A Wire to the New World

The Transatlantic Telegraph Cable

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Quarter Century Wireless Association
National Capital Chapter 70
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Queen Victoria Sends a Text

Plaque opposite the Cable Station in Heart's Content, Newfoundland. From left: Bill Unger, VE3XT, Glenn MacDonnell, VE3XRA and Bryan Rawlings VE3QN.

Bryan Rawlings, VE3QN

On August 16, 1858 Queen Victoria sat down and composed a text message to US President James Buchanan. Her message of 98 words was transmitted more or less instantly via the new network of telegraph cables to Valentia Island off the west coast of Ireland. There a telegrapher carefully began retransmitting the words, one by one, through the 19th century's newest wonder – a cable 2200 miles long lying on the ocean floor uninterrupted by any yet-to-be-invented amplifying devices and ending at a primitive galvanometer in a small village in eastern Newfoundland.

Victoria's message did indeed get to President Buchanan but not much else afterward. A lack of understanding of both the physical and the electrical factors affecting cables of this length doomed the 1858 cable after only three weeks of frustrating operation. In a testimony to the perseverance and the optimism of the age, however, both the energy and the massive funds to try again were summoned and a much-improved cable was laid from Valentia Island in 1865. It snapped and sank just off the Newfoundland coast. Undeterred, the promoters of the cable project ordered up another batch of cable and a second cable was laid in 1866 to Heart's Content on Trinity Bay. It worked perfectly. So satisfactory was it that the 1865 cable, spliced new cable to it and brought the second cable into Heart's Content. Europe and the Americas have never been out of touch since.

The world's press hailed the transatlantic cable's completion with a sense of marvel only equalled in the twentieth century by the Apollo moon landings. Suddenly, what happened in London was instantly known in New York and, via the connected cable networks, from San Francisco to Alexandria. Heart's Content, Newfoundland became for the several decades that followed the centre of the telecommunications world.

Those who conceived the 1858 cable were aware that undersea cables had previously been brought into operation, connecting England to Ireland and to Europe and between southern Europe and North Africa. However, the physics of sending telegraph signals through 2200 miles of wire and of laying and protecting that length of cable under the North Atlantic were challenges that had to be met and overcome and this was finally achieved in the 1866 cable.

The physical problems included controlling the speed at which the cable was played out from the cable laying ship as well as managing the weight of the suspended section of the cable until it settled on the ocean floor. This could, of course, be considerable in deep depths and became the cause of the cable snapping with disastrous consequences.

Then again, the electrical theory affecting a circuit of this length was poorly understood.

To detect the feeble current through a loop of this length, the early operators elected to increase the voltage at the transmitting end – a practice that ultimately destroyed the 1858 cable. There was also little appreciation of the accumulated capacitance of the effect on the received signal of the accumulated inductance of the same of wires lying side by side on the conductors. What was crisp CW at one end was smoothed at the far end requiring the sender to slow the code speed to impractical levels. It's a tribute to the early promoters of the cable project that they sought out the best minds of the age to advise on improvements for the 1866 cable – which advice led to their ultimate success.

The 1858 cable was about 5/8-inches in diameter – about the size of a garden hose – and weighed about 2000 lbs per mile. The newer cable used for the 1865 and 1866 cables weighed about twice as much, had several layers of insulation using improved gutta percha and was armoured with a new compound of iron. The cable-laying ship used was the Great Eastern, the spectacular steam and sail ship designed by England's great 19th century engineer Isambard Kingdom Brunel.

Detection of the signal at the cable stations, in an age before headphones, buzzers and electronics, was accomplished by an improved form of mirror galvanometer in which the meter needle is replaced by a carefully-balanced shaft on which is mounted a small mirror. A beam of light directed at the mirror and then reflected onto a nearby surface greatly amplified the small changes in current and permitted a skilled telegrapher to detect the dots and dashes sent from the far end.

These epochal events all occurred before Edison invented the incandescent light bulb, before Bell invented the telephone, before Hertz demonstrated radio waves, before everything we associate today with modern electronics, yet they opened the door on the modern connected world we experience and revel in today. So, by watching the dancing light set in motion by the telegrapher on the other side of the vast ocean, the telegraphers were helping to close out a world separated by time and distance and usher in our modern world of instant communications.

Queen Victoria's great, great granddaughter now gives a New Year's address before television cameras and her image and words are flashed around the world by satellites and fibre-optic cables and watched by many on their tablets and smartphones. Such is the future that was dawning as the electric telegraph first came to Heart's Content.

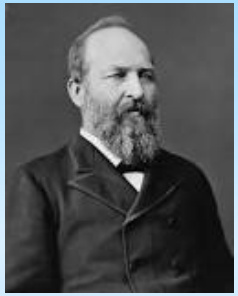
This year marks the 150th anniversary of these great events. We, as Radio Amateurs, and all our fellow citizens in the wider world with their Internet devices and smartphones, trace our communications age back to those simple telegraphers who dared to dream that the Queen of England could indeed text the President of the United States and that in due time we could all communicate instantly with each other. It was fitting that this year's RAC Annual General Meeting was held in Heart's Content at the Cable Station which is now a museum commemorating the telegraph age and the transatlantic cable that terminated there.

First, A Little History …

On April 15th, 1865, President Abraham Lincoln was assassinated

The news reached London 12 days later

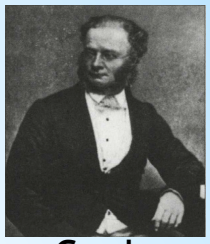
On September 19th, 1881 President James Garfield died of injuries inflicted by an assassin



The news reached London 12 minutes later

This is the story of what made that possible …

The Electric Telegraph …



Cooke

Wheatstone

The practical electric telegraph was the invention of William Fothergill Cooke and Charles Wheatstone of England and Samuel Morse of the U.S.

Morse sent his “What hath God wrought?” message in 1837

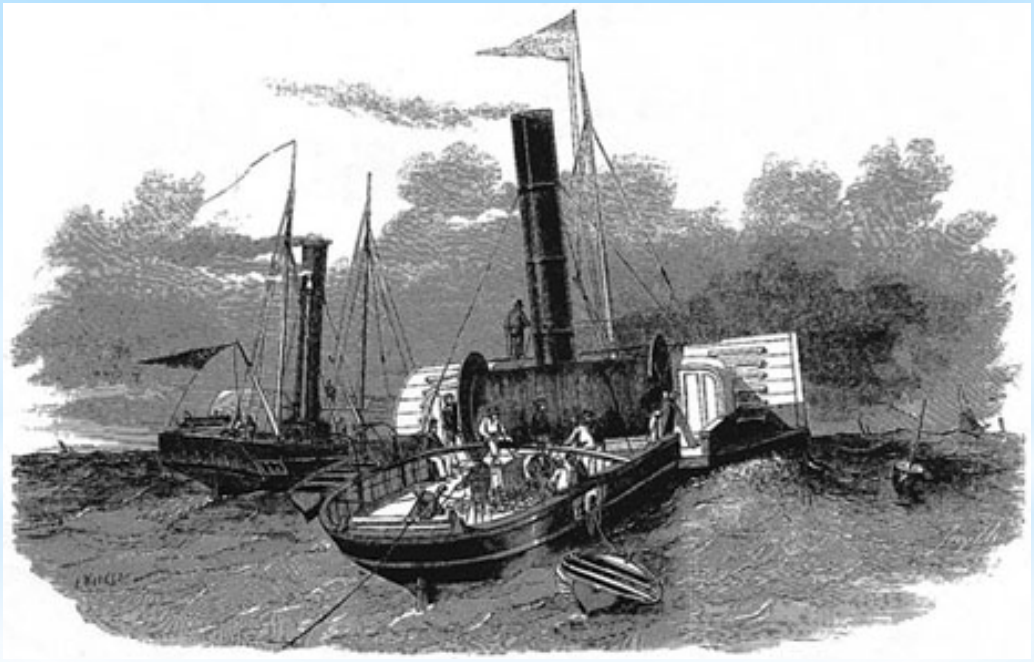
The Growth of Telegraph Networks …

By 1850 telegraph networks existed throughout Europe.

In 1861 in North America, the Pony Express shut down after only nineteen months of operation once a telegraph line was established to San Francisco.

Telegraph Cables Underwater …

In 1850 the first attempt to lay a telegraph cable from Dover to Calais was undertaken by the steamer *Goliah*. By 1855 England was connected to the European Continent and to Ireland.



A Man and an Idea …

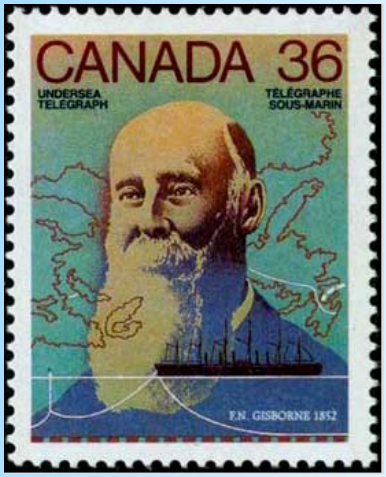
Cyrus Field 1819 – 1892

In January 1854 Cyrus Field was asked to help re-finance a bankrupt venture to extend the North American telegraph network to St. John's, Nfld.

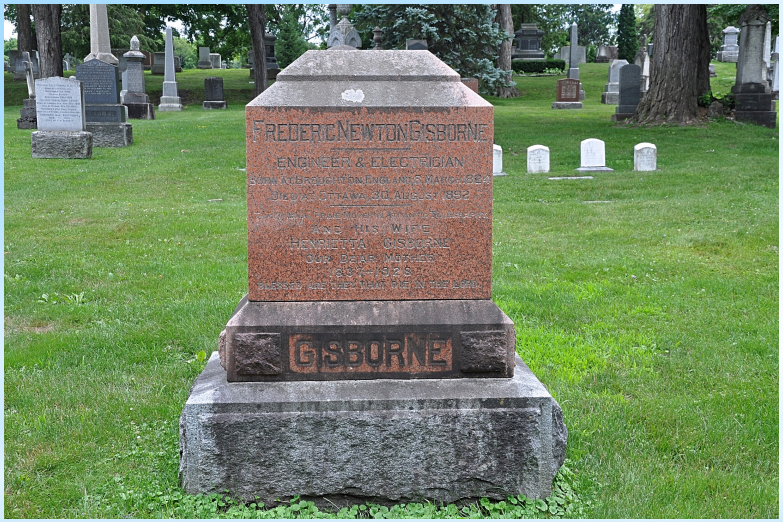
Field, a successful and wealthy New York City businessman, had no expertise in telegraphy and – initially – not very much interest.

Frederick Gisborne …

1824 -1892



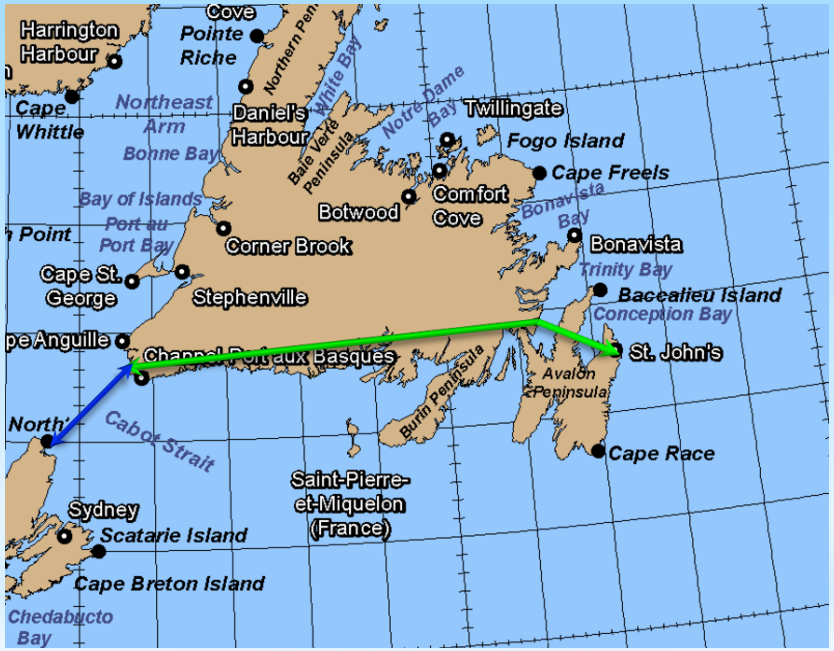
Cyrus Field's meeting was with Frederick Gisborne who had taken leave from his post as General Manager of Nova Scotia's telegraph network to promote a business venture which, it was hoped, would reduce the time it took messages to cross the Atlantic between Europe and the Americas.



Tombstone: Beechwood Cemetery

Gisborne's Project …

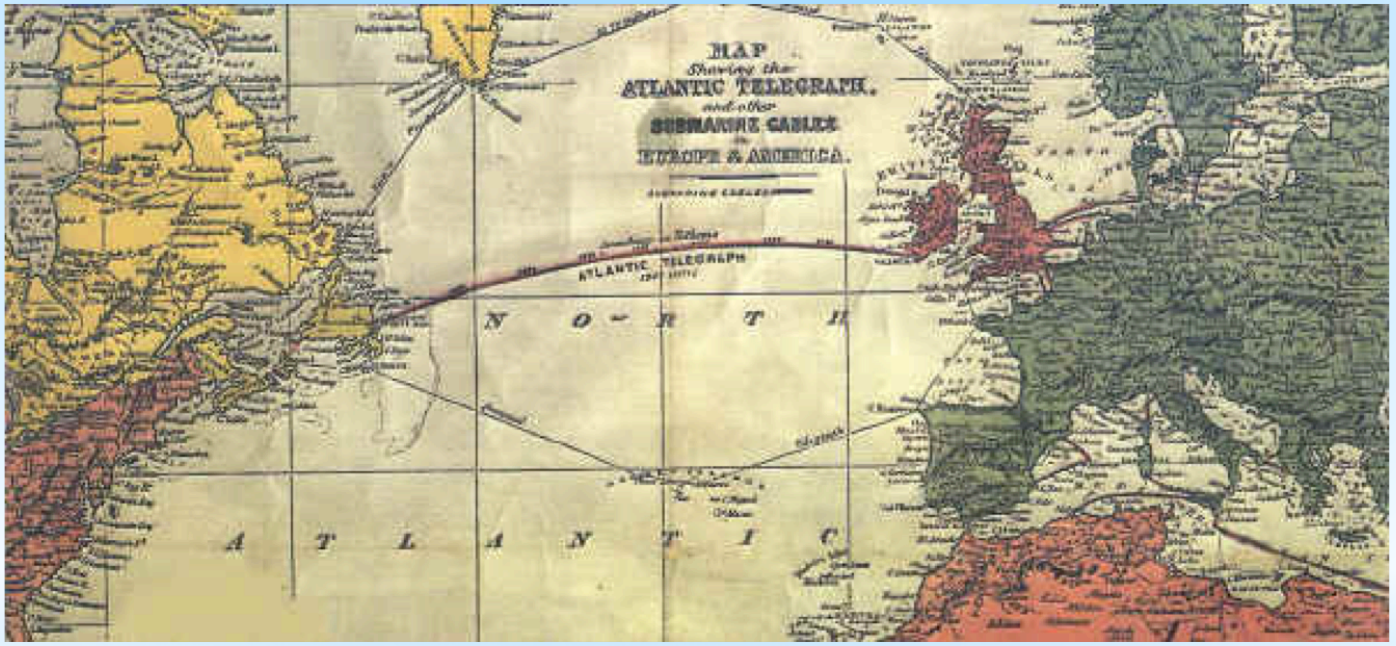
As originally proposed, an undersea cable from Cape Breton to Newfoundland and an overland telegraph line to St. John's.



Ships from Europe could then exchange messages in St. John's and shave two to four days off the communication time to New York– then 12 to 14 days or more.

Thinking big …

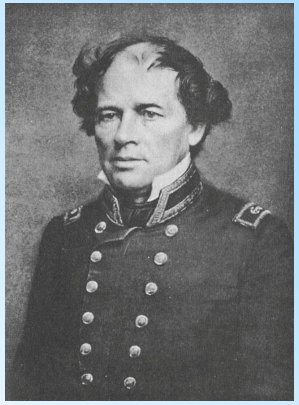
But, Cyrus Field took another look at the map …



Newfoundland to Valentia Island, Ireland – about 2200 miles, the closest distance between Europe and North America. Between them lay an apparently calm and deep ocean plateau – perfect for an undersea cable

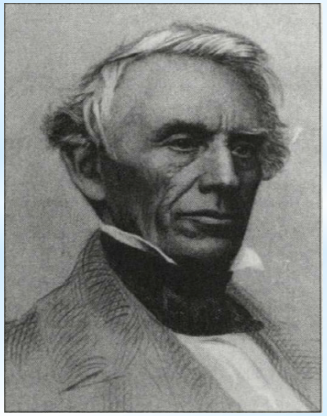
But, could it be done ?

Field consulted two experts …



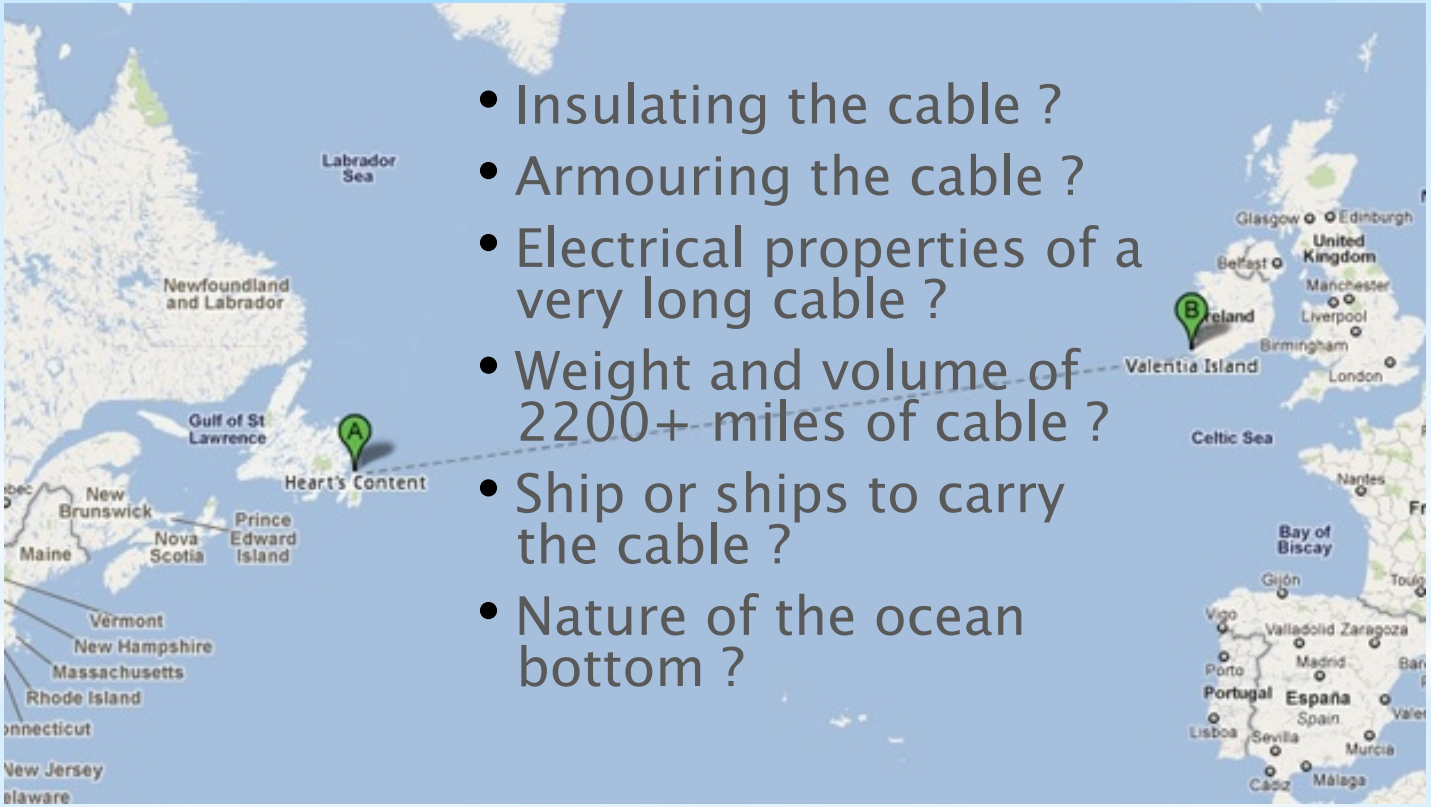
Lt. Matthew Maury USN had just completed a survey of the North Atlantic Ocean.

Samuel F.B. Morse was considered a “father of telegraphy” and originator of the code that bears his name.



A Wire to the New World ?

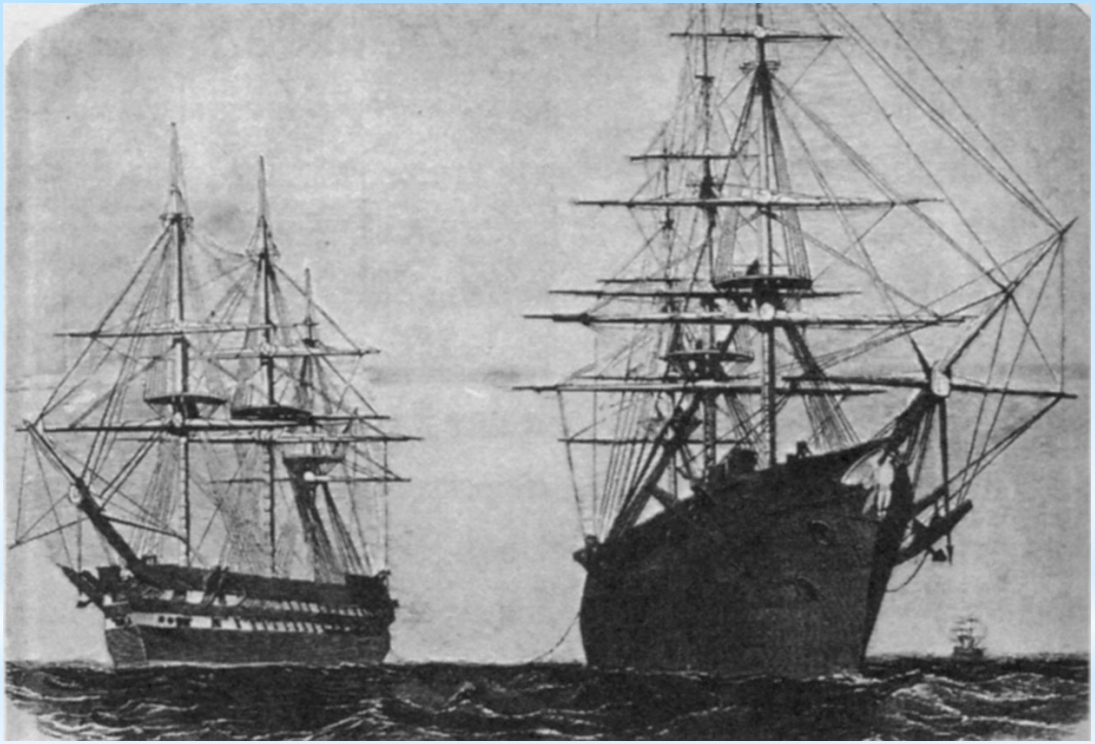
Questions needing answers…



- Insulating the cable ?
- Armouring the cable ?
- Electrical properties of a very long cable ?
- Weight and volume of 2200+ miles of cable ?
- Ship or ships to carry the cable ?
- Nature of the ocean bottom ?

The First Try …

The HMS *Agamemnon* and the USS *Niagara* …



… laid the 1857 and 1858 cables

The 1857/58 Cable Laying …

The crew of HMS *Agamemnon* (1858)

First: A Failure Then: A Success

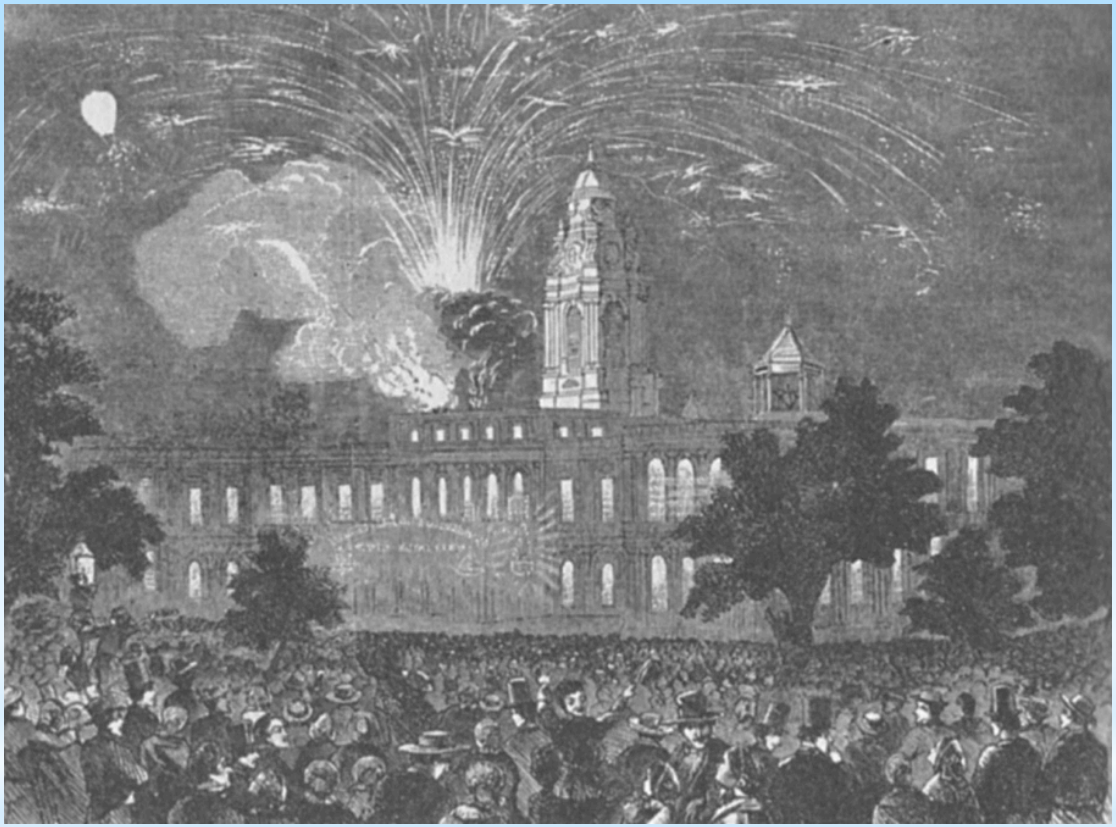
1857

- Both ships sailed from Valentia
- Once all its cable was played out, the *Agamenon* spliced the end of its cable to the *Niagara*'s
- But, 200 miles from the Newfoundland coast, the *Niagara*'s cable snapped and was lost

1858

- The two ships met mid-ocean, spliced their cables and sailed in opposite directions
- The *Agamemnon* laid its cable to Valentia Island
- The *Niagara* then sailed to Newfoundland and landed its cable at Bay of Bulls Arm on the west side of Trinity Bay on August 5th.

Success !!



Ecstatic reaction to the news that Europe and the Americas were joined by a telegraph cable

A Success !!! Turns into a Failure …

- Queen Victoria and President Buchanan exchanged congratulatory messages
- But the cable's performance was poor
- After three weeks it failed completely

What Went Wrong?

UK Government Inquiry into 1858 Cable failure found …

- ✓ Excessive voltage applied to cable
  - Dr. Edward Whitehouse (Wildman Whitehouse) blamed
- ✓ Poor quality control during cable manufacture
- ✓ Cable deterioration during outdoor storage
  - Gutta-Percha insulation left to dry out

Dr. Edward Whitehouse

In the Age of Optimism …
Dealing with Failure…

Cyrus Field, however, was determined to try again …

- His reputation had been hurt in the U.S.
- Little support in the U.S. then experiencing Civil War
- Western Union were promoting an alternative route through Alaska, under the Bering Strait and across Siberia
- But, eventually, he found support and backers in Britain
- Field made over 30 visits to the U.K. during the American Civil War

The Next Attempt …

- Field managed to enlist a new group of (mostly British) investors
- Field engaged the services of William Thomson (Lord Kelvin) to advise on the new effort
- The new attempt would incorporate all that was then known about electrical physics and about the fabrication and protection of underwater cables

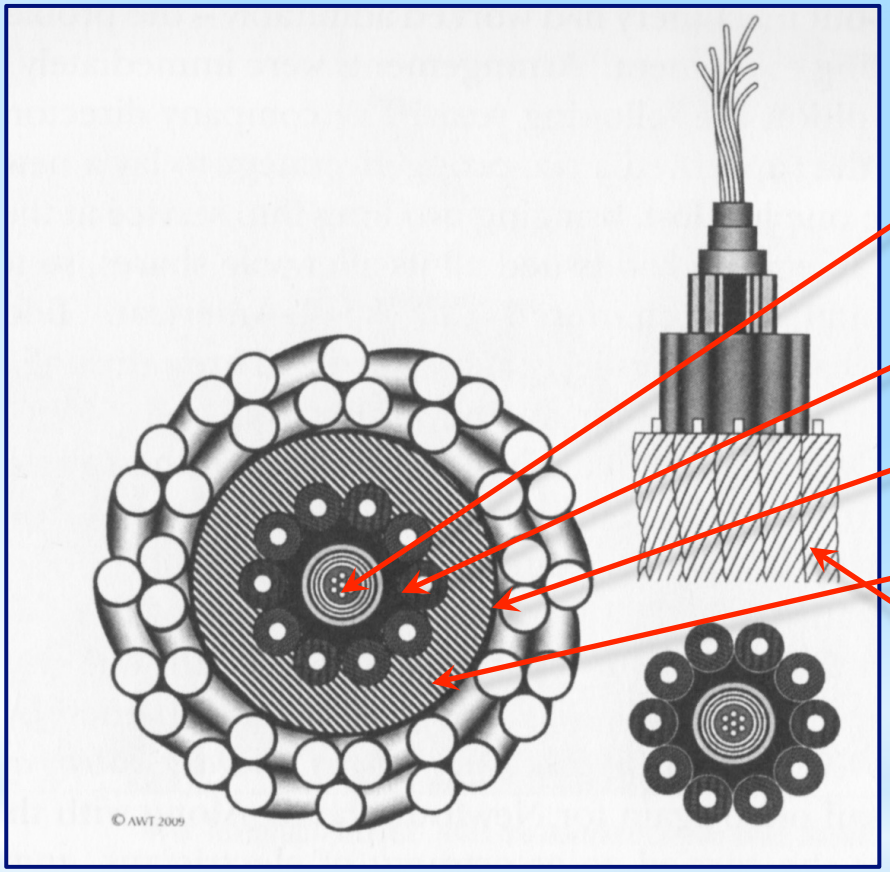
For the New Attempt …

The largest ship in the world …

- ✓ Seven times larger than anything else afloat
- ✓ 693 feet from stem to stern
- ✓ 22,500 tons displacement
- ✓ Had to be launched broadside

The *Great Eastern*

A New and Better Cable Design …



7 strands high-conductivity copper

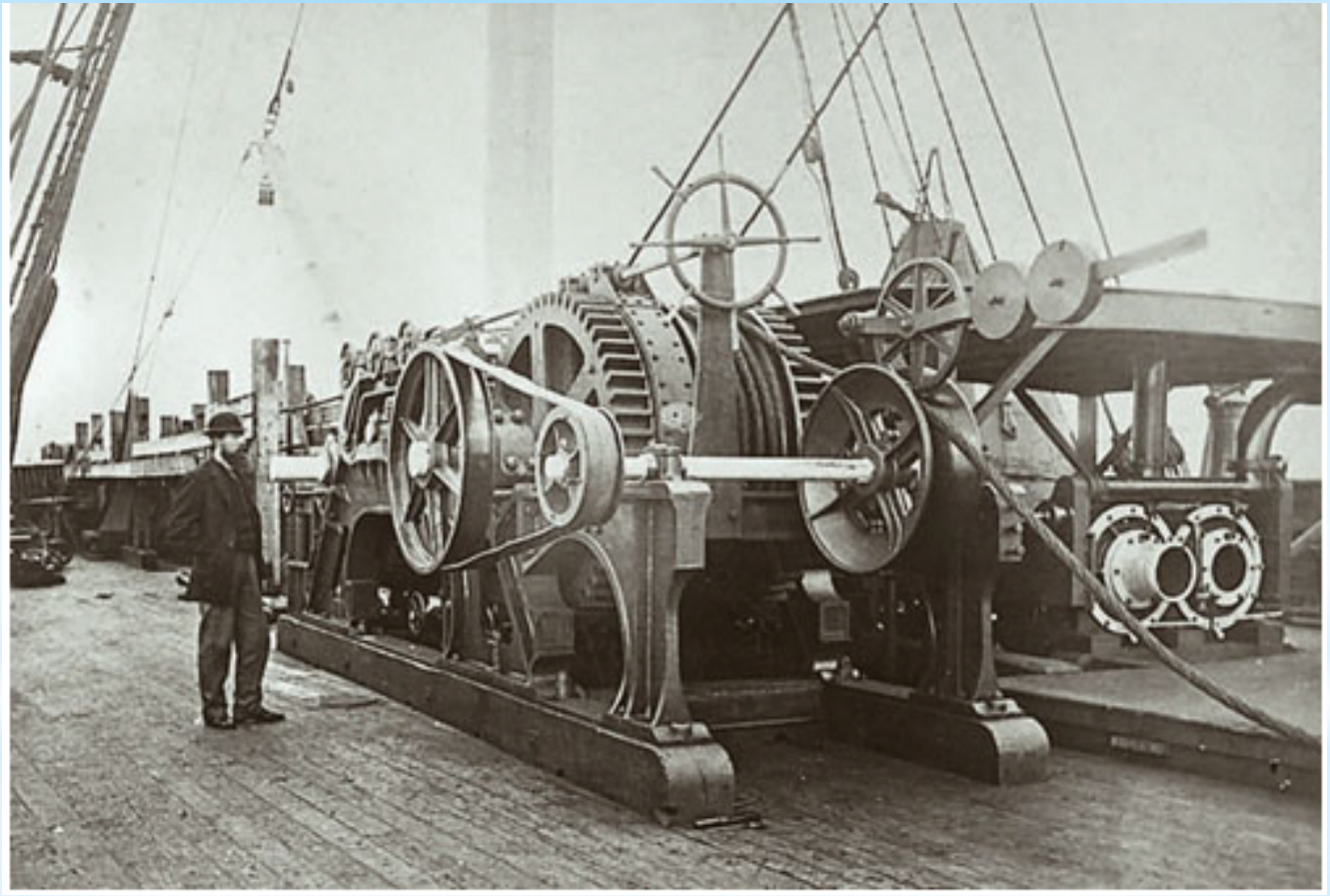
Gutta-Percha insulation

Chatterton's compound

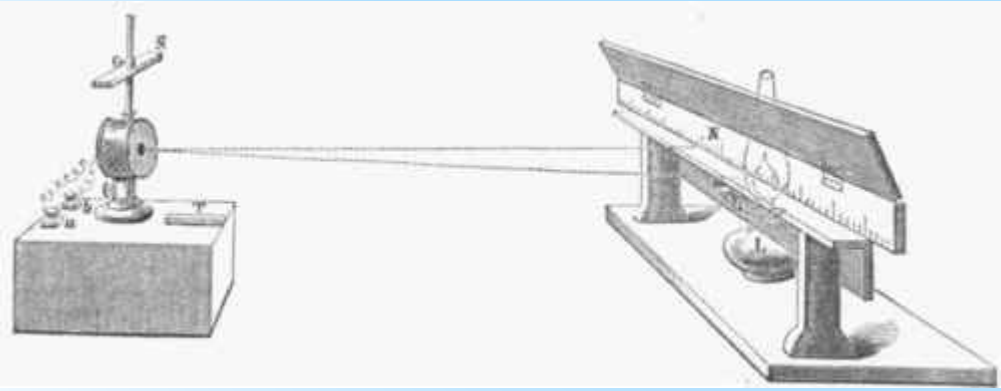
Pitch

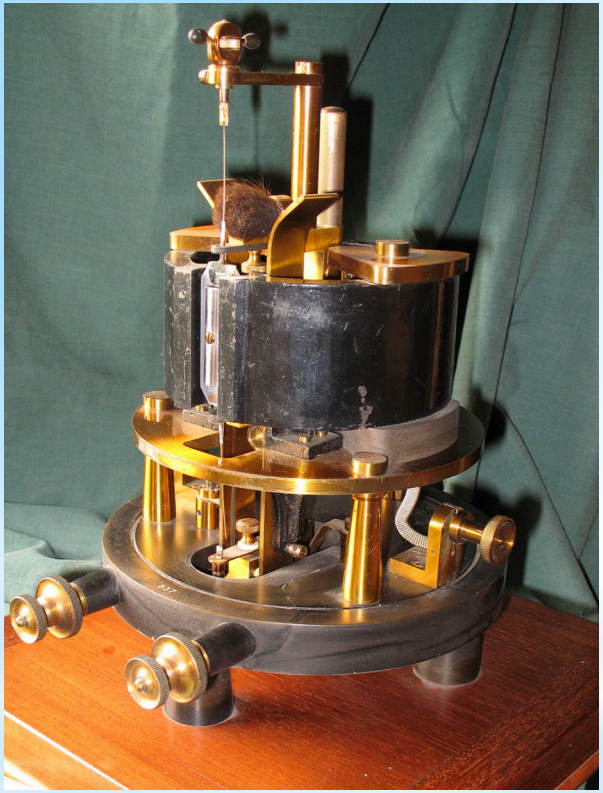
Quality Iron Wire Armouring

An Improved Paying-Out Machine …



And to Detect the Weak Signal …



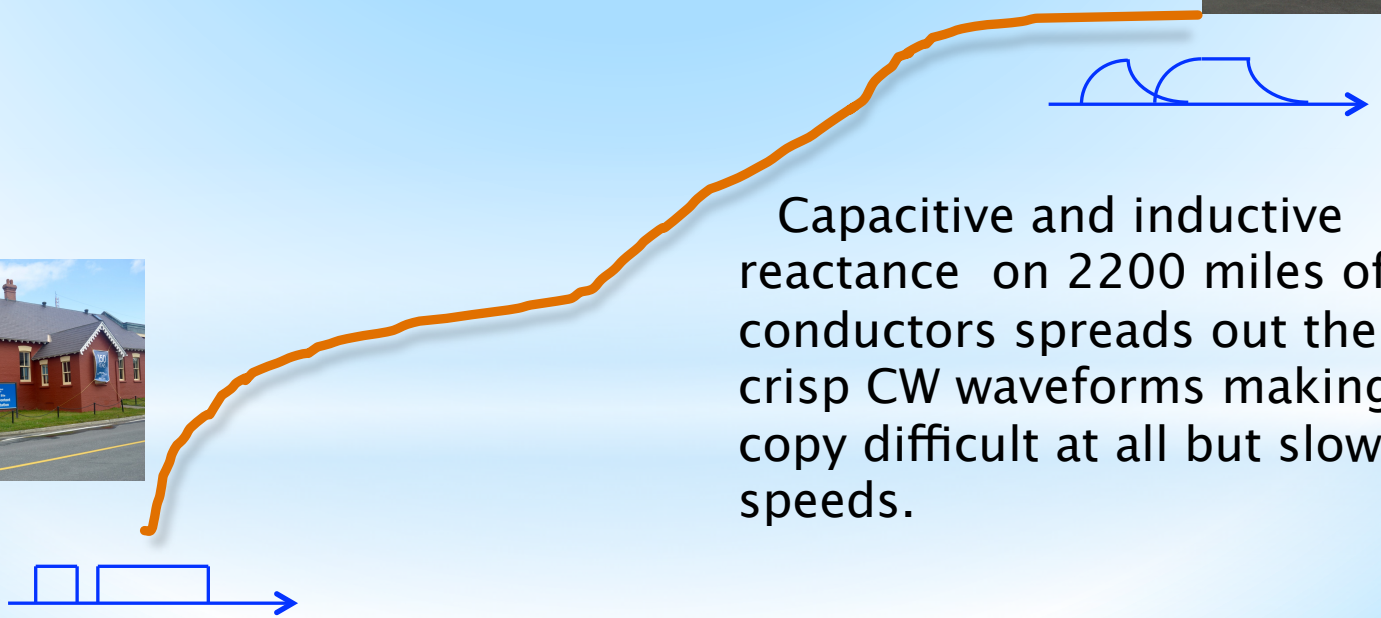


Lord Kelvin's Mirror Galvanometer

The Morse Code could be read in Heart's Content with ten volts or less applied in Valentia.

Dealing with "Retardation" …

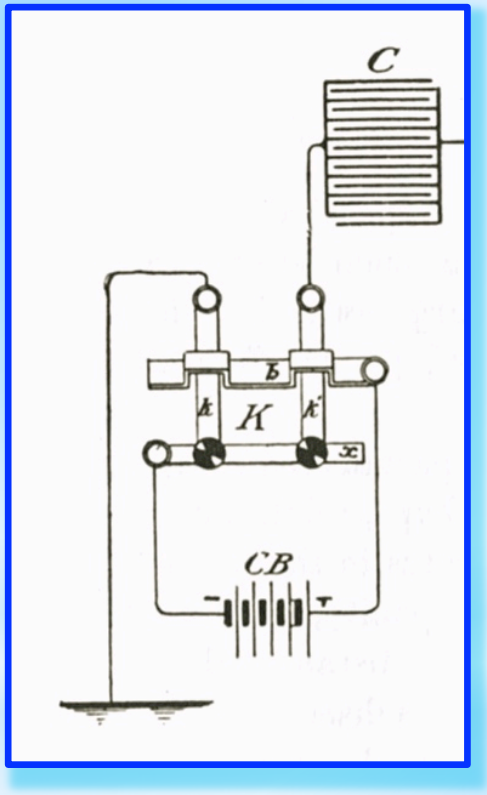
The letter "A" crosses the Atlantic



Capacitive and inductive reactance on 2200 miles of conductors spreads out the crisp CW waveforms making copy difficult at all but slow speeds.

Reading the Cable's Code …

- Dots on left key; dashes on right key.
- The direction of the current through the cable reversed between dots and "dashes"
- Dots moved the light of the mirror galvanometer to the left; "Dashes" moved the light to the right
- One operator read the deflections of the light beam while another wrote down the message
- Called the "duplex" or bi-directional code sender



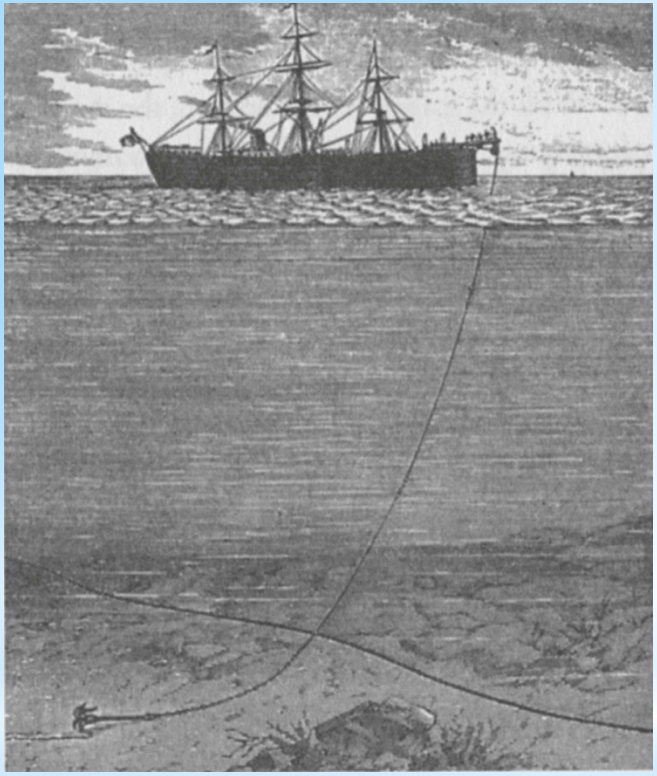
The Great Eastern departs Valentia

July 23rd, 1865

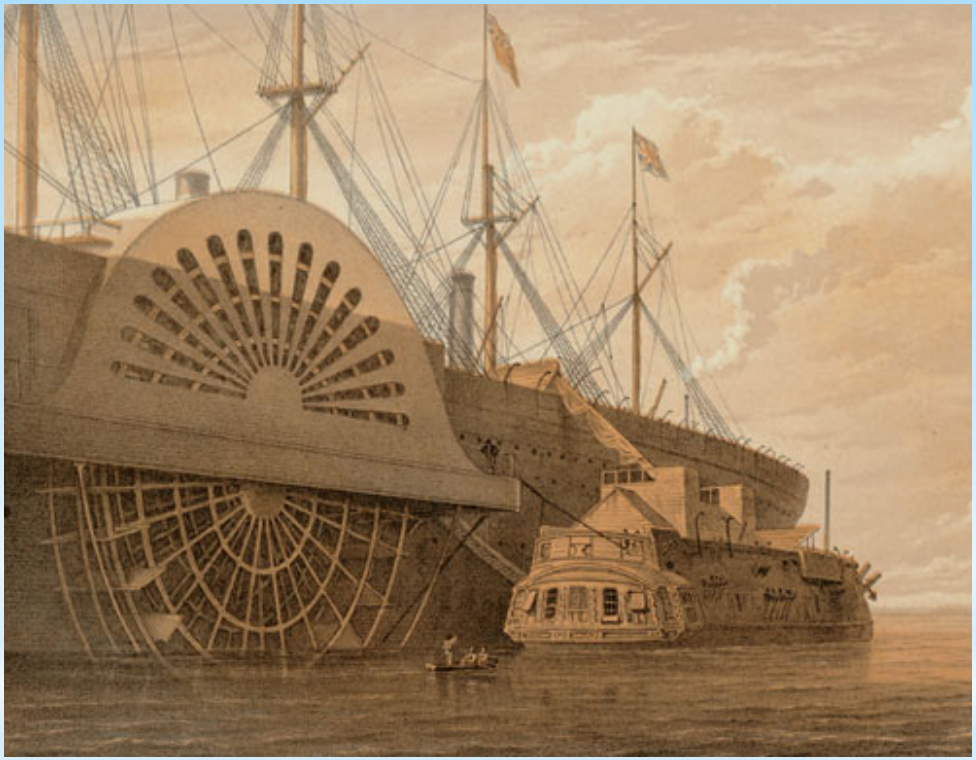
In constant touch with the cable station at Valentia, the *Great Eastern* steadily laid the new cable.

Then, A Heartbreaking Failure …

- Within 600 miles of Newfoundland the cable snapped and was lost
- Three days of grappling caught the cable on several occasions but the crew were unable to raise it on board
- On August 5, 1865 the *Great Eastern* abandoned the effort and set sail for Ireland.



1866: Another Try …



Loading cable onto the *Great Eastern* at Sheerness

Friday, July 13rd 1866 …

- Once again the *Great Eastern* set sail from Valentia Island with a cargo of 2200+ miles of undersea cable
- The cable used in the 1866 run was improved over that used the year before
- The paying-out machinery was upgraded
- The 1866 cable was laid down 30 miles south of the 1865 cable so there would be no risk of confusion if grappling to locate a broken cable
- The *Great Eastern* averaged six knots and the voyage was uneventful

Friday, July 27th 1866 …

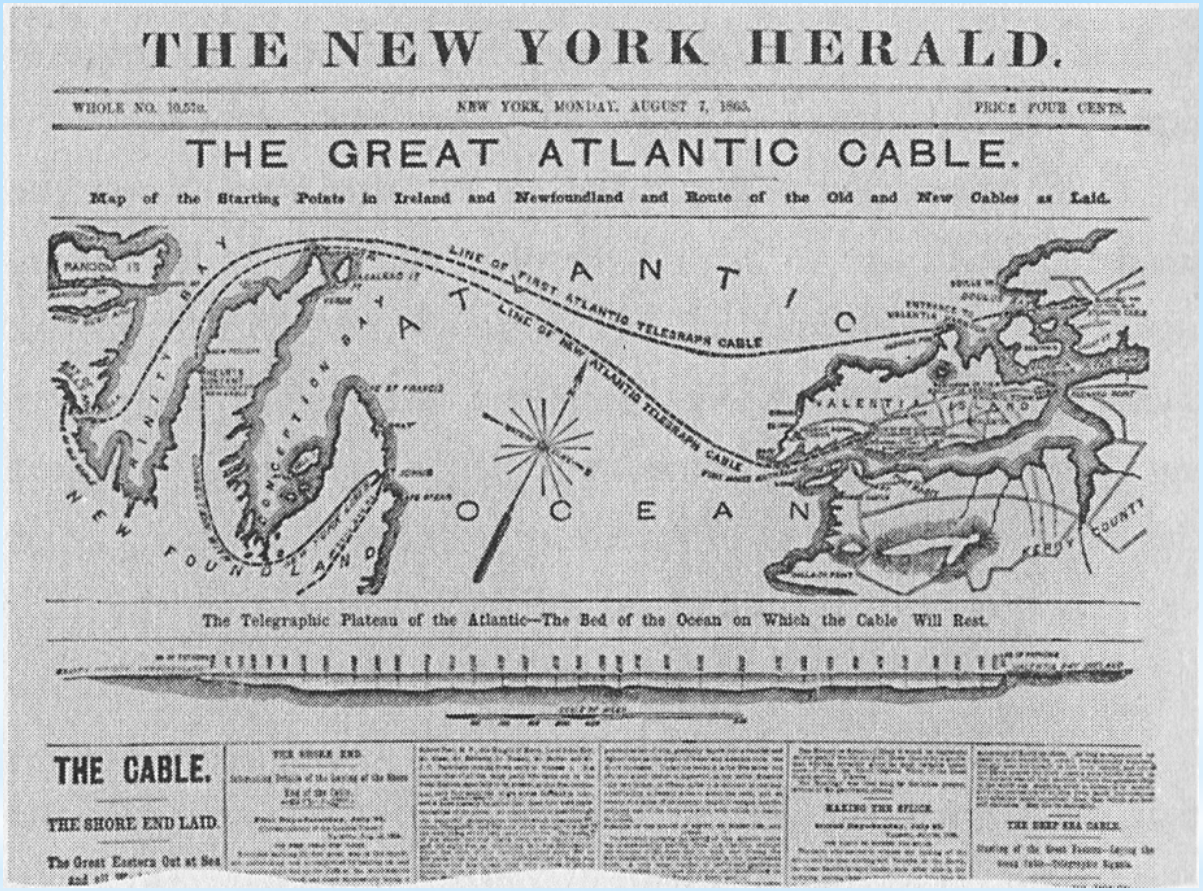
On the fourteenth day the *Great Eastern* entered Trinity Bay. The cable was brought ashore at Heart's Content and wired into the North American network.

Then, an Added Bonus ...

The *Great Eastern* then sailed to where the 1865 cable had been lost, retrieved the cable from the ocean bottom, spliced new cable to it and on September 7th brought a second working cable into Hearts Content.

Europe and the Americas have never been out of electronic communication since.

Success at Last !!



THE NEW YORK HERALD.

WHOLE NO. 10,578. NEW YORK, MONDAY, AUGUST 7, 1865. PRICE FOUR CENTS.

THE GREAT ATLANTIC CABLE.

Map of the Starting Points in Ireland and Newfoundland and Route of the Old and New Cables as Laid.

The Telegraphic Plateau of the Atlantic—The Bed of the Ocean on Which the Cable Will Rest.

THE CABLE.

THE SHORE END LAID.

The Great Eastern Out at Sea

THE SHORE END.

MAKING THE SPLICE.

THE DEEP SEA CABLE.

Operation of the Atlantic cables began immediately at Valentia and at Heart's Content.

Operating the Transatlantic Cable at Heart's Content …

- In 1873 the *Great Eastern* returned with a replacement for the 1865 cable
- A new cable to Valentia was laid west-to-east by the *Great Eastern* in 1874
- In 1880 the *Great Eastern* returned with a replacement for the 1866 cable
- In 1876 the current Cable Station building was opened

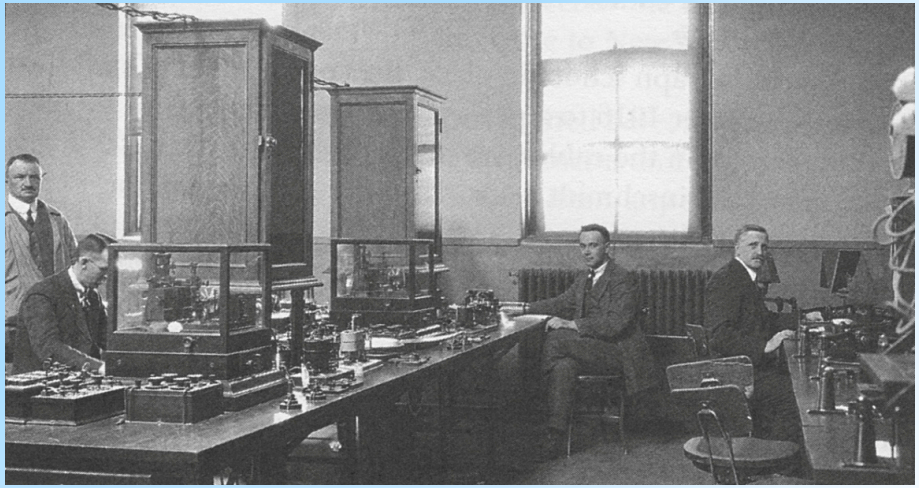
Heart's Content Cable Station …

1876

2016

Almost a Century of Service …

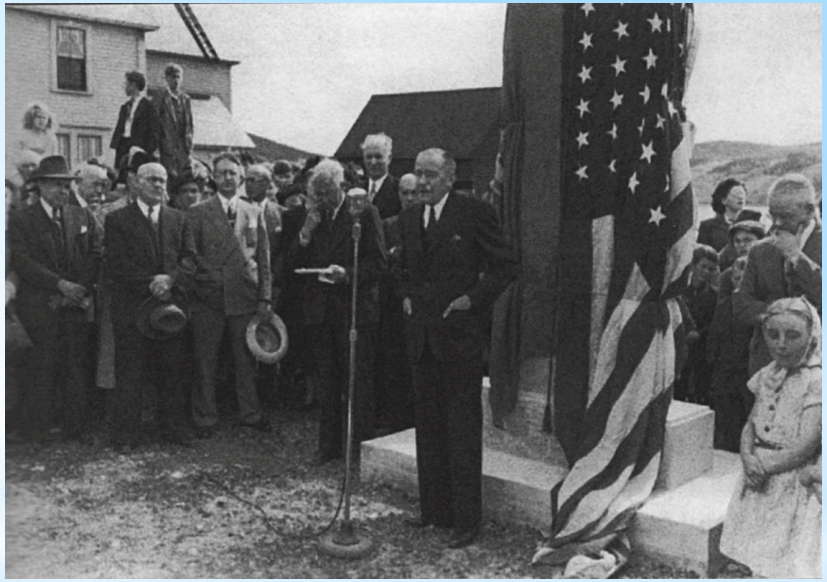
- For a time Heart's Content was the center of the communications world
- Rapidly, however, other cables were laid across other routes



- After his 1901 success with radio at Signal Hill, the cable company blocked Marconi's plan for a wireless telegraph station in Newfoundland
  - But the handwriting was on the wall
- The Cable Station closed in 1965
- It is now a Provincial Historic Site

Heart's Content NL today …

Heart's Content Historic Site …



1948

2016

1866 – 2016 …

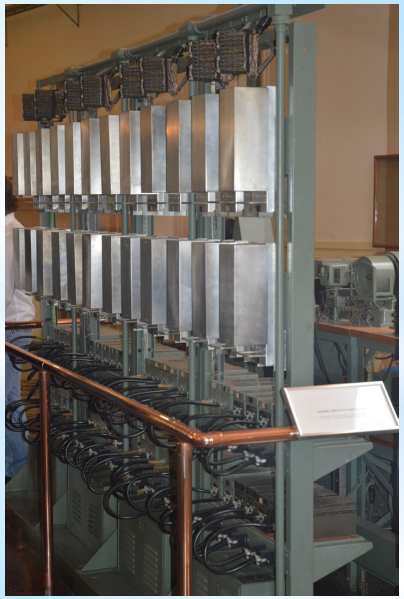

CELEBRATING 150 YEARS OF
GLOBAL COMMUNICATIONS
Heart's Content
Cable Station
Provincial Historic Site

Cable Entrance …

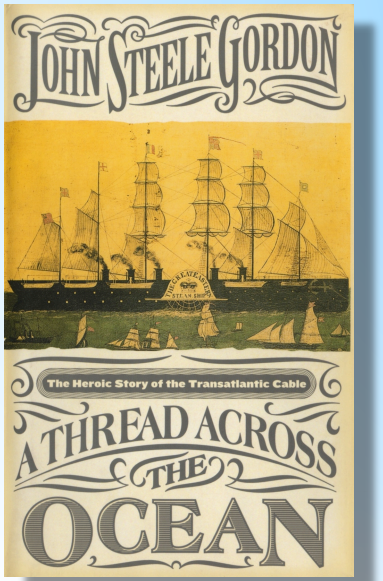
Plaque placed over Access Cable …

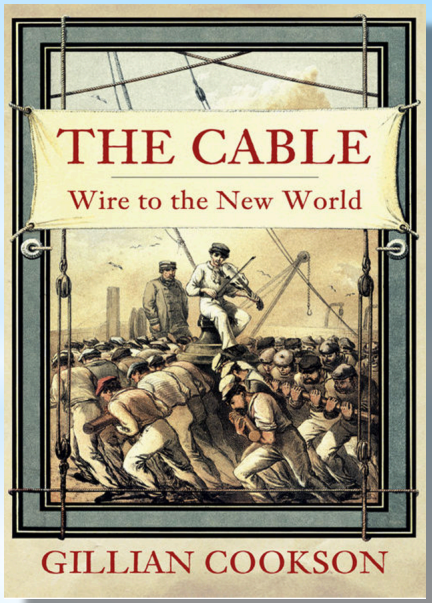
Displays the first message sent through the 1866 cable in English and in Morse Code.

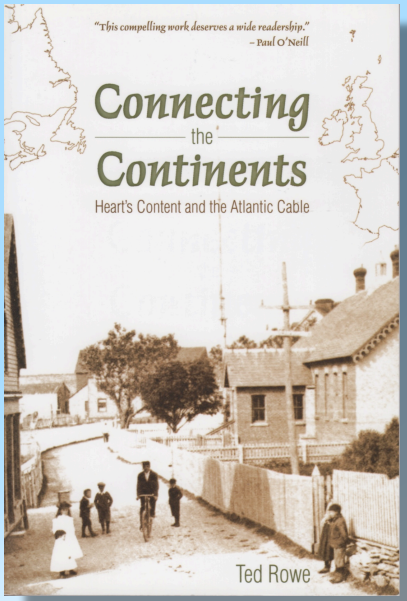

MESSAGE ROUTE
CABLE STARTS HERE
VALENTIA
LONDON
HEARTS CONTENT
TO AMPLIFIERS TO STRENGTHEN AND CORRECT DISTORTION OF SIGNALS
THIS PANEL IS A SIMPLIFIED EXPLANATION OF THE "MESSAGE ROUTE" THE ROOM YOU ARE NOW IN CONTAINS THE ACTUAL APPARATUS ASSOCIATED WITH THE RECEPTION AND TRANSMISSION OF MESSAGES THROUGH HEARTS CONTENT

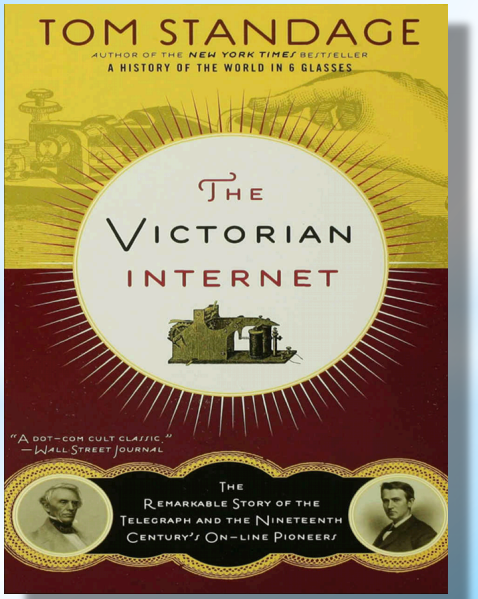


Further Reading for the Curious …



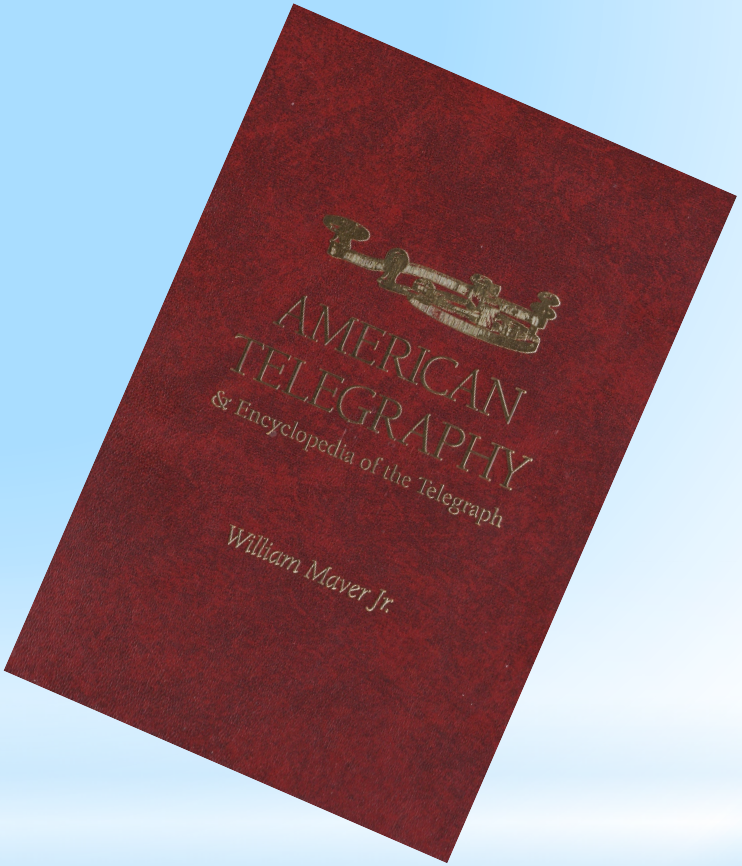




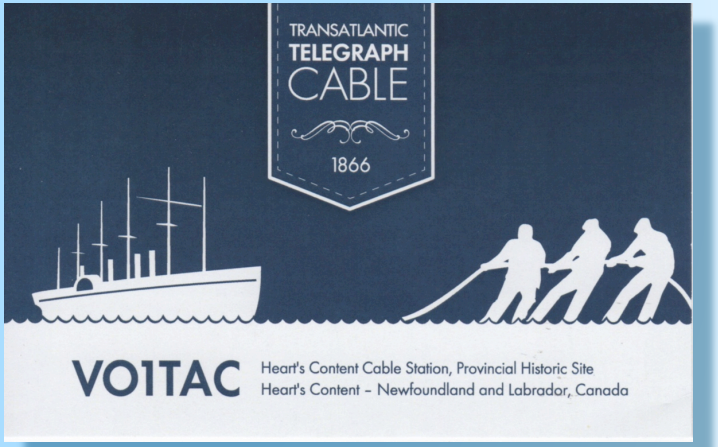


And, Finally …

Thanks to Dick Bonnycastle VE3FUA for the loan of this compendium of telegraphy in the 19th and early 20th centuries.



Photos and illustrations in this presentation are from the aforementioned books, from the public domain and from the author.


TRANSATLANTIC
TELEGRAPH
CABLE
1866
VO1TAC
Heart's Content Cable Station, Provincial Historic Site
Heart's Content – Newfoundland and Labrador, Canada

Thank you!


TRANSATLANTIC
PARK
Newfoundland
Labrador