

HIS 2129



Technology, Society and
Environment since 1800
(Winter 2014)



Electrical Systems: Overview (1)

- The invention and development of devices using the speed of electricity to provide nearly instantaneous communication capped a century of inventions sometimes described as the Industrial Revolution
- Between 1710 and 1810, power sources shifted decisively from water- and wind-power to the engines pioneered by Newcomen and Watt (reliant on atmospheric and steam pressure)
- Between 1730 and 1830, the smelting of iron with coke and the puddling process increased iron output
- Between 1760 and 1860, transportation systems evolved rapidly: turnpikes, canals, steamboats, and steam railways offered ever faster travel and shipping



Electrical Systems: Overview (2)

- In daily life, electricity was used for **communications** (telegraphs, telephones) and then for lighting
- Electric **power** revolutionised daily life and work, especially in factories
- The power demands of **lighting** and then **streetcars** brought about a leap in power production, which made it possible to develop new household electrical devices



Topics: Systems and Electricity

- Systems: oil in the 19th century
- Before the electric age
- Electricity: transforming communications
- Water power: an age of transition
- Electricity: transforming the workplace (1)
- Systems: water power and electricity
- Electricity: transforming public transit (2)
- Electricity: new light at home and in the streets (3)



The Age of Systems

- Thomas P. Hughes has championed the analysis of technological systems that require the intermeshing of numerous components and subsystems
- Bottleneck: a step in a linear process that is unable to handle the same throughput as the other steps
- Reverse Salient: a problem that holds up, more generally, the improvement or progress of an entire system



The Oil System

- By 1849, Canadian inventor Abraham Gesner had distilled kerosene from oil as an *illuminant* to substitute for candles and whale oil
- In 1858, a Hamilton, Ontario, coachmaker by the name of James Miller Williams struck oil in the gum beds of Enniskillen Township, Ontario; this launched Canada's oil industry and oil was soon being shipped out by rail to be sold as illuminant or lubricant
- A boomtown called Oil Springs grew up around the wells; neighbouring Petrolia also profited
- In the United States, Titus Drake struck oil in 1859, in Pennsylvania, just in time as the Civil War increased demand, especially for illumination since whale hunting was hampered by naval operations

Petrolia, ON: City hall (c. 1911)

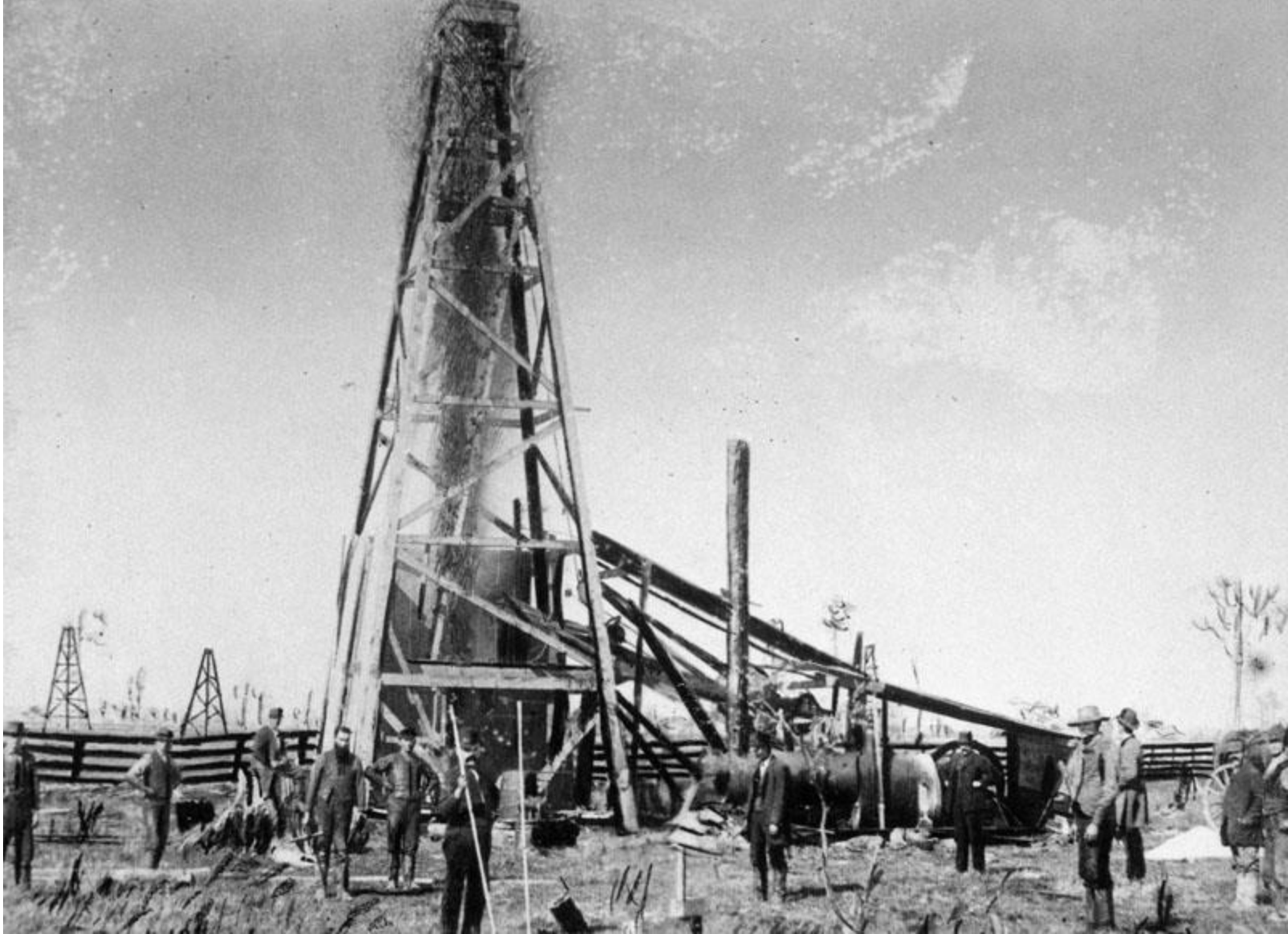


Petrolia, ON: Oil derricks (1886)

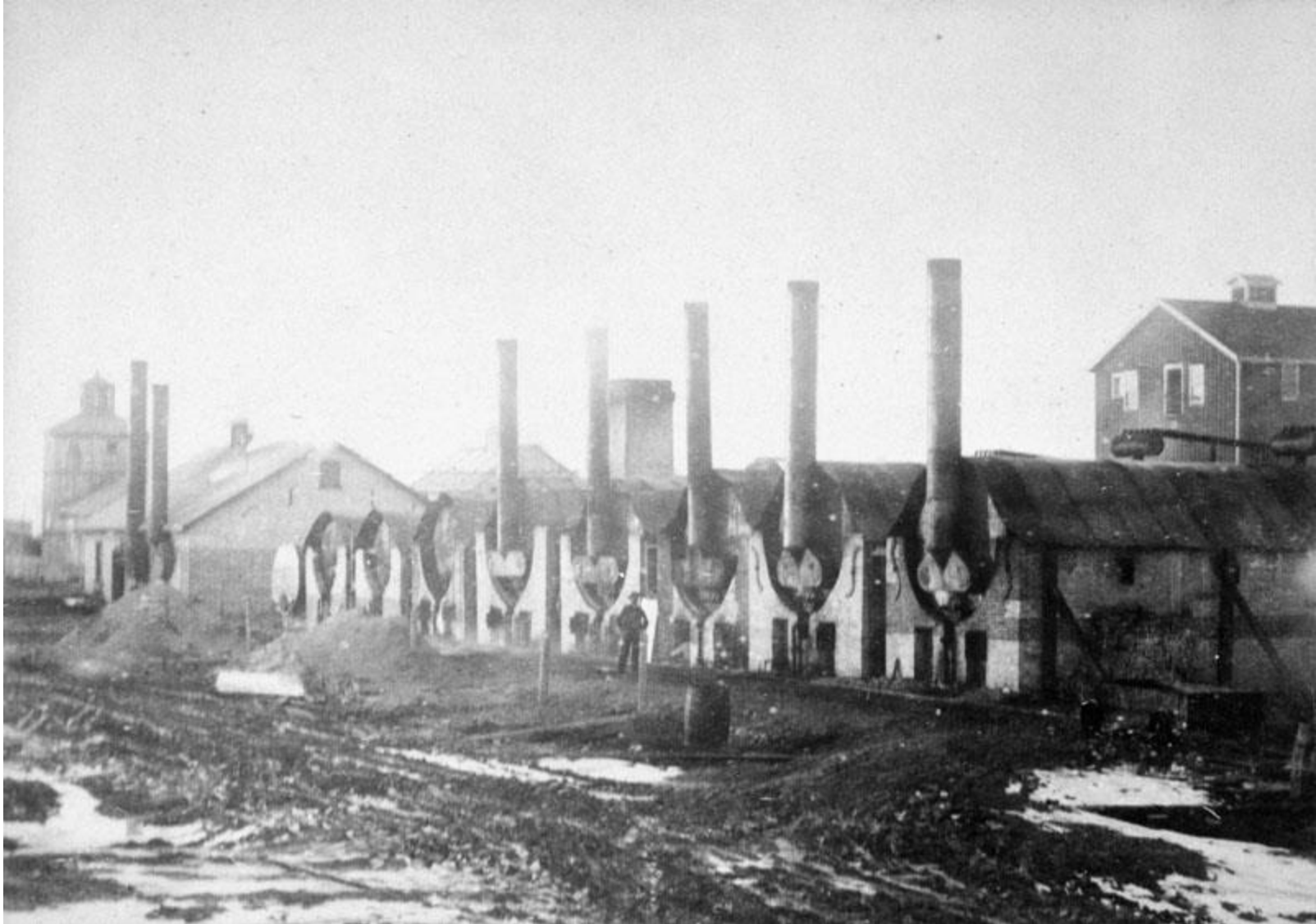


Petrolia, ON: Exploding a torpedo in an oil well (1886)

Robert Bell, Library and Archives Canada, C-030224



Petrolia, ON: Stills of the Producers Oil Refinery (November 1886)



Petrolia, ON: Oil wells (c. 1911)



Petrolia, ON: Oil derricks (1915)



John Boyd (1865-1941), Library and Archives Canada, PA-061253



To recapitulate (1)

- What is a technological system?
- What historian of technology is famous for analyzing technological systems?
- How is a bottleneck different from a reverse salient?
- What were some of the components of the 19th-century oil system?
- What Canadian province became a major oil producer in the 19th-century?
- What did kerosene replace?



Before the Age of Electricity

- Before electricity was applied to sending messages, Europeans got an advance taste of high-speed communications from early telegraph systems
- The aerial or optical telegraphs worked on the relay principle: a signal made from a high place was observed from another with the help of spyglasses and relayed to the next point in the chain
- Such telegraphs, pioneered in France, required a large number of operators, an expensive infrastructure, and were far slower than electric systems



Communication Utopias

- **“The capitals of distant nations might be united by chains of posts, and the settling of those disputes which at present take up months or years might then be accomplished in as many hours.”**
(*Encyclopaedia Britannica*, 1797)
- **“The Atlantic Telegraph—that instantaneous highway of thought between the Old and New Worlds”**
(*Scientific American*, 1858)
- **“The laying of the telegraph cable is regarded, and most justly, as the greatest event in the present century; now the great work is complete, the whole earth will be belted with electric current, palpitating with human thoughts and emotions. It shows that nothing is impossible to man.”**
(Briggs and Maverick, *The Story of the Telegraph*, 1858)

An Aerial Telegraph in Montmartre (1817)



Goblain del^t

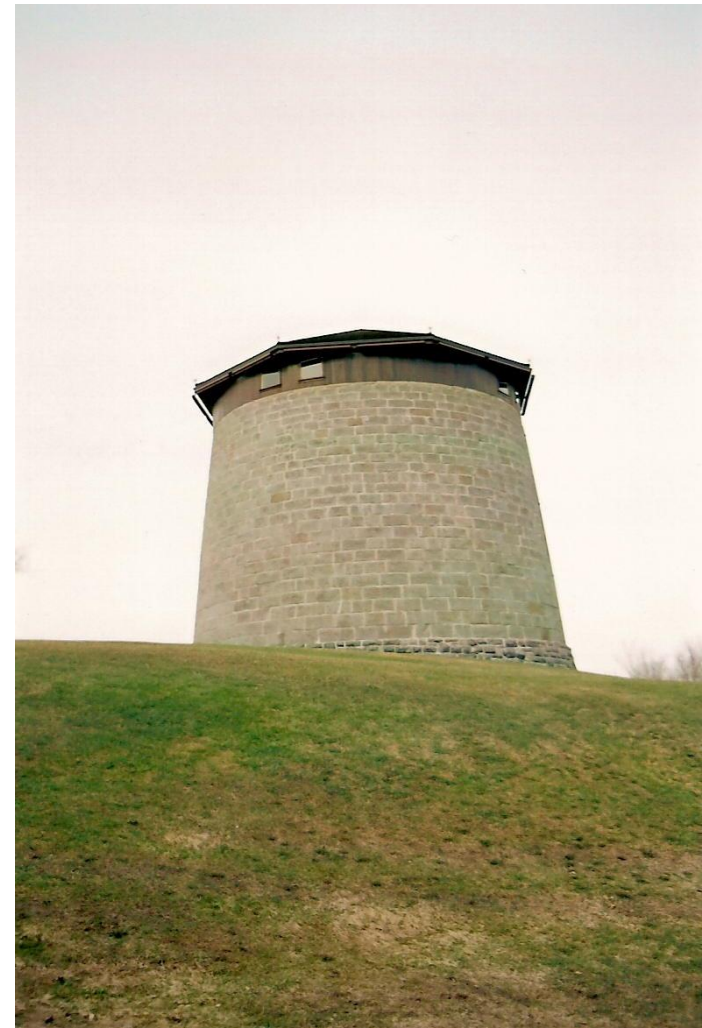
Telegraphe de Montmartre

A 30368

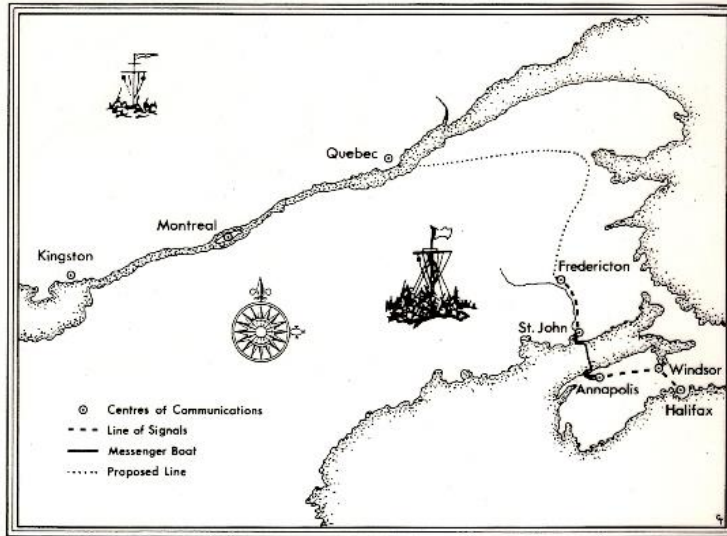
Optical Telegraphs in British North America

- In 1798, the Duke of Kent assumed command of British forces in Atlantic North America at a time of war with France
- As part of his strengthening of defences, prince Edward had a line of optical telegraph stations built that extended from the Halifax Citadel to harbour approaches and, with a shuttle across the Bay of Fundy, to Fredericton in New Brunswick

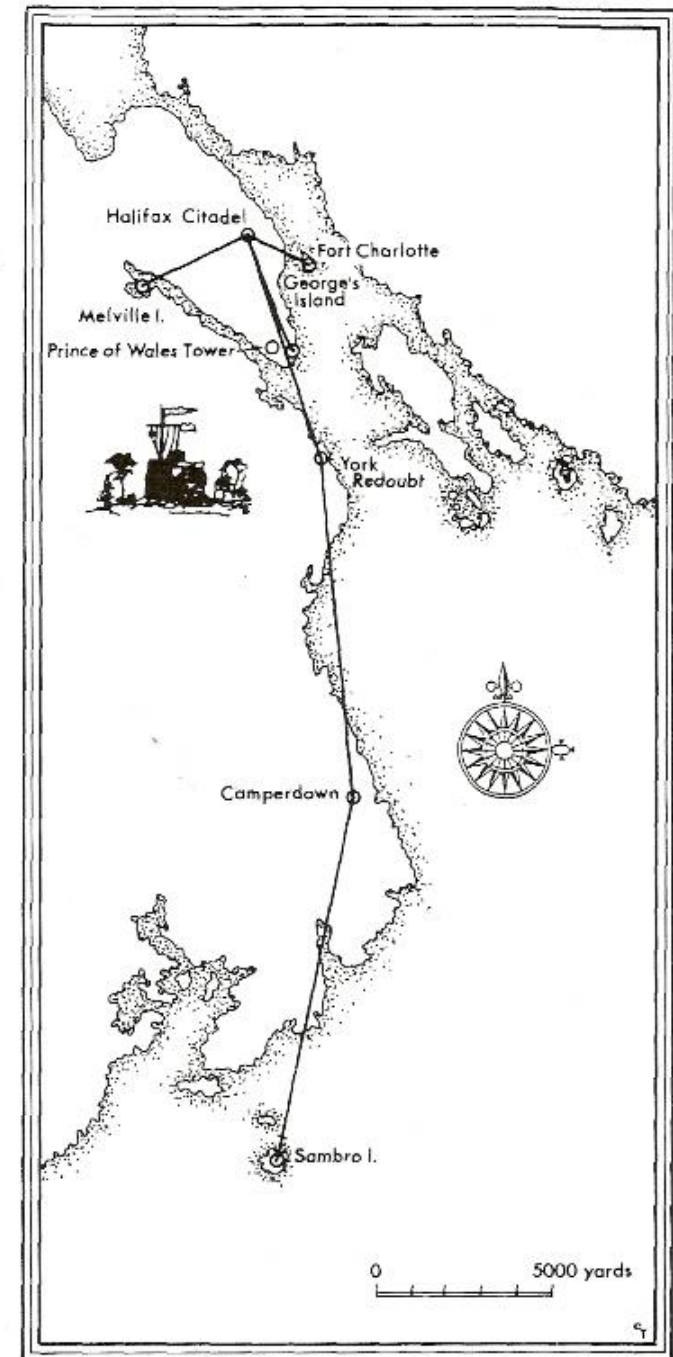
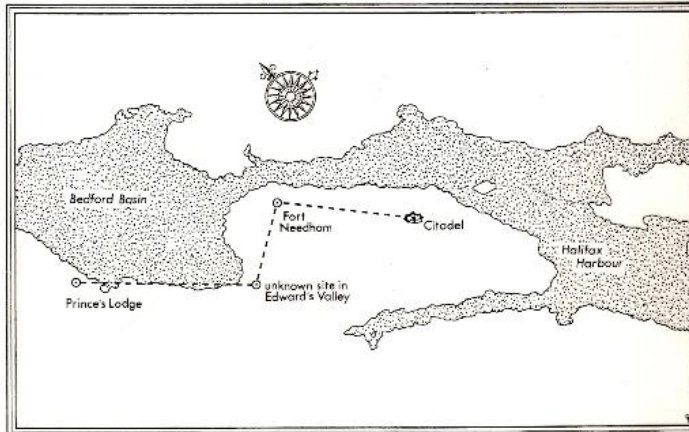
Martello Tower on
the Plains of Abraham,
Quebec City, 2006



The Halifax network (1798)



Signals could easily be sent to the Duke at his residence on Bedford Basin.



The signal system in the Halifax area.

The Development of Optical Telegraphs (1882)



Fig. 3. Mode d'emploi de l'appareil de télégraphie optique du colonel Mangin.

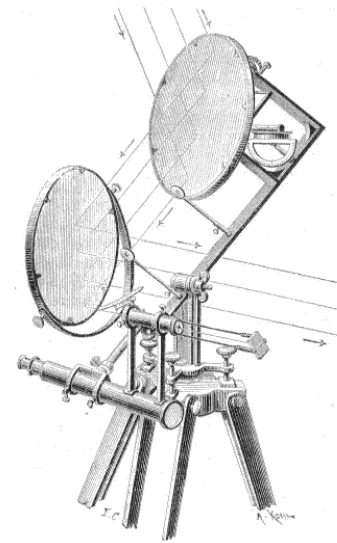


Fig. 1. Héliotélégraphe de Lesouffre.

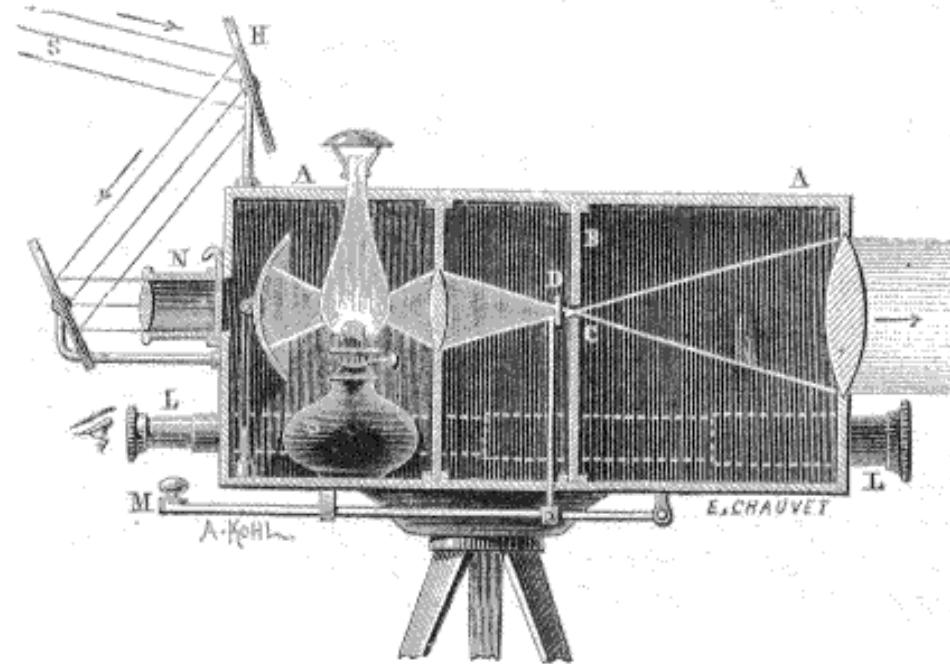


Fig. 2. Appareil de télégraphie optique du colonel Mangin.

Soldiers with heliographs (solar telegraphs)

Cairo, 22 September 1882



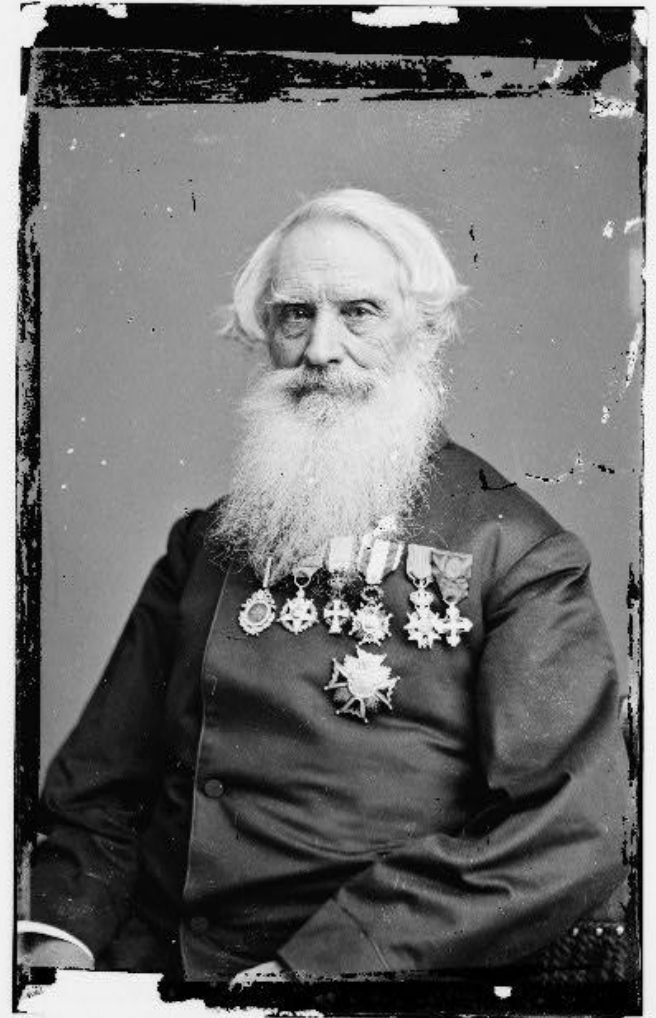


Transforming Communications: The Electric Telegraph Conquers

- People had been trying to invent an electric telegraph since the 18th century
- By the 1830s, several inventors in Europe and North America had solved most of the technical problems
- The stage was set for a dramatic advance in the speed of communications
- While the effects on the environment of the electric telegraph were slight, the effects on human society were predicted to be profound

The Morse System

- Samuel Morse (1791-1872) and Alfred Vail (1807-1859) perfected a telegraph without any of the drawbacks of its competitors
- It used only one wire, it could record the message on paper and it relied on a simple, alphabetical code



Samuel Morse c. 1855-1865



To recapitulate (2)

- What country pioneered the use of aerial telegraphs?
- Was the “Atlantic Telegraph” of 1858 an optical telegraph or an electrical telegraph?
- Was the Duke of Kent’s telegraph of 1798 an optical telegraph or an electrical telegraph?
- How many wires did Morse’s telegraph need to transmit messages?
- What is a heliograph?
- Was Samuel Morse a Canadian inventor?

In Canada,
the first
electrical
telegraph
was tested in
Toronto in
1846



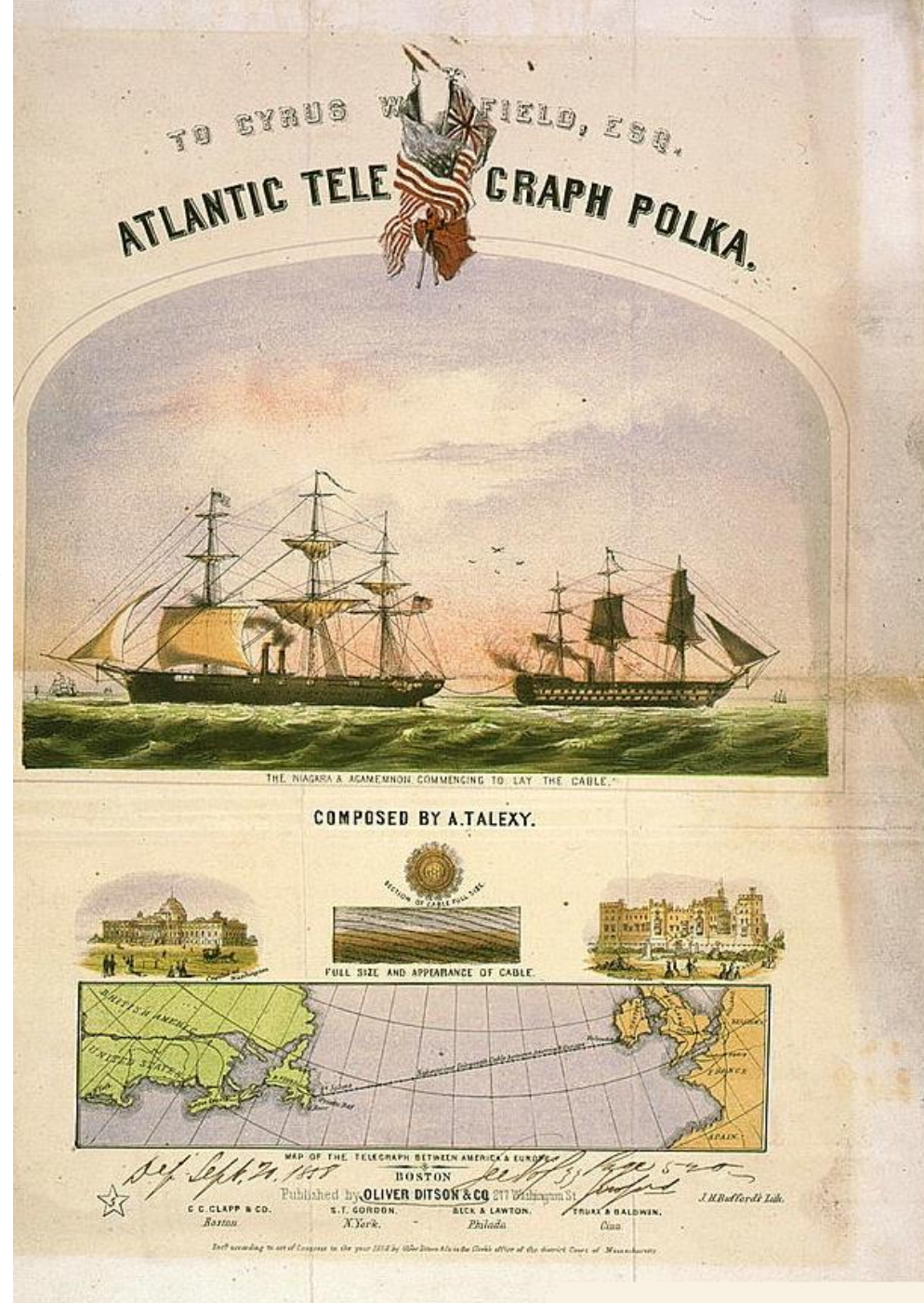
A demonstration on June 24th, 1846, wins over Toronto businessmen who agree to invest in the building of a line connecting Toronto to Buffalo, already linked by telegraph to New York. On December 19th, the line reaches Hamilton. By mid-January 1847, Toronto is linked to Buffalo.

(Cover)

Polka composed
for the laying of
the first
transatlantic cable
in 1858

*

The illustration shows
the ships *Agamemnon*
and *Niagara* beginning
the cable-laying in the
middle of the ocean



Electrical Telegraph in Lytton (BC) in 1865



The *Great Eastern* at anchor in
Heart's Content, NF, in 1866



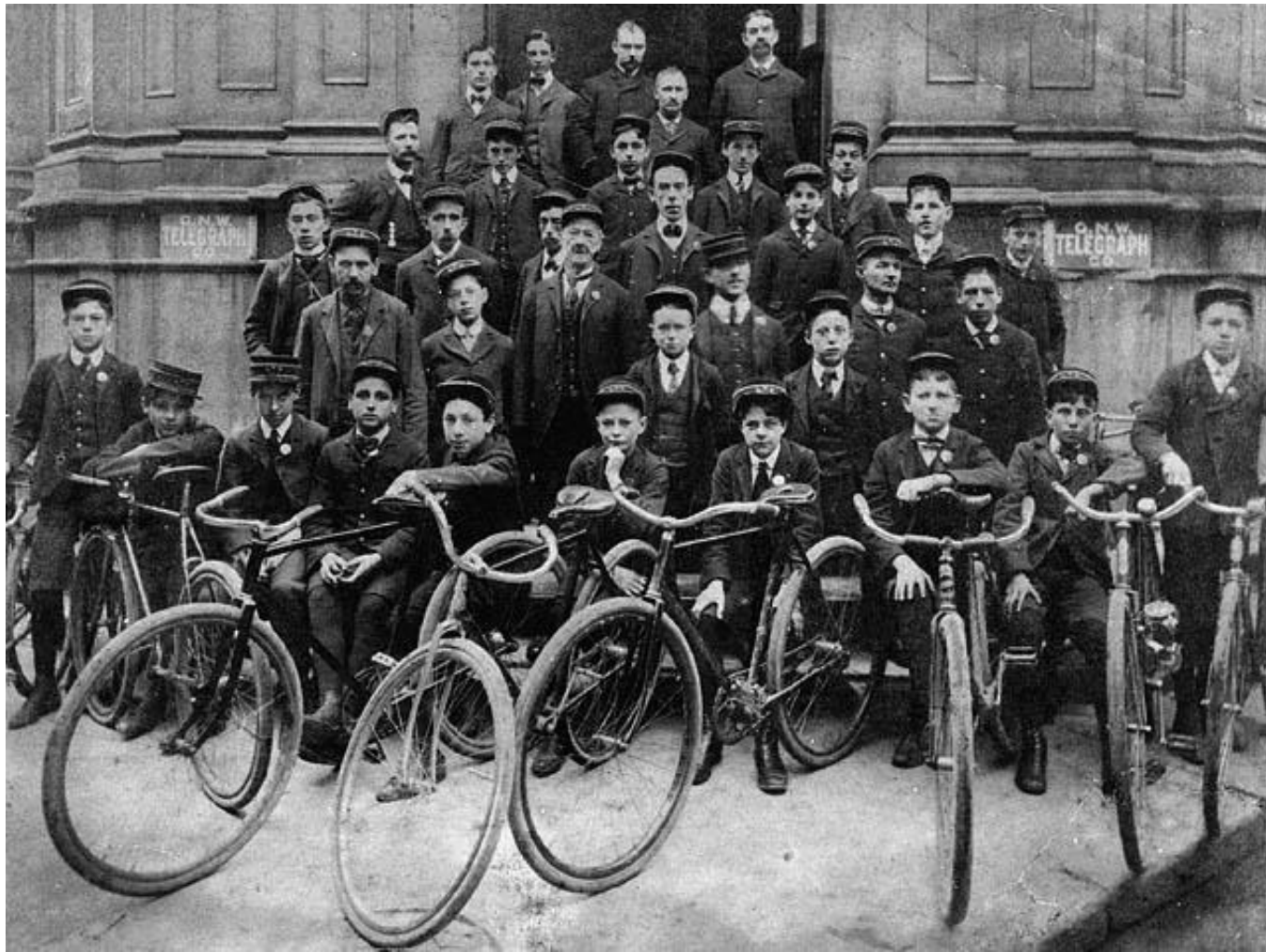


Canadian Troops Following the Telegraph Line near Long Lake (SK) in 1885

Glenbow Archives NA-3205-3



The Messenger Service of the Montreal GNW Telegraph company in 1900

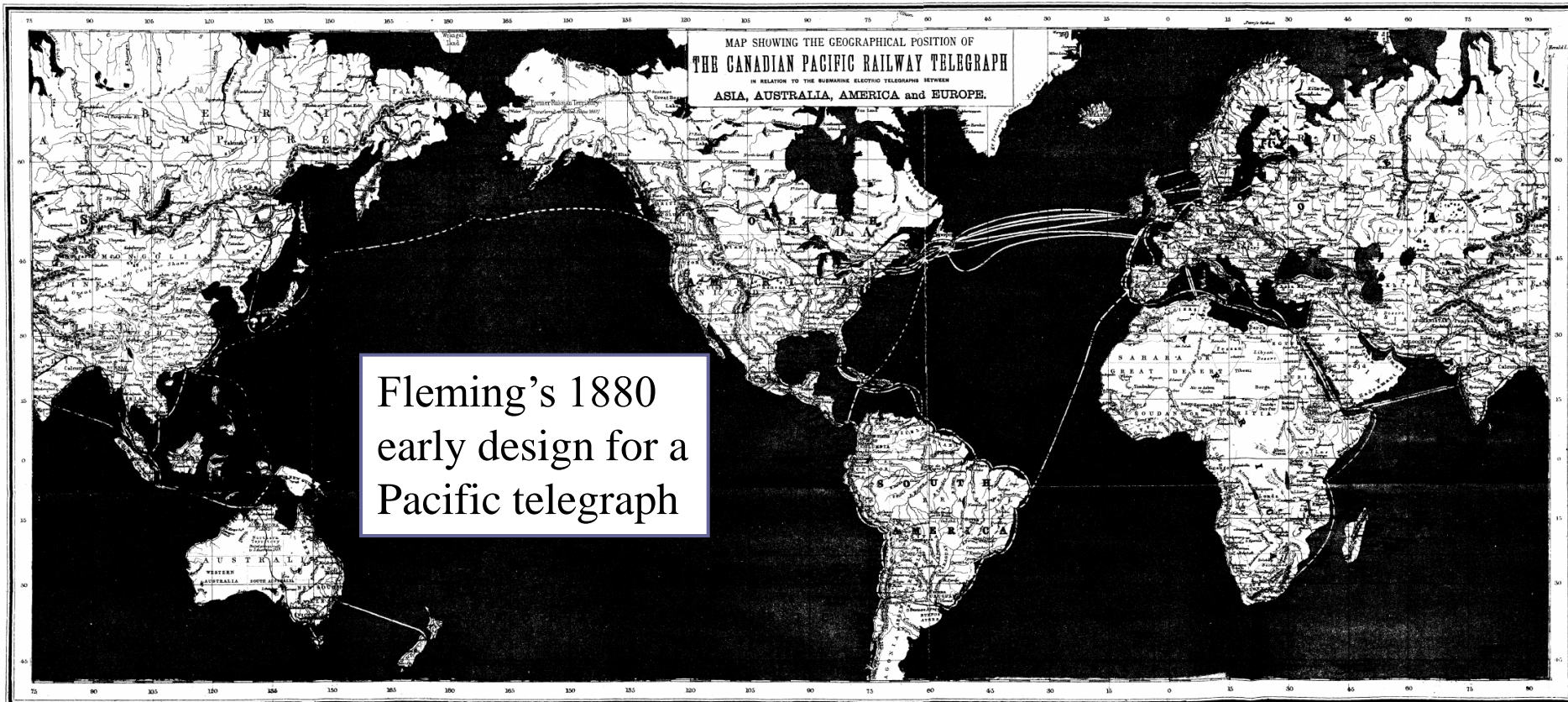


The British Empire's telegraph

- In 1902, Sandford Fleming's final project, a globe-girdling telegraph cable in British hands was created with the completion of the Pacific link between Canada and Australia

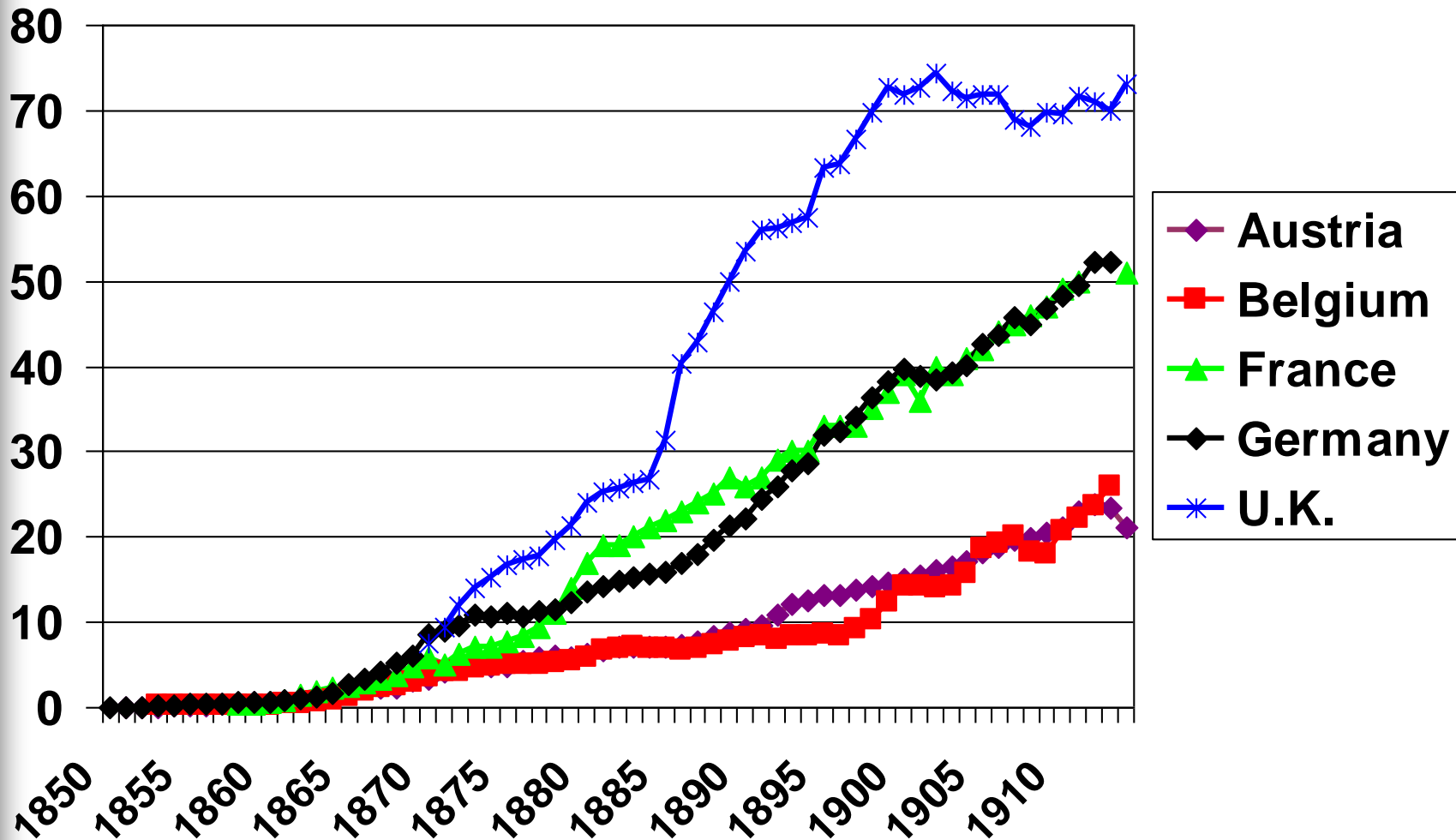
In 1902, Fleming sent two cables to Australia, via London and via Vancouver. An answer to each reached him in Ottawa 8 hours later.

Plate No. 5. To accompany Report of the Engineer-in-Chief, Canadian Pacific Railway, 1880.

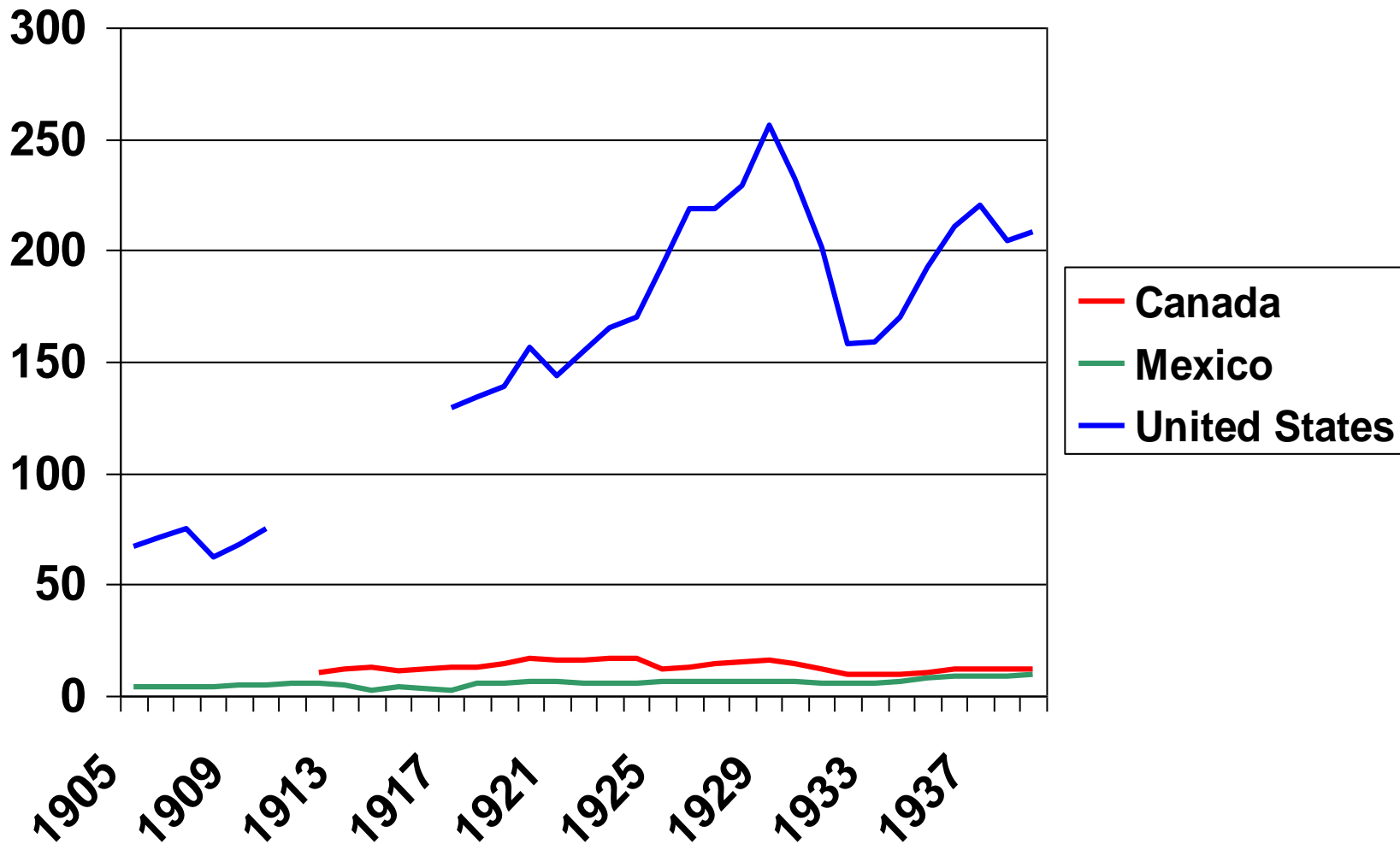


Telegraph traffic in Europe

(telegrams in millions)



Telegraph traffic in North America (telegrams in millions)





To recapitulate (3)

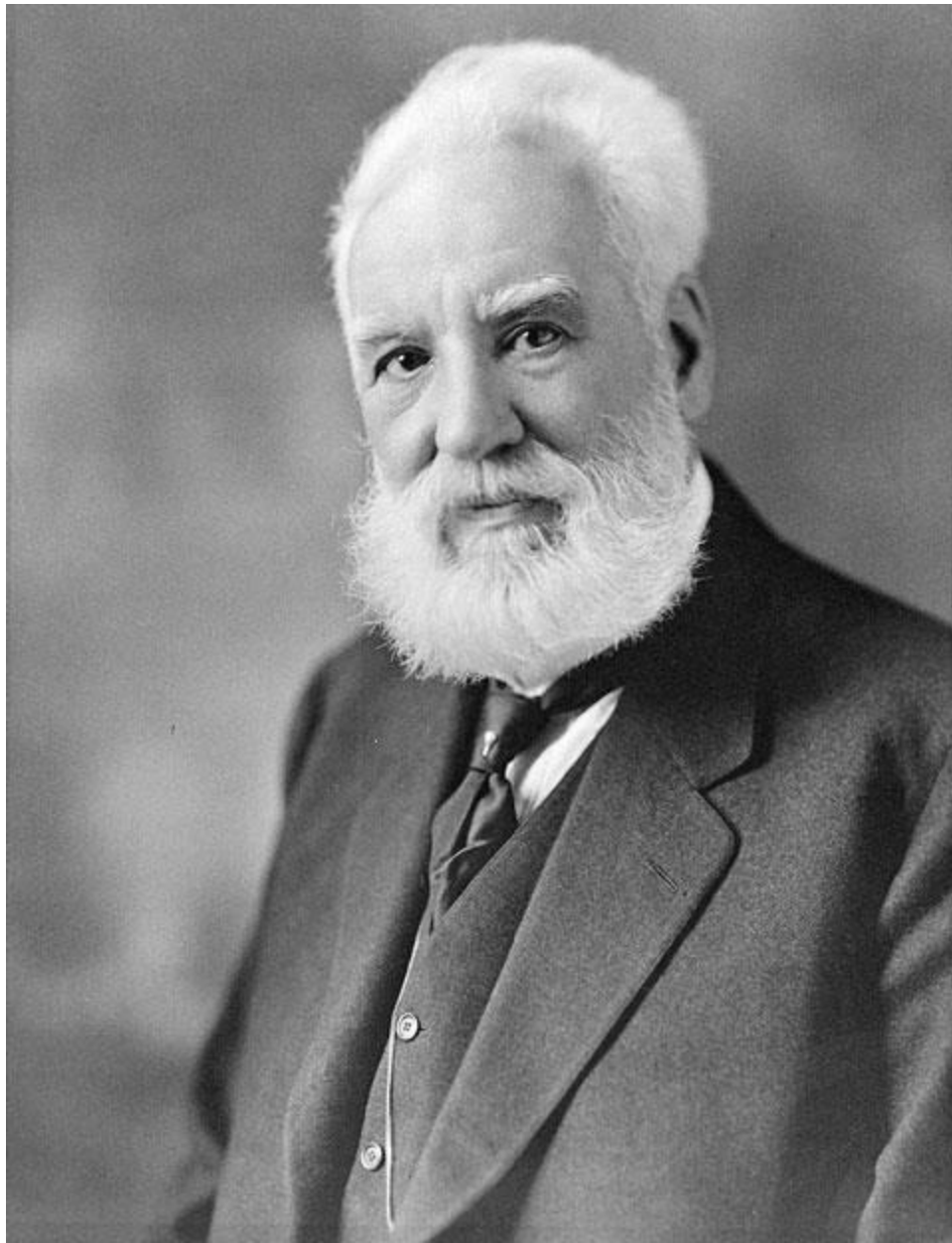
- Which Scottish-Canadian engineer pushed for the completion of a round-the-world, wholly British telegraph line?
- In the late 19th century, was telegraph traffic greater in Germany or in the United Kingdom?
- How long did it take to send a message around the globe in 1902?
- Did Canada's first completed electrical telegraph line start in
 - Lytton, British Columbia?
 - Toronto, Ontario?
 - Heart's Content, Newfoundland?



Phoning Home... and From Home

- The telegraph was great for passing on important information, but it was found in public offices and institutions
- The invention of the telephone brought high-speed communications to the home
- Alexander Graham Bell's invention was expensive at first, but it proved useful, and the telephone network manifested **increasing returns to adoption** in a high degree

Alexander Graham Bell (c. 1914-19)





Inventing the Telephone (1)

- Thirty years after the invention of the electrical telegraph, its limitations had become clear, especially the limited capacity of each wire, able to carry only a few messages at the same time (2 to 4 at most, by Bell's time)
- Several inventors, including Charles Bourseul in France (1854), the German physicist Hermann von Helmholtz (1857), Johann Philip Reis in Friedrichsdorf (*das Telephon*, 1860), the Italian Antonio Meucci (1871) and Elisha Gray in the U.S. (as early as 1872) either developed the principles of telephony or tinkered with rudimentary prototypes

Elisha Gray in the *New York Times*

(July 10, 1874)

MUSIC BY TELEGRAPH.

About two months ago Mr. Elisha Gray, of Chicago, a gentleman well known in the electric telegraph world as a maker and inventor of some of the most valuable instruments now in use, conceived an idea which would be an extraordinary development of telegraphic science if he could only succeed in practically demonstrating it. Short as has been the lapse of time since he first began his experiments, he has succeeded, almost beyond his own anticipations, in perfecting an instrument which will convey sound by electricity over an unbroken current of extraordinary length—that is, without the aid of automatic repeaters. In the ordinary transmission of messages over the telegraph wires to points at long distances, a message is generally repeated by automatic-working instruments about every 500 miles, in order to renew the current of electricity. Mr. Gray has already transmitted sounds, which are distinctly audible at the receiving point over an unbroken circuit of 2,400 miles. This is, more properly speaking, a discovery—not an invention. The invention merely consists in adapting certain appliances to the discovery for the purposes of its practical illustration. It is one of the greatest discoveries made since the early days of Morse.

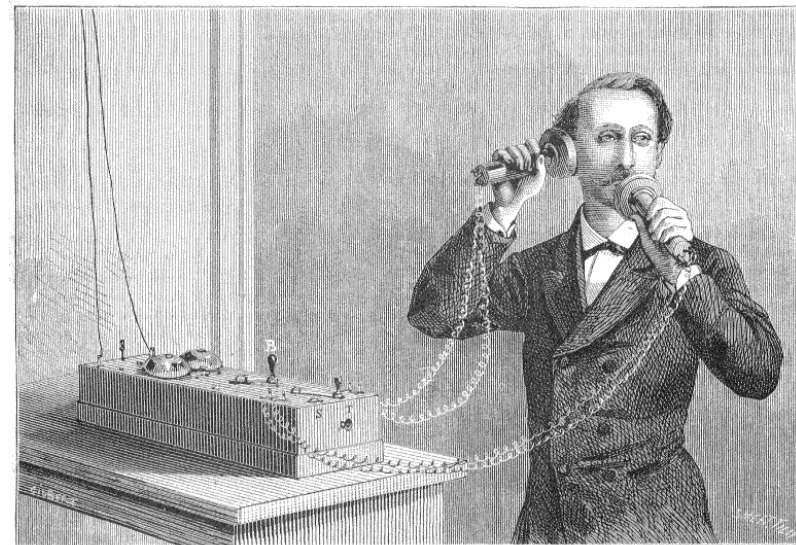
Such noted electricians as Mr. George Prescott say this discovery of Mr. Gray only goes to prove, what all electricians have long agreed upon, that we know little at present of the possibilities of the future of electric science. Mr. Chandler says that he regards it as the first step toward doing away with manipulating instruments altogether, and that he believes that in time the operators will transmit the sound of their own voice over the wires, and talk with one another instead of telegraphing. The writer has seen this novel instrument at work, and has heard music played on a small melodeon, or piano key-board, transmitted through an unbroken circuit of 2,400 miles, and reproduced on a violin attached to the receiving end of the wire. Mr. Gray played "Hail Columbia," "The Star Spangled Banner," "God Save the Queen," "Yankee Doodle," and other well-known airs, and they were unmistakably repeated, note for note, on the violin which lay on a table near at hand. Even an accidental false note was immediately detected on the violin. Mr. Gray exhibited many other experiments with tin cans, small paper drums, &c., which were attached to the receiving end of the wire in the place of the violin. The paper drum gave to the musical sounds just that peculiar buzzing twang which is produced by boys placing a piece of thin paper over a hair comb and then blowing on it. What this will all lead to, or where it will all end, is one of the most extraordinary problems of the day.

The apparatus, by means of which this extraordinary feat in telegraphy is accomplished has been named by Mr. Gray the telephone, or, an instrument designed for the purpose of transmitting sound to a distance. It consists of three general

Inventing the Telephone (2)

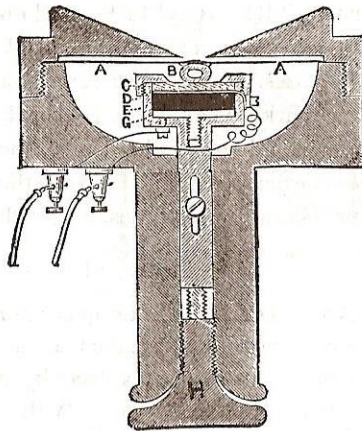
- The telephone would not improve the carrying capacity, but it let people communicate without going through an operator able to use Morse code and to work the machine; nor was it necessary to stick to short messages
- Bell and his contemporaries were set on improving the telegraph, to increase the number of messages carried at once, to take advantage of its **installed base**

A. G. Bell's telephone being tested in Paris over a distance of 15 km, as pictured in *La Nature* on February 2nd, 1878.

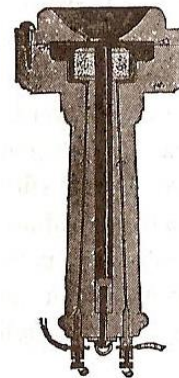


Bell's Breakthrough (1)

- The ability to transmit several messages using distinct frequencies was the key to both voice and music transmission
- Long interested by acoustics, Bell solved the technical difficulties posed by the conversion of the human voice into current variations and the inverse conversion of the electric impulses into an audible and intelligible signal



735. TELEPHONE TRANSMITTER.—A, A, thin iron diaphragm ; B, india rubber in contact with diaphragm and the ivory disc, C ; D, platinum foil between the ivory disc, C, and the carbon disc, E ; G, disc and screw for adjustment of carbon contact ; H, adjusting screw for diaphragm contact.



736. TELEPHONE RECEIVER.—A central magnet, with a coil of fine insulated wire around the end, next the vibrating plate or diaphragm. The variations in the electrical current produce variations in the intensity of the magnet, which set up vibrations of sound in the iron diaphragm.

The Canadian Connection



↑ Bell family home in Brantford, ON

Dominion Telegraph offices in Paris, ON:
receipt of long-distance call in August 1876



Bell's Breakthrough (2)

Figures from the patent granted in Canada on August 22, 1877:

Fig. 1. Perspective view
D: Sounding box
E: Speaking tube

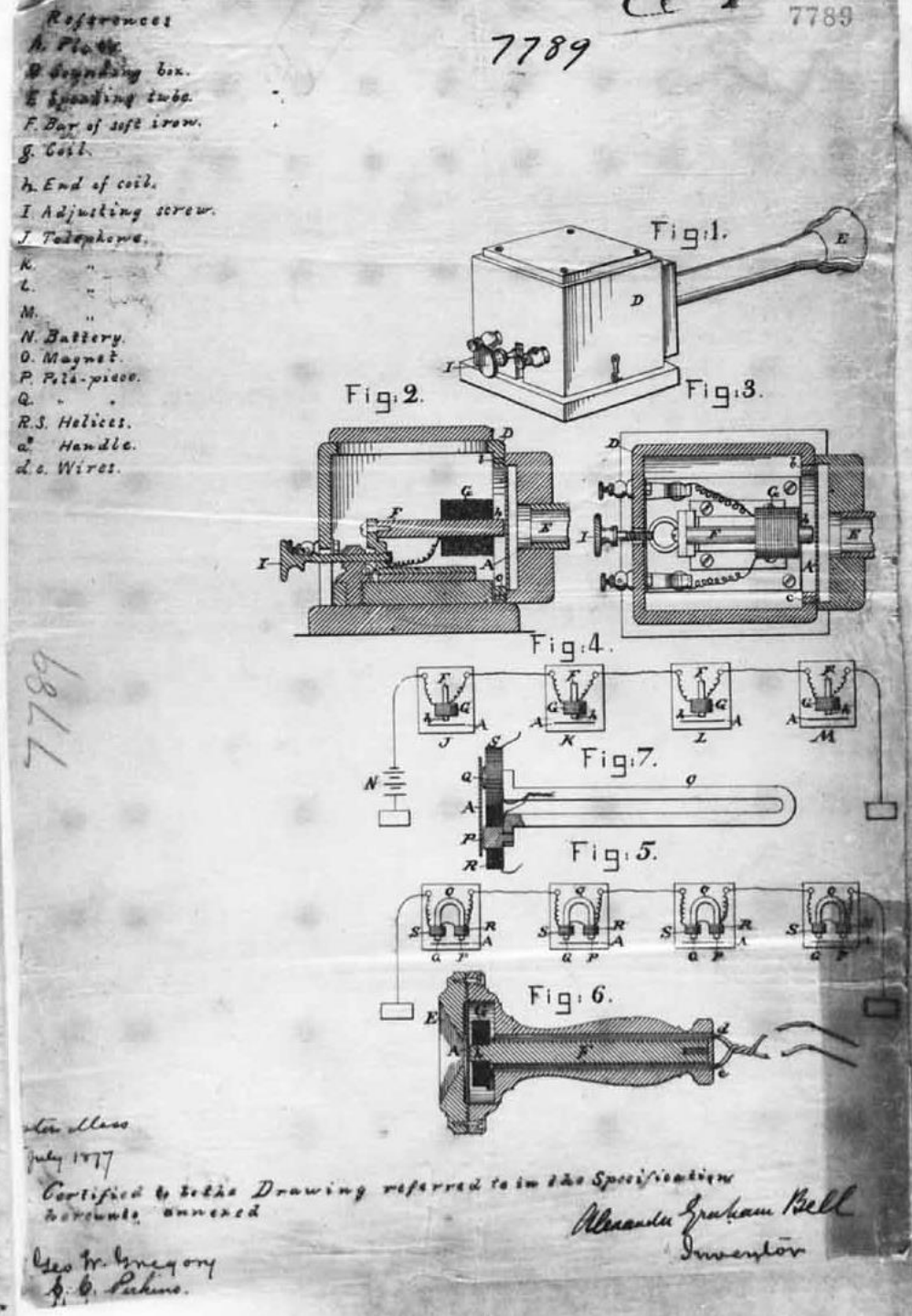
Fig. 2. Vertical section

Fig. 3. Horizontal section

Fig. 4. Diagram of four telephones in a circuit with a battery (**Fig. 5** w/o battery)

Fig. 6. Section of transmitter

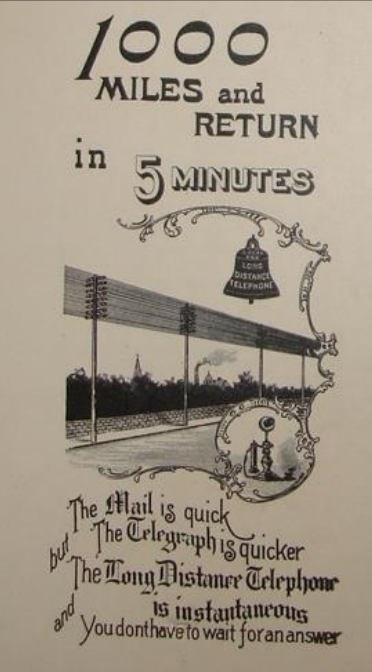
Fig. 7. Electro-magnet



Bell's Breakthrough (3)

- Bell left the commercial use of the telephone to others (including his father-in-law) and pursued a career as a wealthy inventor
- As Western Union refused to buy the rights and then failed to champion Gray's rights, the Bell company enjoyed a full monopoly and took full advantage
- After the original patents lapsed, it was able to regain its predominance by investing in long-distance calling

Early phone use



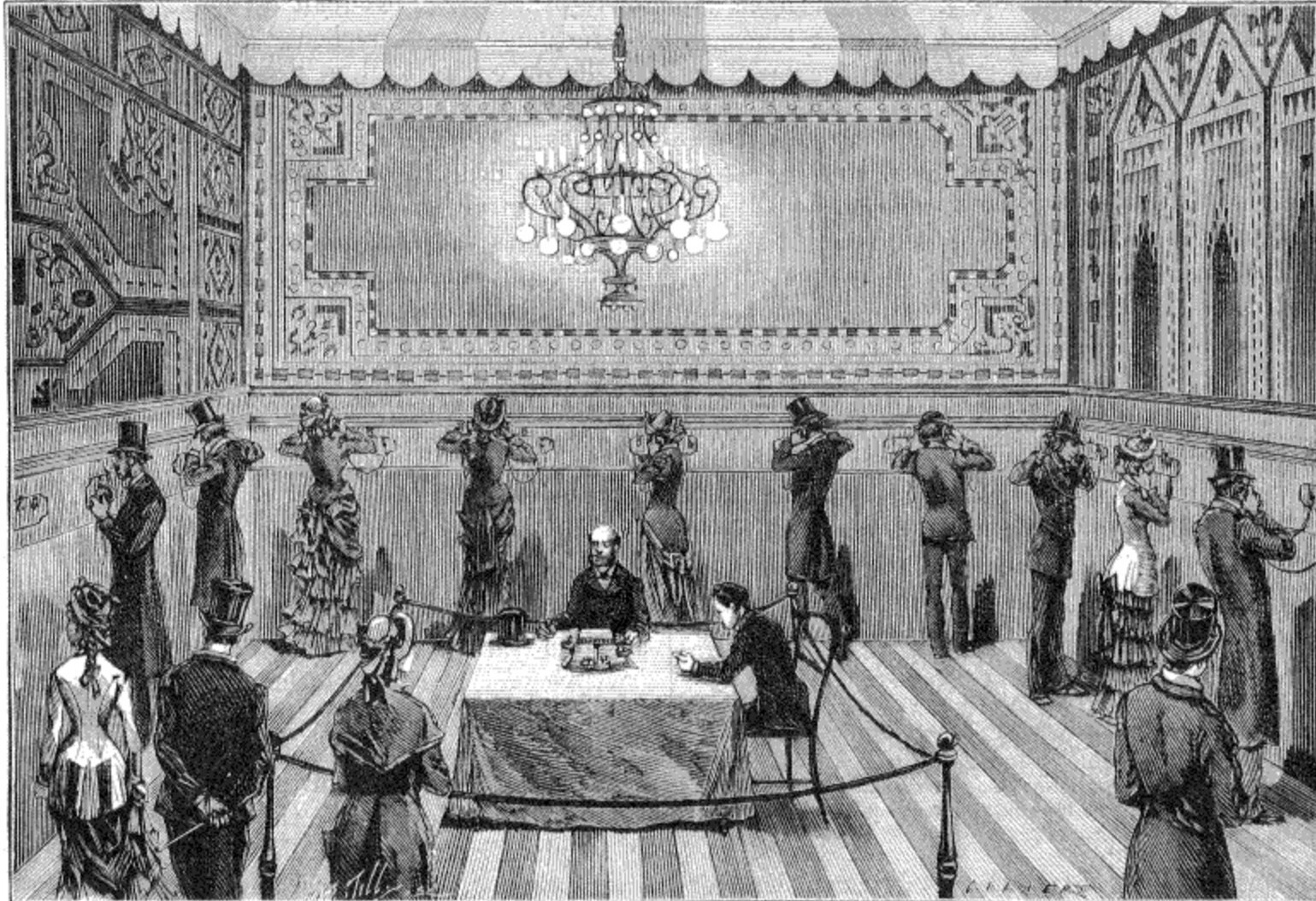
A manikin illustrating the work of an early operator



A three-box telephone, with the electronics in the top compartment, batteries in the bottom, and the transmitter in the middle.

Telephone Broadcasting (1881)

Visitors at an electricity exhibit in Paris listen to opera over the phone (plays had been an option at first, but opera prevailed)



La Nature, September 24, 1881

The Ethereal Telephone (1)

- Even Thomas Watson was inclined at first to treat the telephone as something almost occult



Postcard, c. 1905

The Ethereal Telephone (2)

Postcard series,
c. 1905



PLEASE, MISS, GIVE ME HEAVEN.

"Papa, I'm so sad and lonely," sobbed a tearful little child,
"Since dear Mamma's gone to heaven, Papa, you've not smiled;
I will speak to her, and tell her that we want her to come home;
Just you listen, and I'll call her through the telephone."

By kind permission of CHAS. K. HARRIS. COPYRIGHT.



PLEASE, MISS, GIVE ME HEAVEN.

"If you please, Miss, give me Heaven, for my Mamma's there,
You will find her with the Angels on the golden stair;
She'll be glad it's me who's speaking, call her, won't you, please?
For I want to surely tell her we're so lonely here.

By kind permission of CHAS. K. HARRIS. COPYRIGHT.



IF YOU PLEASE, MISS, GIVE ME HEAVEN.

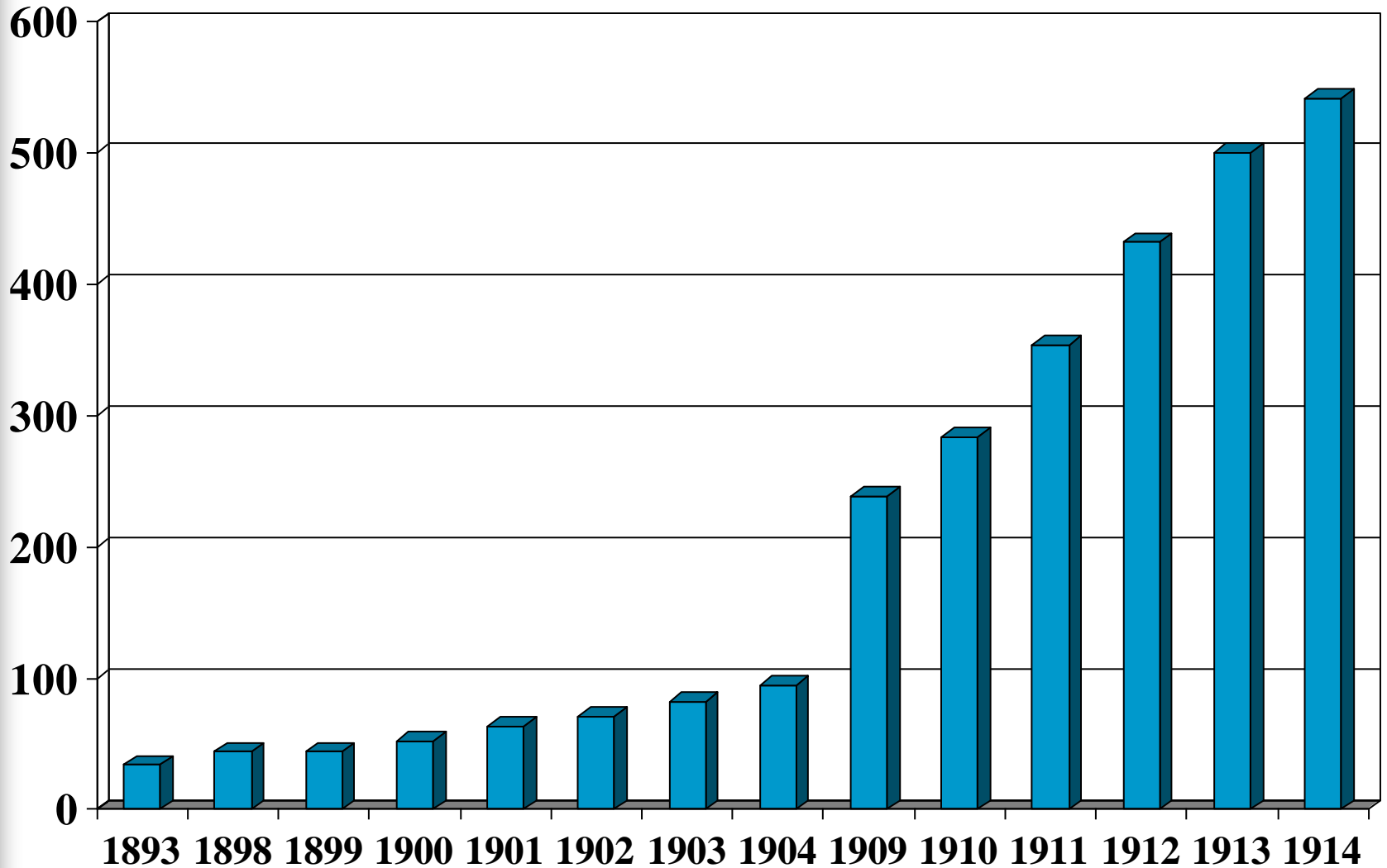
When the girl received this message
Coming o'er the telephone,
How her heart thrilled in that moment,
And the wires seemed to moan;
I will answer, just to please her,
Yes, dear heart, I'll soon come home;
Kiss me, Mamma, kiss your darling,
Through the telephone.

By kind permission of CHAS. K. HARRIS. COPYRIGHT.

(The postcards illustrate a song originally known as "Hello Central, Give me Heaven", by Charles K. Harris of Milwaukee, c. 1900)

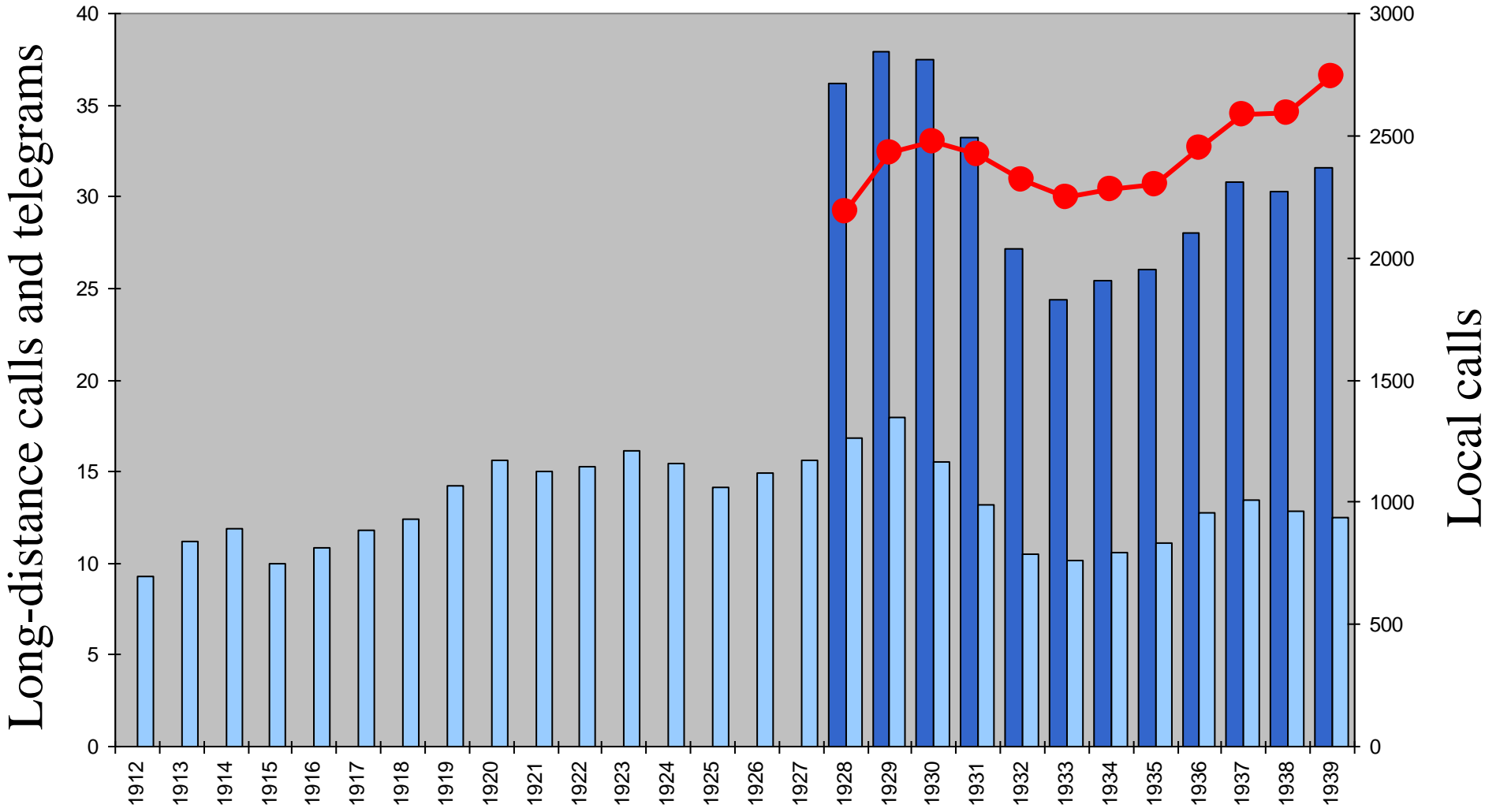
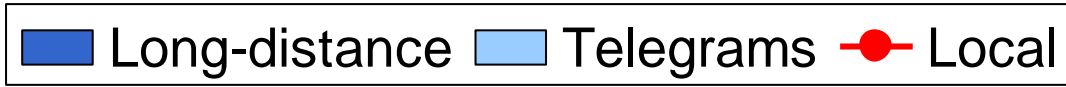
Telephones in Canada (1893-1914)

(thousands of units, with gaps in the data)



Phone Conversations and Telegrams

(in millions, Canadian historical statistics)





To recapitulate (4)

- Was Alexander Graham Bell the first inventor to work on the telephone's invention?
- What is meant by the "installed base" of the electrical telegraph?
- In what year did the number of telephones in Canada reach the half-million mark?
- Once the original patents lapsed, what was the Bell company's way of regaining market dominance?
 - developing automatic dialling, or
 - offering long-distance calls



Electrical Systems: A New Age of Power

- Waterpower use by mills and factories had made the North American countryside into an industrial powerhouse
- In the eastern United States, many sites took advantage of the swiftly flowing rivers along the Appalachian watershed
- As in the eastern U.S., the Chaudière rapids in Ottawa were a focus of early industrialisation using waterpower
- Later, the same site hosted the region's first hydroelectric plant



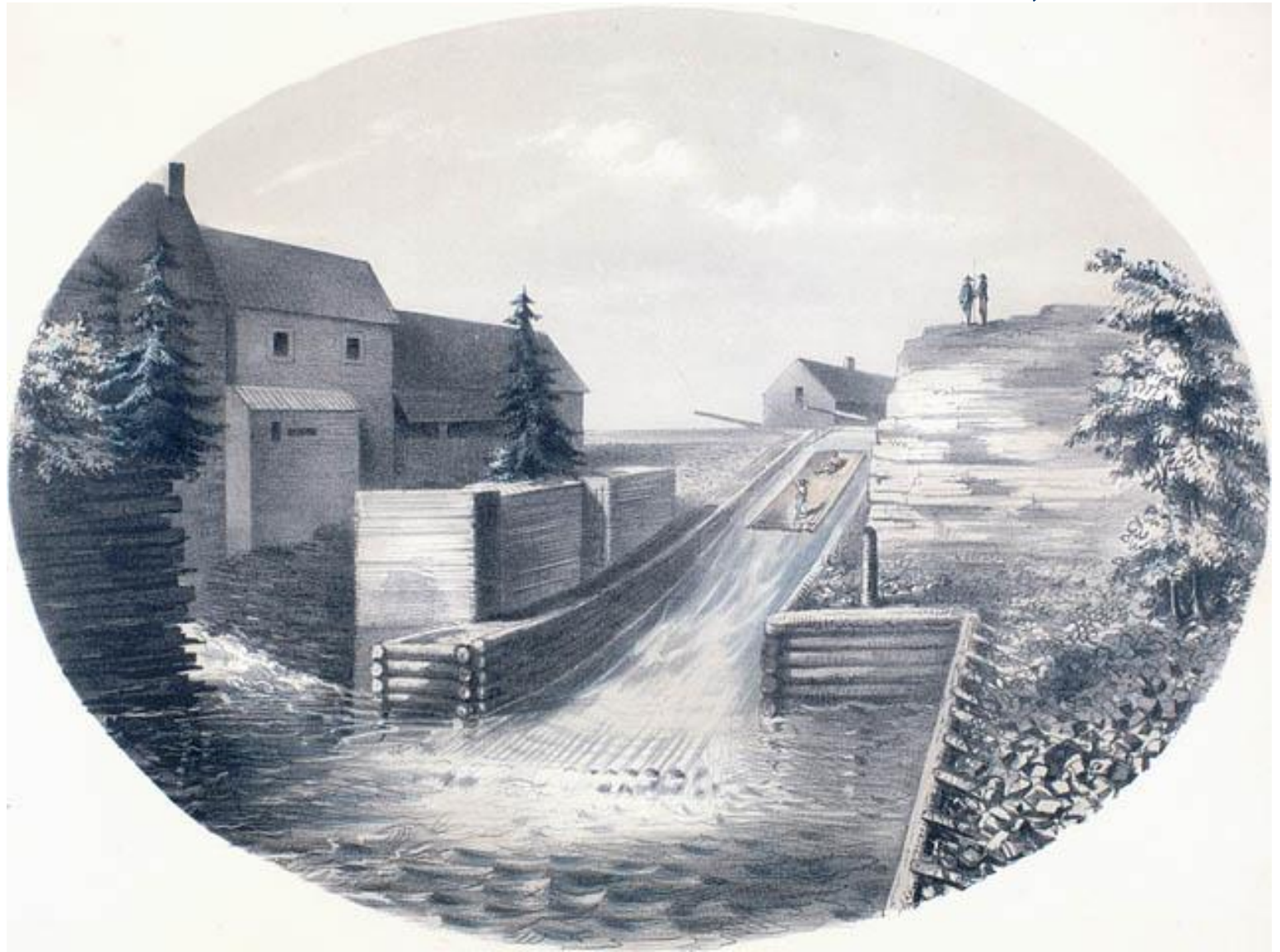
The Case of the Chaudière Falls

- The rapids had long been a bottleneck, forcing fur traders and other travellers to *portage* around them
- If logs were to come down in reasonable shape from the upper Ottawa Valley, they would have to be shepherded around the rapids; a timber slide was built to this end
- However, the early settlers also minded the waterpower potential of the Chaudière Falls, building a small sawmill in 1806
- This sawmill became the core of a cluster of early industries

Bytown Timber Slide, with raft (around 1851, by Alice M. Fulford)



Ottawa Timber Slide (1855, by William Stewart Hunter Jr.)



Chaudière Island development in 1875 (1)

William James Topley (1845-1930),
Library and Archives Canada,
C-002225

A. H. BALDWIN,
Wholesale and Retail Lumber Dealer,

PLANING MILL, CHAUDIERE ISLAND.

OFFICE: VICTORIA ISLAND.

OTTAWA

PHOTOGRAPHER,

WM. J. TOPLEY,



JOSEPH METCALFE,
WHOLESALE READY-MADE CLOTHING,
SPARKS STREET, OTTAWA.

Lumber Planed, Tongued & Grooved,
MATCHED OR SPLIT,
MOULDINGS PREPARED TO ANY PATTERN WHICH THE TRADE USES,
BATTENS & FURRING CUT TO ORDER.

J. S. WHITLOCK, FOSTER, MASS.

Chaudière Island development in 1875 (2)

William James Topley (1845-1930),
Library and Archives Canada,
C-002220

WILLIAM QUEALE,
Lumber Dealer and Commission Merchant,
CORNER SLATER AND SALLY STREETS,
OTTAWA, Ontario.

All kinds of BUILDING MATERIAL Constantly on Hand in Quantities as Required.
Hardwood of all kinds a Specialty.

Lumber of all kinds Bought and Sold on Commission. Classifying Lumber properly attended to suit the different markets.



HICK'S HOTEL.

(LATE LEWIS HOUSE)

PERTH, - - - - - ONTARIO,

WILLIAM HICKS, - - - - - Proprietor

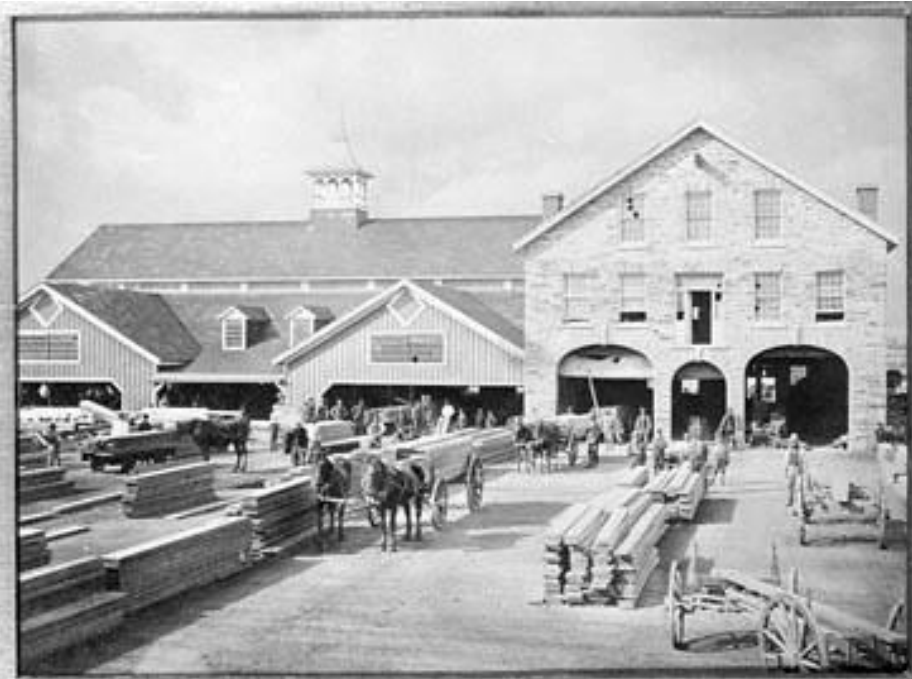
This Room has all been re-fitted and newly furnished, and offers superior accommodation to Guests and at reasonable charges.

Guests Conveyed Free to and from the Cars.

Chaudière Island development (c. 1890)

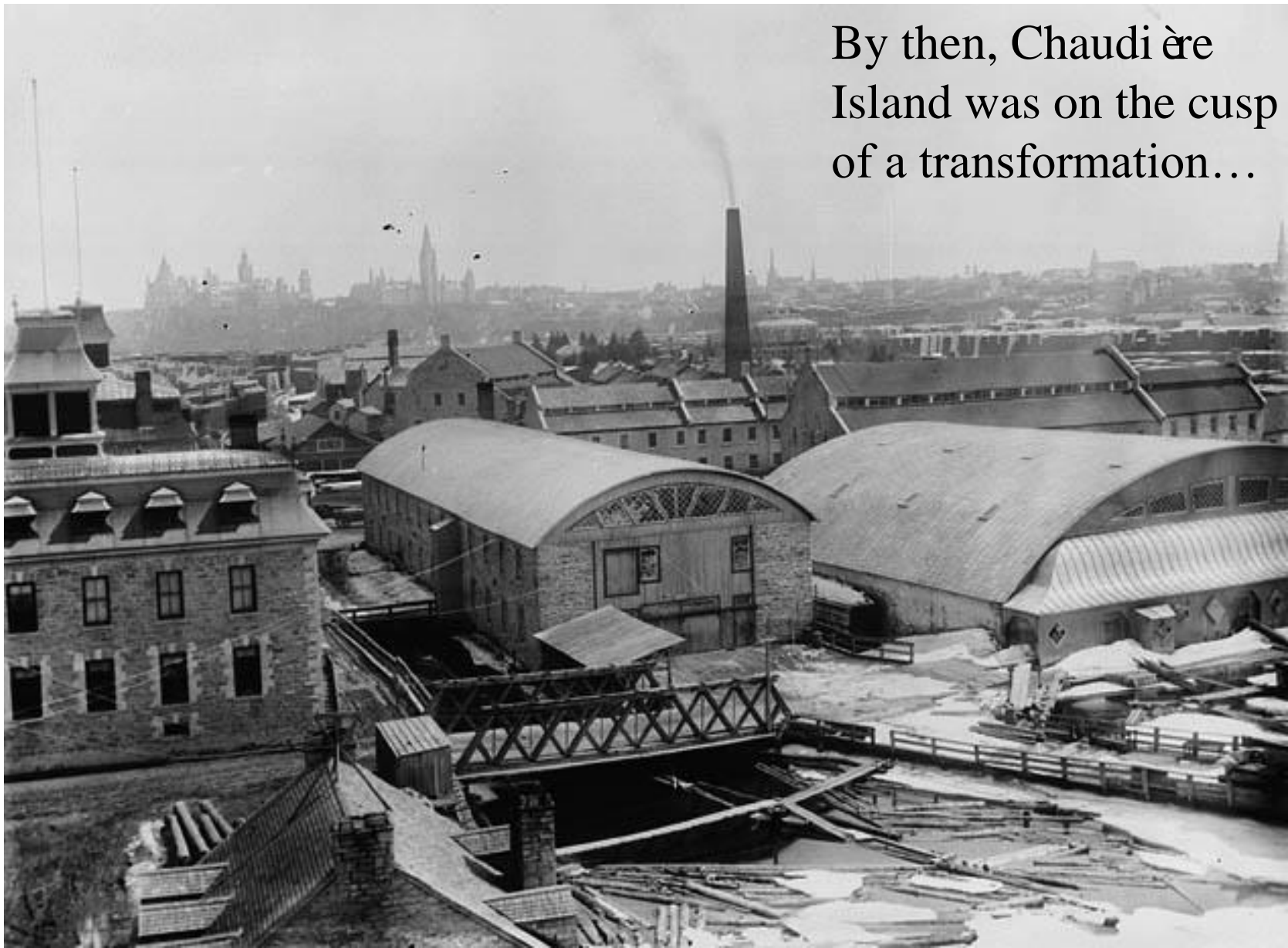
Front and back views of Perley and Pattee's Sawmill by the Chaudière Falls. The mill dated back to 1856.

Notman, Library and Archives Canada, C-000020



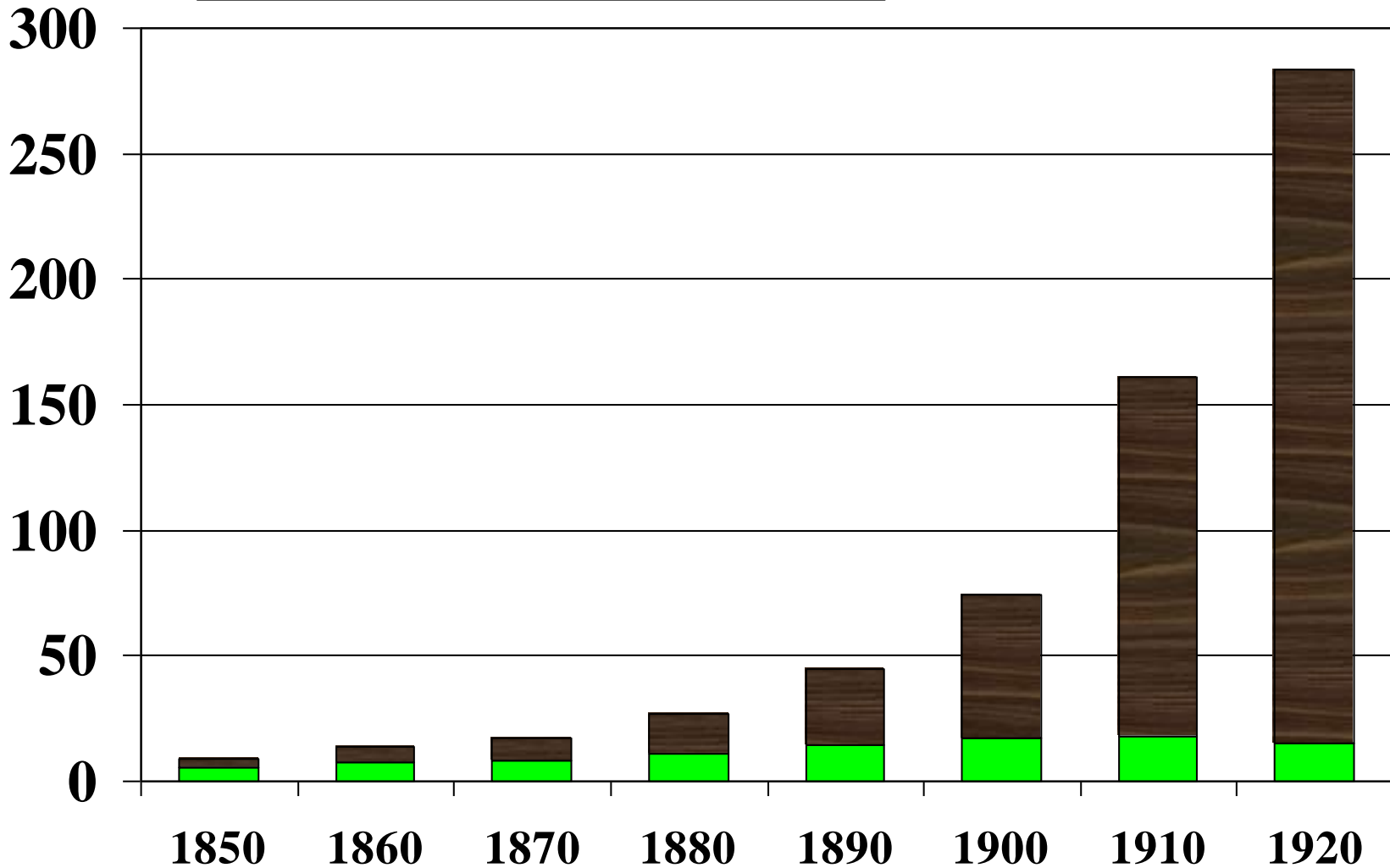
Bridge Street (October 1890)

By then, Chaudière Island was on the cusp of a transformation...



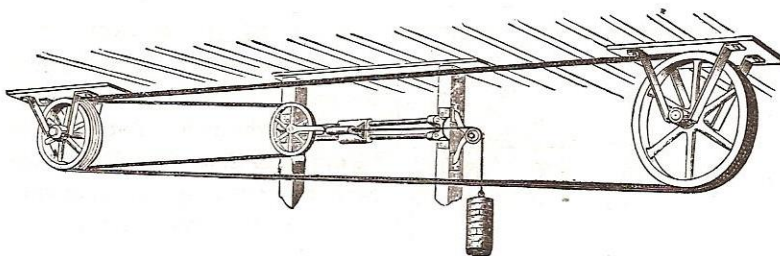
Estimated Mechanical Work Output (U.S., 1850-1920, billions of horsepower-hours)

From animals Inanimate sources

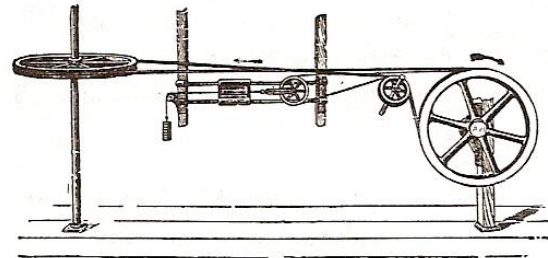


The Wired Age (1)

- Even more than today, the electric era relied on power lines and live wires
- As electricity became available for more than lighting, it transformed the industrial workplace, replacing water and steam power—as well as belts and shafts



61. HORIZONTAL ROPE TRANSMISSION, with tension slide and weight.



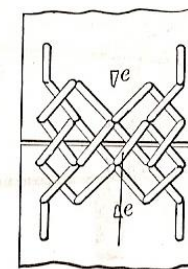
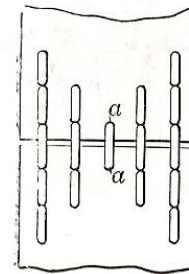
62. ROPE TRANSMISSION from vertical to horizontal shaft, with tension slide and weight.

A London (ON) garment factory around 1910

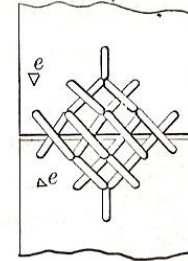
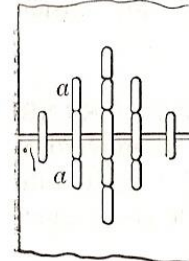


The Art of Belts

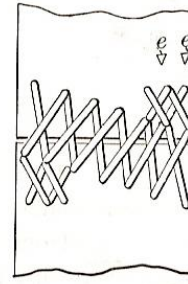
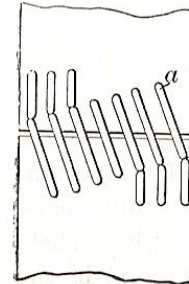
- Even the stitching (or lacing) of belts was a topic worthy of attention in technical manuals of the early 20th century



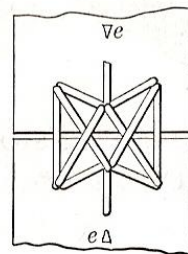
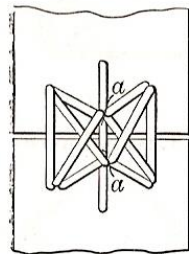
65-66. BELT LACING.—The straight lacing 65 should run next the pulley, while 66 represents the outside of the belt. Lace should be drawn in at *a, a*, to centre; lace each way out and return, ending at *e, e*, 66, on outside of belt.



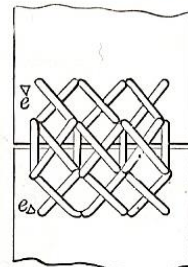
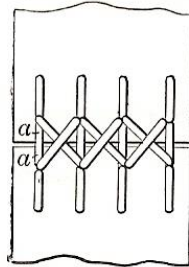
67-68. BELT LACING.—In this style the straight side should run next the pulley, drawing in the lace on one side at *a, a* to its centre, and lace across and back, ending at *e, e* on the outside of 68.



69-70. NOVEL BELT LACING, for quarter-turn belts. Draw lacing in to its centre at *a, a* on inside of belt, crossing on outside of 70, and ending at *e, e*, 70.



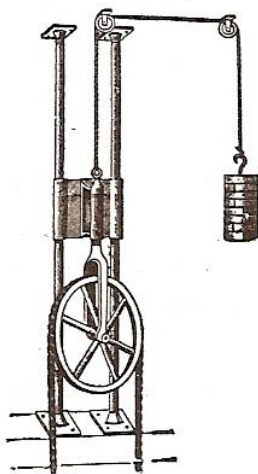
71-72. BELT LACING, for narrow belts. Draw in the lacing at *a, a* to its centre; lace each way and back to centre, ending on the outside of belt at *e, e*, 72.



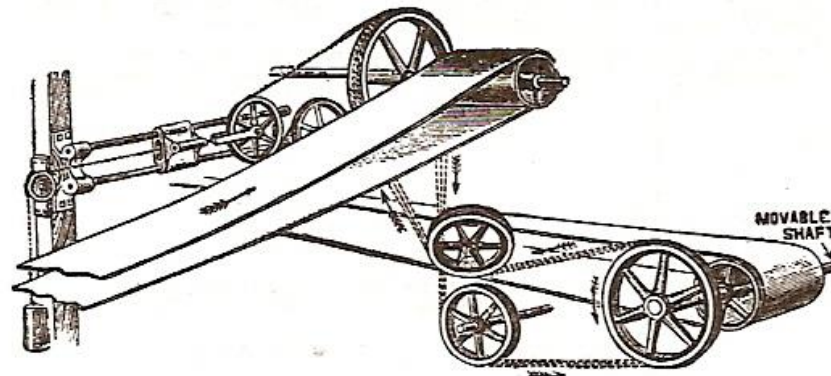
73-74. BELT LACING, for medium width belts. Commencing at *a, a* on the inside of belt 73, drawing the lacing to its centre; rove each end once across, ending at the outside of belt 74 at *e, e*.

The Wired Age (2)

- Factories once dominated by belts and shafts transferring mechanical energy within narrow and gloomy confines were converted into much vaster installations lighted and powered by electricity



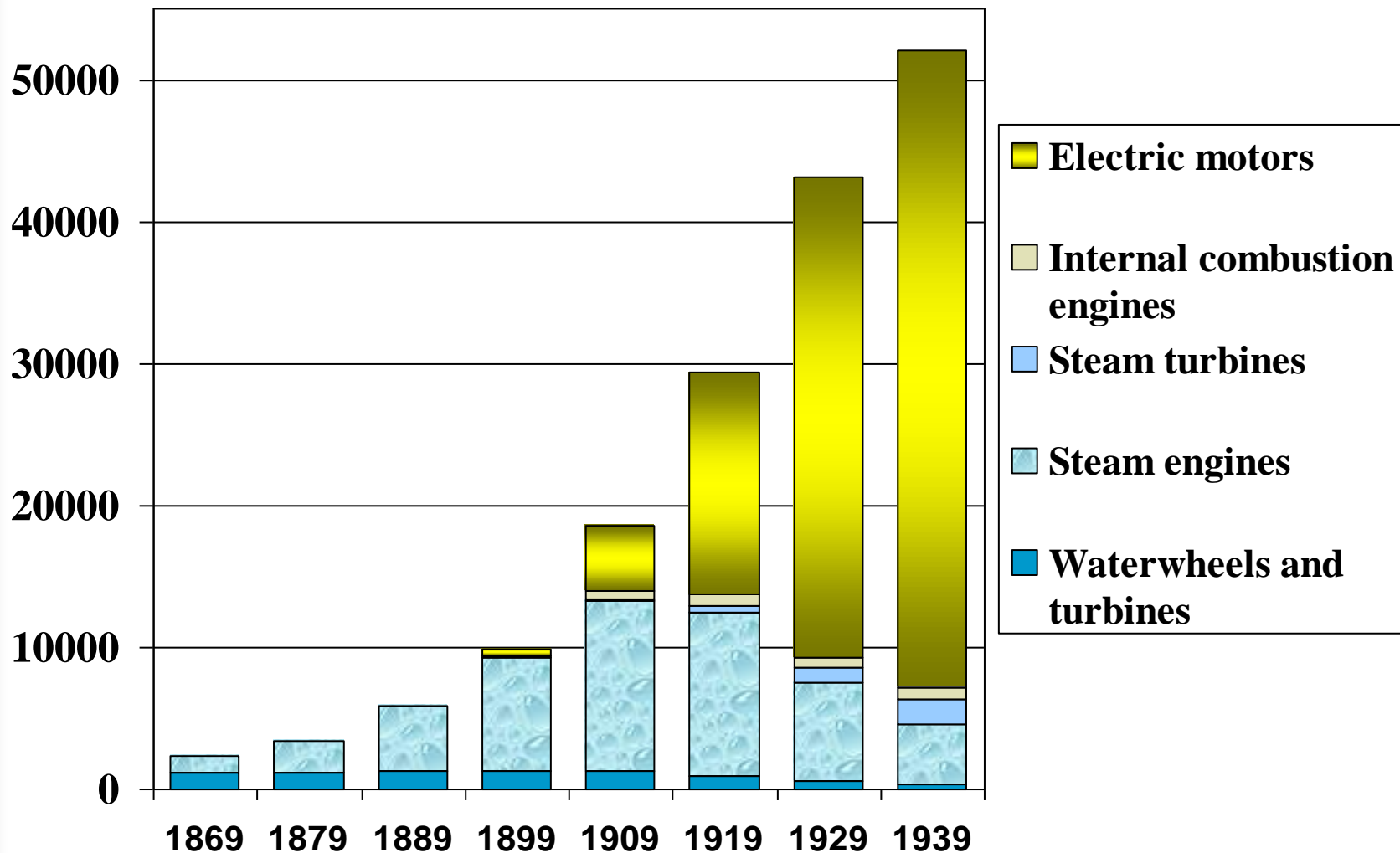
64. VERTICAL TENSION CARRIAGE
with slides and pulley guide.



63. ROPE TRANSMISSION to a movable shaft at right angles from the driving-shaft, with tension slide and weight.

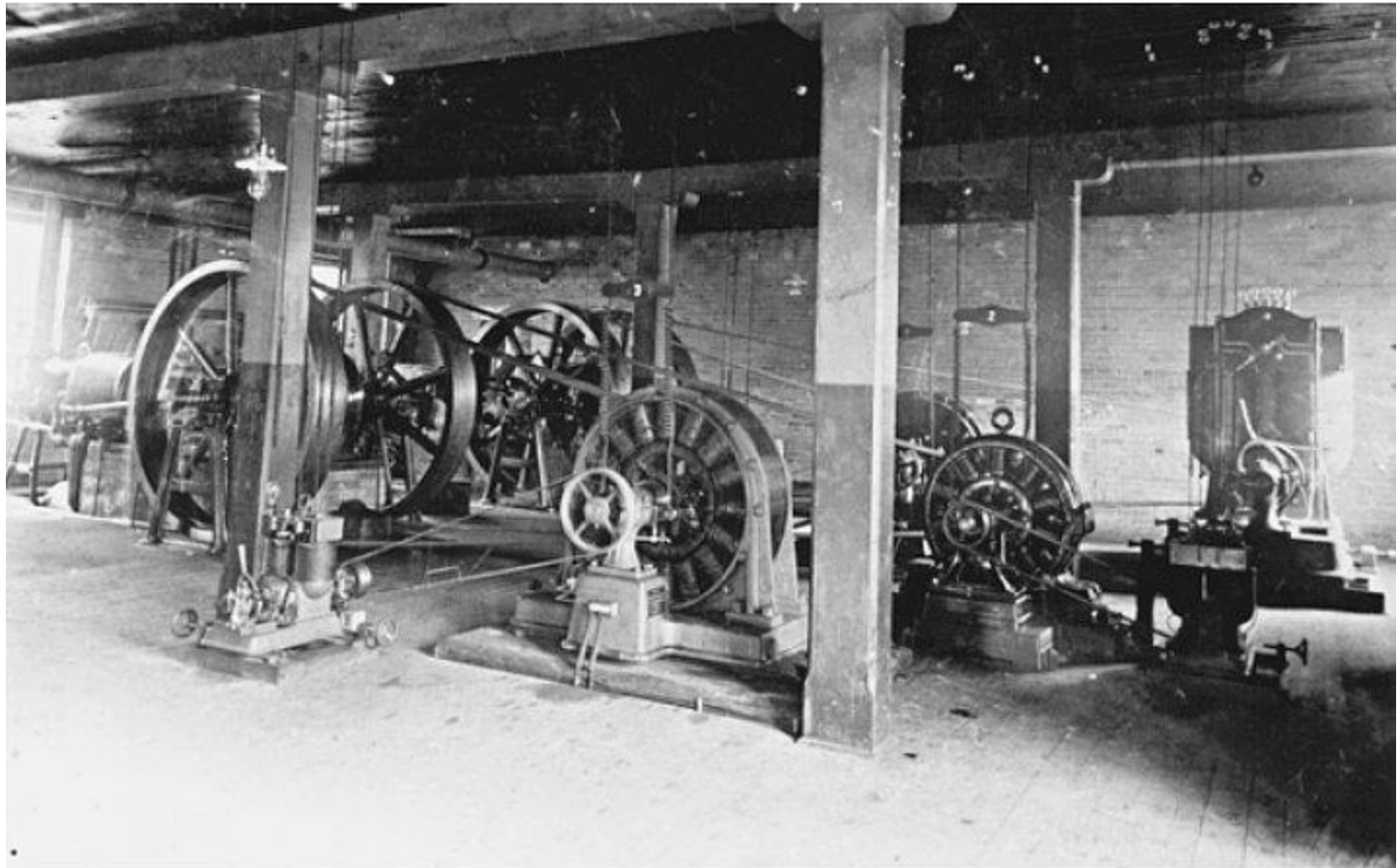
Source of Mechanical Drive in U.S. Manufacturing Establishments

(capacity in thousand horsepower)



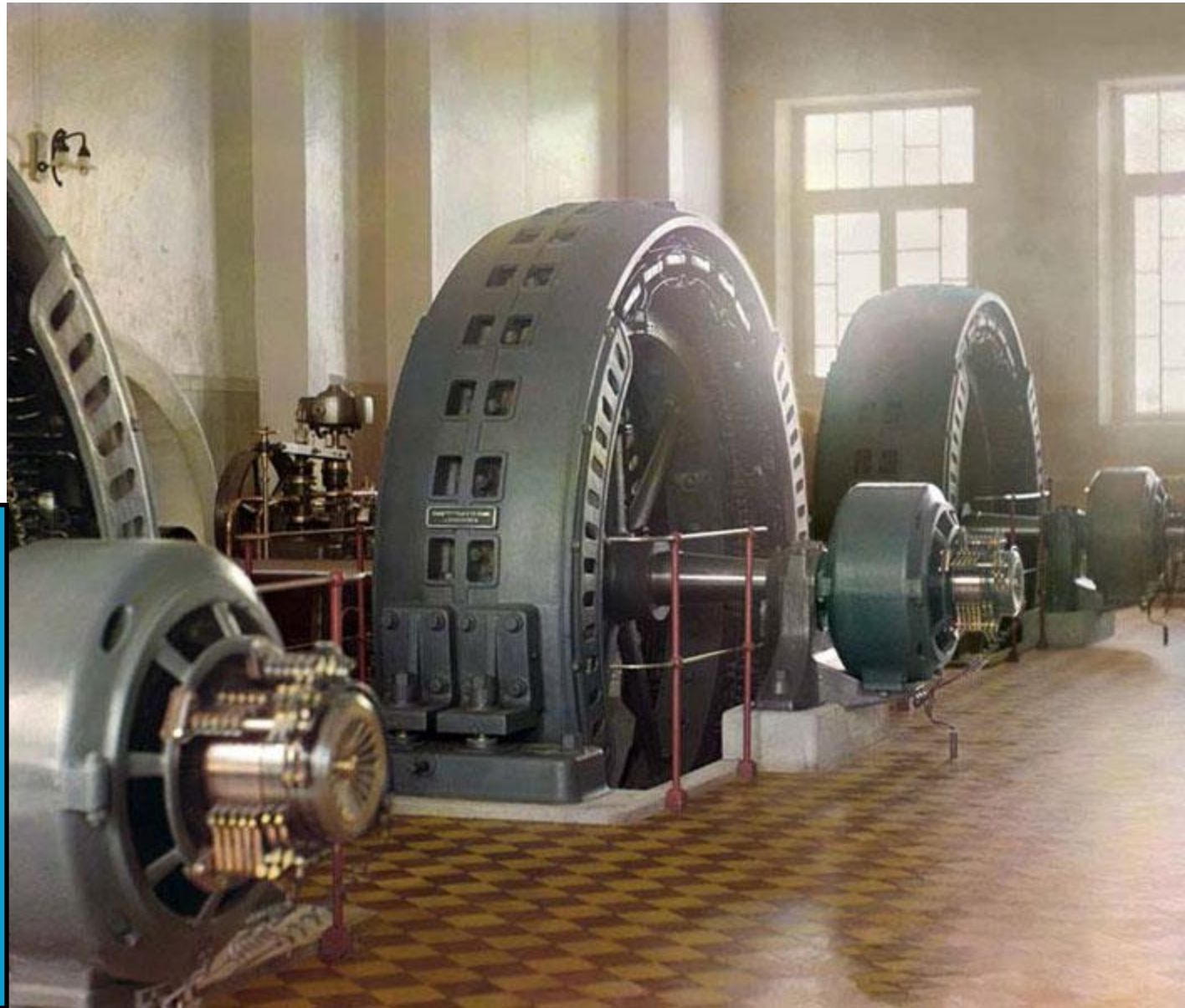
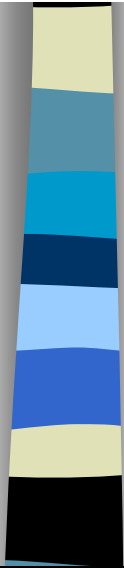
An early Ontario powerplant

Steam engines are run to drive generators, incidentally powering the plant's electric lights.



(Late 19th century)

Budapest-built generators in Russia (c. 1910)



Picture produced from plates taken by Sergei M. Prokudin-Gorskii (1863-1944) through three colour filters. His pictures of pre-WWI Russia were taken between 1907 and 1915, and exhibited in road shows.

John Inglis Bren gun assembly plant in Toronto (May 1941)



WRM-769



To recapitulate (5)

- What was the first use of Chaudière Island's waterpower potential?
- In what decade was most mechanical work in the U.S. supplied for the first time by inanimate sources?
- In what decade did electricity become the main source of mechanical drive in U.S. manufacturing sources?
- How did engineers drive early electrical generators built to provide electricity for lighting?

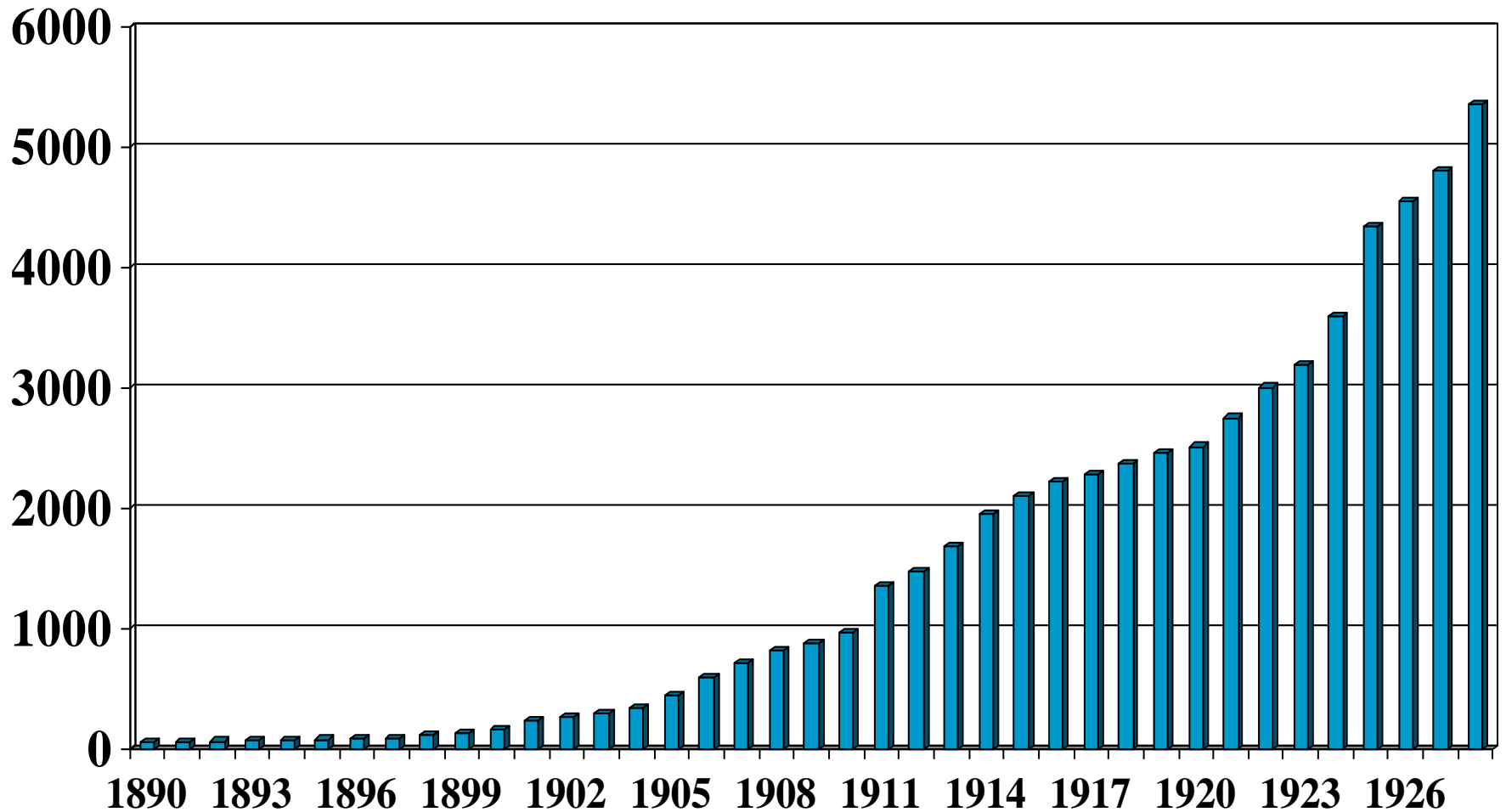


Electricity Meets Waterpower (1)

- Waterpower had long been used as a source of mechanical force
- By the 1850s, vertical-axis turbines attained efficiencies of 60-70%
- In 1882, the world's first known hydroelectric power plant started operating in Appleton, Wisconsin (inspired by Edison's New York plant and using Edison technology)
- The conversion to AC allowed power to be transmitted over longer distances and sparked a boom in the construction of hydroelectric power plants

Canadian Hydraulic Turbine Installations (thousands of HP)

■ Turbines (kHP)



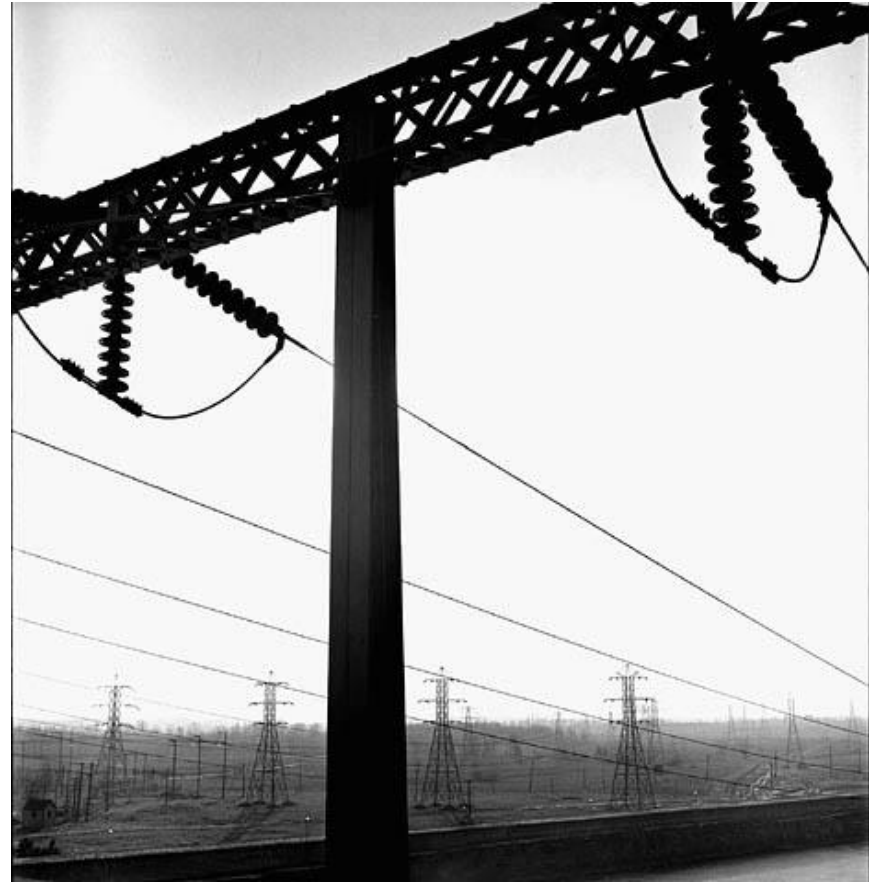
Power Plant at Pointe du Bois on the Winnipeg River in Manitoba (1911)



Electricity Meets Waterpower (2)

- The early power utilities were private concerns, but several jurisdictions soon implemented public ownership of utilities
- When completed in 1925 on the Niagara River, the Queenston-Chippawa power plant of the Hydro-Electric Power Commission of Ontario was the world's largest

Niagara power lines (1944)





Electricity Meets Waterpower (3)

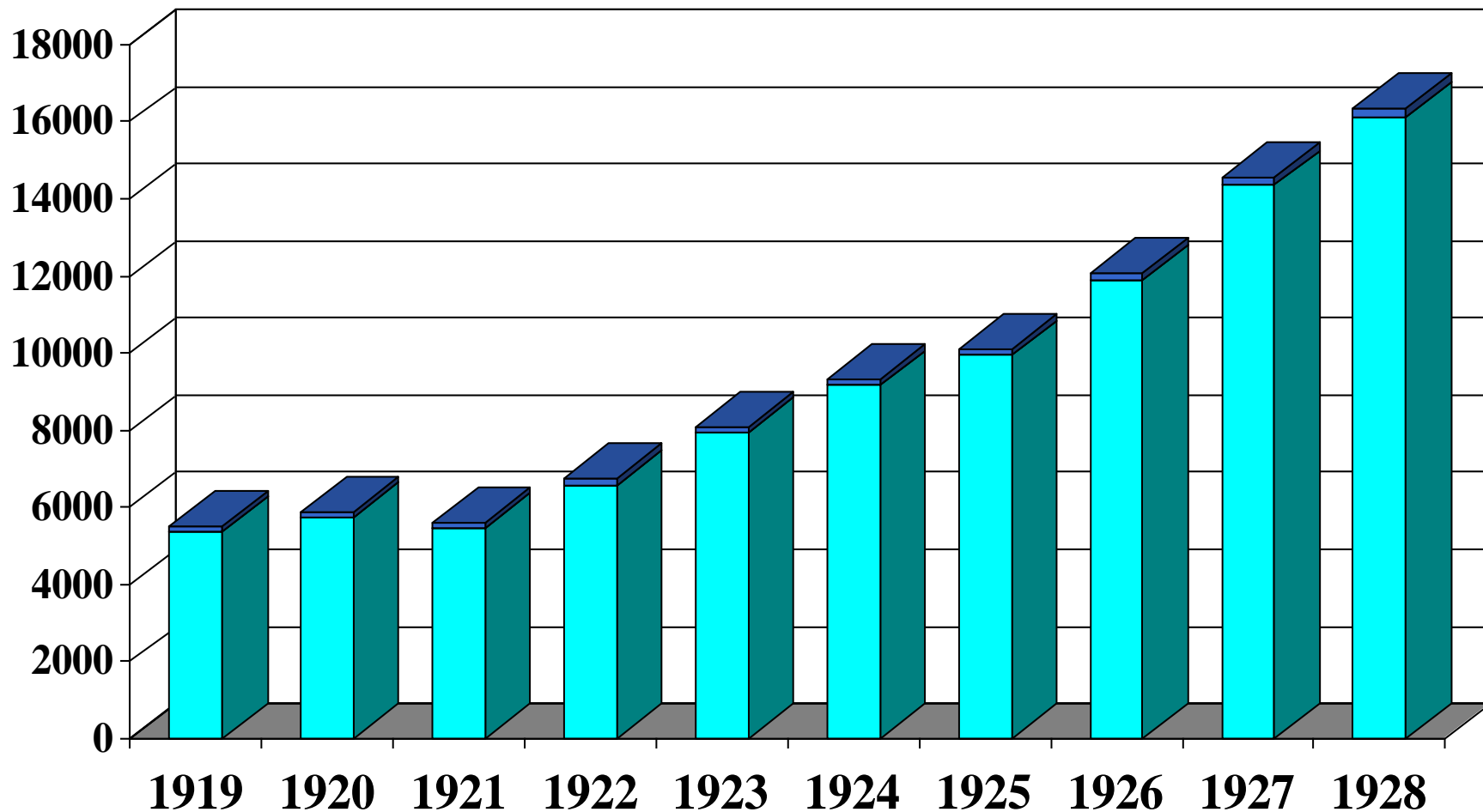
- By then, electrification for all had become a public goal both in the U.S. and Canada, to repair the imbalance between the cities (where 90% of the population had access to electricity) and the countryside (where only 10% of farmers might be connected)
- During this period, central electric stations provide most of the power generated; in 1928, Canadian industrial establishments generating their own electricity (for manufacturing, mining, and electric railways) accounted for only 5% of the total

Hydro vs. Thermal (1919-1928)

(net generation of electricity in millions of kilowatt-hours in Canada)

(Note : some hydro plants include auxiliary thermal generation)

■ Hydro ■ Thermal

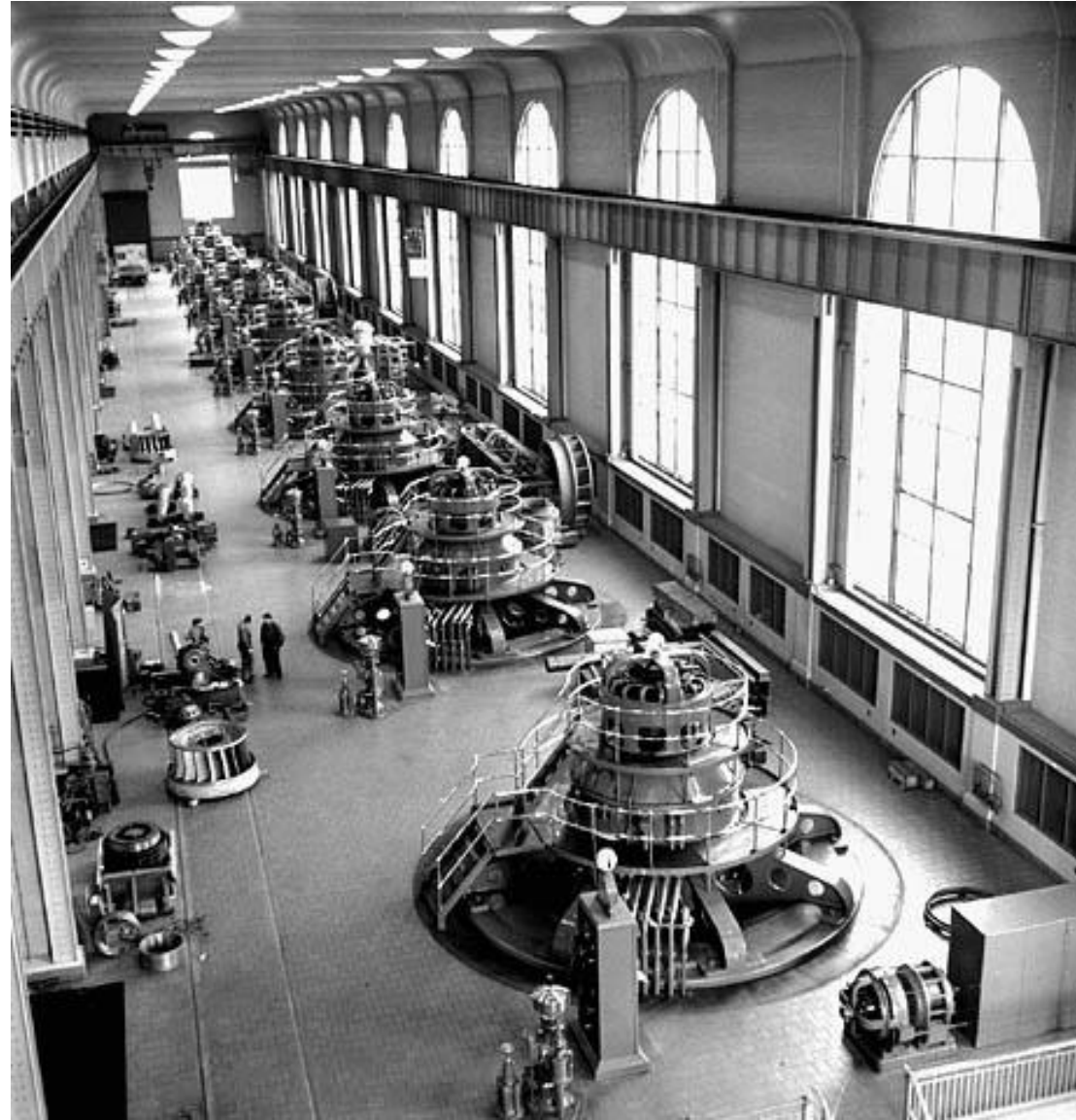




Steam Turbine (*c.* 1942)



Hydroelectric turbines at the Queenston-Chippawa plant (1944)



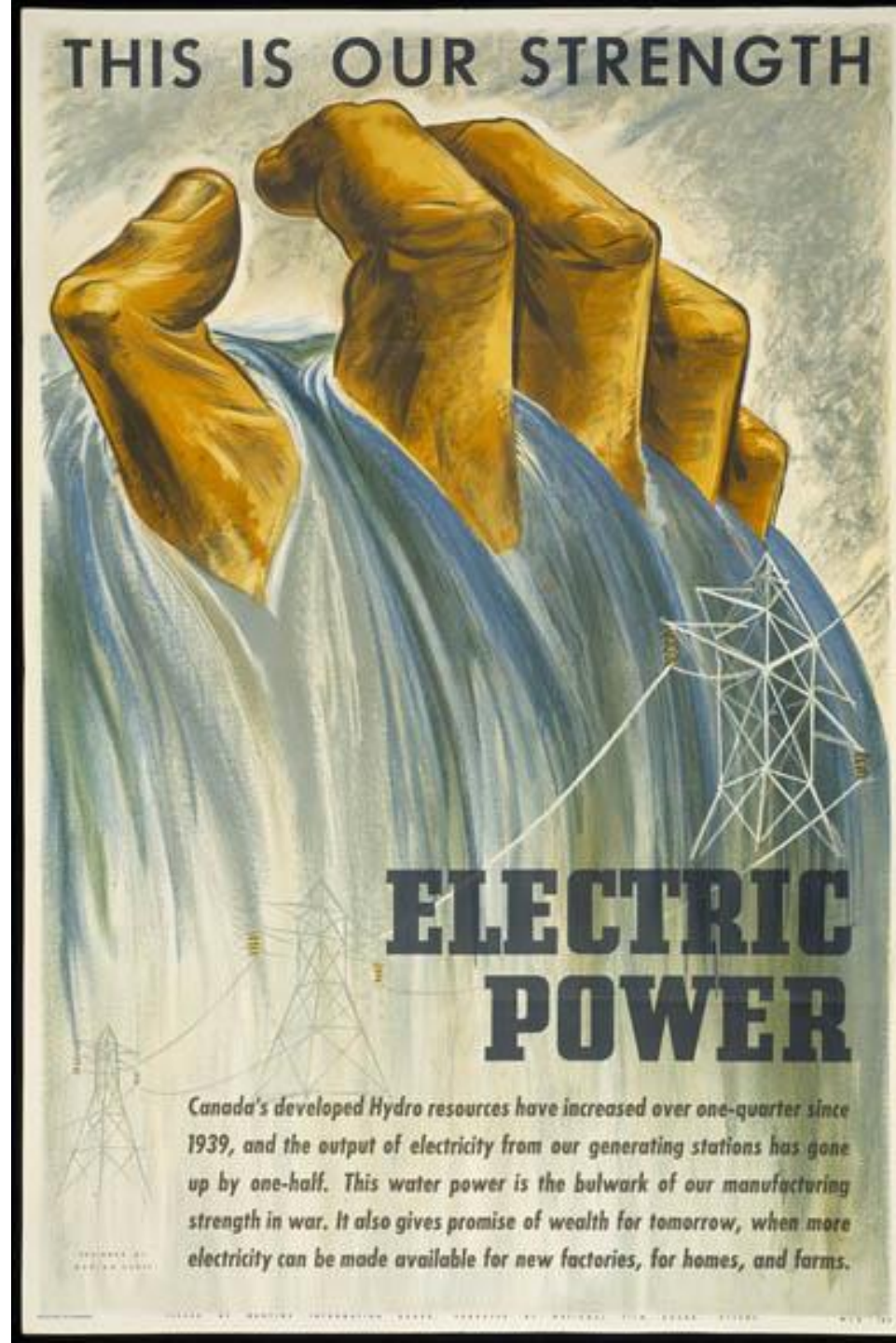
Control room of the Queenston power plant (March 1944)



Queenston power lines (1944)



Wartime
Poster
Extolling
Canadian
Hydroelectric
Power
(c. 1941)





To recapitulate (6)

- What was the main source of electricity generation in Canada between 1919 and 1928?
- What technical innovation was key to the long-distance transfer of electrical power?
- In what province could the world's largest electrical power plant be found in 1925?
- If early power plants were often found far from cities, why were there so few farms with electricity before World War II?
- Were vertical-axis turbines more effective than vertical overshot waterwheels?



Electricity on the Move (1)

- After a century's worth of improvements, steam locomotives were great for pulling massive trains at great speeds
- However, they suffered from some limitations, especially in tight urban surroundings and enclosed spaces
- In 1888, Frank J. Sprague (1857-1934) demonstrated the city-wide distribution of electric power to streetcars in Richmond, Virginia

Public Transit Before Electricity



Horse-drawn charabanc in Paris (1898)

Eugène Atget (1857-1927)

Urban Transit Before Electricity (1)

Paris Omnibus (1898)



Eugène Atget (1857-1927)

Urban Transit Before Electricity (2)

Paris Omnibus (1898)



Eugène Atget (1857-1927)

Urban Transit Before Electricity (3)

Montreal Winter Omnibus (19th century)



© Jean-Louis Trudel, August 2007

Streetcars Before Electricity (1)



Streetcars Before Electricity (2)

Paris, 1898, Eugène Atget (1857-1927)



Streetcars Before Electricity (3)





Electricity on the Move (2)

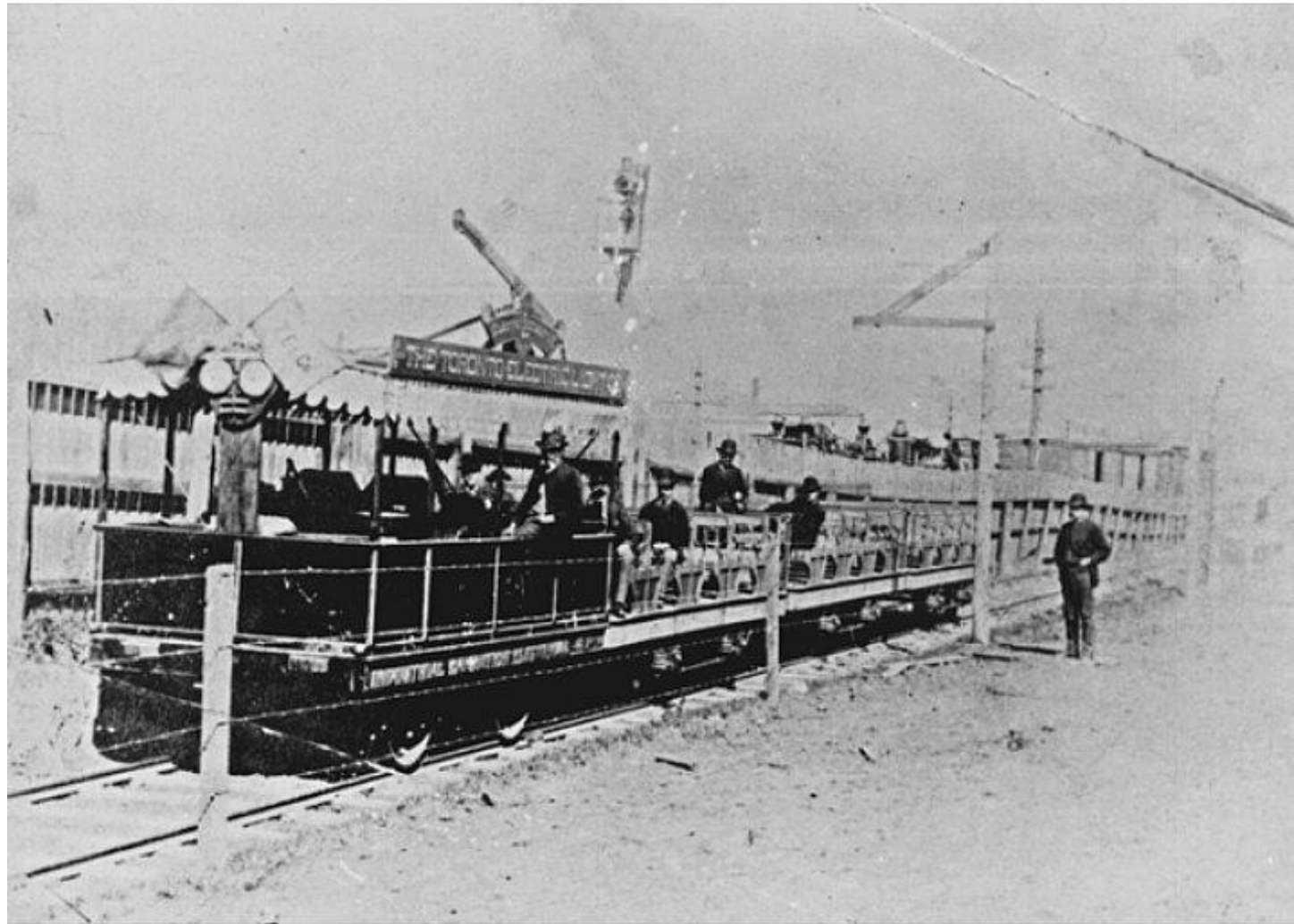
- Electric streetcars (called *trolleys* when they used overhead wires) spread rapidly during the last decade of the nineteenth century
- They were the best answer yet found to the problem of urban transit
- By the mid-1890s, several Canadian cities (Toronto, Montréal, Ottawa, Quebec City) had their own electric streetcars, including some that served specialized purposes (for mail, police work, etc.)

Electric Motor of an Early Streetcar



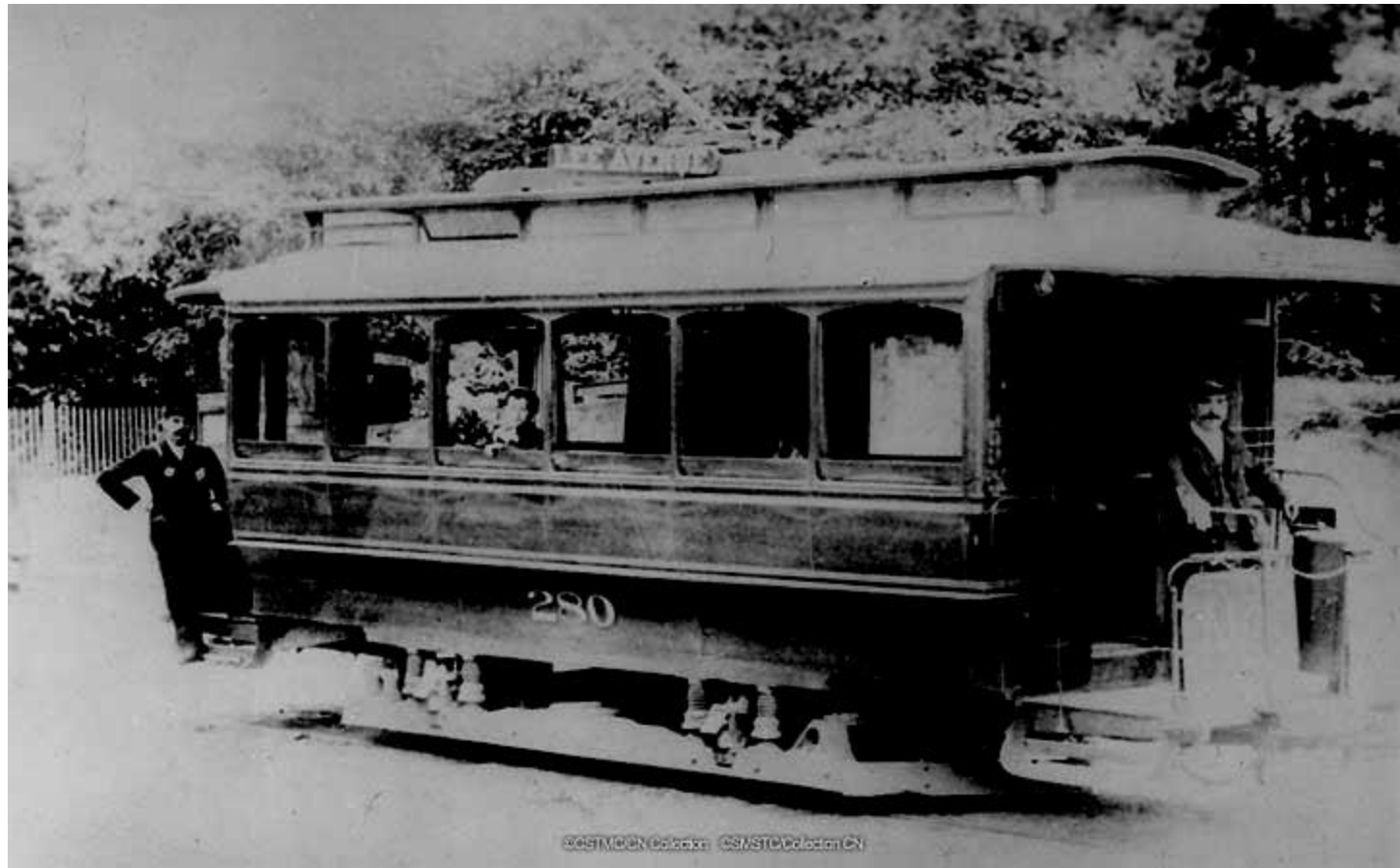
© Jean-Louis Trudel, August 2007

Toronto's First Electric Railway (1885)



It ran from the south end of Strachan Avenue to the Exhibition Grounds.

By 1892, the design of Toronto's electric streetcars matched that of similar streetcars in other cities



Electric streetcar on St. Catherine Street in Montreal (1895)



Quebec City Electric Streetcar on Esplanade Street (c. 1897-1900)



Montreal streetcar with snowplow (c. 1895)

William Notman & Son,
Notman Archives, McCord Museum



Electric Streetcar on King Street East in Toronto (1907)



Frank W. Mickletwaite (1849-1925), Archives Canada



The Ottawa Story: Ahearn and Soper, Electrical Contractors (1881)

- Born in Ottawa, Thomas Ahearn (1855-1938) made his start in the telegraph business, working for Western Union and the CPR Telegraph System
- In 1877, he replicated Bell's telephone over a line from Pembroke to Ottawa based on information published in *Scientific American*; threatened by Bell for patent infringement, he was eventually chosen to manage the first Ottawa branch of the Bell company
- In 1881, he opened a store on Sparks with Warren Y. Soper, also trained in telegraphy, and they represented the Westinghouse Company
- In 1882-1883, they introduced electric lighting to Ottawa, demonstrating arc lights drawing power from generators driven by a small waterwheel at Chaudière Falls

Ahearn and Soper store, 66 Sparks Street, July 1893 (Ottawa, ON)



In 1883, Ahearn and Soper installed one hundred incandescent lights at the University of Ottawa.



Electricity in Ottawa...

- The 1882 experiment by Ahearn and Soper did not lead to street lighting as the gas company had a monopoly on all forms of public lighting
- By 1885, electric street lighting was offered by the Ottawa Electric Light Co. of Clemow, Pattee, and Robinson
- In 1887, Ahearn and Soper created the Chaudiere Electric Light and Power Company to supply power from the Québec side of the river, outside the monopoly
- In 1891, the Bronson family launched Standard Electric
- In 1893-1894, the three companies merged to form the Ottawa Electric Company, which then merged with the Gas Company in 1906 to form Consolidated Light, Heat & Power Limited, supplying most of the Ottawa area's electricity until 1948 (and its takeover by what is now Ottawa Hydro)

Gas lamp on Parliament Hill (Ottawa, ON, April 1875)



William James Topley (1845-1930)
Topley Studio,
Library and Archives Canada

Gaslight on Dalhousie Street (Ottawa, ON, 1882)

William James Topley (1845-1930),
Library and Archives Canada





Electricity: New light at home and in the streets

- In Ottawa as in other North American cities, the electric light made it possible to illuminate both the homes and the streets without the drawbacks of gas lighting, arc lighting, oil lamps, or candles (smell, soot, the risk of fire)
- The new demand for electricity required creating or increasing generating capacity, which could be supplied for other purposes
- Electric light in the home created an entry point for electricity that could be used to power other devices (irons, hot plates, fans)

Electric light on Metcalfe Street (Ottawa, ON, 1916)

Samuel J. Jarvis,
Library and Archives Canada,
PA-024998





The Ottawa Electric Railway

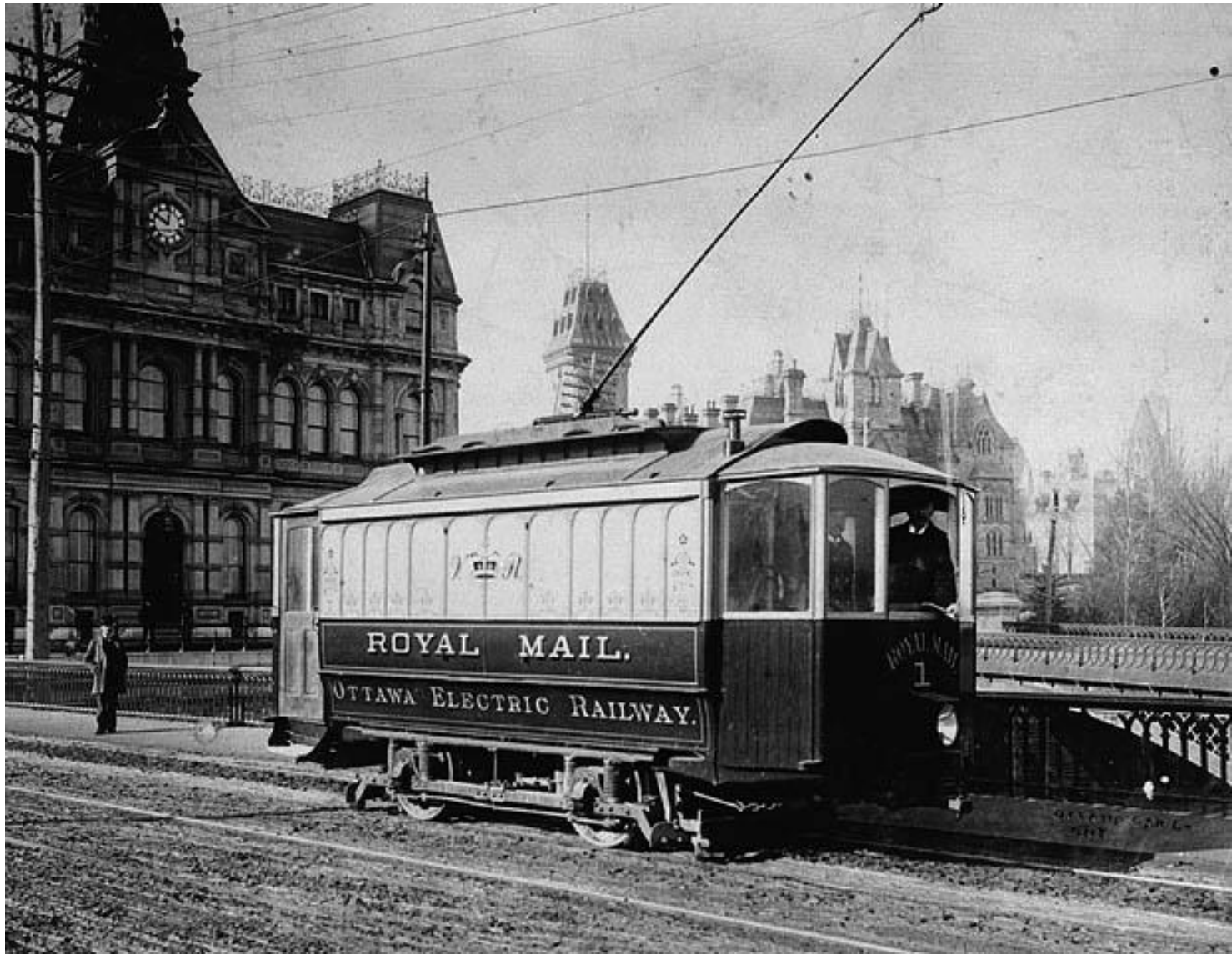
- In 1890, American interests approached the City of Ottawa to build an electric railroad, but negotiations went nowhere
- On October 20, 1890, Ahearn and Soper took over, offering to create a local company to build and operate an electric railway
- The first line was opened on June 29, 1891; horse-drawn streetcars soon proved unable to compete
- In 1894, the Ottawa Electric Railway contracted with the government to carry mail to the Broad Street and Catherine Street railway stations
- The last full day of streetcar service in Ottawa was on April 30, 1959

Residence of Thomas Franklin Ahearn (1886-1962) in June 1902



584 Maria Street
(now Laurier Avenue),
Ottawa, Ontario

Mail car of the Ottawa Electric Railway Company (1894)



Alexandra Bridge with Hull Electric streetcar on the side deck (1915)

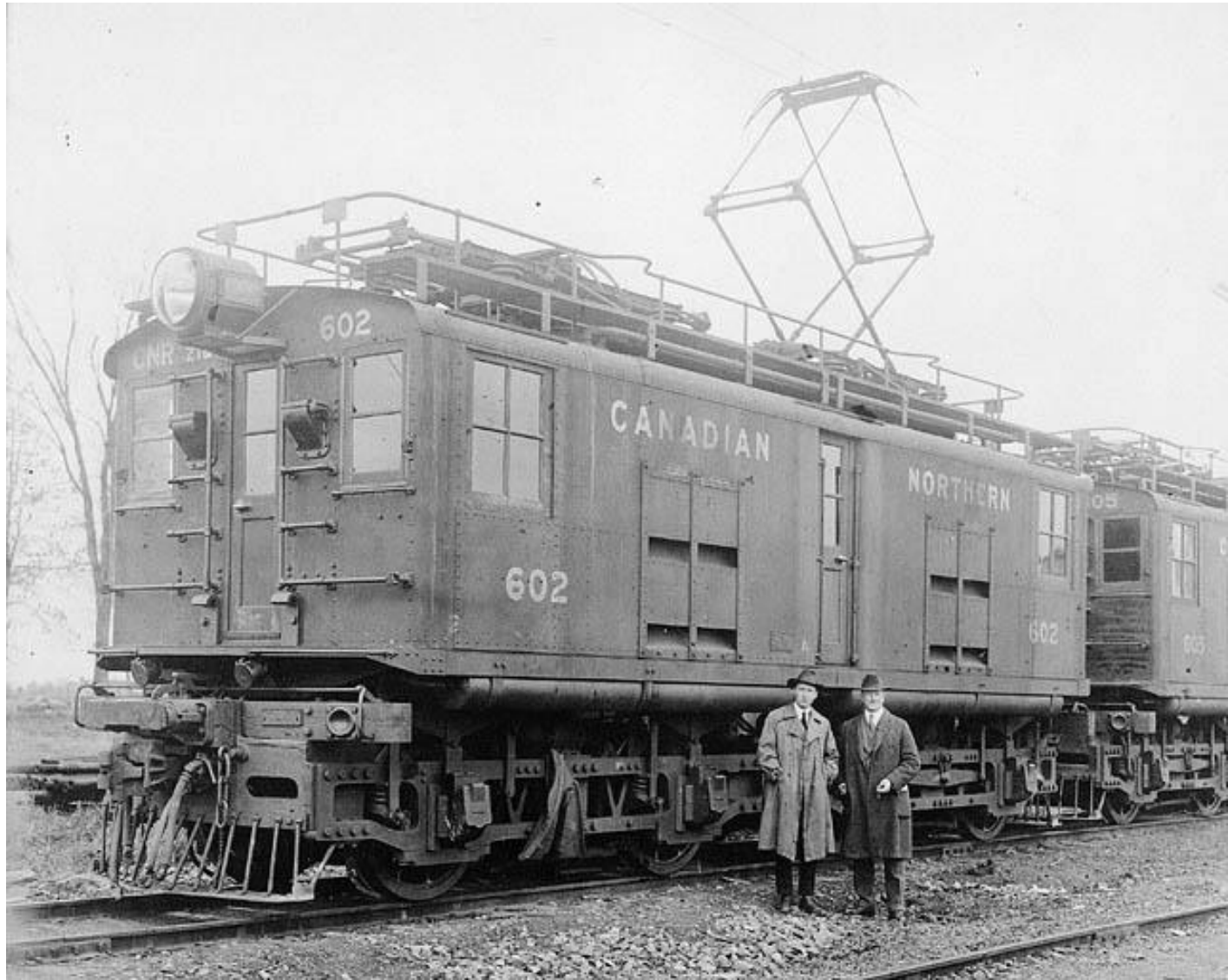




Electricity on the Move (3)

- As more powerful electric motors were produced, it became possible to use them aboard locomotives
- Such electric locomotives could be used in long tunnels (to reduce smoke and fumes)
- Canadian Northern Railways began a 5.2 km tunnel under Montréal's Mount Royal in 1913 to reach a downtown terminal
- Opened by the newly nationalized Canadian National in 1918, the line's underground section relied on electric locomotives

CNR Electric Locomotive used in the Mount Royal tunnel (1914)





To recapitulate (7)

- In what year was Ottawa's first electric streetcar line opened?
- In what city did an electric locomotive use a tunnel to serve a downtown train station?
- Name two applications of electricity use that proved pivotal in advancing the adoption of electricity?
- The use of what electrical technology proved to be good training for the adoption of new electricity uses?
- Name four (4) major electrical technologies Ahearn and Soper experimented with?