Henry, Morse and the Telegraph

Discovery by Scientist – Design by Artist-Entrepreneur

Wire Services: Instant news from around the Globe

Many dates – pay attention only to those in boxes

CEE 102: Prof. Michael G. Littman
Course Administrator: Motuma Tulu mt2593@princeton.edu

Computers for note-taking and course-related searches only
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
Electricity

**Morse** - intelligence at a distance

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Morse by Morse
Morse by Morse

Jed Morse (Father - Geographer) by Morse
Morse by Morse

West by West
Aside – in 1840 Morse also introduces Photography into America

Morse daguerreotype at the Metropolitan Museum of Art

20-30 minute exposure of unknown sitter
Morse’s painting of his Yale geology professor Benjamin Silliman

Samuel Morse

1825: painter - president, National Academy of Design

1835: Professor of Art, NYU

1840: engineer - telegraph patent

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APPLICATION OF ... GALVANIC MULTIPLIER TO ELECTRO-MAGNETIC APPARATUS ...

Silliman 's American Jour. of Science, January, 1831, vol.xix , pp.400 - 408.)

High School Teacher
Joseph Henry holding sounding telegraph
Telegraph - Discovery

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

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Demonstration of compass needle deflection by electric current

**Telegraph - Discovery**

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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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Magnetic Field

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Resistance

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

Ohm's Law

**B = k I N**

Magnetic Field
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Magnetic Field

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Resistance

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Ohm's Law
How does Henry’s sounding telegraph work?

Poles in horseshoe electromagnet reverse when current is reversed.

$B = kI N$

Magnetic Field

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

Resistance

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

Ohm's Law
B = k I N  
**Magnetic Field**

- Demo of telegraph and weakening effect of a long line
- Batteries in series to compensate

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**Resistance**

\[ I = \frac{V}{R} \]  
**Ohm's Law**
The greater the voltage, the greater the current
The longer the path, the greater the resistance

\[ B = k I N \]

Magnetic Field

The greater the current, the stronger the strike – high voltage overcomes high resistance of the long lines

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“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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Philosophical Hall

Library

Telegraph - Design

1832 – Morse’s shipboard idea
1836 – Gale and Vail help out
1838 – Morse shows Van Buren
1842 – Henry helps Morse

Joseph Henry’s House in 1836
Telegraph - Design

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Digital signals in use today – WiFi, Ethernet

Telegraph - Design

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Morse’s original telegraph on display at the Smithsonian

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Telegraph - Design

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Copper-Zinc Battery
MORSE’S PRINTING TELEGRAPH

ELECTROMAGNET

PEN HOLDER FRAME DEFLECTED BY E-MAGNET

MOVING PAPER TAPE
Judge Vail – Morse Investor
Alfred Vail – Morse Partner

MOVEABLE TYPE HOLDER

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

Telegraph - Design

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Morse patents a Binary Code
TELEGRAPH - Early

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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Ezra Cornell
May 24, 1844 at 8:45am

MORSE CODE – dots and dashes embossed on moving tape

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MORSE CODE – dots and dashes embossed on moving tape

May 24, 1844 at 8:45am

Science and Engineering

Discovery
Scientist rings bell at a distance

Development
Gov’t Grant, Private Company

Design
Artist gives telegraph language and plans wide-area network
Science and Engineering

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7th and E St, Washington, DC
Morse idea - replace Post Office
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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

1872 – Stearns invents Duplex Telegraph

CONNECTING CITIES

Telegraph Lines in 1853

Port Jervis
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CONNECTING THE CONTINENT

Pacific Telegraph Act of 1860 (Pony Express ends service)
TELEGRAPH - Later

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US Capitol in 1861

Smithsonian Castle in 1862
Christian Schussele’s “Men of Progress”

- Joseph Henry
- Peter Cooper
- Samuel Morse

US Capitol in 1861

Smithsonian Castle in 1862
Stearns Duplex Idea-1872
TWO MESSAGES ON ONE WIRE

Joseph Henry
Peter Cooper
Telegraph Register
Samuel Morse

sounders
keys

DEMONSTRATION

Christian Schussele’s “Men of Progress”
Joseph Henry
Peter Cooper

Telegraph Register
Samuel Morse

Christian Schussele’s “Men of Progress”

Vail telegraph register at Cornell

SIBLEY COLLEGE at CORNELL
Mathew Brady daguerreotype of his photography teacher, Samuel Morse

Vail telegraph register at Cornell

SIBLEY COLLEGE at CORNELL
Mathew Brady daguerreotype of his photography teacher, Samuel Morse
Key Ideas

Scientific
- Strong Electromagnet
- Binary (dot-dash) Code

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

Symbolic
- Artist as Innovator