Update: The New Champlain Bridge

## PRESIDENT'S PERSPECTIVE | PERSPECTIVE PRÉSIDENTIELLE



Jim Gilliland, Ph.D., P.Eng., LEED® AP  
PRESIDENT, CSCE/PRÉSIDENT SCGC  
PRESIDENT@CSCE.CA

### Communication is Everything

How many times have we all heard the expression "Communication is everything." Communication from the CSCE to its members and the public is necessary to inform everyone regarding issues relevant to civil engineers, as well as sustainability initiatives and innovations being developed across Canada and the around the world. The CSCE must continue to develop and enhance its arsenal of communication tools to remain relevant in our communities.

The CSCE has many active committees and technical divisions that are working in specific fields of civil engineering or are interested in specific aspects of sustainable infrastructure. These committees represent many opportunities to contribute to the CSCE as well as to enhance your professional development and career objectives. Please review the committees on the [csce.ca](http://csce.ca) website and contact the committee chair if you are considering getting involved.

The CSCE also has specific task forces and strategic initiatives that require volunteers to get things done. For example, we are currently working on a new communication "hub" for hosting all CSCE electronic resources, including technical databases. We also have a taskforce dedicated to promoting and developing a Canadian Sustainable Infrastructure Rating System. If either of these initiatives seem interesting to you, or if you have questions about the committees listed on our website, please contact me anytime. It's easy for a CSCE member to get involved in the sustainability conversation—just ask! Get involved and be a part of growing Canada's sustainable infrastructure.

Volunteering with the CSCE to help enhance communications is an important role that provides great value for the CSCE as well as the individual. This role helps promote the accomplishments of CSCE members and also the relevance of the CSCE as a society. Equally as important, communication roles in the CSCE also raise the profile of the individuals taking their time to volunteer and helps the individuals achieve their career goals. I believe that many current volunteers would agree with this perspective. It only takes a couple of hours to contribute something of value, whether it is time at lunch, or looking for interesting stories when you're at home in the evening. Easy forms of communication include short newsletters, social media postings, and linking CSCE members to innovative sources of information around the world. Enhancing communications about CSCE activities is an easy way to learn about CSCE innovations without needing to be directly involved with academic research.

I hope to see everyone at the 2017 Annual Conference in Vancouver, and I'm looking forward to moving the conversation forward! ■

### Tout est une question de communication

Combien de fois avons-nous tous entendu l'expression « tout est une question de communication. » Les communications provenant de la SCGC et destinées à ses membres et au public sont nécessaires afin d'informer tout le monde sur des questions pertinentes aux ingénieurs civils, ainsi que sur les initiatives et les innovations en matière de durabilité qui sont élaborées au Canada et ailleurs dans le monde. La SCGC doit continuer à développer et améliorer son arsenal d'outils de communication afin de demeurer pertinente dans nos communautés.

La SCGC comporte plusieurs divisions techniques et comités actifs qui travaillent au cœur de secteurs spécifiques du génie civil ou qui s'intéressent à des aspects particuliers des infrastructures durables. Ces comités représentent des occasions diverses de contribuer à la SCGC ainsi qu'à votre perfectionnement professionnel et vos objectifs de carrière. Veuillez consulter la liste des comités sur le site Web de la SCGC et contacter le président du comité concerné si vous souhaitez vous impliquer.

La SCGC peut également compter sur des groupes de travail spécifiques et des initiatives stratégiques nécessitant des bénévoles pour faire avancer les choses. Par exemple, nous travaillons présentement sur un nouveau « pôle » de communication pour accueillir toutes les ressources électroniques de la SCGC, incluant les bases de données techniques. Nous avons également un groupe de travail dédié à la promotion et au développement d'un Système canadien de notation de la durabilité des infrastructures. Si l'une ou l'autre de ces initiatives vous interpellent, ou si vous avez des questions au sujet des comités, vous pouvez me contacter à tout moment. Il est facile pour tout membre de la SCGC de prendre part au débat sur la durabilité : vous n'avez qu'à demander ! Impliquez-vous et faites partie de la croissance des infrastructures durables au Canada.

Être bénévole au sein de la Société dans le but de contribuer à améliorer les communications est un rôle important procurant une valeur ajoutée à la SCGC, ainsi qu'aux bénévoles. Ce rôle contribue à promouvoir les réalisations des membres de la SCGC ainsi que la pertinence de celle-ci en tant que société. Tout aussi importants, les rôles en communication au sein de la SCGC augmentent également la visibilité des personnes qui prennent de leur temps pour faire du bénévolat et aident ces personnes à atteindre leurs objectifs de carrière. Je crois que plusieurs bénévoles actuels partageraient ce point de vue. Cela ne prend qu'une couple d'heures pour faire une contribution importante ou pour rechercher des histoires intéressantes à partager, que ce soit sur l'heure du dîner, ou le soir, à la maison. Des formes simples de communication incluent de brefs bulletins d'information, des publications sur les médias sociaux et la communication de sources d'information innovatrices à travers le monde. Renforcer les communications sur les activités de la SCGC est une façon aisée d'en apprendre davantage sur les innovations de la SCGC sans être directement impliqué dans les recherches universitaires.

J'espère vous voir au congrès annuel 2017 à Vancouver. J'ai très hâte de faire avancer le débat! ■