

Wireless Telegraphy and Radio

Wireless Information Network and National Broadcast System

CEE 102: Prof. Michael G. Littman

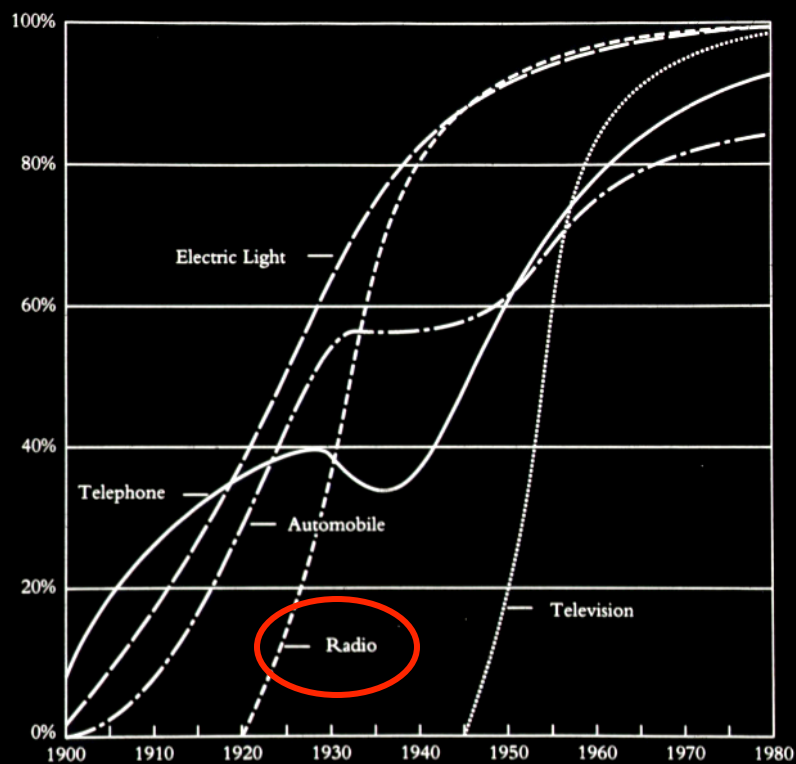
Course Administrator: Hiba Abdel-Jaber hiba@princeton.edu

Computers allowed for NOTETAKING ONLY

Please - NO Cell Phones, Texting, Internet use

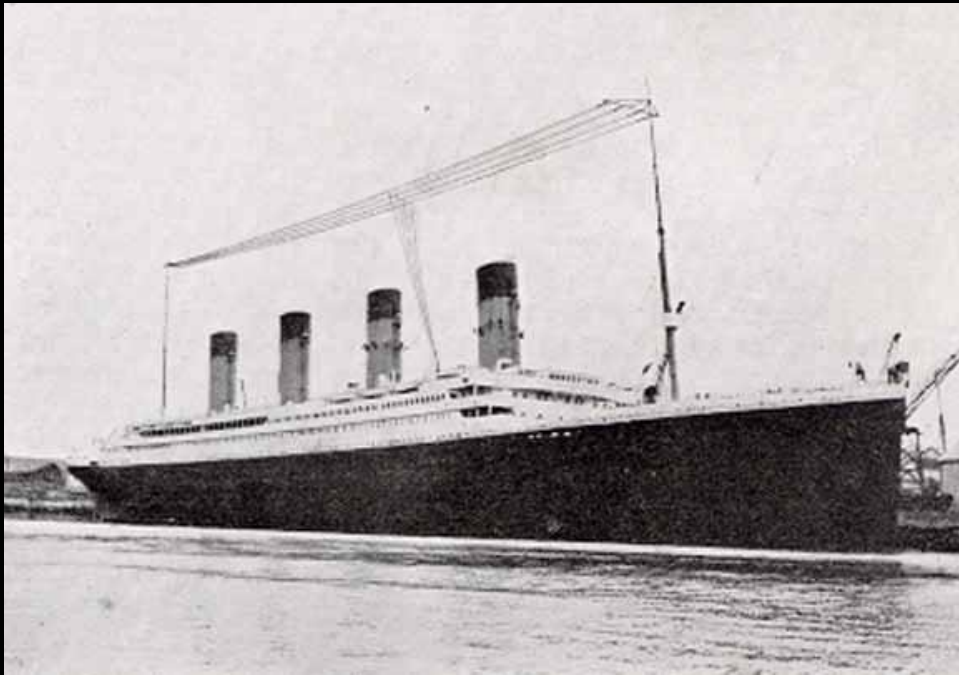
Consumer Goods

1900 - 1980

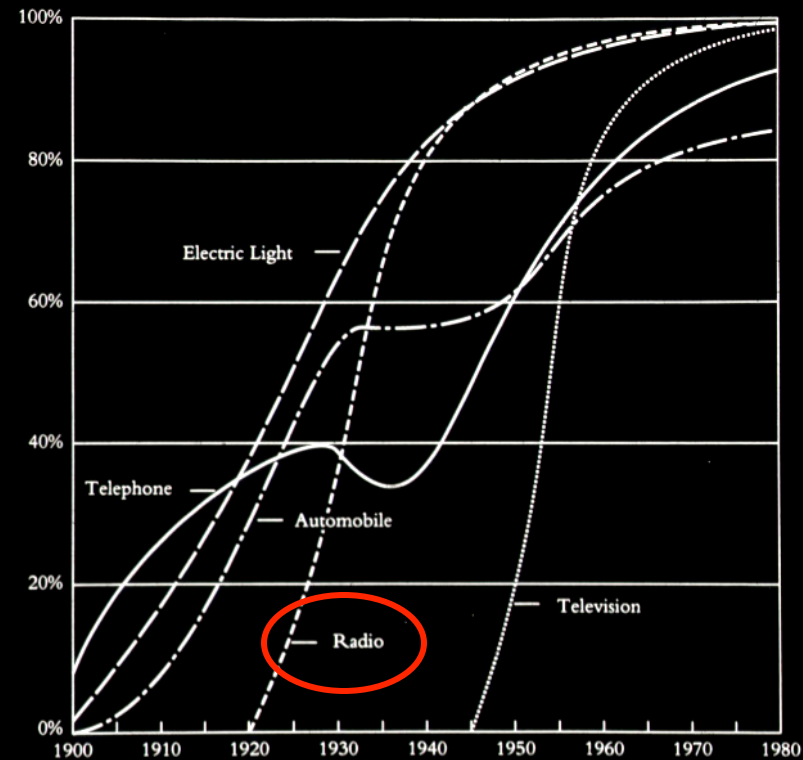


Economics and Politics

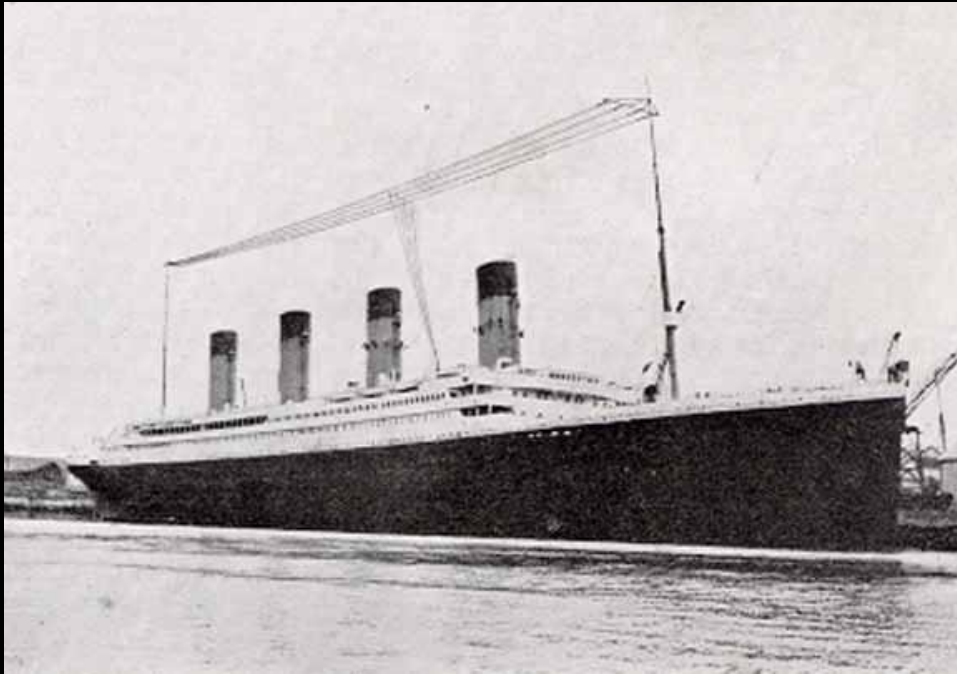
Consumer Goods 1900 - 1980



RMS Titanic with Marconi Antenna



Economics and Politics



RMS Titanic with Marconi Antenna

Electricity

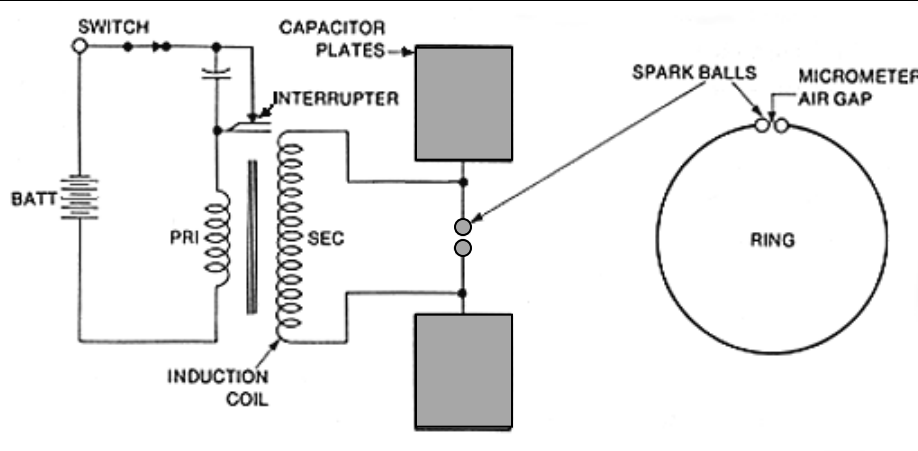
Morse - Intelligence at a distance

Edison - Lighting a city

Westinghouse - Power at a distance

Marconi - Wireless messages at sea

transmitter receiver



Heinrich Hertz's Experiment - 1888

- Spark in transmitter initiates radio burst
- Spark in receiver ring detects radio burst

Electricity

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transmitter receiver



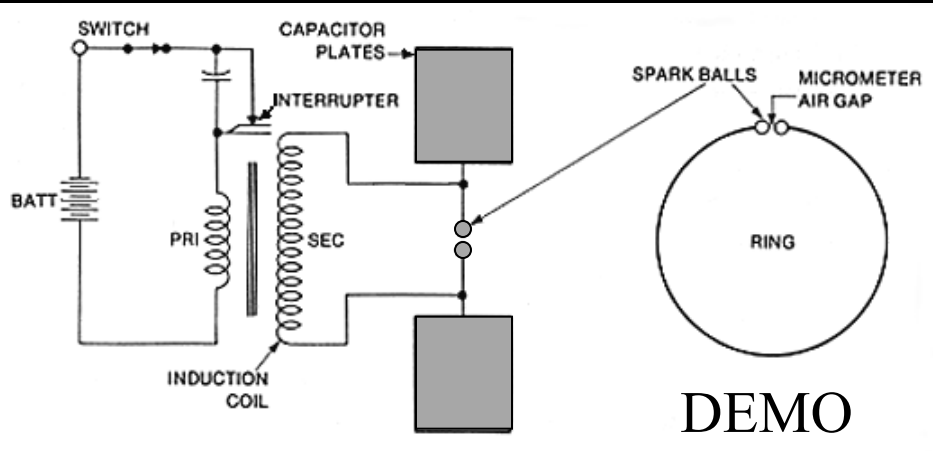
Electricity

Morse - Intelligence at a distance

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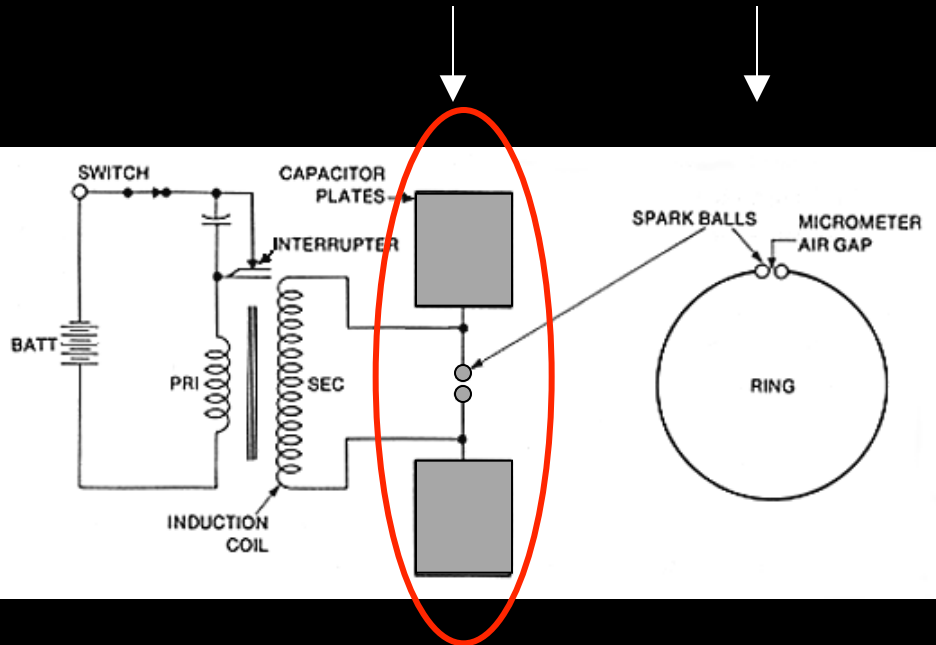
Marconi - Wireless messages at sea



Heinrich Hertz's Experiment - 1888

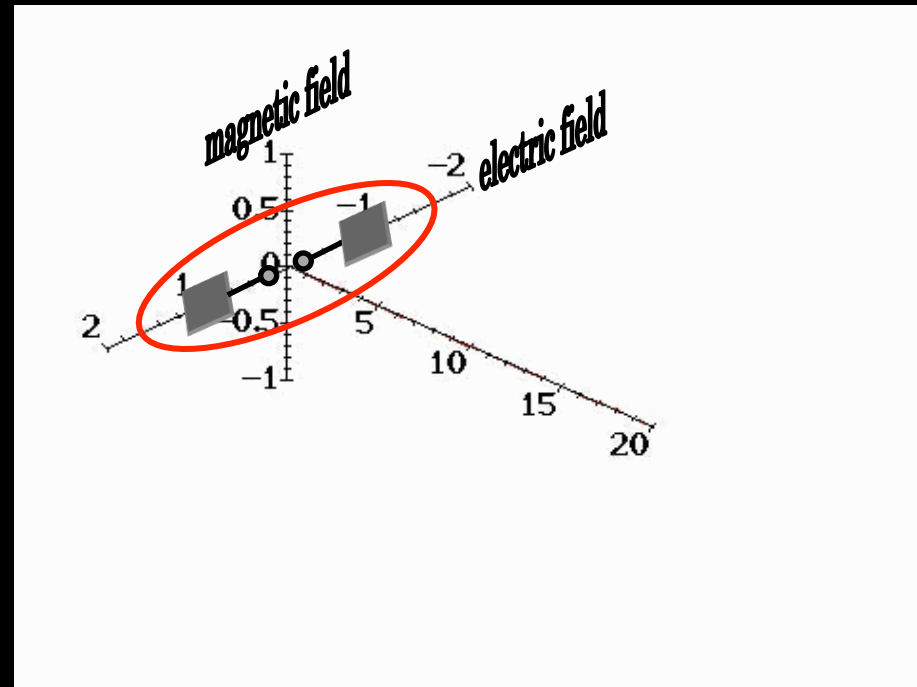
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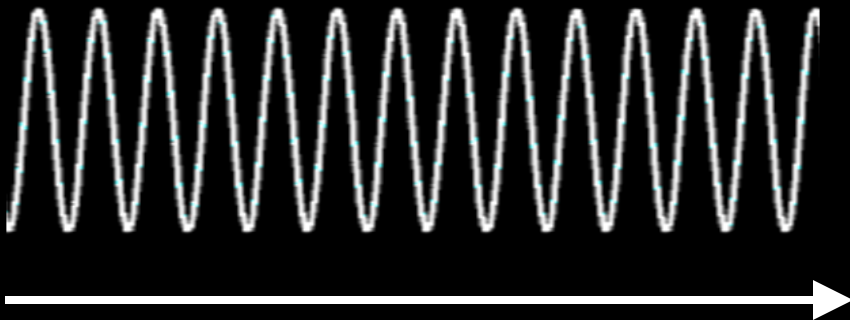
Electromagnetic Wave

wave-speed

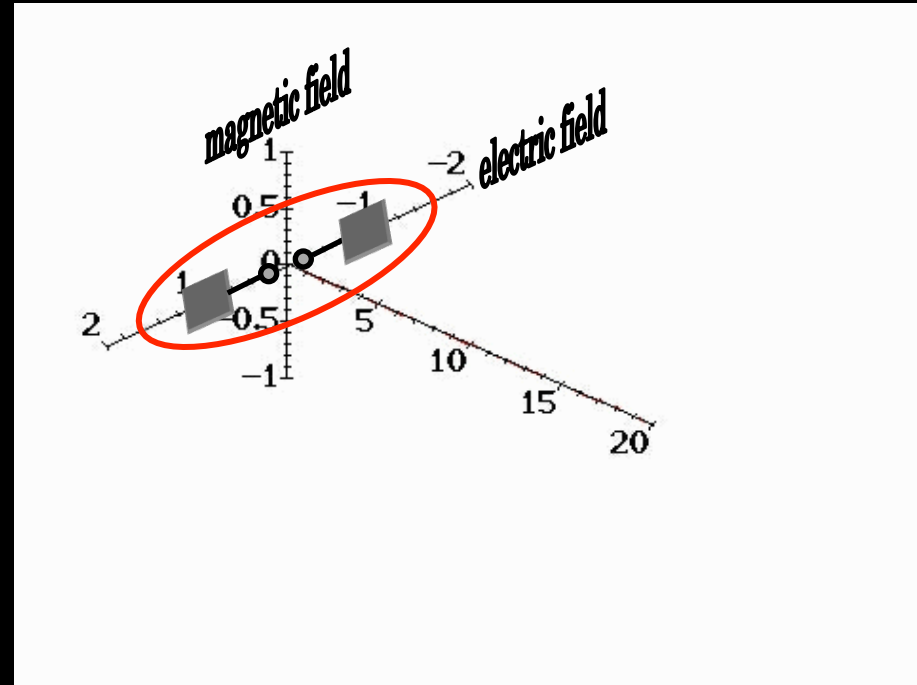
frequency

$$\nu \lambda = c$$

wavelength



Time or Length



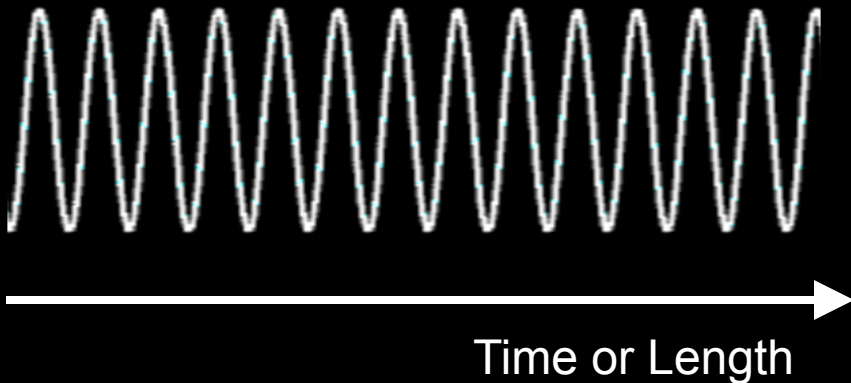
Electromagnetic Wave

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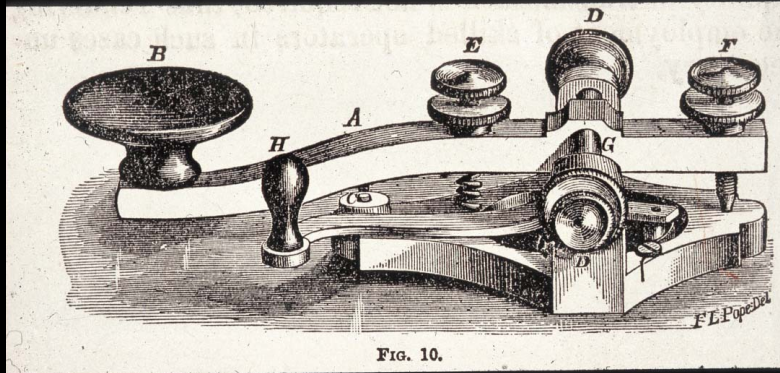
Wireless Telegraph

Hertz Discovery

Marconi Patents

Marconi Demonstrations

Marconi's Wireless Telegraph

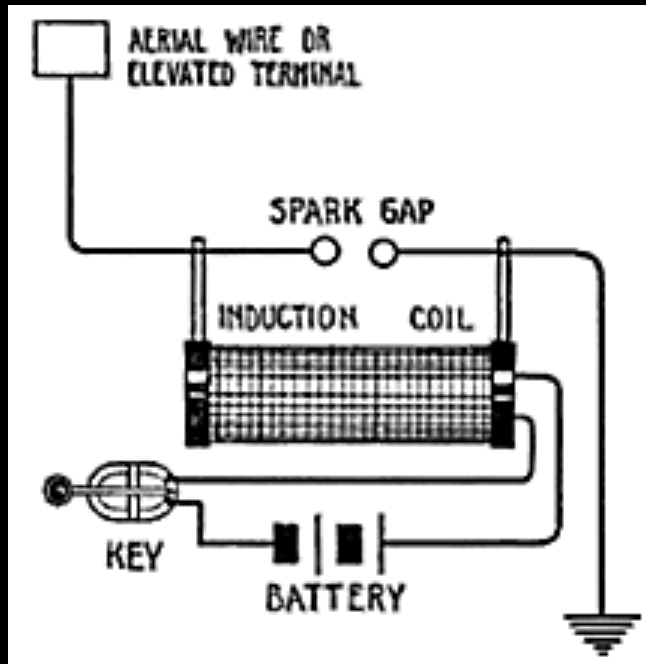


Wireless Telegraph

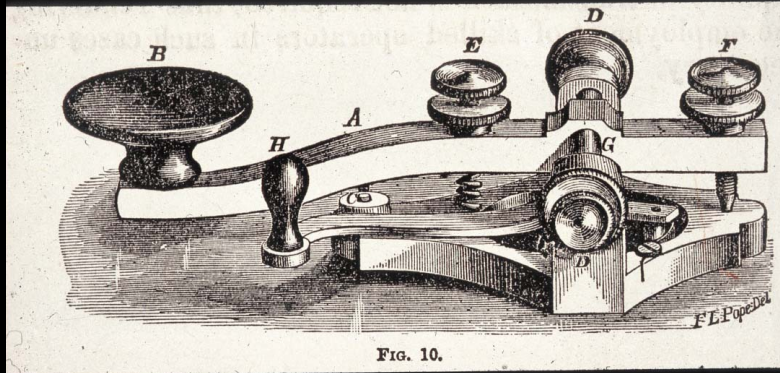
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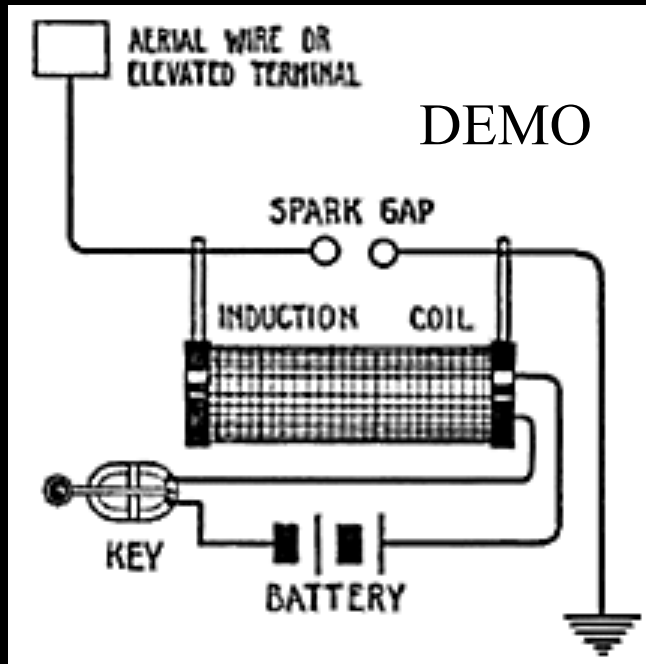


Wireless Telegraph

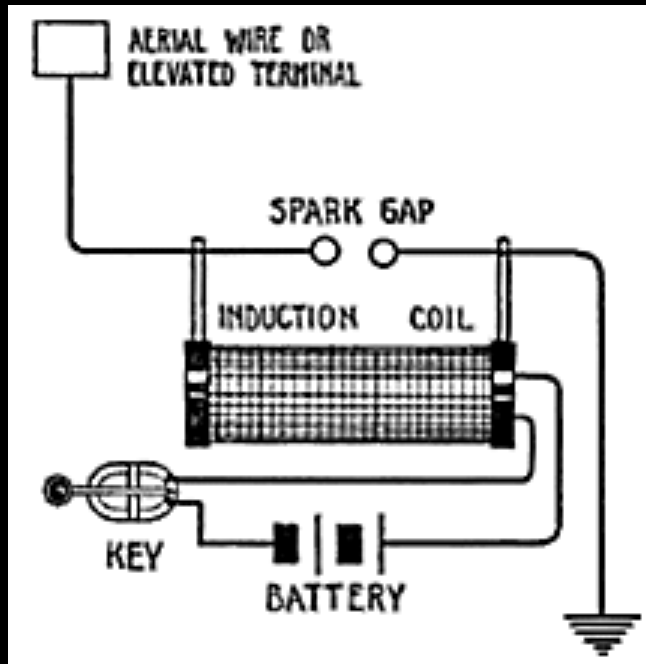
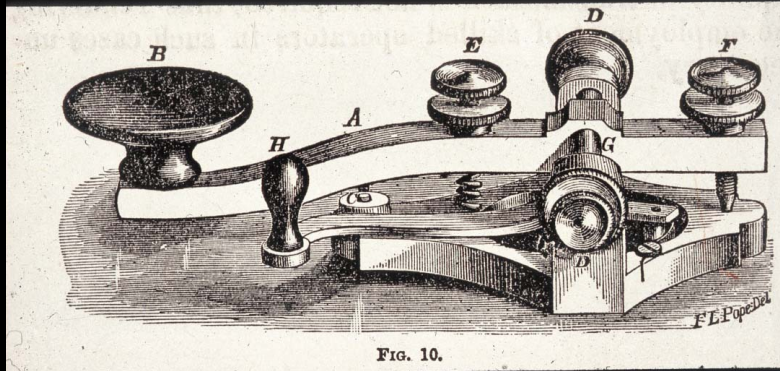
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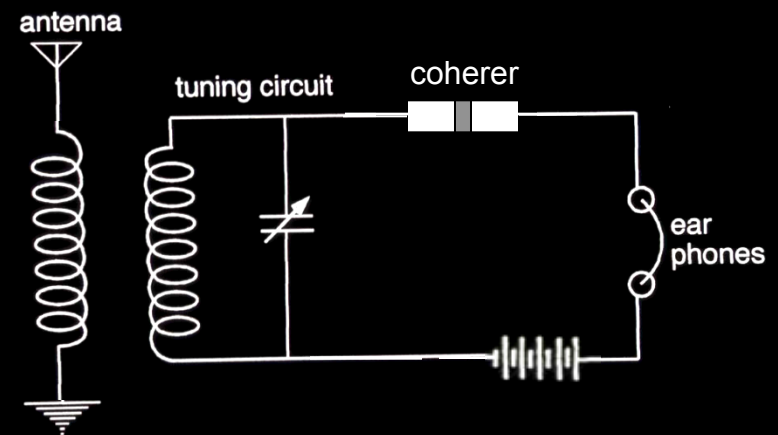
Marconi's Wireless Telegraph



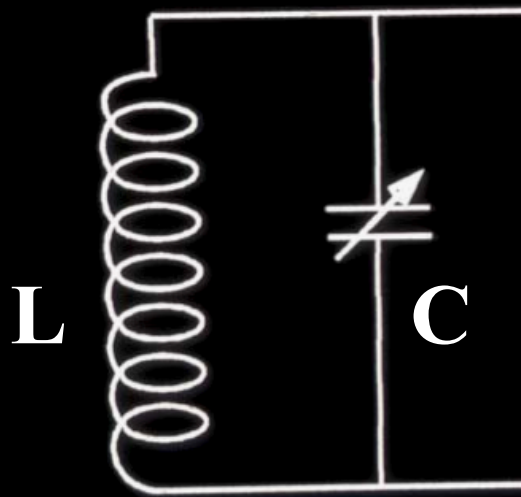




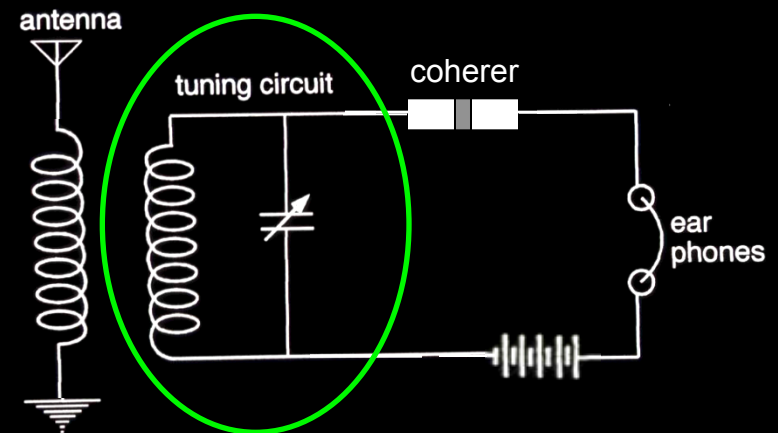
Marconi's Patent for Tuning



Tuning Circuit



Marconi's Patent for Tuning



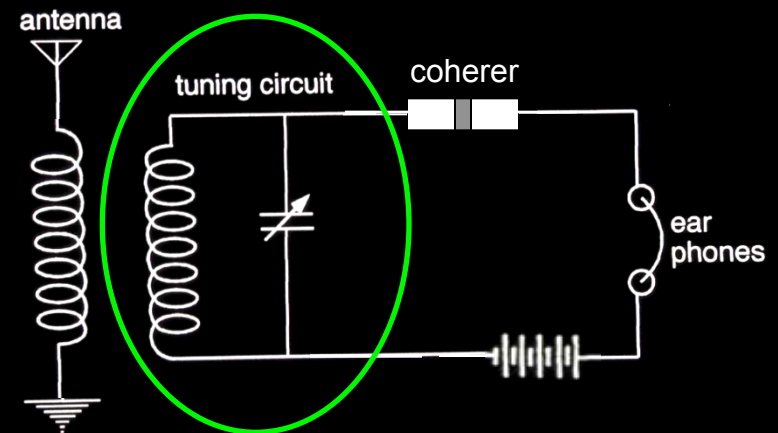
Transmitting antenna



Cornwall (England)



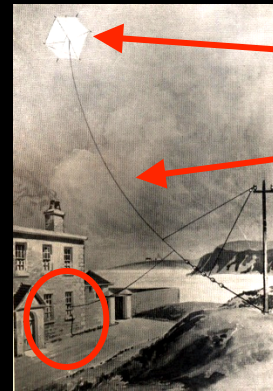
Marconi's Patent for Tuning



Transmitting antenna



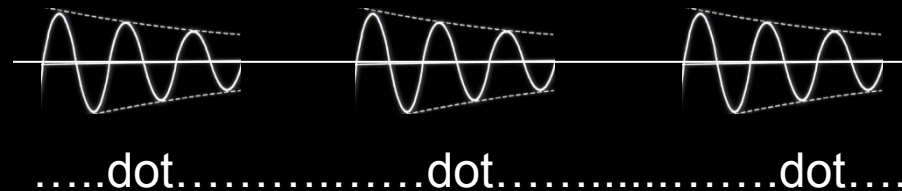
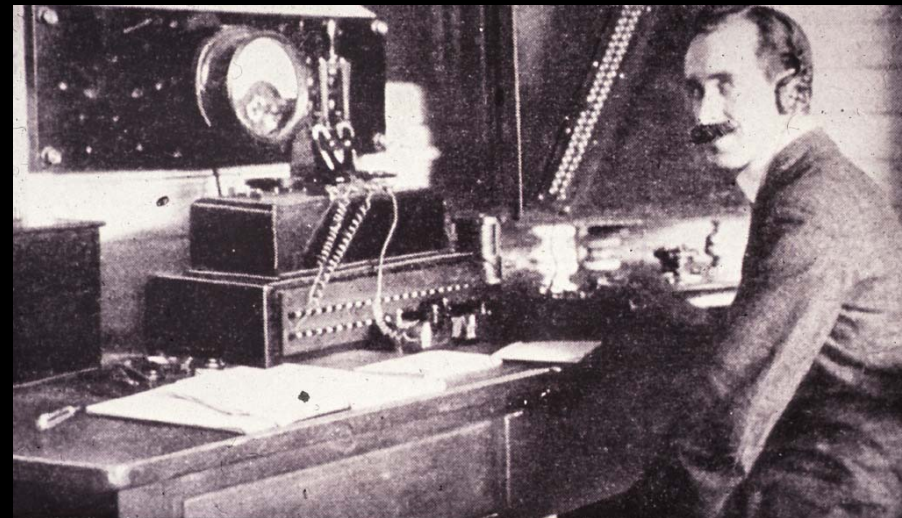
Cornwall (England)



KITE

Receiving antenna

Saint John's (Newfoundland)

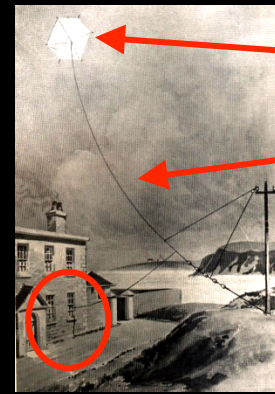


December 12, 1901 17

Crossing the Atlantic

1856	Morse	telegraph
1901	Marconi	wireless
1927	Lindberg	airplane

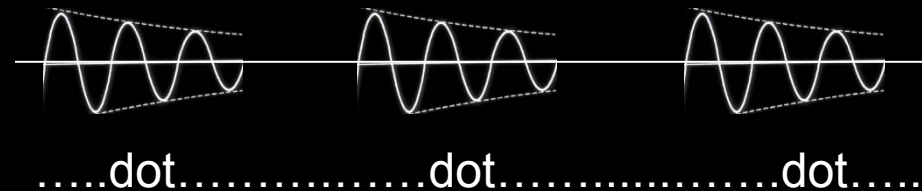
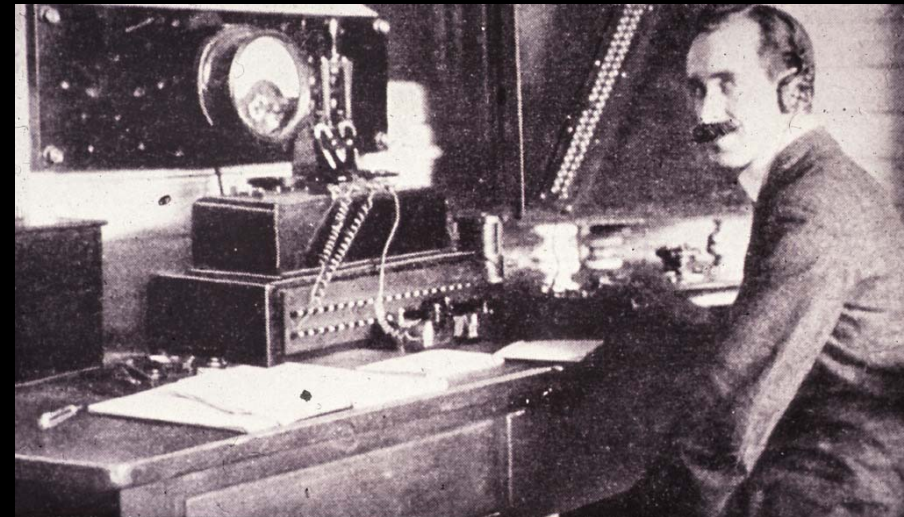
Marconi gets Nobel Prize in 1909



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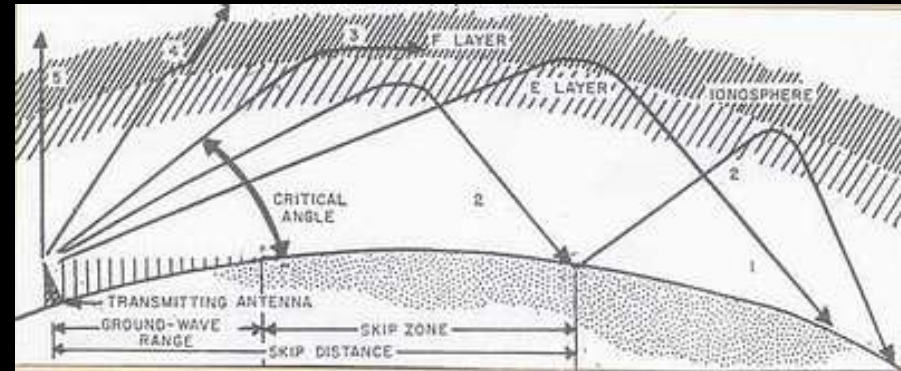


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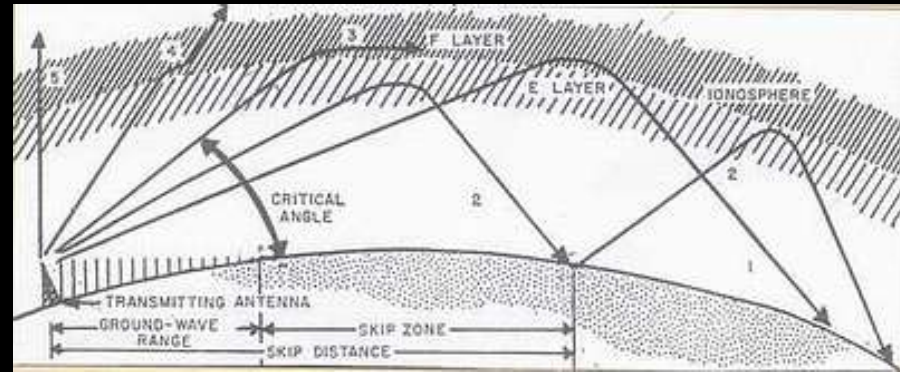


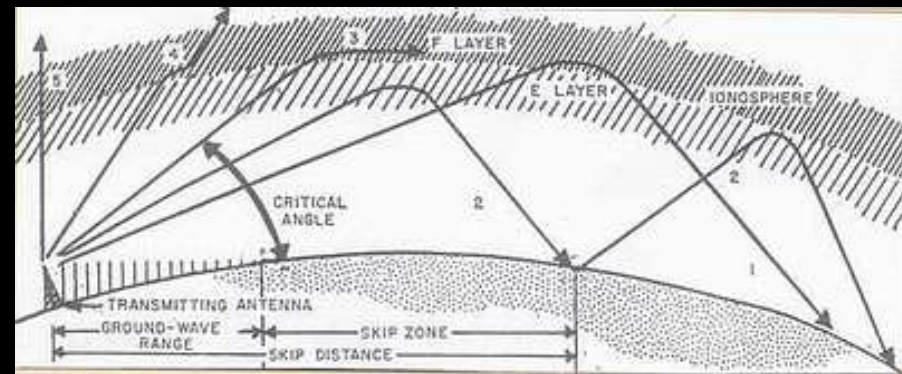
Wide World Wireless Plan in 1912

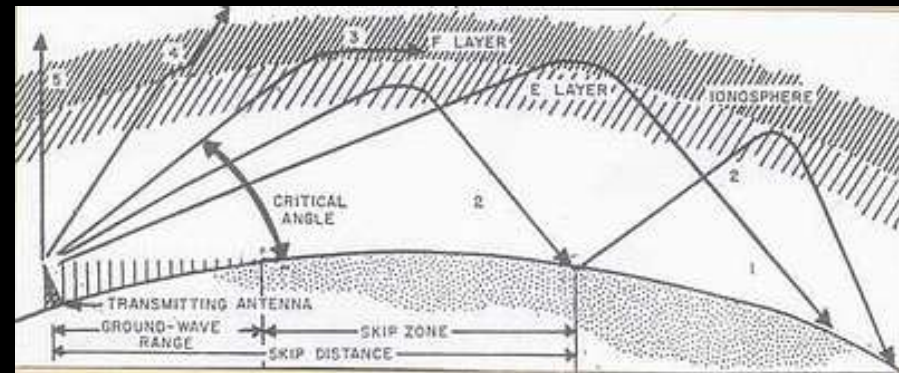


Each location to be a station pair, ...

Transmitter in New Brunswick NJ
Receiver in Belmar NJ



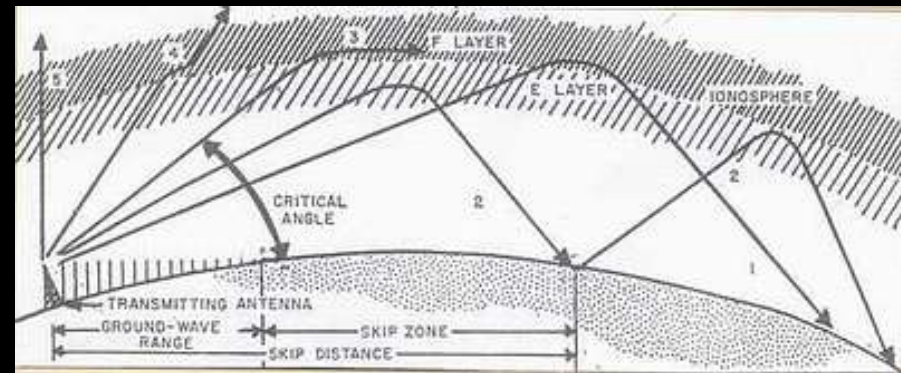




Theories of Innovation

applied science
social process
individual genius

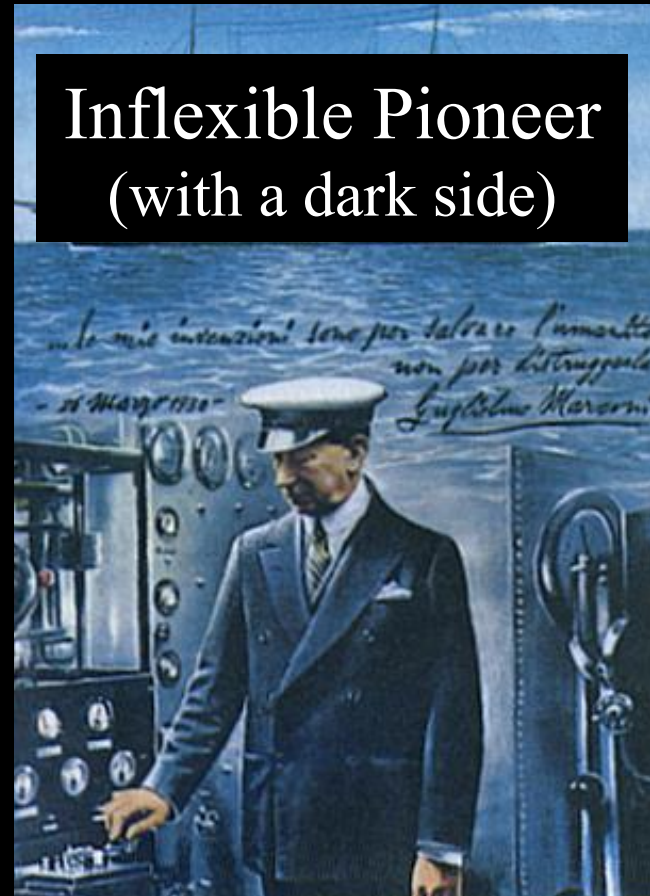




Theories of Innovation

applied science
social process
individual genius

Inflexible Pioneer
(with a dark side)



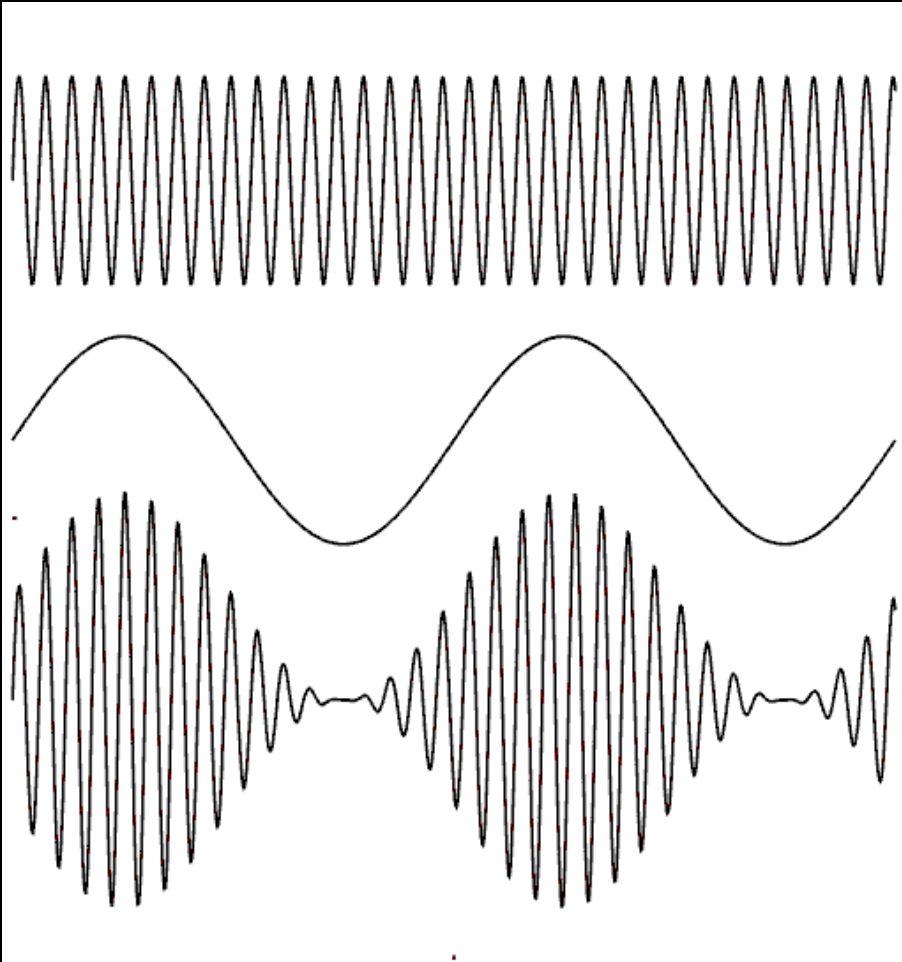
Theories of Innovation

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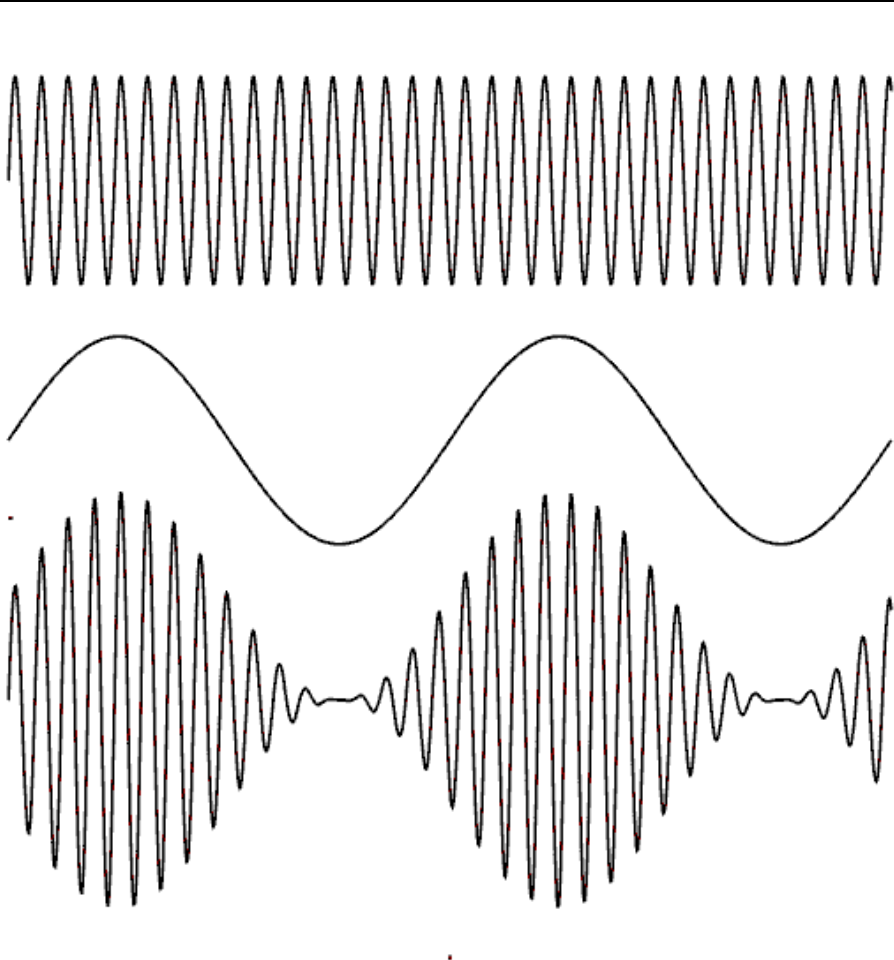
EE Prof. Reginald Fessenden
University of Pittsburgh - 1906

Amplitude Modulated (AM) Carrier Wave



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Amplitude Modulated (AM) Carrier Wave

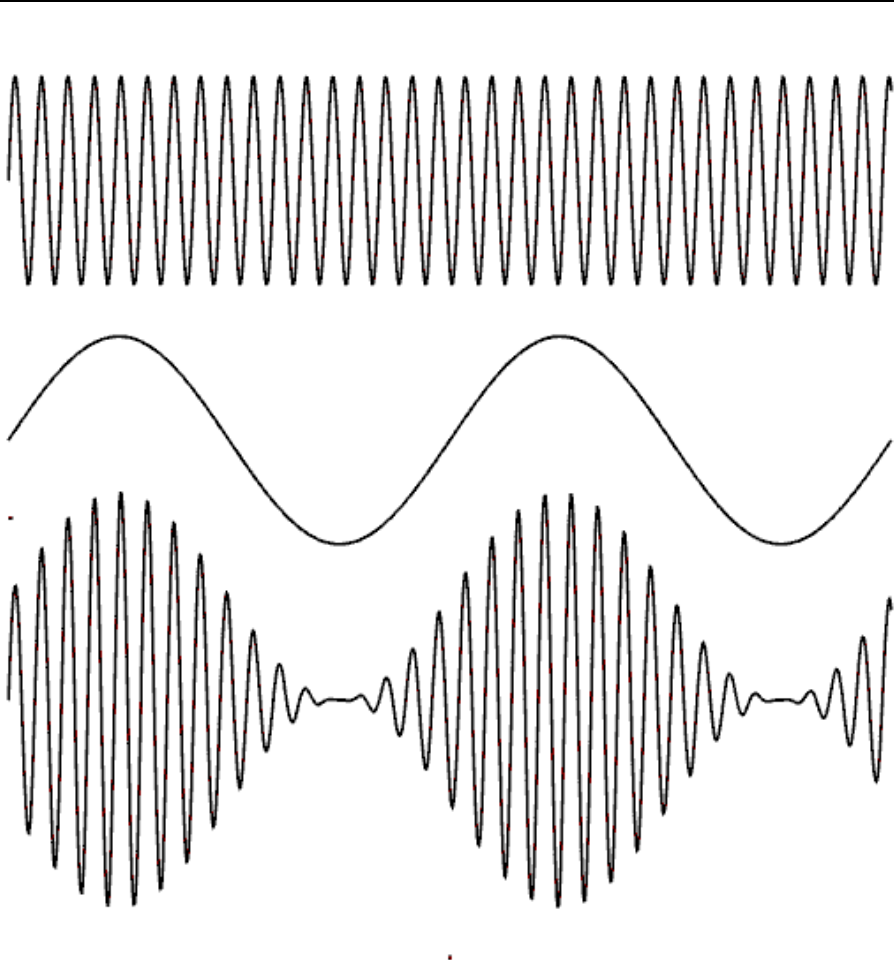


← 550 – 1600 KHz (Carrier Freq.)
example – 1010 KHz (WINS)

← 20 – 10,000 Hz (Audio Freq.)
example – 440 Hz (musical note A₄)

← Combined Wave

Amplitude Modulated (AM) Carrier Wave



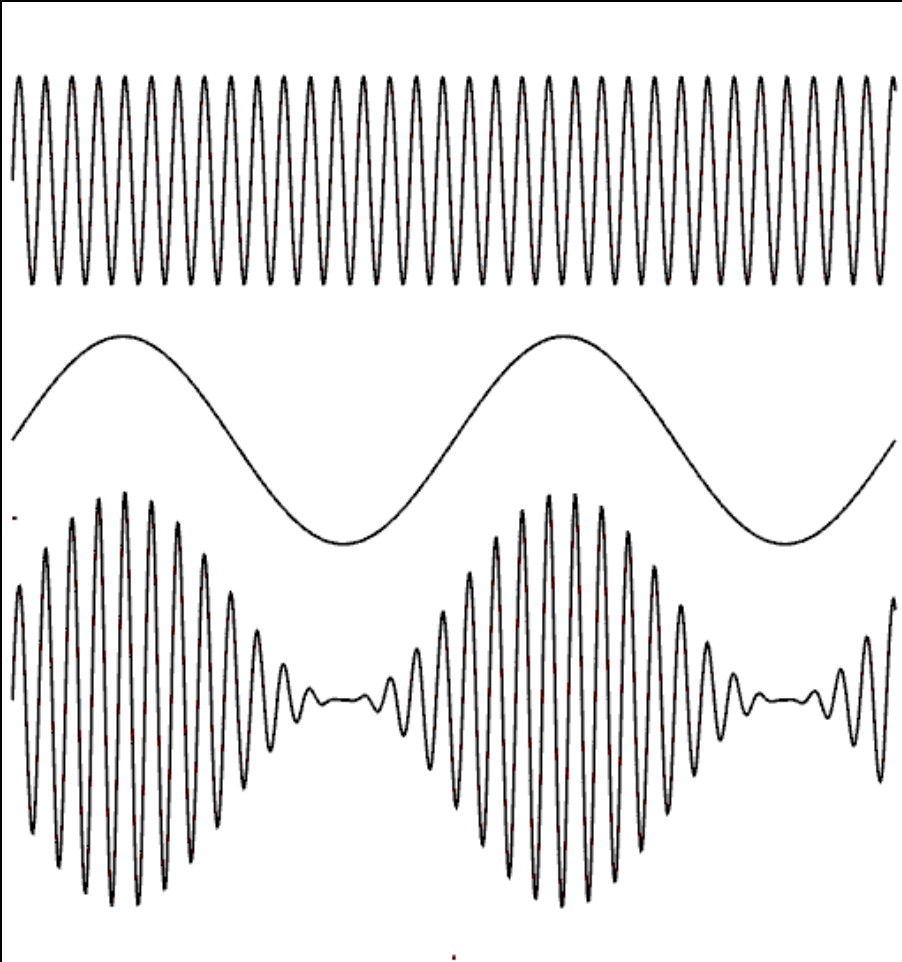
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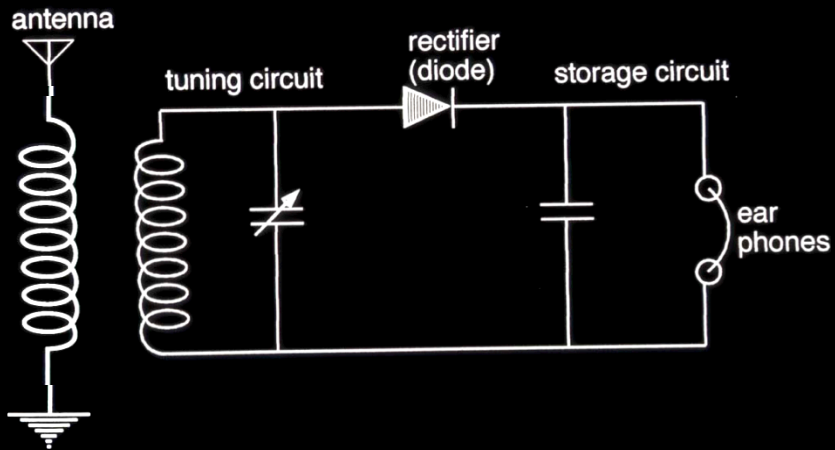
← Combined Wave

Demonstration of Amplitude Modulation
and Detection

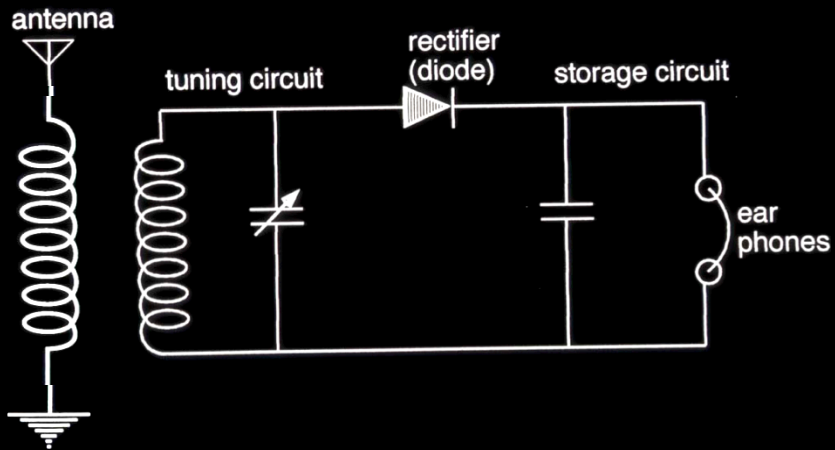
Amplitude Modulated (AM) Carrier Wave



Cat's Whisker Crystal Radio



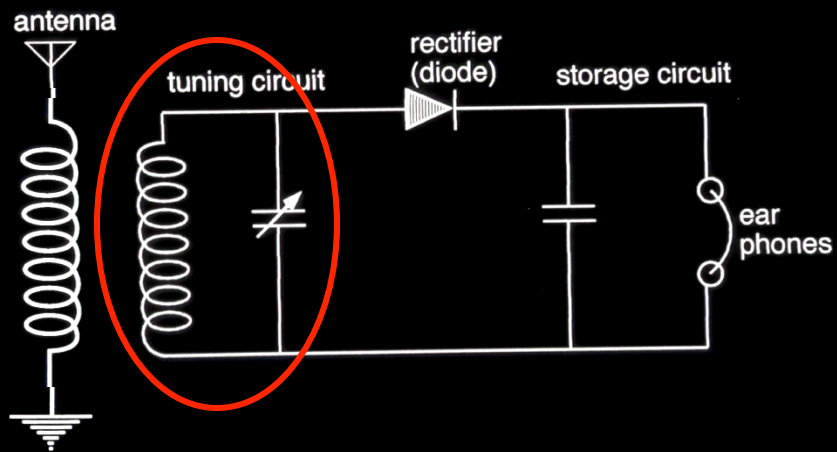
Cat's Whisker Crystal Radio



Where is the Tuner ?



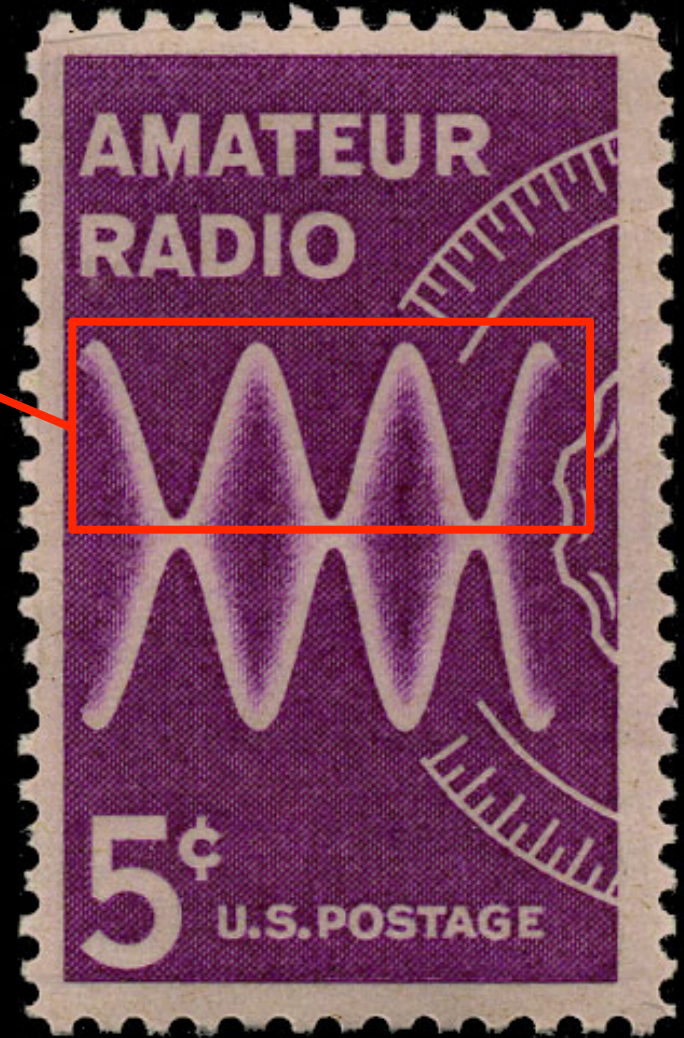
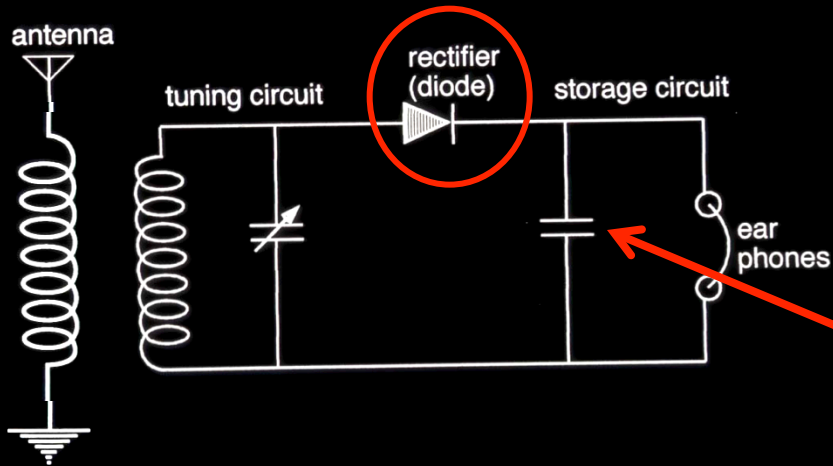
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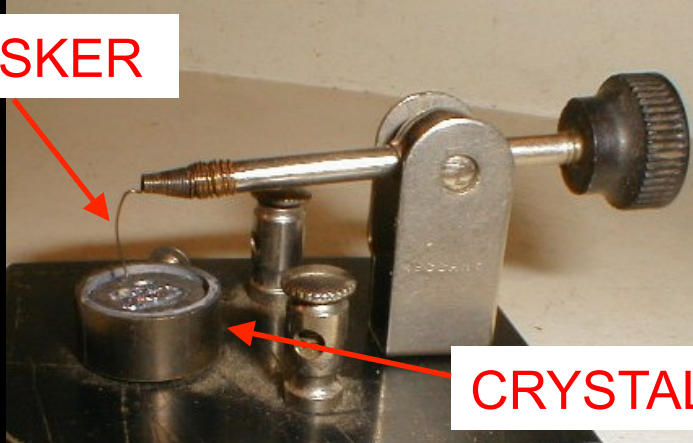
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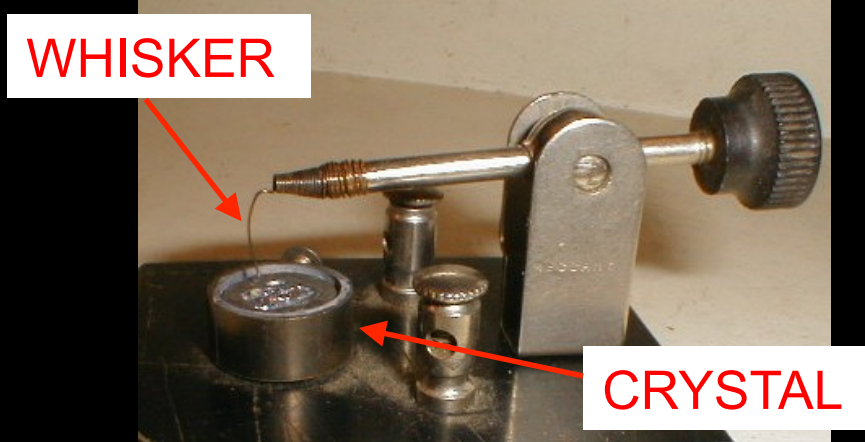
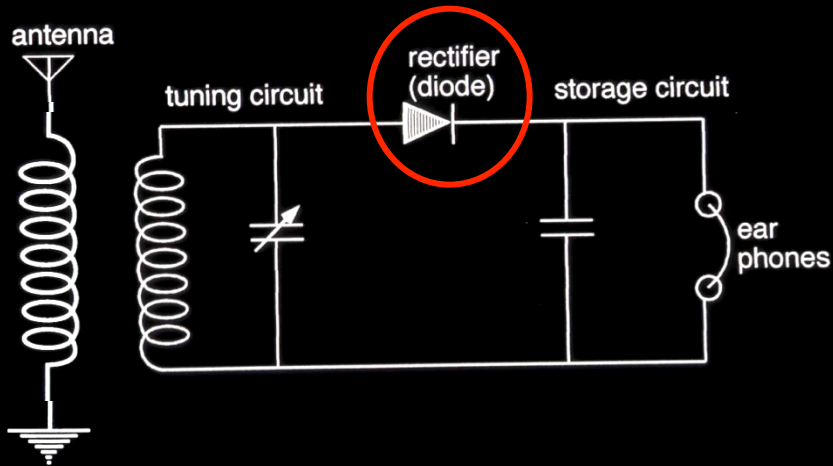


WHISKER



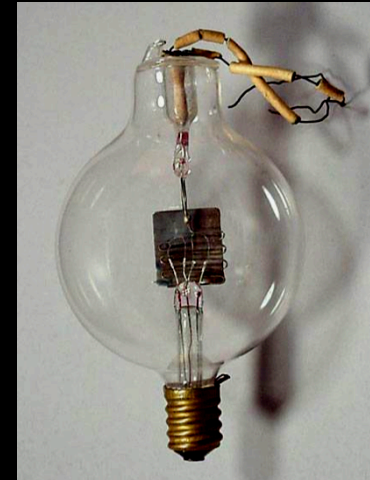
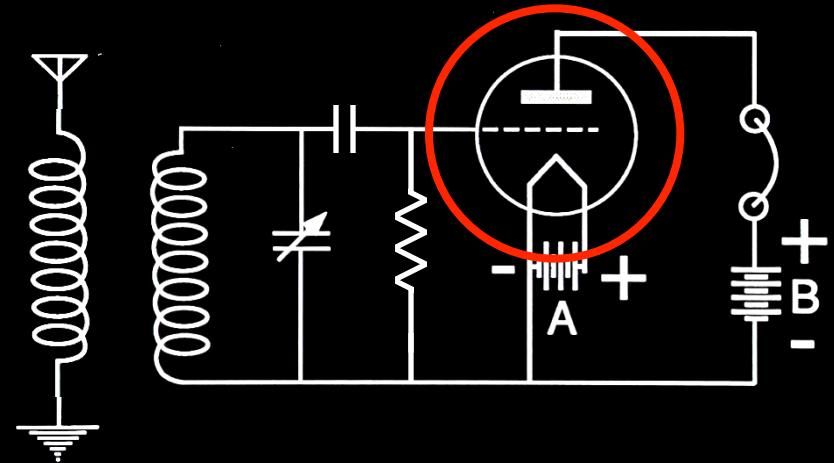
Crystal Diode as
One-Way Valve

Cat's Whisker Crystal Radio



Crystal Diode as
One-Way Valve

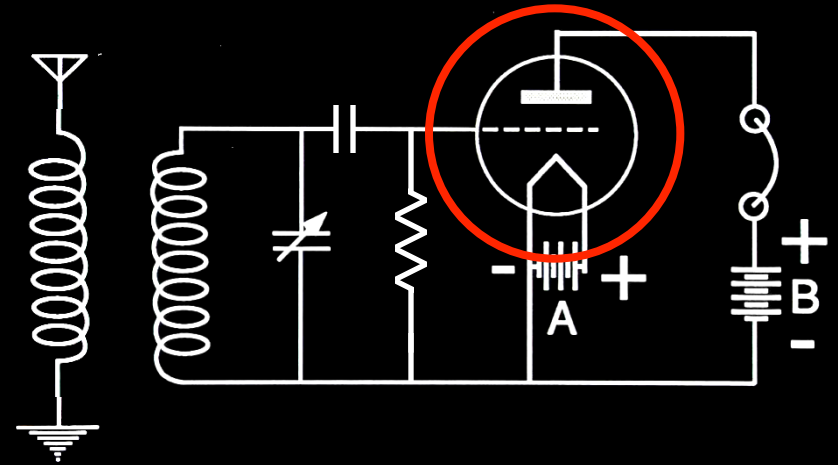
Vacuum Tube Radio



Light Bulb Triode as both
One-Way Valve and Amplifier



Vacuum Tube Radio



Light Bulb Triode as both
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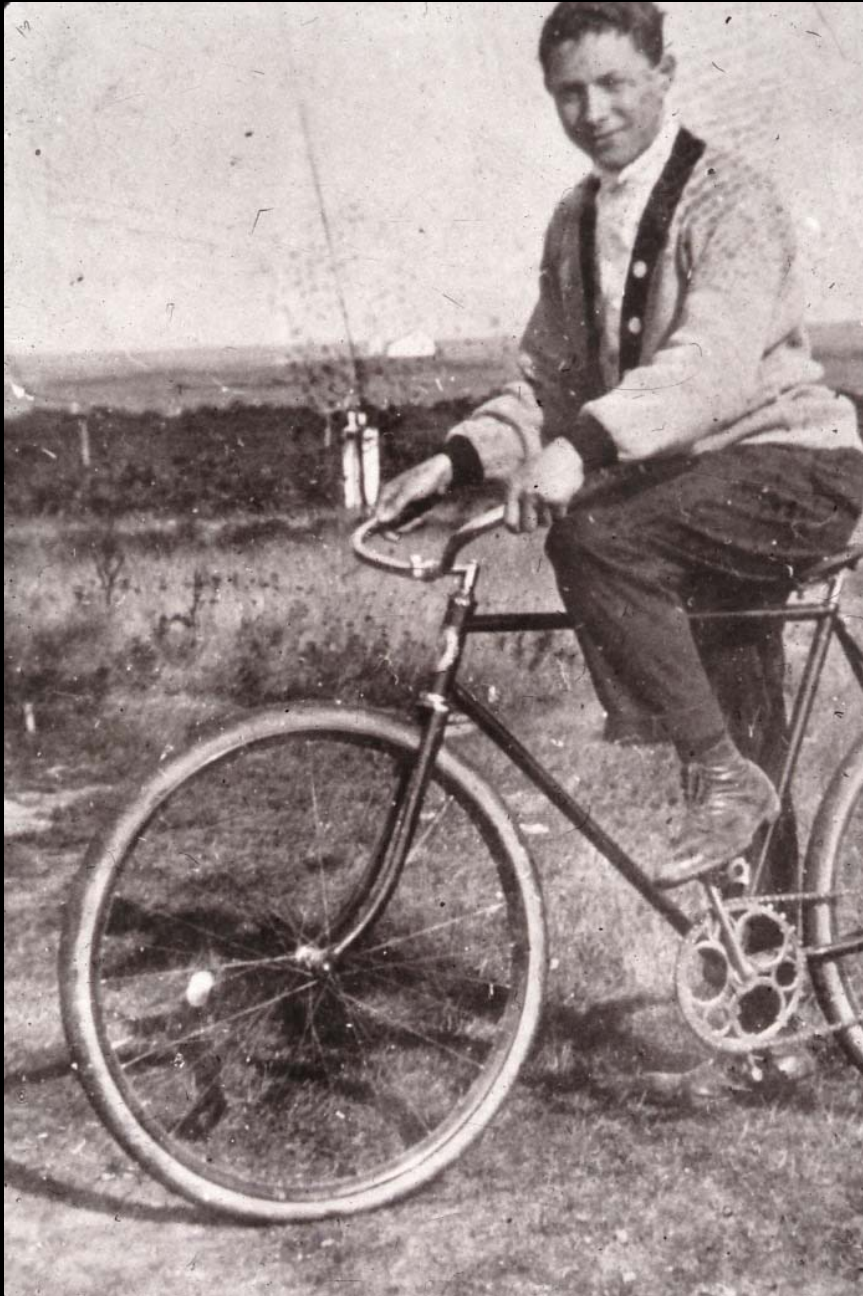
David Sarnoff

early (before WWI)

Telegrapher and office boy
American Marconi Company

Meets Columbia Univ. Student
Edwin Armstrong

Commercial Manager of
American Marconi Company



David Sarnoff

early (before WWI)

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Commercial Manager of
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“I have in mind a plan of development which would make radio a ‘household utility’ in the same sense as the piano or phonograph. The idea is to bring music into the house by wireless.”

- Sarnoff in 1915

David Sarnoff

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Telegrapher and office boy
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Edwin Howard Armstrong

Regeneration Circuit

First IRE Medal of Honor

SUPERHET Circuit

FM Radio Circuit



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Regeneration Circuit

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FM Radio Circuit





After WWI ...



Radio Corporation of America

RCA founded out of American Marconi
with GE executive as CEO

RCA buys AT&T's patents

RCA buys Westinghouse's patents

... and then dominates American Radio

After WWI ...



Listening to KDKA (Pittsburgh) - 1921

Radio Corporation of America

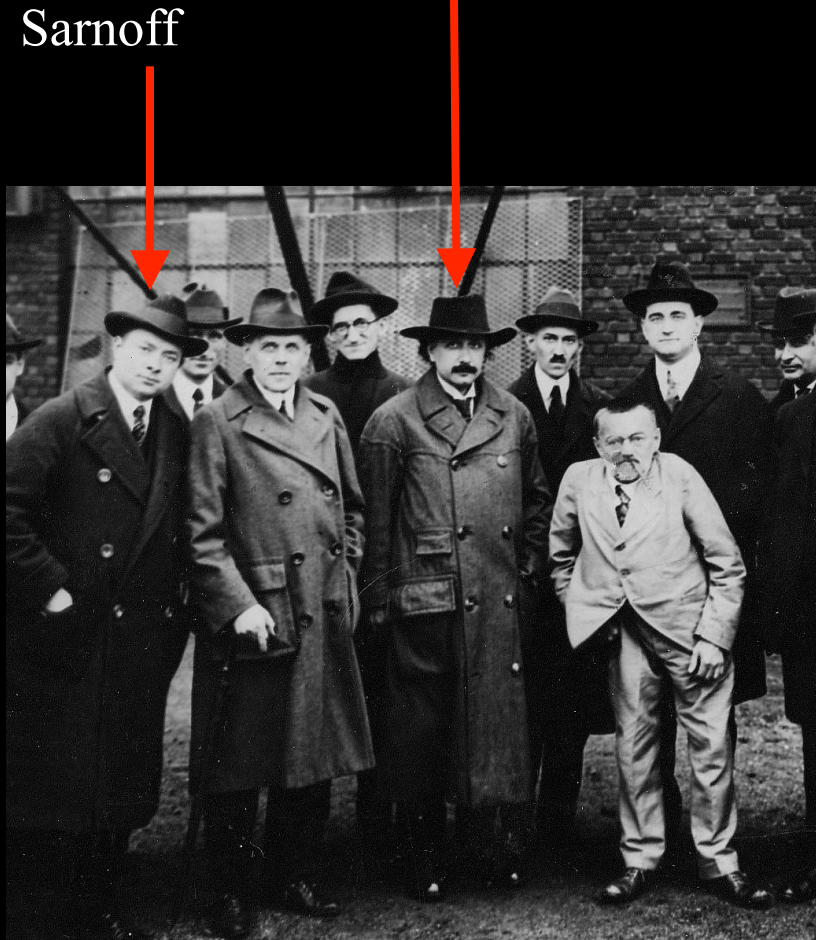
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New Brunswick NJ – 1921

After WWI ...

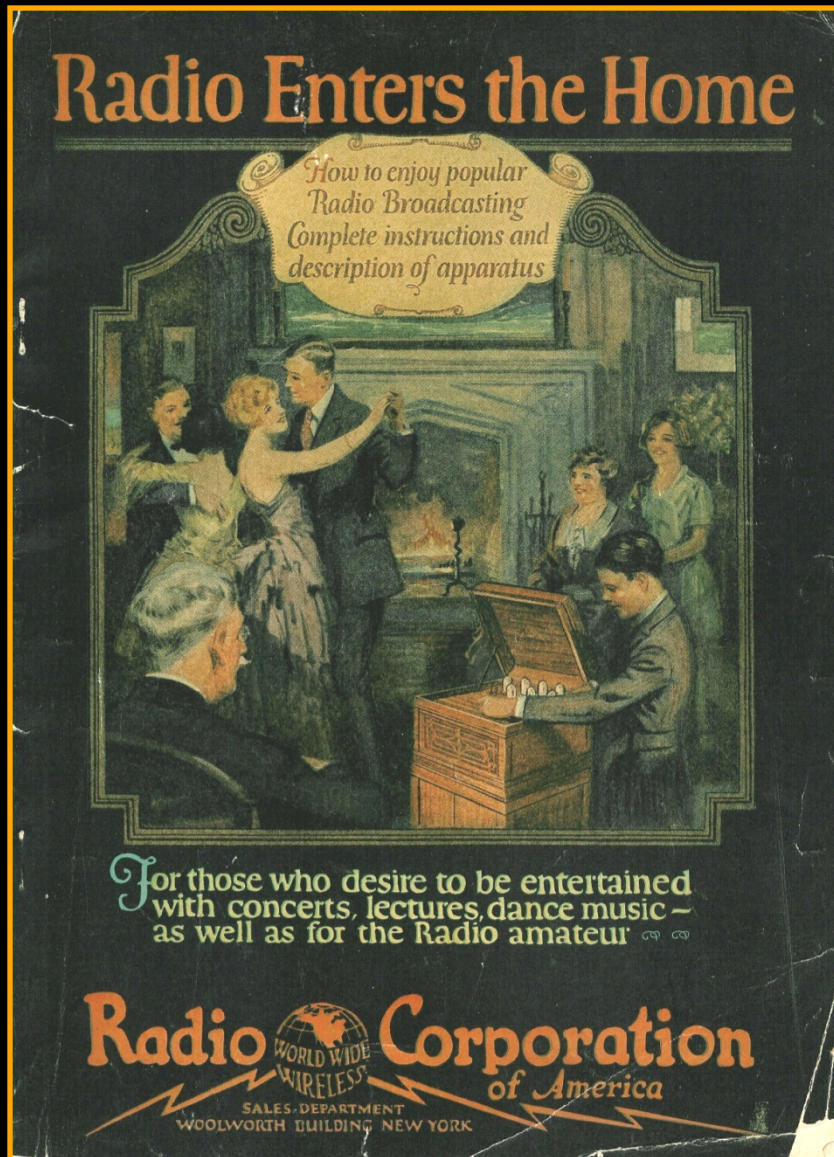
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RCA Catalog of Products - 1922

Radio Enters the Home

How to enjoy popular
Radio Broadcasting
Complete instructions and
description of apparatus



For those who desire to be entertained
with concerts, lectures, dance music -
as well as for the Radio amateur

Radio Corporation
of America
SALES DEPARTMENT
WOOLWORTH BUILDING NEW YORK



Newlyweds - Edwin and Marion Armstrong
in December 1922



First Broadcasting Network - 1926



Newlyweds - Edwin and Marion Armstrong
in December 1922



First Broadcasting Network - 1926



Newlyweds - Edwin and Marion Armstrong
in December 1922



Entrepreneur

First Broadcasting Network - 1926



David Sarnoff
President of RCA in 1929



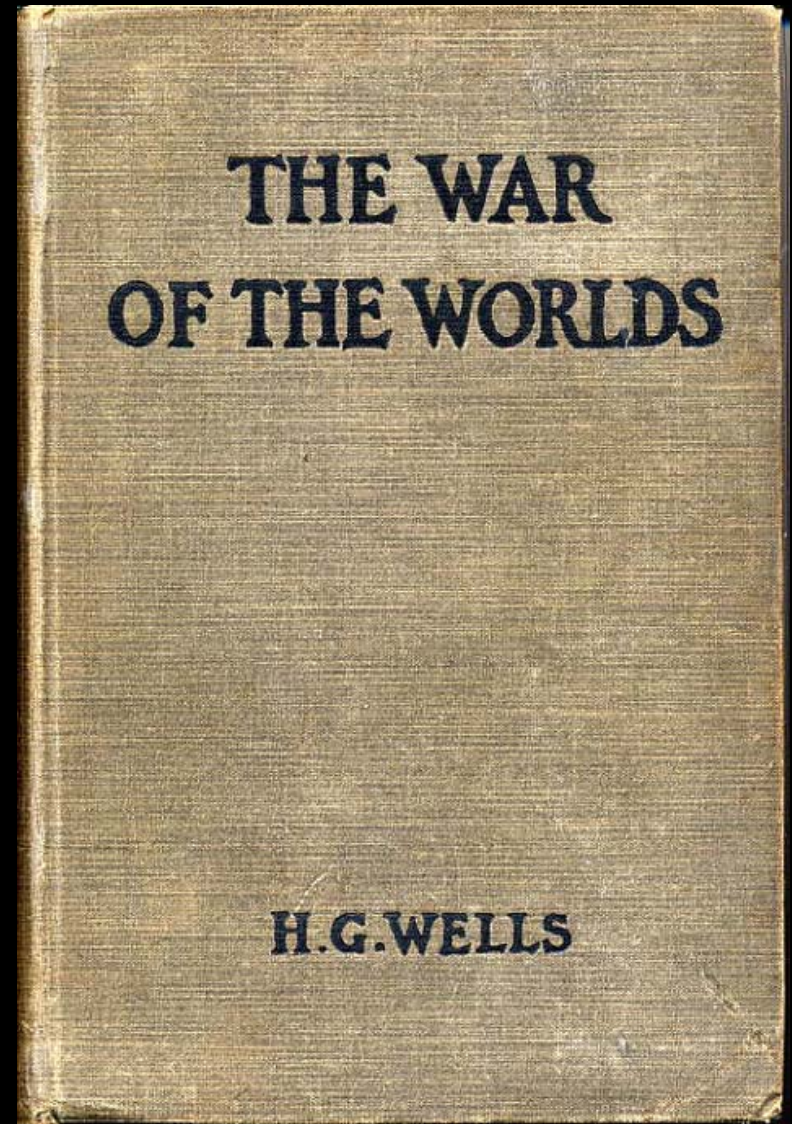
Radio Drama: Mercury Theatre
on the Air with Orson Wells



David Sarnoff
President of RCA in 1929



Radio Drama: Mercury Theatre
on the Air with Orson Wells



3:34 into radio broadcast



Radio Drama: Mercury Theatre
on the Air with Orson Wells

Ladies and gentlemen, we interrupt our program of dance music to bring you a special bulletin from the Intercontinental Radio News.

At twenty minutes before eight, central time, Professor Farrell of the Mount Jennings Observatory, Chicago, Illinois, reports observing several explosions of incandescent gas, occurring at regular intervals on the planet Mars. The spectroscope indicates the gas to be hydrogen and moving towards the earth with enormous velocity.

Professor Pierson of the Observatory at Princeton confirms Farrell's observation, and describes the phenomenon as, quote, "like a jet of blue flame shot from a gun," unquote.

We now return you to the music of Ramón Raquello, playing for you in the Meridian Room of the Park Plaza Hotel, situated in downtown New York.

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The New York Times.

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NEW YORK, MONDAY, OCTOBER 31, 1938.

FP

TH

Printed at Mount Chase Station,
Franklin, New York, U. S. A.

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MEAD STANDS PAT AS A NEW DEALER IN BID FOR SENATE

Democratic Candidate Opposes
Any Except Minor Changes in
Labor and Security Laws

UPHOLDS THEORY OF TVA

Radio Listeners in Panic, Taking War Drama as Fact

Many Flee Homes to Escape 'Gas Raid From
Mars'—Phone Calls Swamp Police at
Broadcast of Wells Fantasy

A wave of mass hysteria seized thousands of radio listeners throughout the nation between 6:30 and 8:30 o'clock last night when a broadcast of a dramatization of H. G. Wells's fantasy, "The War in the Sky," led thousands in the air over station WJLB, and

OUSTED JEWS FIND REFUGE IN POLAND AFTER BORDER STAY

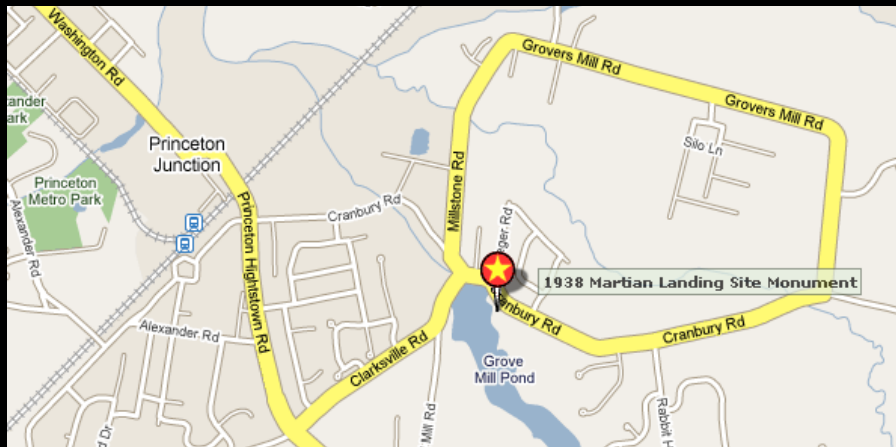
Exiles Go to Relatives' Homes
or to Camps Maintained by
Distribution Committee

REVEAL CRUELTY OF TRIP

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Halloween Prank in 1938



Grover's Mill, West Windsor NJ

The New York Times.

Copyright, 1888, by The New York Times Company.

Printed at the New York Times Building,
New York, N. Y.

NEW YORK, MONDAY, OCTOBER 31, 1938.

FP

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By Bloc
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Two Times,
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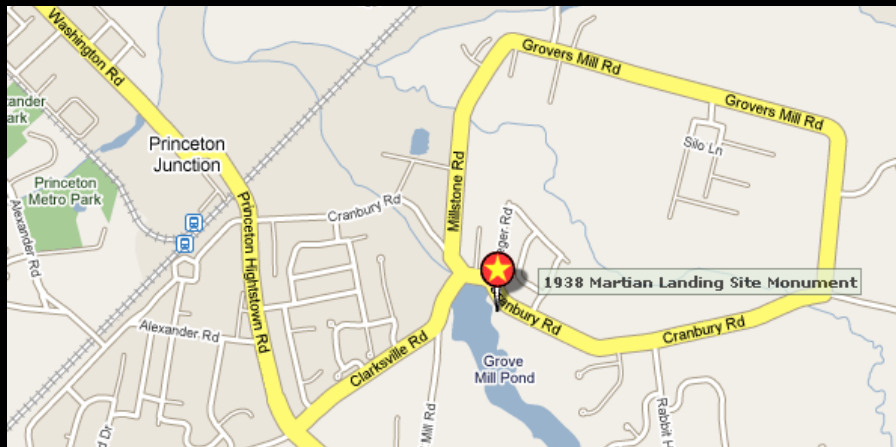
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REVEAL CRUELTY OF TRIP

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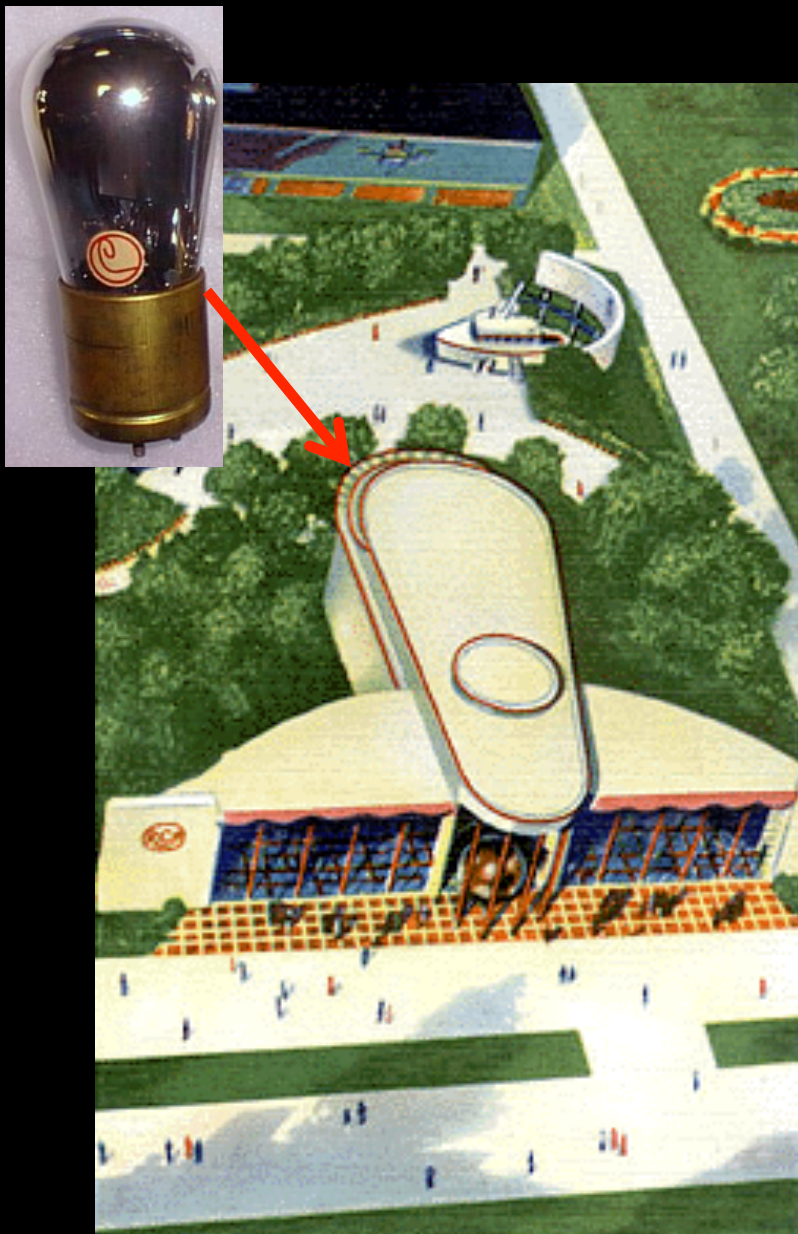
Halloween Prank in 1938



Grover's Mill, West Windsor NJ



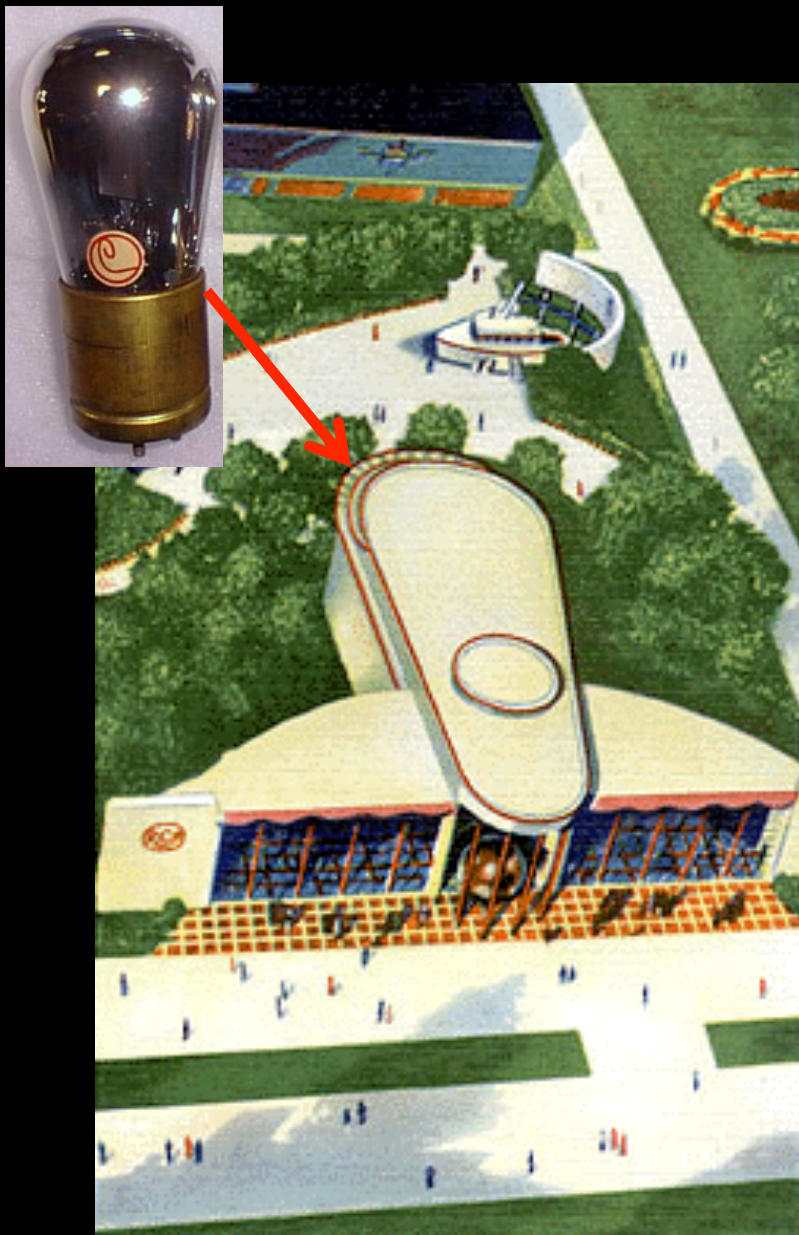
Presidential Fireside Chats with US Citizens 1933 - 1944



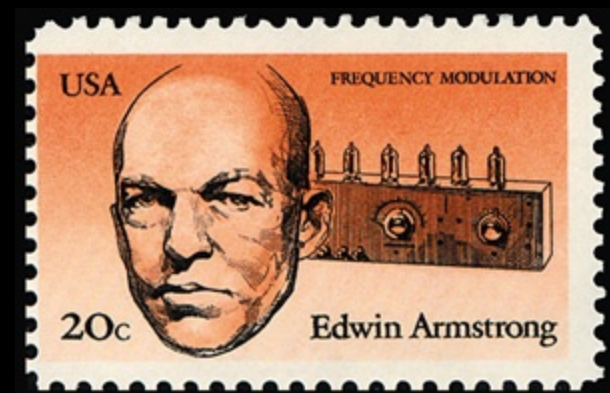
RCA Building at 1939 World's Fair

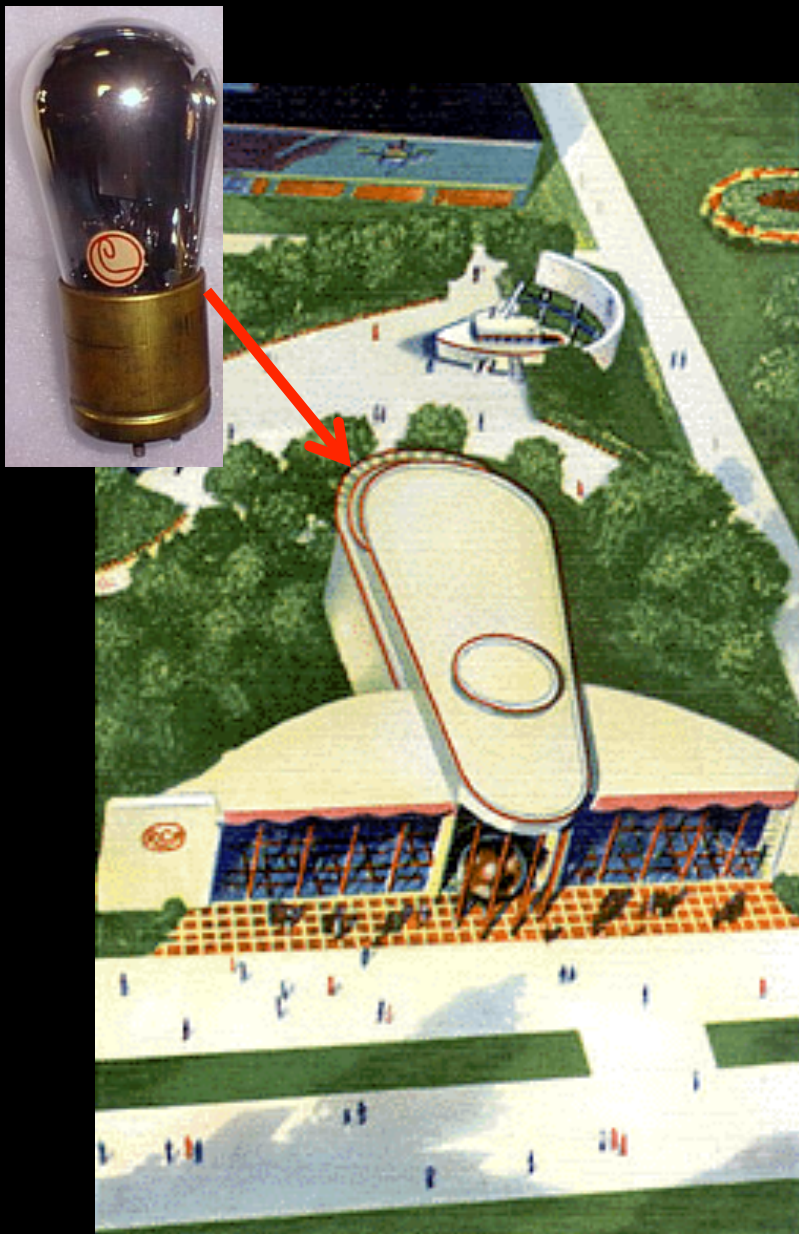


Presidential Fireside Chats with
US Citizens 1933 - 1944



RCA Building at 1939 World's Fair





RCA Building at 1939 World's Fair



Maj. Armstrong Leaps to Death; FM Inventor; 63



Maj. EDWIN ARMSTRONG.

Note Blames Estrangement

Maj. Edwin Howard Armstrong, 63, the electronics genius who invented FM radio, leaped to his death today from his 13th-floor apartment at River House, 435 E. 52nd St.

A note found by the police in the empty Armstrong apartment indicated that Maj. Armstrong had sought death because of a recent estrangement from his wife, Mrs. Esther Marion Armstrong, now visiting a sister in Granby, Conn.

Maj. Armstrong, professor of electrical engineering at Columbia University, who won the Medal of Merit and a Presidential citation for his contribution to military communications by radio, was recognized as having done more than any other man toward improving radio in the past 30 years. His newest development was a system for multiplexing FM radio so that more than one program could be sent out simultaneously on the same wavelength.

Body Found on Roof.

Maj. Armstrong's body, fully clothed, was found on the roof

Maj. Armstrong, Genius Of Radio, Dies in Plunge

(Continued From Page One.)

E. A. Laurence, of 101 E. 89th St., told reporters that the major had no "immediate illness" when he examined him recently.

The police learned that Mrs. Armstrong left for New York immediately upon hearing of her husband's death. A friend made arrangements to have the body taken to Campbell's Funeral Home at 81st St. and Madison Ave.

No Motive Learned.

Associates at Columbia could not ascribe any motive for suicide. So far as they know, they said, Maj. Armstrong had not complained of illness and had shown no indications of mental depression. He had been at the Marcellus Hartley Laboratories, of which he had charge, within the last few days.

Major Armstrong was credited with having made the four most important contributions to radio. First, he devised the regenerative circuit which took radio out of the crystal detector stage and made possible the loudspeaker. Second came the superheterodyne circuit, which ever since its invention has been the basis of radio reception. Third came the super-regenerative circuit, and finally, in 1933, FM (frequency modulation) radio, which permits reception without static interference of any kind. The audio reception accompanying television is frequency-modulated.

Served in Two Wars.

Maj. Armstrong served in the Army Signal Corps in World

he might have access to the laboratories. He became a full professor at the university in 1934.

Worked Atop Palisades.

Major Armstrong conducted most of his radio experimentation from a small red brick building shielded by tall trees and a high wire fence off Route 9W at Alpine, N. J., atop the Palisades. Most persons would not have known of the existence of a radio outfit there but for the 400-foot transmitter tower that rose above it.

Radio engineers the world over, however, knew of its existence and they and thousands of listeners knew it only as FM Station W2XMN and W2XEA operating on 44.1 and 92.1 megacycles. Few, however, knew that it was an experimental station, or that it was the granddaddy of all FM radio stations. For the most part its programs, devoted largely to dance music, gave no hint of experimentation.

Won Many Citations.

Over the years, Maj. Armstrong won many honors. On Jan. 28, 1947, President Harry S. Truman presented him with the Army Medal of Merit and a citation stating that "Maj. Armstrong contributed greatly to the improvement of military communication by his inventions in the field of radio and by his unselfish, patriotic service to the signal corps." Other honors included:

Medal of Honor of Institute of Radio Engineers, 1947; Retelator

TIME

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Ham Radio Operators become Electronics Industry Pioneers



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9DRV



Frederick Terman
6AE

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W9GTY



Steve Wozniak
6A6BND



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Key Ideas

Scientific:

Marconi's Tuning Circuit
Armstrong's Many Circuits

Social:

Communications Systems
Government Regulated

Symbolic:

Fireside Chat with a Nation