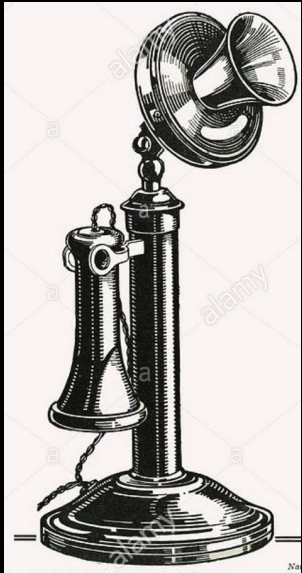


Bell and The Telephone

Iron Disc Receiver (Bell) and Carbon Button Transmitter (Edison)

Private Company (Bell) to Public-Regulated Monopoly (AT&T)

Amateur (Bell) versus Expert (Gray)



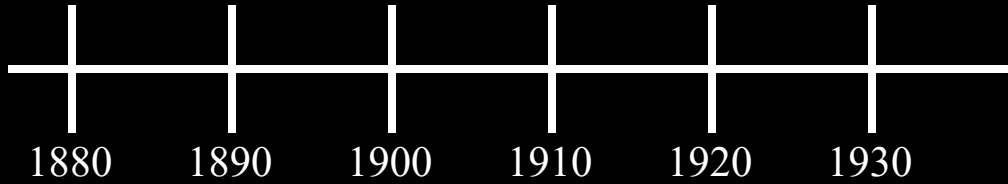
CEE 102: Prof. Michael G. Littman

Course Administrator: Mauricio Pereira mp34@princeton.edu

Computers for note-taking and course-related search

Rise of the Great Industries

1876 - 1939

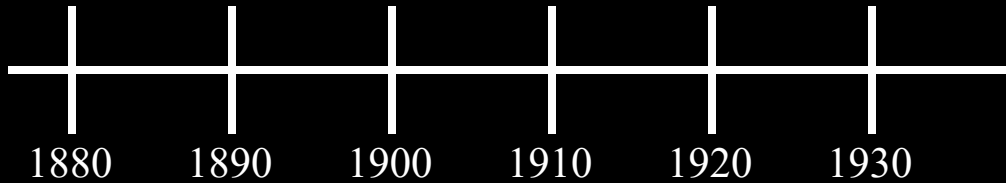


Edison

Westinghouse

Rise of the Great Industries

1876 - 1939



Edison

Westinghouse

Bell

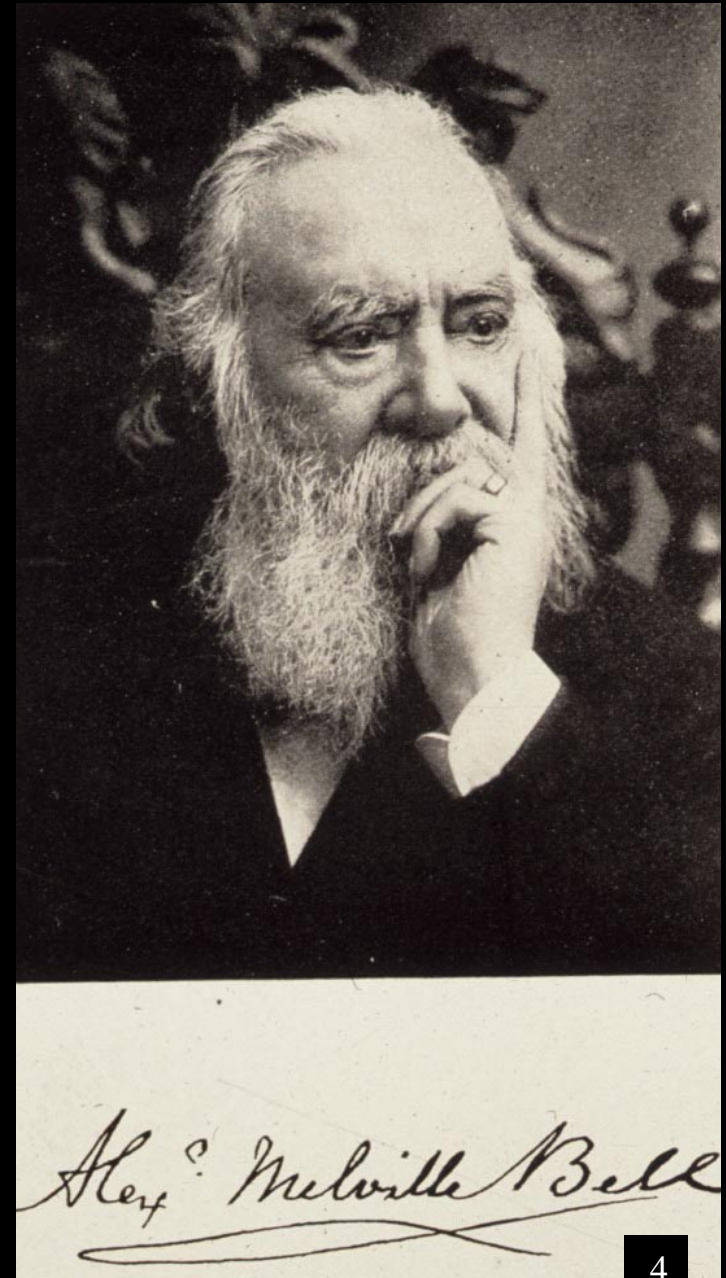
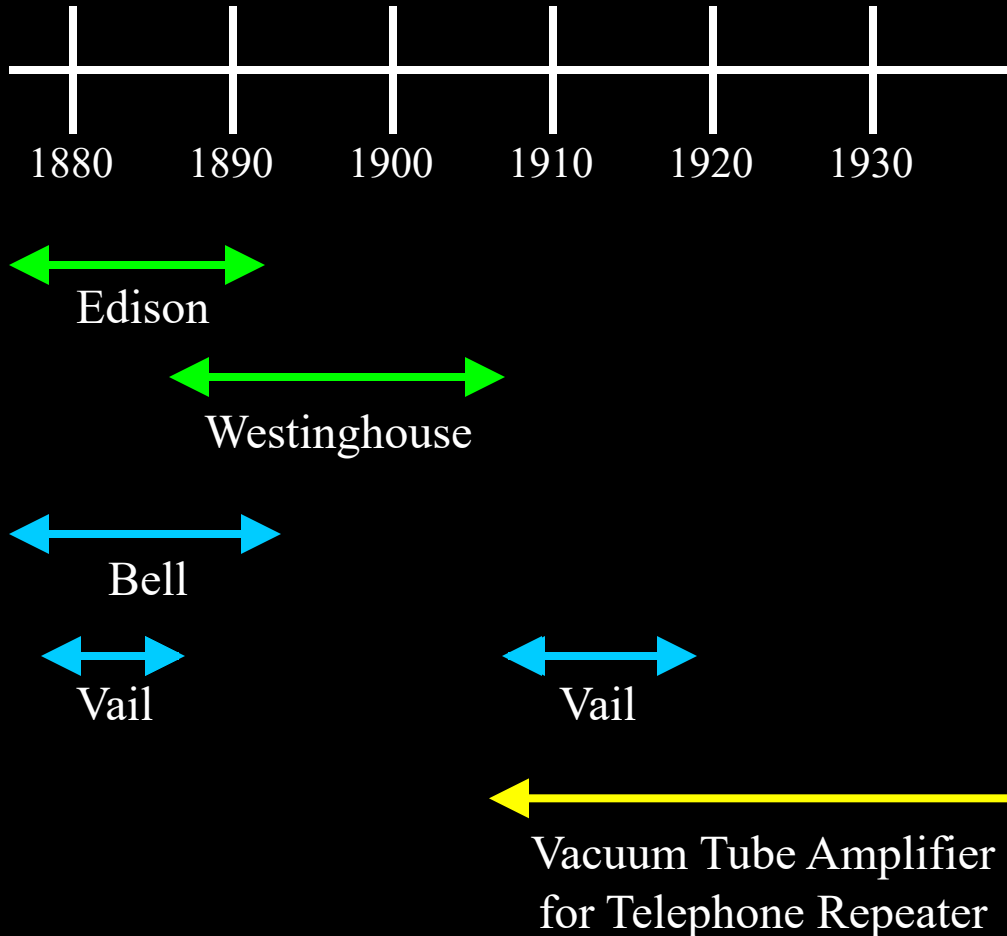
Vail

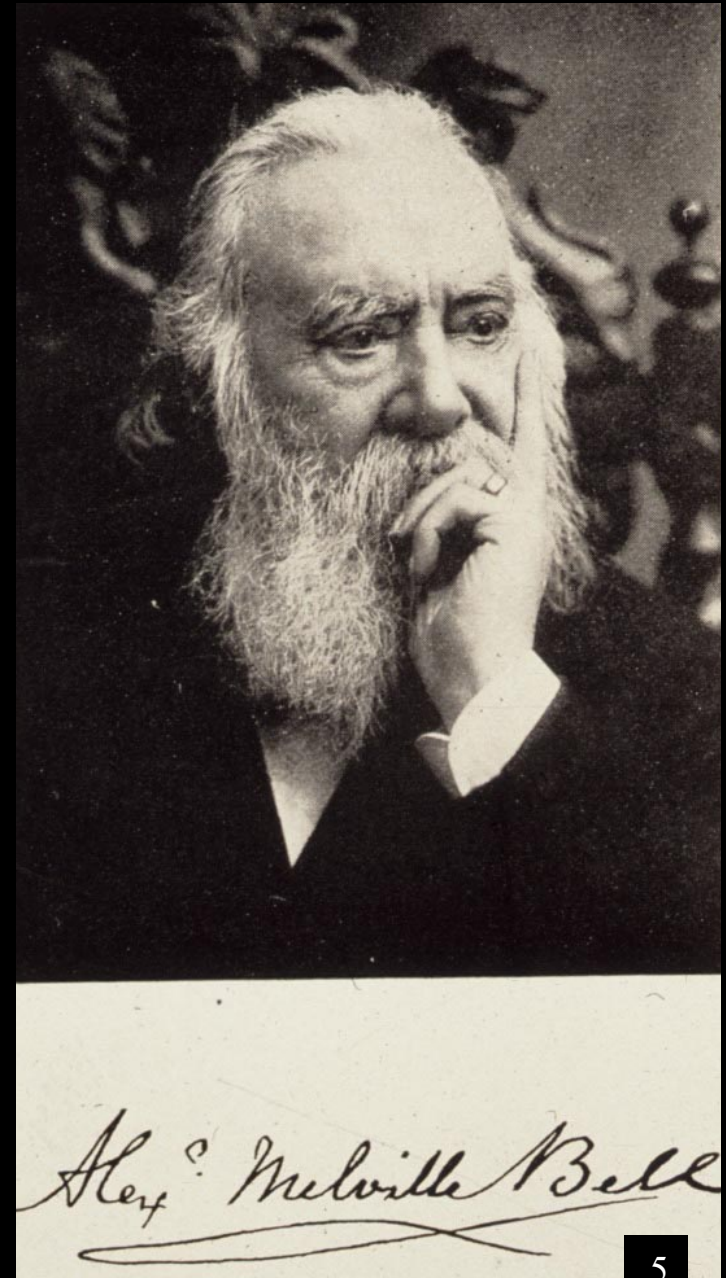
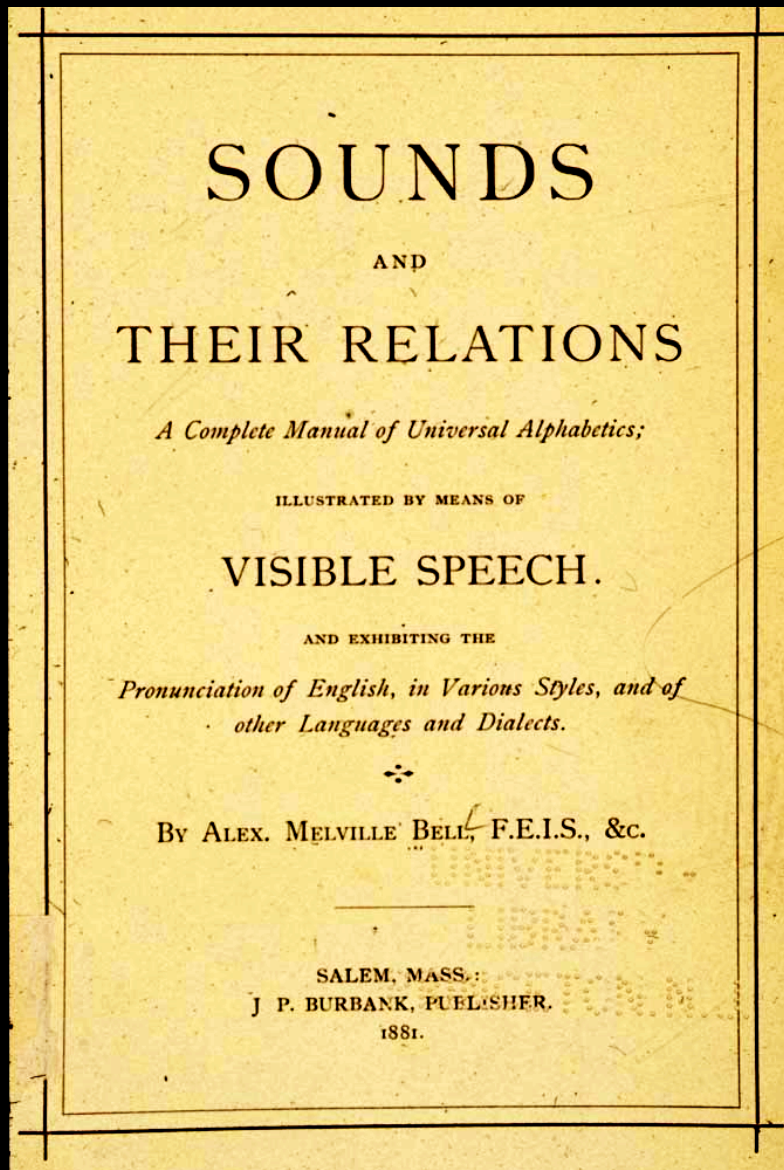
Vail

Vacuum Tube Amplifier
for Telephone Repeater

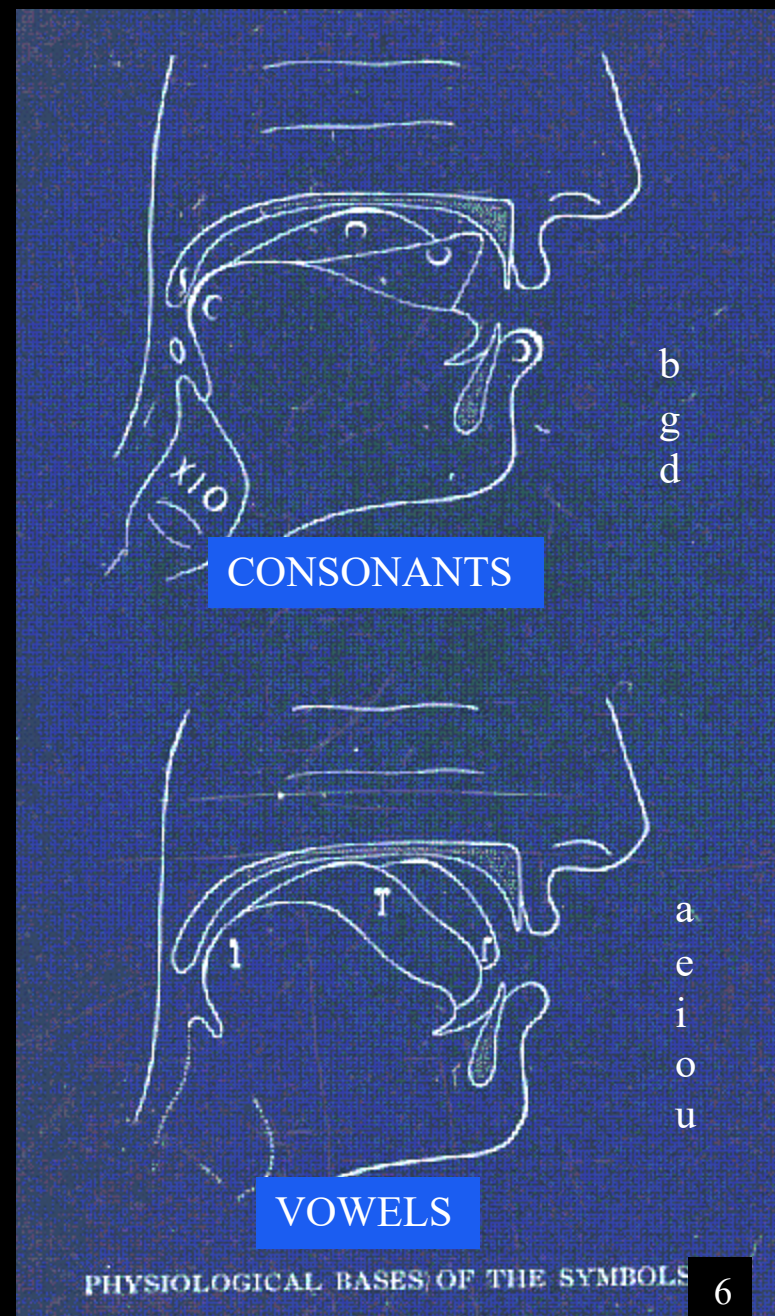
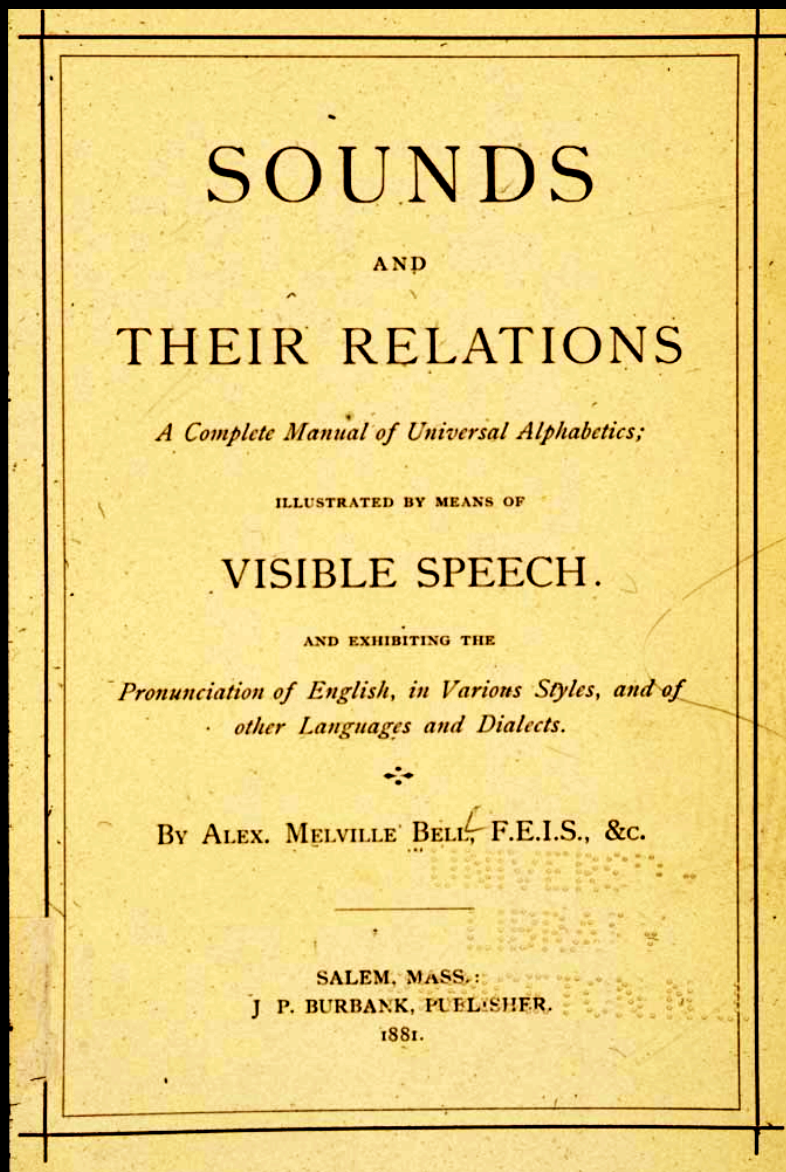
Rise of the Great Industries

1876 - 1939






“... represent any sound the human mouth could utter,” – AG Bell



“... represent any sound the human mouth could utter,” – AG Bell

VISIBLE SPEECH.
INVENTED IN 1864 BY
Prof. A. Melville Bell.

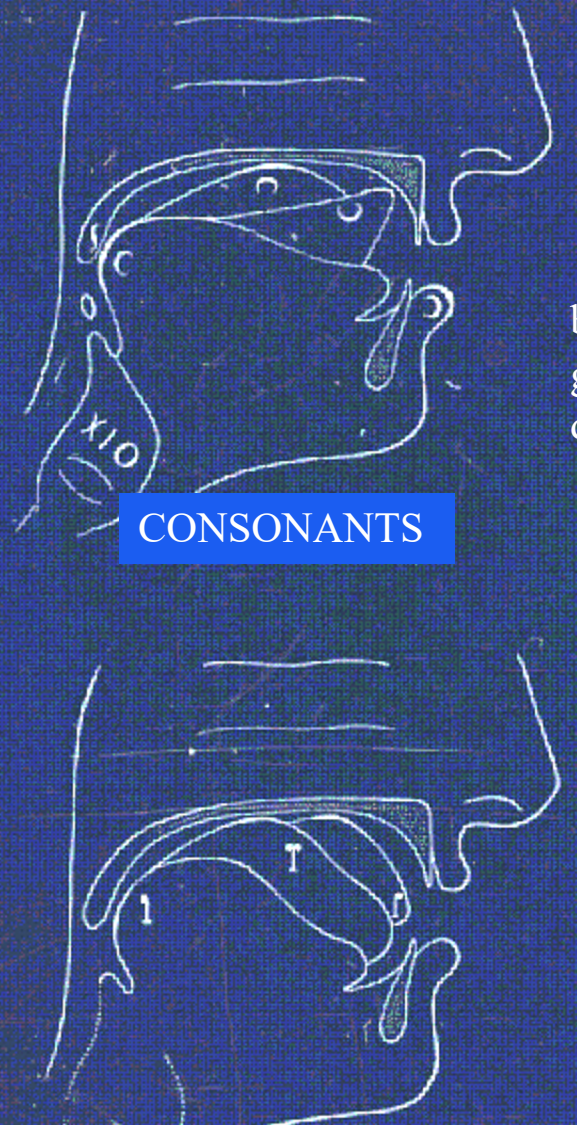


א ב ג ד ה ו ז ח ט י כ ל מ נ ס ע פ צ ק ר ש ת	א ב ג ד ה ו ז ח ט י כ ל מ נ ס ע פ צ ק ר ש ת	א ב ג ד ה ו ז ח ט י כ ל מ נ ס ע פ צ ק ר ש ת	א ב ג ד ה ו ז ח ט י כ ל מ נ ס ע פ צ ק ר ש ת
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Inaugural Work published 1867
 First used for the instruction of
 the deaf in England 1869.— Acknowledged
 by the Philological Society in 1869.
 Introduced into America by the Boston
 School for the deaf 1871.— Used in the
 Mission field in China 1872.—
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 Mission field in China 1872.—
 Adopted by the Boston University
 1874.

PRESENTED TO THE MEMBERS OF THE BOSTON SOCIETY OF ARTS, BY
A. GRAHAM BELL, 18 BEACON STREET.



CONSONANTS

VOWELS

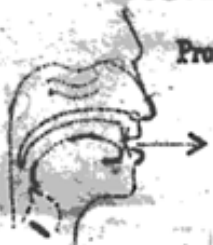
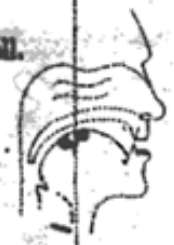
PHYSIOLOGICAL BASES OF THE SYMBOLS

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VISIBLE SPEECH.
INVENTED IN 1864 BY
Prof. A. Melville Bell.

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[Hebrew text describing the Visible Speech system and its use in the Boston School for the Deaf, 1871, and in the Mission field in China, 1872. It also mentions its adoption by the Boston University in 1874.]

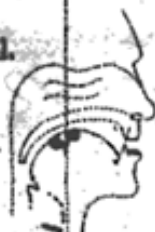
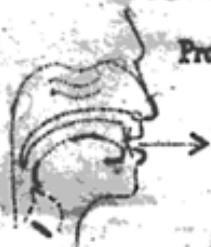
*Inaugural Work published 1867
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 Boston School for the deaf 1871
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 China 1872. Adopted by the
 Boston University 1874

VISIBLE SPEECH.

INVENTED IN 1864 BY
Prof. A. Melville Bell.



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Alexander Graham Bell (1847 – 1922)

Scotland to Canada

Teaches deaf in Boston

Professor at Boston University



Alexander Graham Bell (1847 – 1922)

Scotland to Canada

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Professor at Boston University



Class Picture – BOSTON 1871

Alexander Graham Bell
Teacher of the teachers



Class Picture – BOSTON 1871

Alexander Graham Bell
 Teacher of the teachers



Mr. A. Graham Bell's Card of Terms.

PRIVATE INSTRUCTION.

Vocal Physiology, Defects of Speech, Elocution, &c.

<i>A Single Lesson in any department,</i>	\$5.00
<i>A Course of Twelve Lessons,</i>	\$50.00

INSTRUCTION OF THE DEAF IN SPEECH,

Including the general education of very young pupils,

<i>Per annum,</i>	\$500.00
-------------------	-----------	----------

TEACHERS OF THE DEAF AND DUMB,

Including the mastery of Visible Speech, with the privilege of attending the Deaf Classes, and learning practically the methods of instruction,

<i>The Complete Course,</i>	\$500.00
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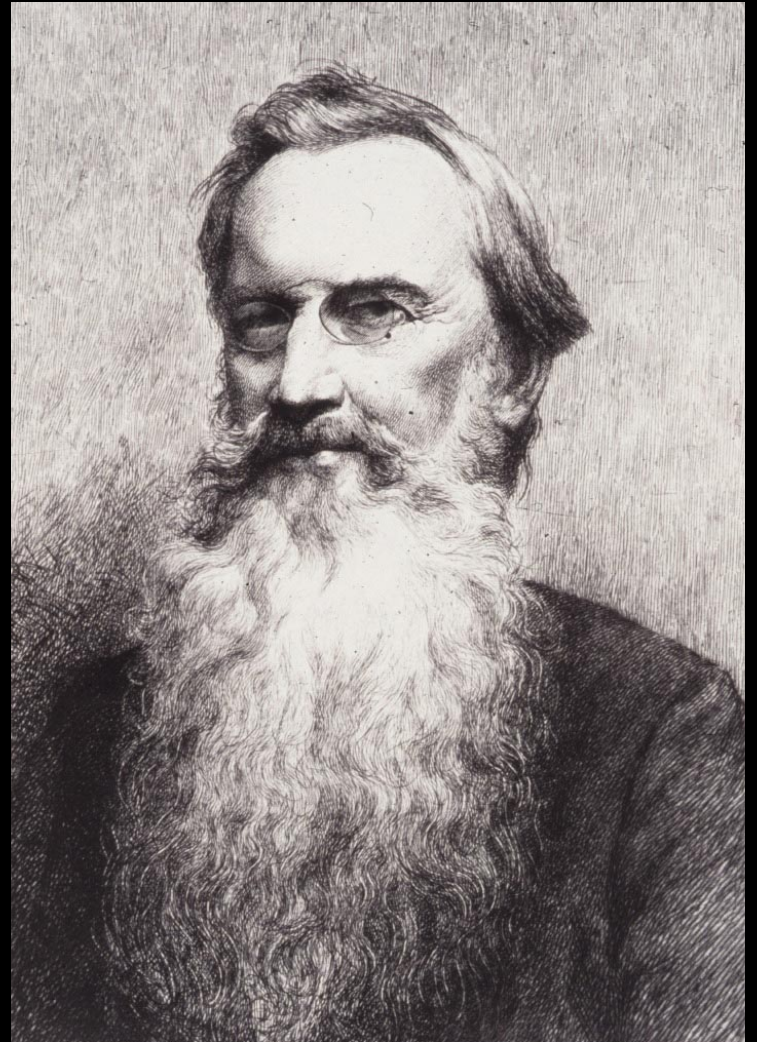
In cases where Teachers can spend only a limited time in Boston, the terms are modified, as follows:

<i>Per Week,</i>	\$50.00
<i>Per Month,</i>	\$150.00

The Fees are payable in advance.

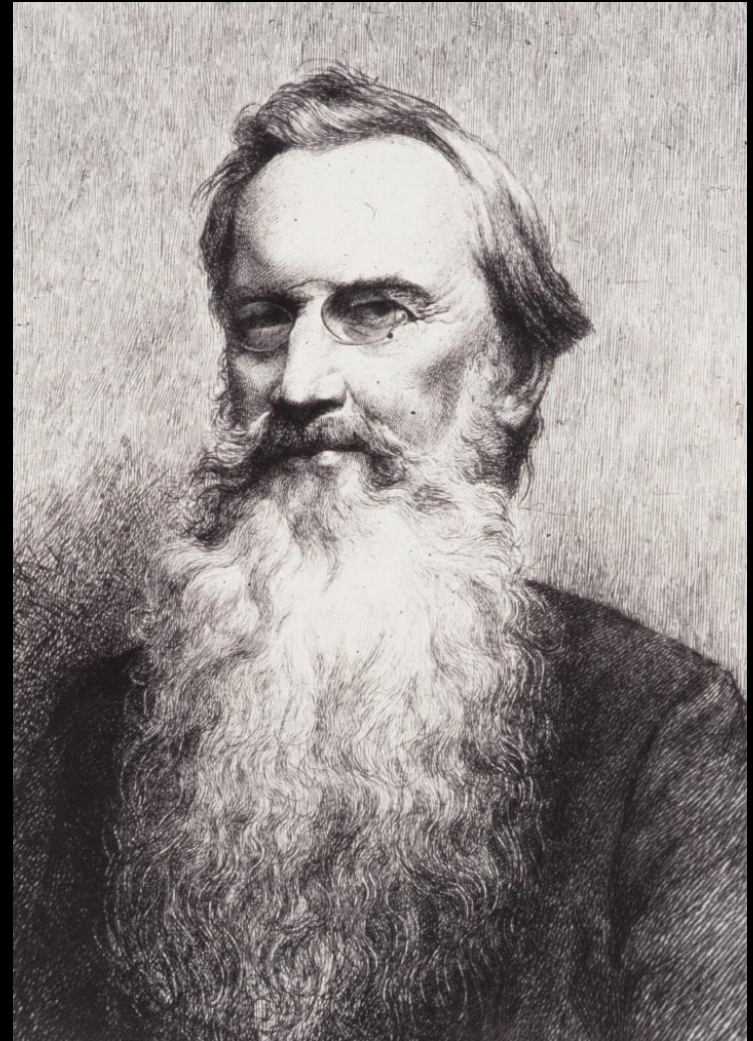
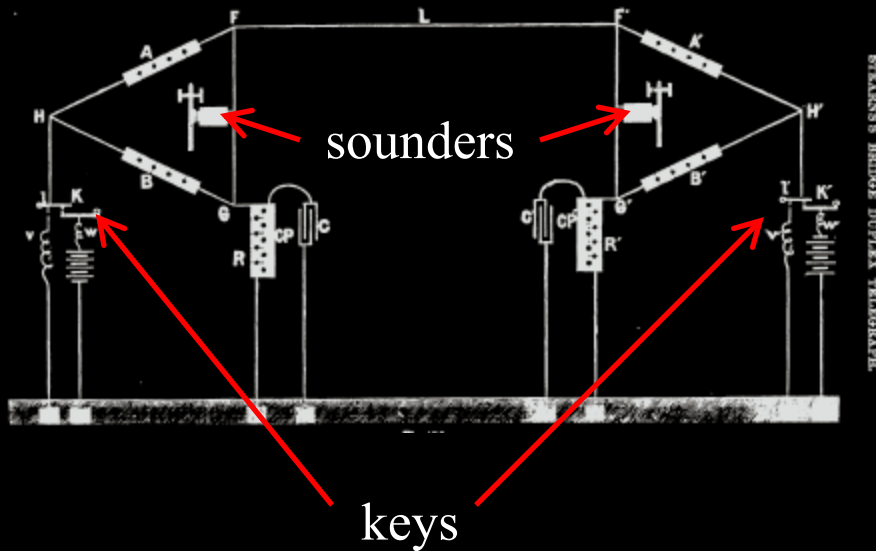
Deaf pupils entering by the year, pay quarterly in advance.

35 West Newton Street, Boston, Mass.



Stearns Duplex Idea-1872

TWO MESSAGES ON ONE WIRE

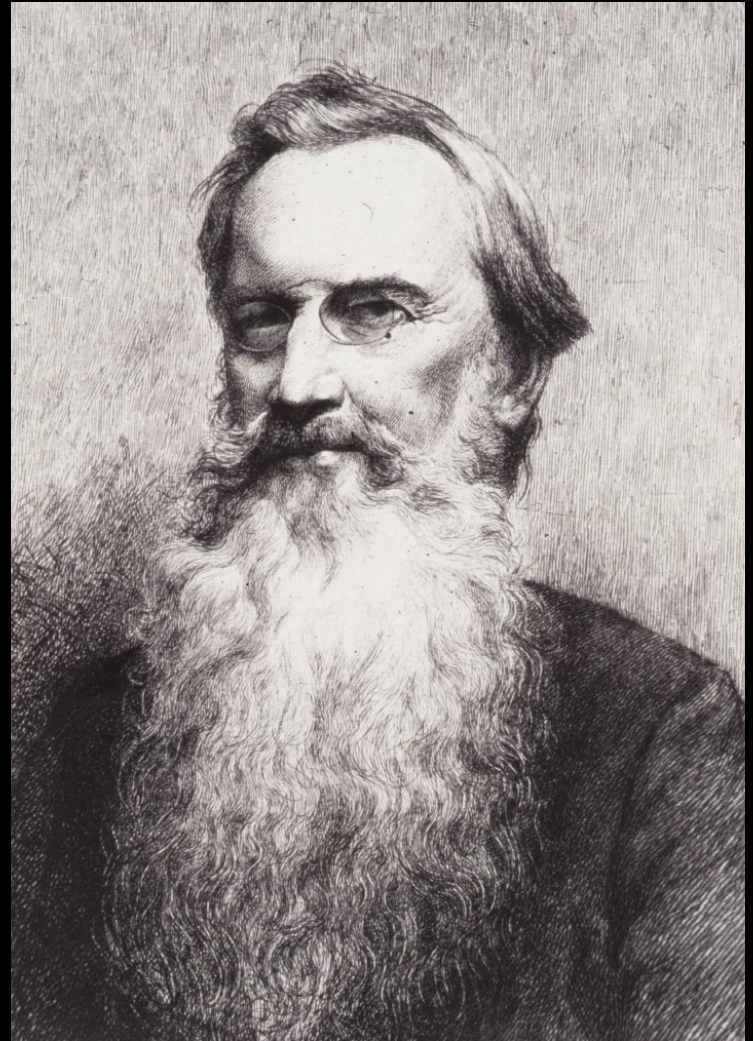


Hubbard felt that Western Union was a monopoly that mostly served the wealthy. He lobbied Congress to take over, arguing that the public would be better served if run by Postal Service

MULTIPLEXING

Bell's idea in early 1874 for sending multiple messages on a single telegraph line.

Demo of Concept using Guitar



CHAS. WILLIAMS, JR.,

(Established 1856,)

Successor to

HINDS & WILLIAMS,

Manufacturer of

**Telegraphic & Magnetical
APPARATUS,**

Galvanic Batteries, &c.

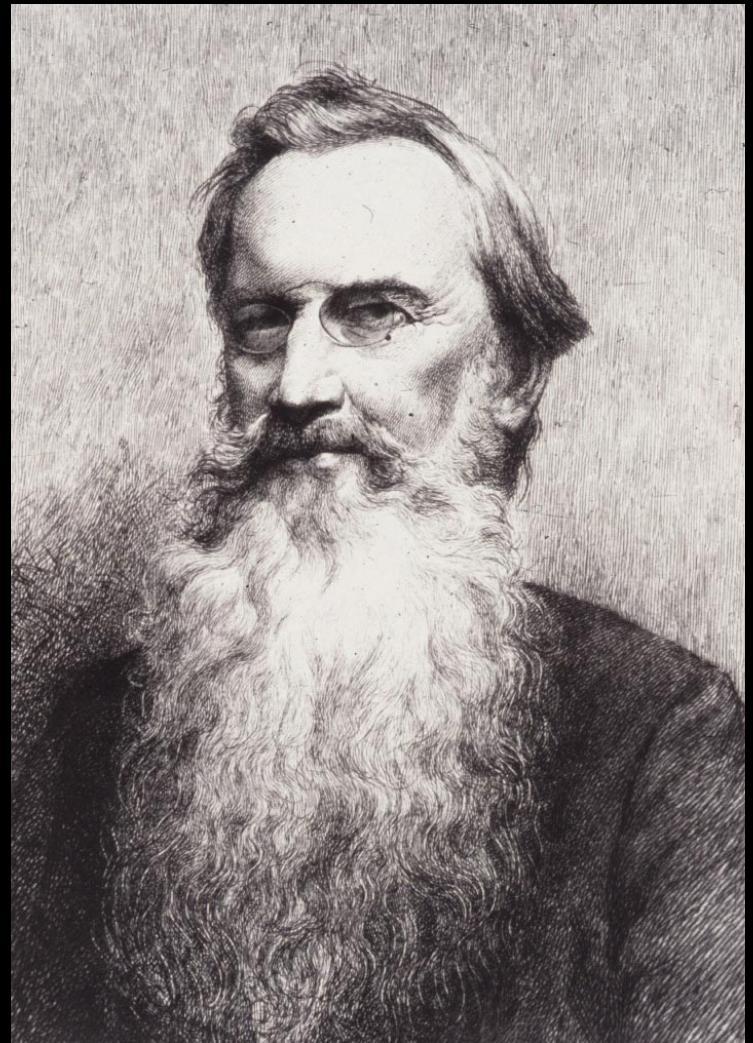
Wholesale and Retail Dealer in

TELEGRAPH SUPPLIES,

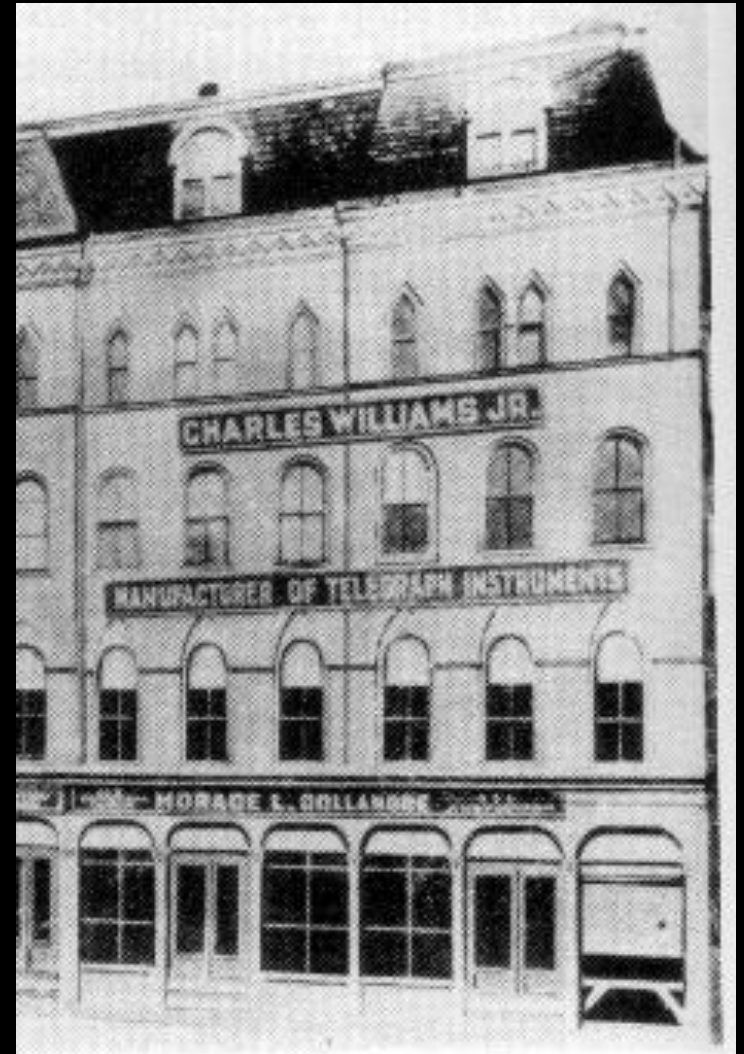
109 Court Street,

(Minot's Buildings,)

BOSTON, MASS.



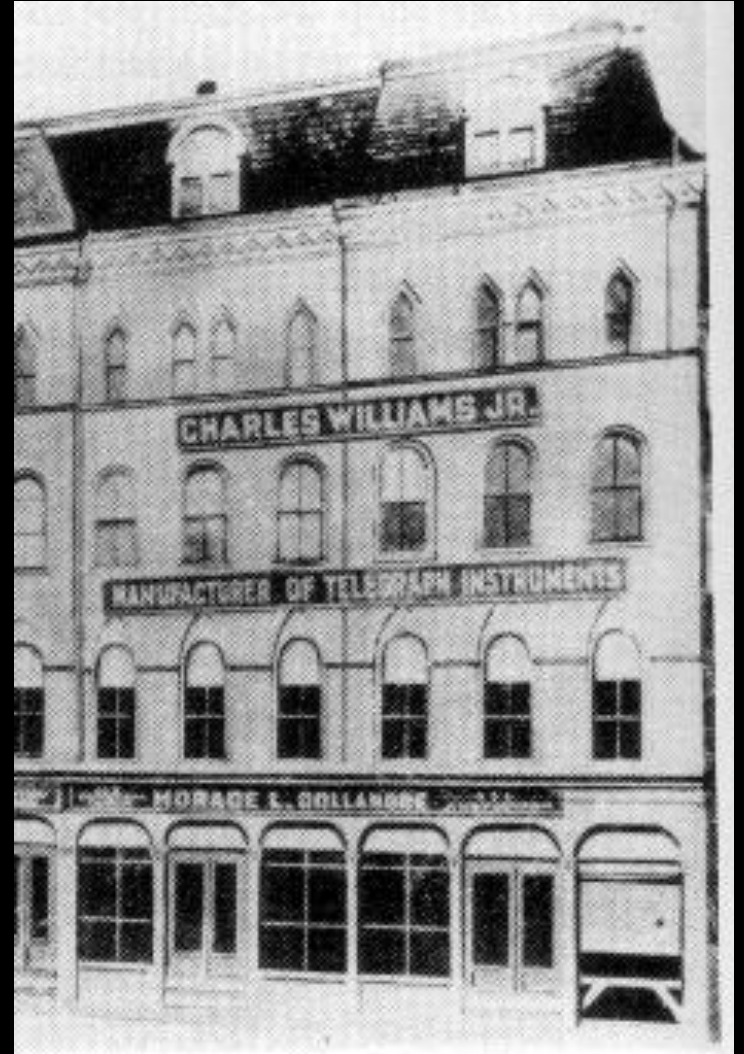
CHAS. WILLIAMS, JR.,
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Bell rents a workbench
Bell's 1st R&D Lab

Bell to Thom Watson

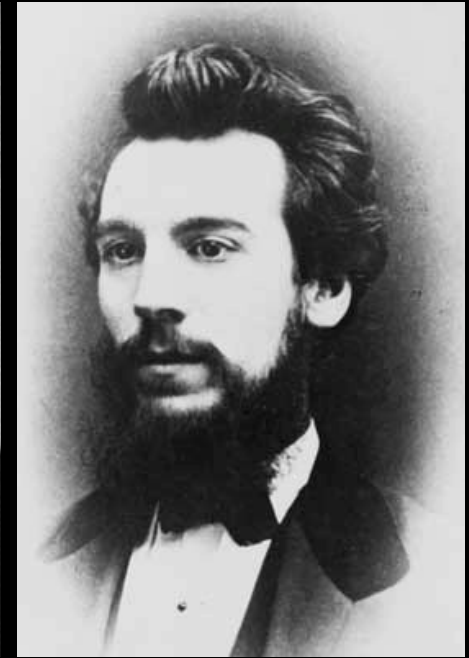
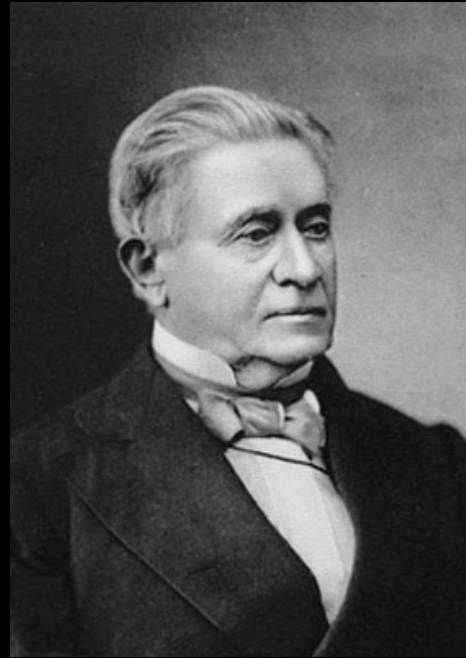
“Watson, if I can get a mechanism which will make a current of electricity vary in intensity, as the air varies in density when a sound is passing through it, I can telegraph any sound, even the sound of speech.”



Bell rents a workbench
Bell's 1st R&D Lab

Bell to Thom Watson

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Bell visits Henry in March 1875

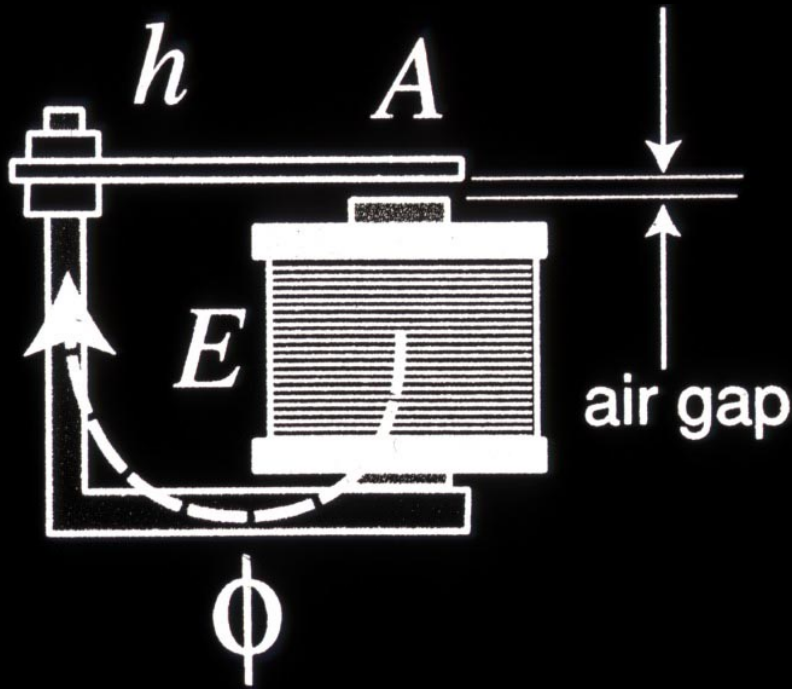
Henry tells Bell

“Get it” (that is, electrical knowledge)

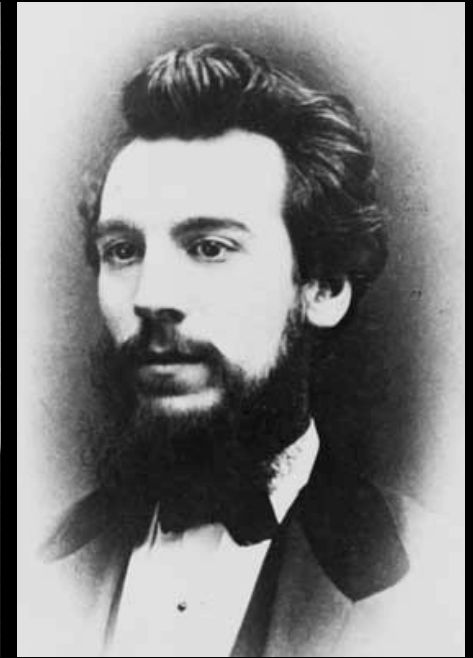
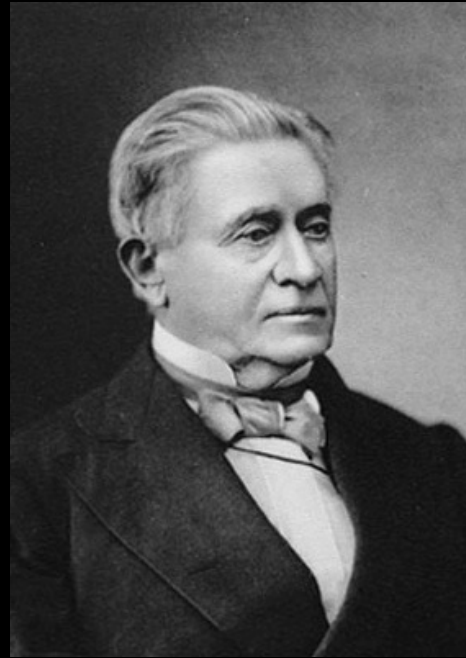
Bell tells his parents

“I cannot tell you how much these two words have encouraged me.”

Invents a sounder – coil wrapped around iron loop with a freely vibrating iron reed – loud when pulsed at frequency of the reed



Bell's Iron Loop Device



Bell visits Henry in March 1875

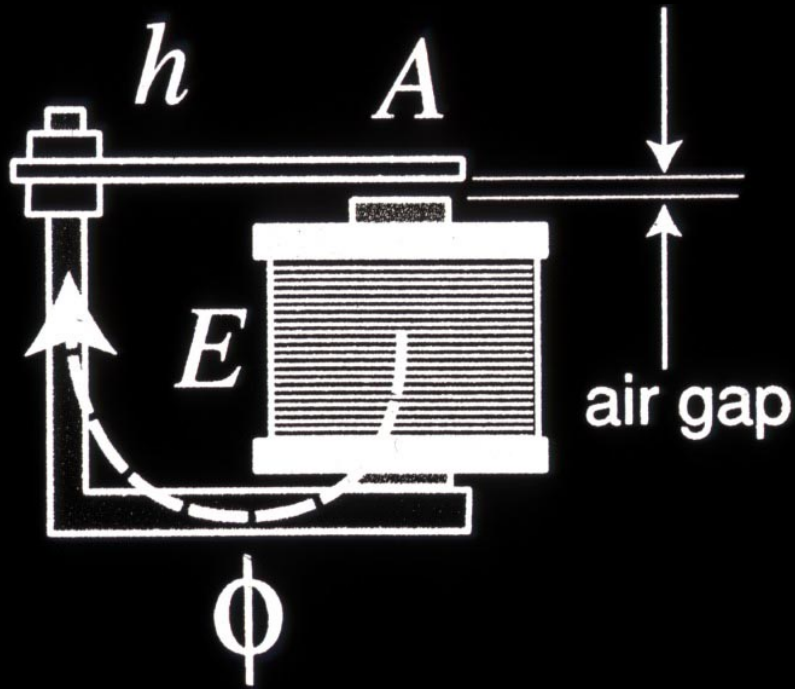
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“Get it” (that is, electrical knowledge)

Bell tells his parents

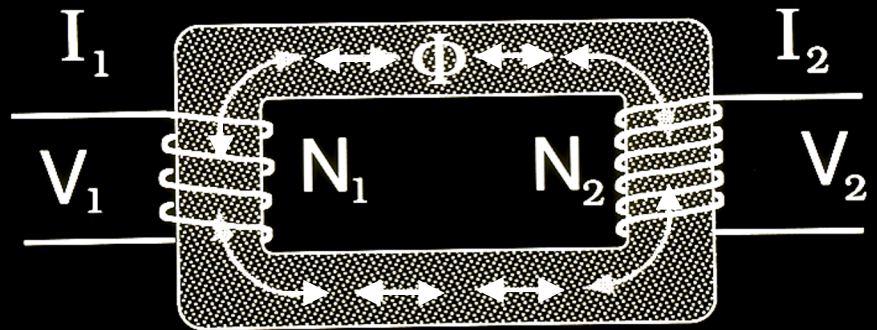
“I cannot tell you how much these two words have encouraged me.”

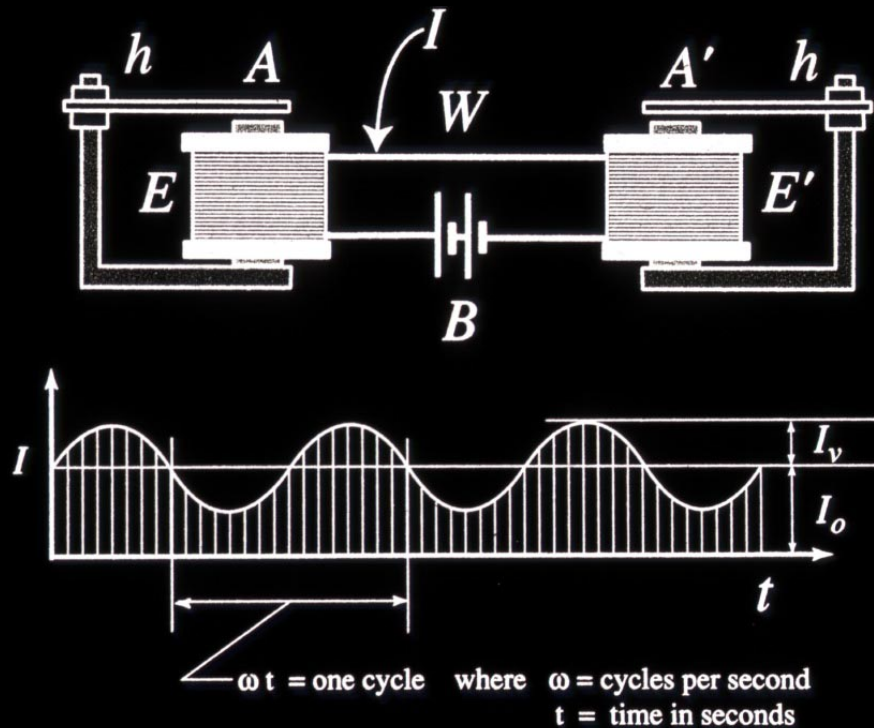
Invents a sounder – coil wrapped around iron loop with a freely vibrating iron reed – loud when pulsed at frequency of the reed



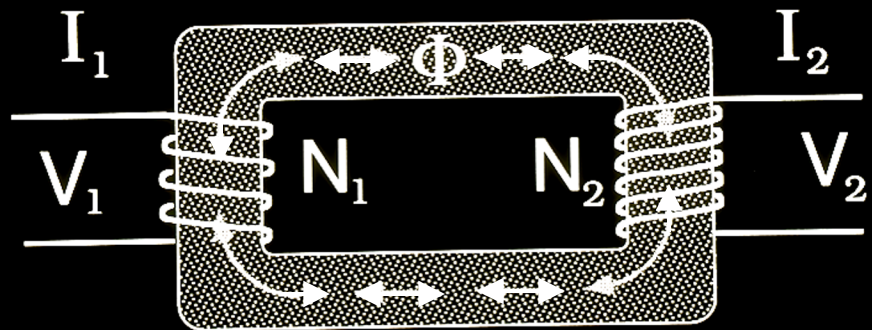
Bell's Iron Loop Device

Very similar to a
TRANSFORMER



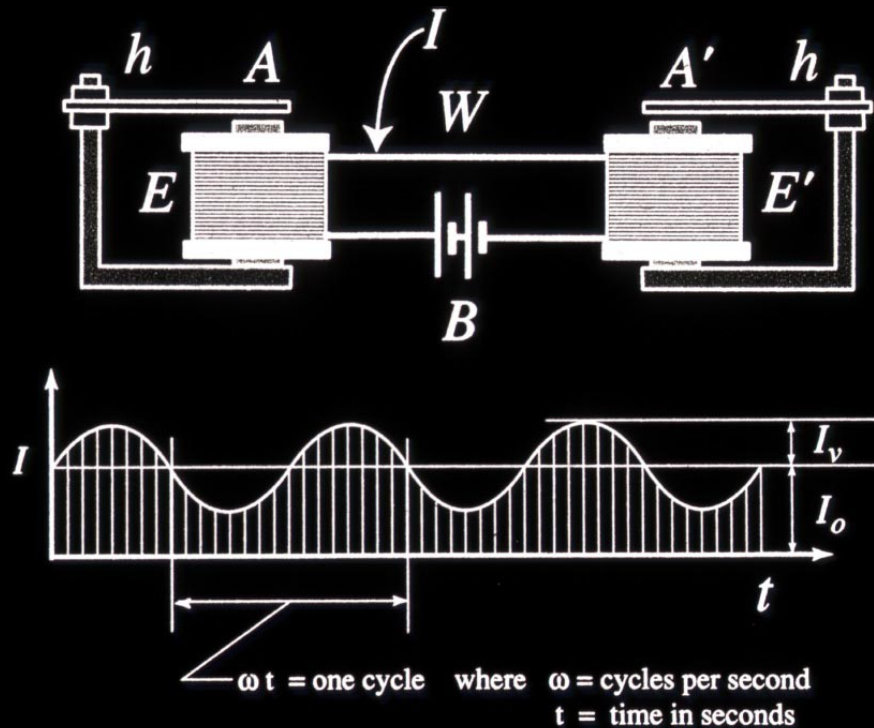


Very similar to a
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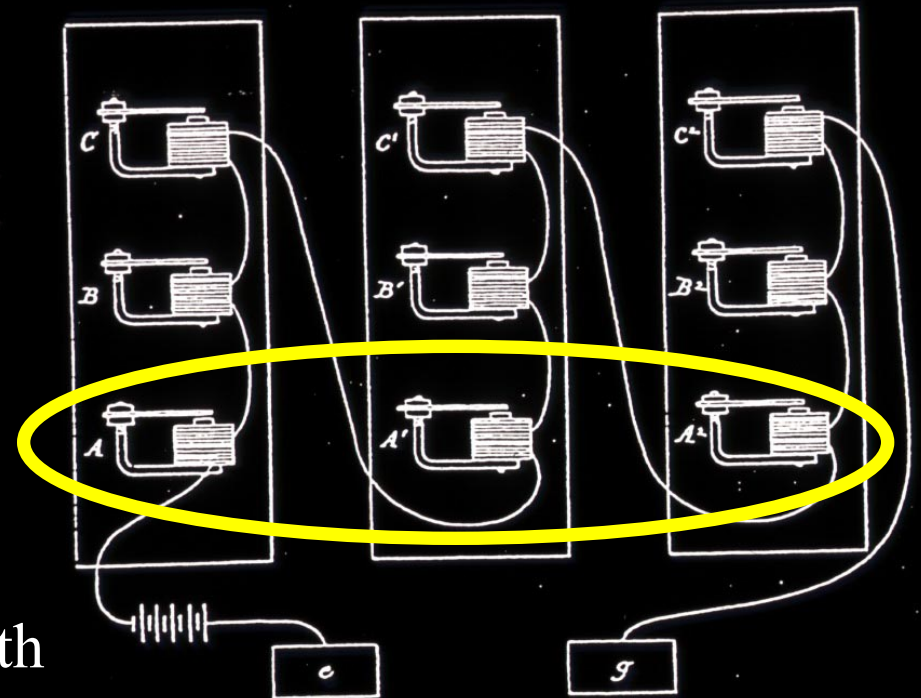


Add a battery, and the iron loop device is reversible – works as both tuned transmitter and tuned receiver

When many loop devices are wired in series, all reeds of the same frequency can send and receive to each other – for example, when musical reed A is plucked, only reeds A' and A'' will sound – other B and C reeds are silent



Add a battery, and the iron loop device is reversible – works as both tuned transmitter and tuned receiver

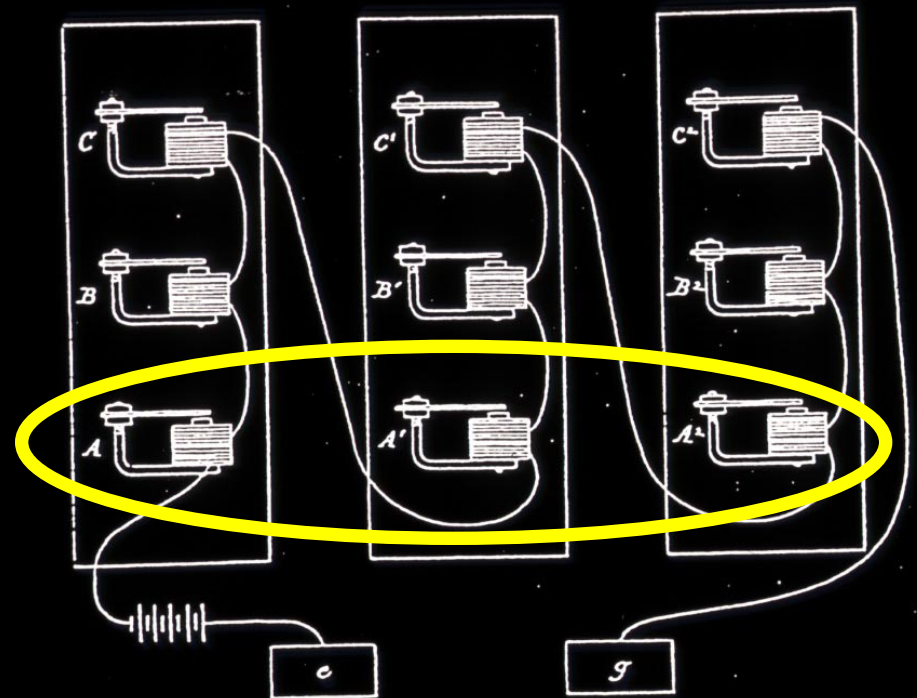


Demonstration of Multiplexing

Bell's Harmonic Telegraph device to send multiple messages on one line.

- Transmission Demo
- Reception Demo

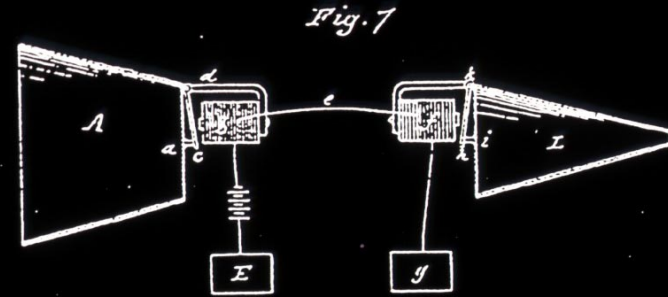
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Demonstration of Multiplexing

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- Transmission Demo
- Reception Demo



Witnesses

Charles F. Smith
W. J. Harrison

Inventor:

A. Graham Bell
by atty. Robert Bailey

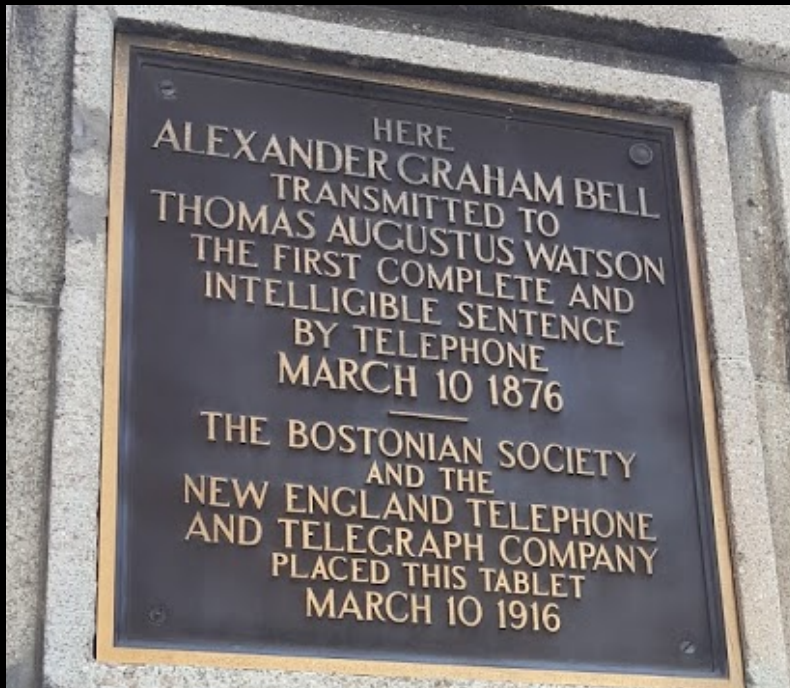
Bell extends idea to edge-clamped iron disk instead of vibrating iron reeds – voice is sent and received

Patent No. 174,465

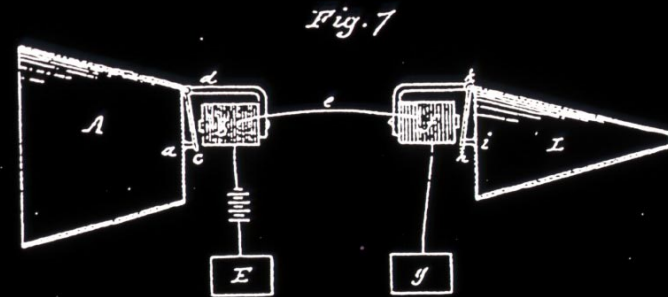
Hubbard beats Gray – Feb 14, 1876

Working model – March 10, 1876

Most profitable patent in history



5 Exeter Place – 2nd R&D Lab



Witnesses

Charles F. Smith
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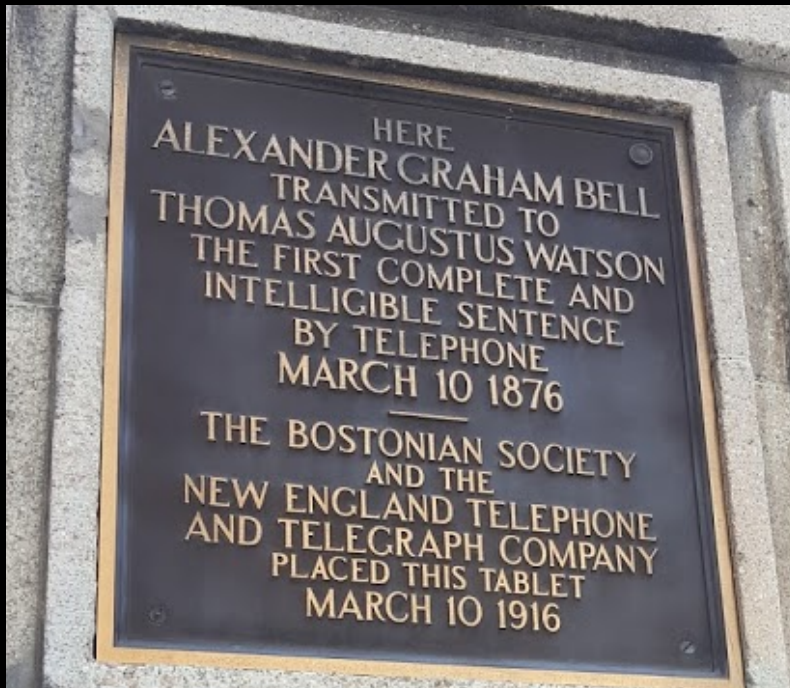
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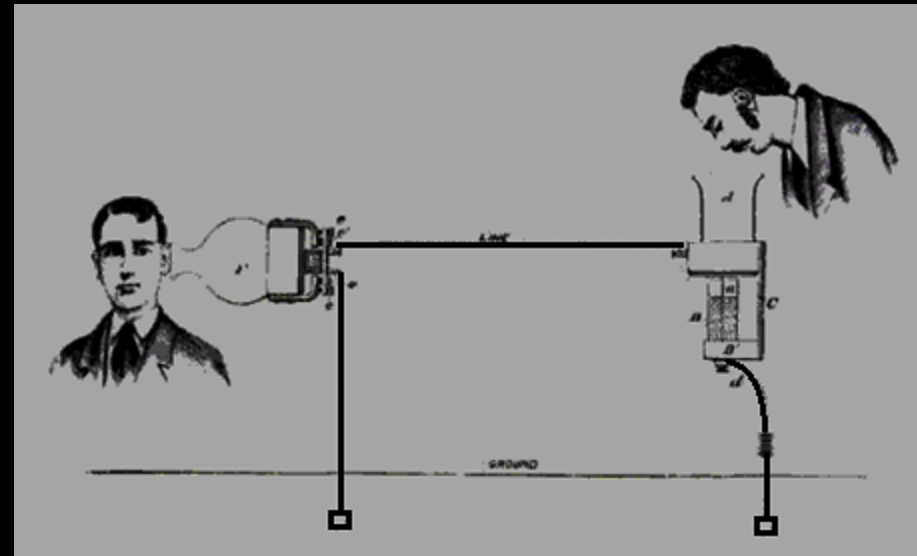
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Working model – March 10, 1876

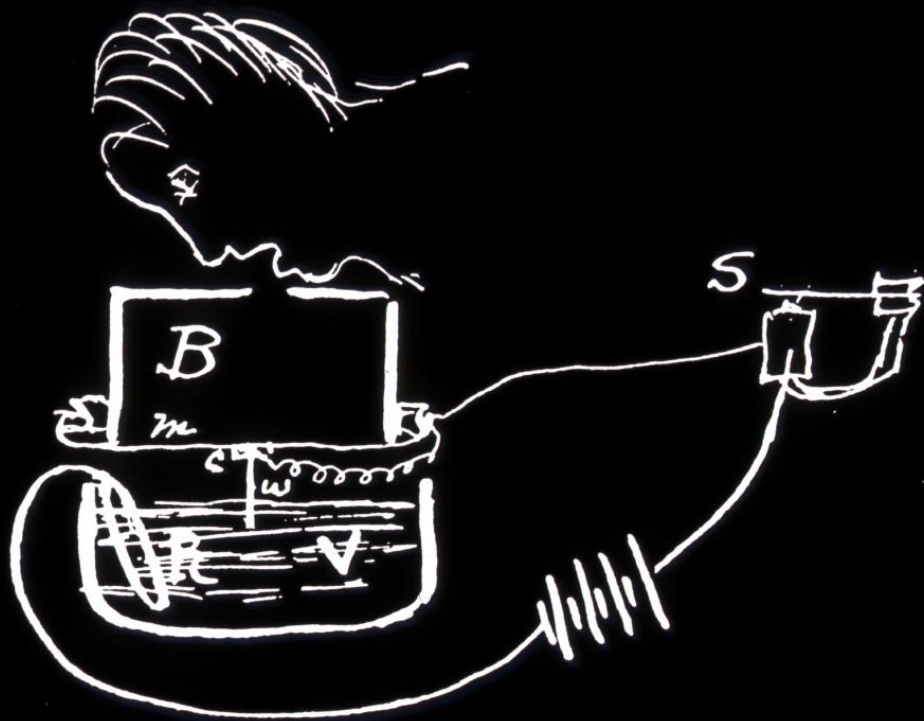
Most profitable patent in history



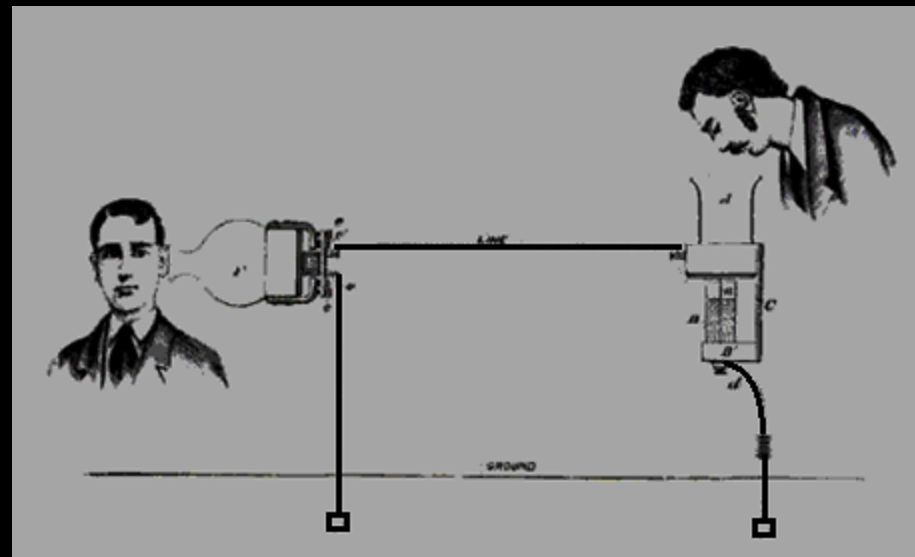
5 Exeter Place – 2nd R&D Lab



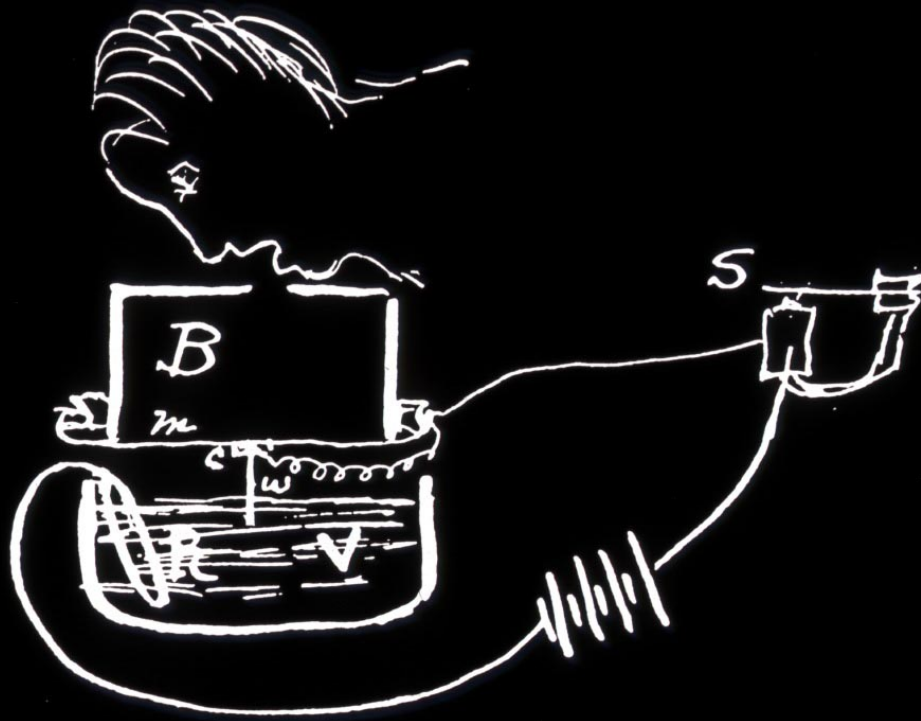
Gray's Caveat



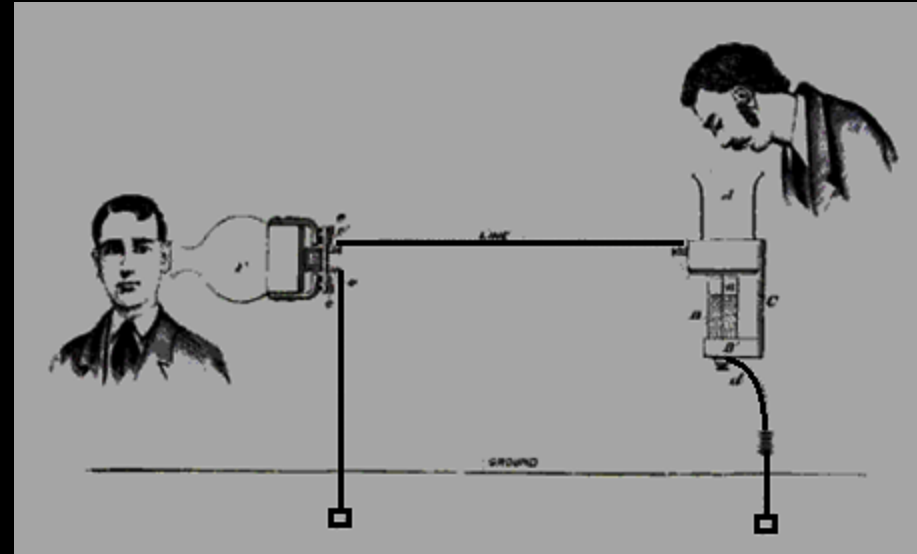
Bell's Notebook



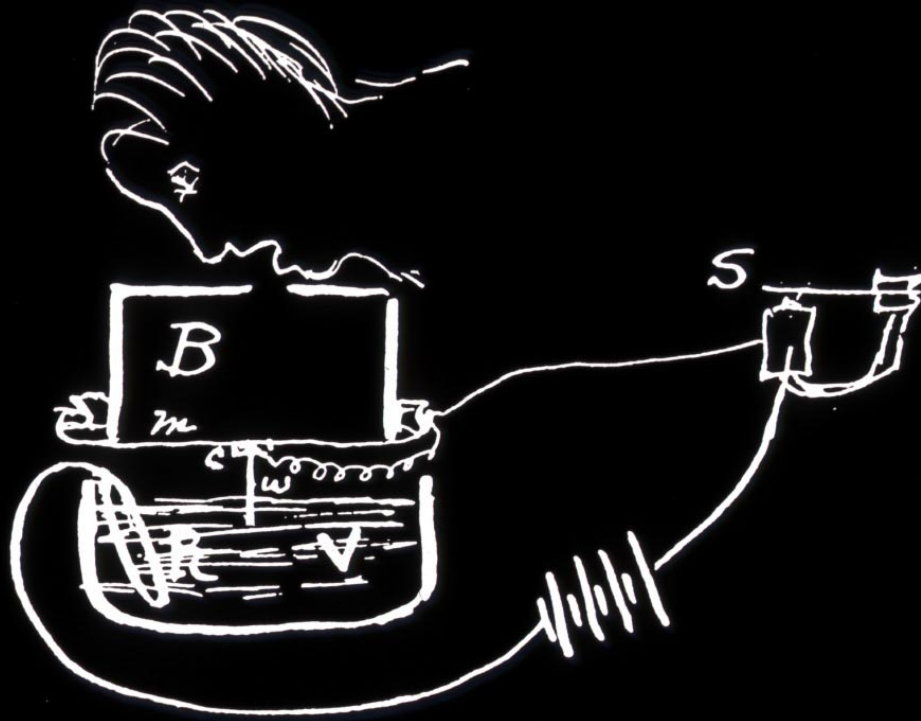
Gray's Caveat



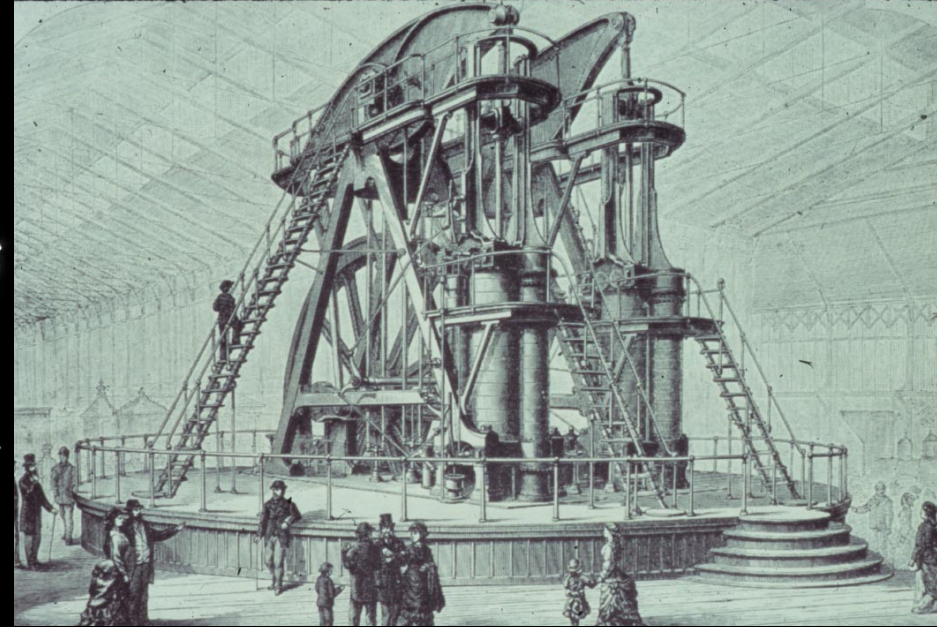
Amateur



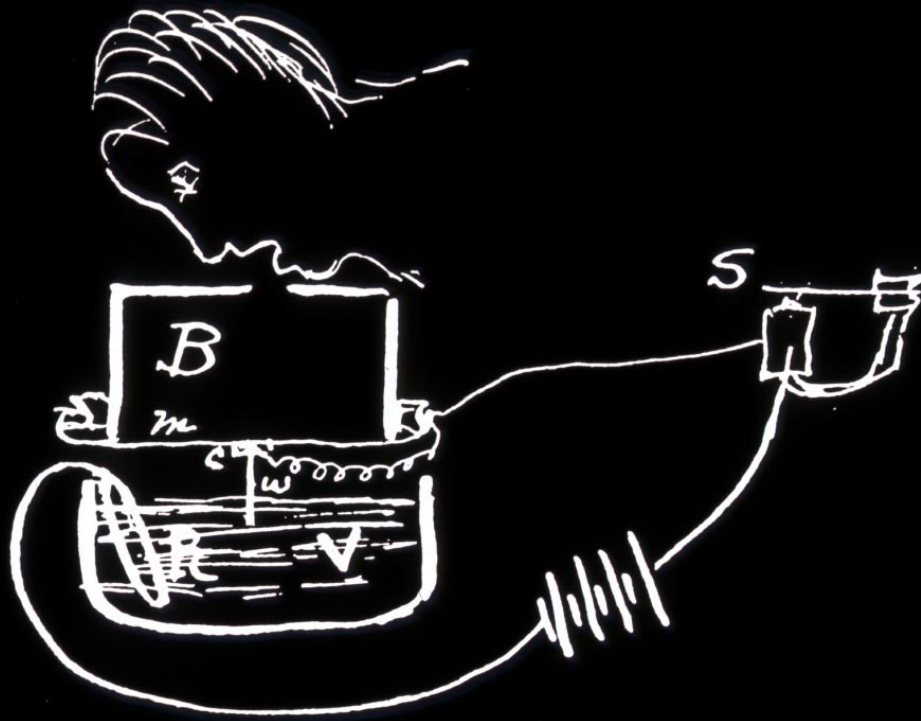
Expert



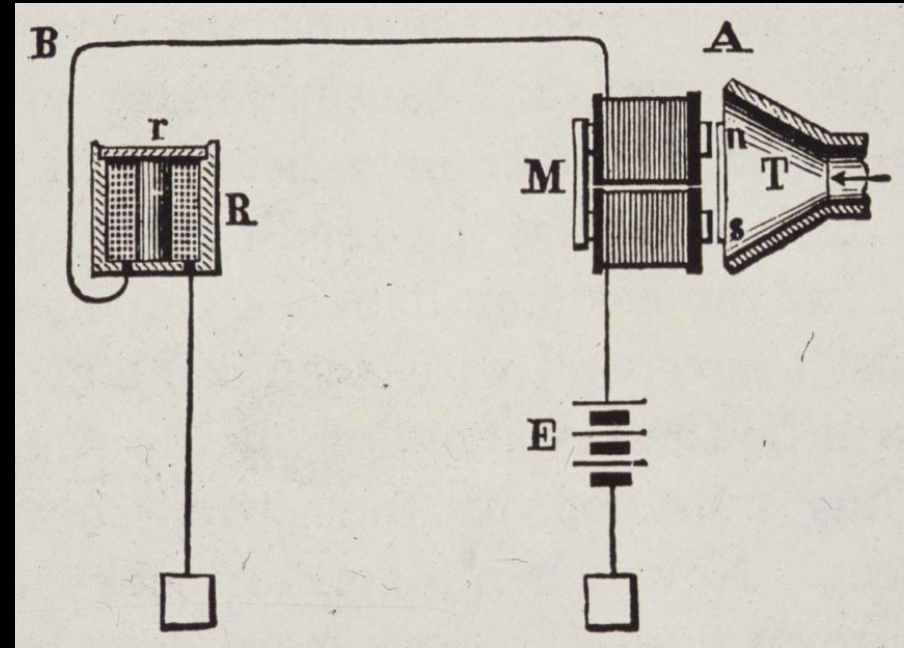
Amateur



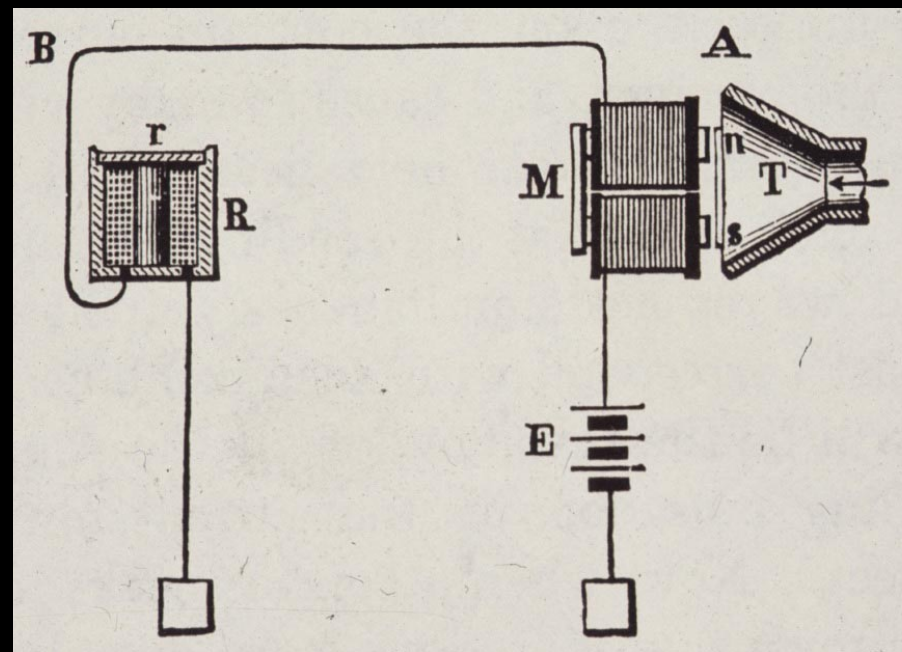
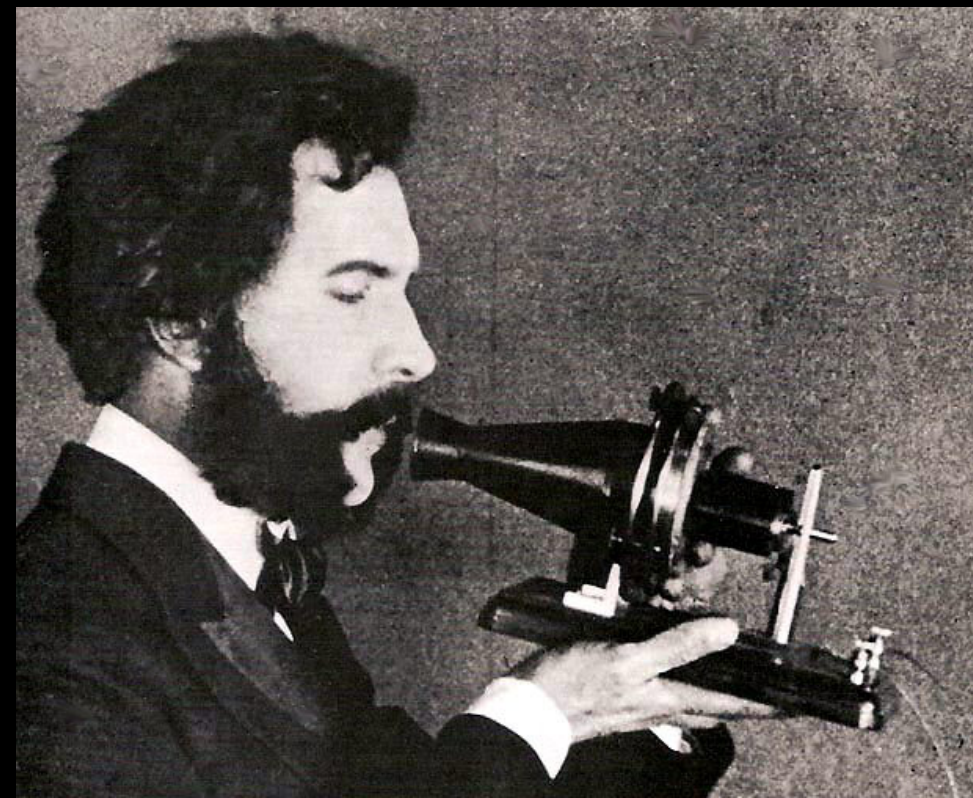
Philadelphia Centennial Fair - 1876



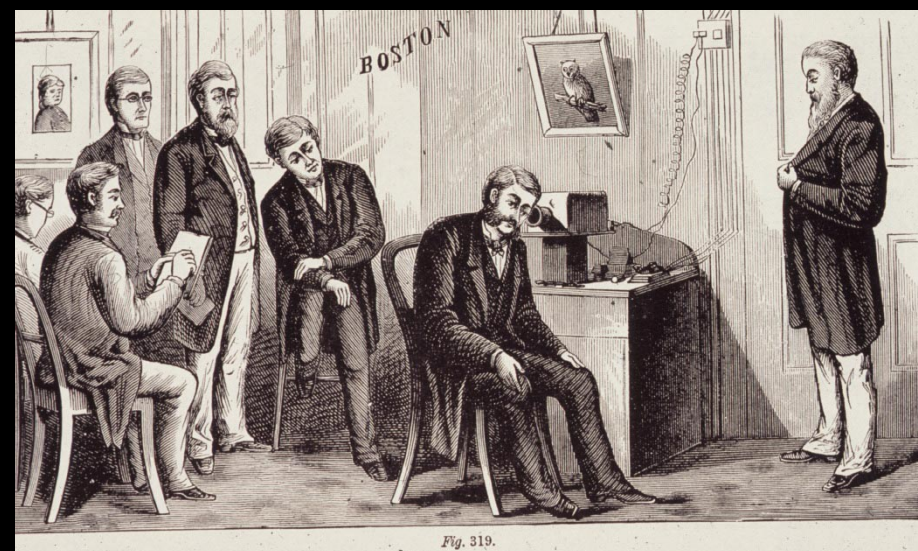
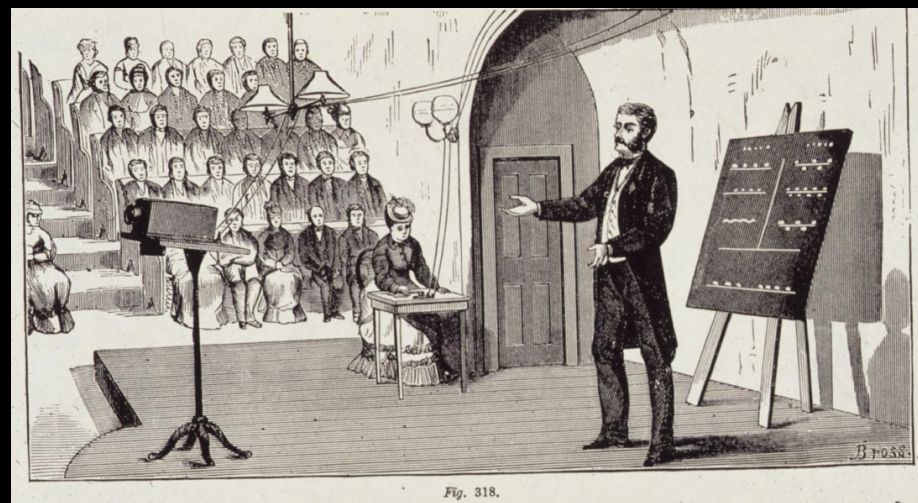
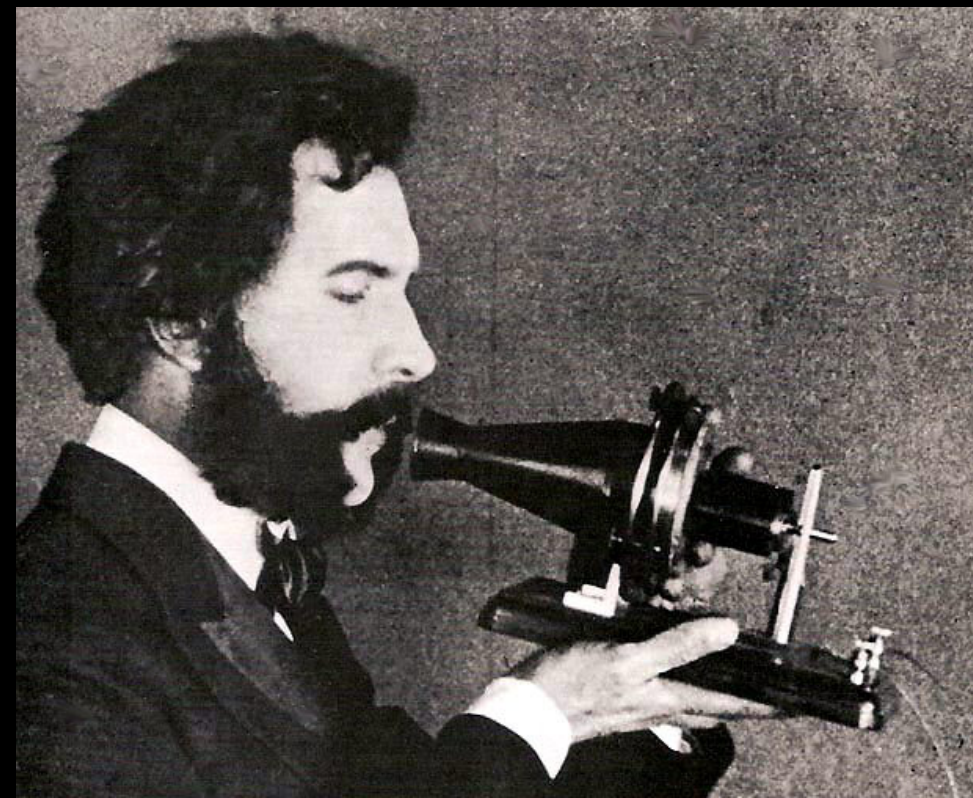
Amateur



Bell's Centennial Telephone - 1876



Bell's Centennial Telephone - 1876



Salem to Boston – 16 miles

Bell Telephone Company

1877 — Hubbard, Sanders and Bell
form a company

1877 — Bell marries Mabel Hubbard

1878 — Hubbard hires Theodore Vail

PRIVATE COMPANY

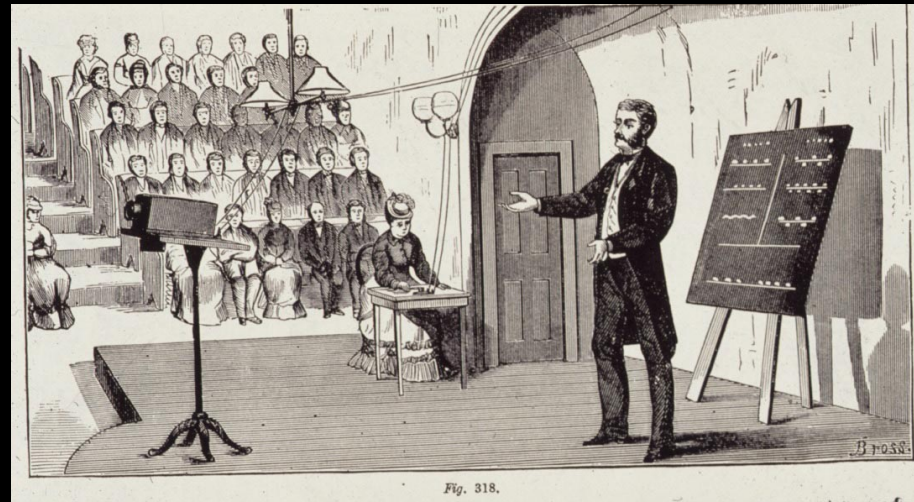


Fig. 318.

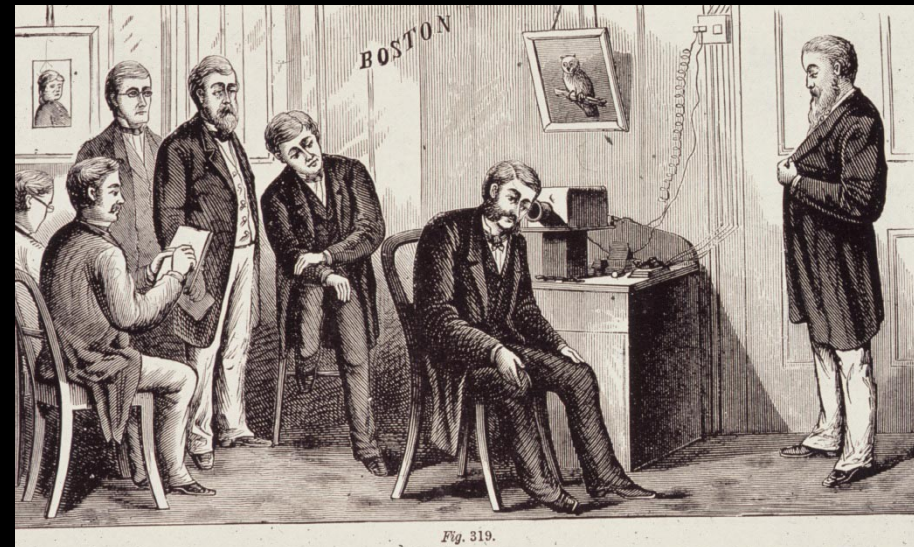


Fig. 319.

Salem to Boston — 16 miles

Bell Telephone Company.

GARDINER G. HUBBARD, TRUSTEE.

A. GRAHAM BELL, ELECTRICIAN.

109 COURT STREET.

~~THOMAS SANDERS, TREASURER.~~

THOMAS A. WATSON, SUPT.

Entrepreneur

Inventor

Investor

Manager

Bell Telephone Company

1877 — Hubbard, Sanders and Bell
form a company

1877 — Bell marries Mabel Hubbard

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PRIVATE COMPANY

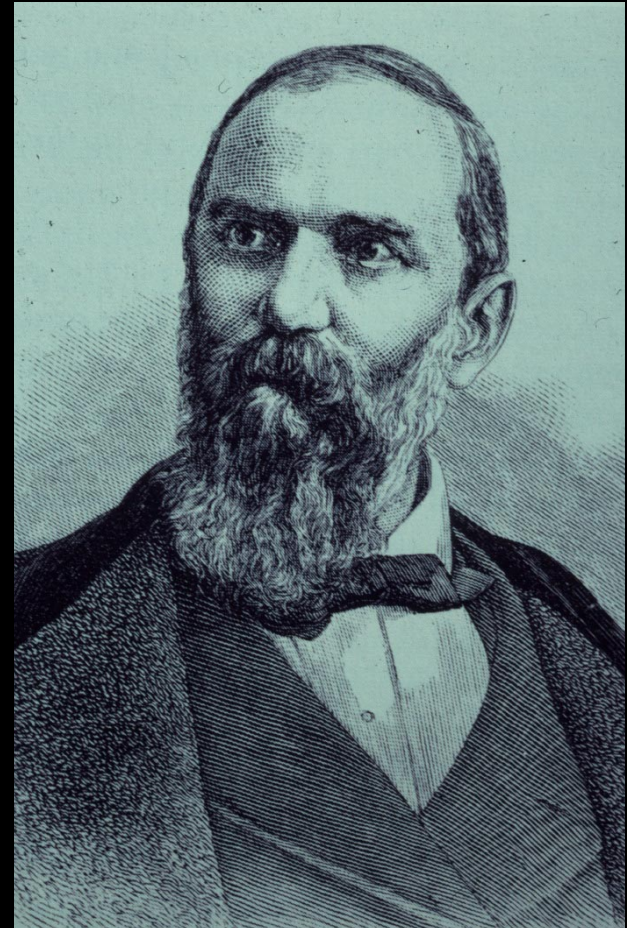
Bell Telephone Company

1877 — Hubbard, Sanders and Bell
form a company

1877 — Bell marries Mabel Hubbard

1878 — Hubbard hires Theodore Vail

PRIVATE COMPANY



Western Union
William Orton



Bell Telephone
Theodore Vail



Western Union
William Orton



Bell Telephone
Theodore Vail

BOSTON DAILY ADVERTISER

SATURDAY MORNING, OCT. 25, 1879.

THE TELEPHONE SETTLEMENT.

The rival and conflicting interests in the various telephone patents have at last been harmonized, and Professor Bell is master of the field. The stockholders of the National Bell Telephone Company met in this city yesterday, and ratified the compromise by which all matters in controversy were terminated. The Western Union Telegraph Company, acting for and on behalf of the Gold and Stock Telegraph Company, the American Speaking Telephone Company and the Harmonic Telegraph Company, agrees to withdraw from the telephone business in the United States, leaving the field entirely clear to the company operating under the Bell patents. All persons who hold rights from other companies will be licensed under these patents. The Western Union further agrees to allow the Bell Telephone Company a percentage on the telegraphic business received through its instruments, and to cooperate to the extent of its power.

Under this adjustment the Bell Telephone Company acquires all the telephonic inventions of Elisha Gray of Chicago, of Thomas A. Edison, of George M. Phelps, and all

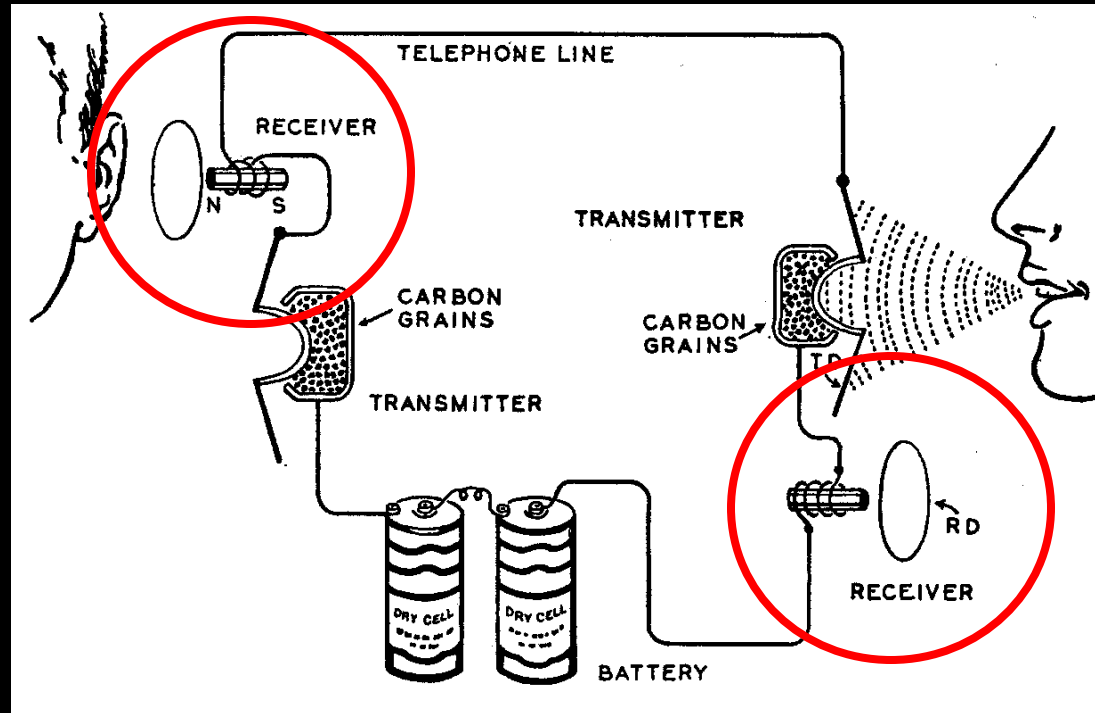
others who had assigned their interests to the Western Union or other allied companies. The right to connect telephonic district or exchange systems remains exclusively with the Bell Company, which will also license the Western Union to use the telephone for transmitting telegraphic messages. The compromise thus not only secures freedom from litigation and control of all the patents now out for the purpose of transmitting human speech, but establishes harmony of interests between the Western Union and the new company, which must be of inestimable value to both.

The sum paid by the Bell Company to secure this most satisfactory settlement is not stated, but is presumed to be a large one; and from a commercial point of view it is money well invested. The National Bell Telephone Company was formed a very short time ago, with a nominal capital of \$850,000 in shares of one hundred dollars each. The last sale of shares was at seven hundred dollars, though the company has not yet paid a dividend. The large earnings have been used partly in extending the plant and partly in litigation, which at one time threatened to make this, like other valuable patents, a painful and costly possession. Now that litigation is ended and the world is all before it, the Bell telephone has a future of fame and fortune in store for it not surpassed by any of the great discoveries of our time.

Bell Telephone acquires all telephonic patents of Elisha Gray and T. A. Edison



Bell Telephone
Theodore Vail

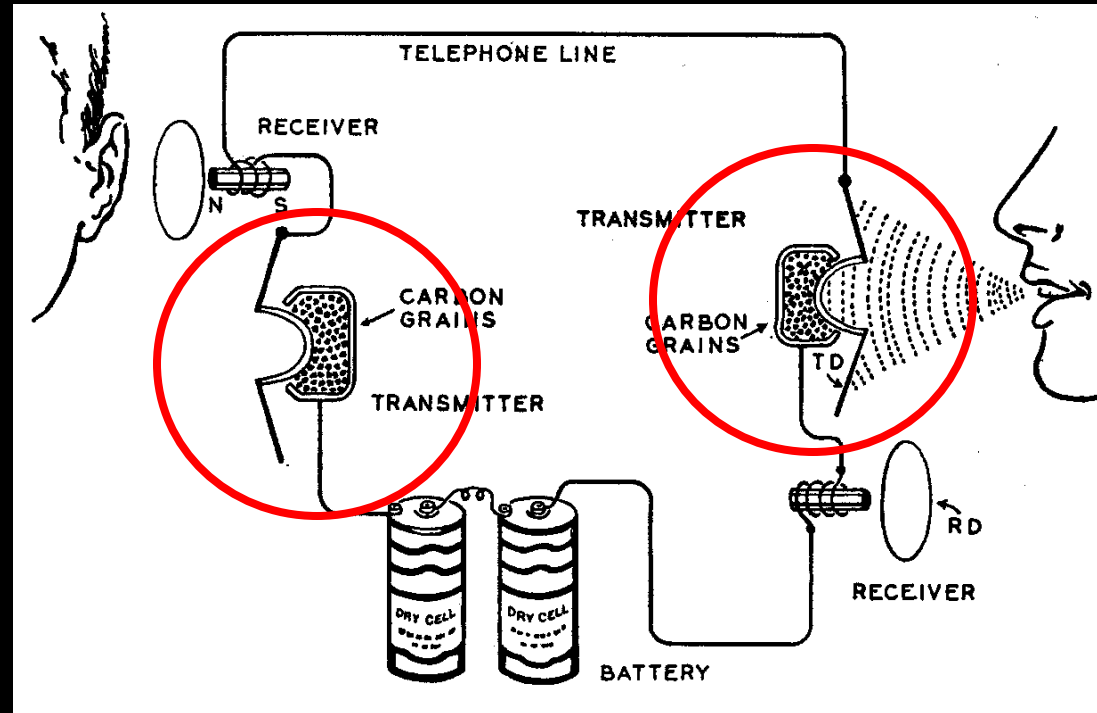


Telephone System using Bell's
Receivers and Edison's Transmitters

Electromagnetic
Receiver



Bell Telephone
Theodore Vail



Telephone System using Bell's
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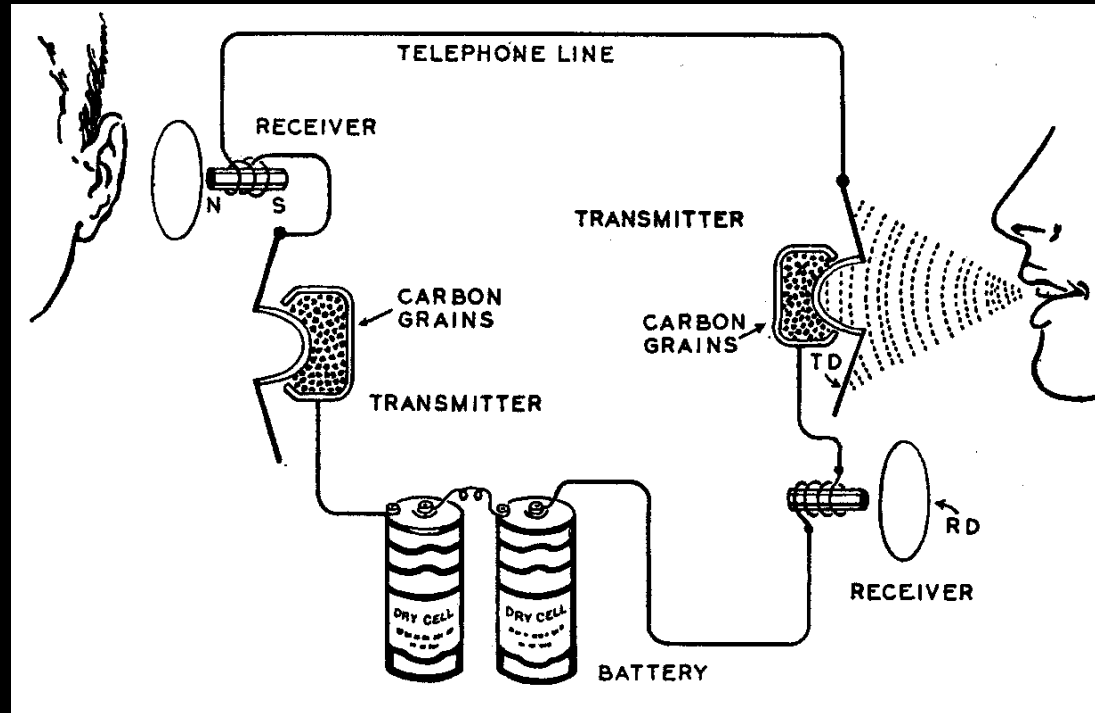
Electromagnetic
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Variable Resistance
Transmitter

SERIES CIRCUIT – DEMO



Bell Telephone
Theodore Vail

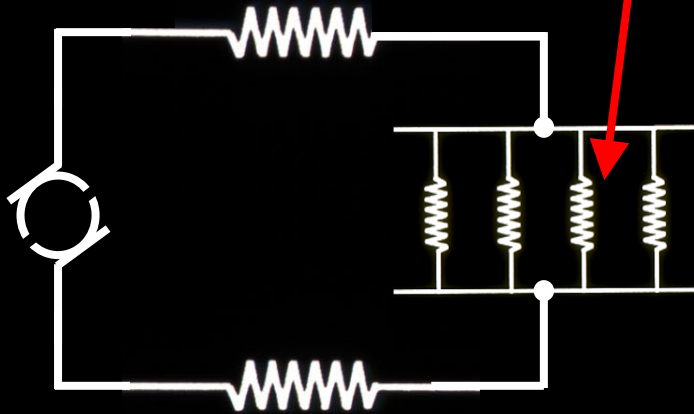


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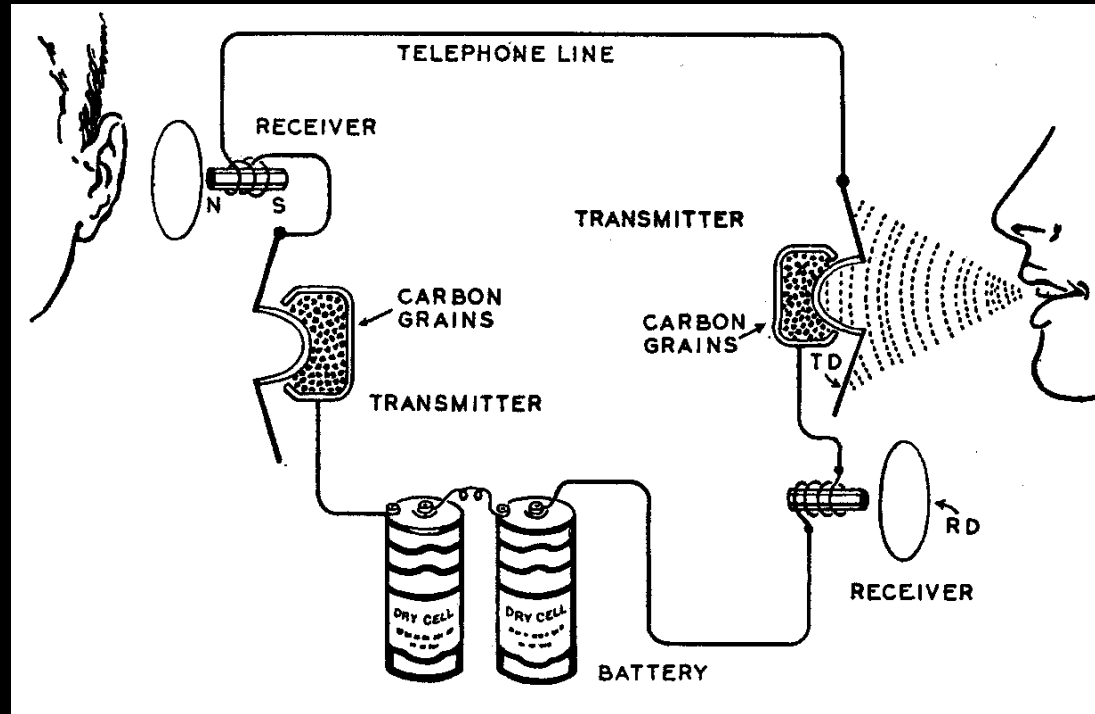
Compare with
Edison's central
station system



Dynamo, wires, and load
in **SERIES**

Bulbs are connected in
PARALLEL

SERIES CIRCUIT – DEMO

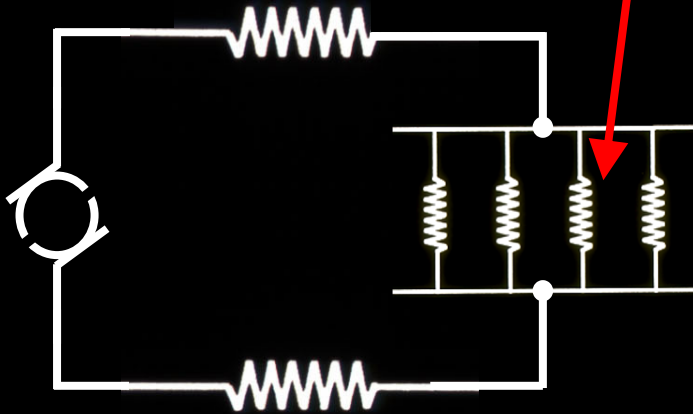


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Theodore Vail FIRST TERM

1878 – Wins Patent Cases

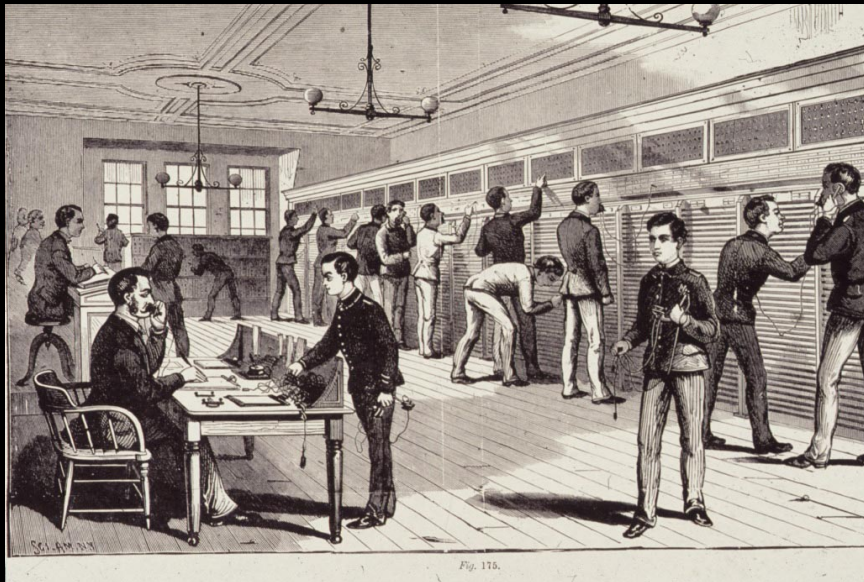
1881 – Buys Western Electric

1885 – Forms AT&T

1887 – Resigns

Theodore Vail

FIRST TERM

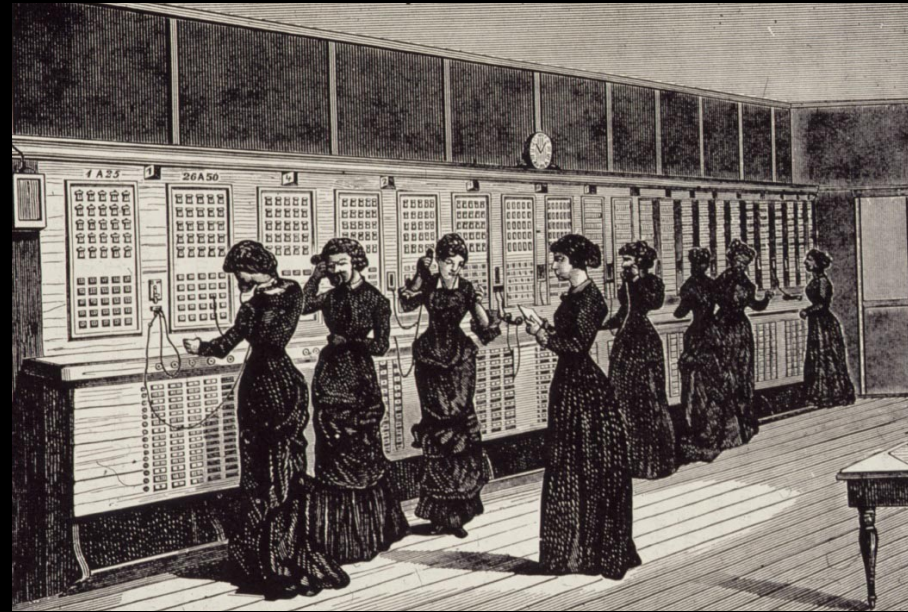


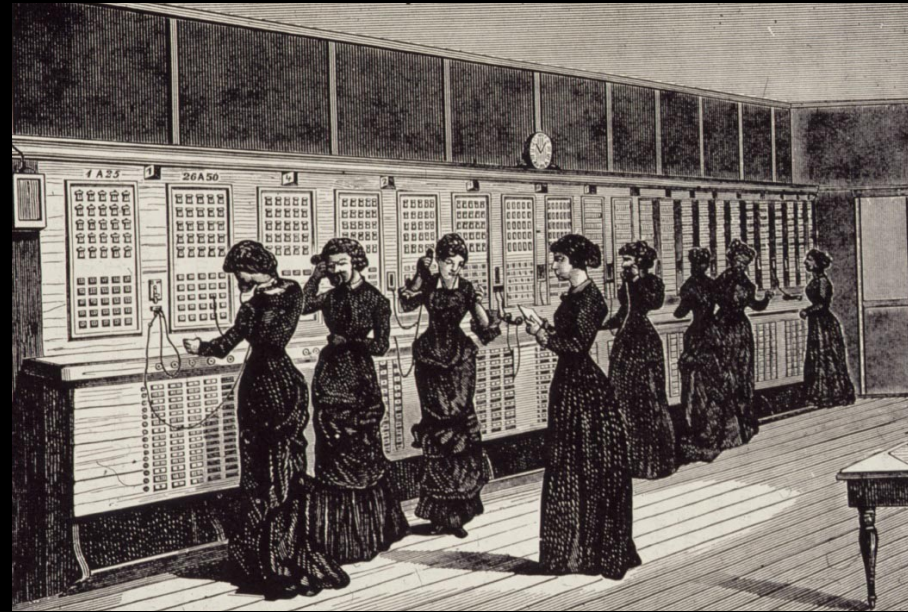
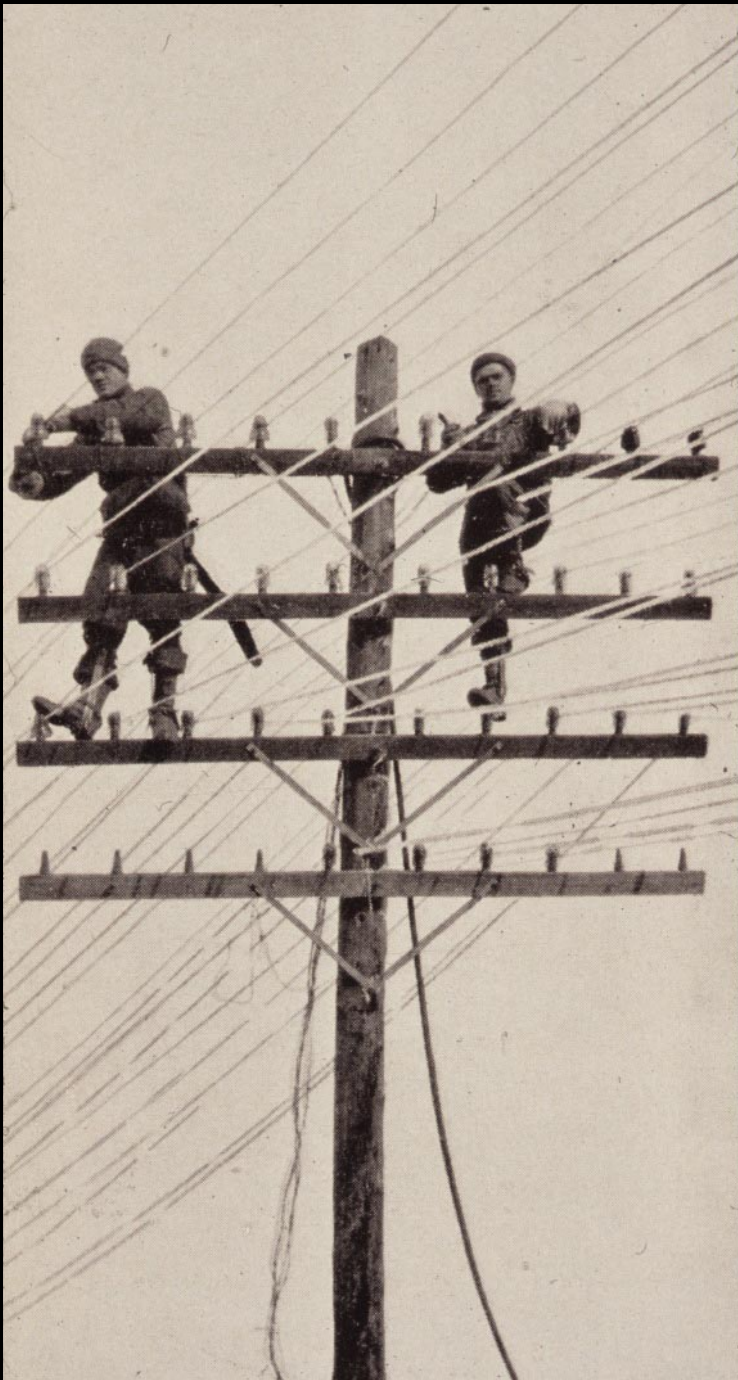
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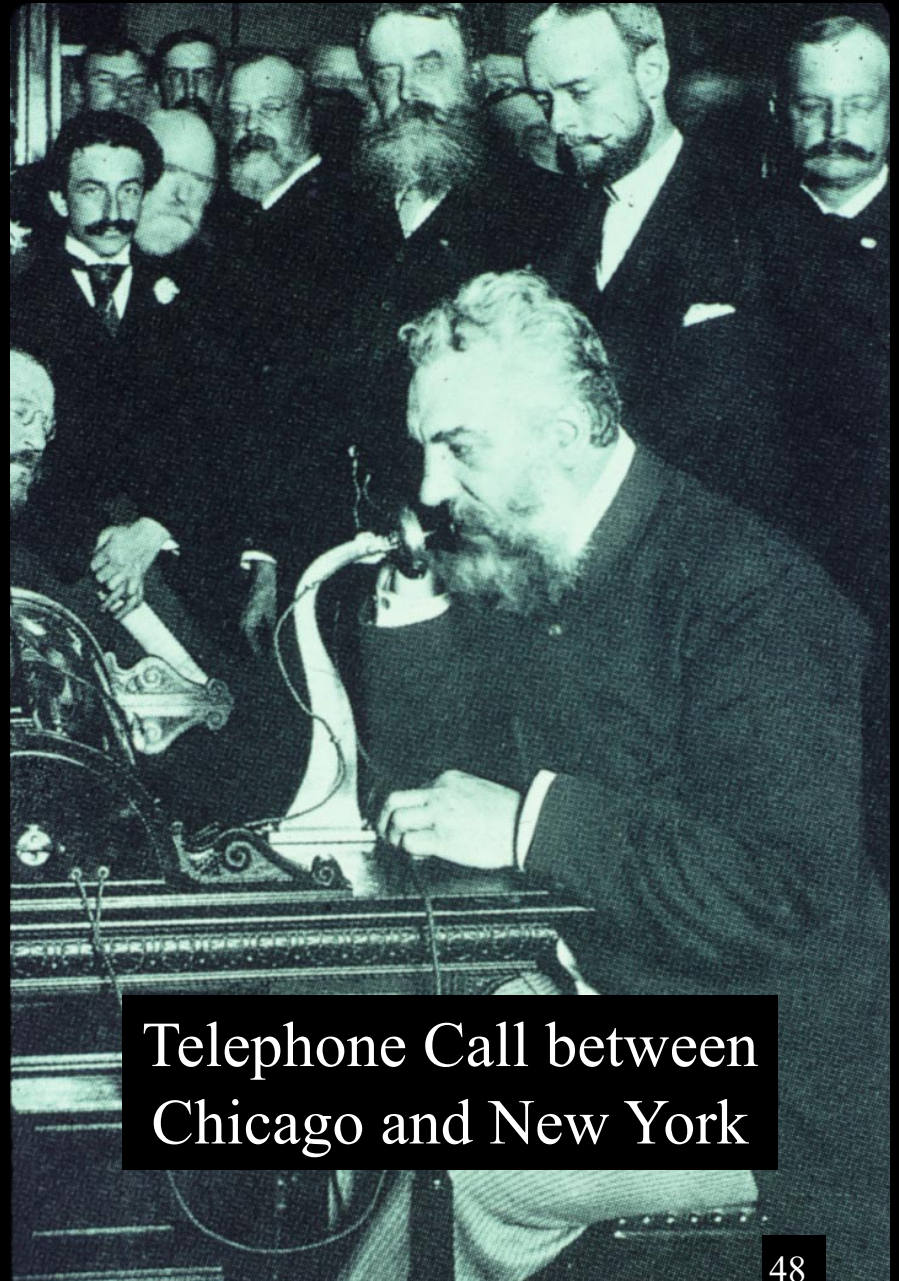
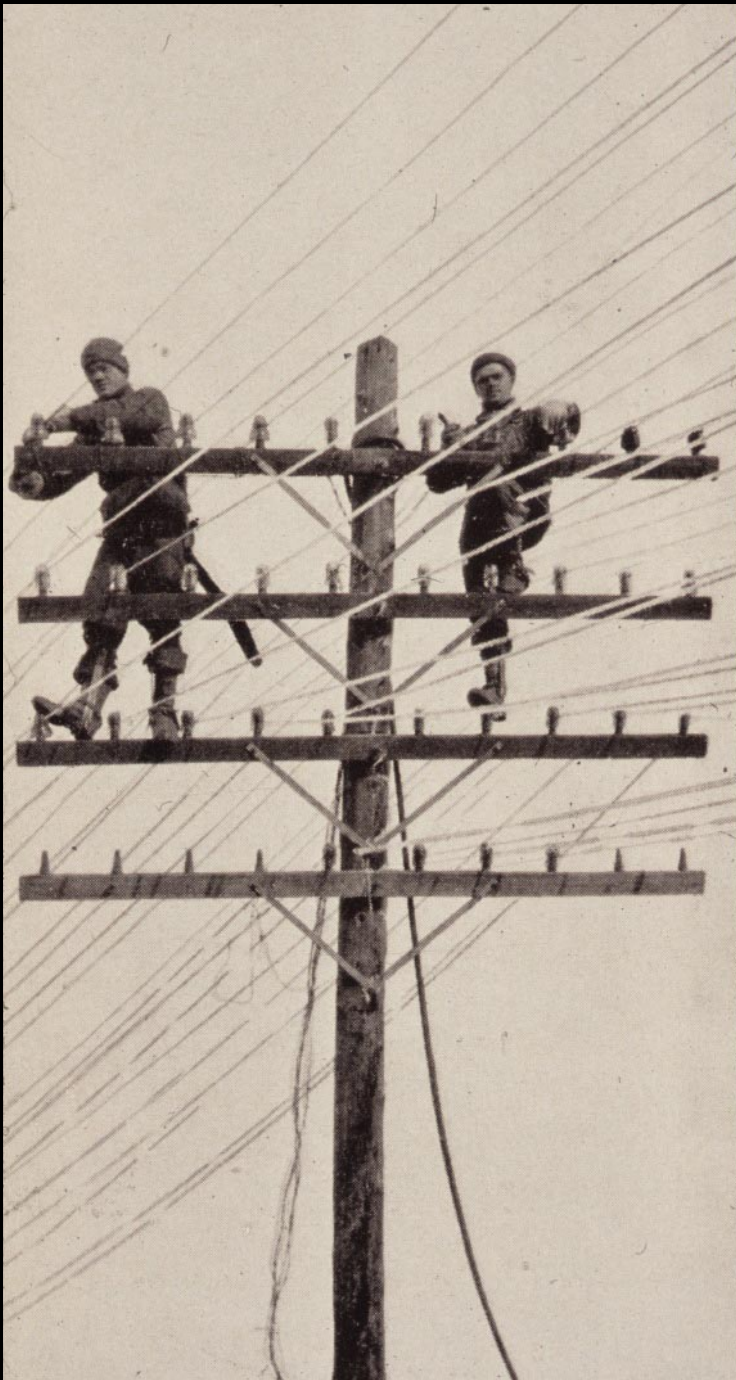
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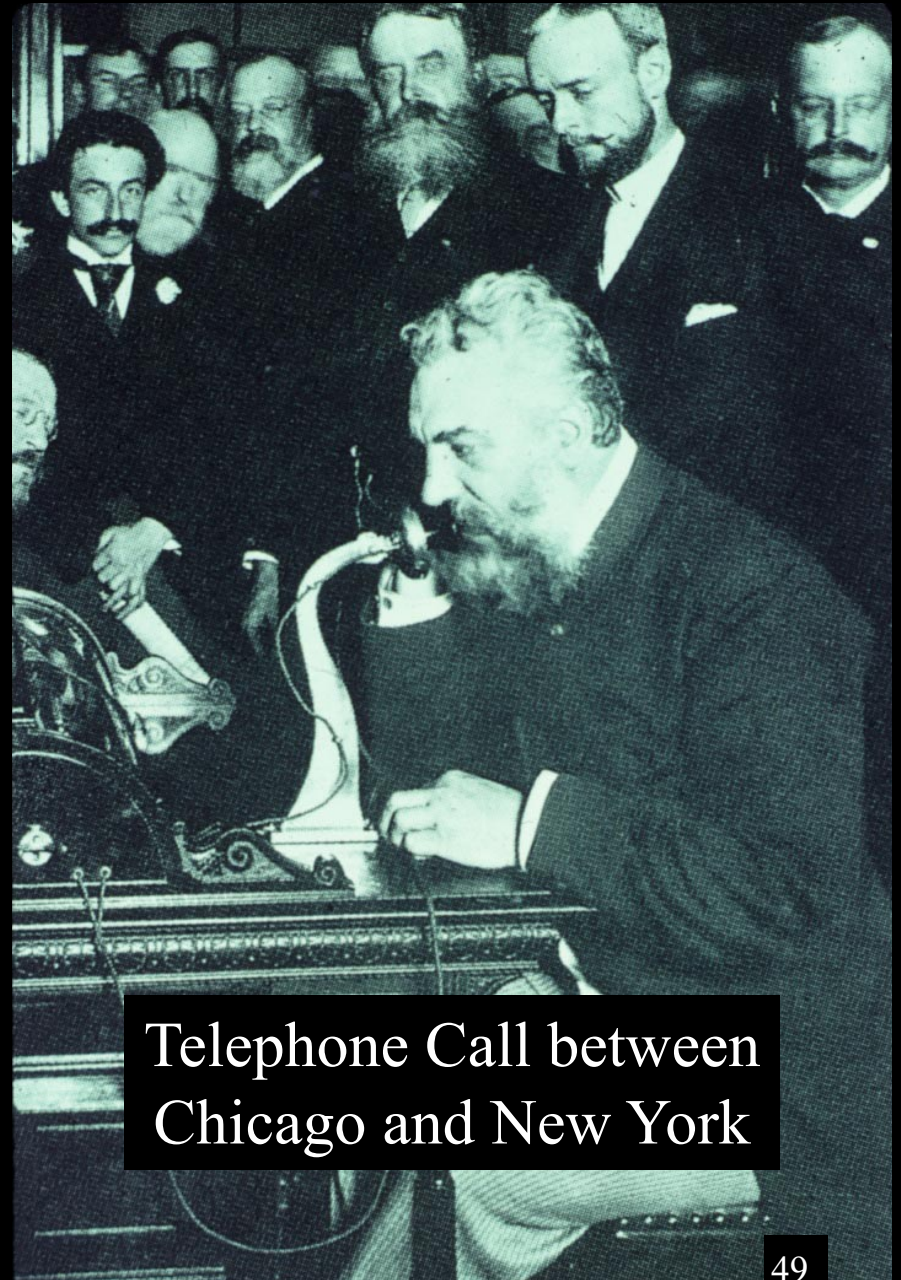
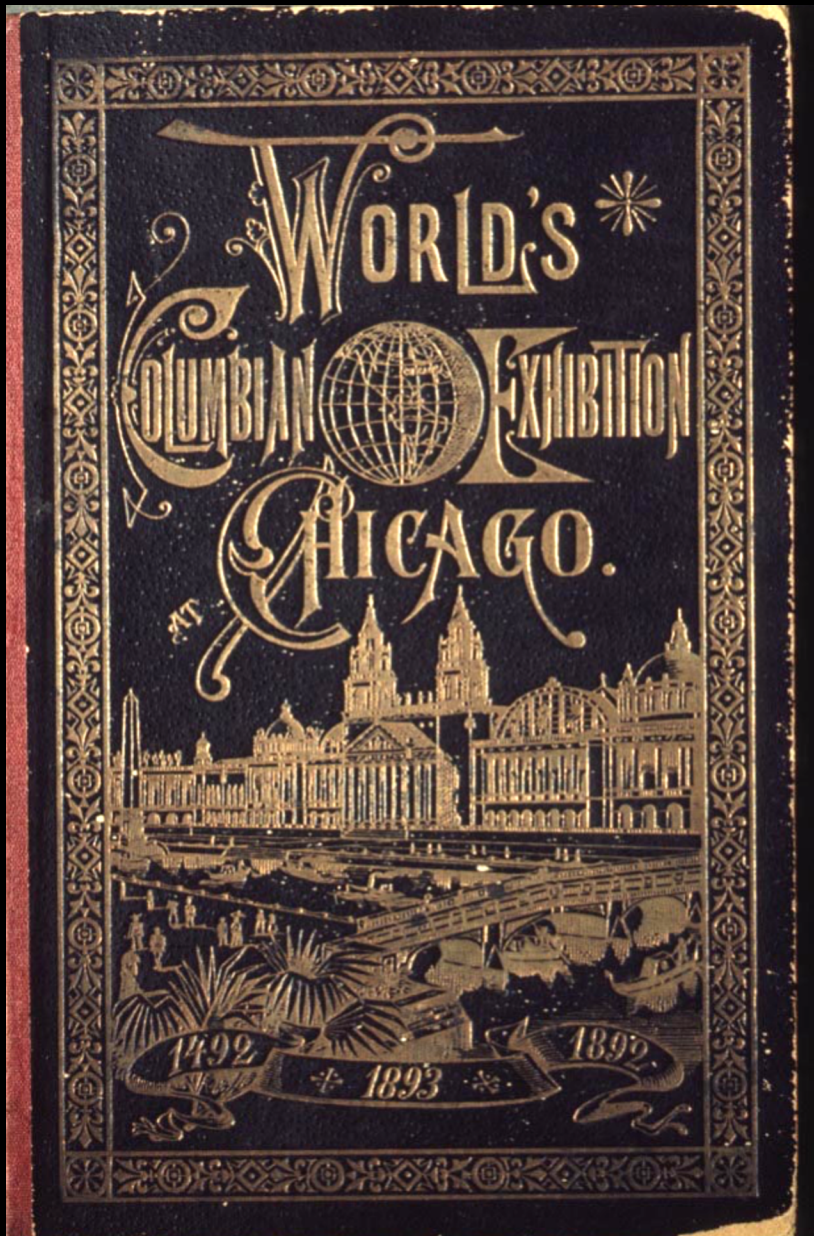
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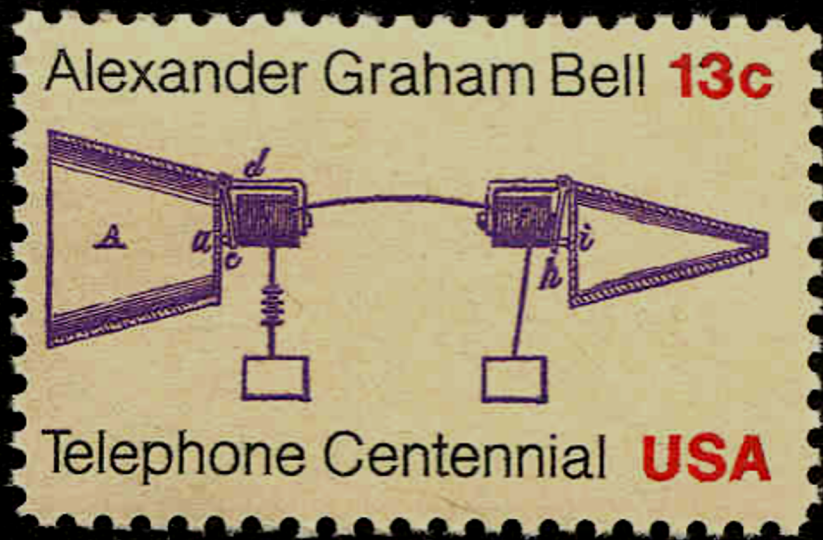




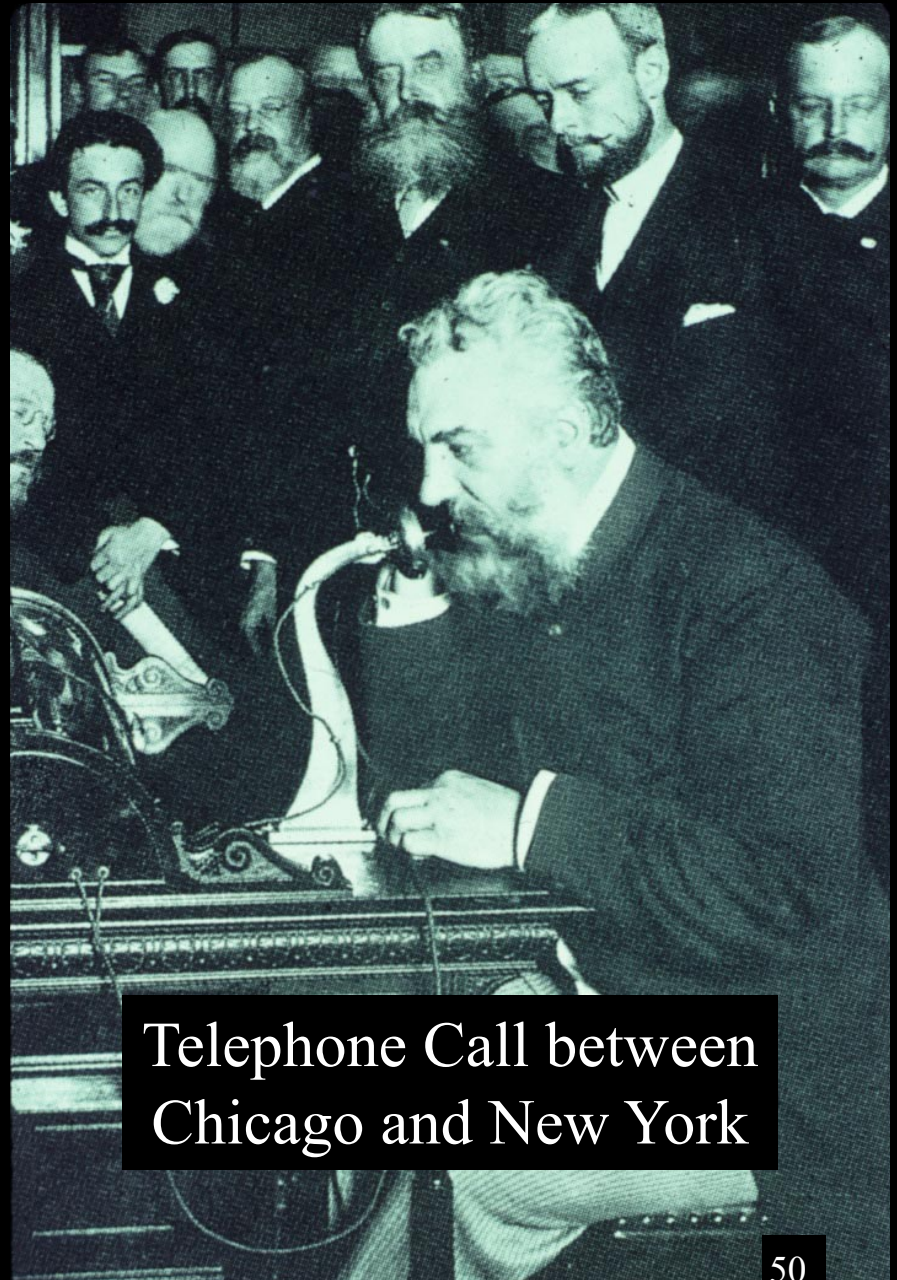
Telephone Call between
Chicago and New York

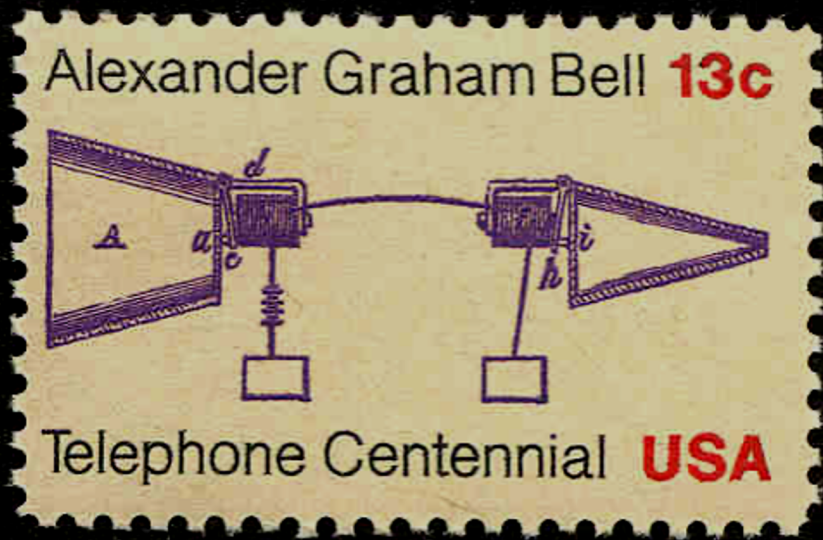


Telephone Call between
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- Patent runs out in 1893
- Over 600 new telephone companies are formed
- Many cities have more than one telephone company
- AT&T long distance service limited to certain companies





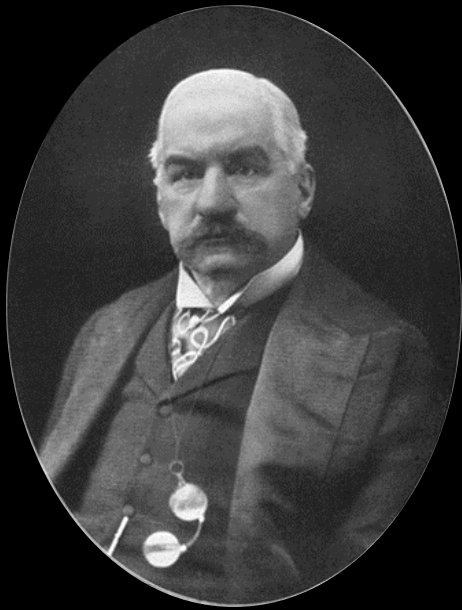
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Theodore Vail SECOND TERM

1907 – JP Morgan takes over
AT&T and hires Vail

1910 – Vail runs Western Union

1913 – AT&T agreement
ICC regulated monopoly



J. Pierpont Morgan

Scientific:

AT&T investor

Social:

Universal service

Symbolic:

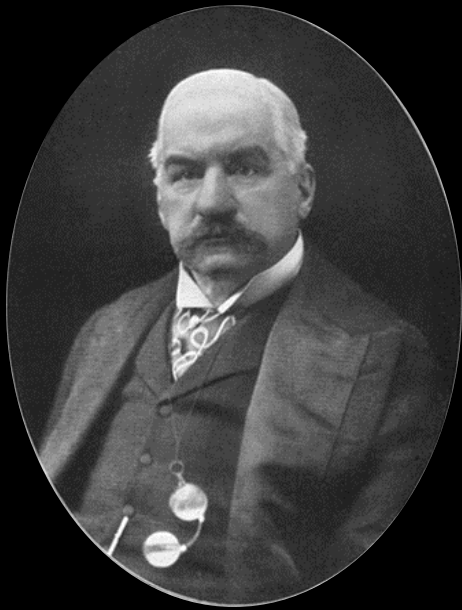
America's banker

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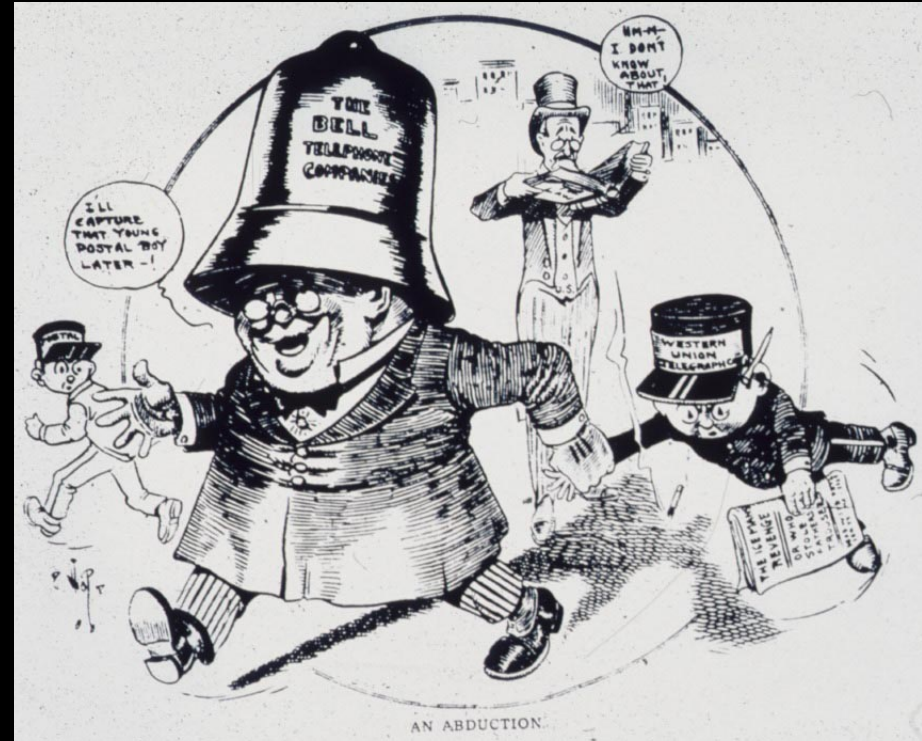


Theodore Vail: "I'll capture that young postal boy later"

Uncle Sam: (Looking at Constitution)
"Hm-m - I don't know about that"

Connecting the Continent

1861	Western Union	TELEGRAPH
1869	Union Pacific Central Pacific	RAILROAD
1915	AT&T	TELEPHONE



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Century Series Stamps – 1910's
Vacuum tube repeaters used to
boost signal strength



Mr. Theodore N. Vail
on behalf of the
American Telephone and Telegraph Company
and its Associated Companies
requests the honor of the presence of
Mr. Alexander Graham Bell
at the celebration of the completion
of the Transcontinental Telephone Line
at four o'clock on Monday afternoon
the twenty-fifth of January
One thousand nine hundred and fifteen
The Telephone Building
15 Dey Street, New York

Bell in New York City



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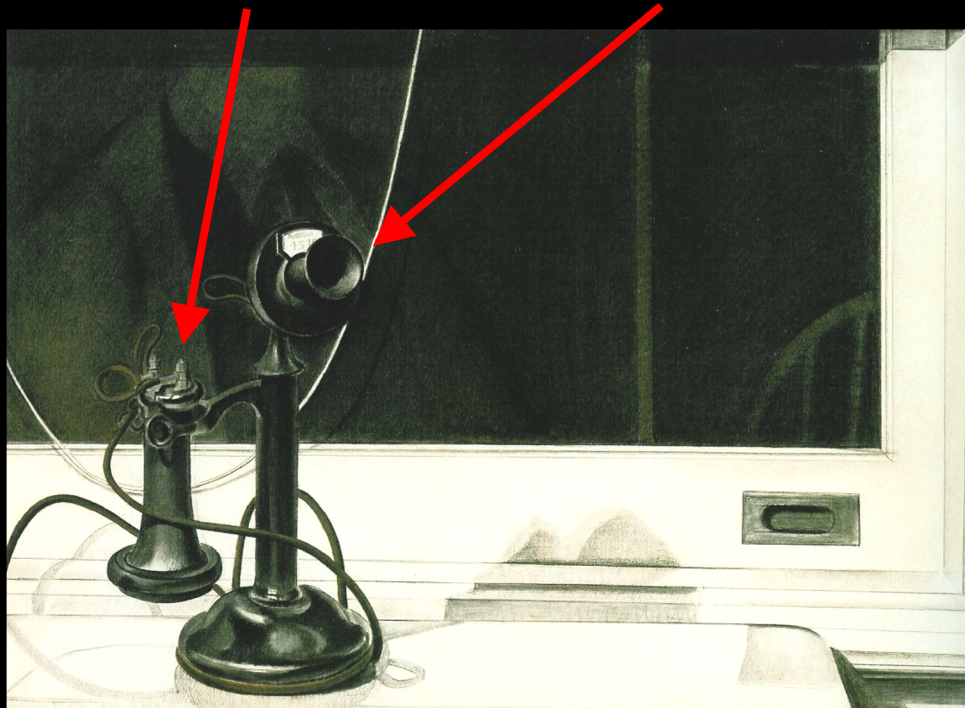
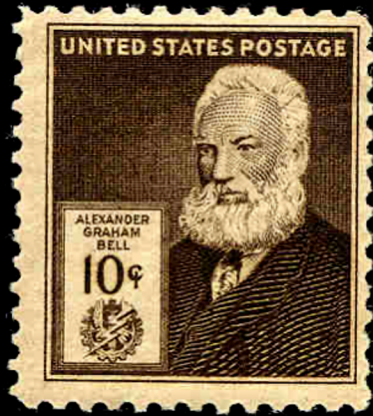


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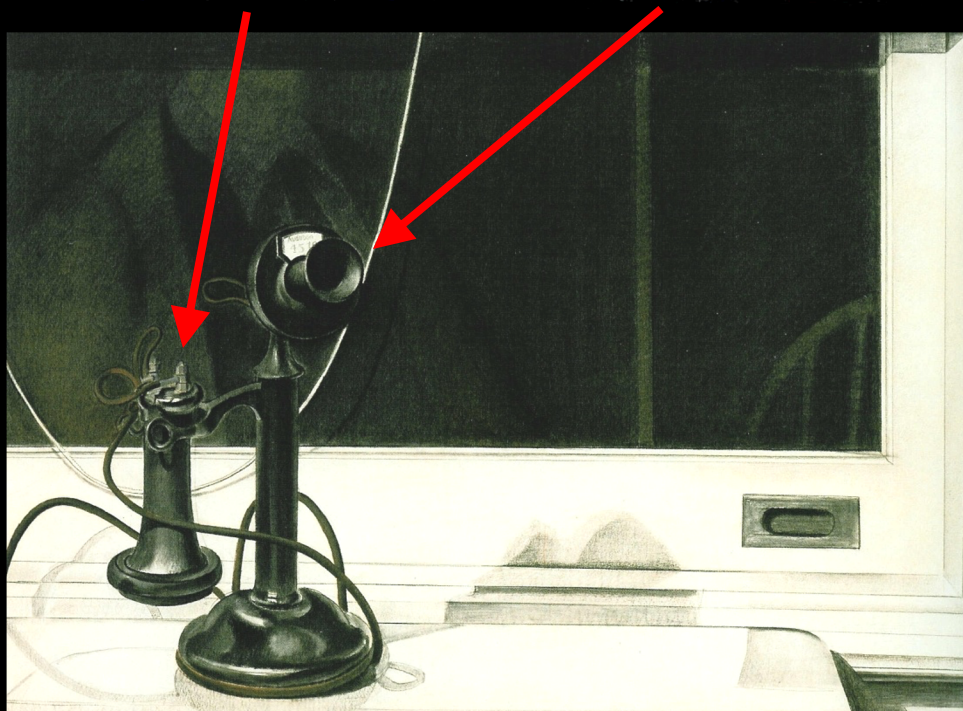
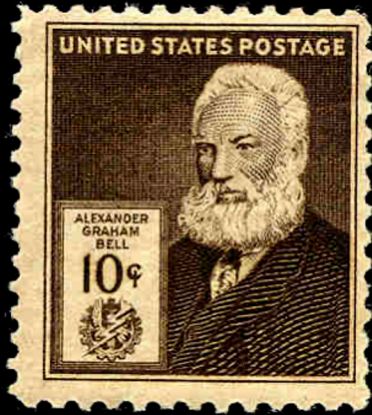


Watson in San Francisco



Charles Sheeler – Self Portrait

Watson in San Francisco



The Telephone

Scientific:

sound to undulating current
undulating current to sound

Social:

private company
public-regulated monopoly

Symbolic:

conversations at a distance

Charles Sheeler – Self Portrait