

OCT 4 – 6, 2015 • Queens University • Kingston, ON Canada

Challenges and Innovations in Tunnelling

The History of Tunnelling in Kingston

Dr. Mark Diederichs, PhD., PEng., FEIC.

Dept. Geological Sciences and Geological Engineering
Queen's University

Oct 5, 2015



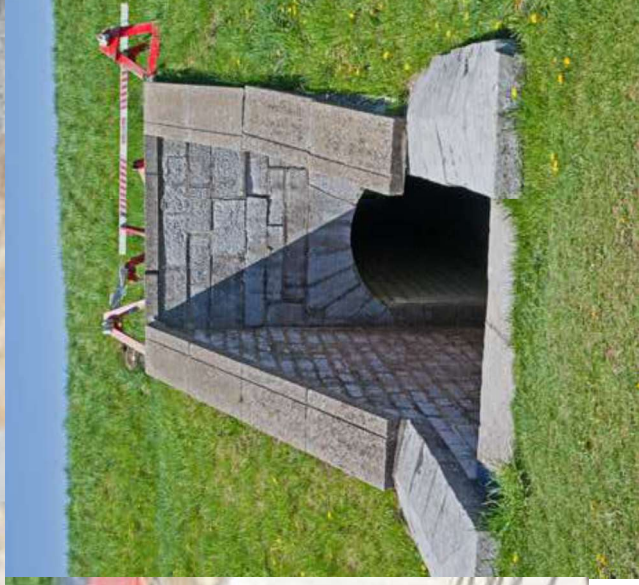
Tunnelling Association of Canada
Association Canadienne Des Tunnels

The History of Tunnelling ^{and} in Kingston

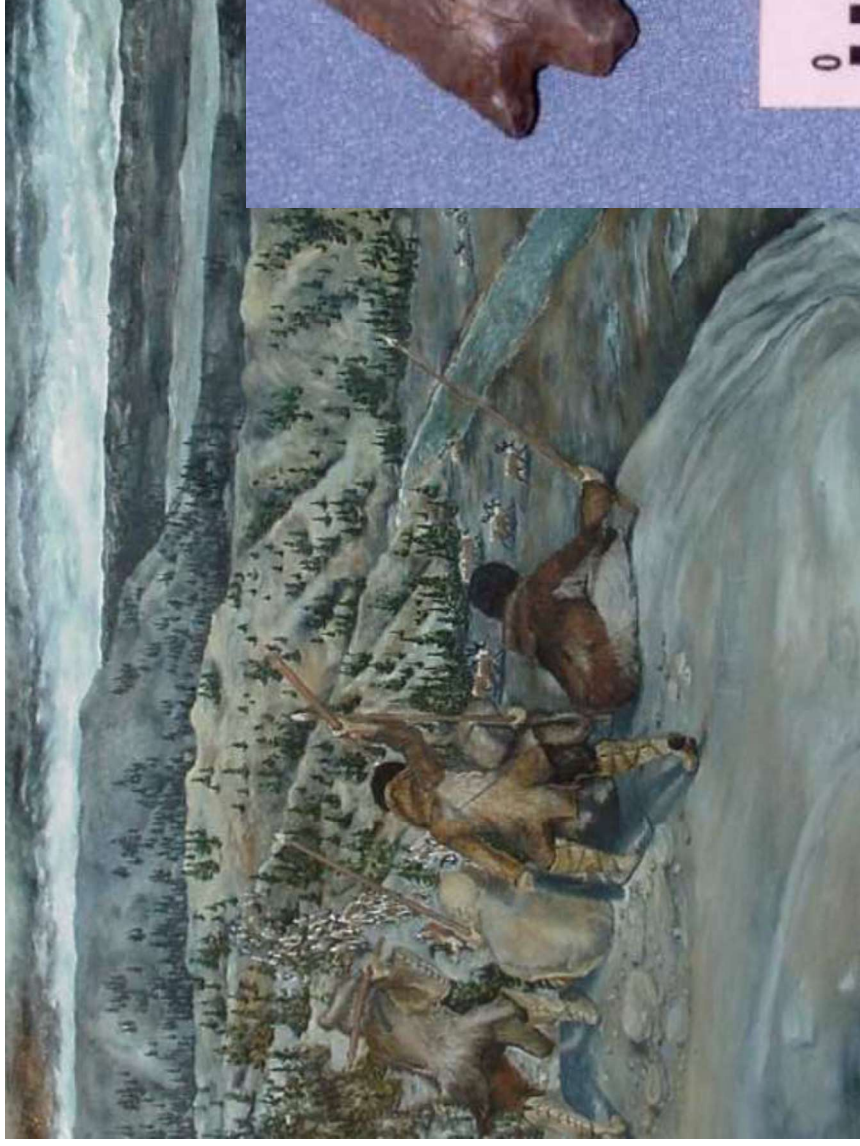
Dr. Mark Diederichs, PhD, Peng, FEIC
Professor, Geological Engineering
Queen's University, Kingston



Queen's
UNIVERSITY



HISTORY OF KINGSTON: Archaic Period Hunters



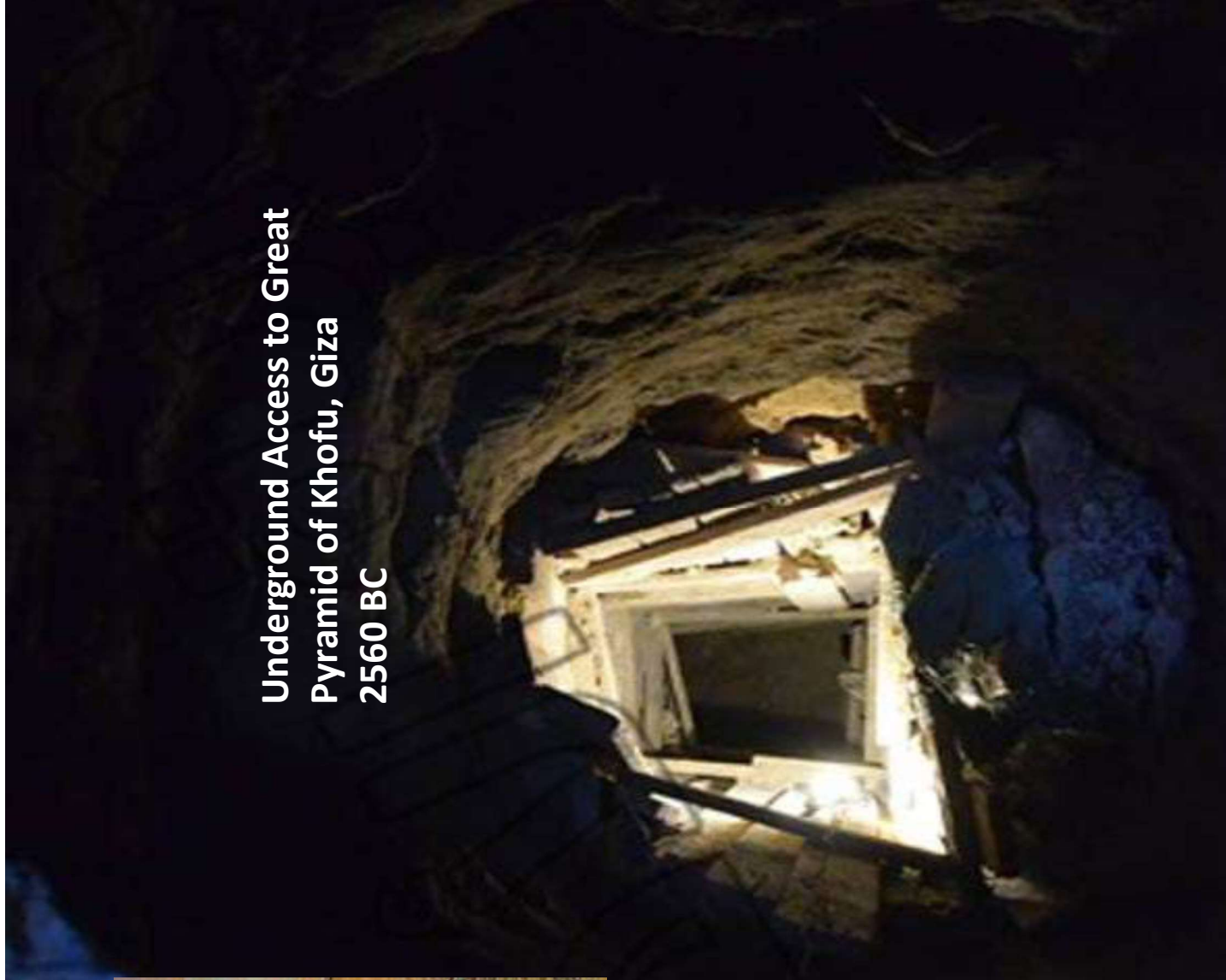
Evidence of Year
Round Occupation
around 3000 BC





**Underground Access to Great
Pyramid of Khofu, Giza
2560 BC**

HISTORY OF TUNNELLING



2180–2160 B.C.

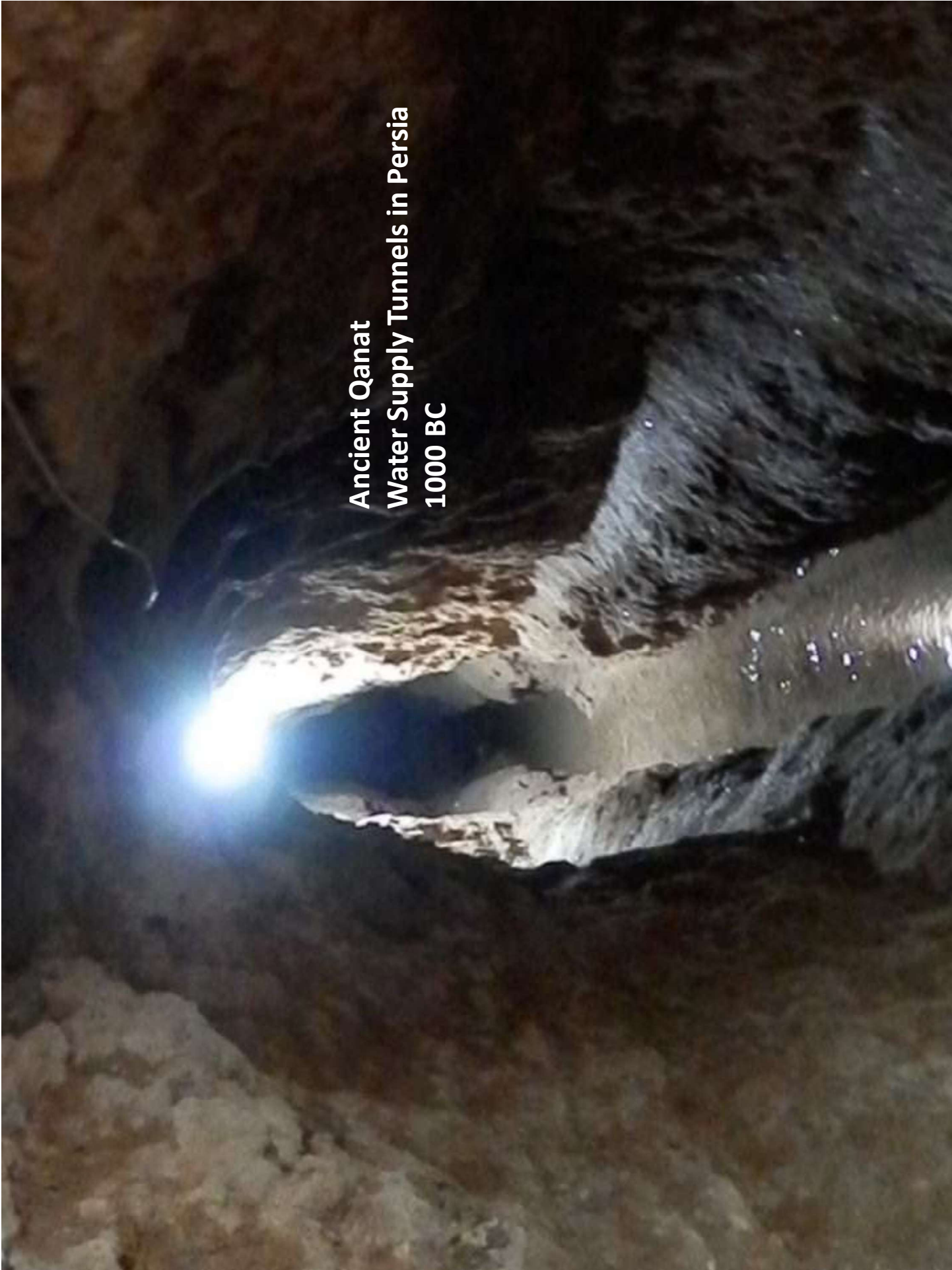
Babylonians dig a 3000-foot-long tunnel under the Euphrates



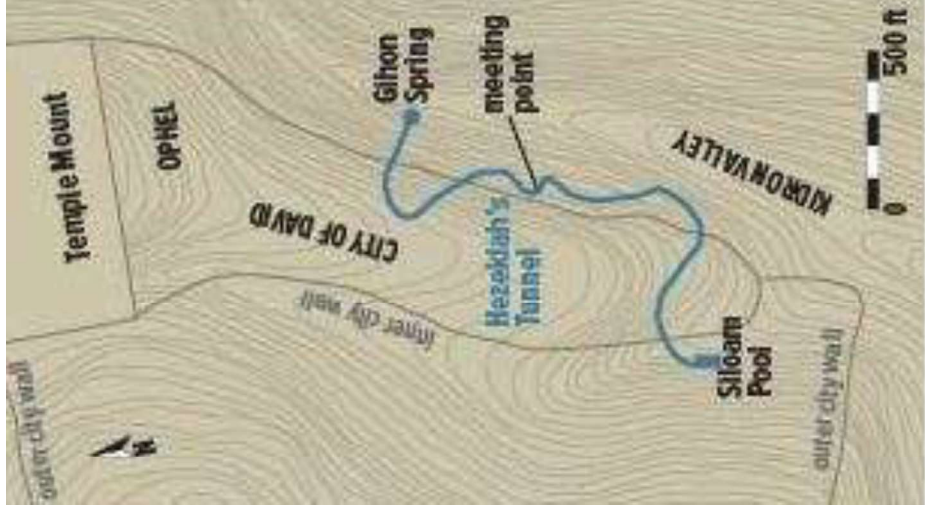


Evidence of Early Settlement
Before 1000BC to 500 AD

**Ancient Qanat
Water Supply Tunnels in Persia
1000 BC**

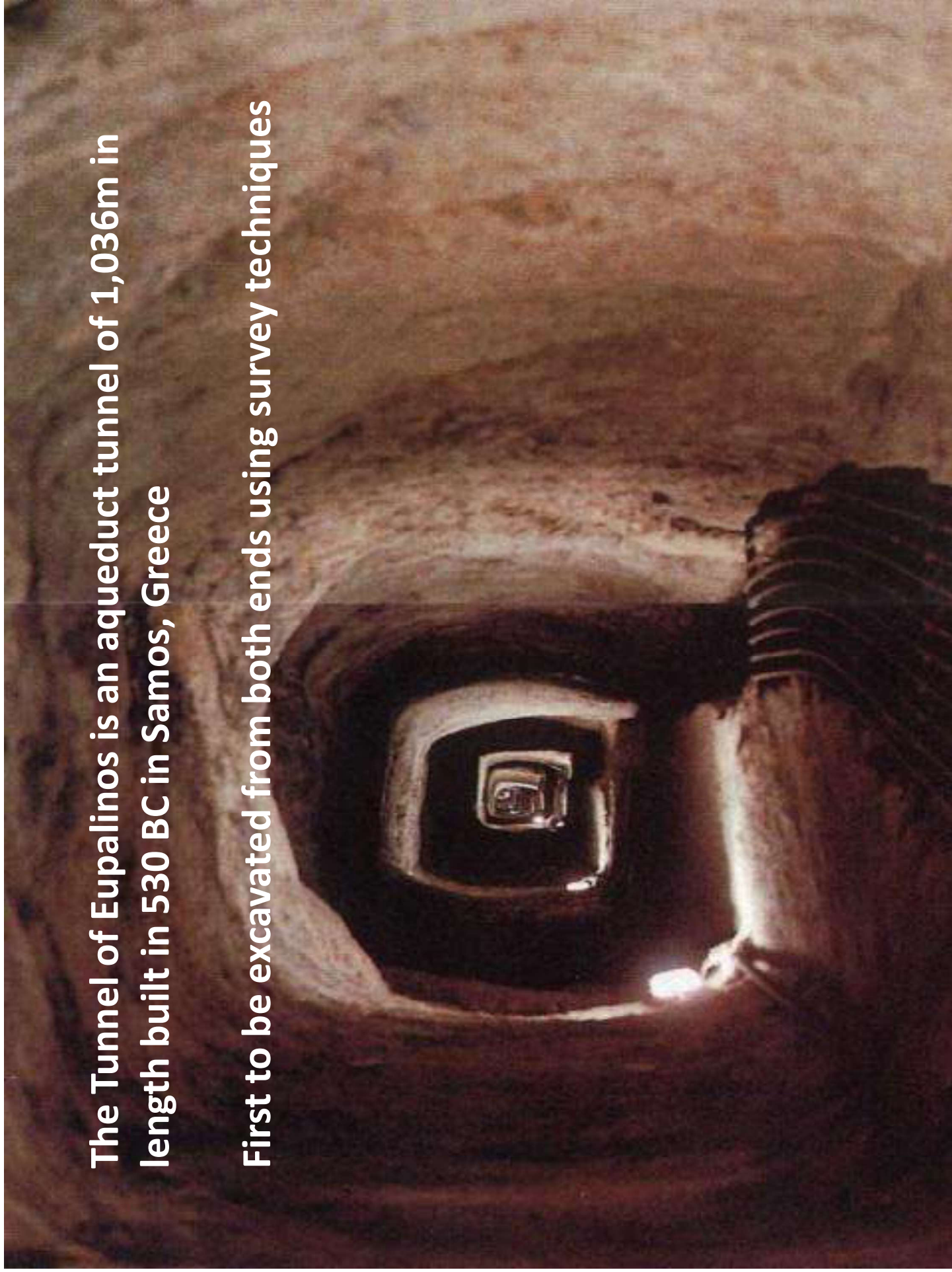


700 BC Siloam Tunnel Jerusalem



The Tunnel of Eupalinos is an aqueduct tunnel of 1,036m in length built in 530 BC in Samos, Greece

First to be excavated from both ends using survey techniques

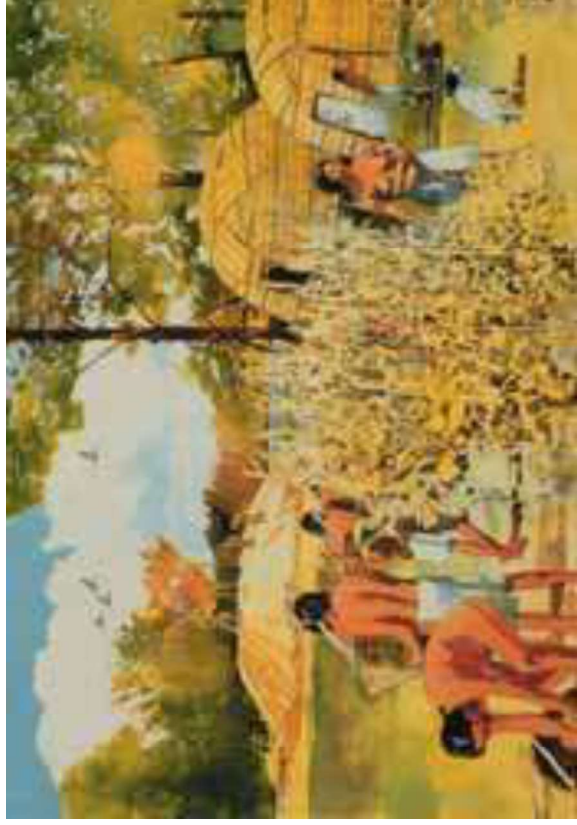


Teotihuacan Tunnel
Ceremonial and Burial Chamber
Mexico
2000 years old (1st Century AD)

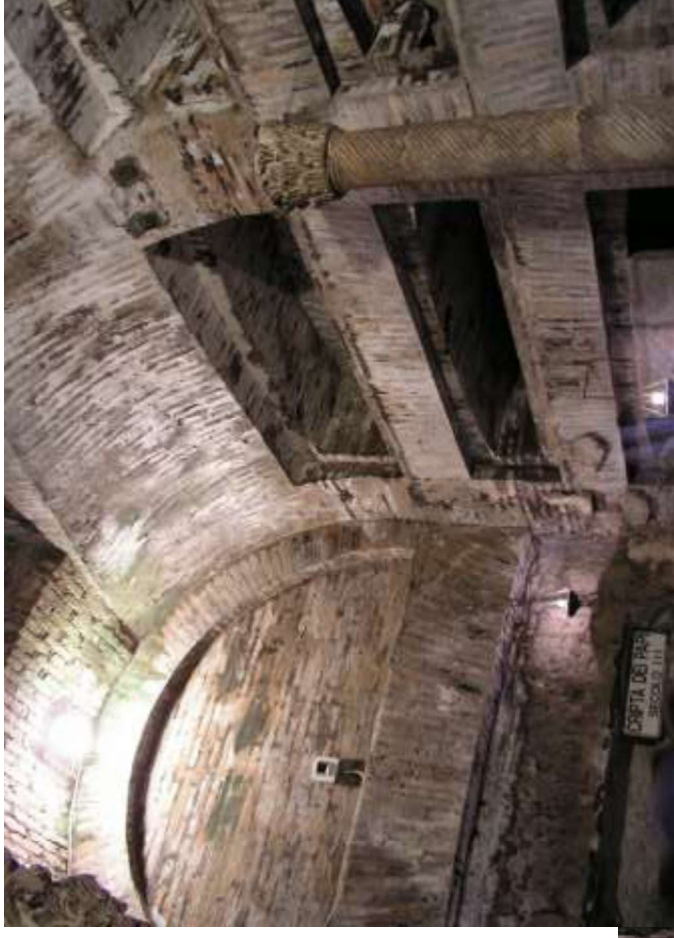


Permanent Iroquois Settlement at Kingston

- From approx. 500 AD



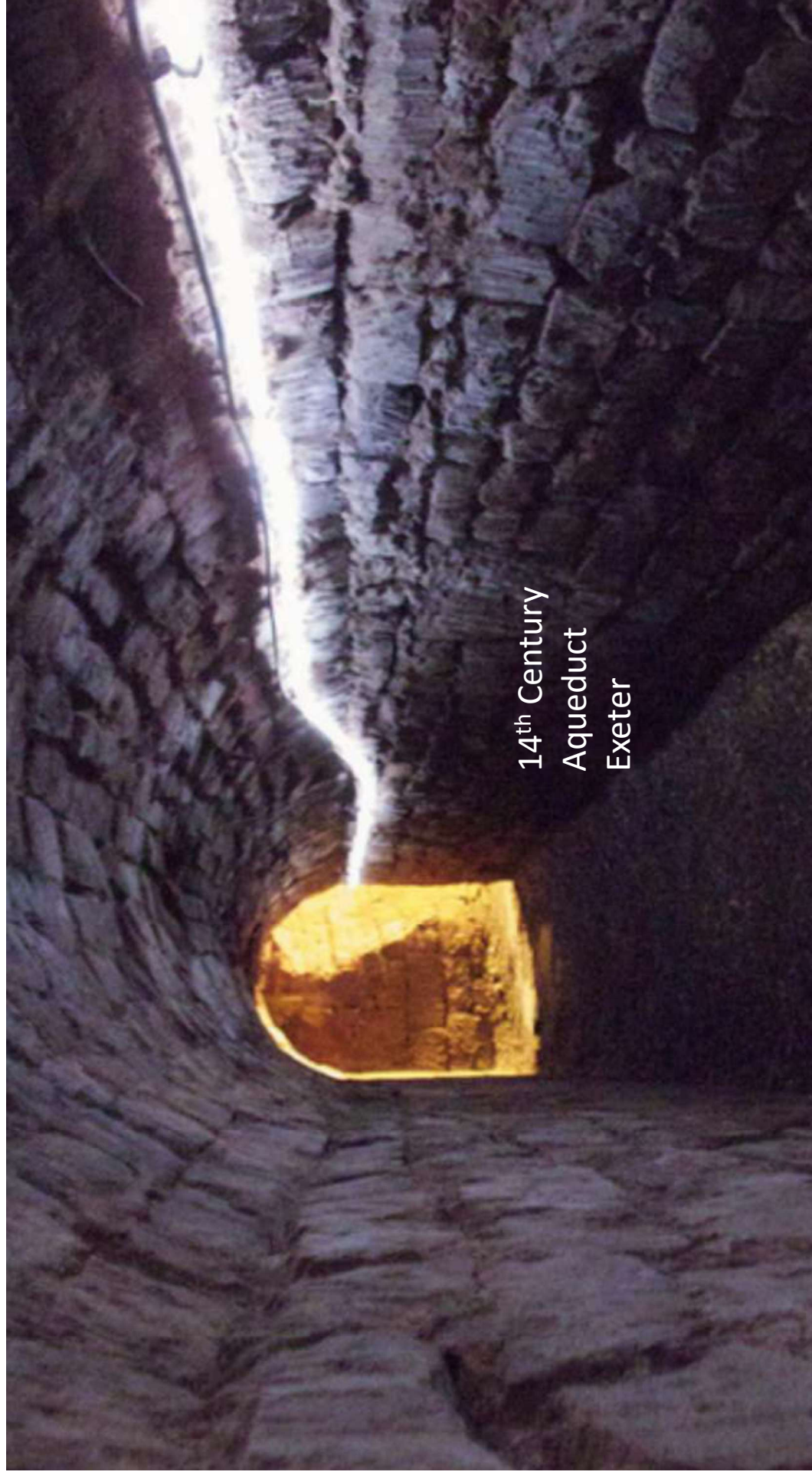
Catacombs of Rome 200-700AD



**Large organized
communities
Iroquois Village
around 1400-1500 AD**



Medieval Tunnels 14th-15th century Europe Water Supply and Sewers



14th Century
Aqueduct
Exeter

Leading up to Contact with West

Jacques Cartier 1534

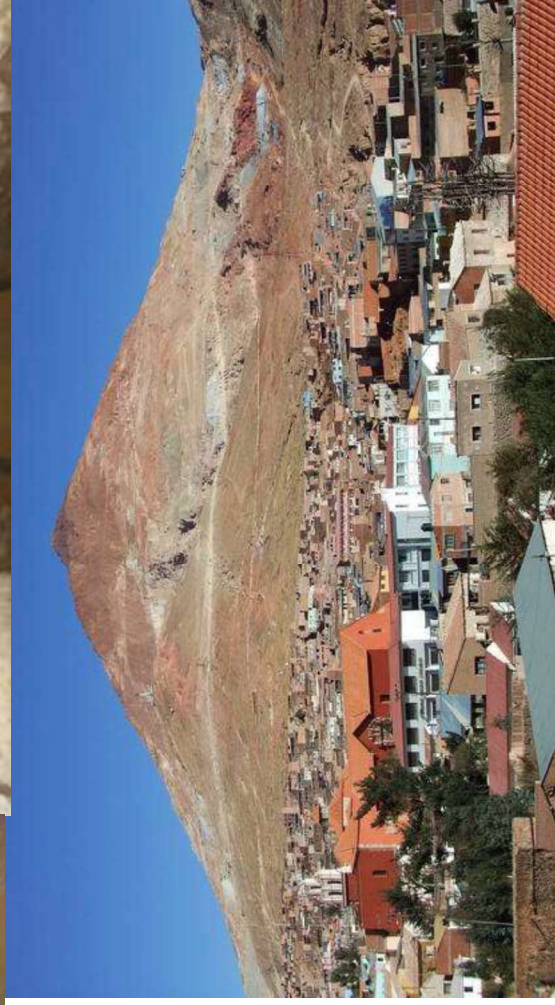
His memoirs indicate that some of the Aboriginal people he met on the St Lawrence had encountered Europeans previously, had traded furs for foreign goods, and had stored pelts in anticipation of future contacts.



Access Tunnels Potosi Volcano 1530's – present day



Half of the World's Silver at the time
came from this mine



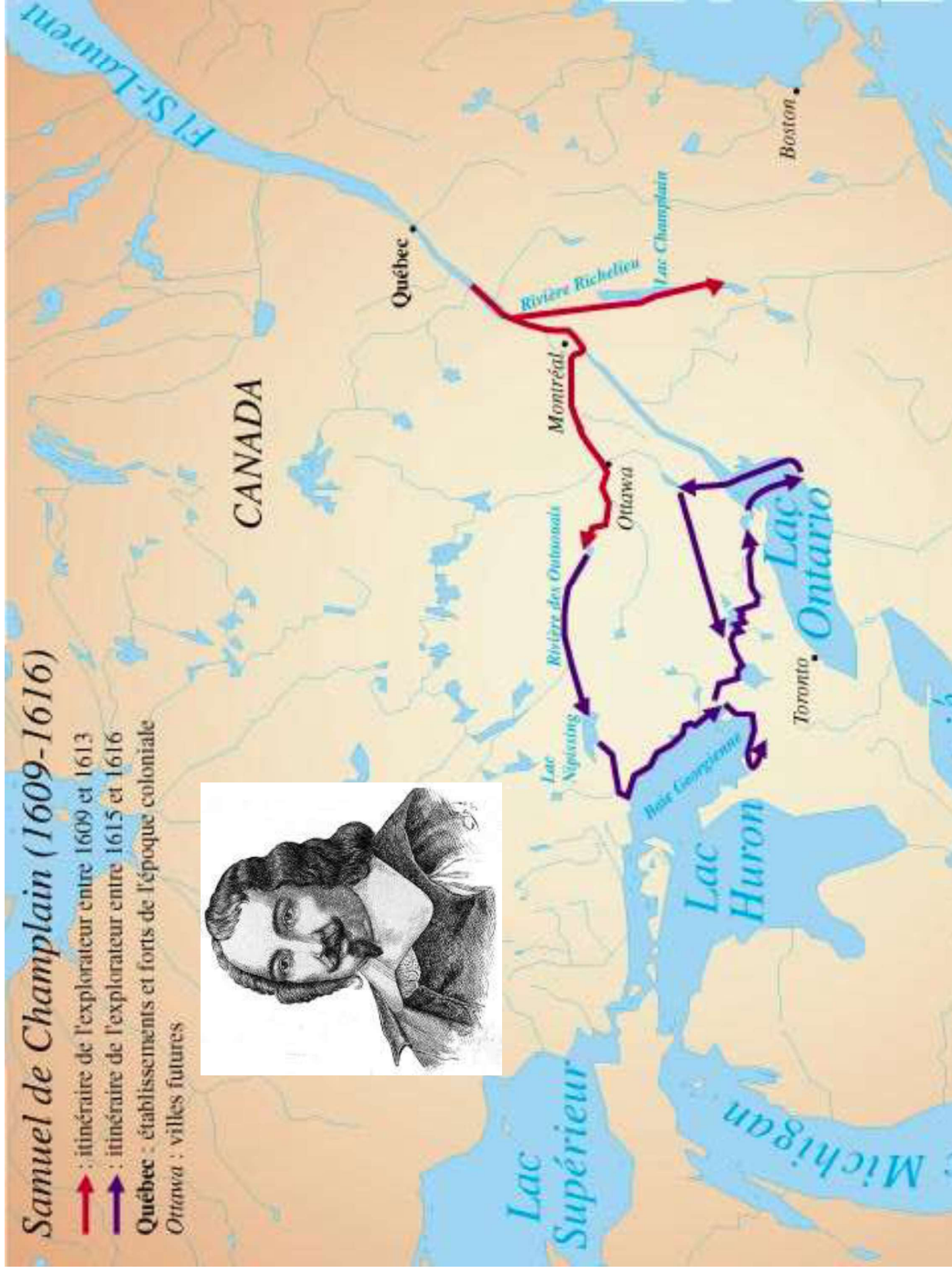
Samuel de Champlain (1609-1616)

→ : itinéraire de l'explorateur entre 1609 et 1613

↻ : itinéraire de l'explorateur entre 1615 et 1616

Québec : établissements et forts de l'époque coloniale

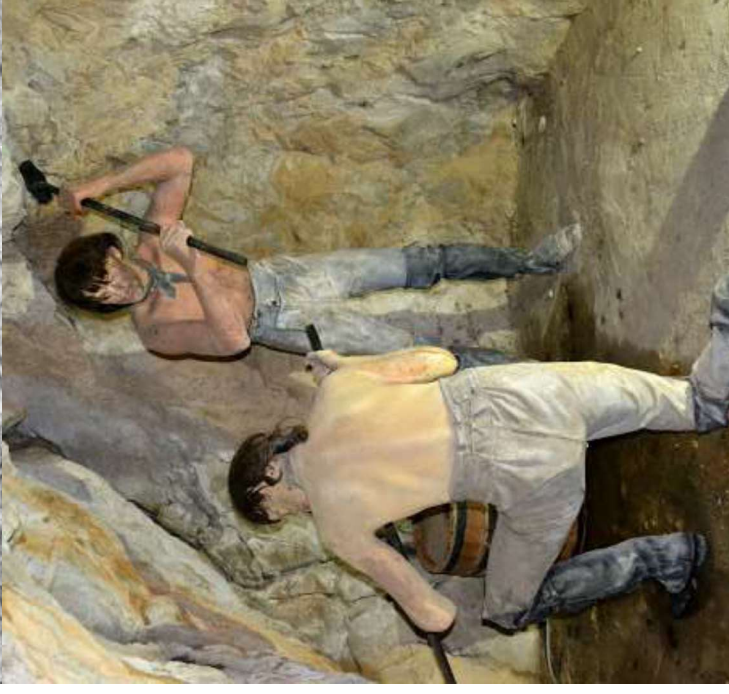
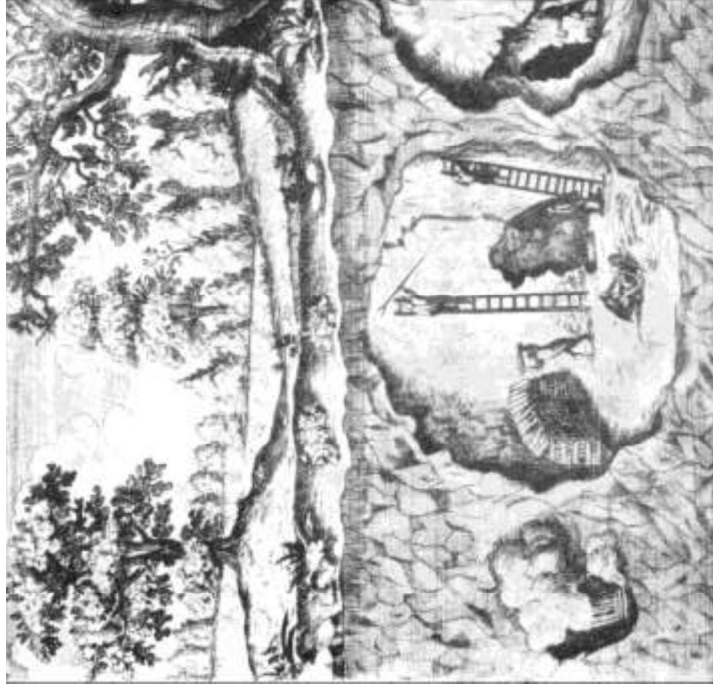
Ottawa : villes futures



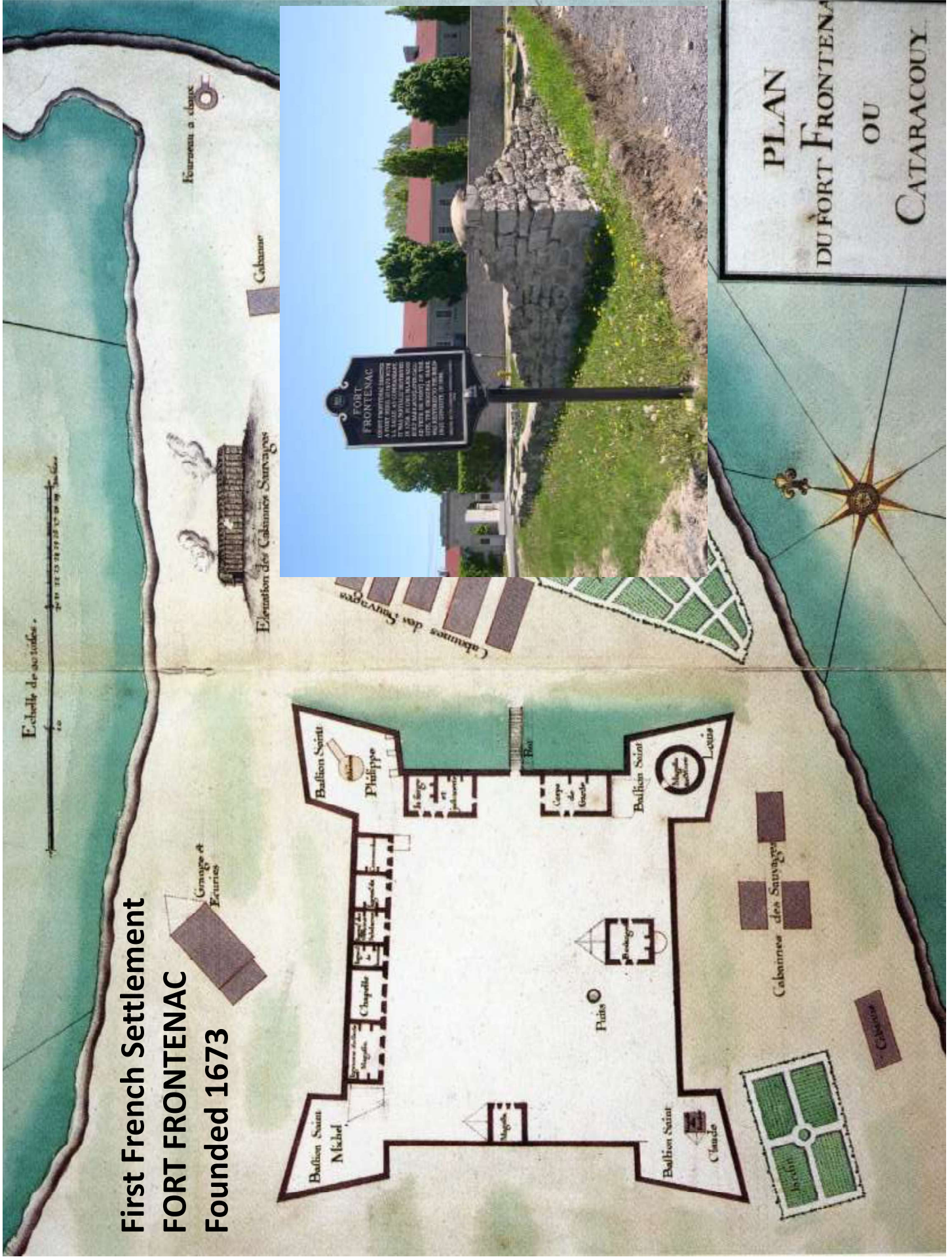
Early 1600s

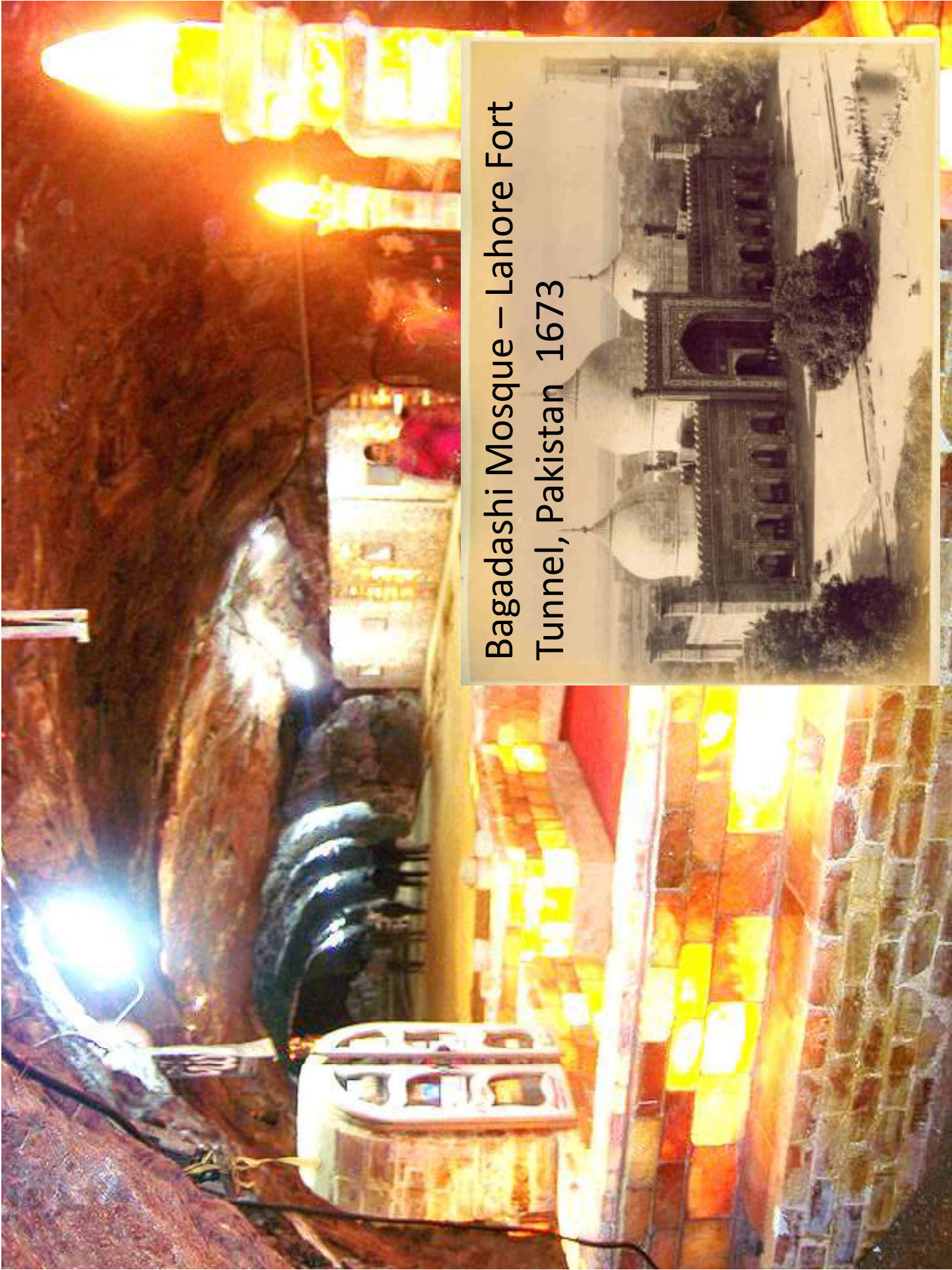
- Prior to 1600, harder rock was excavated using a method called fire quenching. The rock was heated so that it expanded, before being quickly drenched with cold water

- Gunpowder was first used in tunnelling in the early 1600s, but until the slow-burning fuse was invented in 1831, it was very dangerous.



**First French Settlement
FORT FRONTENAC
Founded 1673**



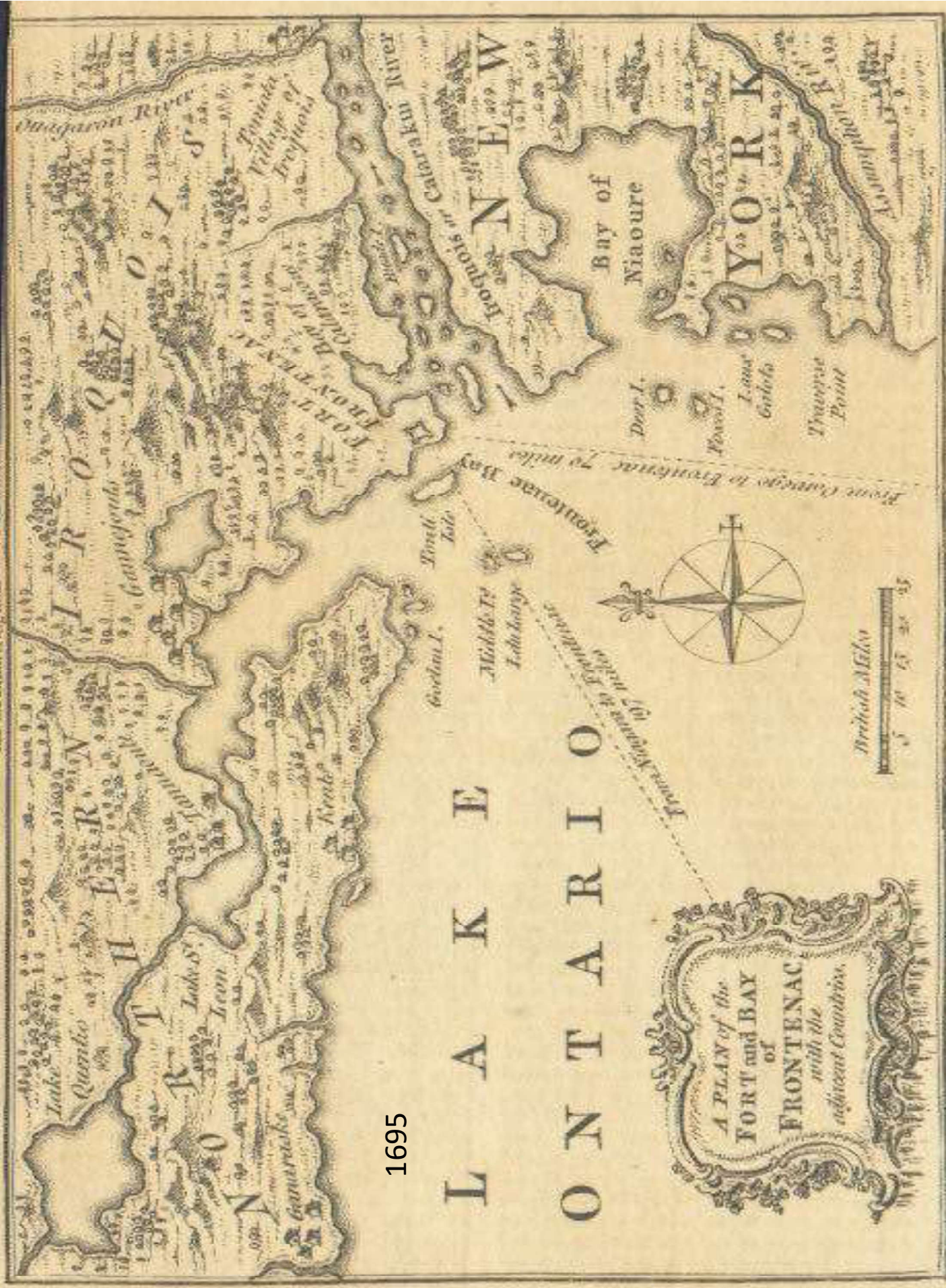


Bagdashi Mosque – Lahore Fort
Tunnel, Pakistan 1673

1695

LAKELONTARIO

A PLAN of the
FORT and BAY
of
FRONTENAC
with the
adjacent Countries.





**Hyde Valley Conduit
Greenwich, England
1695**

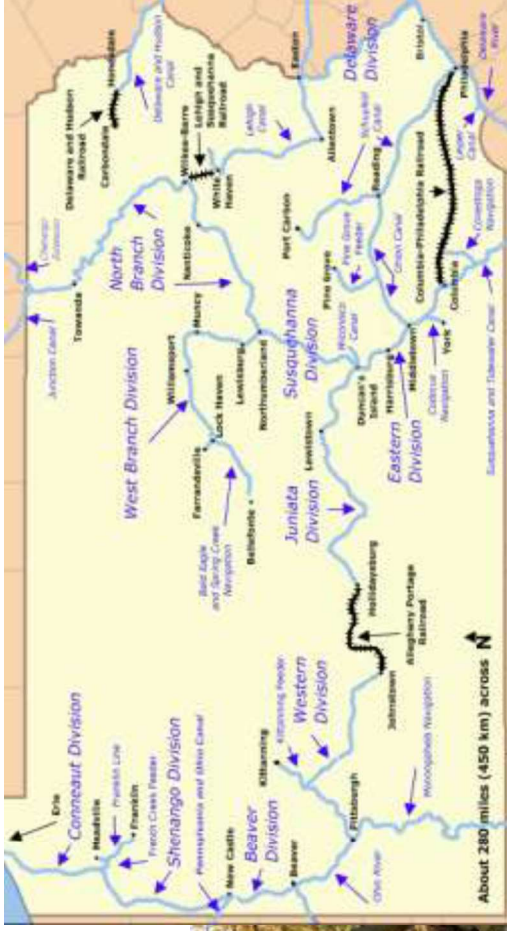
Dominion of U

First
Executive
Council of
Upper
Canada
1792



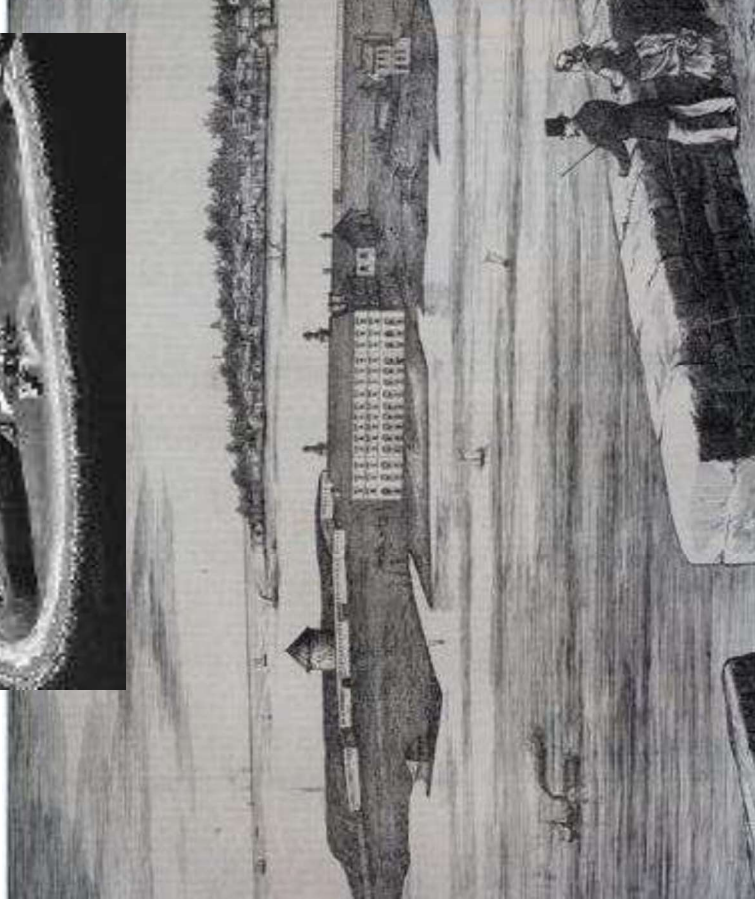
Union Canal Tunnel – Pennsylvania

1792

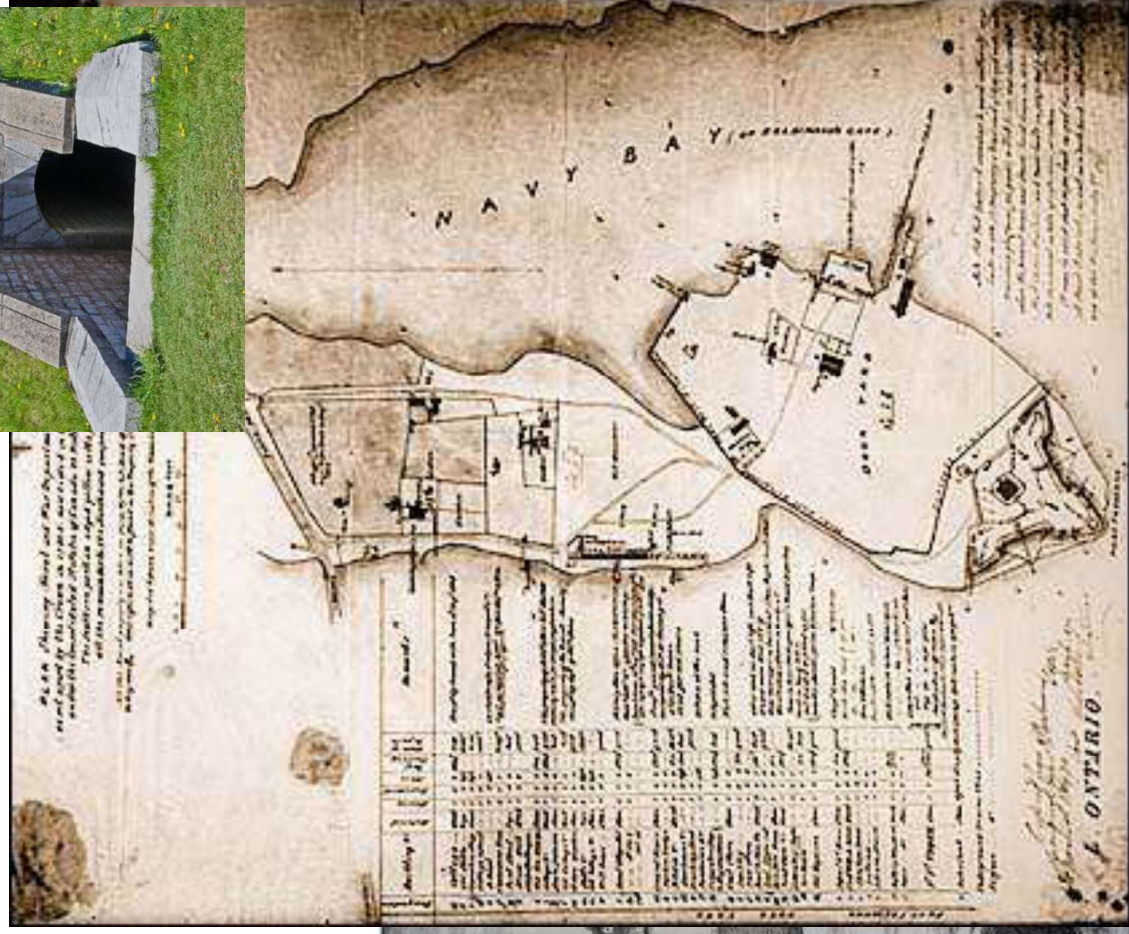


First canal ever surveyed in the U.S.
Spurred by the 1791 discovery of anthracite in the upper Susquehanna Valley

Fort Frederick 1812



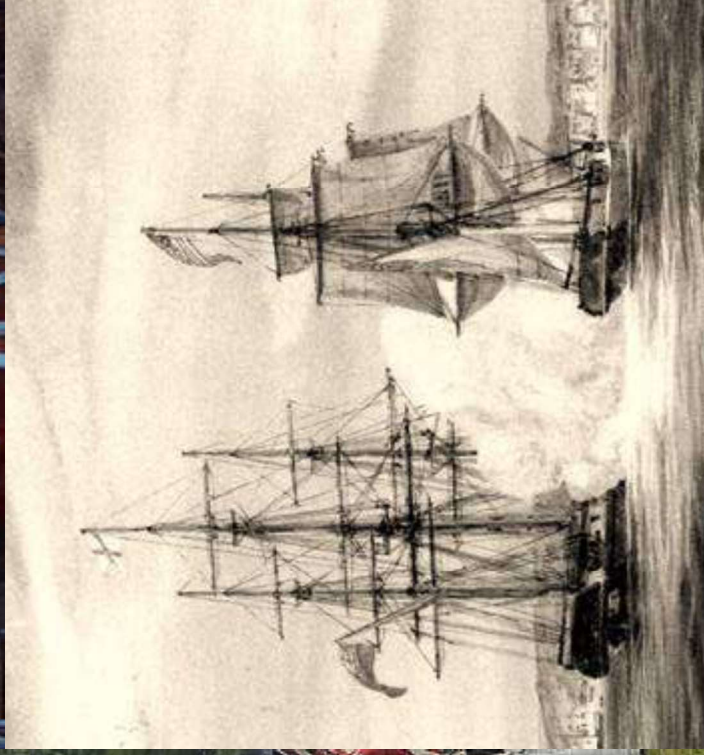
Kingston's First Tunnel?



Battle of 1812

**We did it in 1812,
and we can do it again.**

Don't f [redacted] with Canada.



Tunnel at Dundurn Castle in Hamilton Ontario

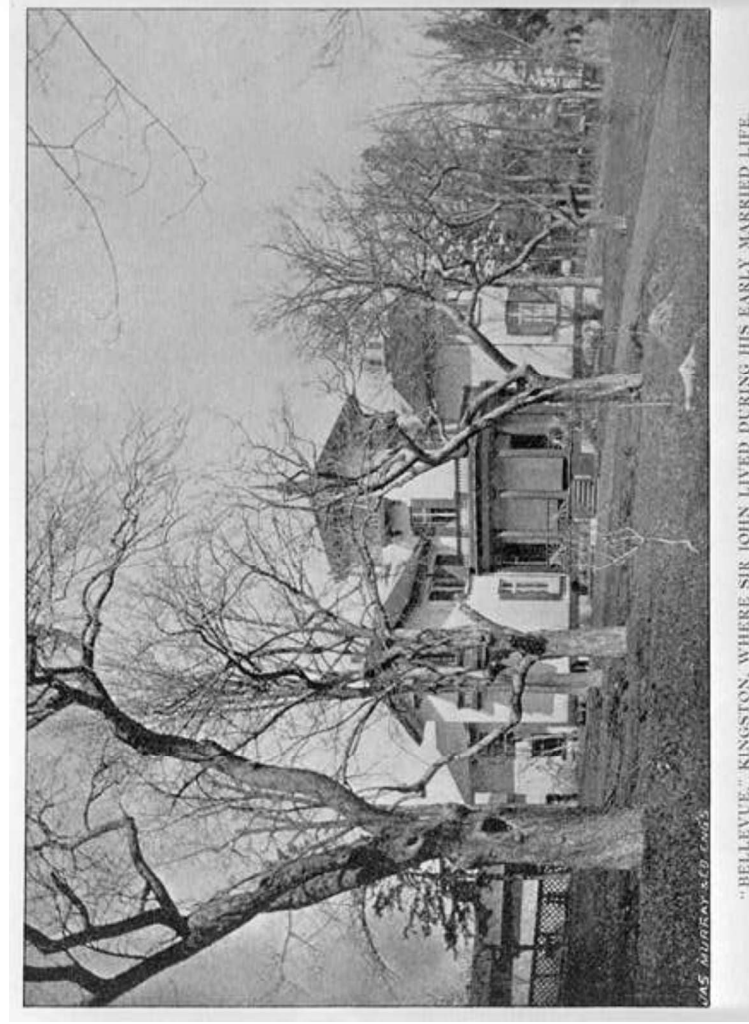
18000 square foot mansion owned by Richard Beasley built in 1812

1813 taken over by British Army

Tunnel used to store gun powder



1815 Birth of Sir John A. MacDonaldd



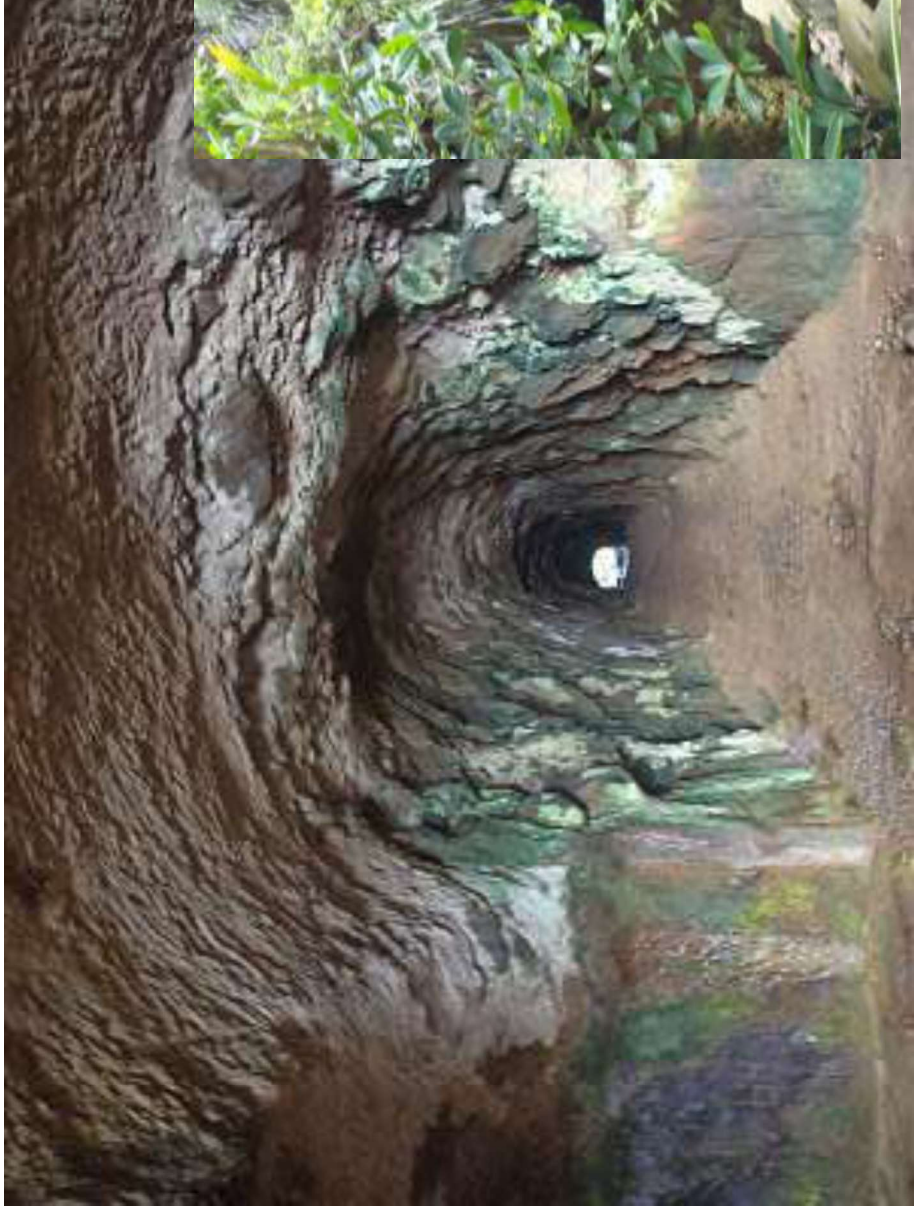
"BELLEVUE," KINGSTON, WHERE SIR JOHN LIVED DURING HIS EARLY MARRIED LIFE.

1815 Black Point Tunnel

St. Vincent and the Grenadines

Constructed by the British using slave labour

360 foot tunnel to transport
of sugar from the mills of
Grand Sable Estate to the
wharf at Byrea.



Kingston Mills Locks 1832 – Part of Rideau Canal System



Beaminster Tunnel 105 m road tunnel in Dorset, England.
The tunnel was completed in 1832; first road tunnel built in Britain
and the only pre-railway road tunnel in the country still in use.



1835 Kingston Penitentiary Opens



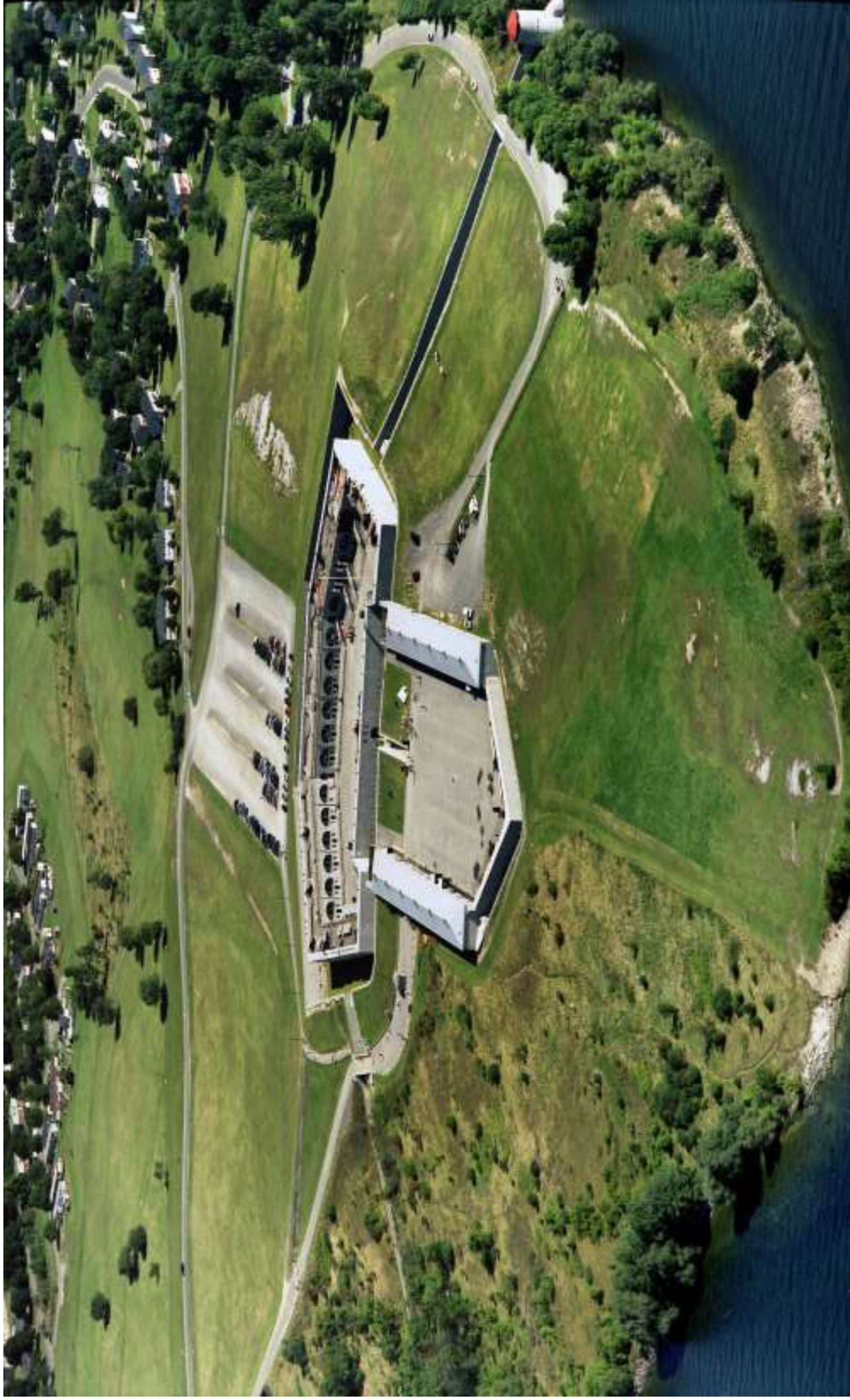
1835 Black Rock
Tunnel Pennsylvania
Still in use



1835 Goathland
Tunnel North Yorkshire



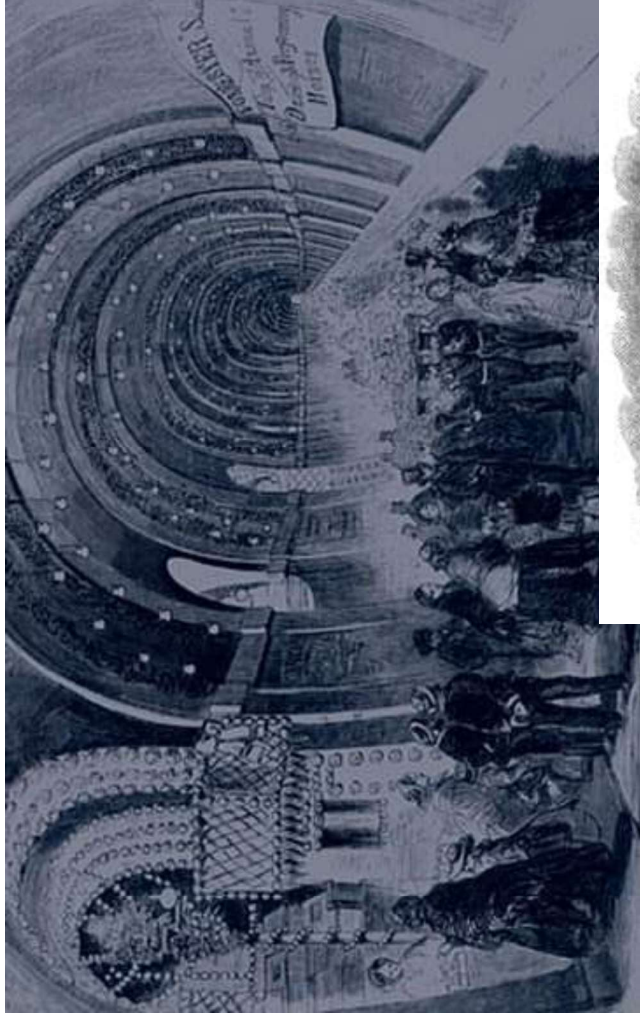
Fort Henry Constructed began 1813
Rebuilt in 1836 (current structure)
Now Ontario's only UNESCO site



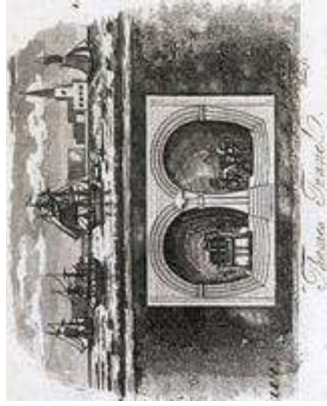
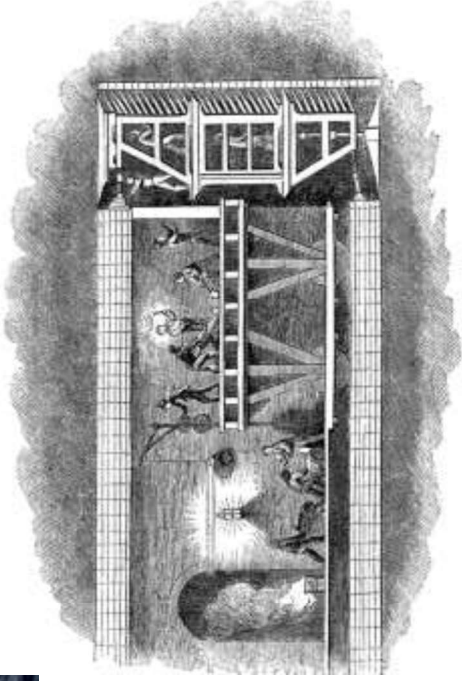
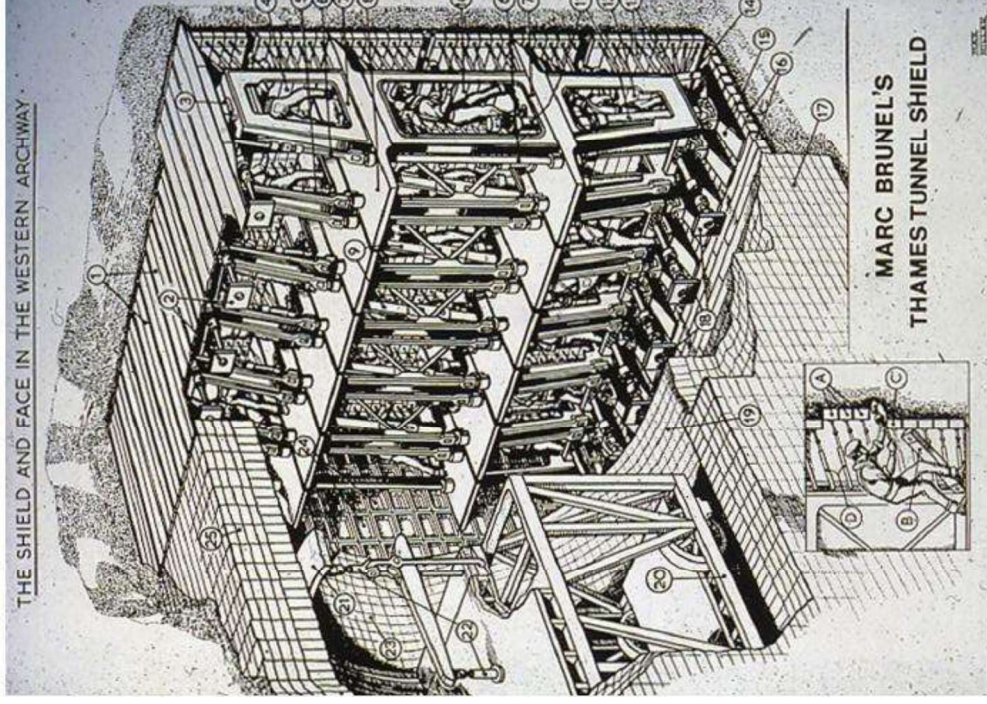
Brunel's Tunnel – River Thames

1825-1843

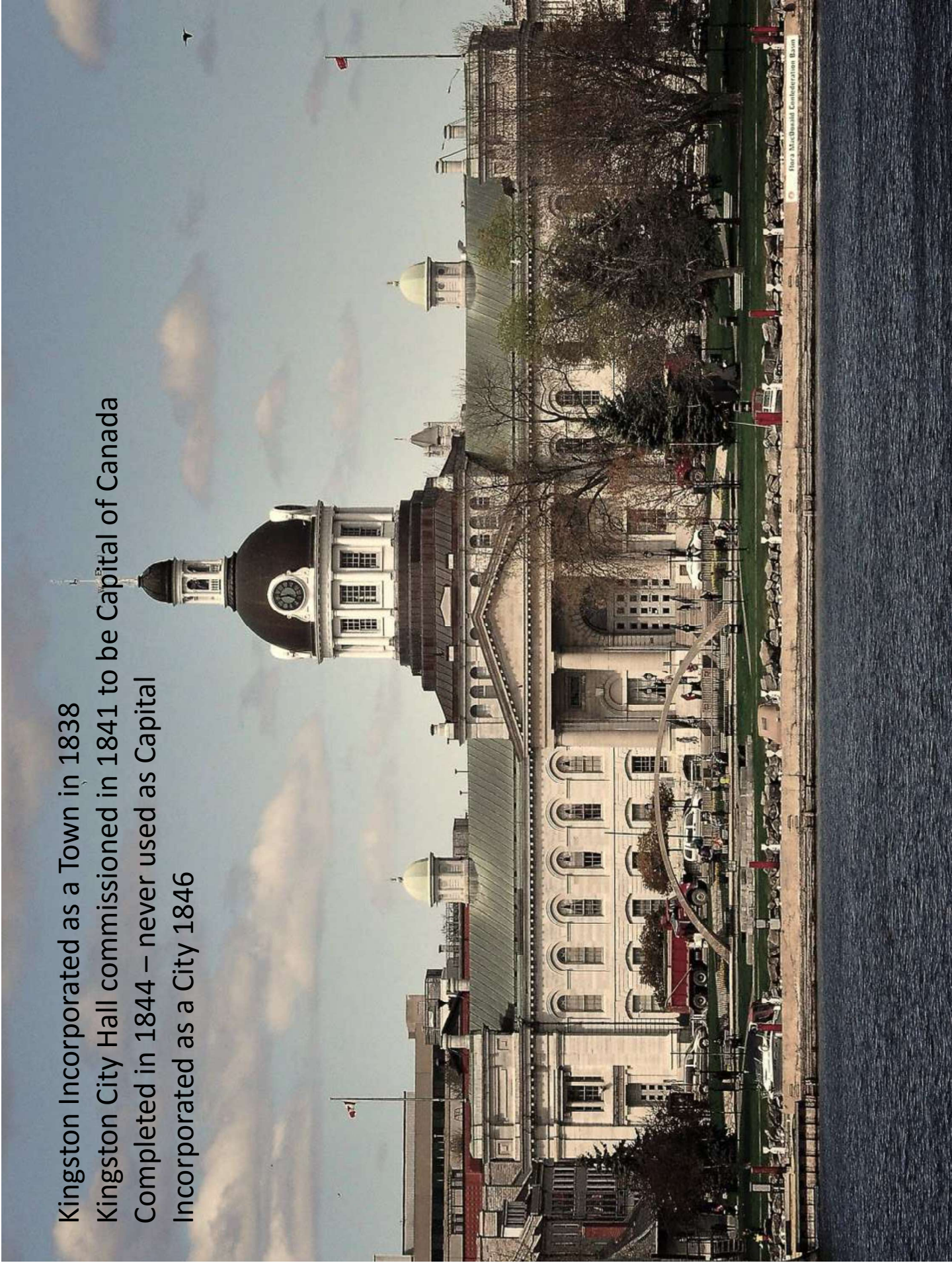
Final Successful Shield started in 1836



First TBM



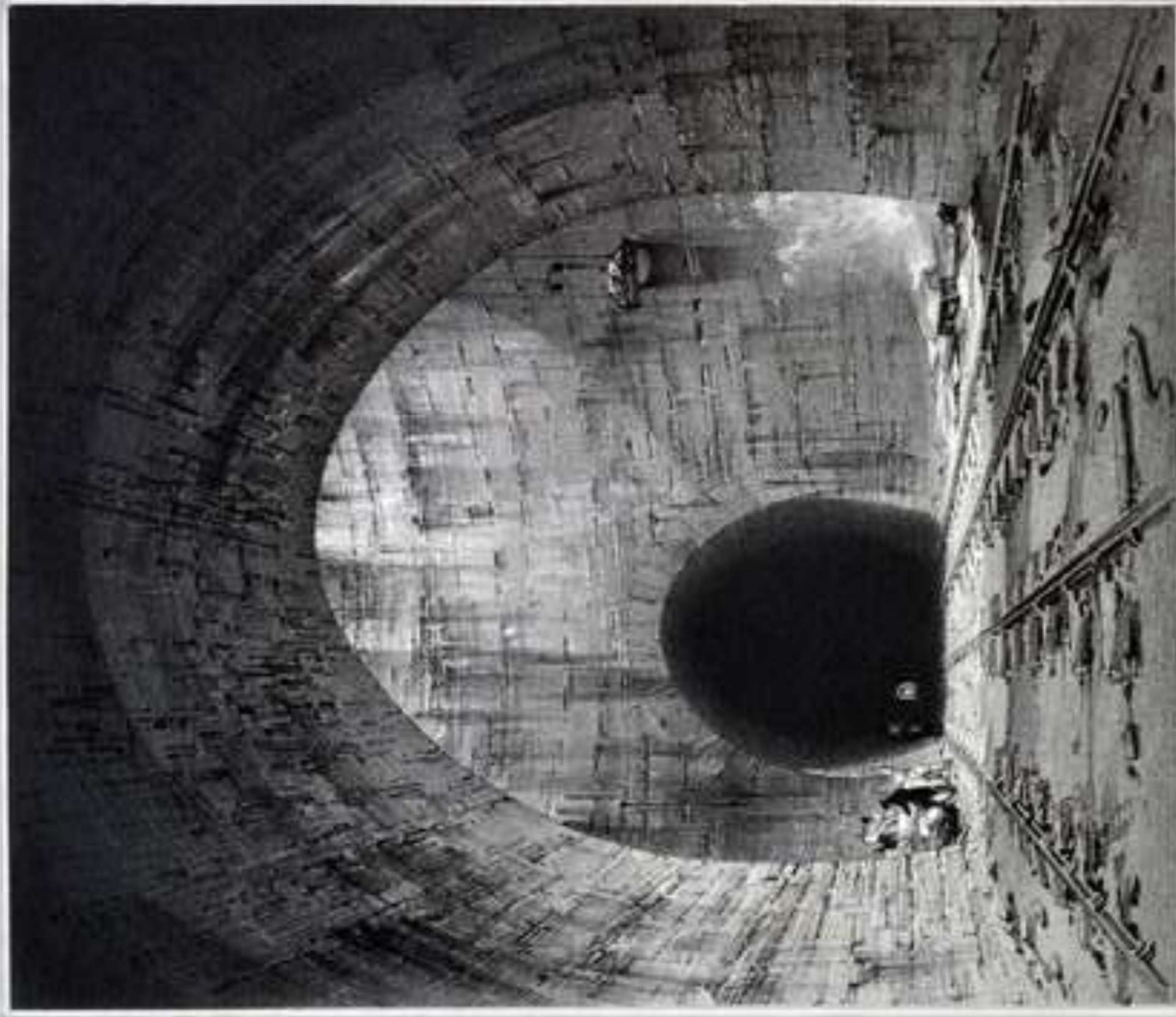
Kingston Incorporated as a Town in 1838
Kingston City Hall commissioned in 1841 to be Capital of Canada
Completed in 1844 – never used as Capital
Incorporated as a City 1846



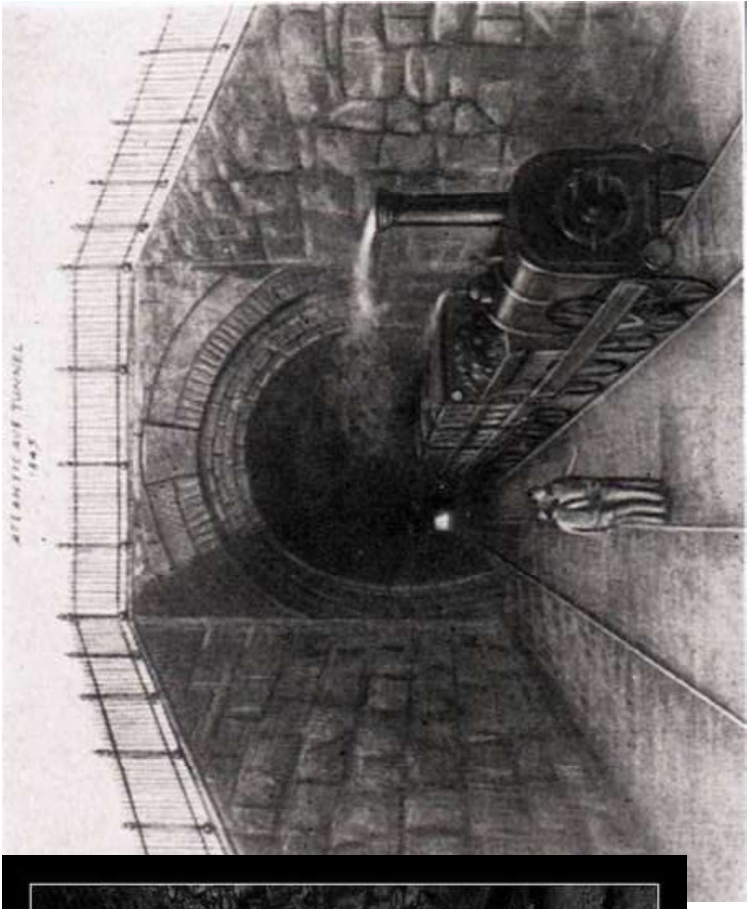
Kilby Tunnel and Ventilation Shaft

1838

Northamptonshire
England



THE GREAT TUNNELING SHAFTE - NORTHAMPTONSHIRE



1844

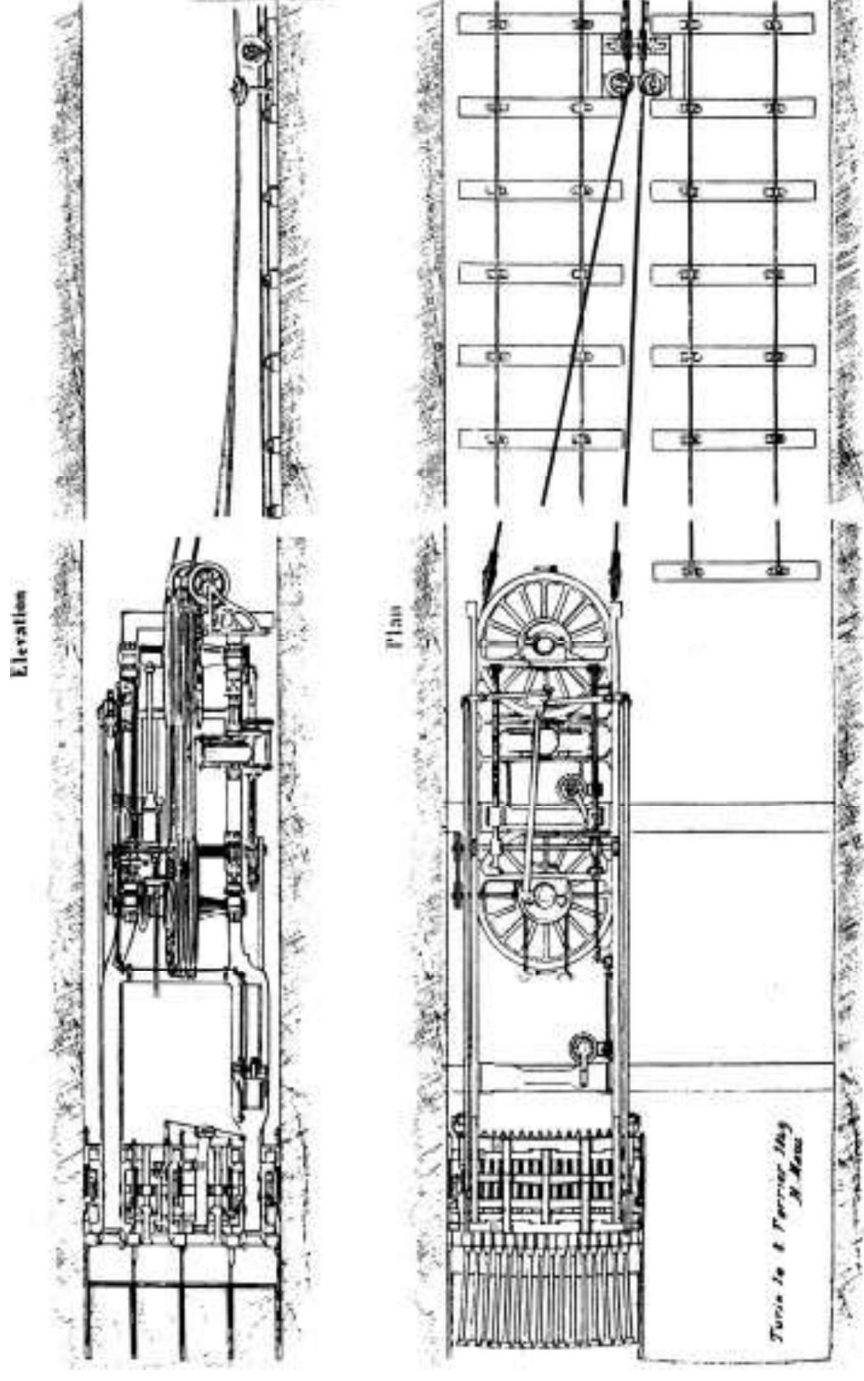
Long island Rail Tunnel – Atlantic Avenue Brooklyn

Les Grands-goulets Road Tunnel - France



First Hard Rock Tunnel Machine Built to construct the Mount Cenis Tunnel 1846

Not used due to concerns about
compressed air efficiency over 12km tunnel



Frame for
Percussion
Drills

Queen's College Established by Royal Charter by Queen Victoria 1841

Classes Begin in a small wood house on Colborne
Street in 1842 (2 professors and 13 students)



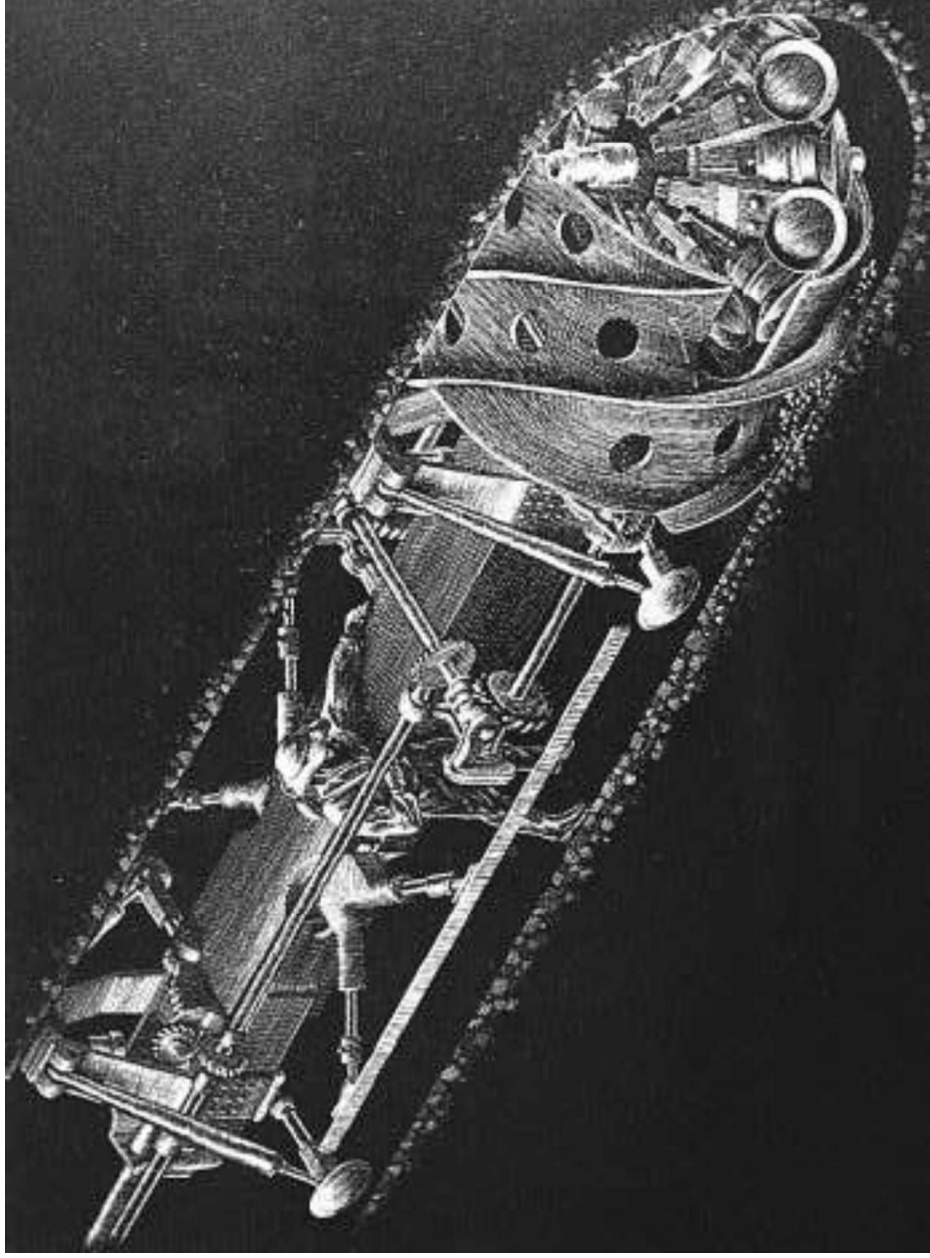
Brunel's Box Tunnel 1841 Between Bath and
Chippenham 3000 ft - Longest Rail Tunnel



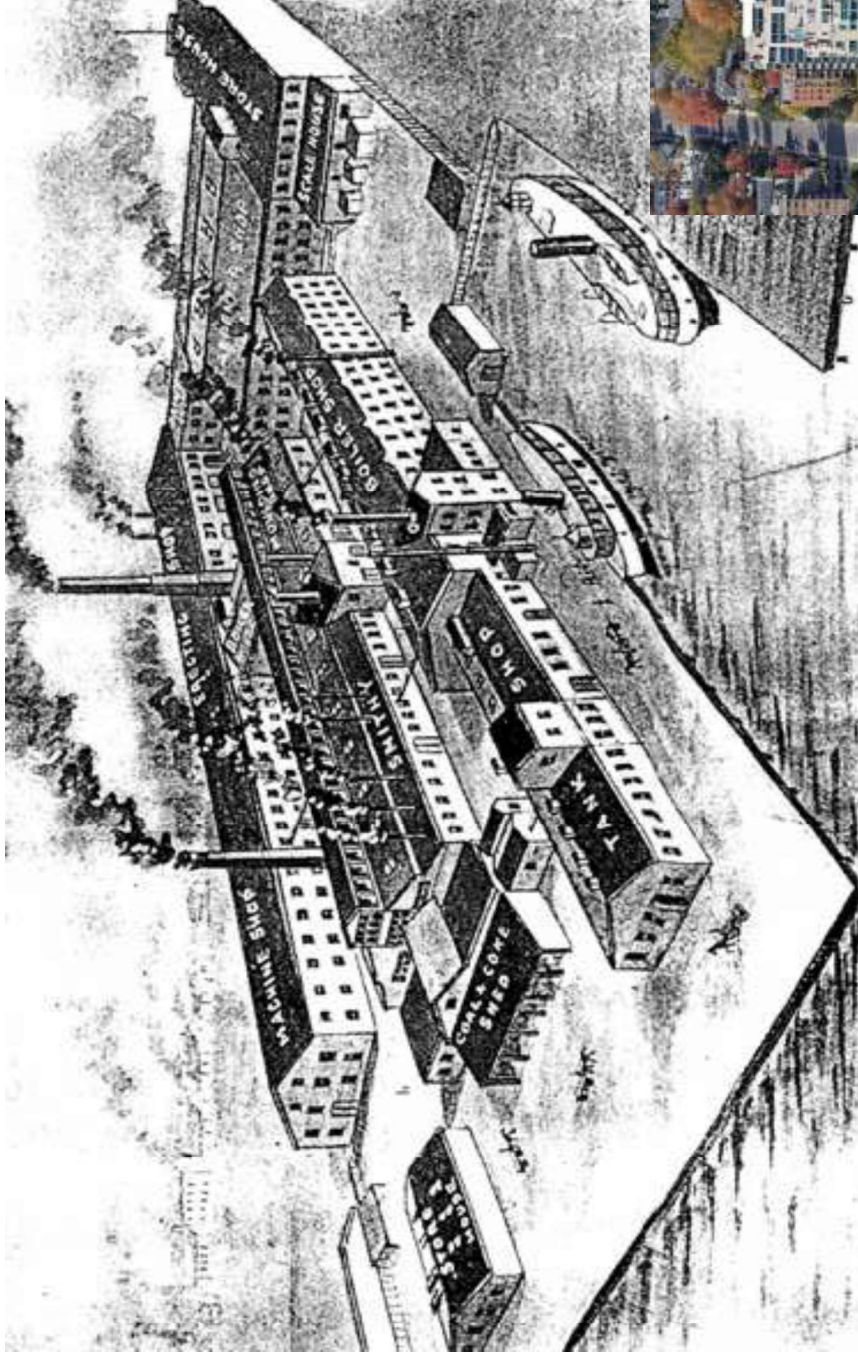
My House Built in 1847
Spice Mill, Abatoire, Meat Market,
Rooming House, B & B, Chez Diederichs



First Patent for a Disc Cutter 1847
Charles Wilson (USA)
Machine Built and Tested in 1851-53



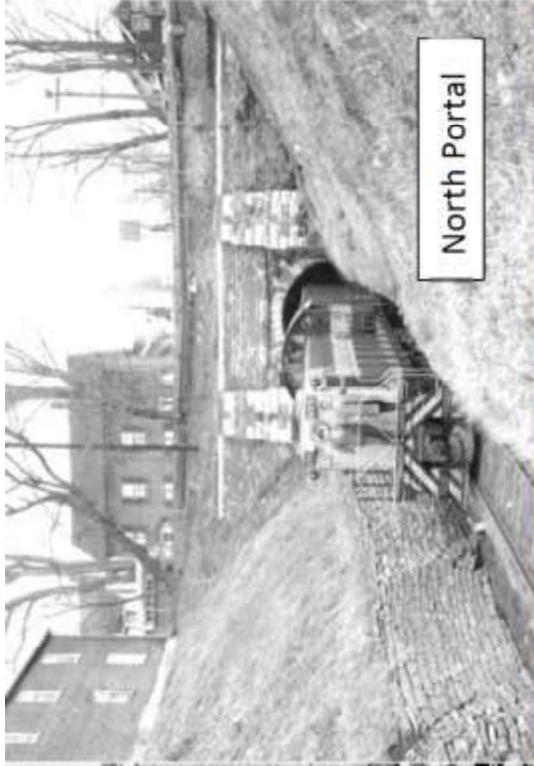
1854 Kingston Locomotive Works



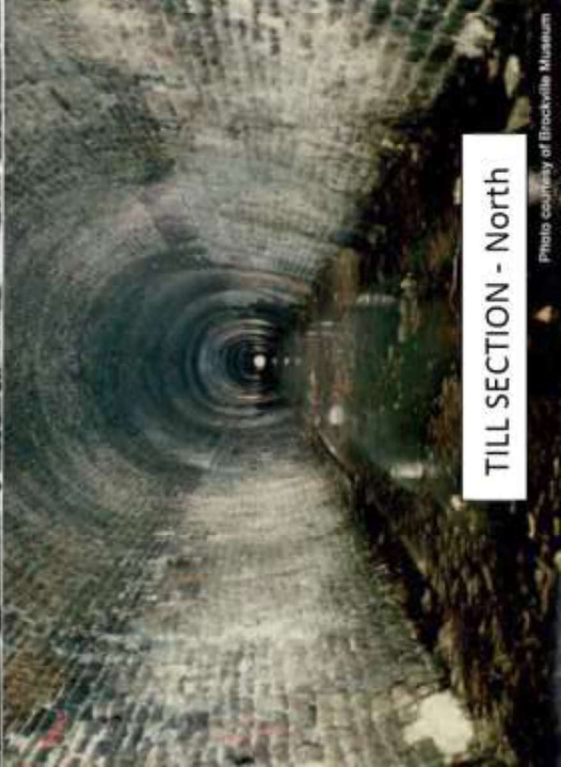
1854 Brockville Tunnel Begins Canada's First Railway Tunnel



South Portal

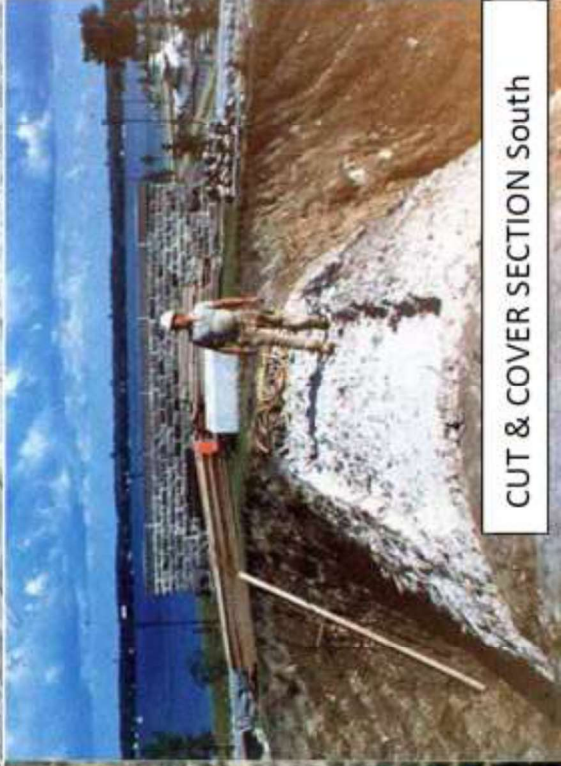


North Portal



TILL SECTION - North

Photo courtesy of Brockville Museum



CUT & COVER SECTION South

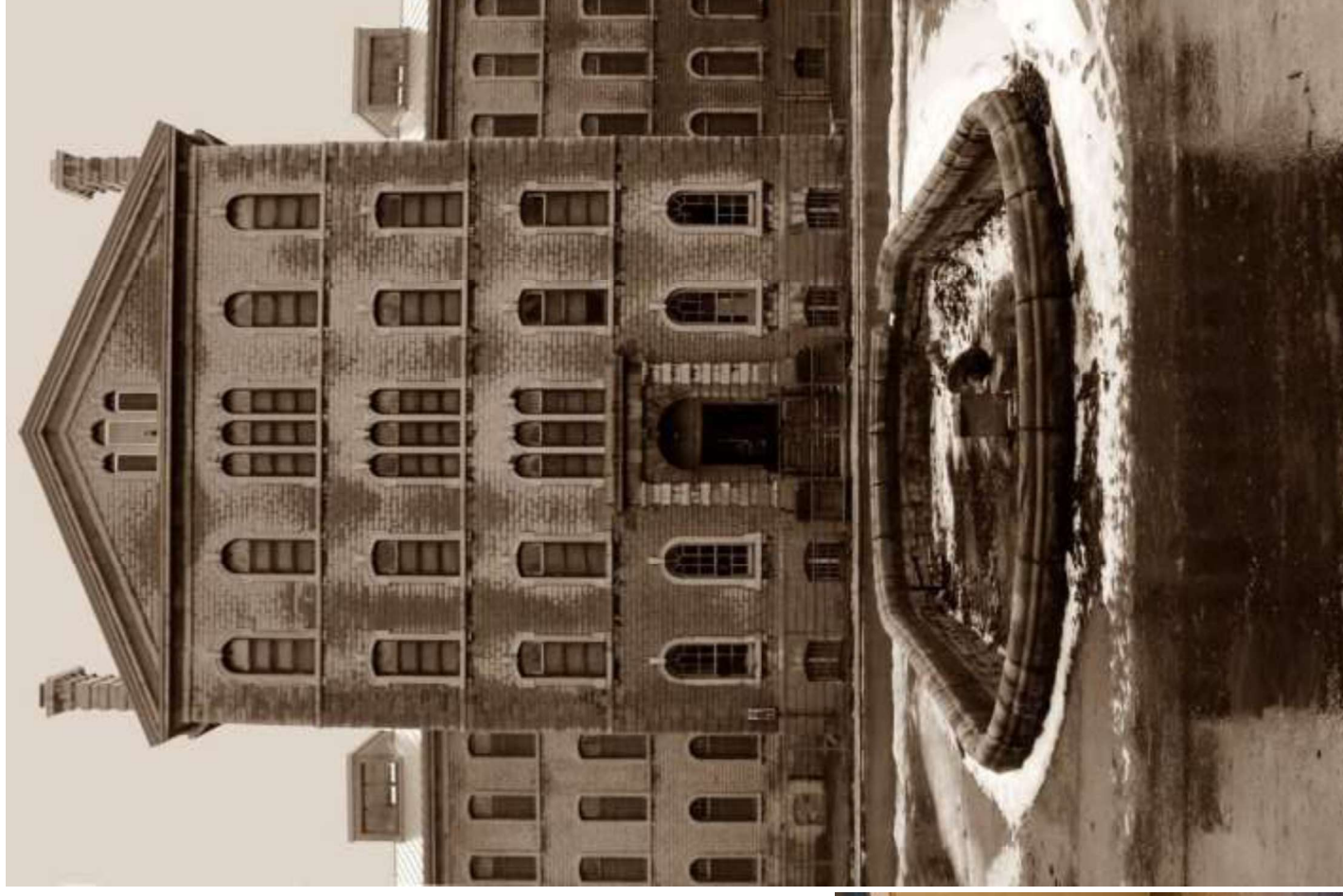
1854 Brockville Tunnel Begins Canada's First Railway Tunnel



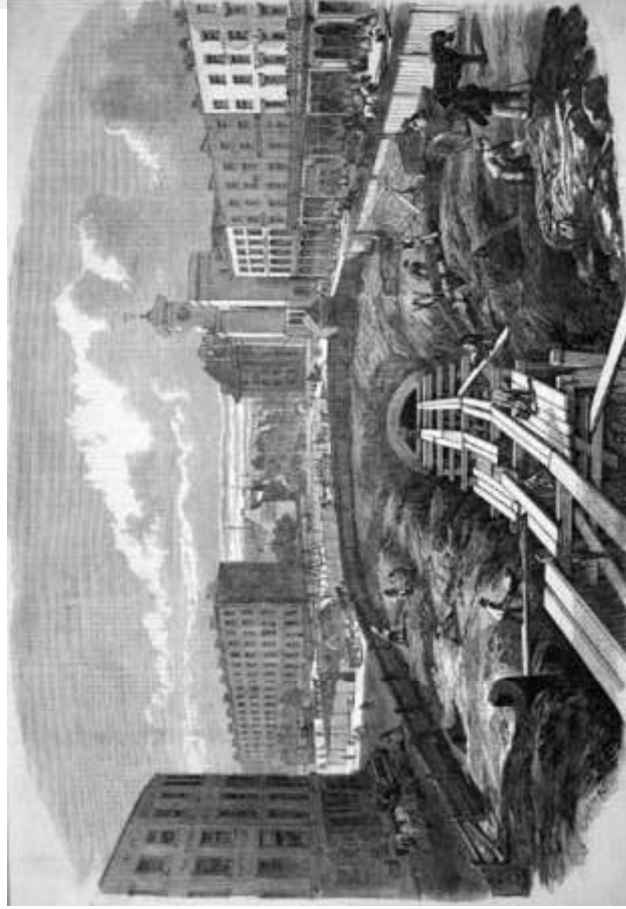
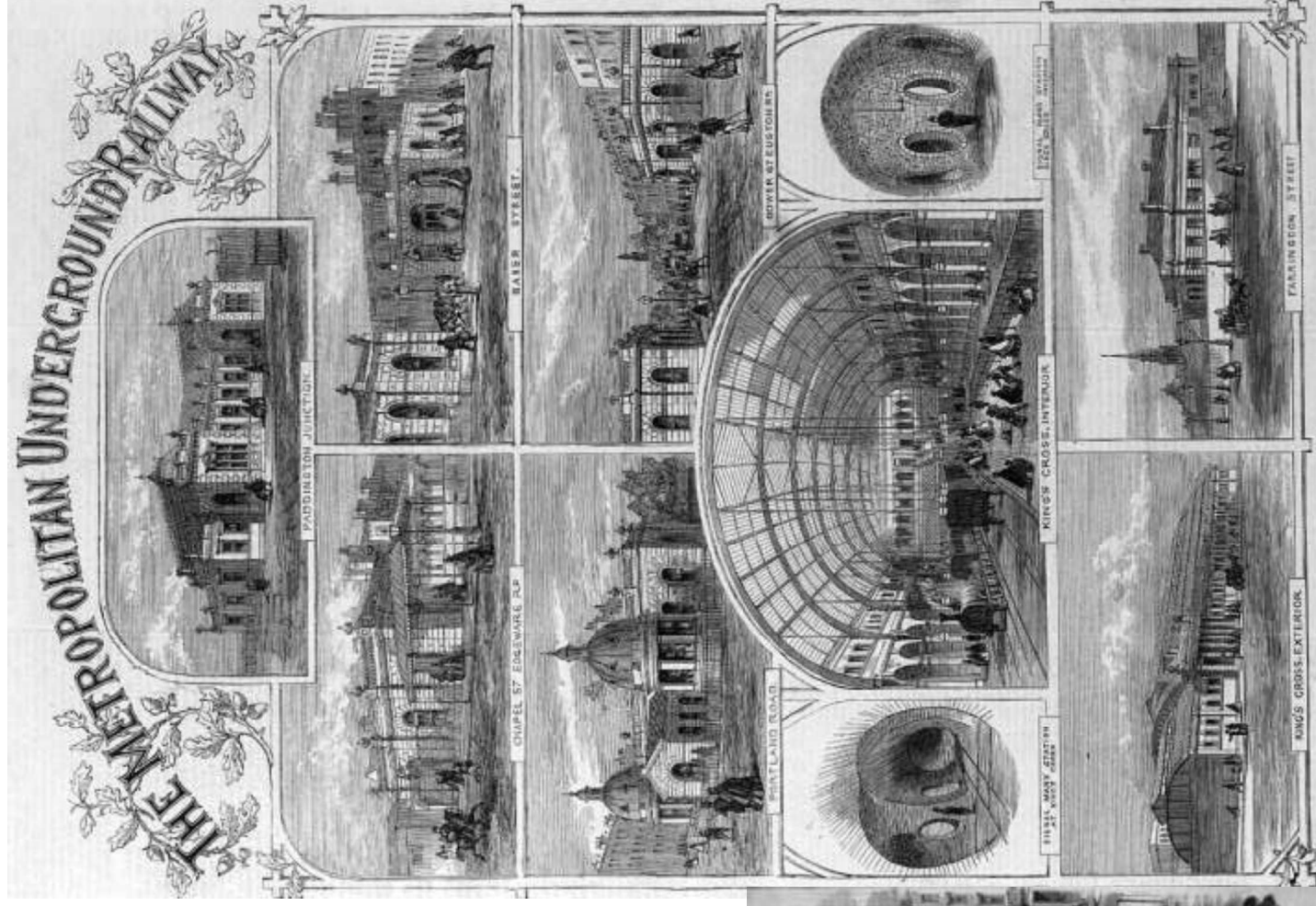
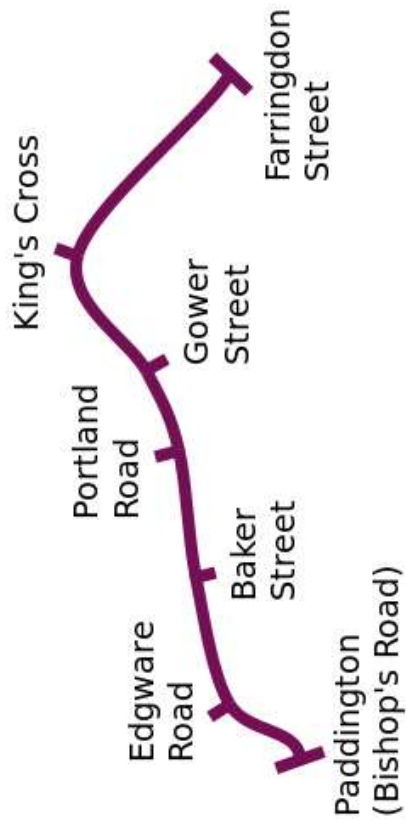
1854 Brockville Tunnel Begins Canada's First Railway Tunnel



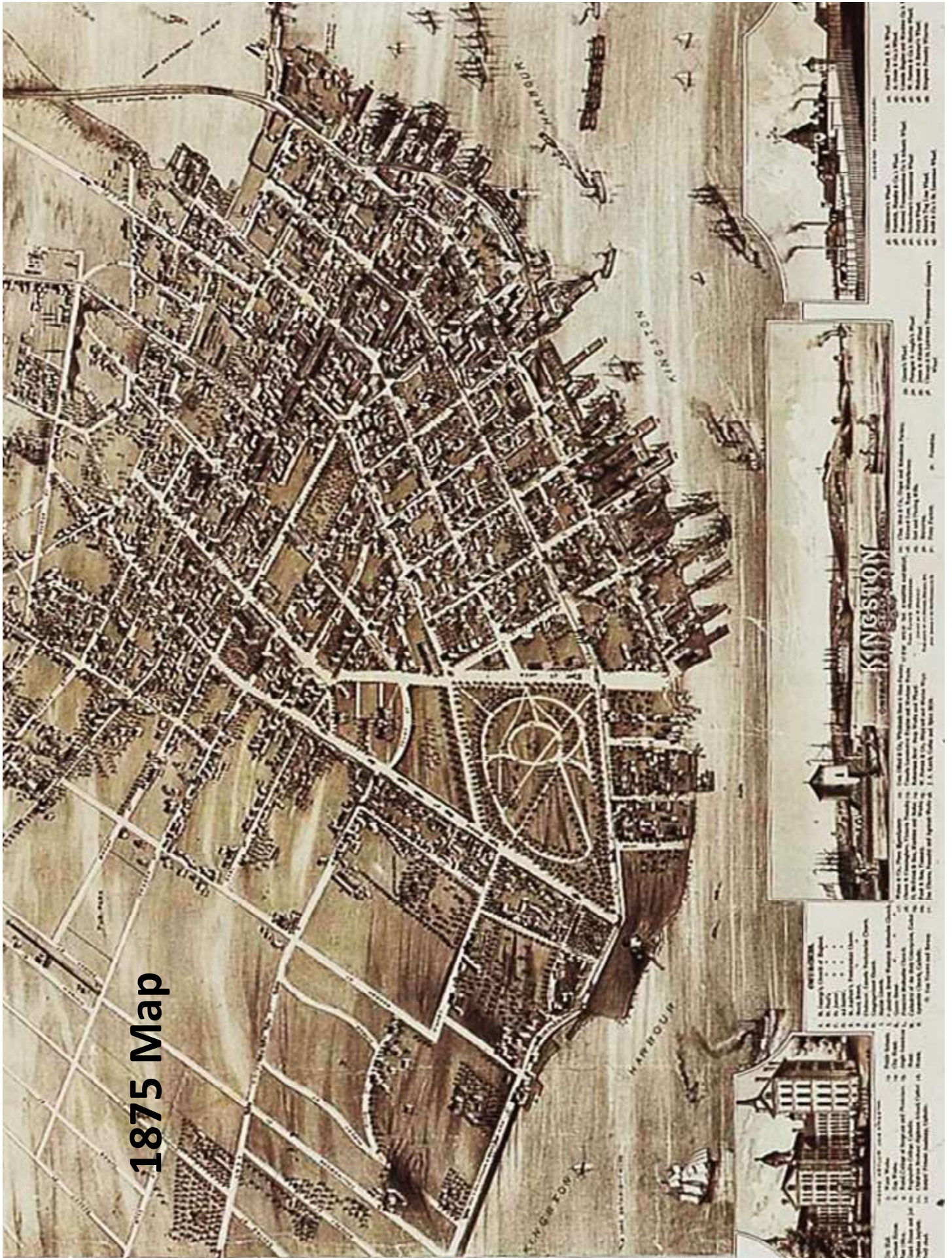
1862 Kingston's Rockwood "Insane Asylum" Opens



1862 – First Subway London



1875 Map



- LEGEND**
- 1. City Hall
 - 2. Court House
 - 3. City Bank
 - 4. City Jail
 - 5. City Prison
 - 6. City Almshouse
 - 7. City Poor House
 - 8. City Workhouse
 - 9. City Hospital
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 - 11. City School
 - 12. City Church
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 - 30. City Anchorage
 - 31. City Wharves
 - 32. City Docks
 - 33. City Piers
 - 34. City Quays
 - 35. City Harbors
 - 36. City Bays
 - 37. City Straits
 - 38. City Inlets
 - 39. City Coves
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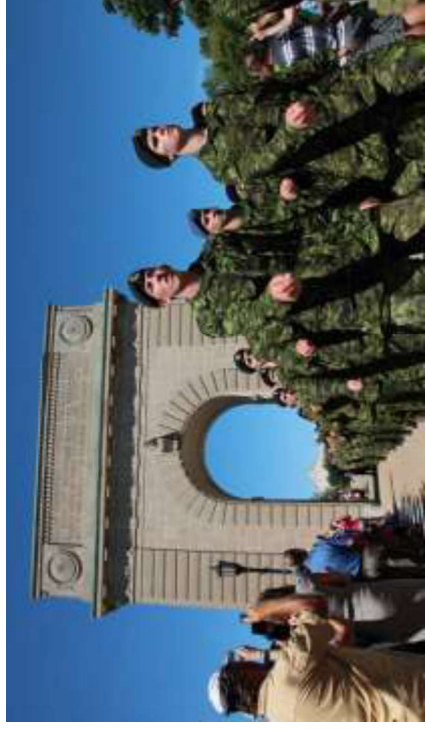
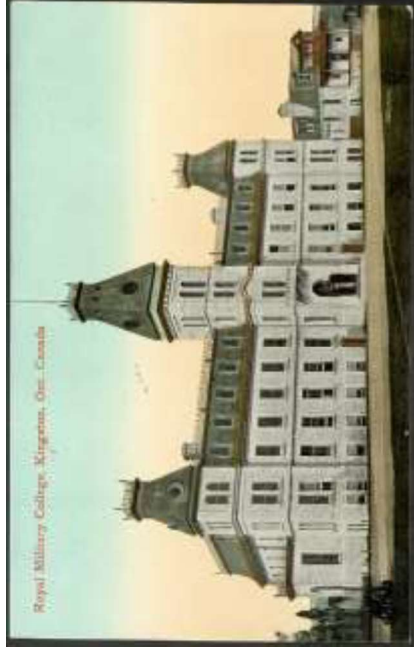
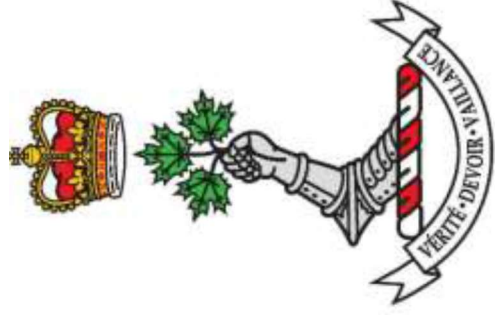
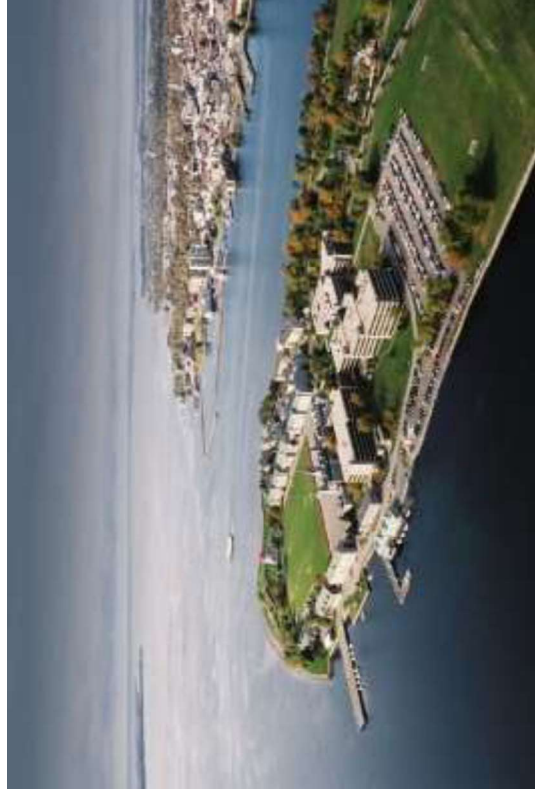
Hoosac Tunnel Vermont

1875

7.64km \$21million



1876 Royal Military College Established



1876 Hex River Rail Tunnel (Left Bore)
Longest Tunnels in Africa 13.5 km



1881 Queen's Granted University Status

Theology Hall
Served as
The Central
Queen's
Building for
Many Years



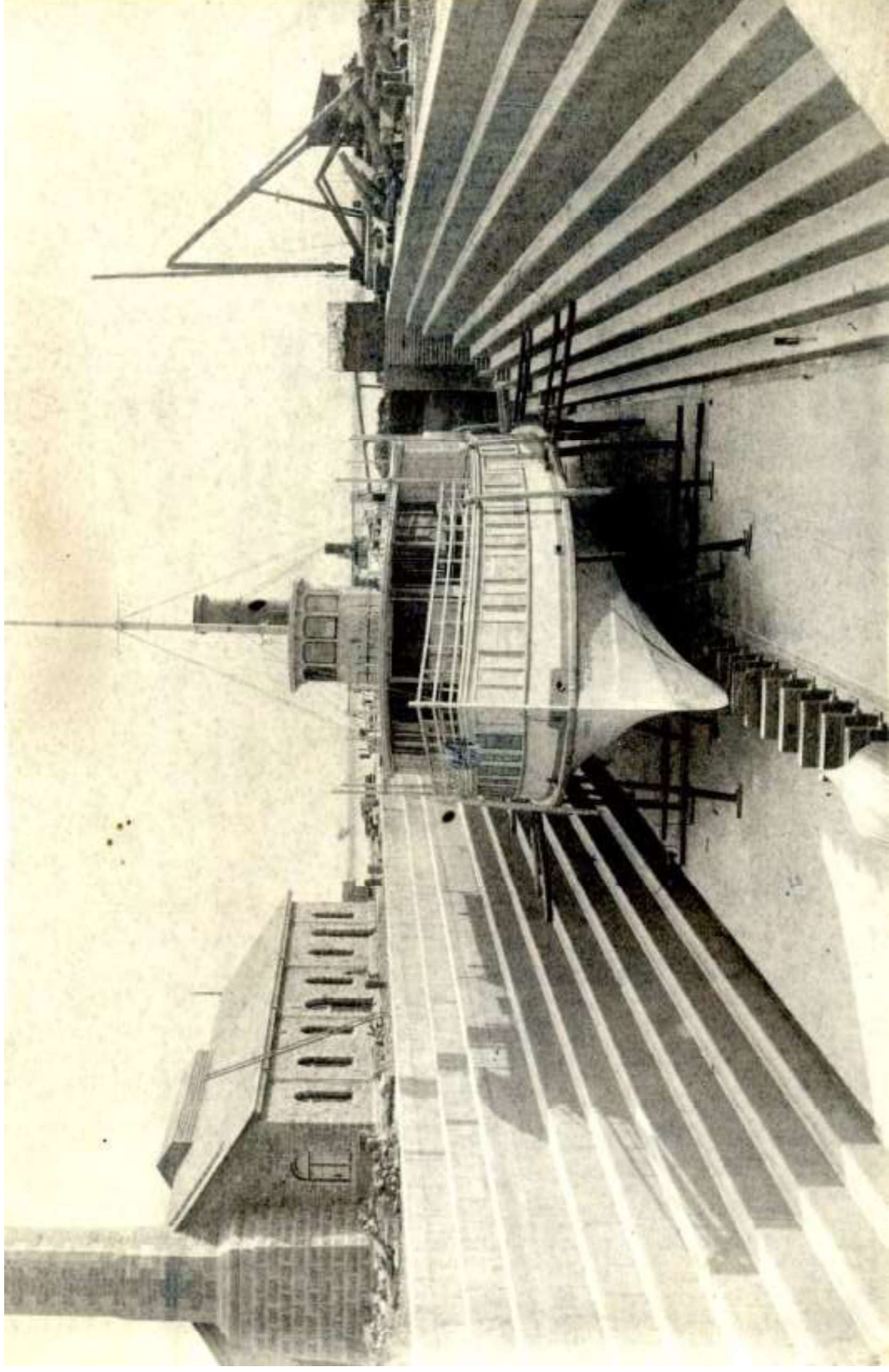
1881 Gotthard Rail Tunnel Opens
15 km long cost 200 lives



1890 – Kingston Dry Dock

First Accusation of Political Patronage

\$350K Project commissioned in the riding of Sir John A Macdonald



Grant Hall 1905



Queen's and RMC at War

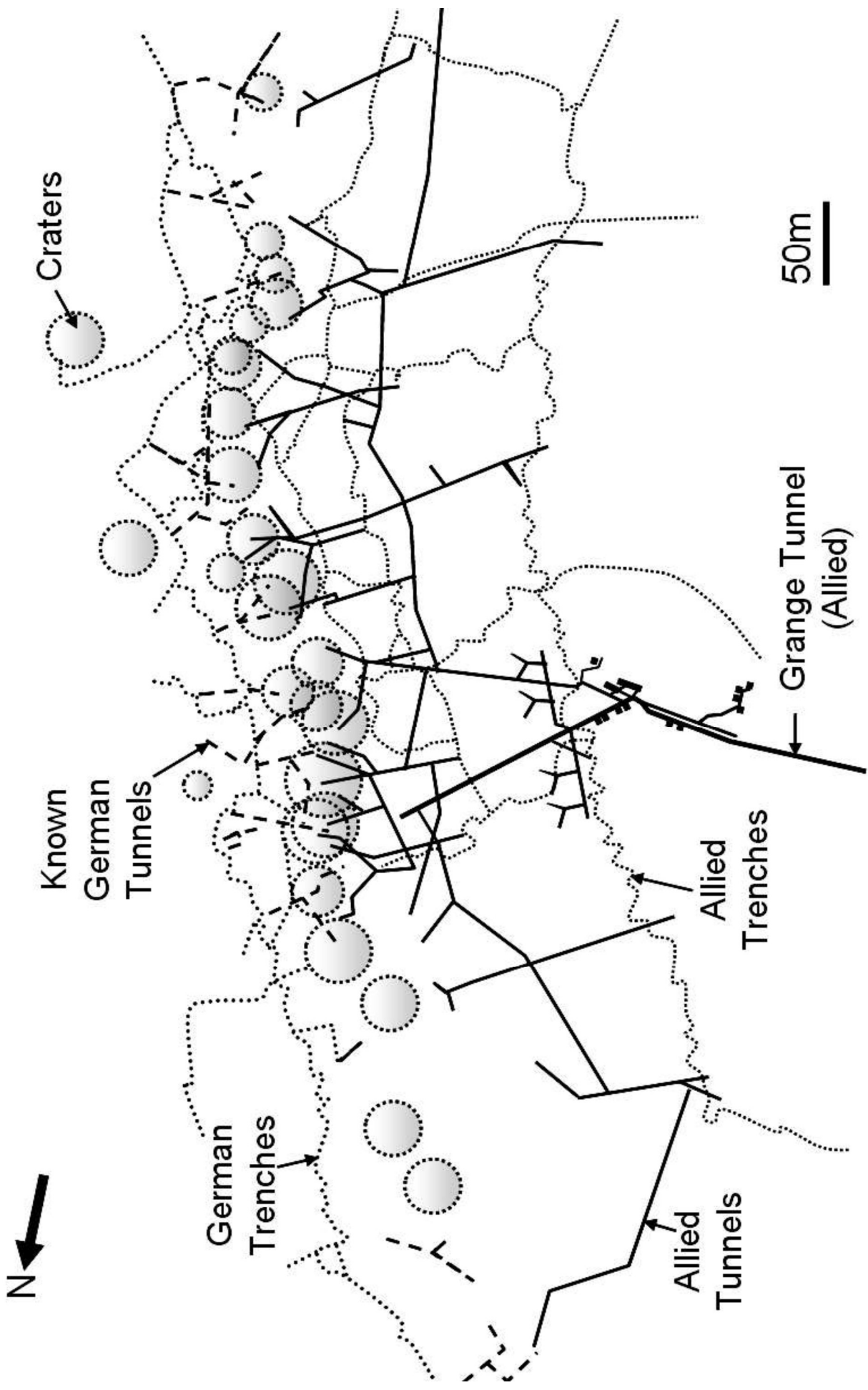
1500 Queen's Students and

1000 Ex-Cadets from RMC

fought in WWI

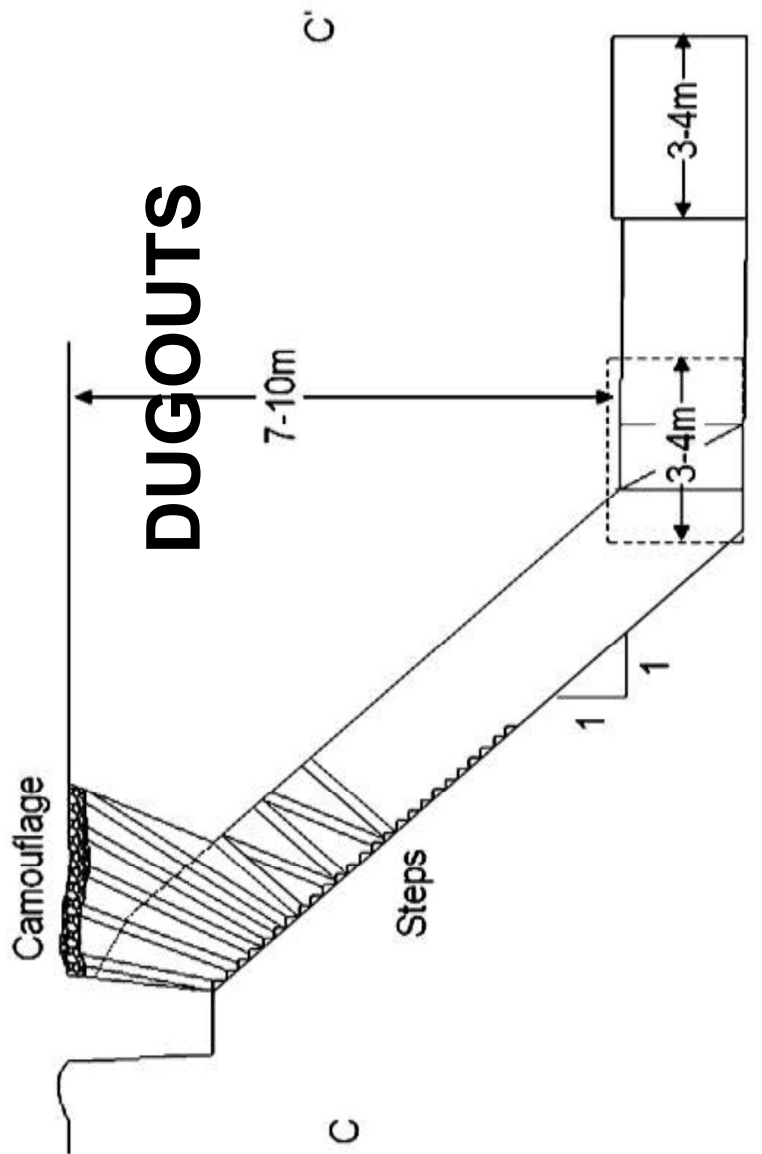
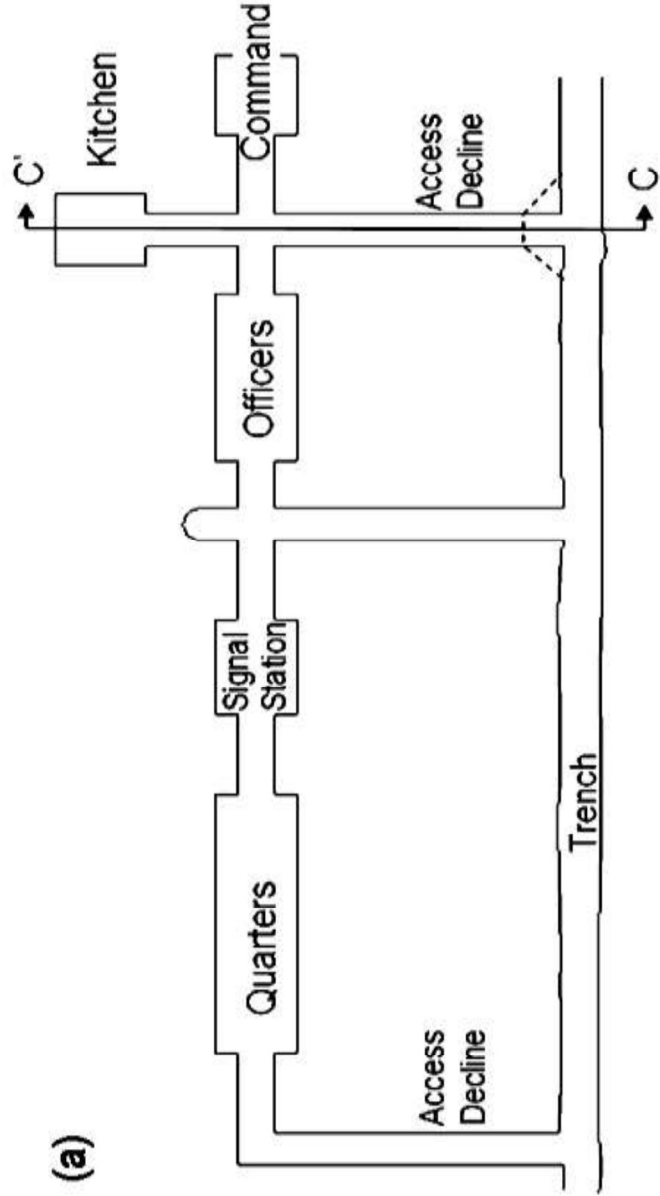


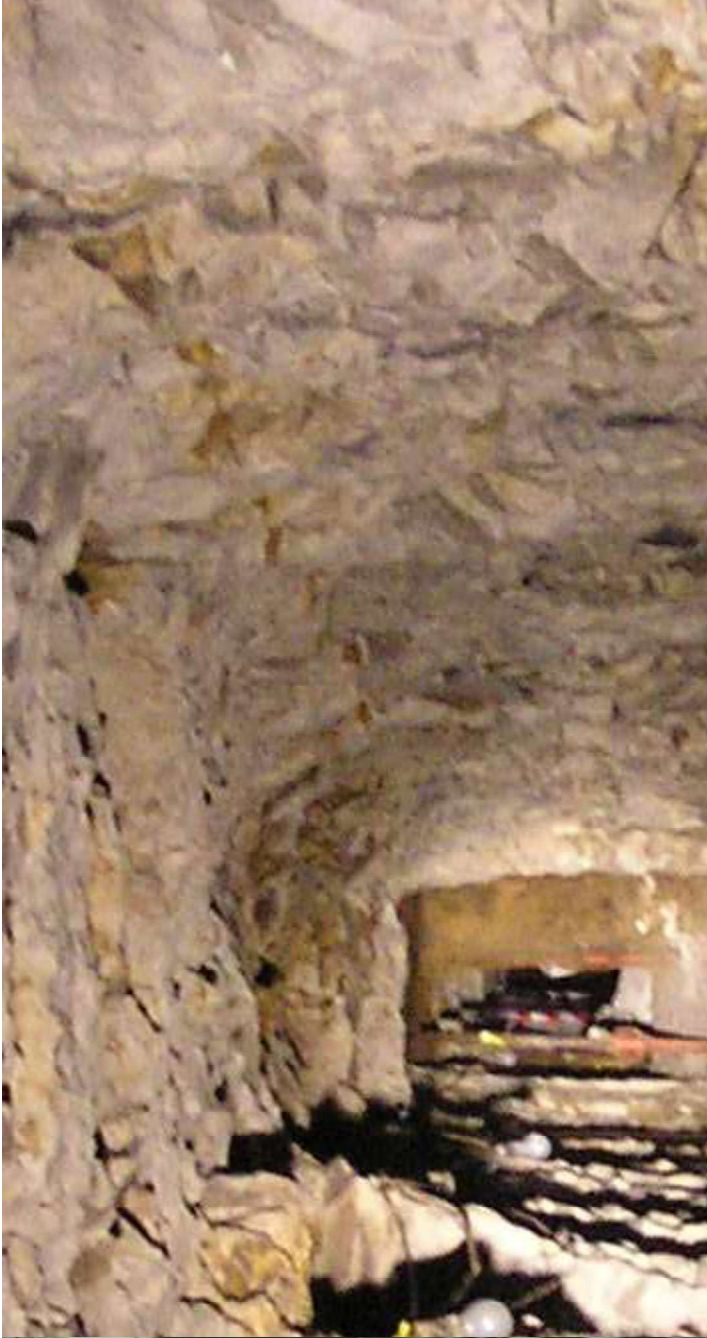
Canadian Tunnels and Craters at Vimy



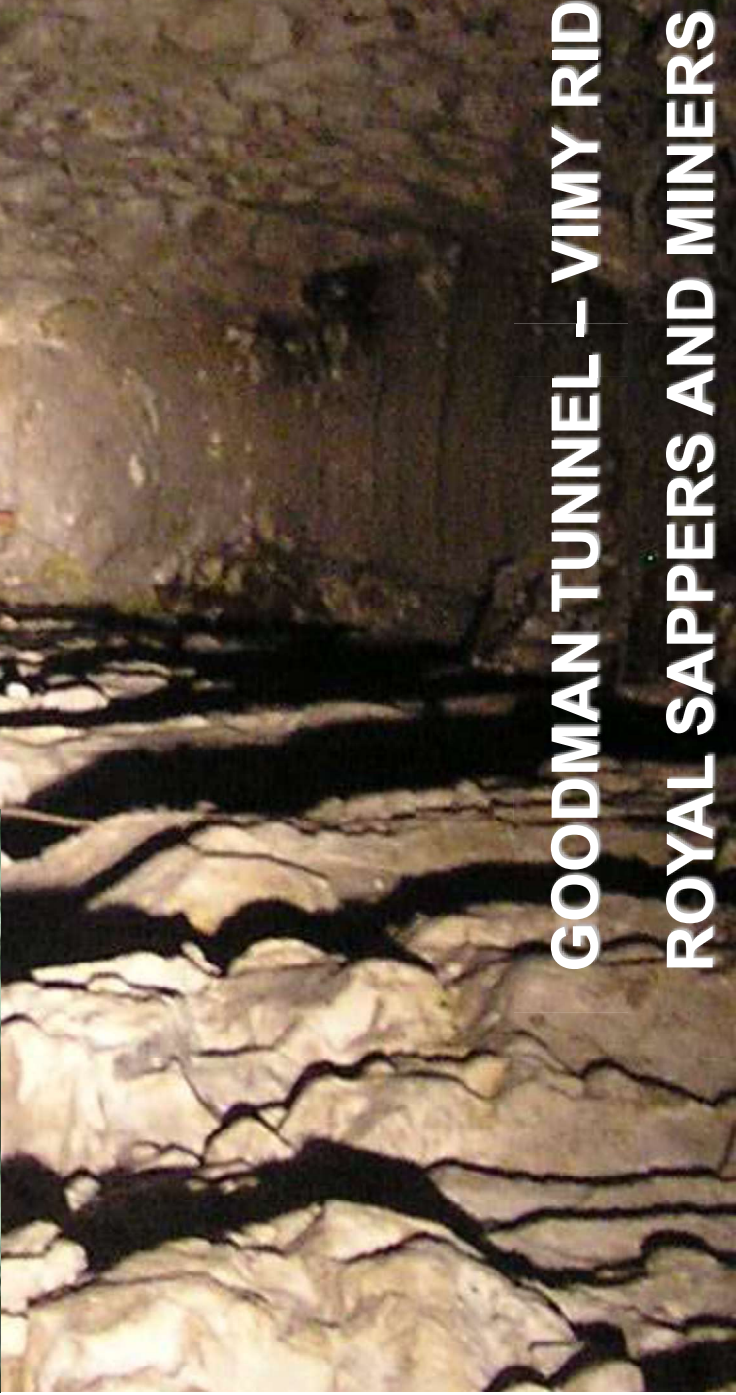
Sapper's tunnels







**GOODMAN TUNNEL -- VIMY RIDGE
ROYAL SAPPERS AND MINERS**



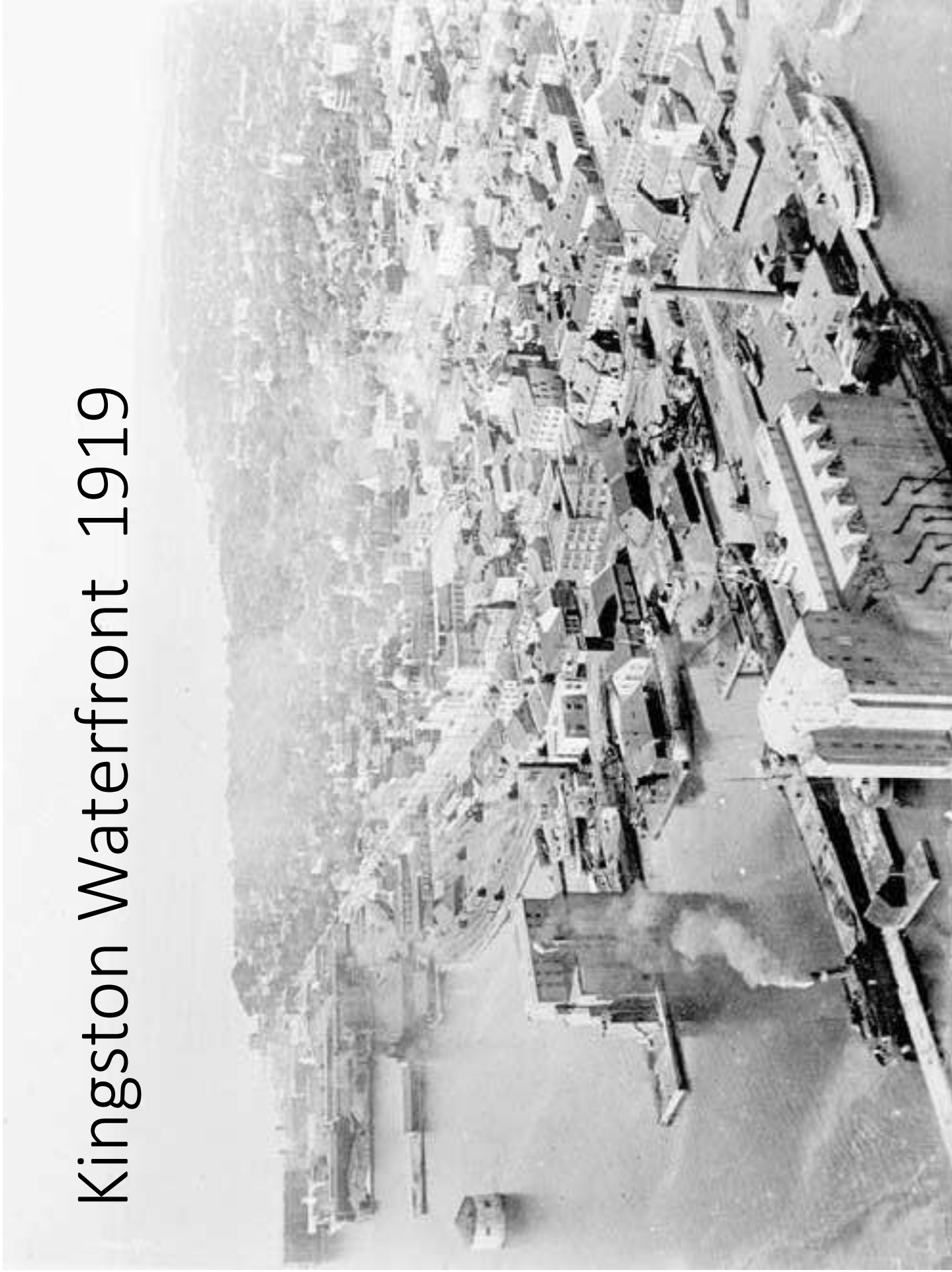




Queen's University 1919-20



Kingston Waterfront 1919



1919 Othello Tunnels BC

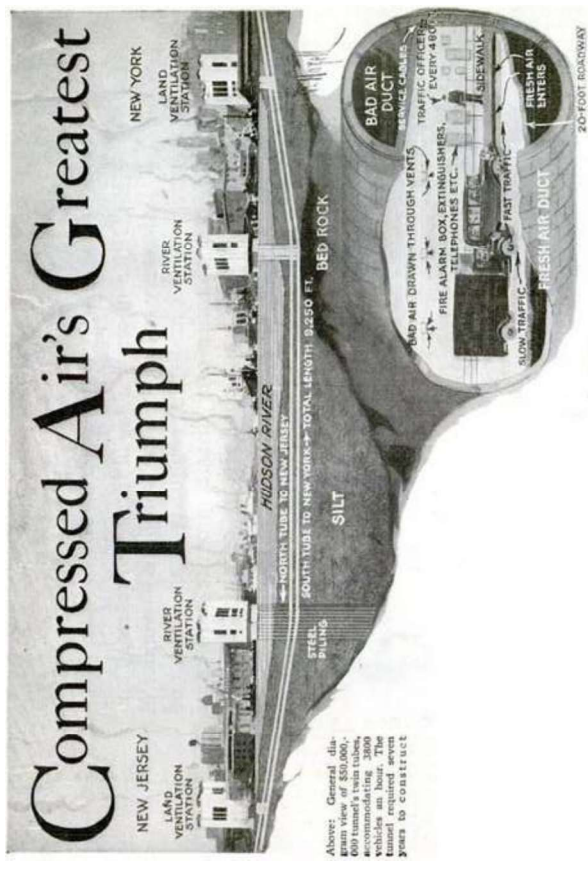
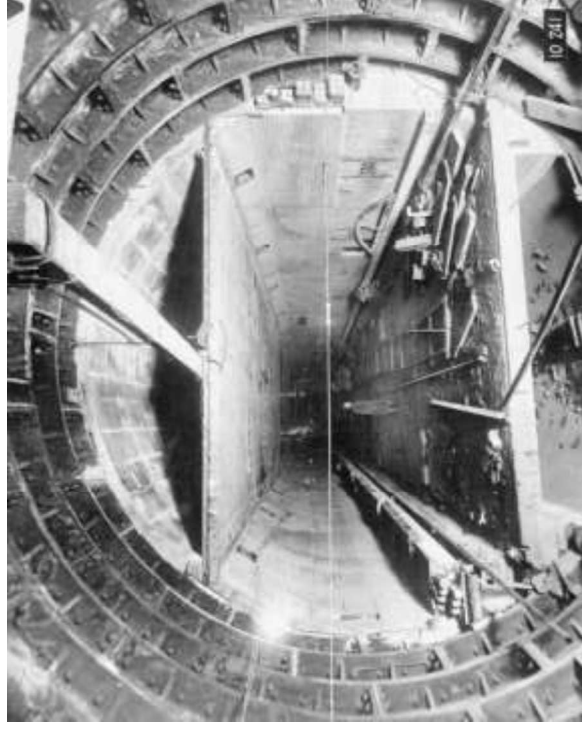
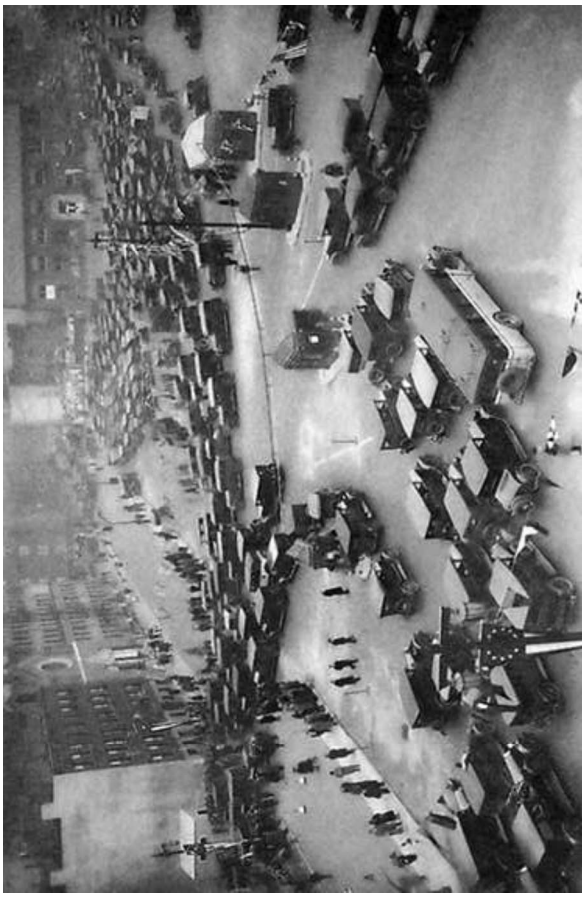


Kettle Valley Railway (KVR)

1920 Paris Metro Expansion



1920-1927 Construction of the Holland Tunnel New York City



1930 Windsor Detroit Tunnel

First to Link Two Nations

Windsor-Detroit Tunnel

Is Unique; Cost Is

\$25,000,000

Nov 17-1930

1,000 Cars Hourly

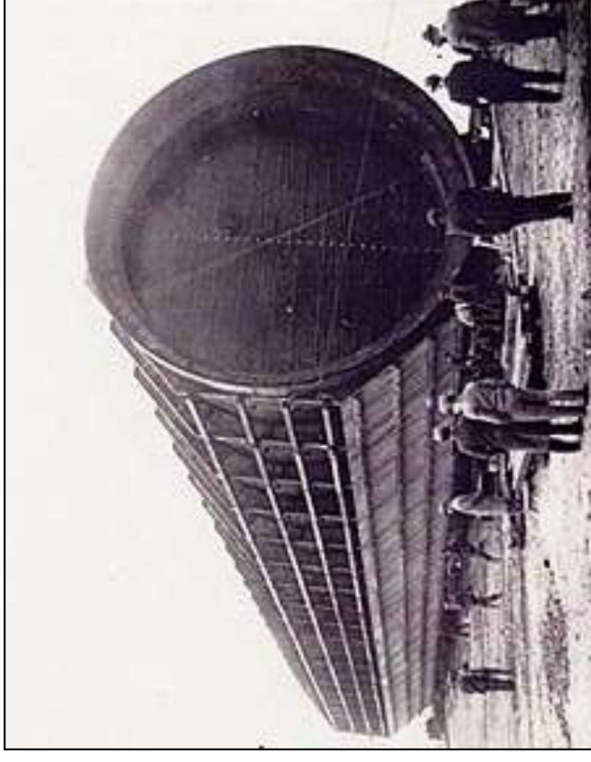
Capacity Of 22-Foot Road-

way Is Large; Saves

Time For Commuters

The Windsor and Detroit tunnel is the first vehicular subway ever built between two nations. Two others are in use in the United States—the Holland tunnel in New York and the George A. Posey tunnel, connecting Oakland and Alameda, California.

Construction took about 26 months to finish and was completed almost one year ahead of schedule. The total cost was \$23 million.



Queen's at war again WWII

QUEEN'S



C. O. T. C.

Under the direction of Major E. H. Brown, M.C., B.D., of the 1st Dr. Guards, General's Foot Guards, together with Capt. P. C. Fock, an anti-aircraft officer with the C.O.S., Queen's, the full-time members of the C.O.T.C. during the last and winter months. Freshmen and sophomores contributed 150 hours of their time to this. Next year freshmen students only hours.



The strength of the program was increased by approximately 300 all ranks by the inclusion of cadets from the University Air Squadron, which was disbanded in December in accordance with the demobilization policy of the RCAF.

The training program included two weeks at the Cranleigh Range, Oriskany, in November and December, and a week at the RCAF base at the Cranleigh Range, Oriskany, in November and December. A great deal of time was spent on the firing of rifles, shotguns and blasting caps. The fire power of enemy weapons and methods of chemical warfare were demonstrated.

These classes, with the assistance of the C.W.A.C., W.R.N.S., and R.C.A.F. W.D. members, but the special role of some 150, and most prominent, CONRAD camp was "The Best Yet".



Top left - Lt Col. E. A. Walker, Colonel Walker, C.O.T.C., C. S. 1000th at Cranleigh Range, Oriskany, in November and December, 1945, when Colonel Walker visited the camp of 11 weeks. After arriving camp with the Royal Canadian Ordnance Corps, Colonel Walker came to Queen's at the request of the English Department.



A year's end of winter training is done in the barracks when the training year ends. At left, Capt. H. C. Fock, demonstrates the mechanics of marksmanship preparation to entering C.O.T.C. trainees in D.C.S.A. winter range competition.



Many tunnels during this period

Movie based on true first-hand account of the mass escape from Stalag Luft III in Sagan



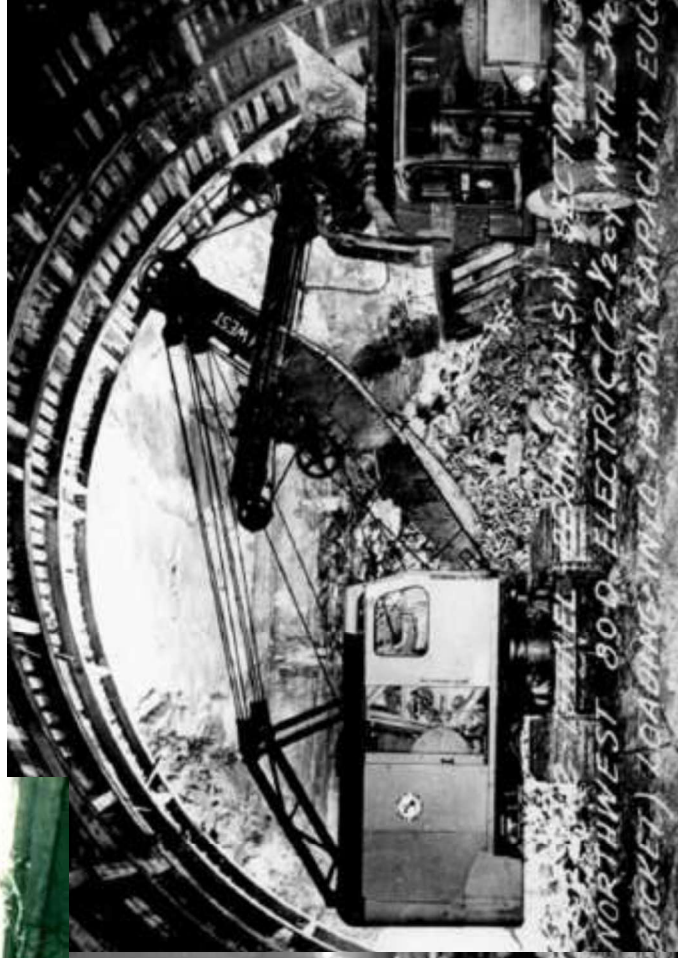
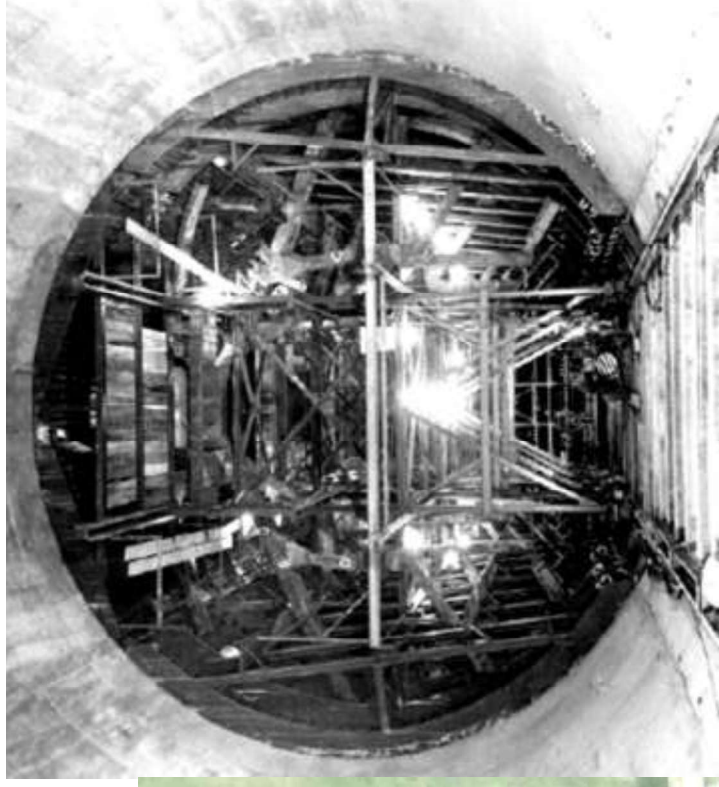
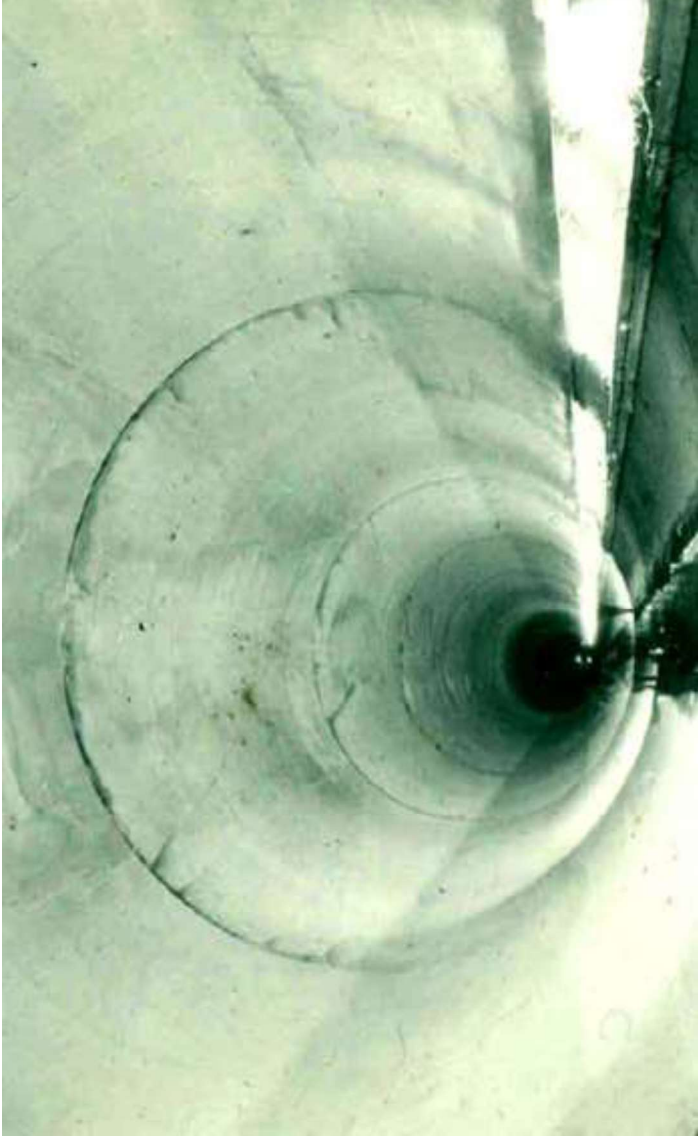
1953 Queen's University gets a New Boss



The 50's Toronto Subway



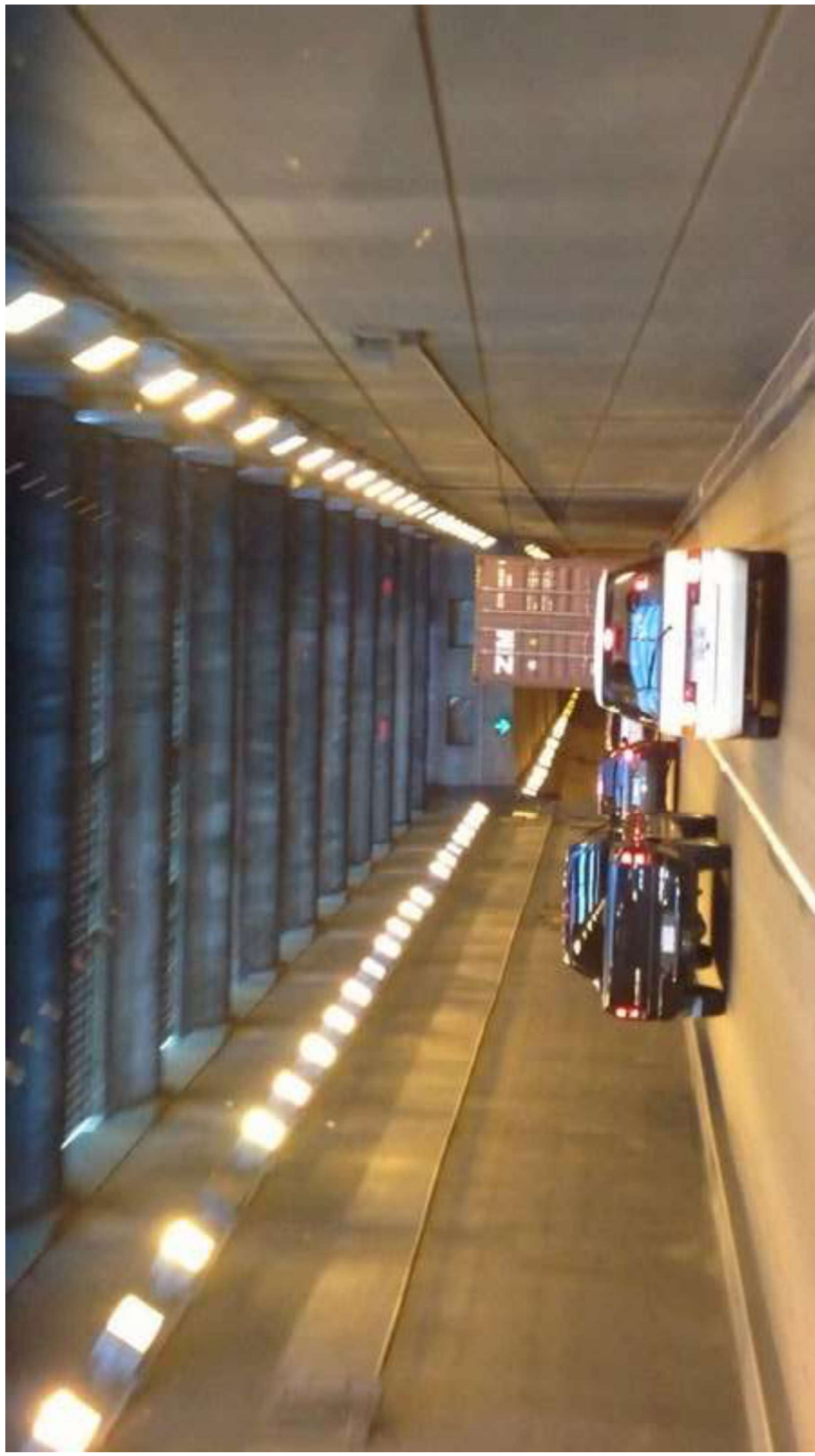
The 50's Niagara Beck II



The 50's George Massey Tunnel

Vancouver

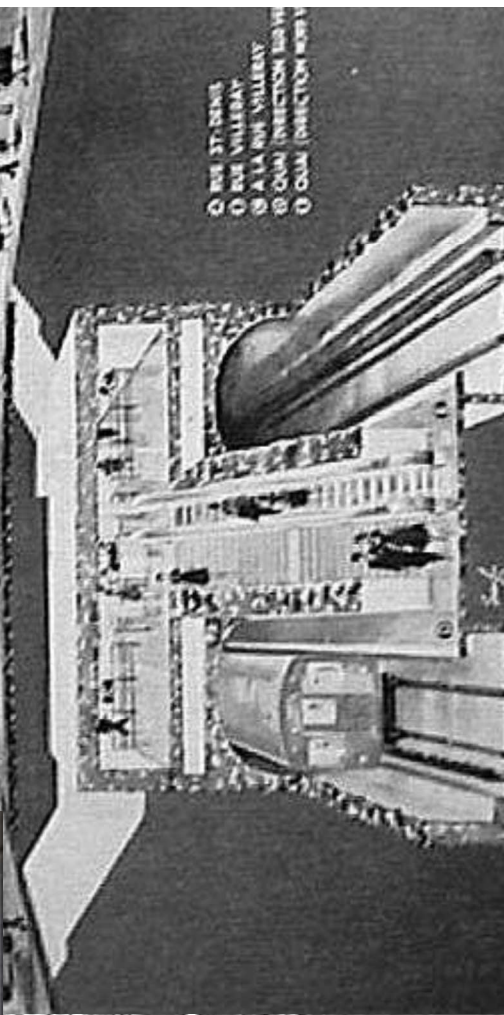
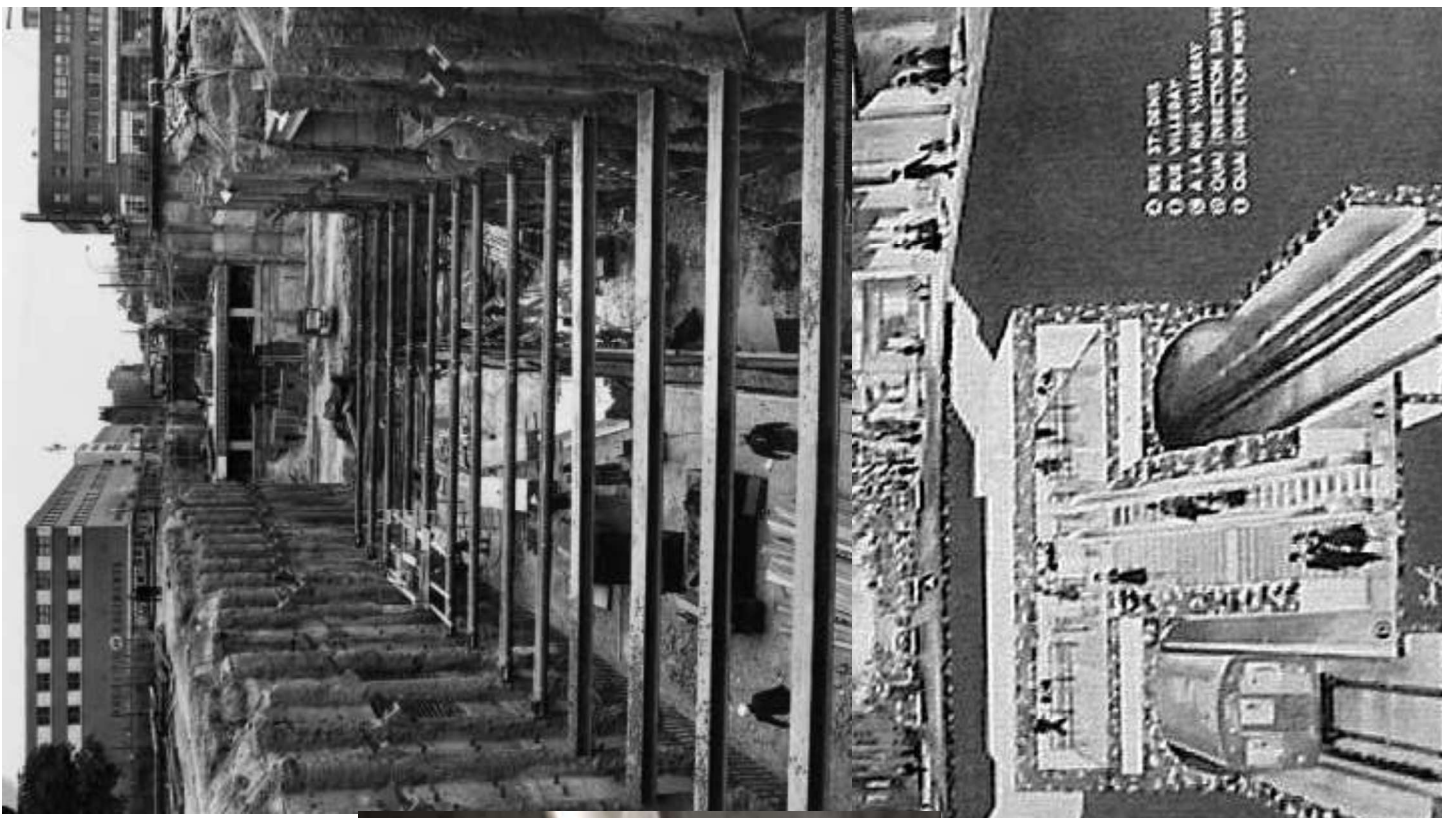
Immersed Tube Tunnel Completed on Time and on Budget



1960's St. Lawrence College Opens



1960's Montreal Metro



1960's Mont Blanc Tunnel



1970s

- Ugliest building in Canadian History is Erected on Princess (also tallest in Kingston so no one is spared the pain!)



1970s HongKong Cross Harbour Tunnel

Two steel road tunnels each with
two lanes constructed using the
single shell immersed tube method

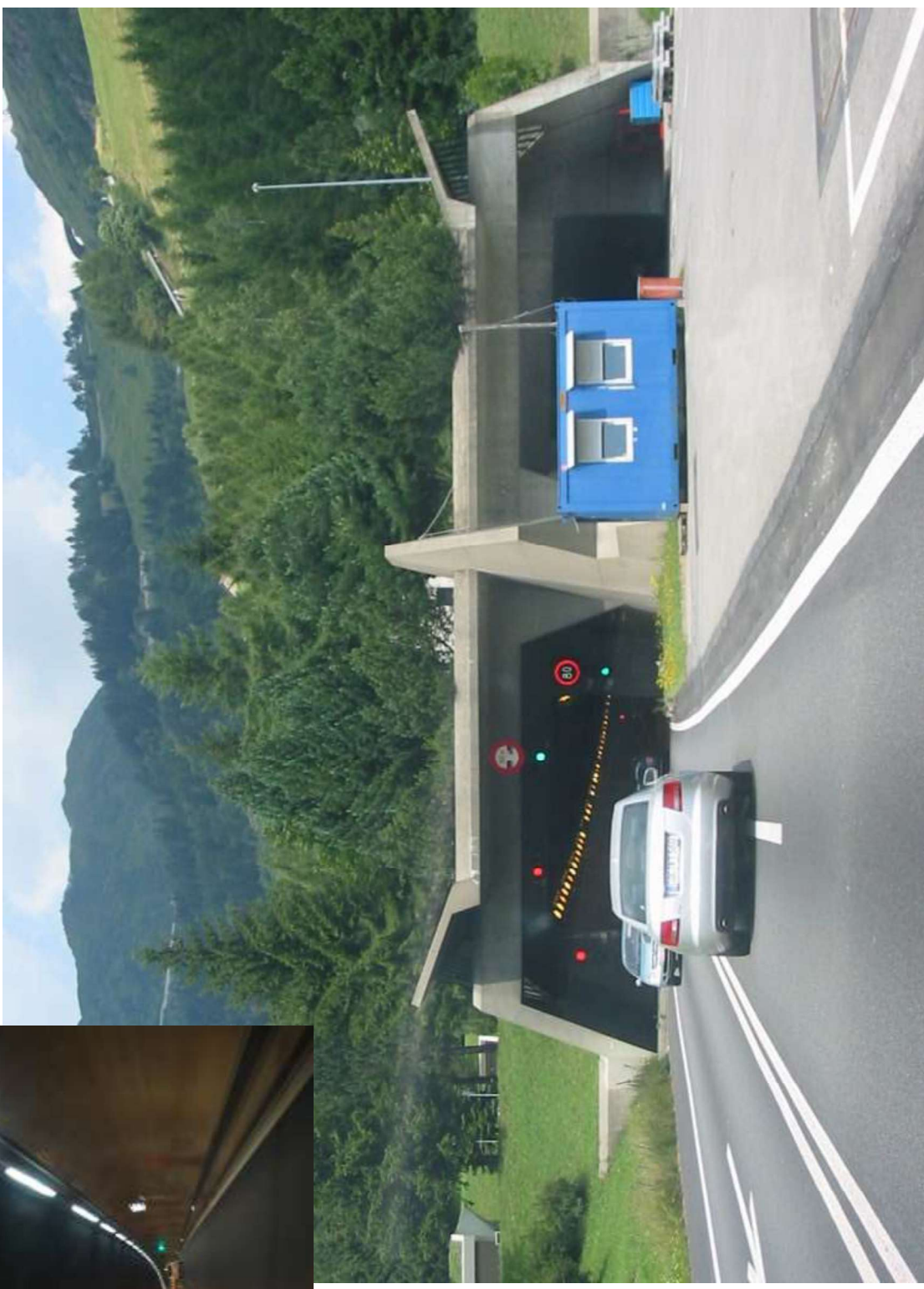


1980's
The
DISCO
YEARS

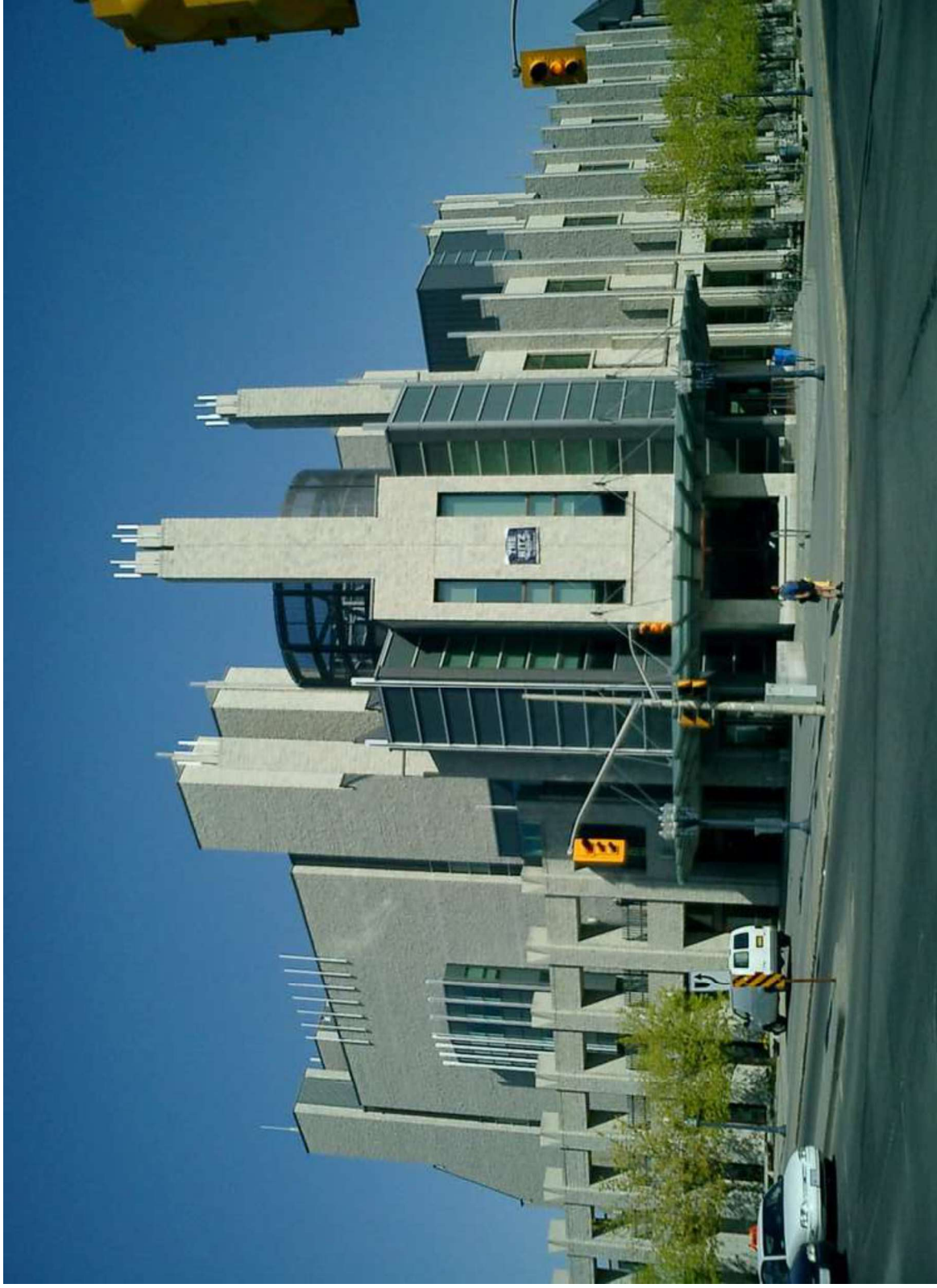


1980's Gotthard Road Tunnel, CH

17km

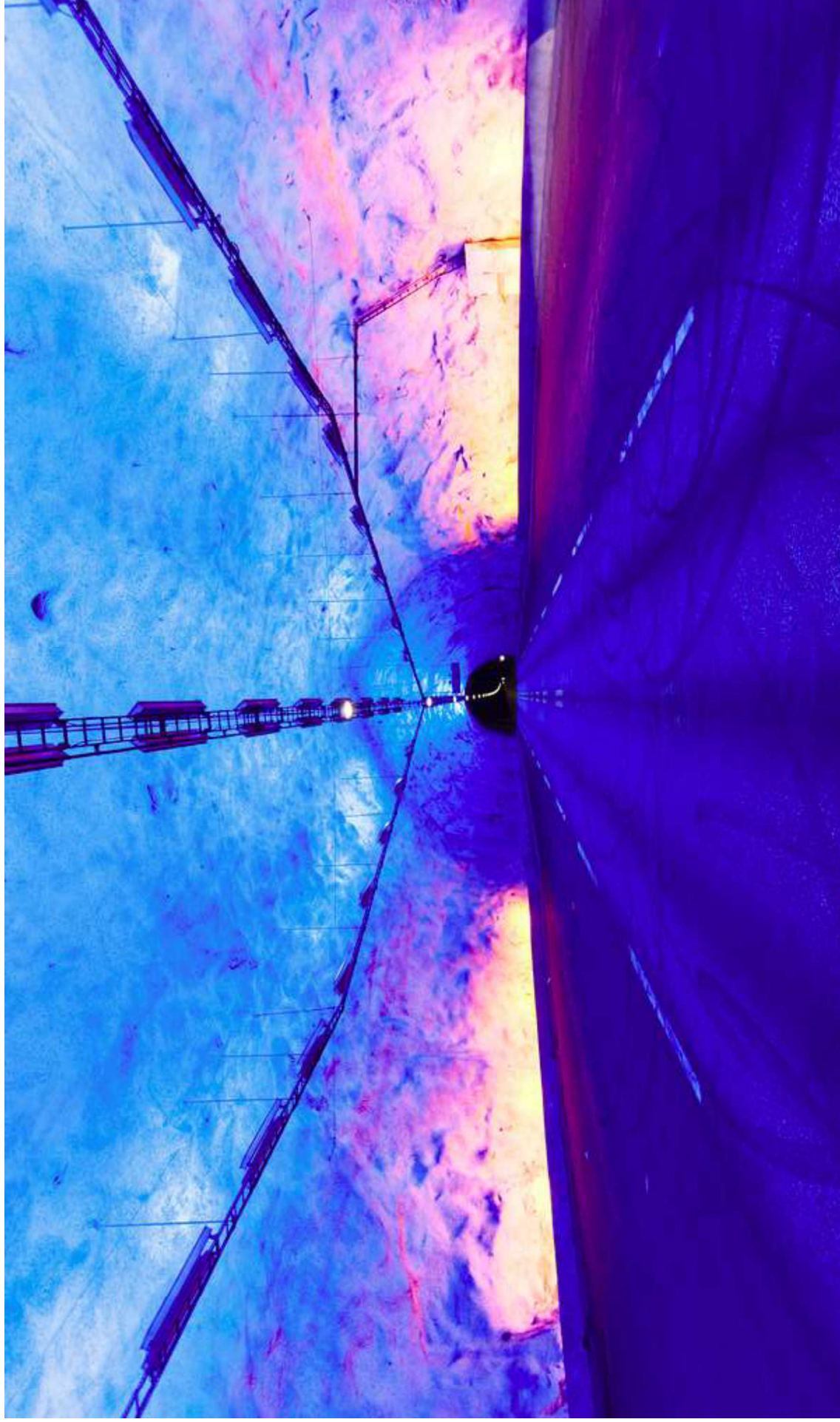


1990's Stauffer Library



1990's Laerdal Tunnel Norway

24.5 km First Rockbursts in a Transport Tunnel



21st Century Kingston and Queen's Renewal



Niagara Beck III Tunnel



Niagara Beck III Tunnel



Gotthard and Loetichberg Base Tunnels, CH



Ceneri Base Tunnel, Switzerland



Torino METRO
Italy



Thessalonaki METRO
Greece



Sparvo Tunnel, Italy



Barriefield Sewer Line Kingston's First TBM !!



Thank You !
Enjoy your dinner!

