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

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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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Samuel Morse

1825: painter - president, National Academy of Design

1835: Professor of Art, NYU

1840: engineer - telegraph patent
Eli Whitney

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1840: engineer - telegraph patent
Albany

Buffalo
Dewitt Clinton

Buffalo

Albany

Dewitt Clinton
Prof. Benjamin Silliman

Dewitt Clinton
THE
AMERICAN JOURNAL
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SCIENCE AND ARTS.

CONDUCTED BY

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Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and
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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
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Demonstration of compass needle deflection by electric current

Why is this demonstration important?

Telegraph - Discovery

- 1820  Electricity linked to Magnetism
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Electromagnet in circuit with copper-zinc batteries and on-off switch

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Ohm's Law

\[ I = \frac{V}{R} \]

Resistance

\[ R = \frac{\rho L}{A} \]
Ohm's Law

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

Resistance

$$R = \frac{\rho L}{A}$$
How does Henry’s sounding telegraph work?

Pole-reversal
• 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

\[ I = \frac{V}{R} \]

Ohm's Law

\[ R = \frac{\rho L}{A} \]

Resistance
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

**Ohm’s Law**

\[ I = \frac{V}{R} \]

The greater the voltage, the greater the current

**Resistance**

\[ R = \frac{\rho L}{A} \]

The longer the path, the greater the resistance
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

Parallel – more available current
Series – greater voltage

1 volt and up to 1 amp
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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Telegraph - Design

- 1832 – Morse’s shipboard idea
- 1836 – Gale and Vail help out
- 1838 – Morse shows Van Buren

Philosophical Hall

Library

Joseph Henry’s House in 1836
Telegraph - Design

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181th Anniversary of Digital Code
31th Anniversary of CD

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MORSE’S PRINTING TELEGRAPH

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MORSE’S PRINTING TELEGRAPH

ARTIST’S CANVAS STRETCHER
Copper-Zinc Battery
MORSE’S PRINTING TELEGRAPH

ELECTROMAGNET

PEN HOLDER FRAME DEFLECTED BY E-MAGNET

MOVING PAPER TAPE
MORSE’S PRINTING TELEGRAPH

MOVEABLE TYPE HOLDER

CONTACTS USING MERCURY
DEMONSTRATION

MOVEABLE TYPE HOLDER

CONTACTS USING MERCURY
Judge Vail – Morse Investor
Alfred Vail – Morse Partner

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MORSE PATENTS THE IDEA OF A BINARY INFORMATION CODE

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MORSE PATENTS THE IDEA OF A BINARY INFORMATION 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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38 miles connecting Baltimore to Washington

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

Congress - $30,000 to Morse
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Smith - hires Ezra Cornell

38 miles connecting
Baltimore to Washington
May 24, 1844 at 8:45am

MORSE CODE – dots and dashes

Ezra Cornell
Discovery
Scientist and remote sounder

Development
Gov’t Grant, Private Company

Design
Artist plans whole network

May 24, 1844 at 8:45am

MORSE CODE – dots and dashes
Science and Engineering

Discovery
Scientist and remote sounder

Development
Gov’t Grant, Private Company

Design
Artist plans whole network

7th and E St, Washington, DC
7th and E St, Washington, DC

Telegraph Lines in 1853

CONNECTING CITIES
TELEGRAPH - Later

1845 – independent telegraph companies; patent disputes

1856 – Western Union – Cornell becomes the major stockholder

1861 – Western Union completes Transcontinental Telegraph Line

1872 – Stearns invents Duplex Telegraph

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Christian Schussele’s “Men of Progress”
Joseph Henry

Samuel Morse

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Joseph Henry

Samuel Morse

Telegraph Register

Christian Schussele’s “Men of Progress”

Stearns Duplex Idea-1872
TWO MESSAGES ON ONE WIRE

DEMONSTRATION

sounders

keys
Christian Schussele’s “Men of Progress”

Joseph Henry

Samuel Morse

Telegraph Register

Vail telegraph register at Cornell

SIBLEY COLLEGE at CORNELL
Vail telegraph register at Cornell

SIBLEY COLLEGE at CORNELL
Telegraphers

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

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

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

Scientific
Electromagnetic Binary Code

Social
Public Investment
Private Industry

Symbolic
Artist as Innovator