Henry, Morse and the Telegraph

Discovery by Scientist – Design by Artist-Entrepreneur

Many dates – pay attention only to ones in boxes

CEE 102: Prof. Michael G. Littman
Course Administrator: Arianna Sherman ariannas@princeton.edu

Computers 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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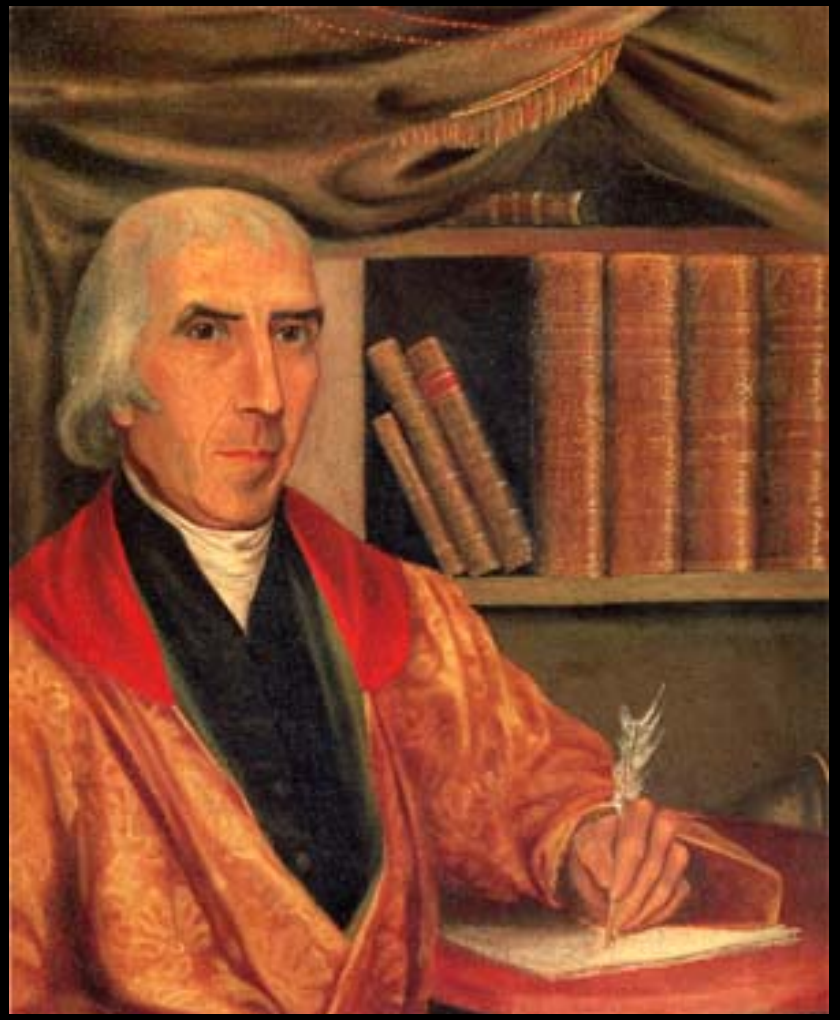

Jed Morse (Father - Geographer) by Morse

Morse by Morse

West by West

Morse by Morse

Lucretia Morse (his wife) 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 by Morse

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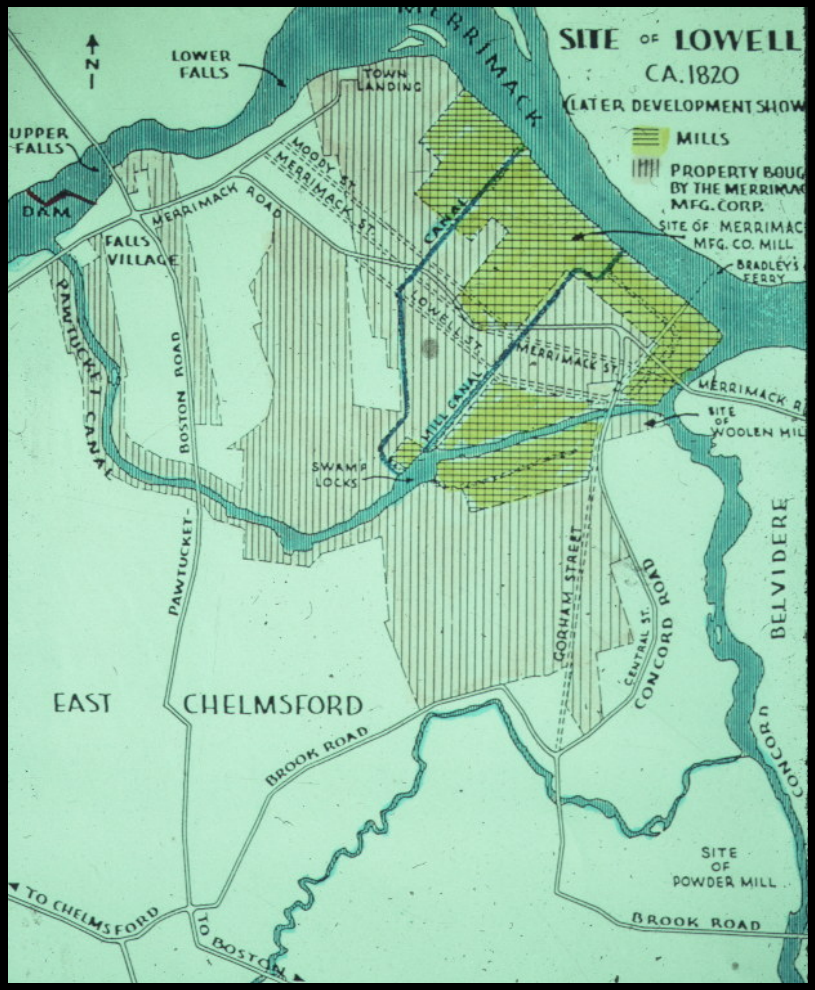
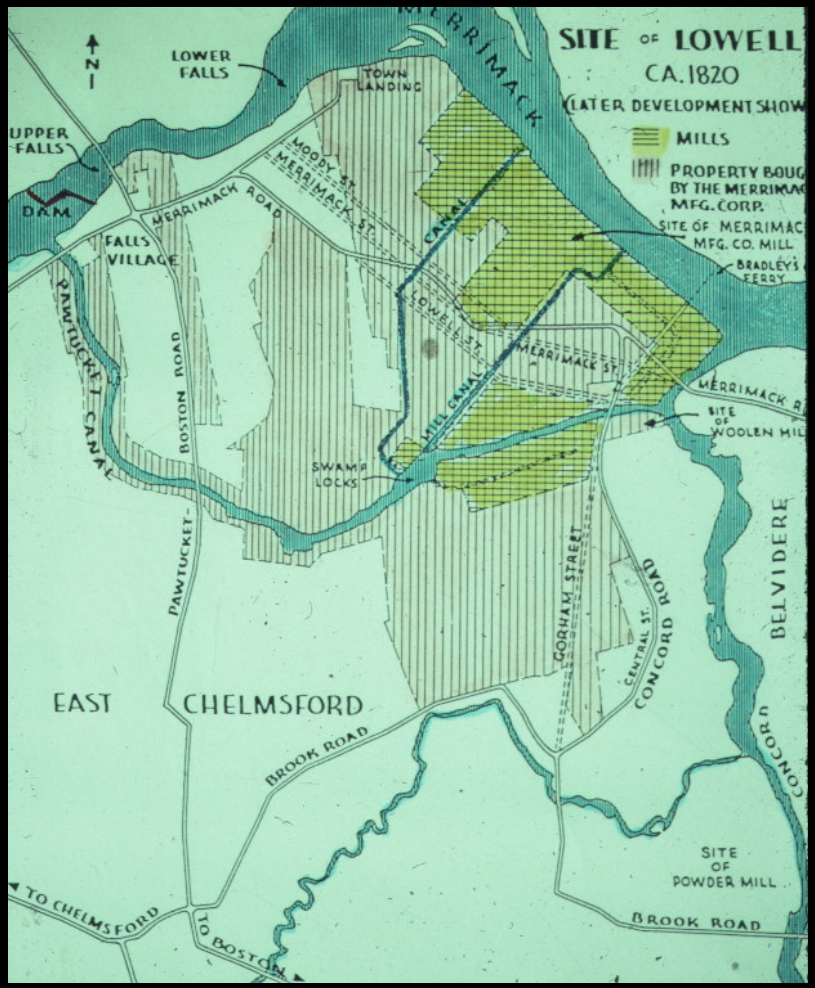


Buffalo

Albany



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Dewitt Clinton by Morse

Samuel Morse painting of his Yale geology teacher, Benjamin Silliman

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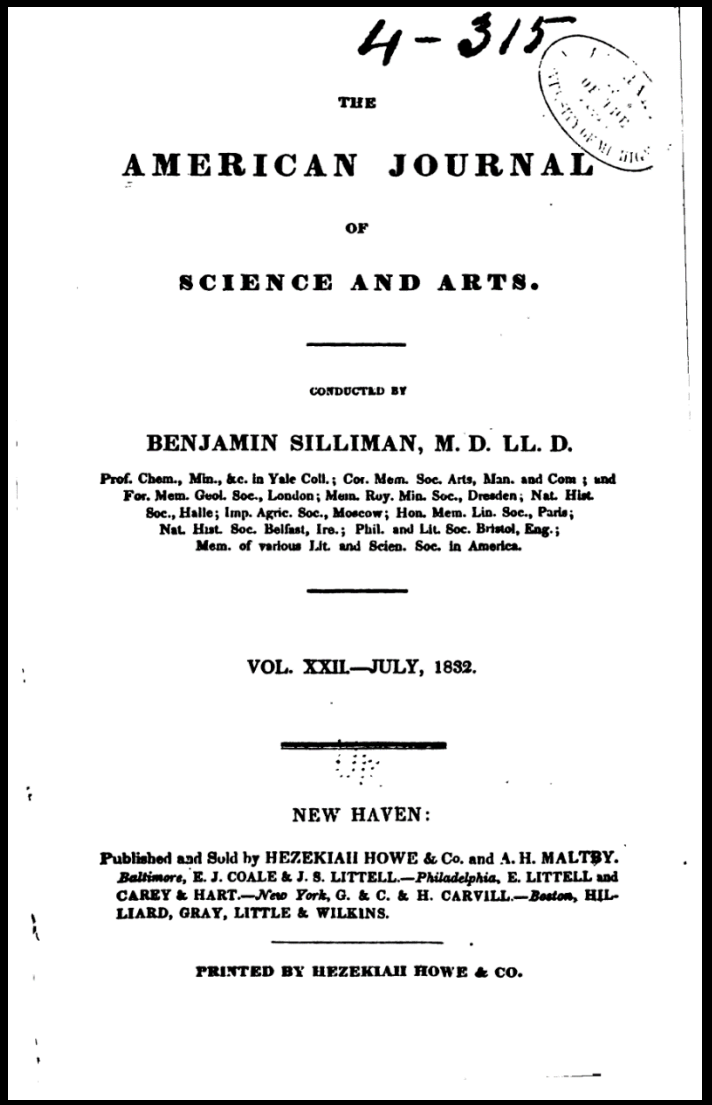

4-315

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

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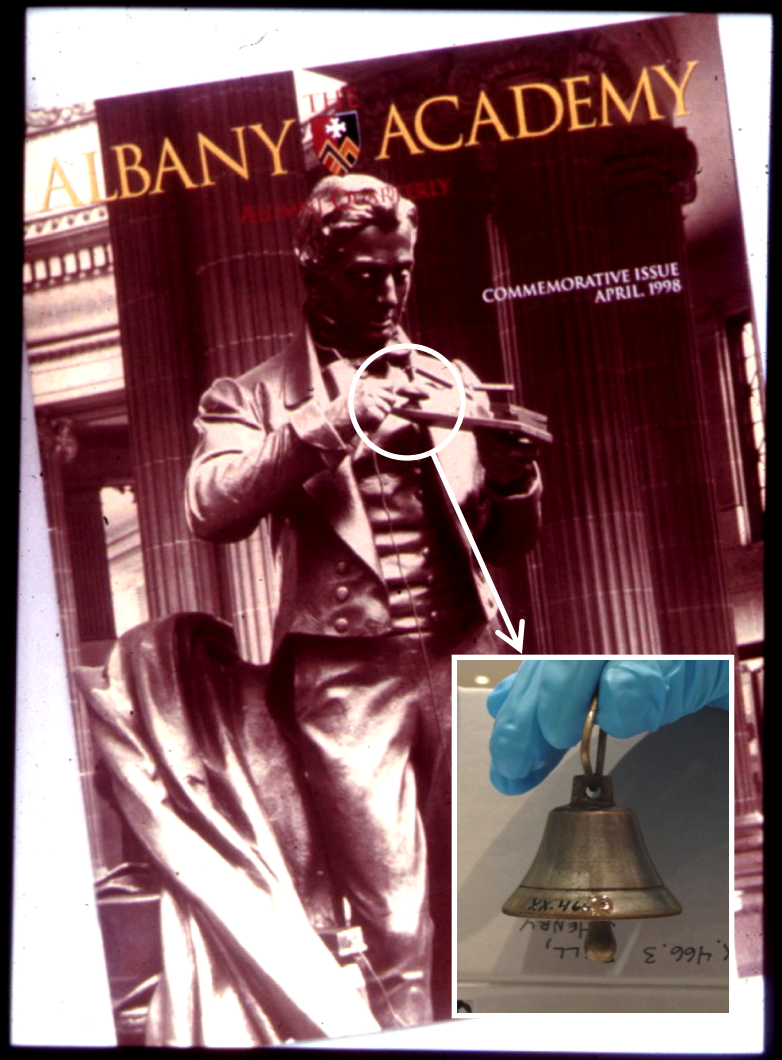
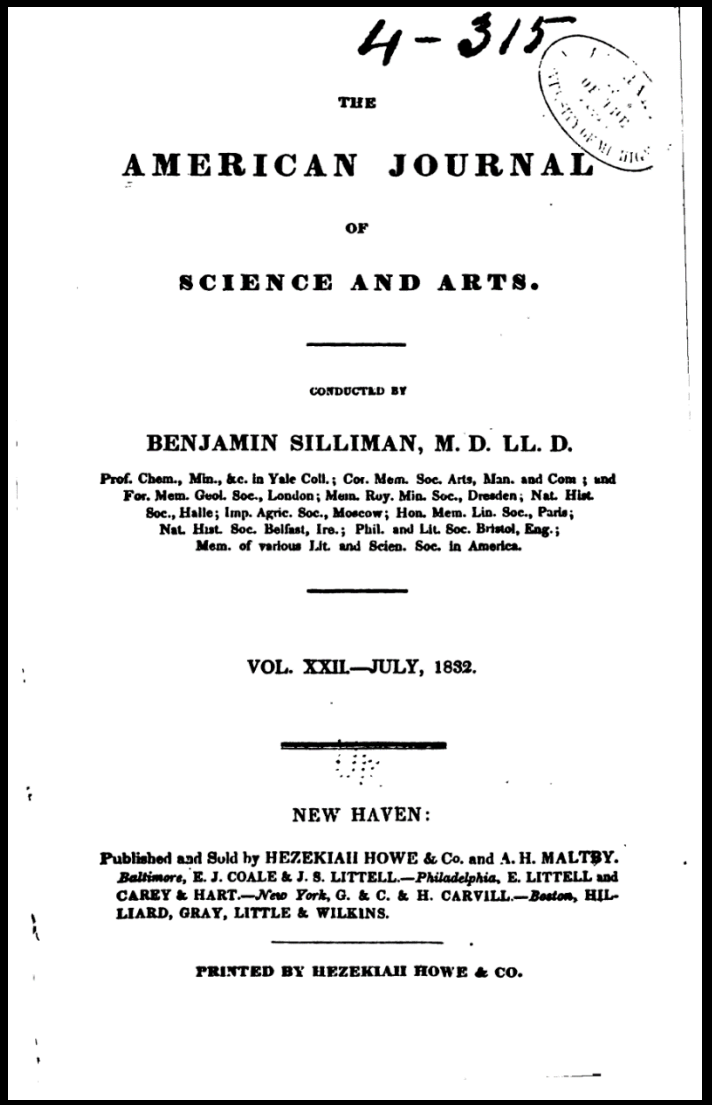


Science and Math HS Teacher Joseph Henry holding the first sounding telegraph



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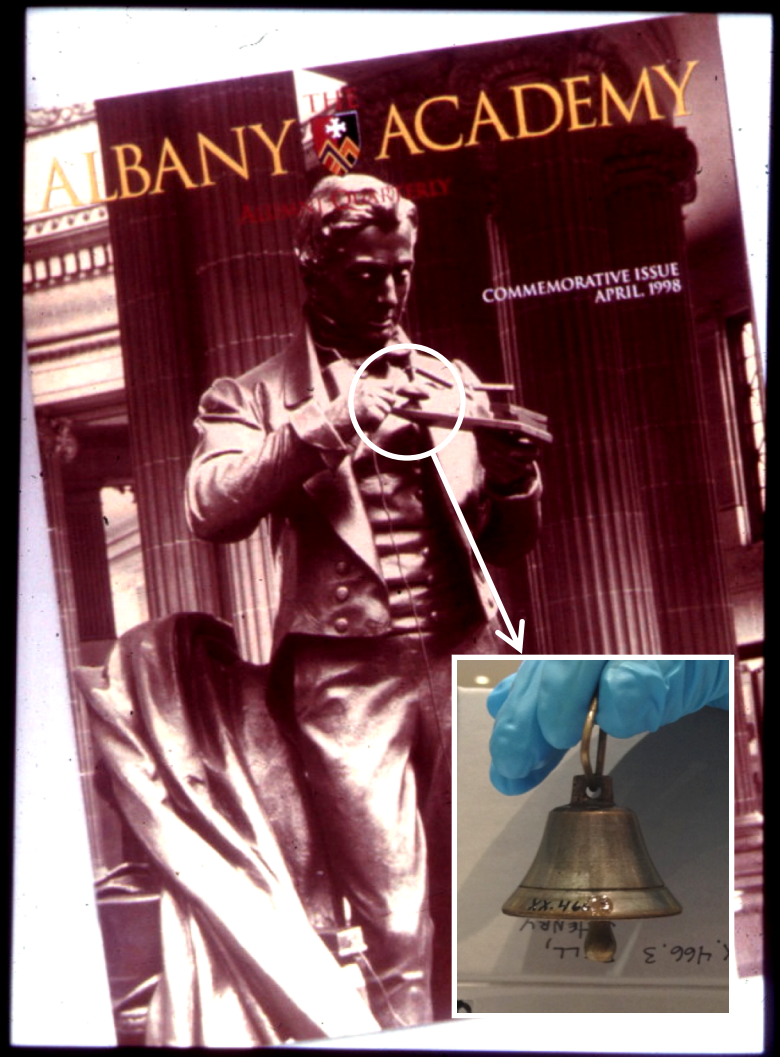

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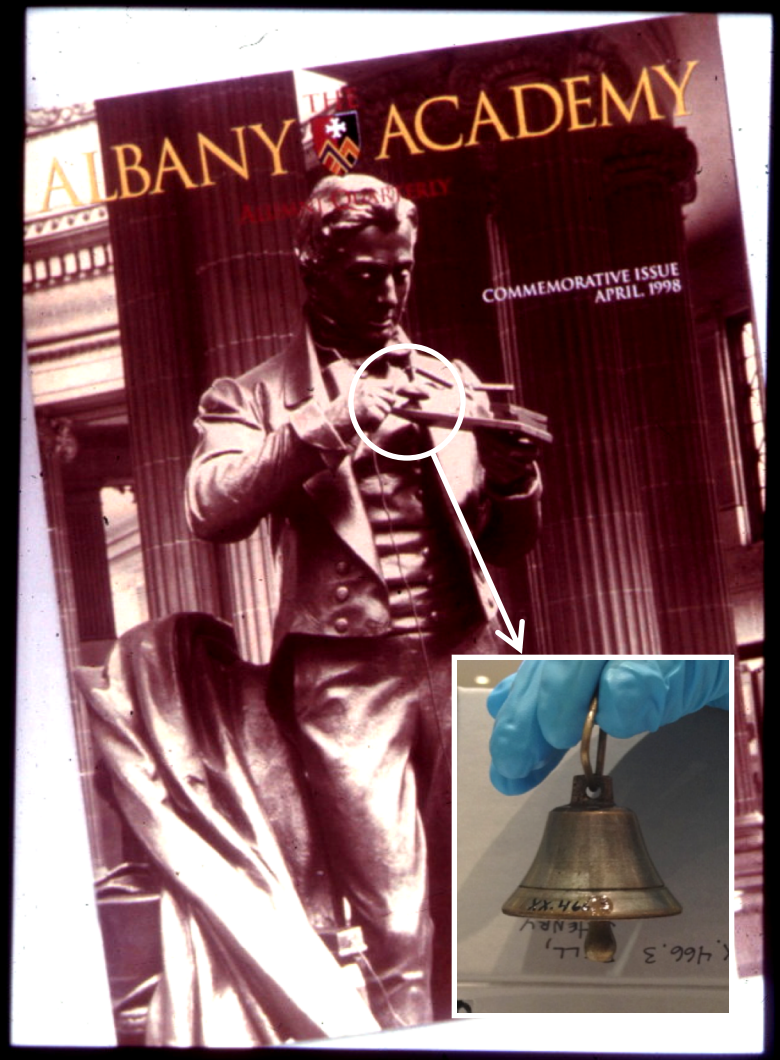

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Telegraph - Discovery

1820	Electricity linked to Magnetism
1825	First Horseshoe Electromagnet
1831	Henry's Strong Electromagnet and Sounding Telegraph
1832	Henry comes to Princeton

Demonstration of compass needle deflection by electric current

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Demonstration of compass needle deflection by electric current

Why is this demonstration important?

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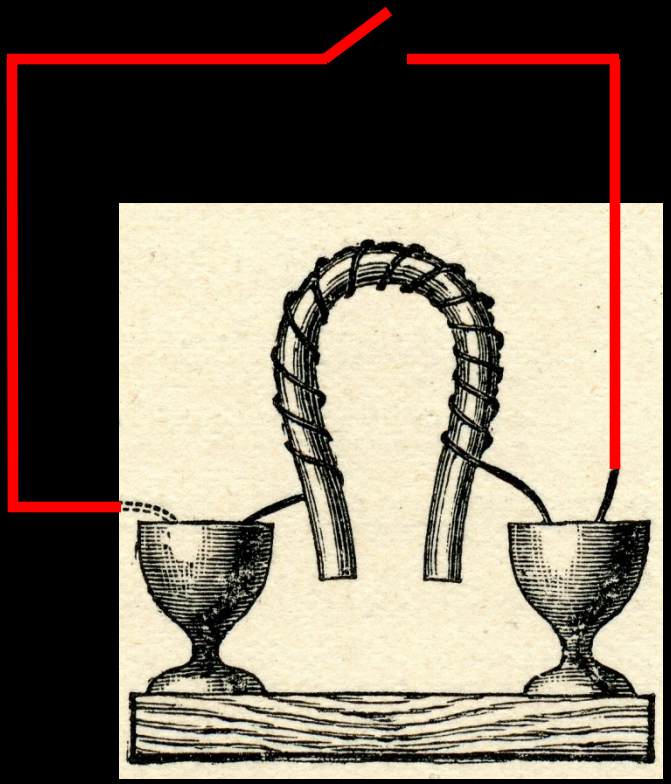

Electromagnet in circuit with two copper-zinc-acid batteries and on-off switch

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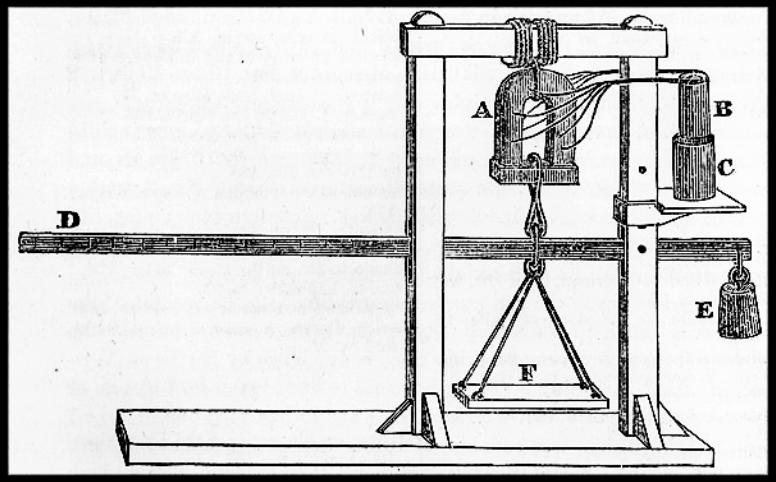
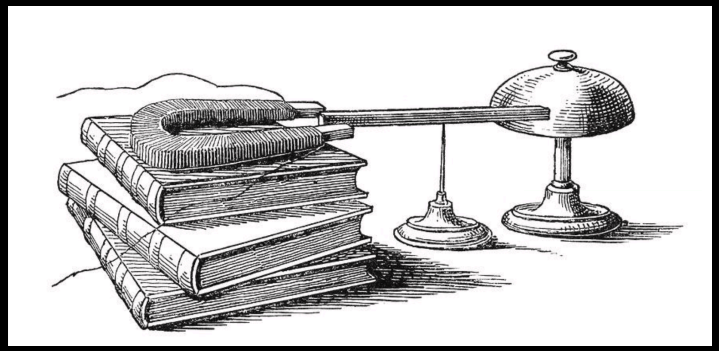


$$B = k I N$$

Magnetic Field



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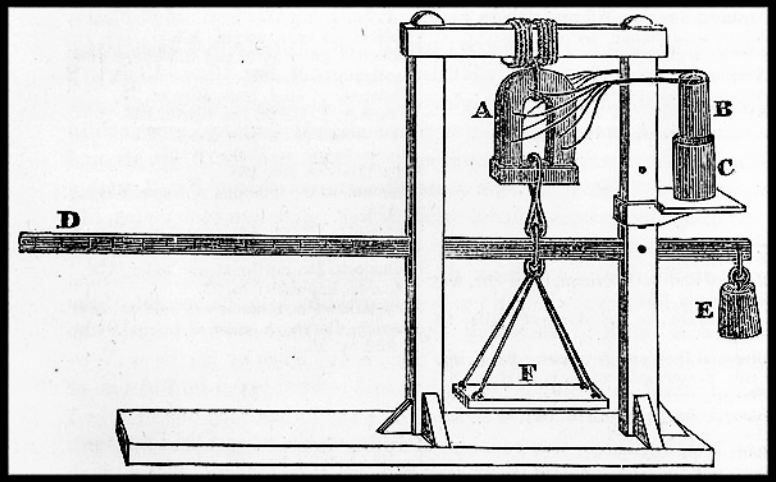

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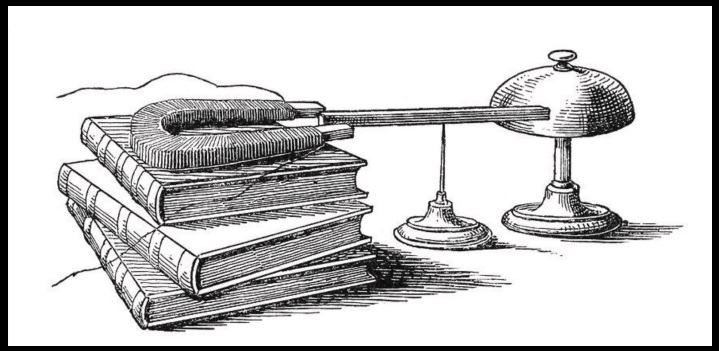
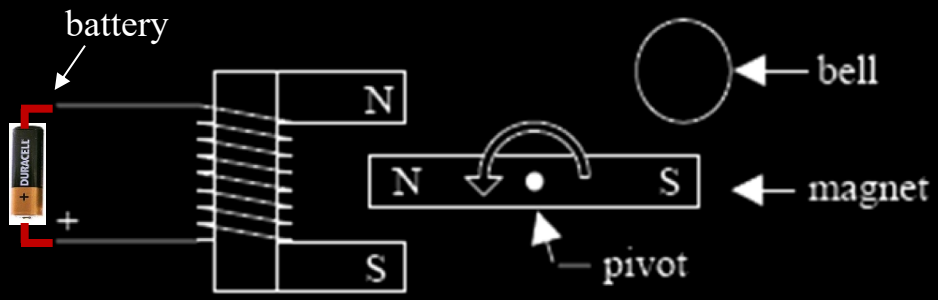


$$R = \frac{\rho L}{A}$$

Resistance

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

Ohm's Law



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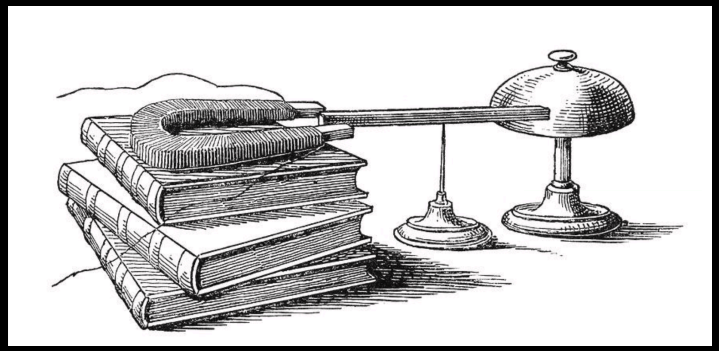

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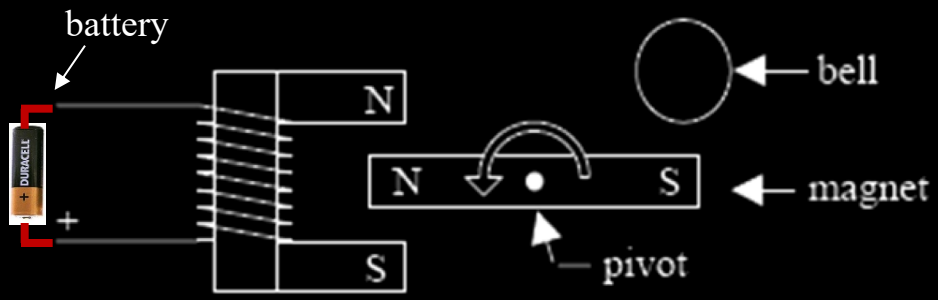

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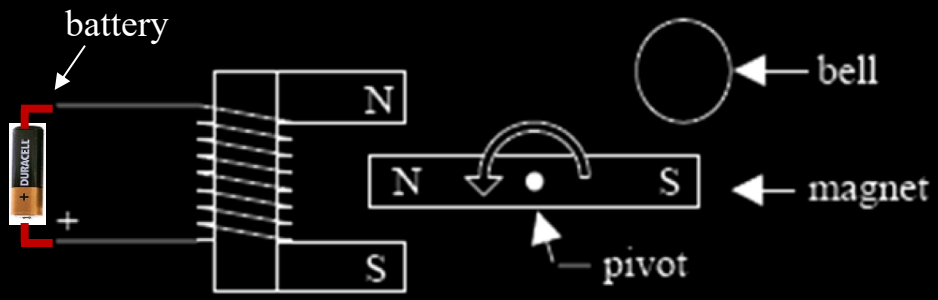
Ohm's Law

How does Henry's sounding telegraph work?

Poles in horseshoe electromagnet reverse when current is reversed



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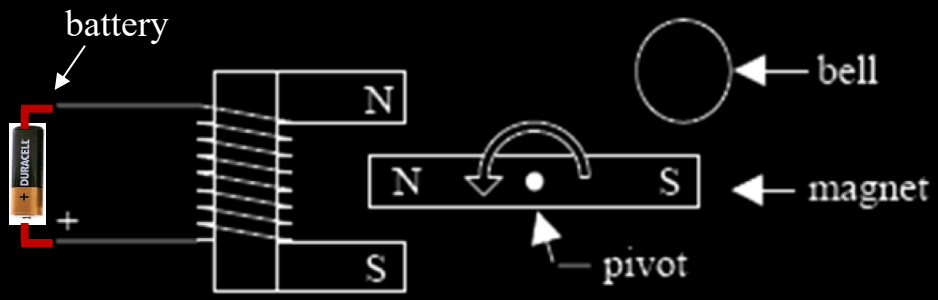
- Demo of telegraph and weakening effect of a long line
- Multiple batteries in series compensate for long line



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Magnetic Field

Long-path magnetic force can match short-path by using a greater voltage

- Demo of telegraph and weakening effect of a long line
- Multiple batteries in series compensate for long line

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

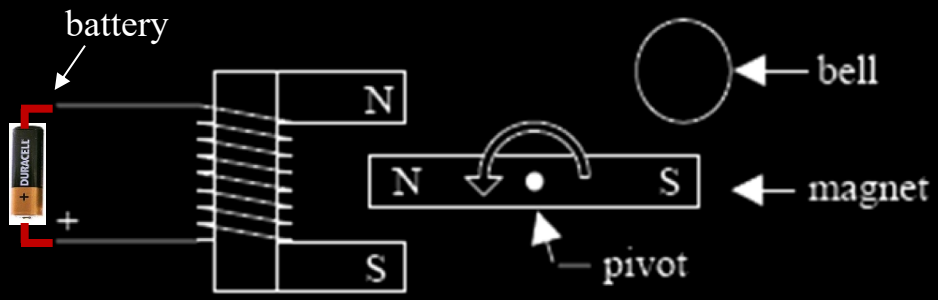
Resistance

The longer the path, the greater the resistance

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

Ohm's Law

The greater the voltage, the greater the current



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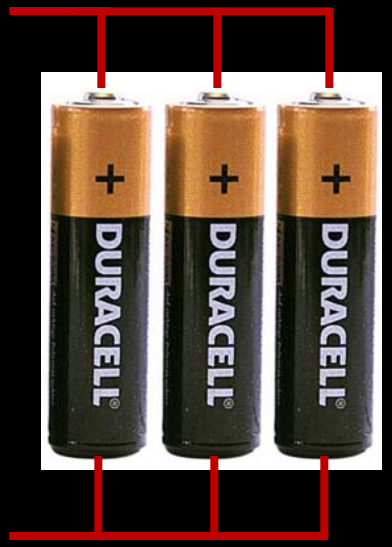
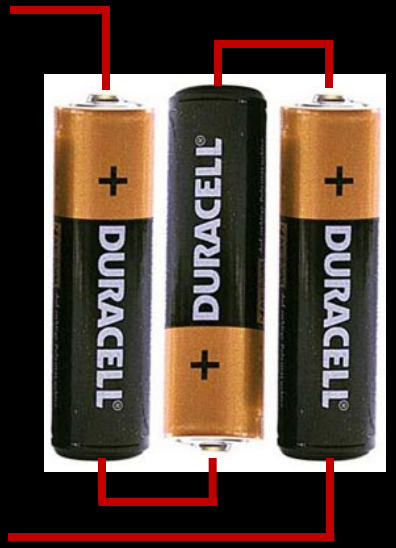
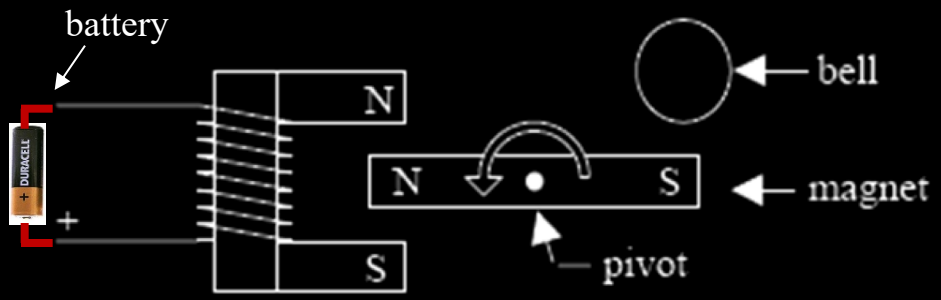
1 volt and
up to 1 amp



Parallel – more available current



Series – greater voltage



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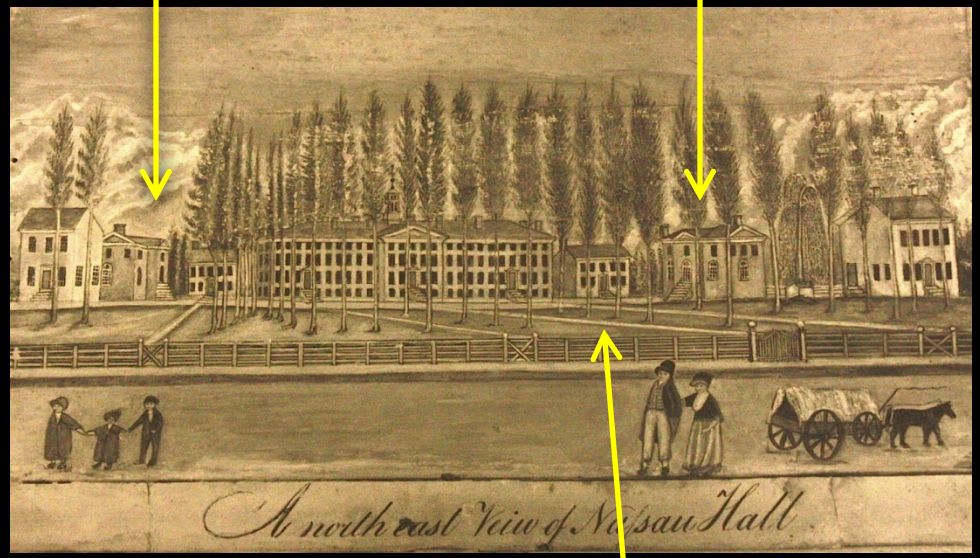
" The electro-magnetic telegraph was invented by me in Albany in 1830."

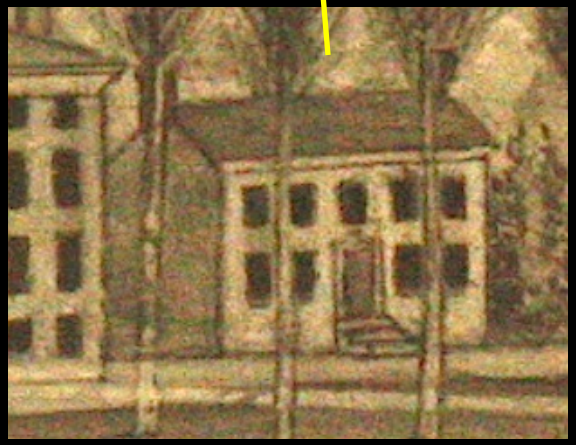
"I think that the first actual line of telegraph using the earth as a conductor was made in the beginning of 1836. A wire was extended across the front campus of the College grounds from the upper story of the Library building to the Philosophical Hall on the opposite side, the ends terminating in two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

- Joseph Henry

Philosophical Hall

Library





Joseph Henry's House in 1836

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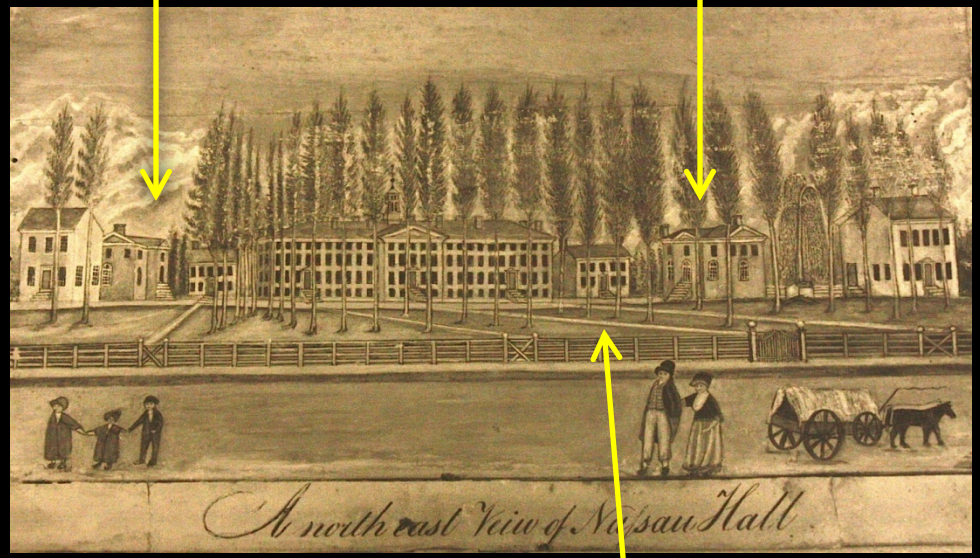

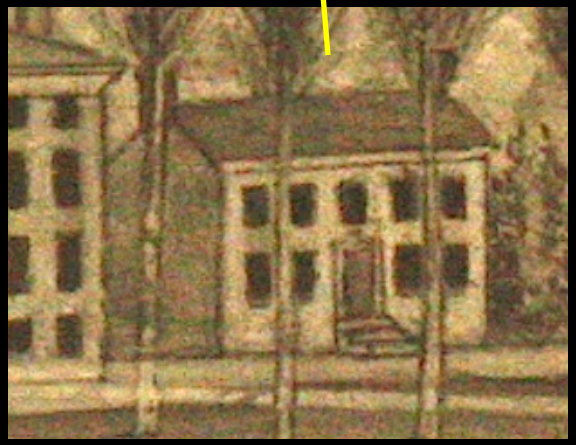

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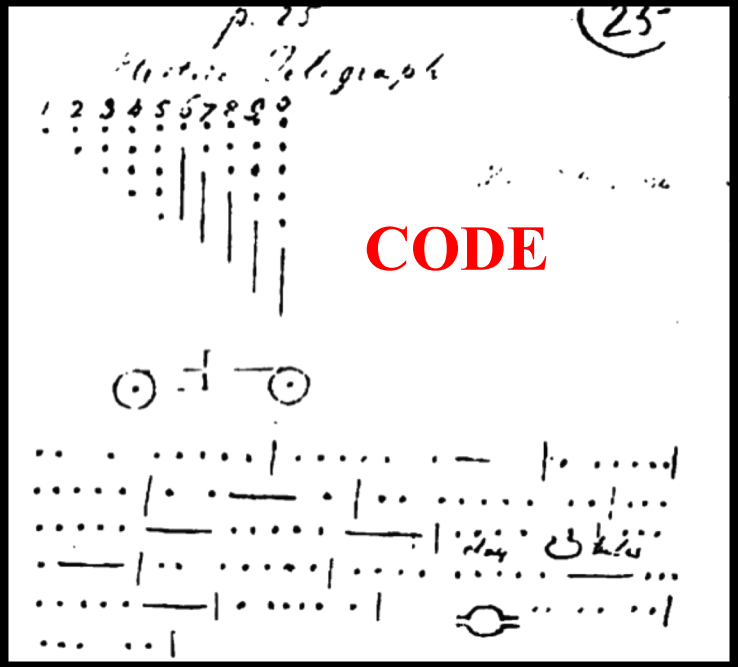
Telegraph - Design

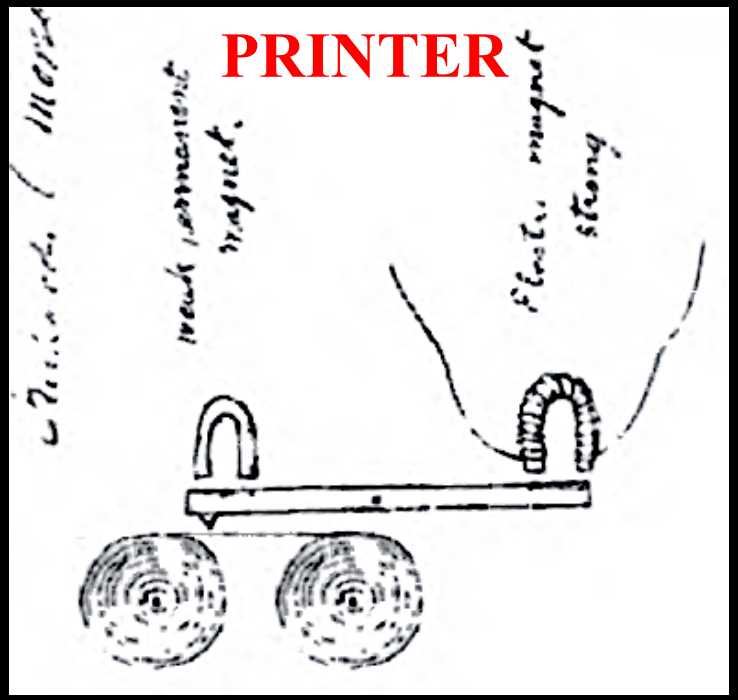
1832 – Morse's shipboard idea

1836 – Gale and Vail help out

1838 – Morse shows Van Buren

1842 – Henry helps Morse





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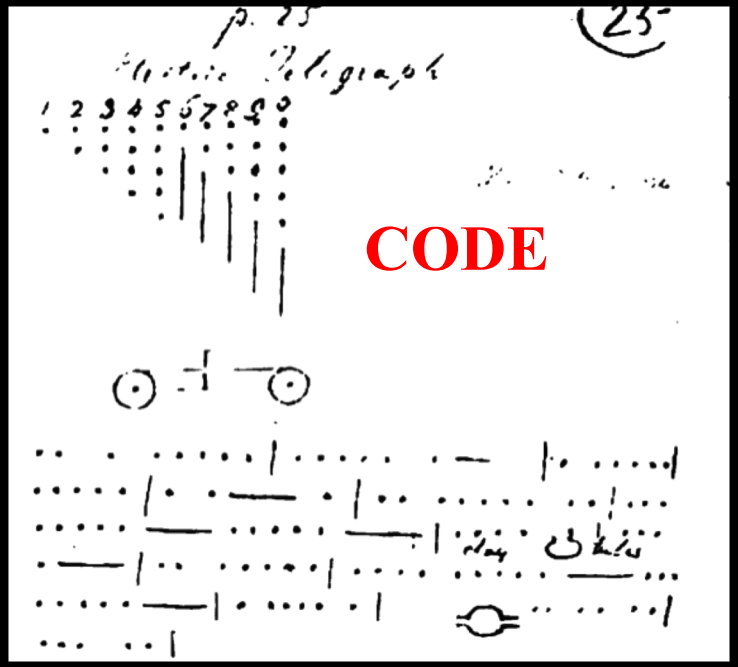
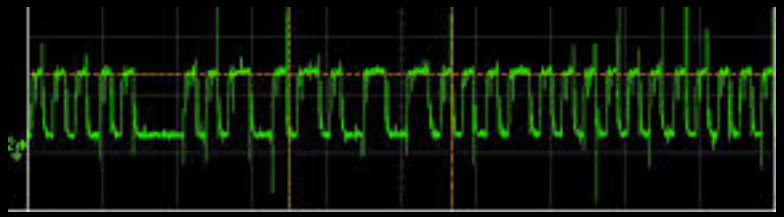


Digital signals in use today – WiFi, Ethernet



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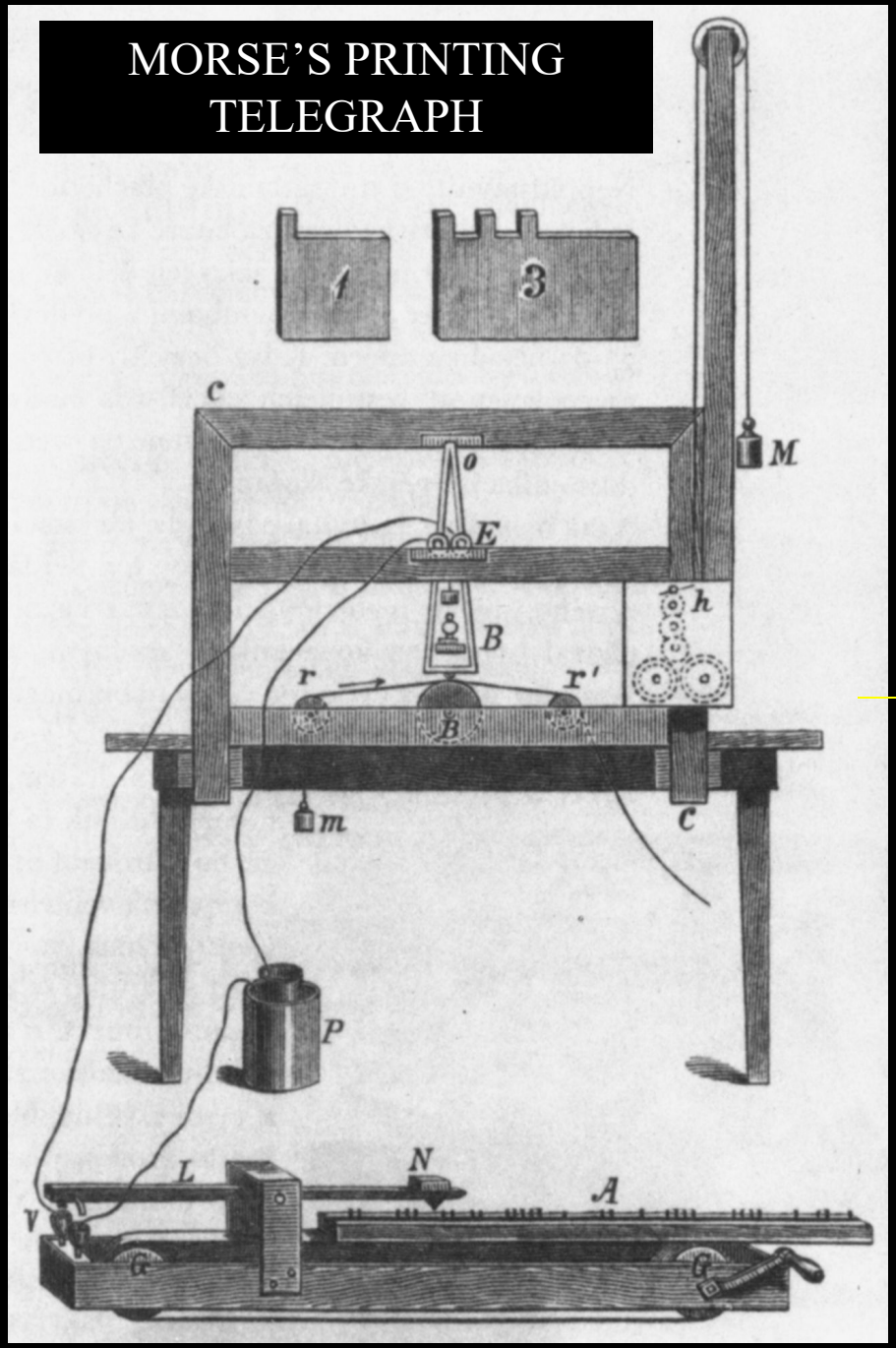

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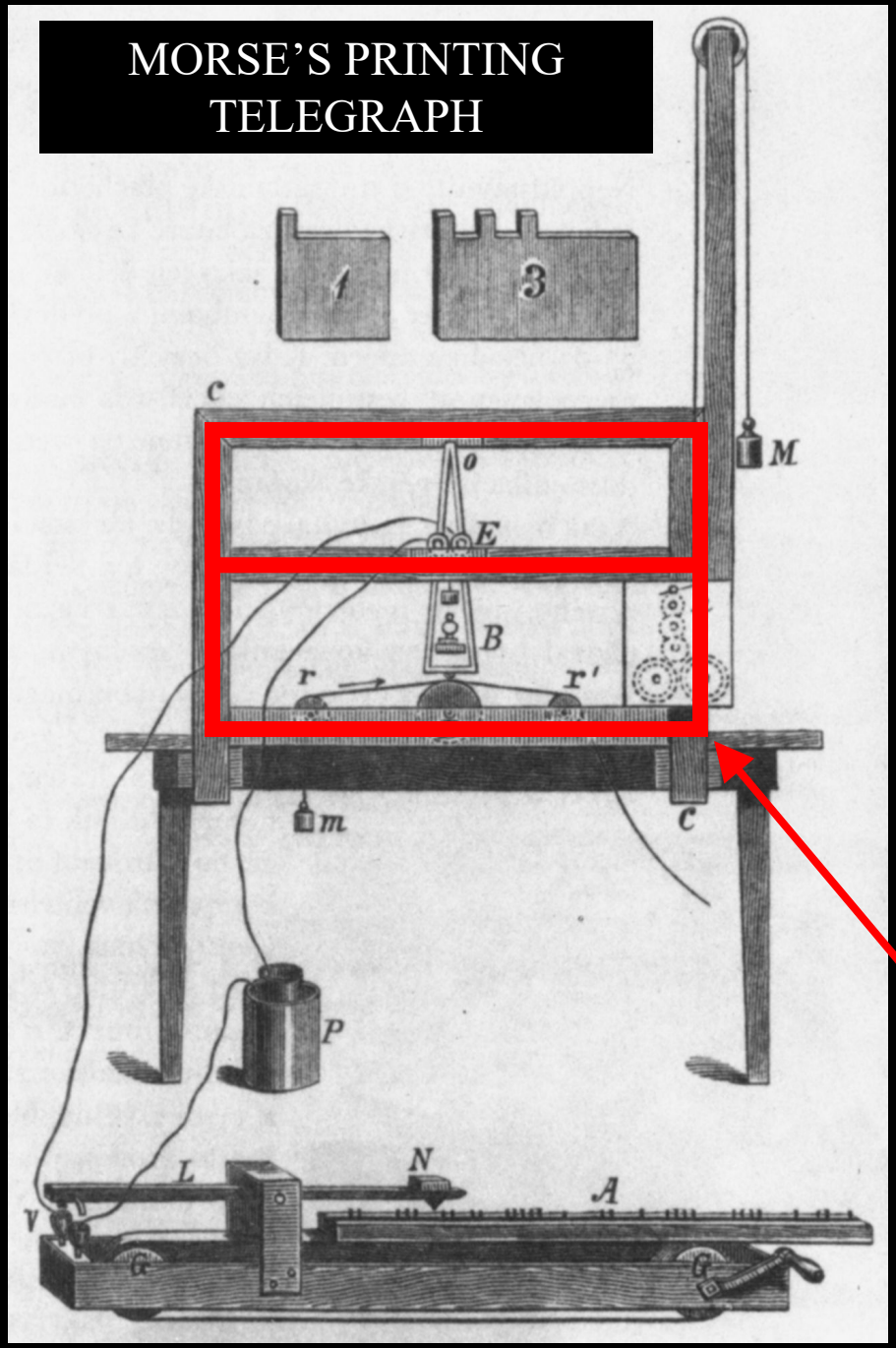
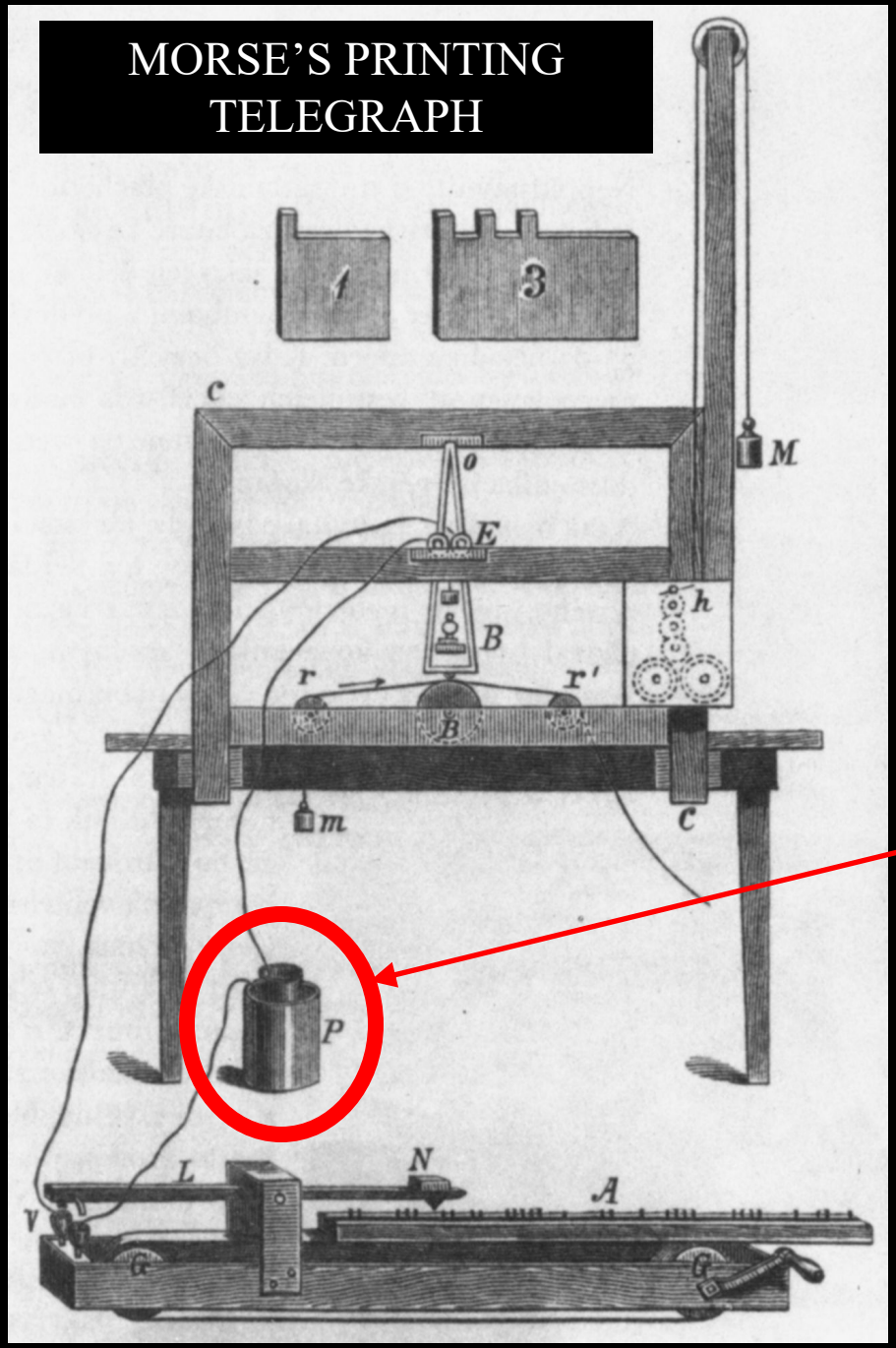


ARTIST'S CANVAS STRETCHER

MORSE'S PRINTING TELEGRAPH



Copper-Zinc Battery

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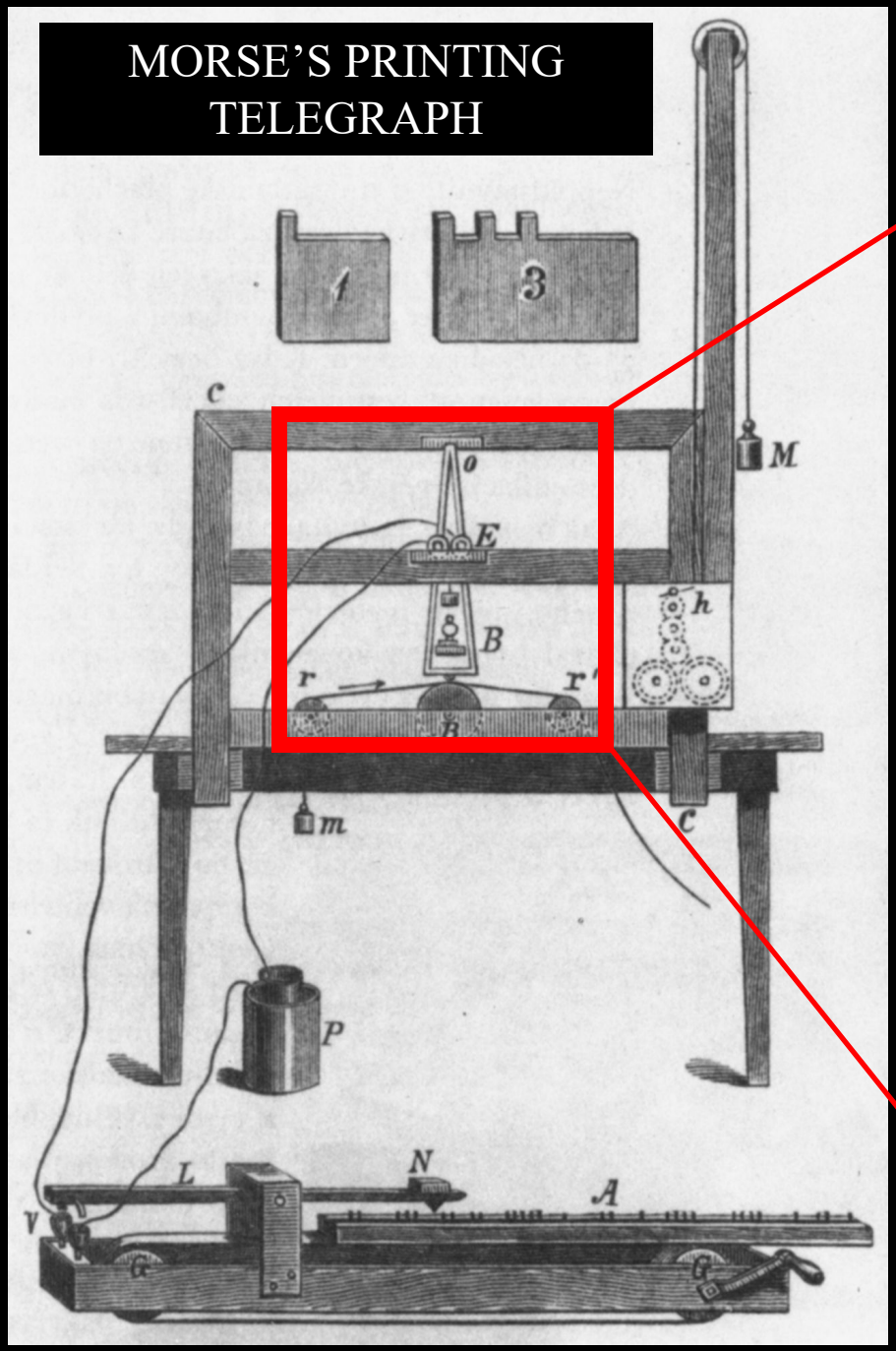
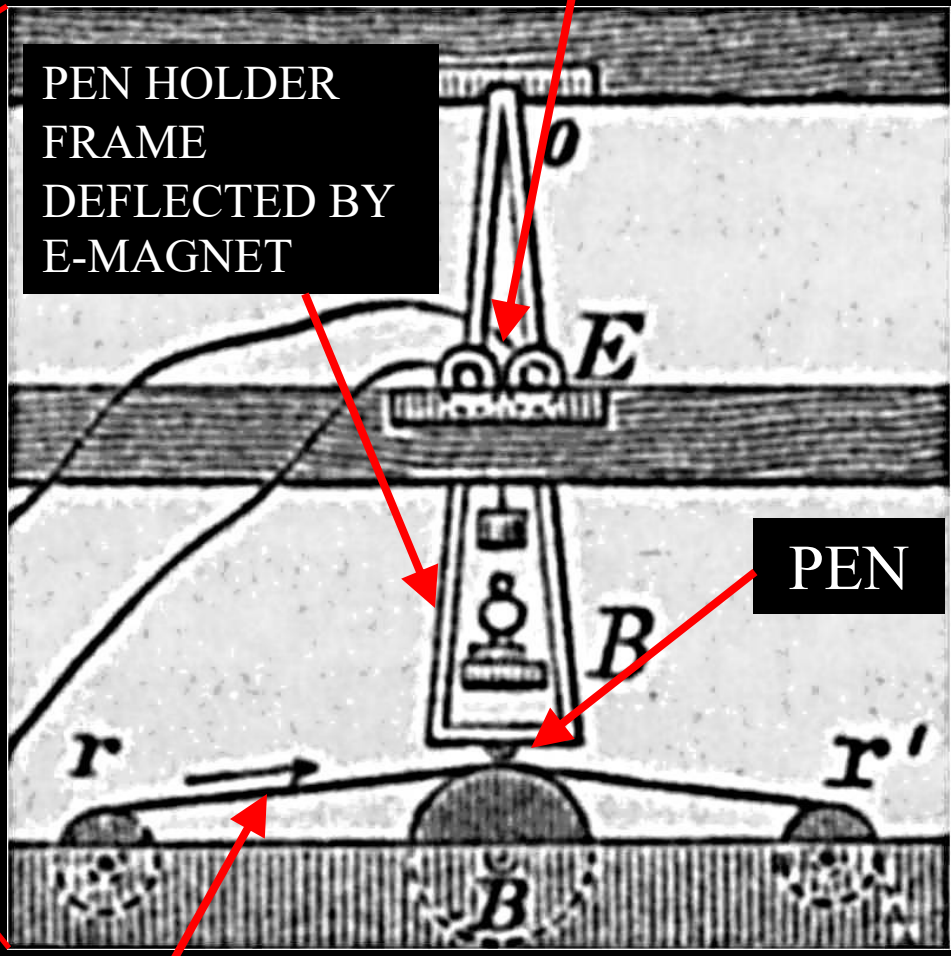


ELECTROMAGNET

PEN HOLDER FRAME DEFLECTED BY E-MAGNET



PEN

MOVING PAPER TAPE

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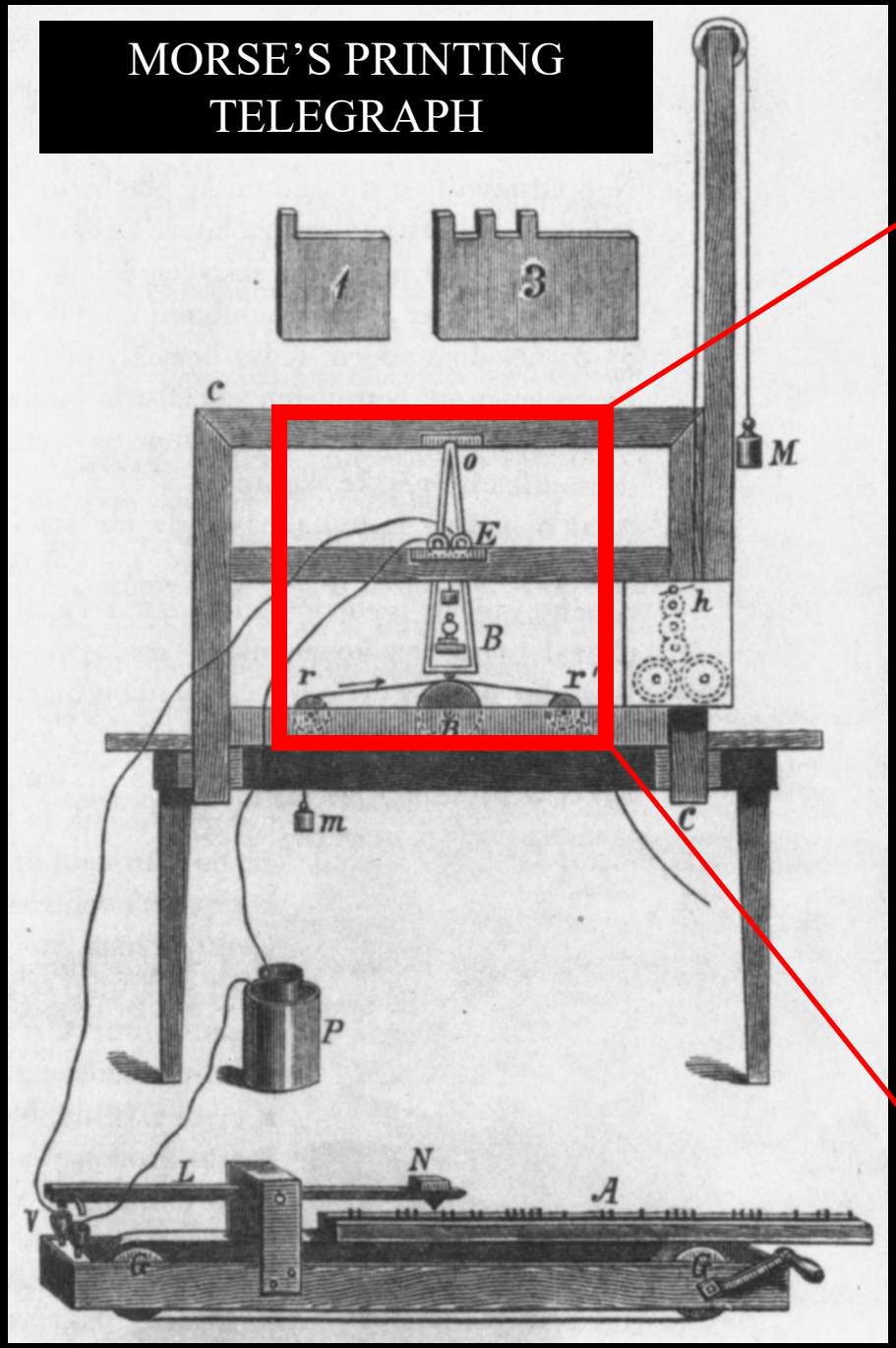

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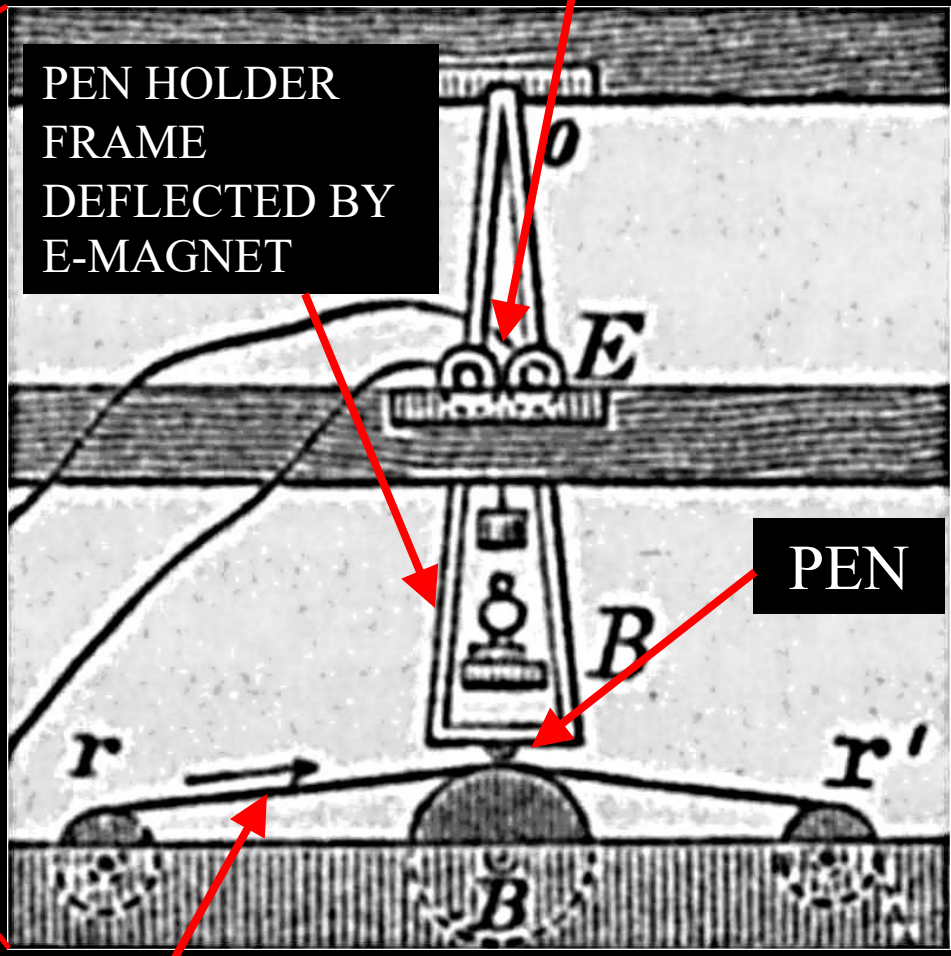

PEN

DEMONSTRATION

MOVING PAPER TAPE

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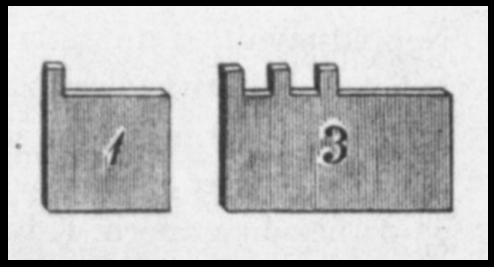
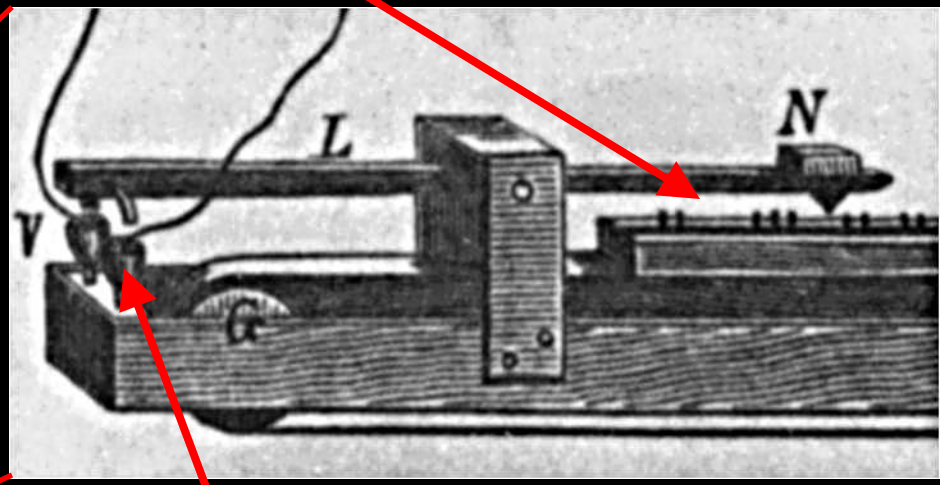
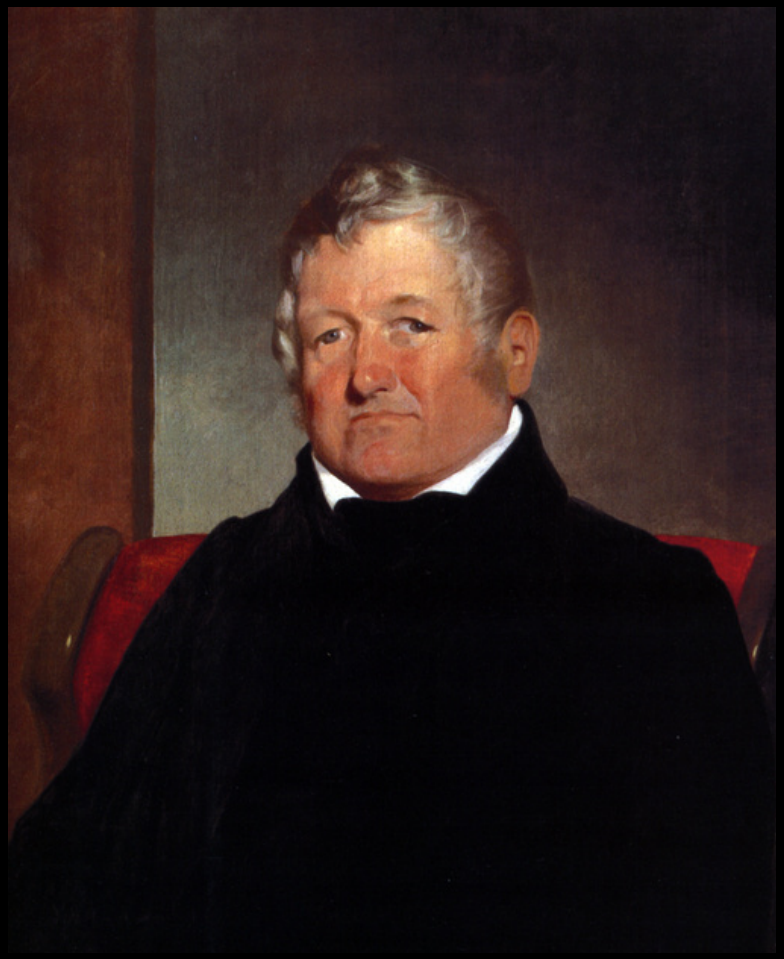


MOVEABLE TYPE HOLDER

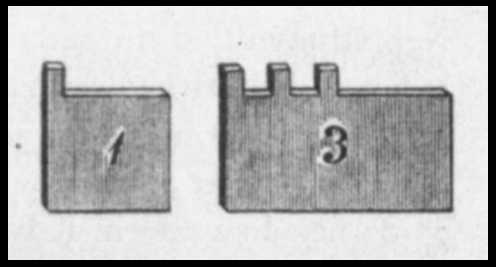


CONTACTS USING MERCURY



Judge Vail – Morse Investor

Alfred Vail – Morse Partner



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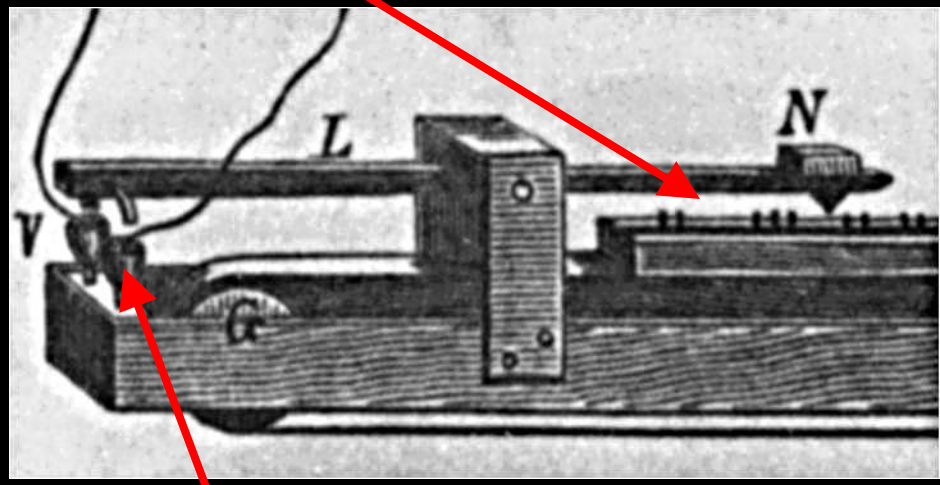
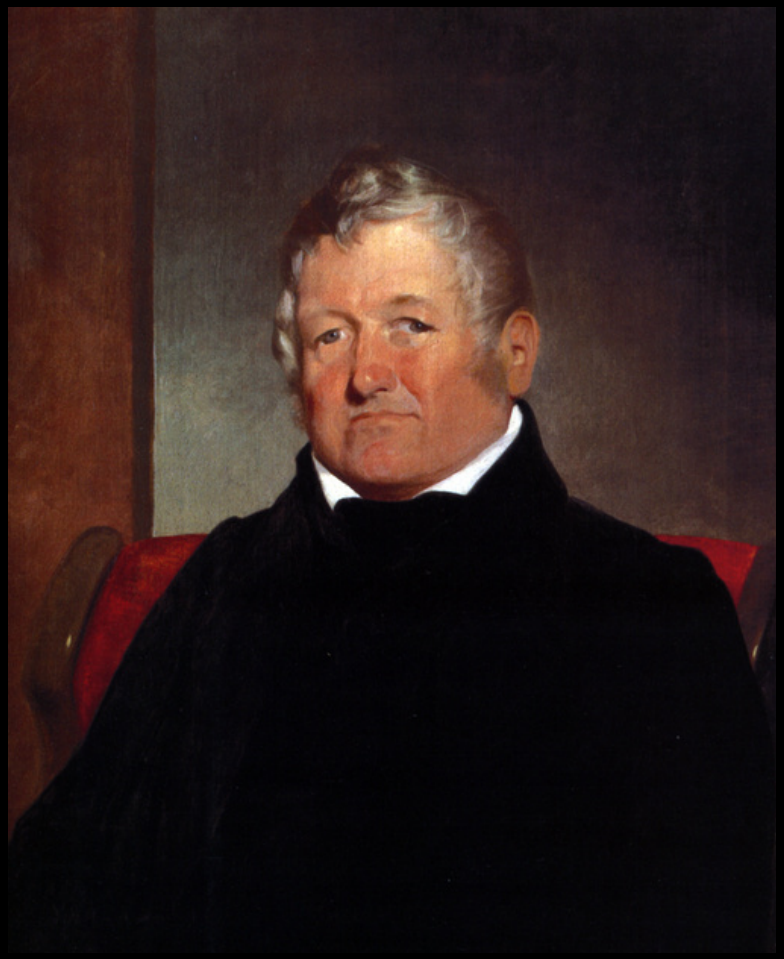


CONTACTS USING MERCURY



Judge Vail – Morse Investor

Alfred Vail – Morse Partner

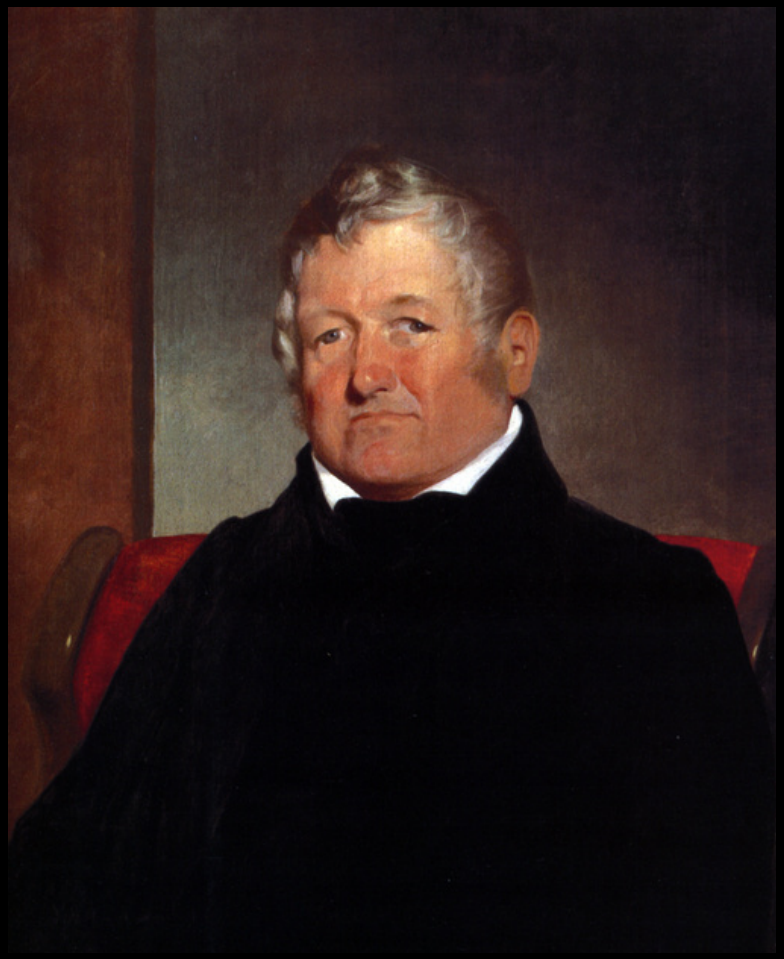
Telegraph - Design

1832 – Morse's shipboard idea

1836 – Gale and Vail help out

→ 1838 – Morse shows Van Buren

1842 – Henry helps Morse



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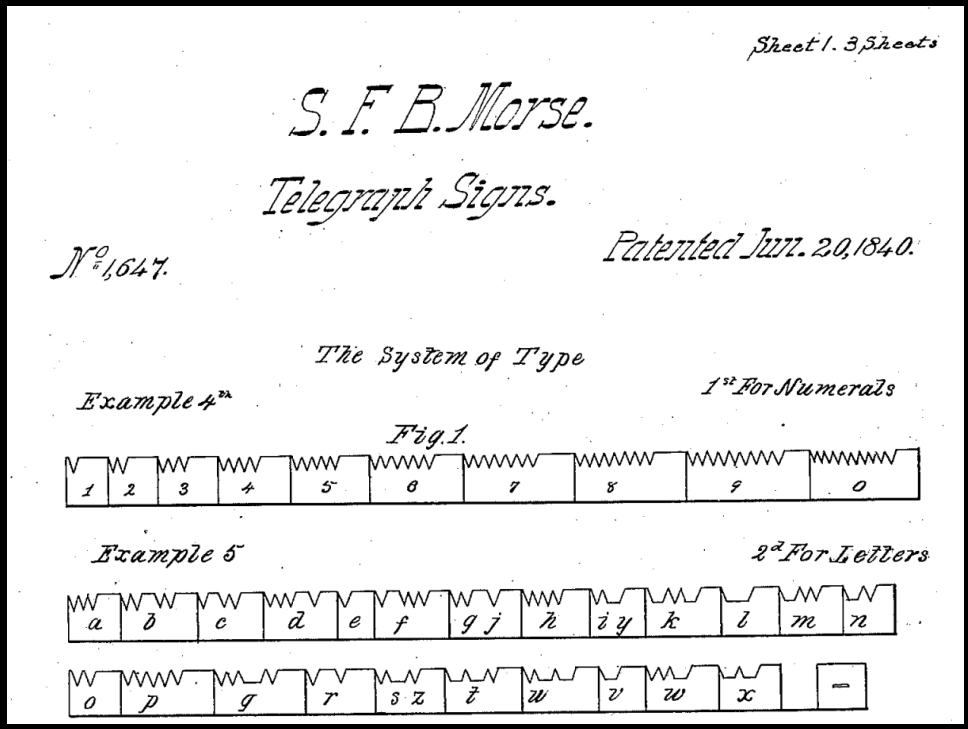


Sheet 1. 3 Sheets

S. F. B. Morse.

Telegraph Signs.

No. 1,647. Patented Jun. 20, 1840.

The System of Type

Example 4th — 1st For Numerals

Fig. 1.

1 2 3 4 5 6 7 8 9 0

Example 5 — 2d For Letters

a b c d e f g j h i y k l m n

o p q r s z t w v w x —

Morse patents a Binary Code

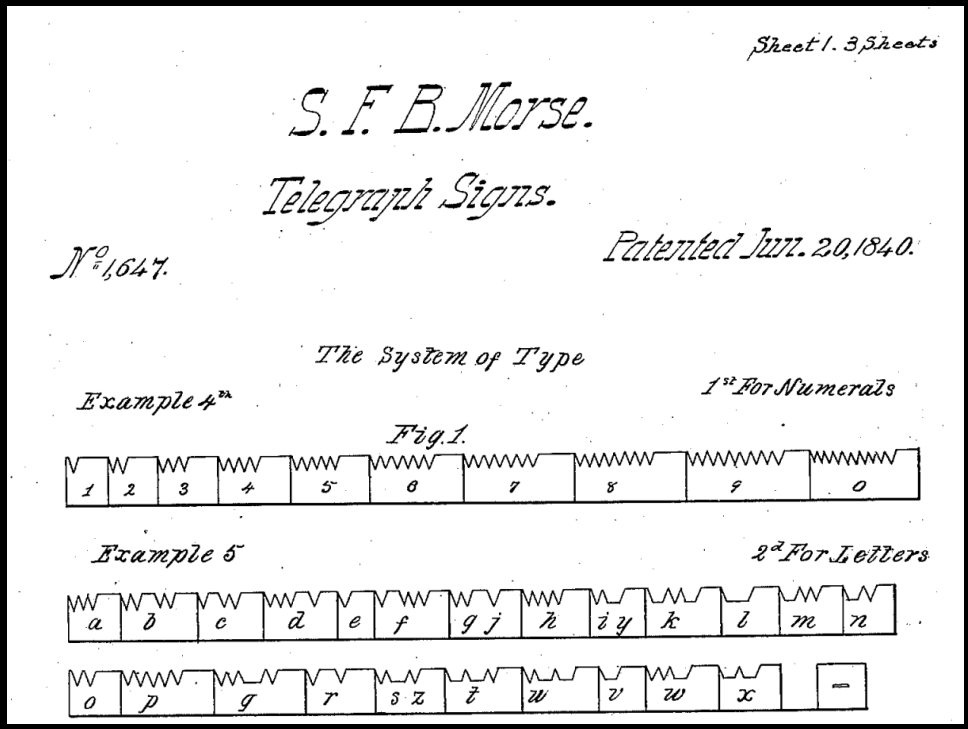
TELEGRAPH - Early

Congress - $30,000 to Morse

Morse - hires Vail & Cong. Smith

Smith - hires Ezra Cornell

38 miles connecting
Baltimore to Washington



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

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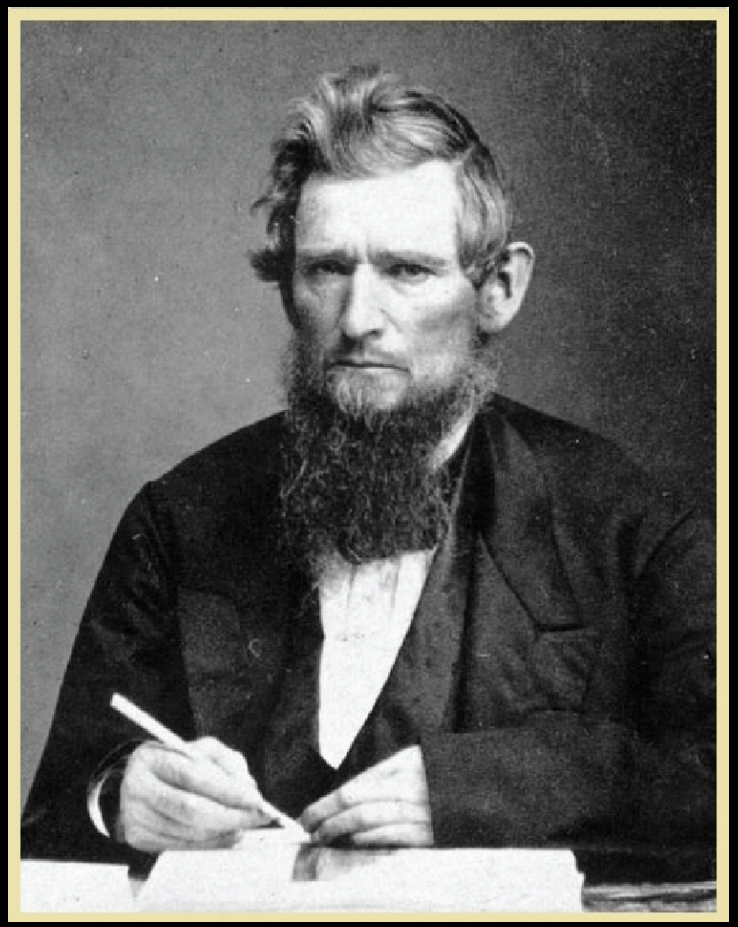
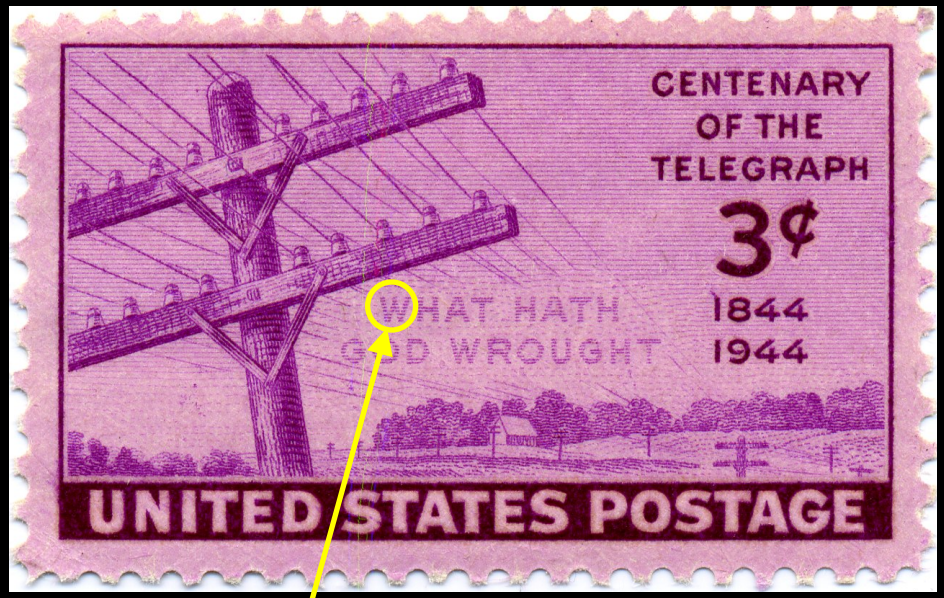
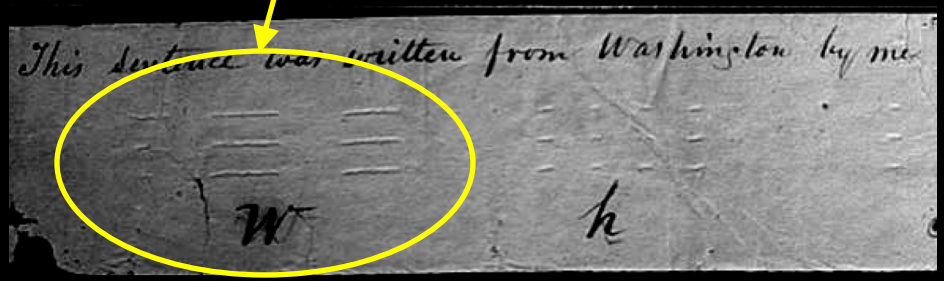


Ezra Cornell



May 24, 1844 at 8:45am



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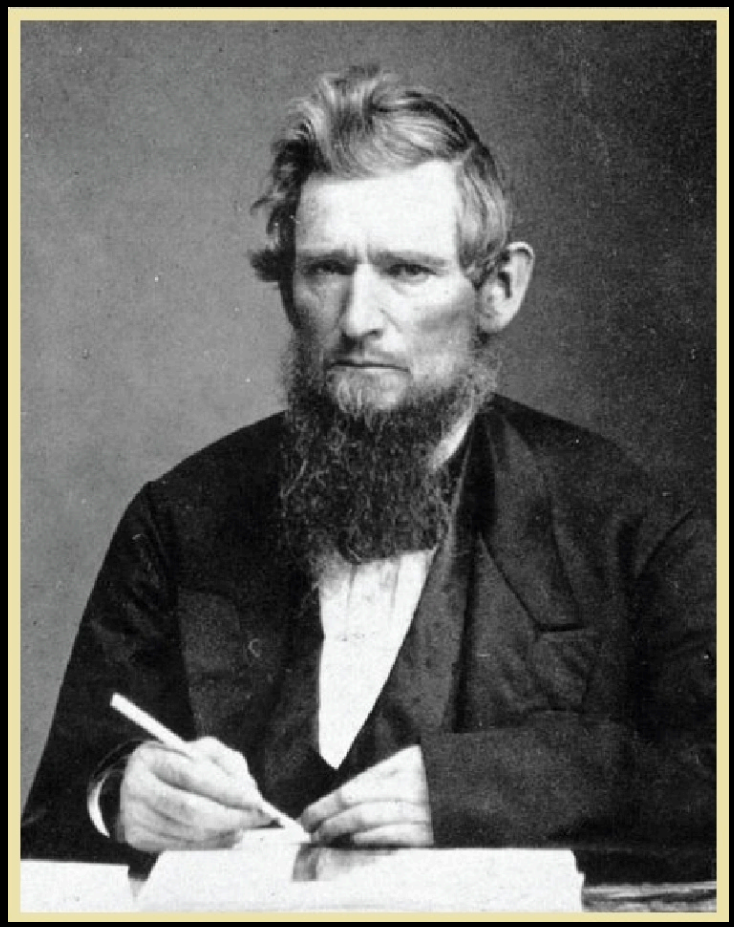
MORSE CODE – dots and dashes embossed on moving tape



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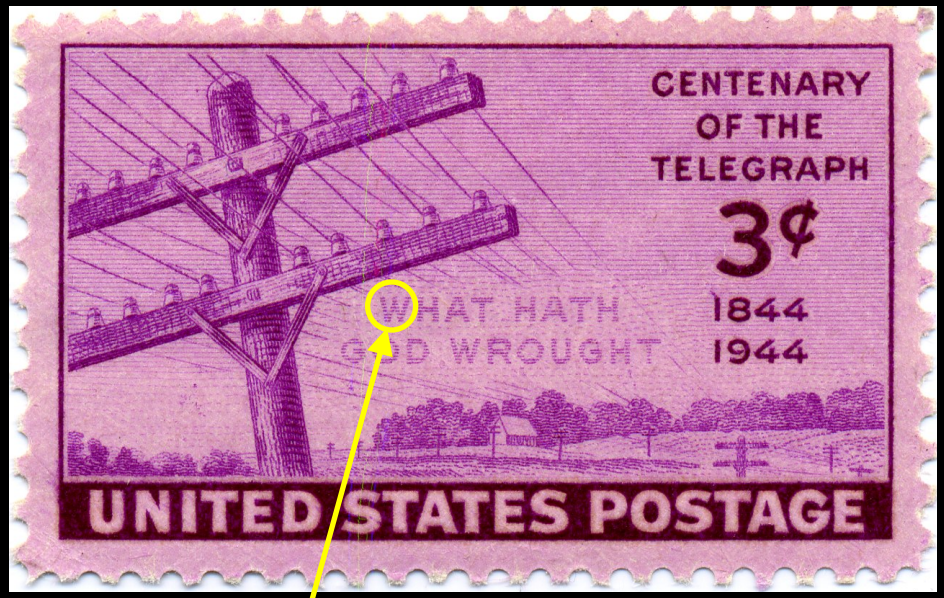

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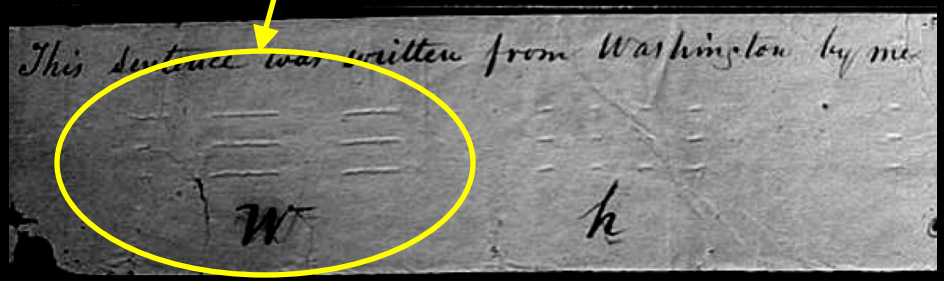

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Science and Engineering

Discovery

Scientist rings bell

Development

Gov't Grant, Private Company

Design

Artist plans network

7th and E St, Washington, DC
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Telegraph Lines in 1853

CONNECTING CITIES

TELEGRAPH - Later

1845 – independent companies; wire services; patent disputes

1856 – Western Union – Cornell becomes the major stockholder

1861 – Western Union completes Transcontinental Telegraph Line

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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.,

Professor in the New York City University, &c., &c., &c.

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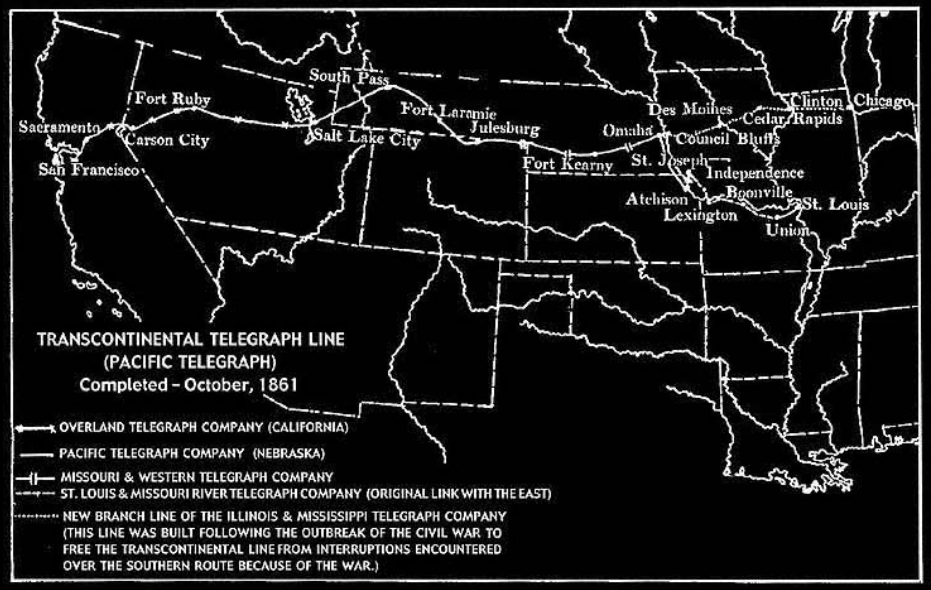

CONNECTING THE CONTINENT

Pacific Telegraph Act of 1860
(Pony Express ends service)

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US Capitol in 1861

Smithsonian Castle in 1862

Joseph Henry

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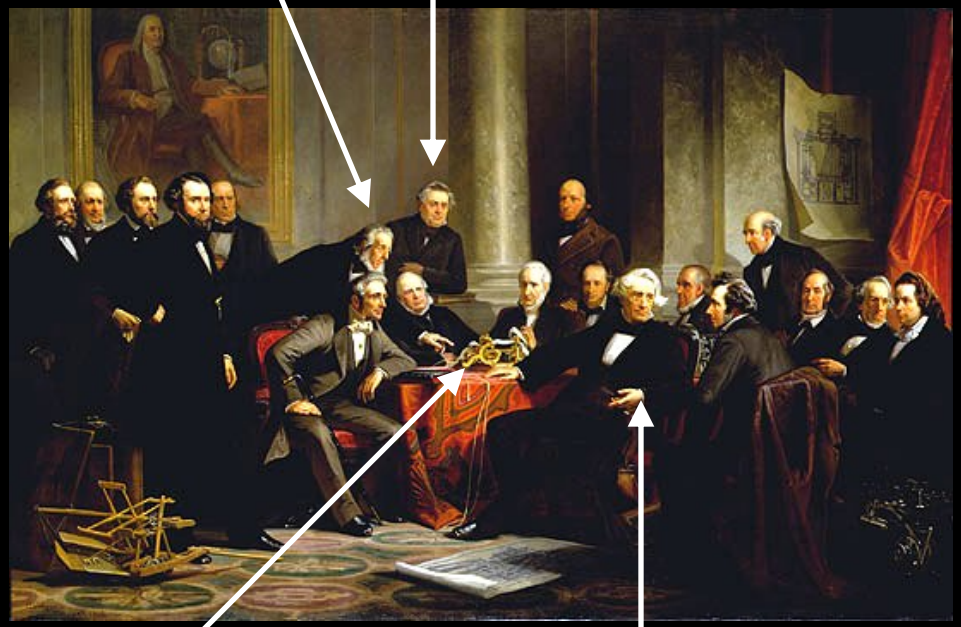

Telegraph Register

Samuel Morse

Christian Schussele's "Men of Progress"

US Capitol in 1861

Smithsonian Castle in 1862

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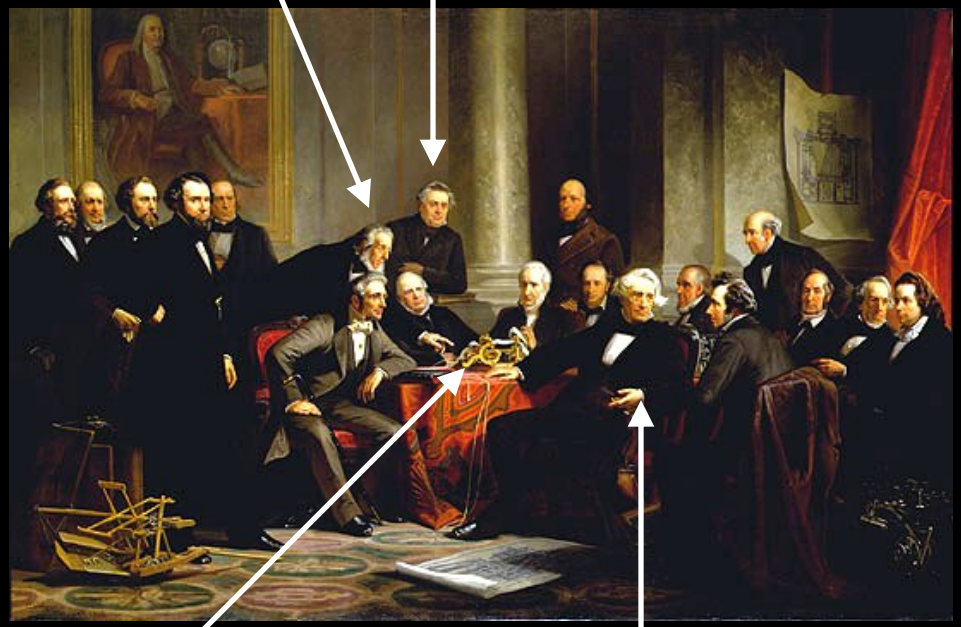

Telegraph Register

Samuel Morse

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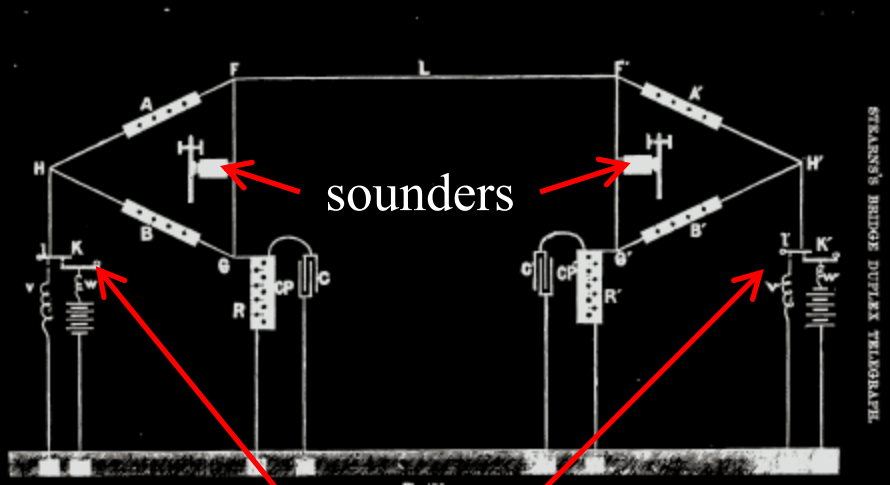
Stearns Duplex Idea-1872

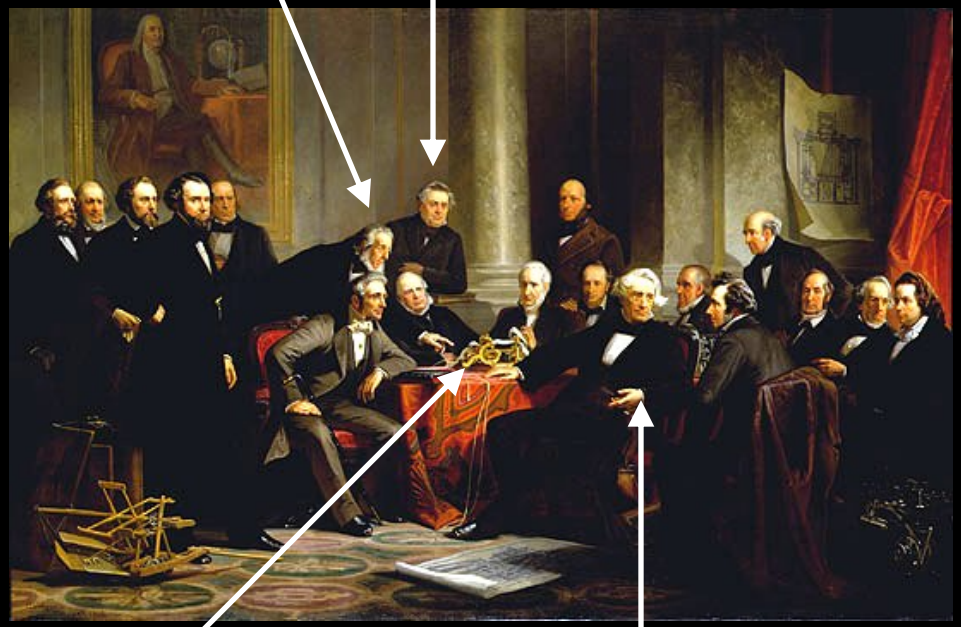
TWO MESSAGES ON ONE WIRE



DEMONSTRATION

Joseph Henry

Peter Cooper



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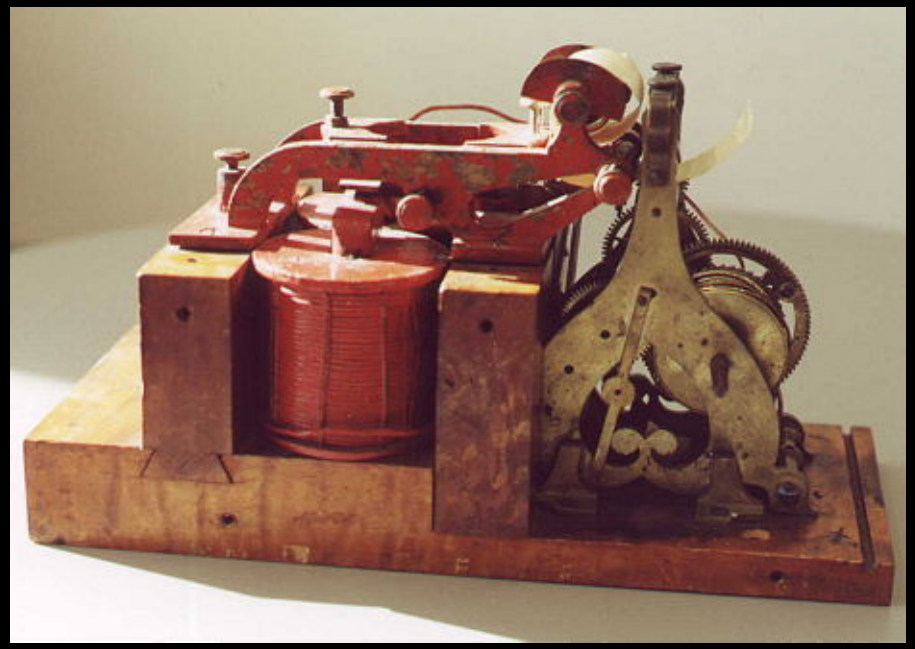
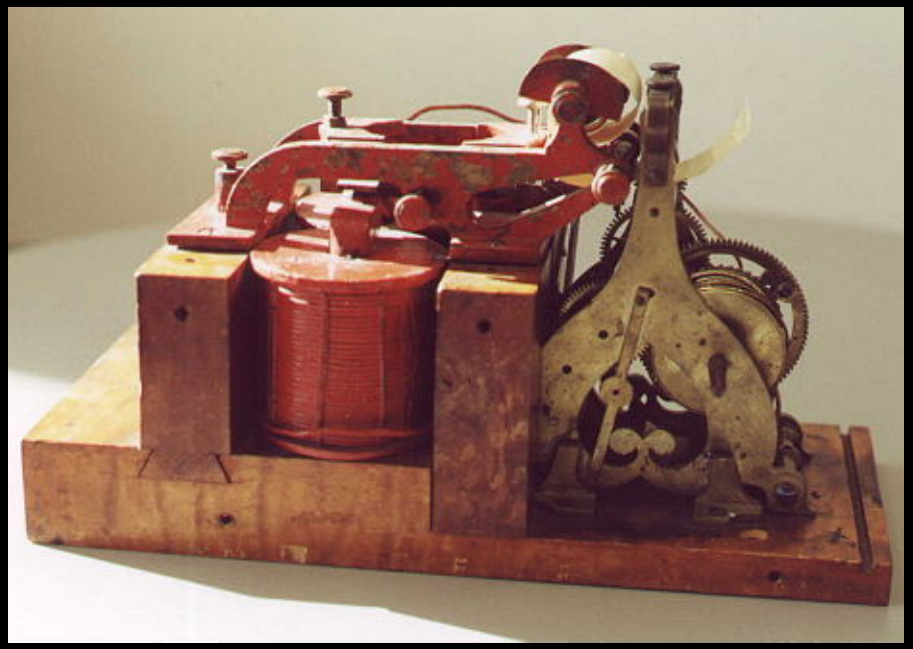


Vail telegraph register at Cornell

SIBLEY
COLLEGE at
CORNELL

Mathew Brady daguerreotype of his photography teacher, Samuel Morse



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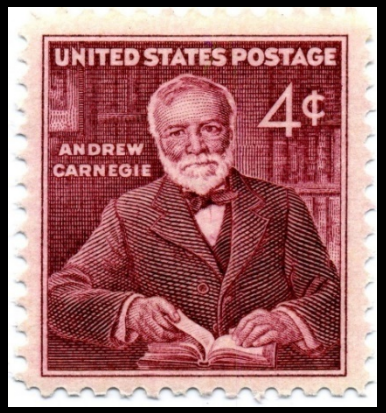
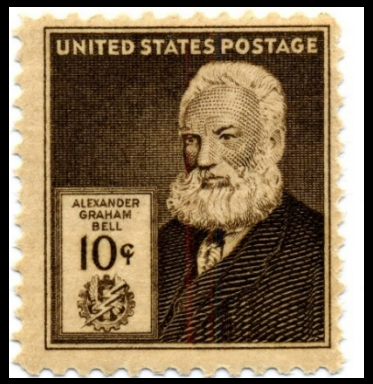
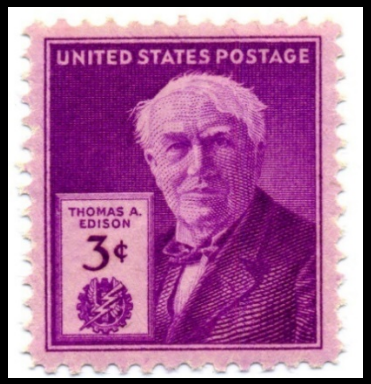
Telegraphers

Mathew Brady daguerreotype of his photography teacher, Samuel Morse







Telegraphers

Key Ideas

Scientific

- Strong Electromagnet
- Binary (dot-dash) Code

Social

- Government Investment
- Private Telegraph Company
- Wire Services inform Public

Symbolic

- Artist as Innovator