Henry, Morse and the Telegraph

The Scientist and The Artist - Discovery and Design

CEE 102: Prof. Michael G. Littman
Course Administrator: Hiba Abdel-Jaber hiba@princeton.edu

Computers allowed for NOTETAKING ONLY
Please - NO Cell Phones, Texting, Internet use

Connecting the Continent
1830 – 1883

Information - Transportation

Edward Hopper’s “Railroad Sunset”

Connecting the Continent
1830 – 1883

Information - Transportation

Edward Hopper's "Railroad Sunset"

Electricity

Morse - intelligence at a distance

Edison - lighting a city

Westinghouse - power at a distance

Marconi – wireless global telegraphy

Morse by Morse

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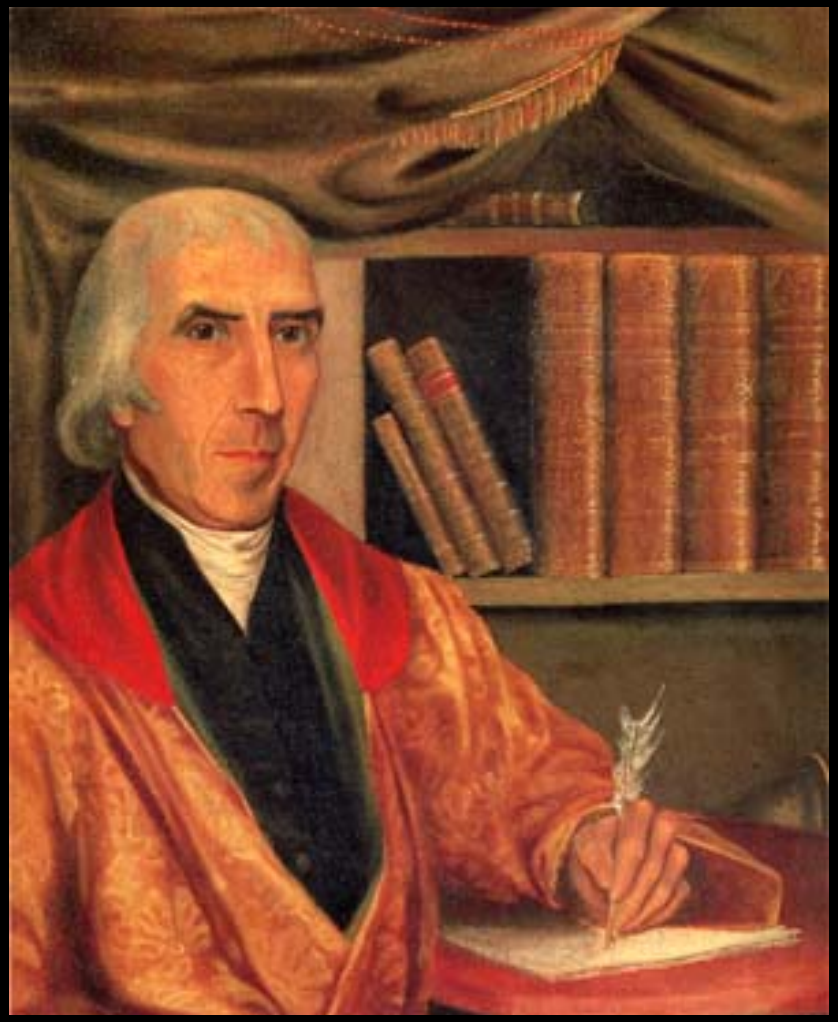

Morse by Morse

West by West

Morse by Morse

Morse by Morse

Samuel Morse

1825: painter - president, National Academy of Design

1835: Professor of Art, NYU

1840: engineer - telegraph patent

Eli Whitney

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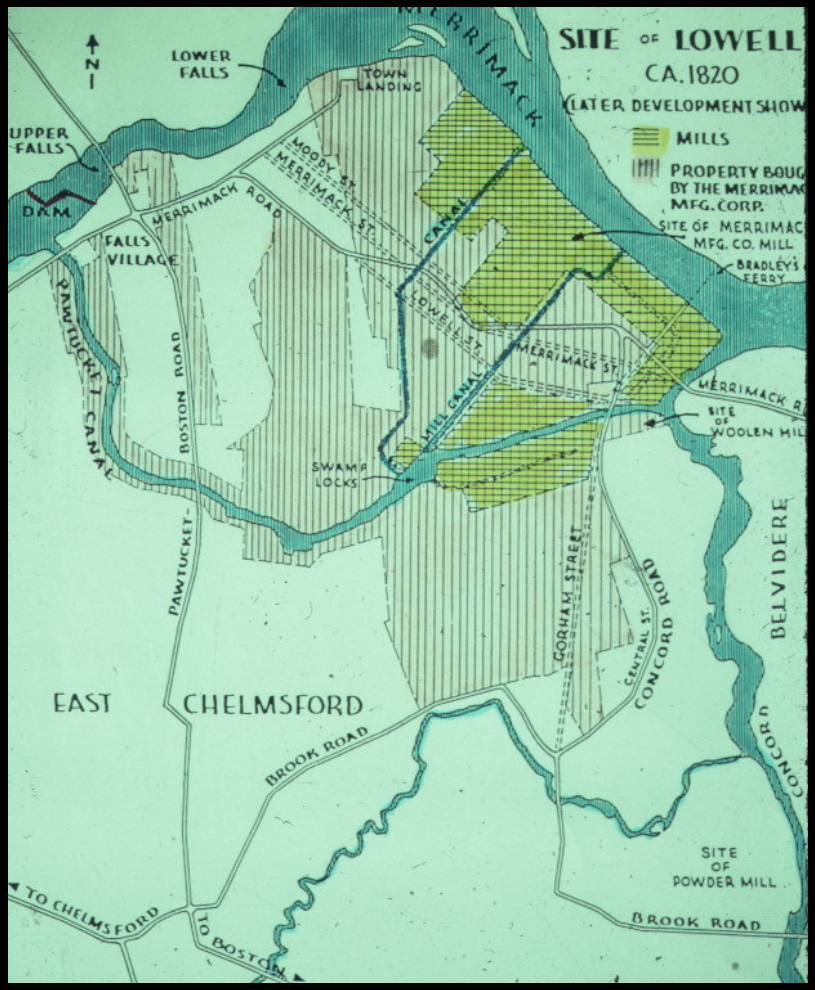
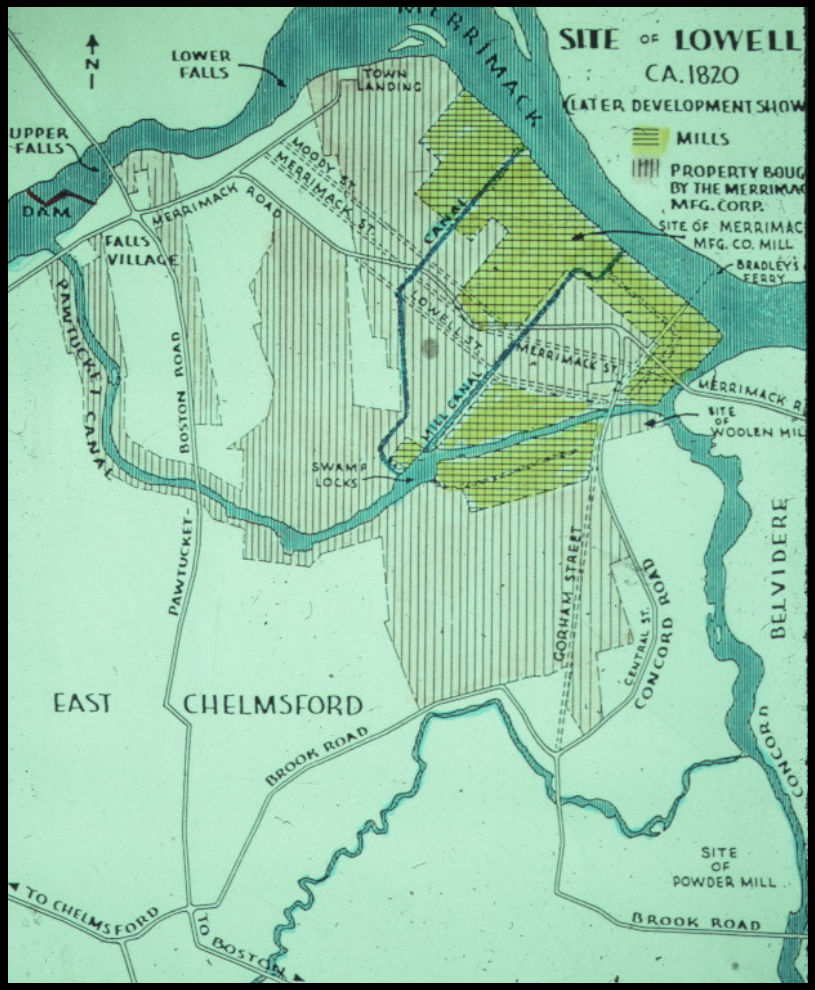

SITE OF LOWELL
CA. 1820
(LATER DEVELOPMENT SHOWN)
MILLS
PROPERTY BOUGHT BY THE MERRIMACK MFG. CORP.
SITE OF MERRIMACK MFG. CO. MILL
BRADLEY'S FERRY
MERRIMACK
LOWER FALLS
TOWN LANDING
UPPER FALLS
DAM
MOODY ST.
MERRIMACK ST.
MERRIMACK ROAD
FALLS VILLAGE
CANAL
LOWELL ST.
MERRIMACK ST.
MILL CANAL
PAWTUCKET CANAL
BOSTON ROAD
SWAMP LOCKS
SITE OF WOOLEN MILL
PAWTUCKET-
GORHAM STREET
CENTRAL ST.
CONCORD ROAD
BELVIDERE
EAST CHELMSFORD
BROOK ROAD
SITE OF POWDER MILL
TO CHELMSFORD
TO BOSTON
BROOK ROAD

Buffalo



Albany

Buffalo

Albany

Dewitt Clinton

Prof. Benjamin Silliman

Dewitt Clinton

Prof. Benjamin Silliman

4-315

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

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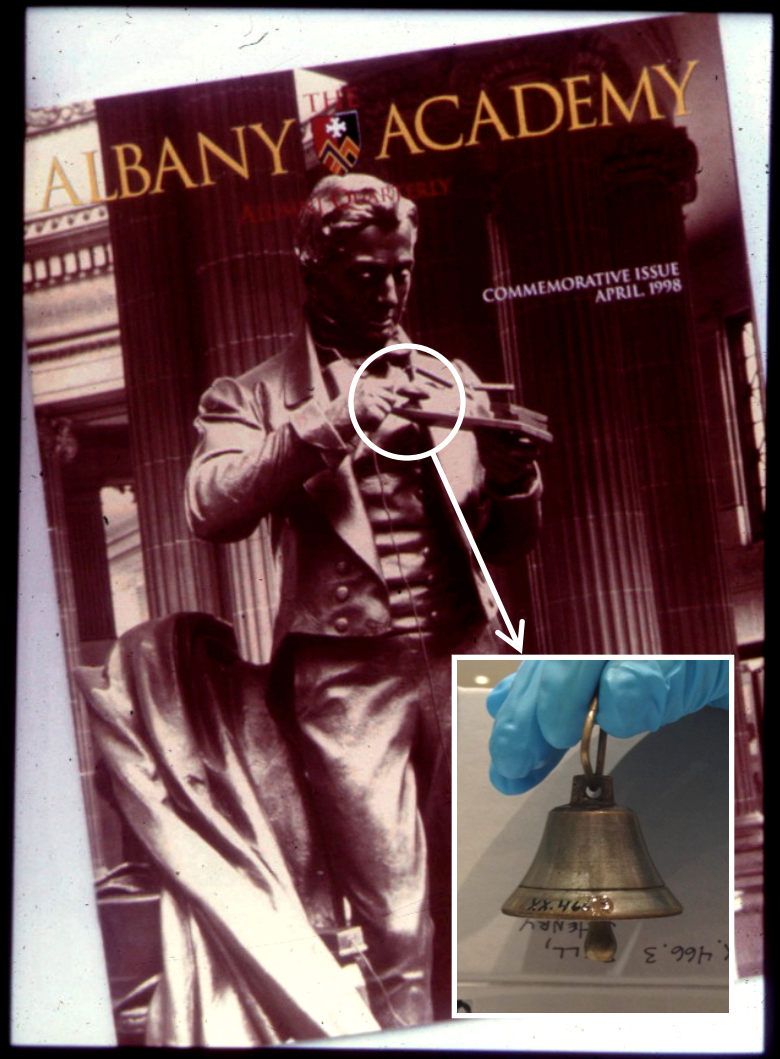

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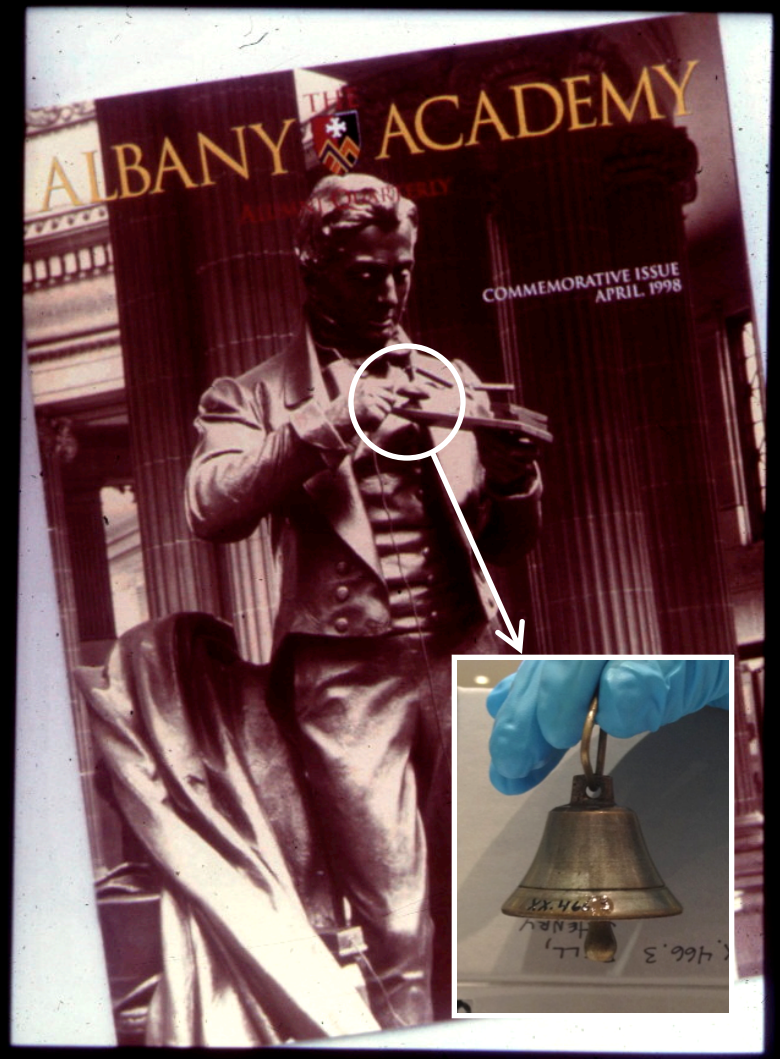
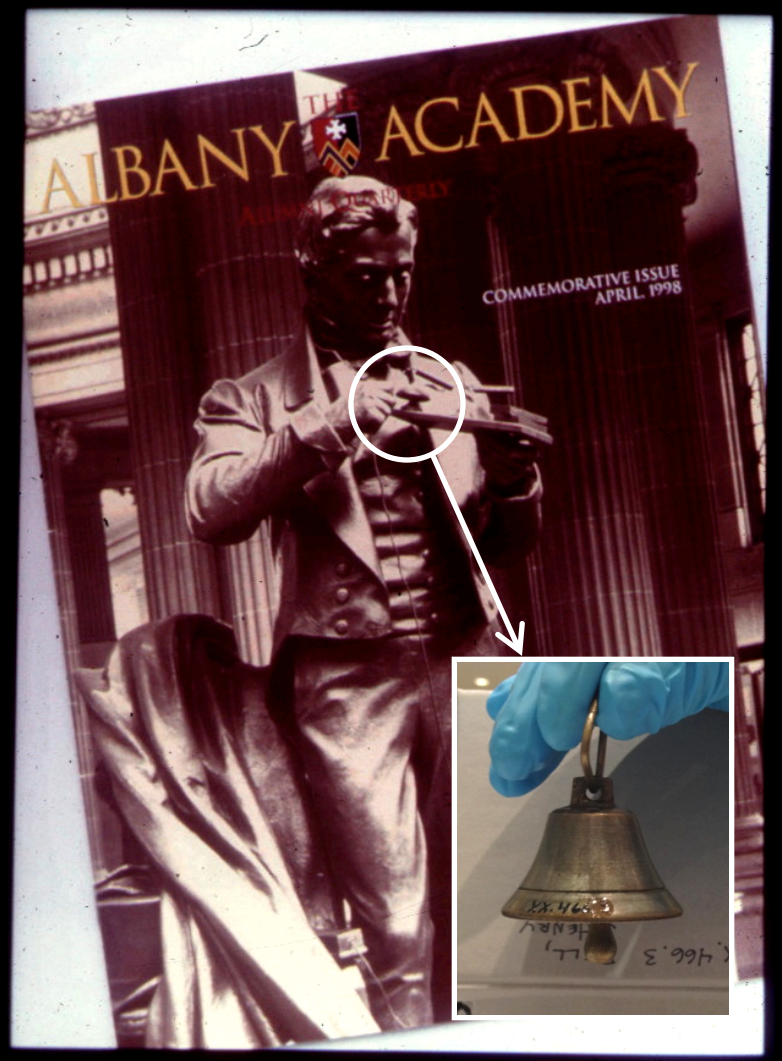

THE
ALBANY ACADEMY
COMMEMORATIVE ISSUE
APRIL 1998


NEW YORK
BIRTHPLACE OF
MODERN ELECTRICITY
HERE DISCOVERING MAGNETIC
INDUCTION, JOSEPH HENRY
PIONEERED THE TELEGRAPH
AND ELECTRIC MOTOR, 1829-31
STATE EDUCATION
DEPARTMENT 1940



Telegraph - Discovery

1820 Electricity linked to Magnetism

1825 First Horseshoe Electromagnet

1831 Henry's Strong Electromagnet and Telegraph

Demonstration of compass needle deflection by electric current

Telegraph - Discovery

1820	Electricity linked to Magnetism
1825	First Horseshoe Electromagnet
1831	Henry's Strong Electromagnet and Telegraph

Demonstration of compass needle deflection by electric current

Why is this demonstration important?

Telegraph - Discovery

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	1825	First Horseshoe Electromagnet
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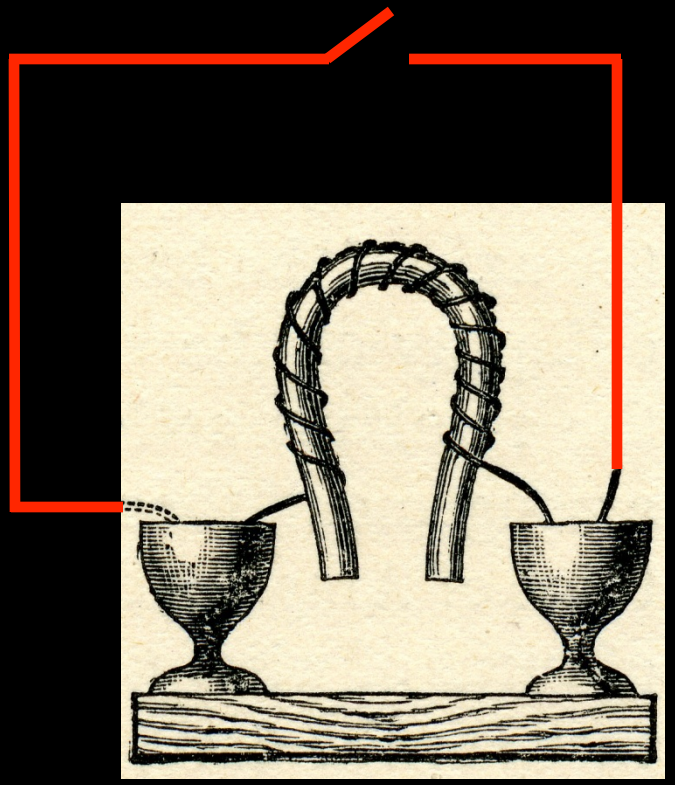

Electromagnet in circuit with copper-zinc batteries and on-off switch

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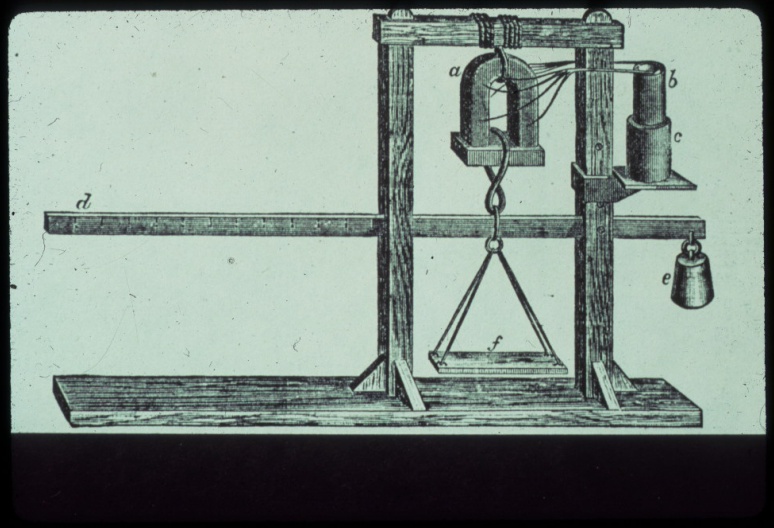

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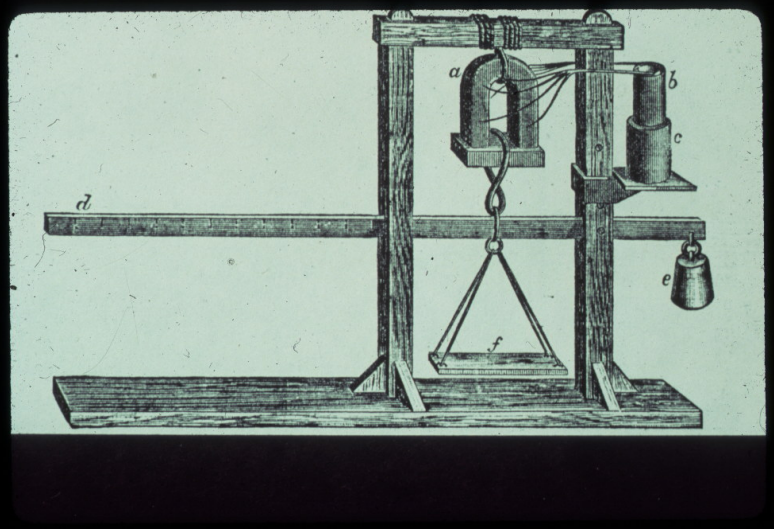

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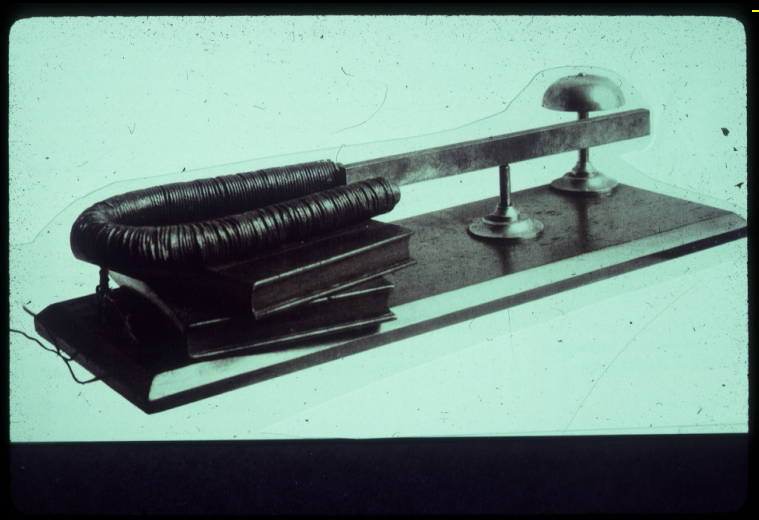
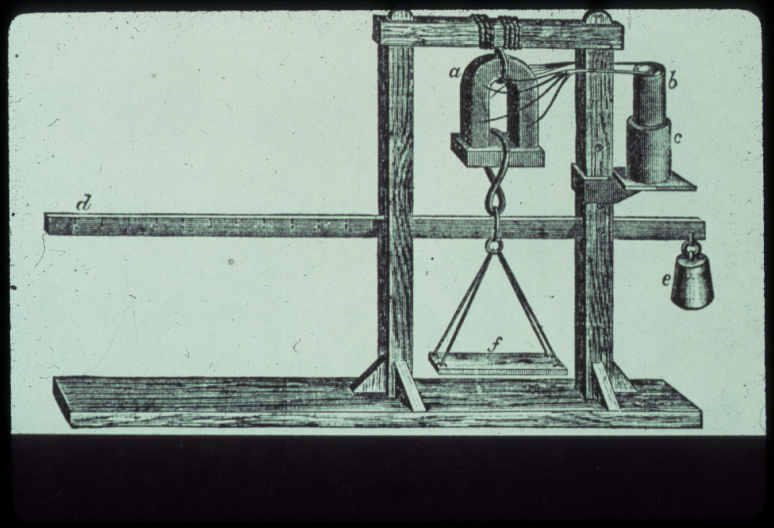
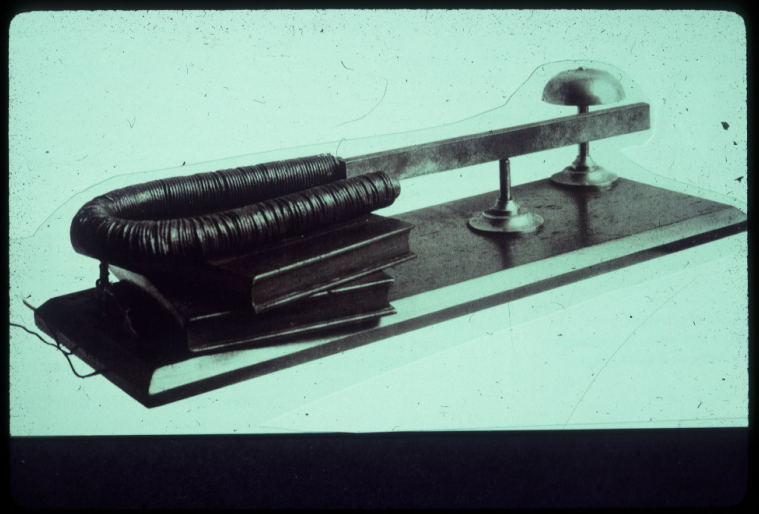




$$I = \frac{V}{R}$$

Ohm's Law

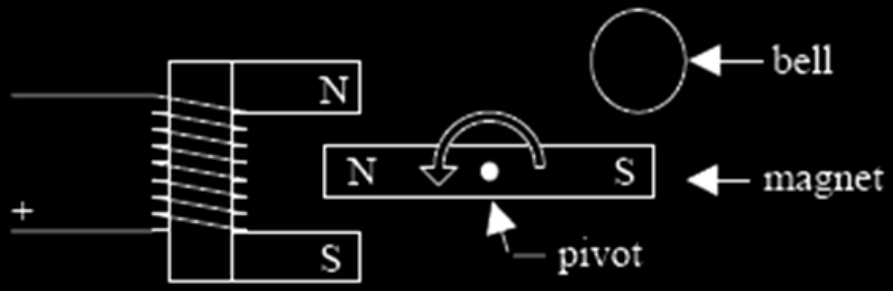


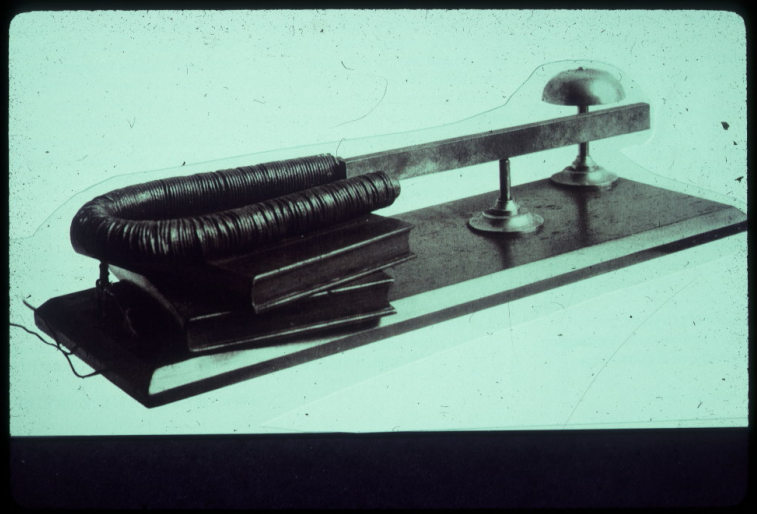
$$R = \frac{\rho L}{A}$$

Resistance

$$I = \frac{V}{R}$$

Ohm's Law





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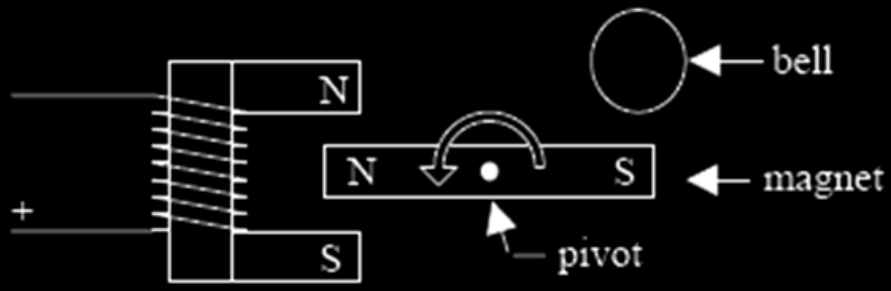


$$I = \frac{V}{R}$$

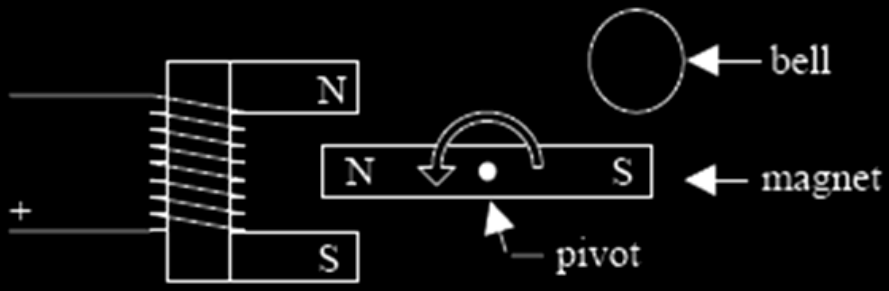
Ohm's Law

How does Henry's sounding telegraph work?

Pole-reversal

$$R = \frac{\rho L}{A}$$

Resistance



$$I = \frac{V}{R}$$

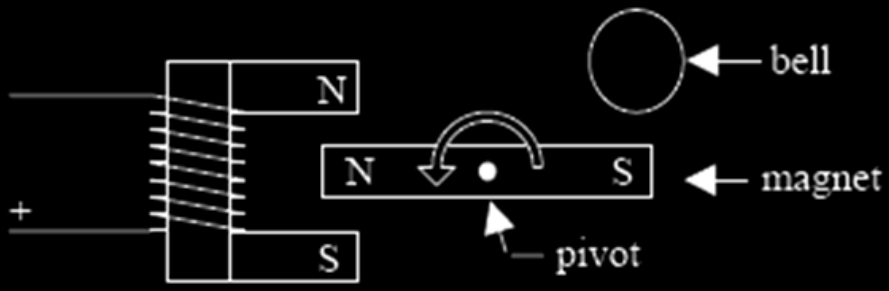
Ohm's Law

- Demo of telegraph and weakening effect of a long line
- Multiple batteries in series compensate for long line
- Earth as return conductor – allows for single wire telegraph

$$R = \frac{\rho L}{A}$$

Resistance

How Ohm's Law helps us to understand Henry's experiment?



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$$I = \frac{V}{R}$$

Ohm's Law

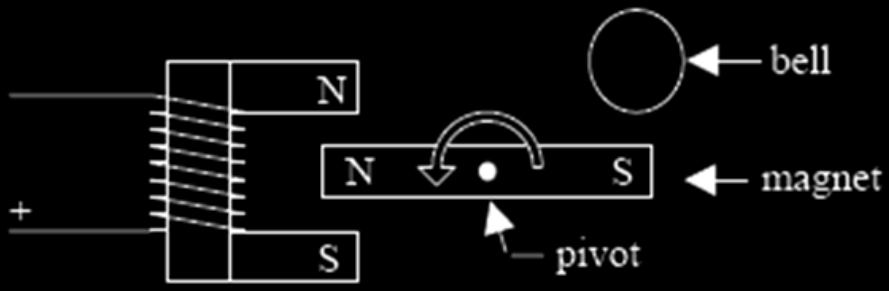
The greater the voltage, the greater the current

$$R = \frac{\rho L}{A}$$

Resistance

The longer the path, the greater the resistance

How Ohm's Law helps us to understand Henry's experiment?



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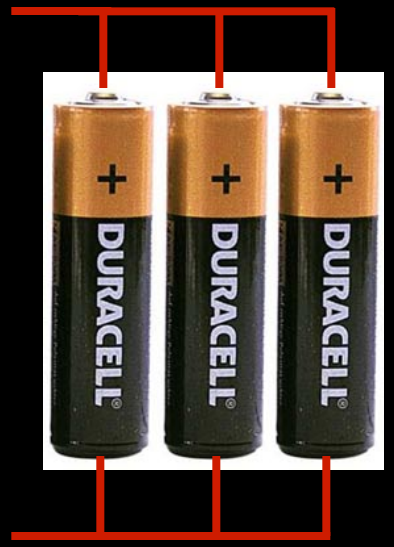
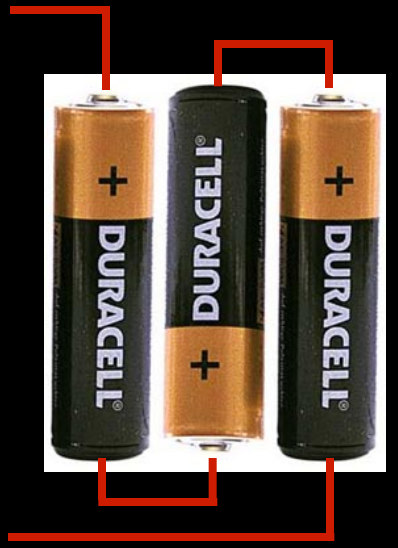
1 volt and
up to 1 amp

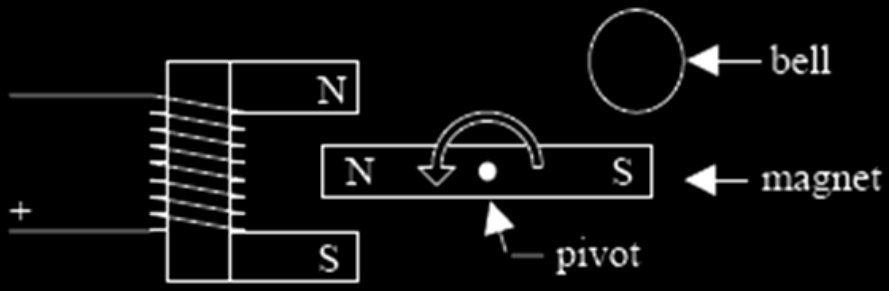


Parallel – more available current



Series – greater voltage

How Ohm's Law helps us to understand Henry's experiment?



- Demo of telegraph and weakening effect of a long line
- Multiple batteries in series compensate for long line
- Earth as return conductor – allows for single wire telegraph

" The electro-magnetic telegraph was invented by me in Albany in 1830."

"I think that the first actual line of telegraph using the earth as a conductor was made in the beginning of 1836. A wire was extended across the front campus of the College grounds from the upper story of the Library building to the Philosophical Hall on the opposite side, the ends terminating in two wells. Through this wire signals were sent from time to time from my house to my laboratory."

- Joseph Henry

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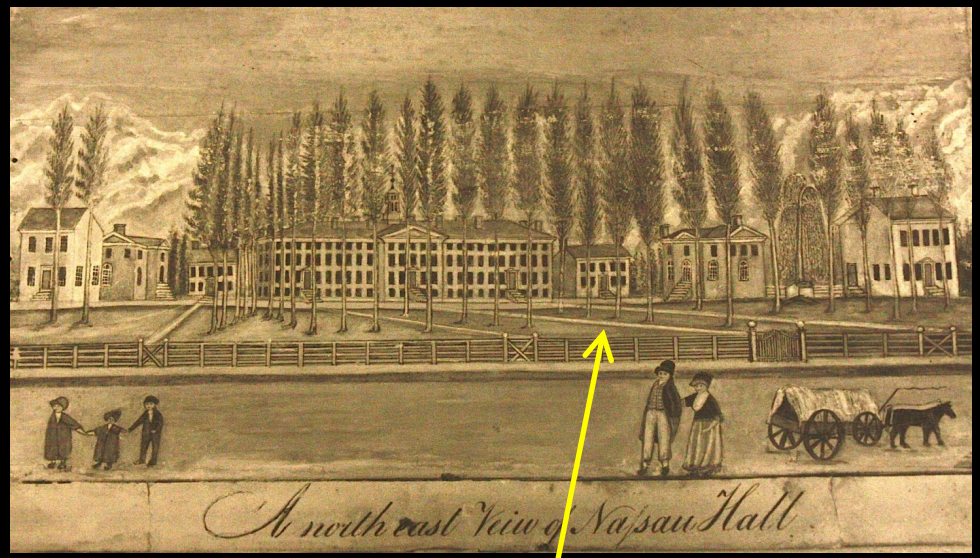

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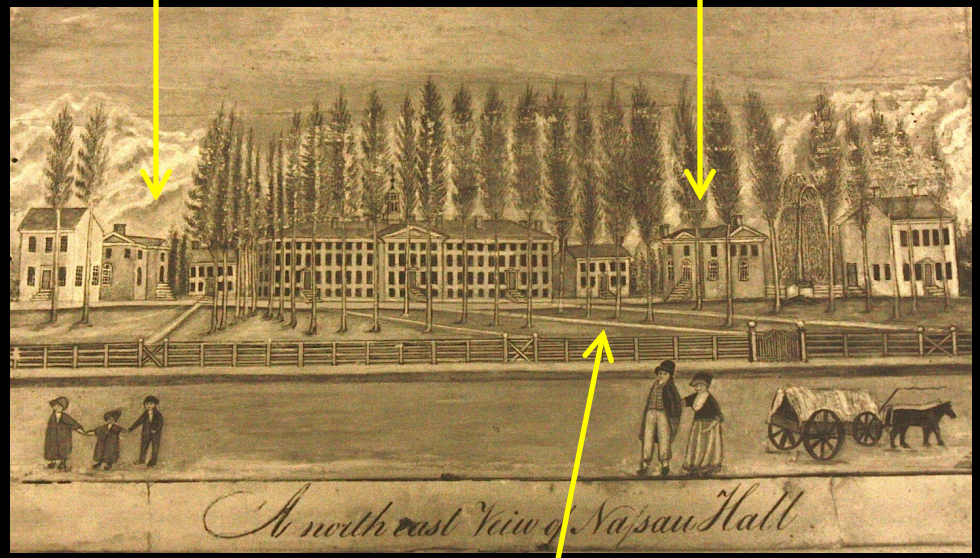
Philosophical Hall

Library



Joseph Henry's House in 1836

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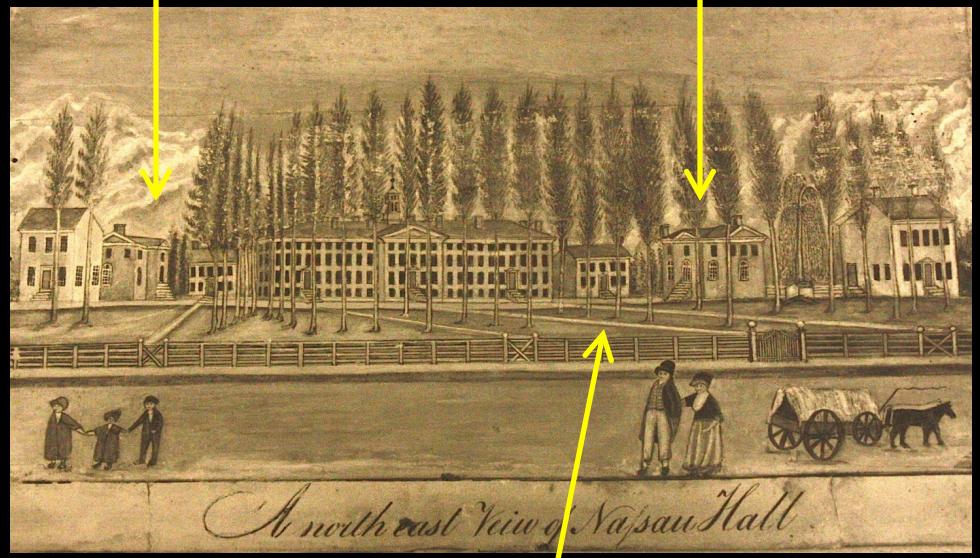

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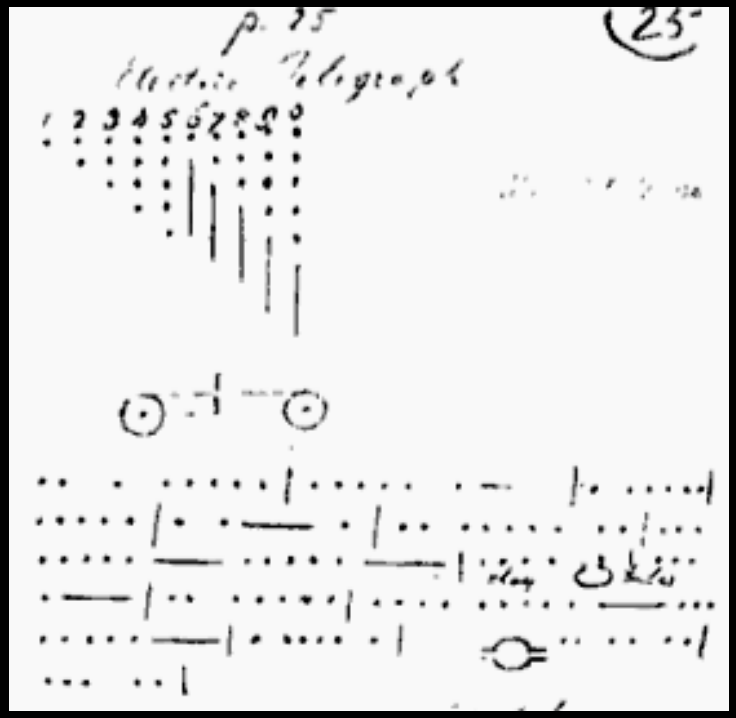
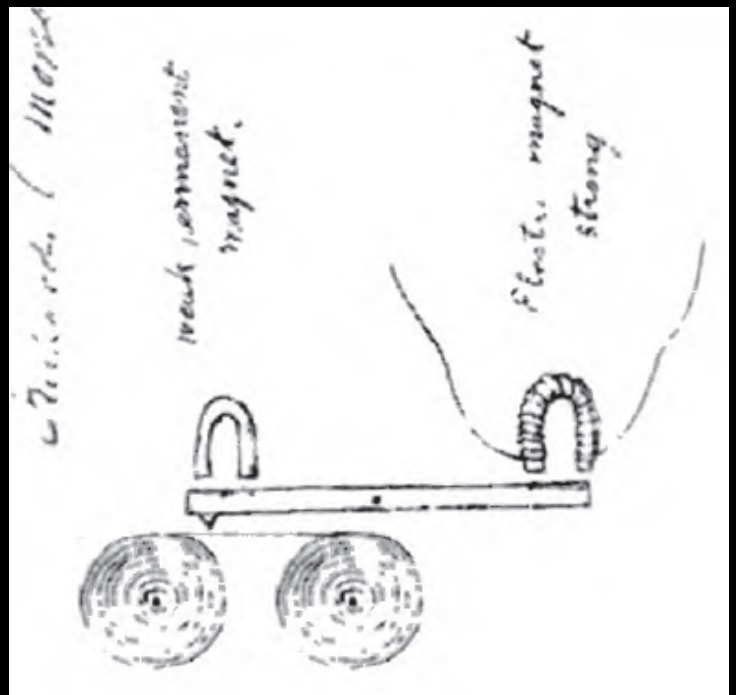
Telegraph - Design

1832 – Morse's shipboard idea

1836 – Gale and Vail help out

1838 – Morse shows Van Buren





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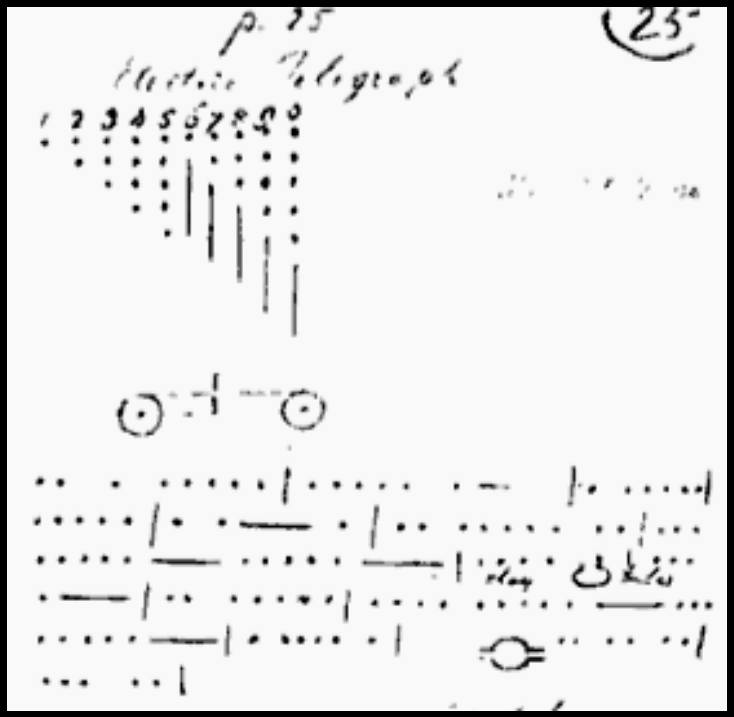

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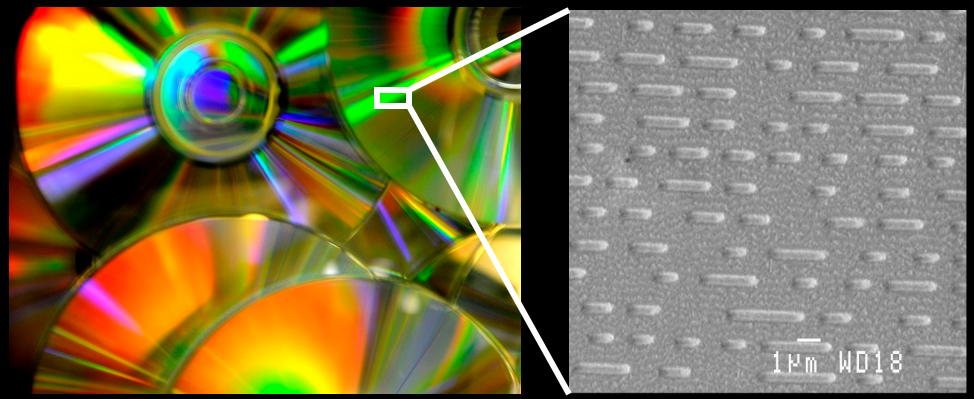
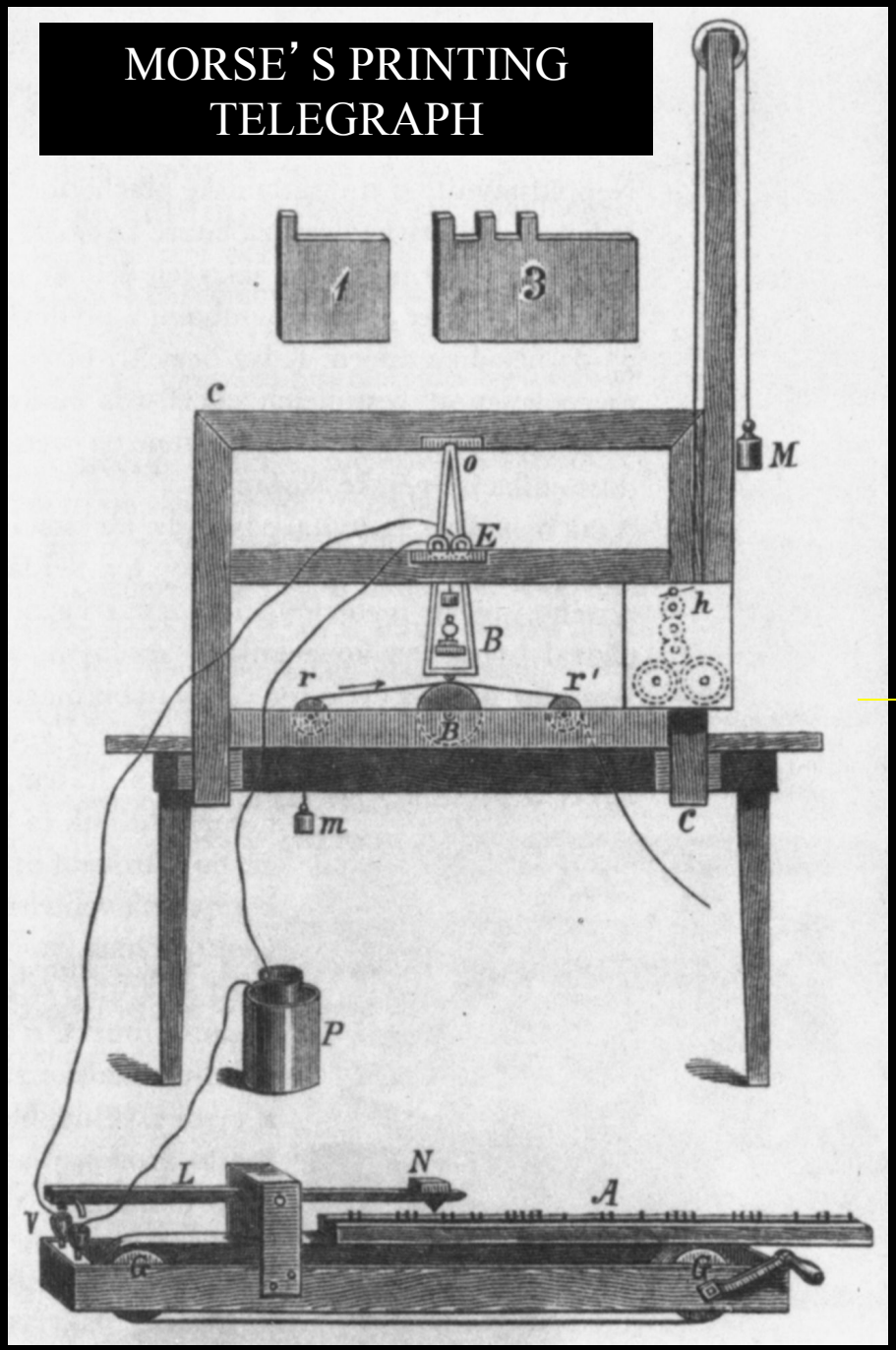
181th Anniversary of Digital Code
31th Anniversary of CD



MORSE'S PRINTING TELEGRAPH



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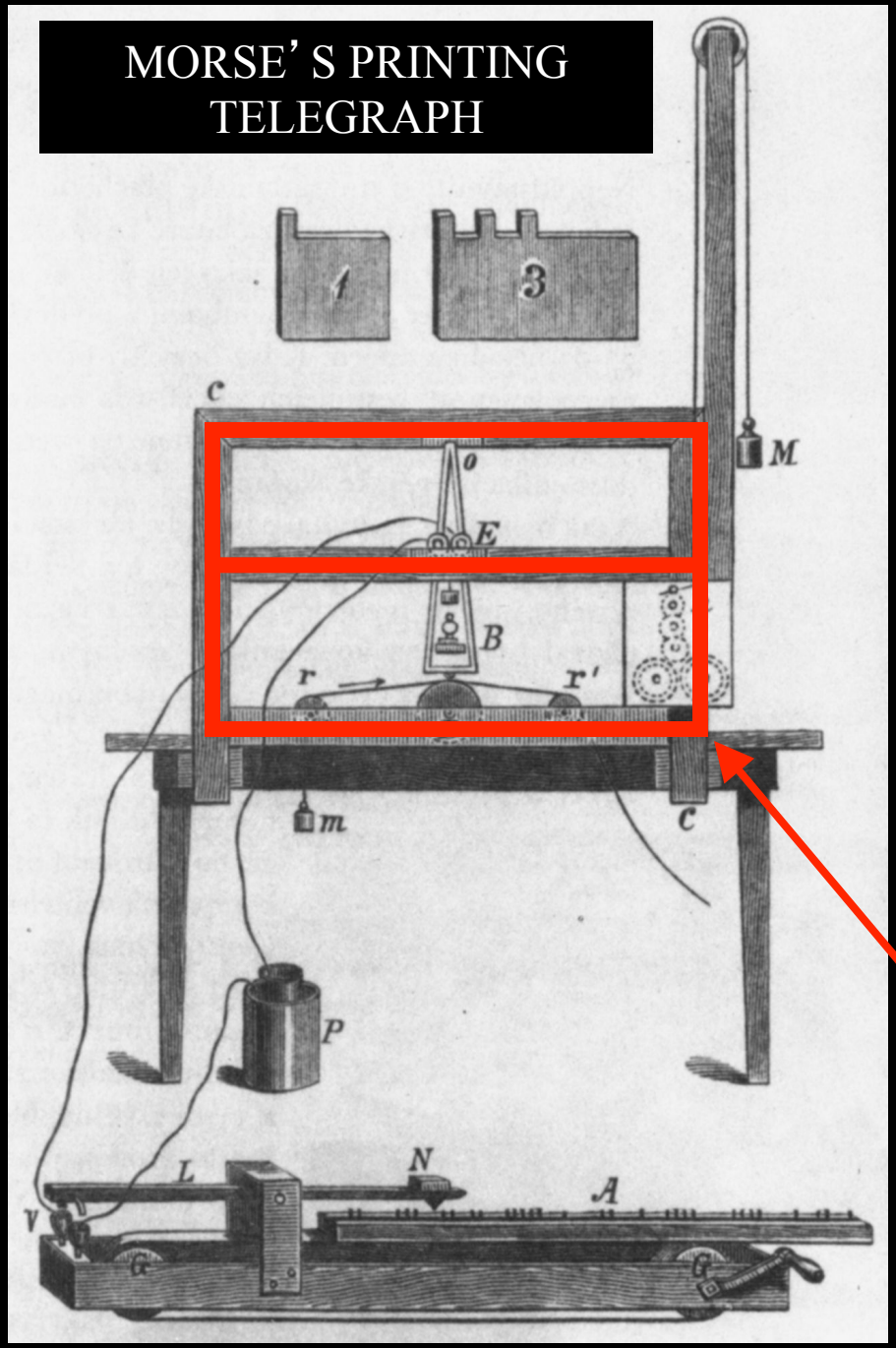
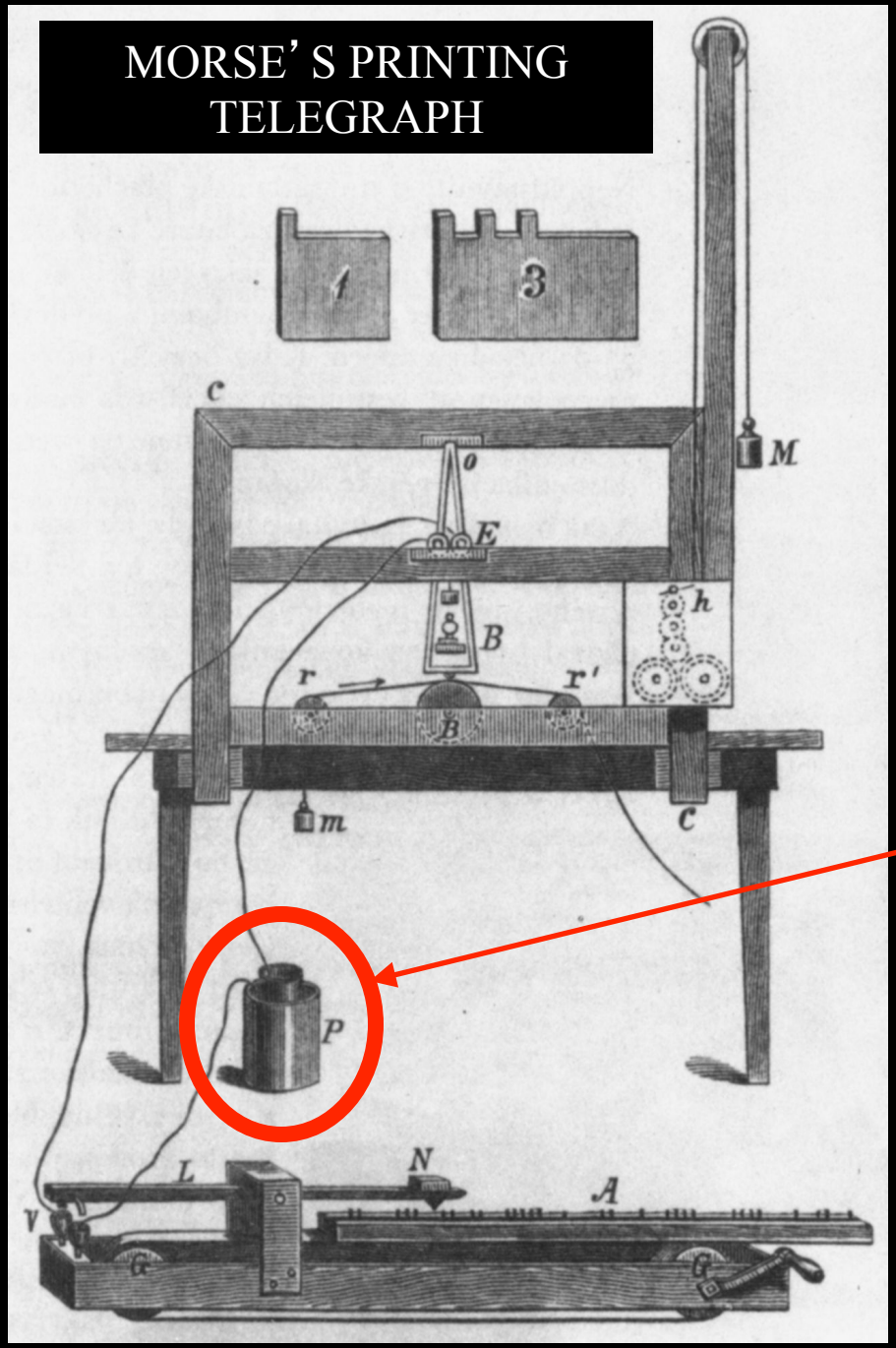


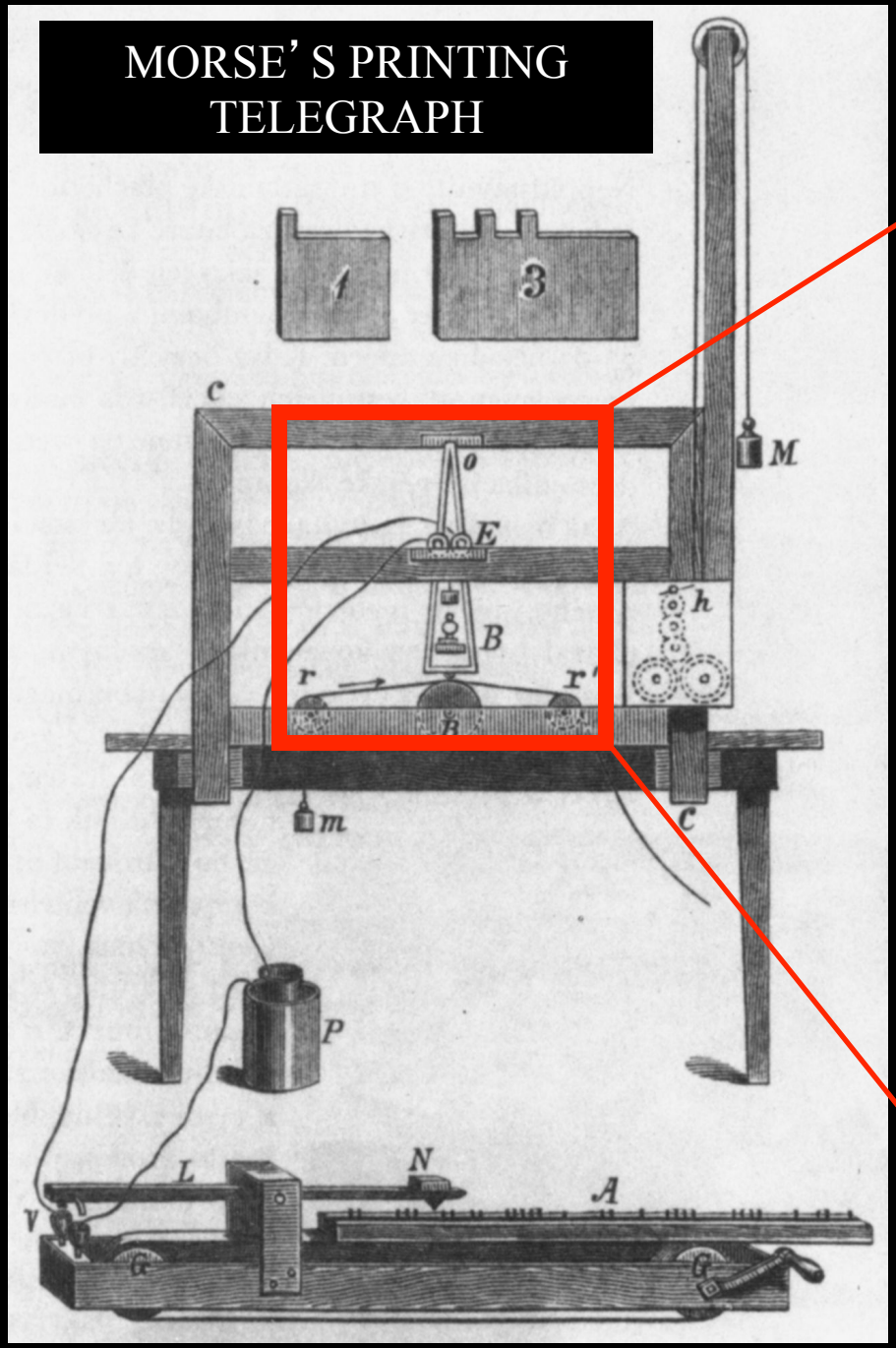
ARTIST'S CANVAS STRETCHER

MORSE'S PRINTING TELEGRAPH



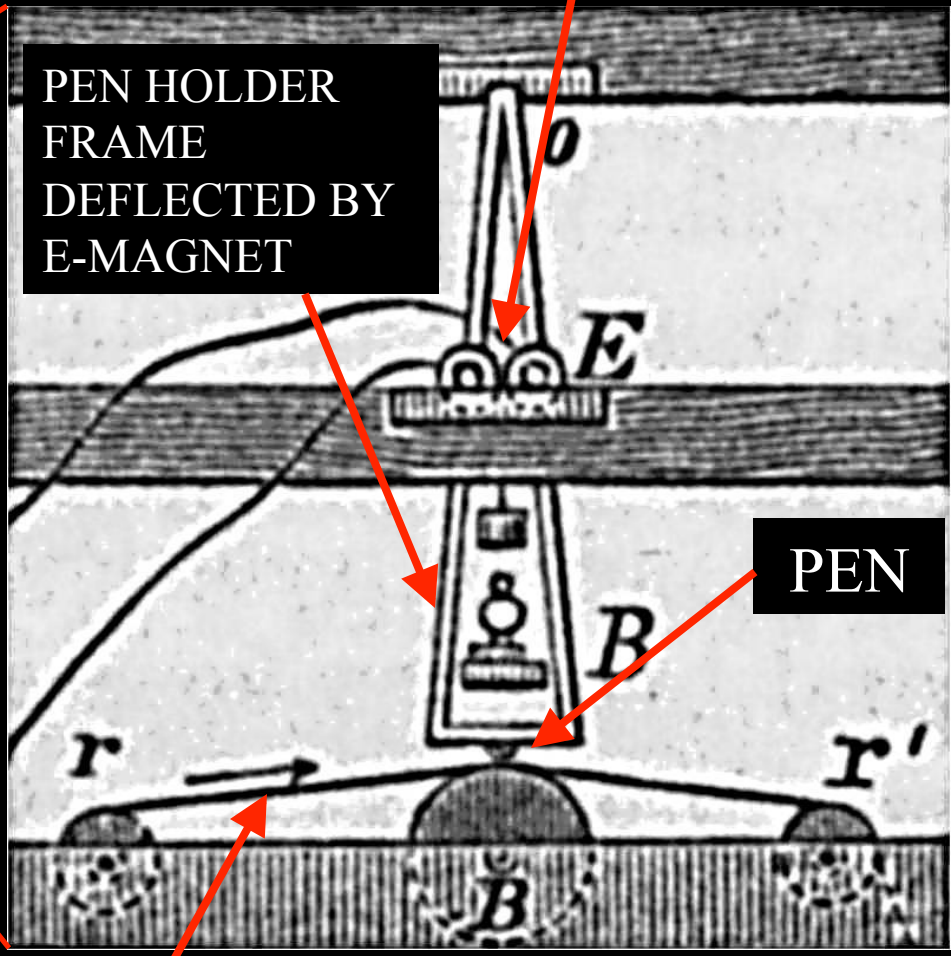
Copper-Zinc Battery

MORSE'S PRINTING TELEGRAPH



ELECTROMAGNET

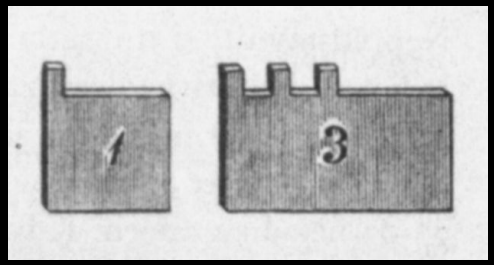
PEN HOLDER FRAME DEFLECTED BY E-MAGNET



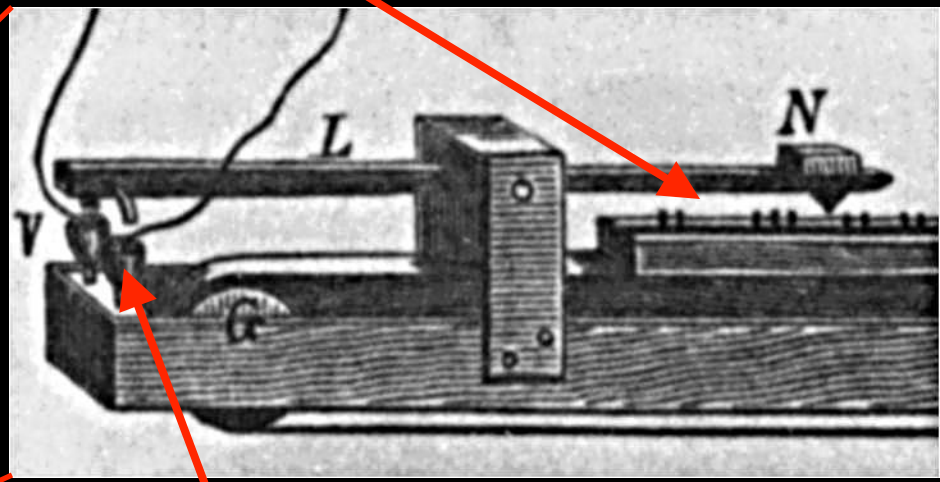
PEN

MOVING PAPER TAPE

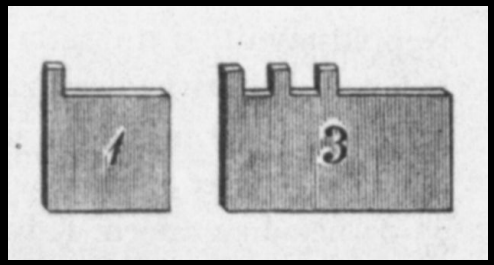
MORSE'S PRINTING TELEGRAPH



MOVEABLE TYPE HOLDER

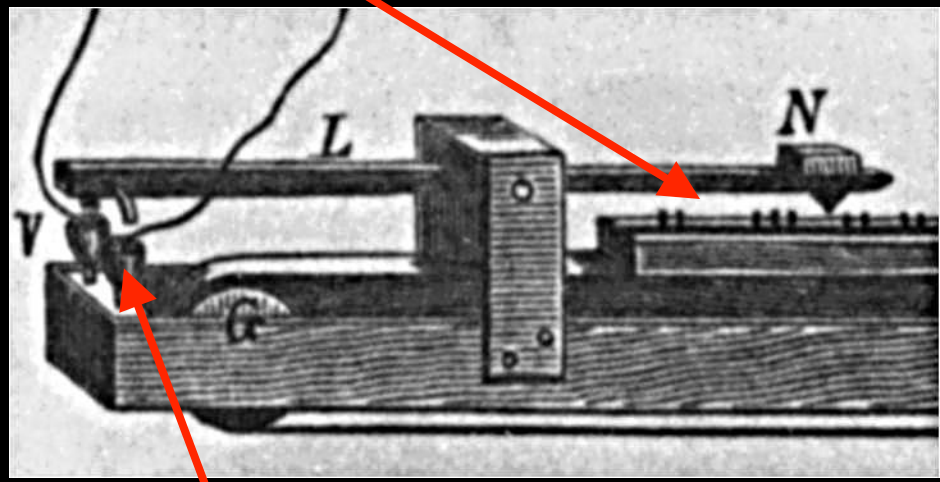


CONTACTS USING MERCURY



DEMONSTRATION

MOVEABLE TYPE HOLDER



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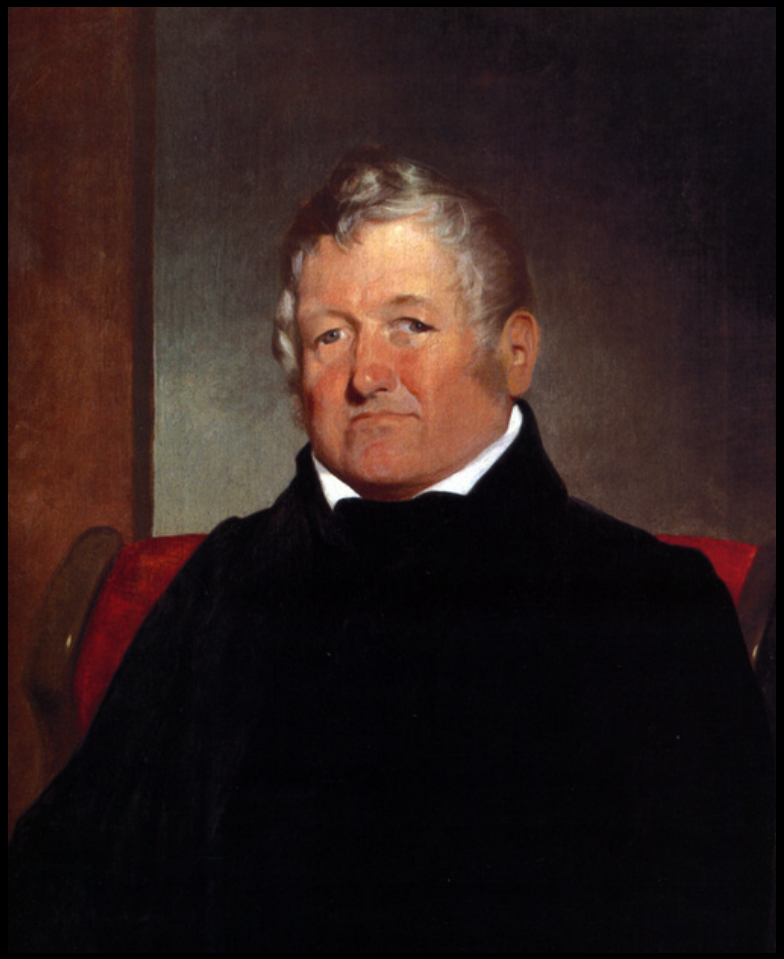
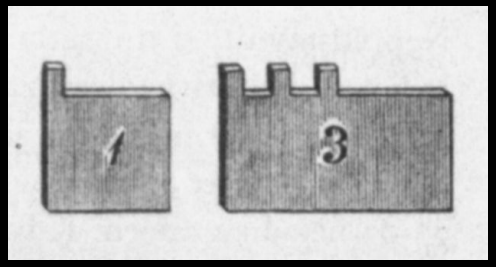


Judge Vail – Morse Investor

Alfred Vail – Morse Partner



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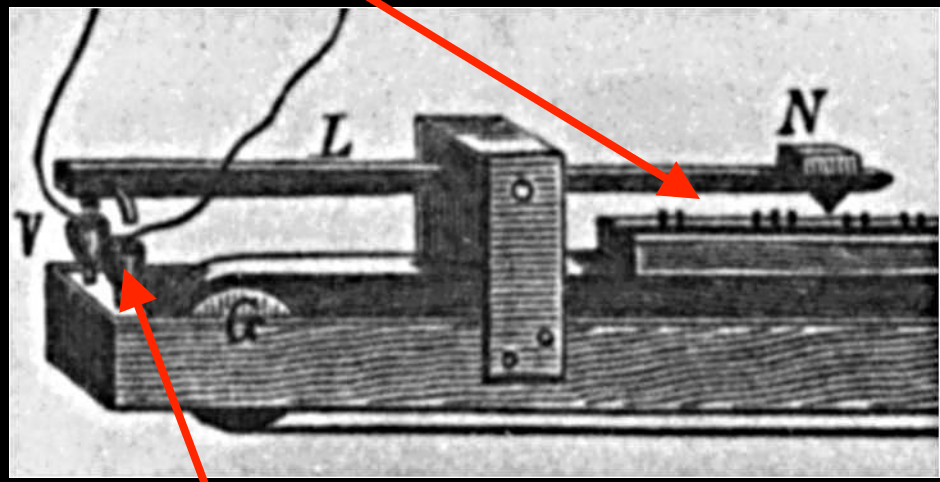
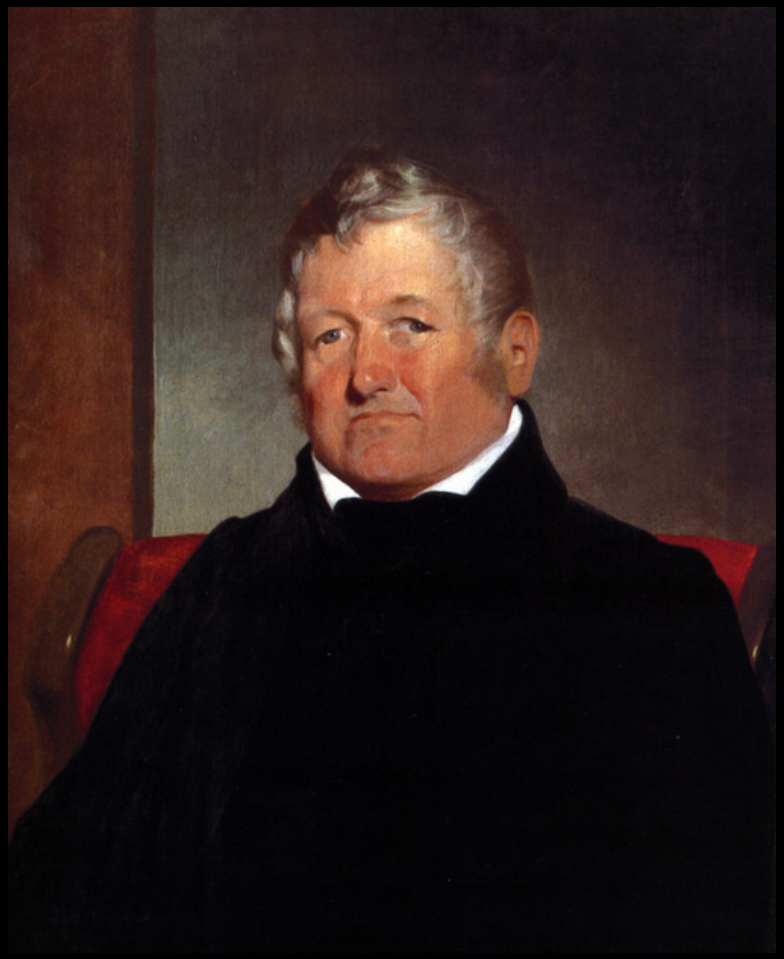


CONTACTS USING MERCURY



Judge Vail – Morse Investor

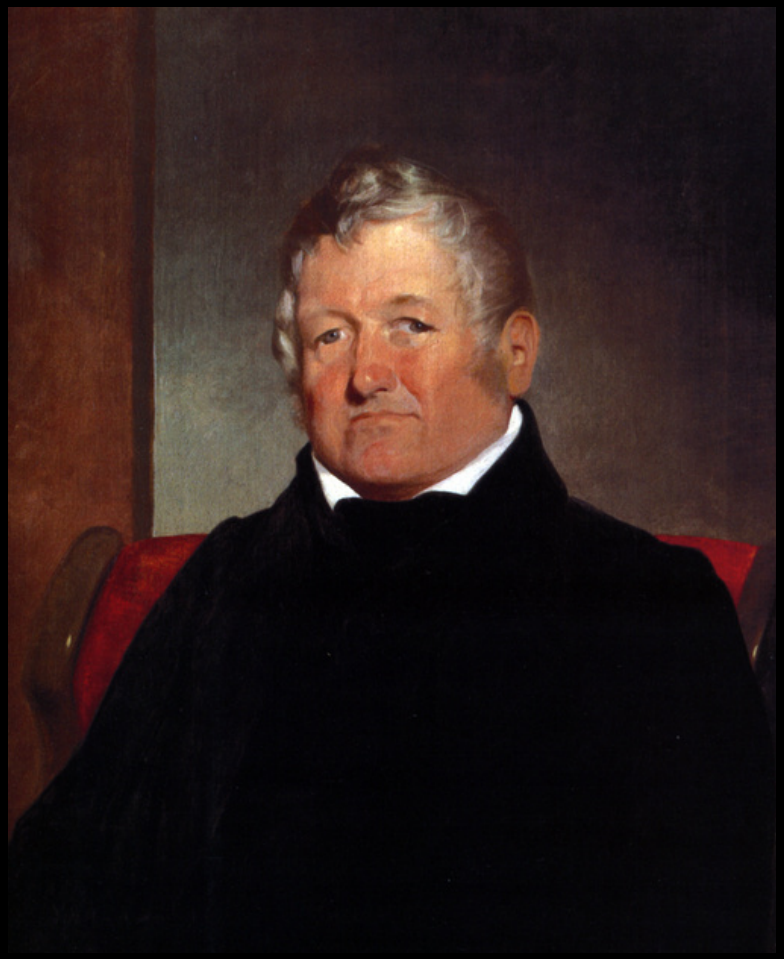
Alfred Vail – Morse Partner

Telegraph - Design

1832 – Morse's shipboard idea

1836 – Gale and Vail help out

→ 1838 – Morse shows Van Buren



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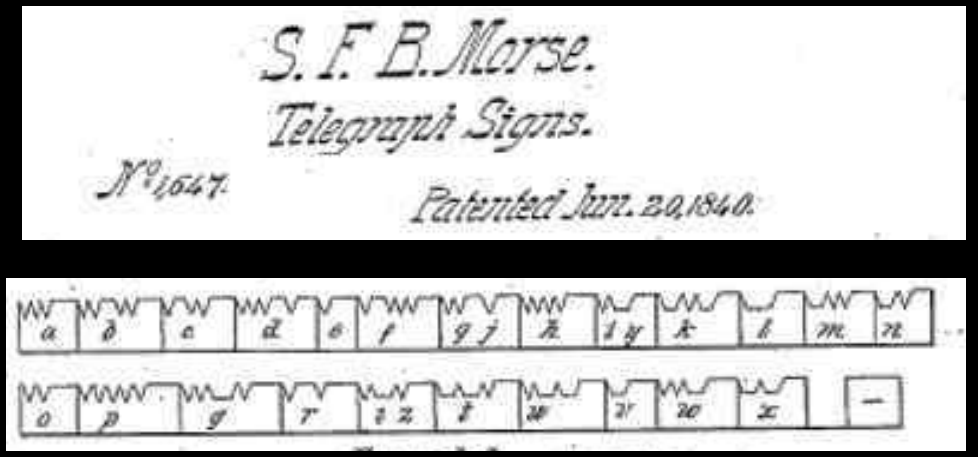

MORSE PATENTS THE IDEA OF A BINARY INFORMATION CODE

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Congress - $30,000 to Morse

Morse - hires Vail & Cong. Smith

Smith - hires Ezra Cornell

38 miles connecting
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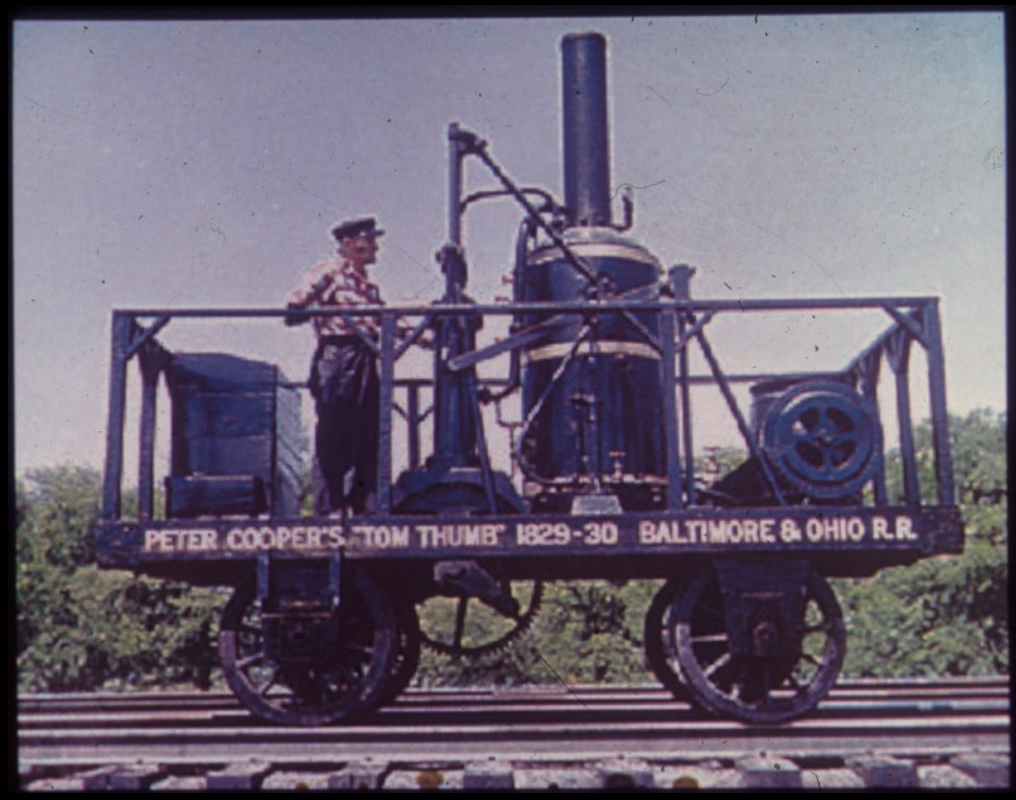

Telegraph Wires along **B&O** RR Right-of-Way

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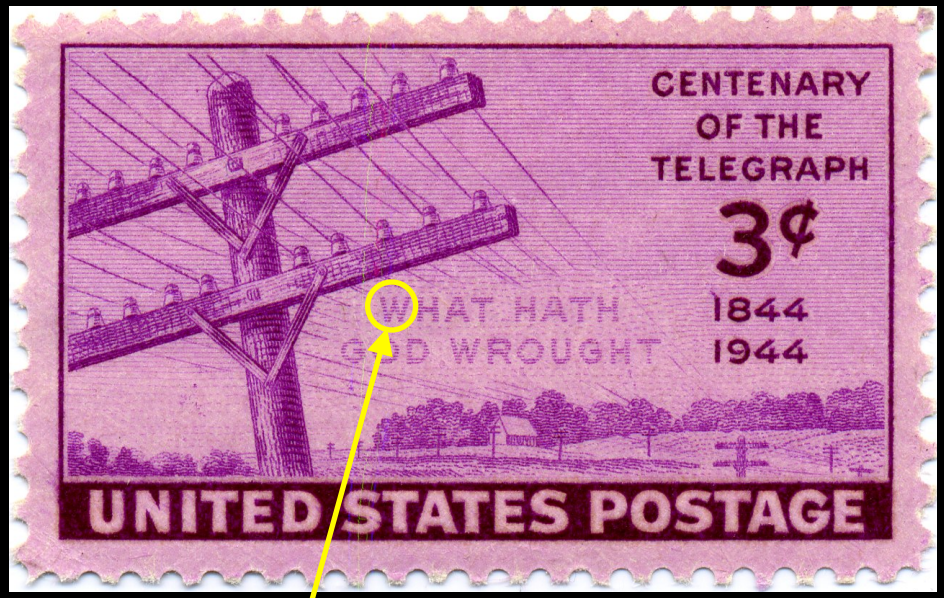
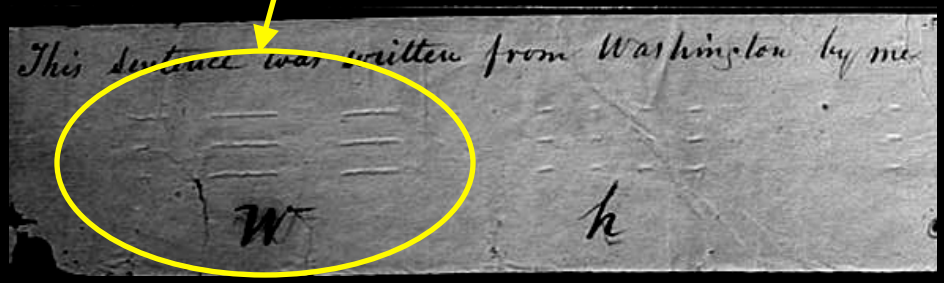


May 24, 1844 at 8:45am



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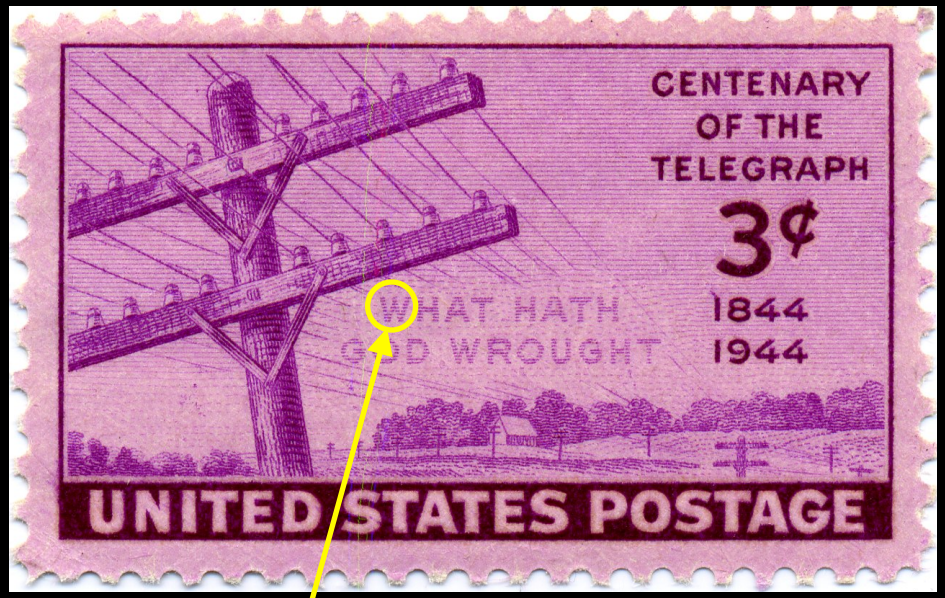
MORSE CODE – dots and dashes

Ezra Cornell



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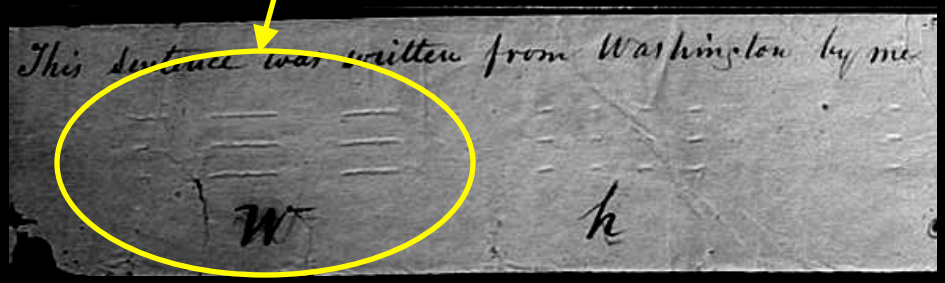

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MORSE CODE – dots and dashes

Science and Engineering

Discovery

Scientist and remote sounder

Development

Gov’t Grant, Private Company

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Artist plans whole network

7th and E St, Washington, DC

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Telegraph Lines in 1853

CONNECTING CITIES

TELEGRAPH - Later

1845 – independent telegraph companies; patent disputes

1856 – Western Union – Cornell becomes the major stockholder

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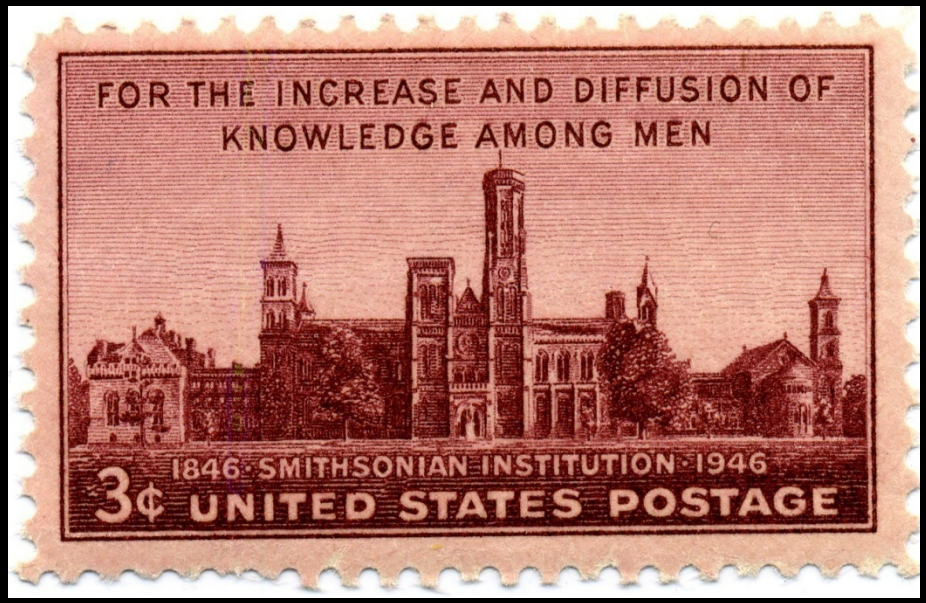

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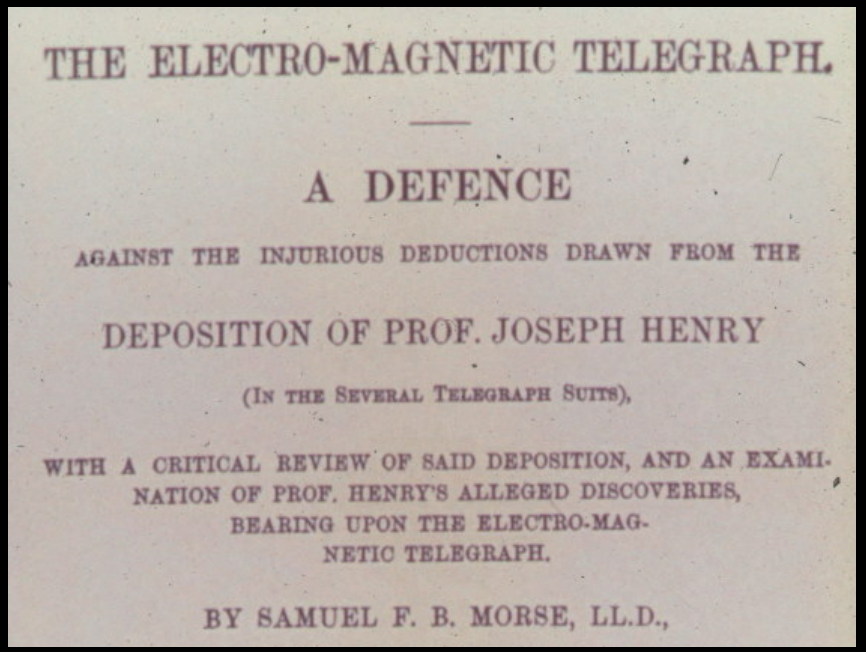

THE ELECTRO-MAGNETIC TELEGRAPH.

A DEFENCE

AGAINST THE INJURIOUS DEDUCTIONS DRAWN FROM THE

DEPOSITION OF PROF. JOSEPH HENRY

(In the Several Telegraph Suits),

WITH A CRITICAL REVIEW OF SAID DEPOSITION, AND AN EXAMINATION OF PROF. HENRY'S ALLEGED DISCOVERIES, BEARING UPON THE ELECTRO-MAGNETIC TELEGRAPH.

BY SAMUEL F. B. MORSE, LL.D.,

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CONNECTING THE CONTINENT

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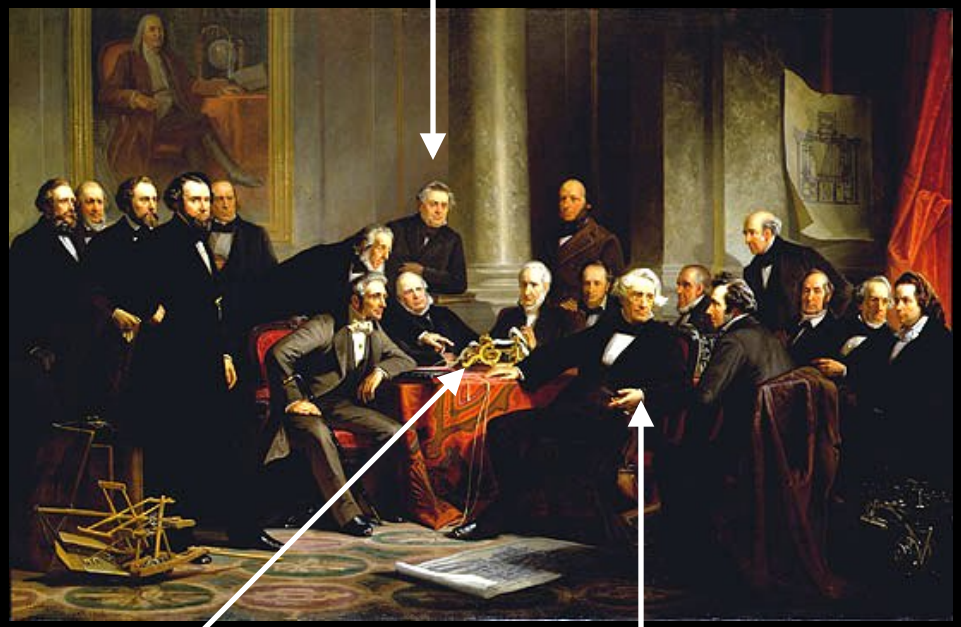
Christian Schussele's "Men of Progress"

Joseph Henry



Telegraph Register

Samuel Morse

Christian Schussele's "Men of Progress"

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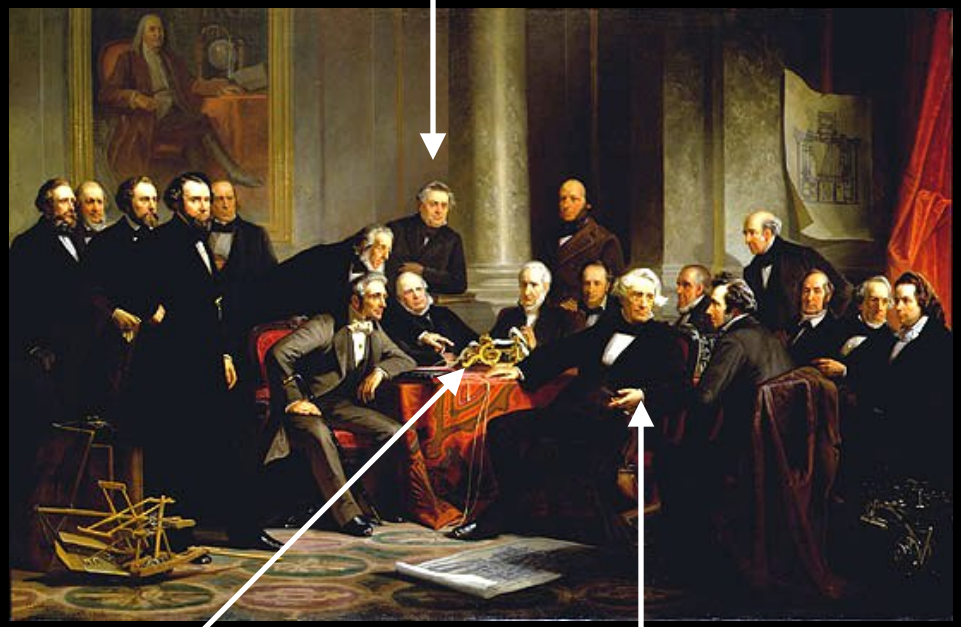

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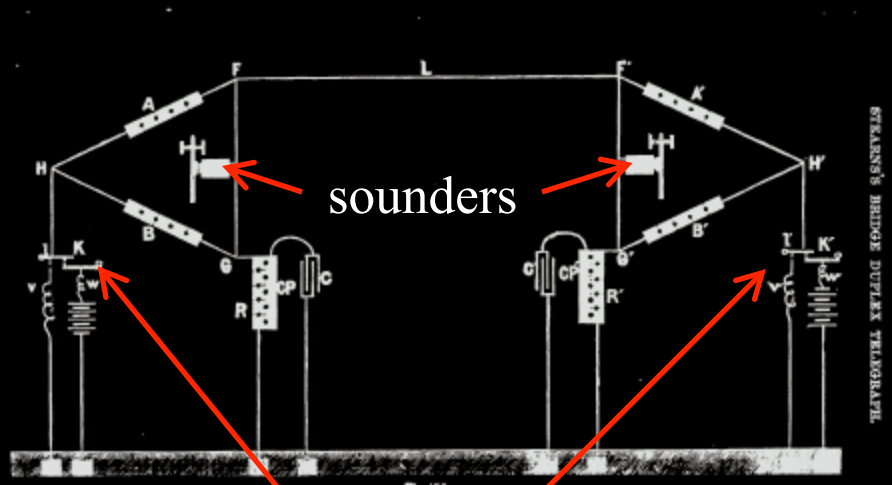
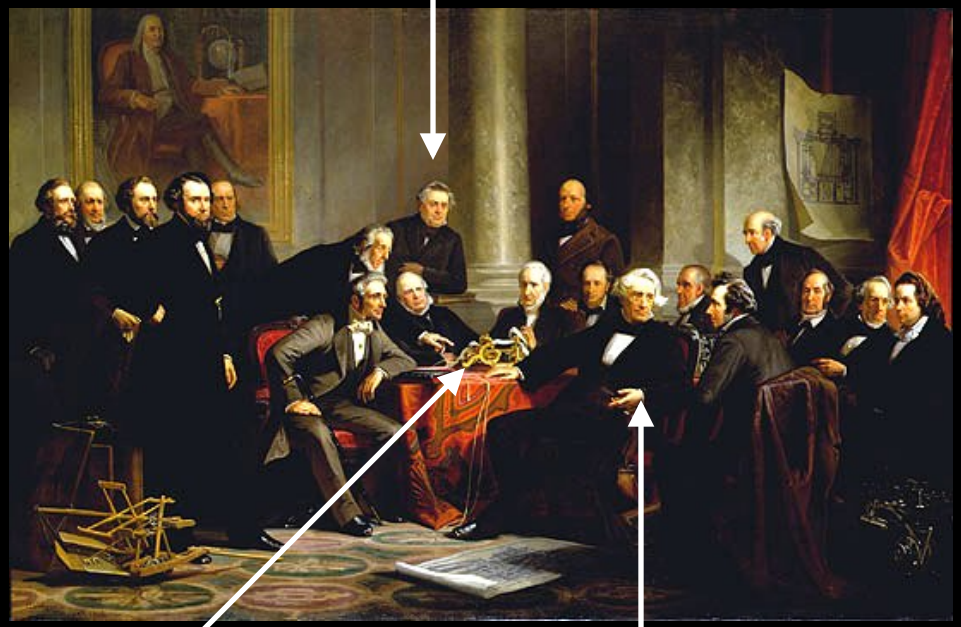
Stearns Duplex Idea-1872
TWO MESSAGES ON ONE WIRE



DEMONSTRATION

Joseph Henry



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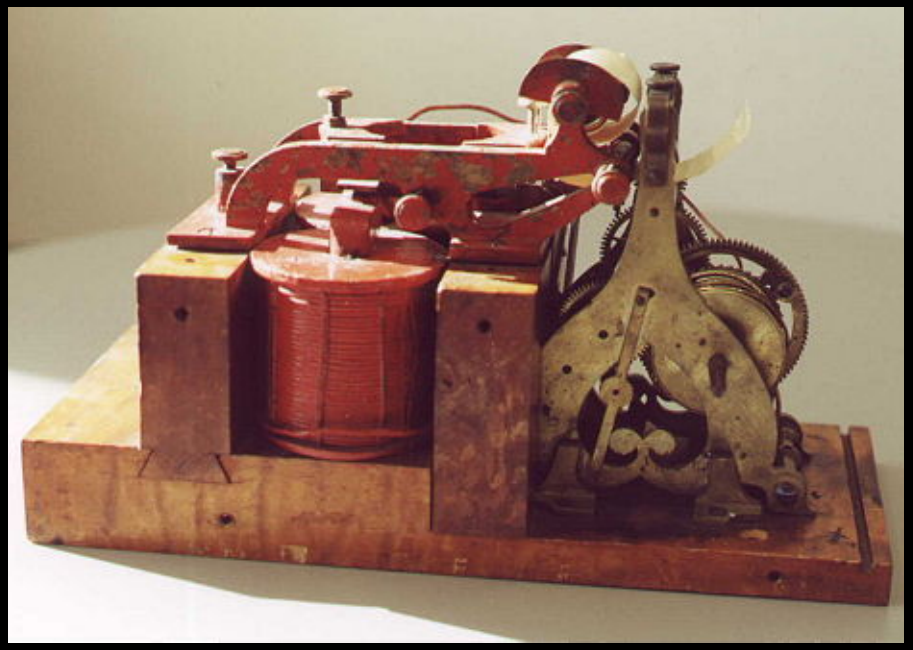

Vail telegraph register at Cornell

SIBLEY
COLLEGE at
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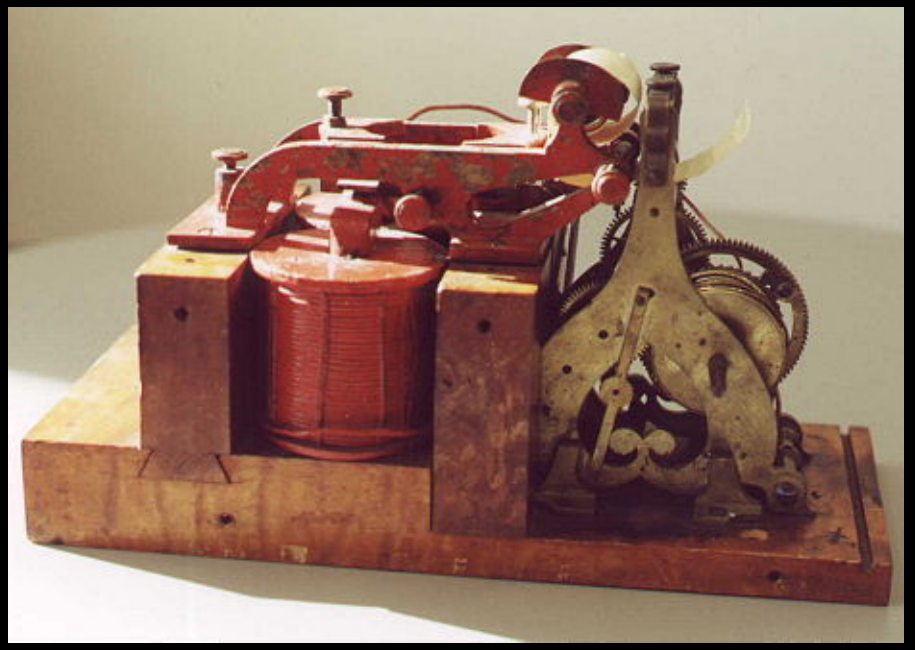

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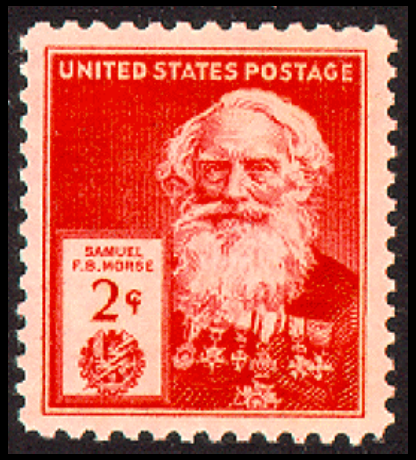
Telegraphers

Morse	telegraph
Carnegie	steel industry
Bell	telephone
Edison	electric power
Marconi	wireless



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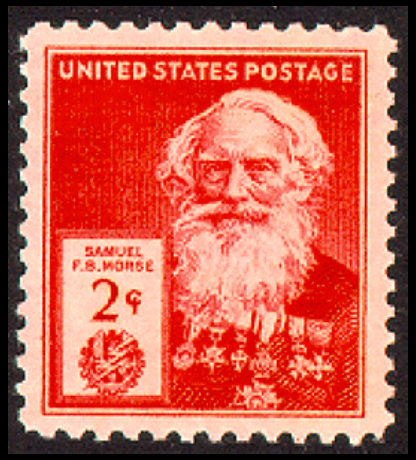

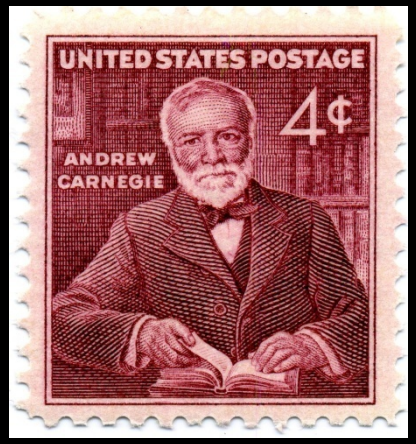

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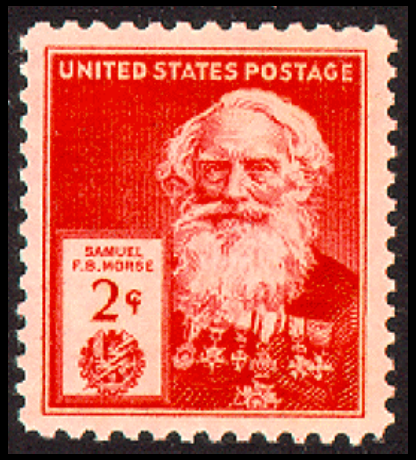

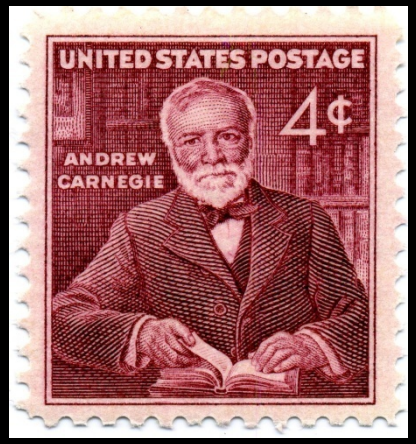

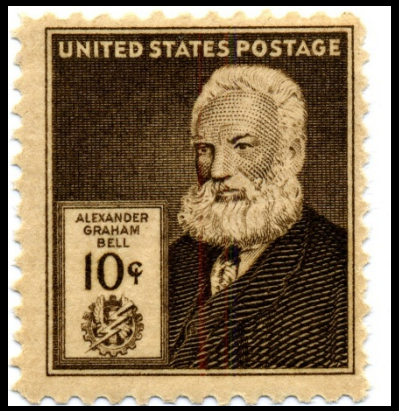

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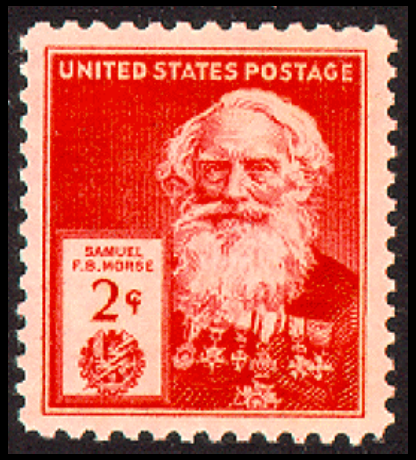

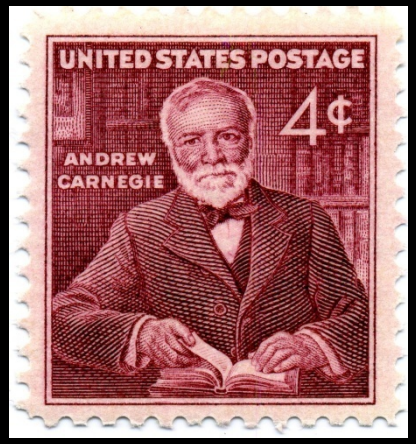

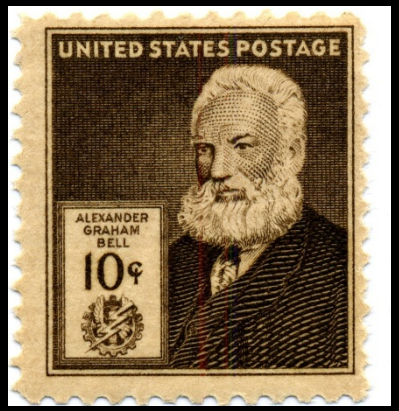

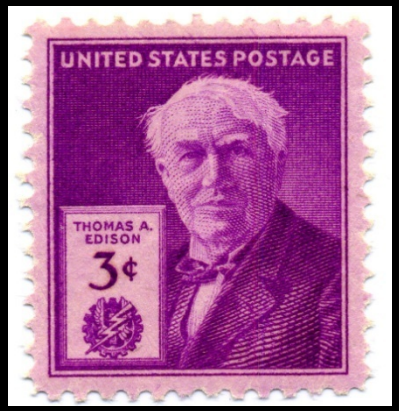

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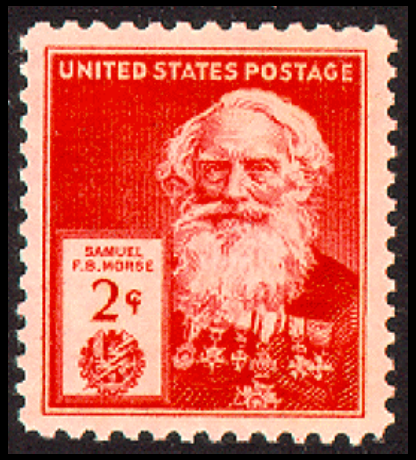

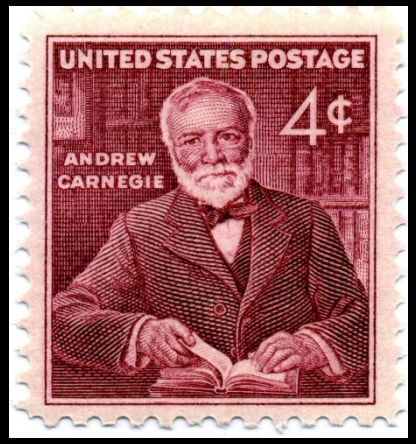

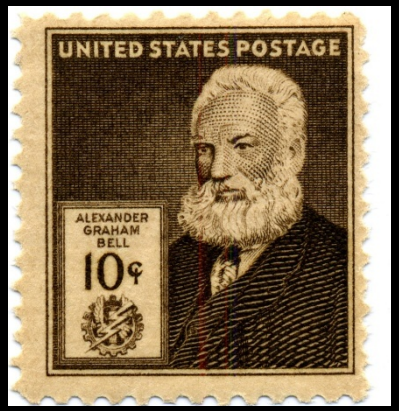

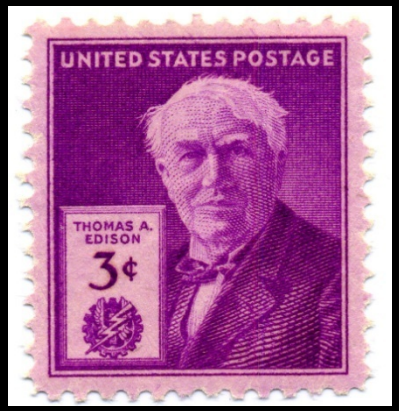

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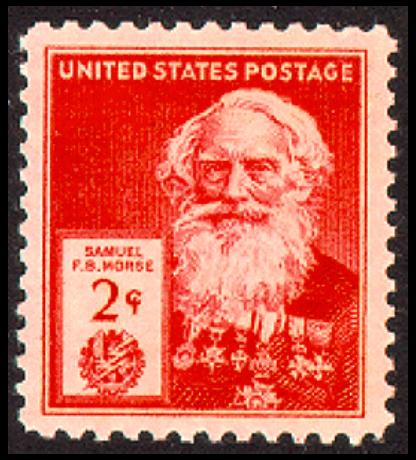

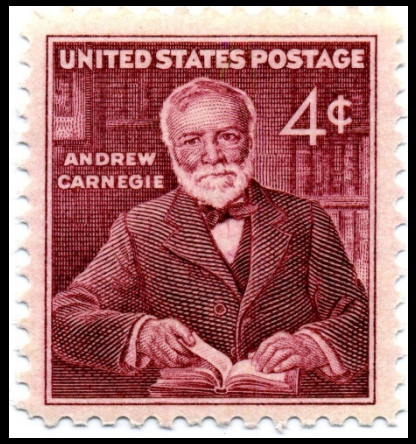

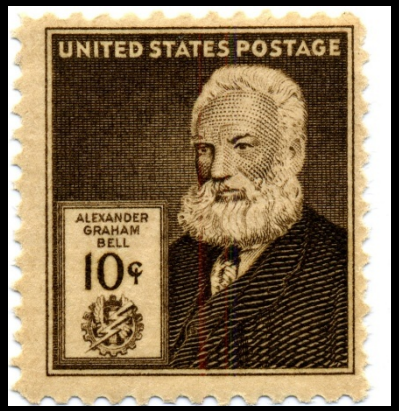

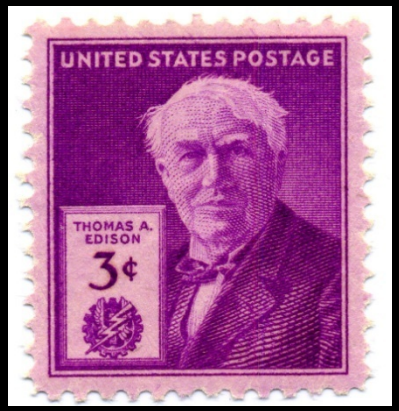

Key Ideas

Scientific

- Electromagnetic Binary Code

Social

- Public Investment
- Private Industry

Symbolic

- Artist as Innovator