Dunlap's

RADIO & TELEVISION ALMANAC

Men, Events, Inventions and Dates That Made History in Electronics from the Dawn of Electricity to Radar and Television

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DUNLAP'S RADIO & TELEVISION ALMANAC

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Dunlap's **RADIO & TELEVISION ALMANAC**

BOOKS BY ORRIN E. DUNLAP, Jr.

DUNLAP'S RADIO MANUAL
THE STORY OF RADIO
ADVERTISING BY RADIO
RADIO IN ADVERTISING
THE OUTLOOK FOR TELEVISION
TALKING ON THE RADIO
MARCONI: THE MAN AND HIS WIRELESS
THE FUTURE OF TELEVISION
RADIO'S 100 MEN OF SCIENCE
RADAR: WHAT IT IS AND HOW IT WORKS
UNDERSTANDING TELEVISION
DUNLAP'S RADIO & TELEVISION ALMANAC

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Preface

The purpose of this book is to present the chronological history of radio and television as a handy and accurate reference. It is a record of facts and dates that tell the story of progress step by step, linked with the names of the men who blazed the trails.

Here will be found historic events and inventions that led to the development of wireless telegraphy. Then unfolds the year to year advance of radio as a new system of world communication, as a science, art, and industry providing employment for thousands upon thousands of workers—service and pleasure to millions of people.

This log of radio milestones is a compendium of "firsts" in wireless, inventions, patents, industrial progress, commercial applications, and "firsts" in broadcasting, radiophoto, facsimile, television, and radar as well as radio's important record in the two World Wars.

The author, a senior member of the Institute of Radio Engineers and member of the Veteran Wireless Operators Association, has had opportunity to witness many historic events in radio since his first association with the art as a wireless amateur in 1912; as an operator with the Marconi Wireless Telegraph Company of America, 1917; U. S. Navy radio operator in World War I; radio editor of The New York Times, 1922-40; and since 1940 as a member of the executive staff of Radio Corporation of America. Through

personal contact with Marconi, de Forest, Zworykin, Tesla, Alexanderson, Sir Robert Watson-Watt, and many pioneers in radio and television, the author has had first-hand accounts of history-making events.

So that he would have the main happenings quickly available for review at the end of each year, the author began to compile this record in 1922 while radio editor of The Times. Since that time he has kept the diary up-to-date from day to day for his own use, registering names and dates before they were dimmed or lost with the passing years.

O. E. D., Jr.

New York City.

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Science Blazes New Trails

Man in his endless pursuit of knowledge constantly seeks to unlock secrets of Nature that will open the way to new fields of discovery and invention. Science like geography has its Columbus and Magellan, its De Soto and Ponce de Leon, searching for new continents, new and shorter technological routes, exploring the wilderness of space, and seeking, through biological science, better health and the Fountain of Youth.

Year after year, from the sun dial to the atomic clock, the pioneers of science have blazed new trails over which coming generations might travel and communicate with greater speed and convenience, and live in greater comfort. As a result, the social consequences of invention continually change the pattern of daily life. Some inventions and new principles, heralded in their day of discovery as vastly significant, are worn thin and their wonder eroded to but grains of sand as the years roll on.

Yet, other scientific creations of man's ingenuity are more granite-like in resisting the onslaught of Time. Gradually, they are consolidated in orderly manner by the passing years to form epochal steps on the highway of progress, that lead ever upward to new pinnacles from which man can look toward the future and foretell to some extent the realistic advances that lie beyond the horizon.

Who would have believed it if some soothsayer in 1900 had been so bold as to predict that in 50 years millions of

people in their homes and automobiles, and even pedestrians, would be listening to music and voices from across the world! People were only beginning to read about wireless and they viewed it with skepticism. The word radio was unknown. When Marconi sent messages across the English Channel in 1900, few suspected that he would be able to "jump a spark" across the Atlantic.

A year later he linked the continents and the achievement was heralded as "the first great triumph of the twentieth century." Who would have believed in those days that millions of people some day would be looking-in over the same invisible waves to see pictures by television. Yet all this has come to pass within the memory of those who today have lived more than half a century.

Swift is the pace of science, and there is every indication that the pace will quicken in the next 50 years. The radio and television which we know today will be just as different in the year 2000 as the Marconi wireless of 1900 compared with the television of 1950. There will be international television as now there is world-wide radio. The Stars and Stripes will be seen 'round the earth in red, white, and blue. A red rose in New York will be as true to its color in London or Melbourne when seen by television, as the sound of a violin in San Francisco is true to its original tone when heard across the Pacific.

The pace in 1900 was that of the stereopticon, the kaleidoscope, nickelodeon, bicycle and the horse and buggy. Now the airplane, the motor car, diesel, jet, and turbo-prop engines are at the forefront. The fastest train in 1900 covered 60 miles an hour on a special run. The fastest ship took almost 6 days to cross the Atlantic, and now a stratoliner soars across in 8 hours or less.

Indeed, those who have lived through the past 50 years

have witnessed the most rapid growth and progress this country, or any country, ever experienced. They have seen America advance and prosper because it has cultivated science and has given freedom to creative thought. They have seen a young America approaching maturity; they have seen the American way of life tested in the crucible of two World Wars, the demands of which gave tremendous impetus to science. They have seen any number of false ideologies and dictators pass into oblivion. After victory, the "Arsenal of Democracy" opened wide its gates to reveal a vast store of new scientific developments ready to extend America's advance in peace.

Economists are bold to predict that the output of goods and services for the United States may reach 600 billion dollars a year within 50 years, which will be more than double the output of 1950. The population, now close to 150 million is expected to rise to 200 million by the time the year 2000 comes up on the calendar.

Science with many surprises will continue to amaze coming generations as it would anyone who now could turn back the clock and stand on the threshold of 1900. How slow and quiet it would seem, how far apart the continents would be and how wide the oceans. But science has annihilated time; it has shrunk the globe.

Fifty years ago, there was no world-wide radio, no television, airplanes, talking pictures, electron tubes, electric refrigerators, air conditioning, orlon, nylon, rayon, or atomic energy. The phonograph as a talking-machine was something new that squeaked with promise. There were slightly over a million telephones in the United States—now more than 40,000,000. Roads were of dirt and pavements were confined to a few Main Streets in 1900. The electric light was just beginning to shine and the kerosene lamp was

concluding its brightest moments. Cathode rays, X-rays, and the electron had only been discovered. Penicillin, streptomycin, aureomycin and other antibiotic drugs obtained from molds were yet to be found—and the electron microscope yet to be developed so that bacteria, viruses, and other micro-organisms of the submicroscopic world might be seen and photographed.

Some may ask the question whether the pace of the past can continue; whether there is any further opportunity for invention? The answer is that the future will be much greater than the past, the achievements of which will fade into insignificance in the dim corridors of Time.

The legacy of the past 50 years is a wide and great foundation on which to build the future. Every new development inevitably leads to others. The number of people being educated in science is rapidly increasing. Thousands upon thousands of young people are taking up research in both physical and biological sciences. Many great laboratories have been erected; they are gateways to the future. Modern men of science, working in concerted effort, attack problems and solve them far more quickly than the lone scientists who plodded along with scant resources in their search to make dreams come true.

Invention in this day is almost "on order." The old trial-and-error system which Edison and Marconi followed has been discarded. Suppose Marconi had had electron tubes as now available, or television pioneers had had the iconoscope and kinescope—how much more rapid their progress would have been. But they had no electron tubes, no microphones—only coherers, crystal detectors, and spark transmitters. Now the electron tube, limitless in its possibilities, is a master key to progress, not only in radio and television but in many industrial fields.

Industry will speed and expand scientific research to meet the vigorous competition which the future will bring. The hope of industrial survival in the years to come will be found in research that will create new products, new ways of doing things, and new services. As a result, the marvels of today will fade into history along with the horse and buggy, cigar-store Indians, and the silent films.

Television's influence on motion pictures, on sound broadcasting, on books and magazines will be far-reaching; habits will radically change for they are destined to be increasingly governed by the demands of the eye coupled with timeliness.

There will be far more travel encouraged by new highways, greatly improved motorcars, and by faster, more comfortable planes. Atomic engines on the rails and on the seas also may rush travelers everywhere as people are stimulated by television to become gregarious sightseers of the world.

There will be more leisure time because of countless new appliances and new comforts in living. Life will be lengthened because of new medical discoveries, curative medicines and new drugs.

Countries may no longer be rich solely because of natural resources but also because of chemistry. The ingenuity of scientists in creating substitutes for raw materials will add to a nation's pre-eminence and strengthen its national security. Synthesized substitutes may be found for coal, iron and steel, just as nylon has to a great extent supplanted silk, or as plastics, plywood, and artificial rubber have won acceptance as vital industrial materials. An endless array of new products manufactured at a high rate of production by robot machinery will vastly change the world. Industries will be less and less dependent upon what is mined from

the earth or taken from the forest. Revolutionary developments in chemistry and agriculture will bring new foods and food substitutes rich in nourishment and vitamin content.

The age-old printing industry will feel the magic touch of science. The fast presses of today will appear slow when people 50 years from now look back to 1950. Magazines now printed at the rate of 5,000,000 copies a week may reach 50,000,000 or more, printed and delivered in the home by Ultrafax at the rate of a million words a minute!

Within the past 50 years, out of the First World War, emerged the science of *electronics*, and out of the Second World War, *atomic energy*. Based upon knowledge already gathered, man would be blind not to realize that they are manifestations of the future. Electronics and atomics are scientific power behind man's destiny, and his fate and that of civilization will depend on how he uses them—for construction or destruction.

Evolution moves forward, not backward. Scientists have long recognized that one of the most important features about time is its irreversibility; the hours flow on, never to come back.

Science in step with Time also continually advances, sometimes swiftly, sometimes imperceptibly, dependent upon man's ingenuity in applying the laws of Nature. There is no dead-end in science—the future is a book to be opened page by page, and its pages are numbered in the years of the centuries yet to come.

1. *The Dawn of Electricity*

640 B.C.–1843 A.D.

Electricity first revealed itself to the ancients as lustrous sparks. Men first thought of it as light because of its sparkle. "Electrum," as they called it, was a mystery, and they began to wonder more and more if it were some new and living force related to magnetism and akin to sunlight. The Greeks discovered that "elektrons" performed odd antics which light had never been known to do, and early English scientists defined it "electricity."

Gradually, philosophical and mathematical minds began to explore its mystic actions and as they observed it had real power they began to seek the laws of Nature that might govern its behavior. They tested the phenomenon of frictional electricity on a glass rod when it was rubbed with fur. And Franklin found that these mysterious sparks created by friction were of the same general character as lightning.

Then it was discovered that electricity possessed magnetic effects and seemed to have ability to go through the air—they called that induction. That led experimenters to wonder if this miracle force might be used for signaling, for they observed that it would flow even a thousand feet over a hemp thread. Volta produced a new "engine of research"—the battery. Faraday and Henry with their electromagnets pointed the way to the electric generator and motors, and

as a result electricity revealed it was a new servant of man awaiting his commands. Men pondered whether this new energy might be harnessed to run machines. Out of the electromagnetism idea came the electric telegraph, the induction coil, magnetos, dynamos, and transformers.

Scientists, mathematicians, and physicists formulated new theories and began to build instruments to measure electrical effects and to study the principles; they determined that electricity was comprised of volts and amperes and that as a current it traveled over some materials with greater ease than over others; they found that it was both "positive" and "negative" and that it could even be stored in a condenser.

Indeed, here was a dynamic force so entrancing that men of science set out to "sift the grain of electrical and magnetic phenomena from the chaff of medieval phantasy." And if they found that this magnetic magic pervaded all space, all the universe might become their laboratory, for was not the earth a giant magnet in itself!

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640 B.C. Thales of Miletus noticed that amber, after being rubbed, acquired the property of attracting straws and other light objects. This phenomenon of frictional electricity suggested the word "electricity," for the Greeks called amber "elektron" because of its sunny luster.

1600 A.D. William Gilbert (England) published his work *De Magnete* in which he used the term "electric force."

1650 Otto von Guericke (Germany) invented the air pump and first frictional electric machine.

1654 Robert Boyle observed that electric attraction takes place through a vacuum.

1666 Sir Isaac Newton (England) performed fundamental experiments on discovery of the spectrum.

1676 Olaus Roemer (Denmark) discovered that light travels at a finite velocity.

1706 (January 17)—Benjamin Franklin born in Boston, Mass.; died April 17, 1790.

1725 Stephen Gray (England) observed that electric forces could be carried about 1,000 feet by means of a hemp thread, thus discovering electrical conduction.

1733 Charles F. Dufay (France) observed that sealing wax rubbed with cat's fur was electrified but differed from an electrified glass rod. He termed one "vitreous" and the other "resinous." Franklin later introduced the terms "positive" and "negative" electricity.

1745 (February 18)—Allesandro Volta inventor of voltaic cell, or battery, was born in Como, Italy; died March 5, 1827.

Pieter Van Musschenbroeck of Leyden, Holland, discovered the principle of the electrostatic condenser, which was called the Leyden jar.

1749 Benjamin Franklin, by his celebrated kite experiment, proved lightning to be an electrical phenomenon.

1780 Luigi Galvani (Italy) made historic observations relative to twitching frog legs, which led to invention of the voltaic cell. He called it "animal electricity"; thus history records him as discoverer of the fact the electricity flowed as a current, and it was called "galvanic" electricity.

1791 (April 27)—Samuel F. B. Morse, inventor of the telegraph, born at Charlestown, Mass.; died April 2, 1872, New York City.

(September 22)—Michael Faraday, "Columbus of the Electrical Age," born in London, England; died August 25, 1867, London.

1794 Alessandro Volta (Italy) invented the voltaic cell.

1800 William Herschel (England) discovered infra-red rays.

1801 Sir Humphry Davy (England) displayed the first electric carbon arc light.

1819 Hans Christian Oersted (Denmark) discovered magnetic action of an electric current and published an account of the influence of galvanic current on a magnetic needle.

1820 Johann Schweigger (Germany) invented the first practical galvanometer—an instrument to measure electric current.

James Bowman Lindsay (Scotland, 1799–1862) conducted experiments in communication by use of the conductive properties of water; also was one of the

first to demonstrate a continuous light produced by electricity.

1821 André M. Ampere (France) made research in electricity that established the relationship between electricity and magnetism.

1825 Georg Simon Ohm (Germany) propounded the law named for him—Ohm's Law—$I = E/R$.

1827 Sir Charles Wheatstone (England) coined the term "microphone" for an acoustic device he had developed to amplify weak sounds.

1828 (April 16)—Willoughby Smith, a pioneer in telegraphic signaling and cables, was born at Great Yarmouth; died July 17, 1891, Eastbourne, England.

1829 James Swain of Philadelphia described an "acoustic" alphabet to be used in communication through a wall. This alphabet was made up of the letter T for "tap" and S for "scratch" and when translated into dots and dashes it resembled a telegraph code.

1830 Joseph N. Niepce and Louis Daguerre (France) produced the first practical process of photography.

1831 Michael Faraday (England) conducted experiments and formulated laws of electromagnetic induction that led to development of the magneto, dynamo, and induction coil.

Joseph Henry discovered mutual-induction and self-induction, improved the electromagnet, and made the first electric bell.

1831 (November 13)—James Clerk Maxwell, discoverer of the ether, born at Edinburgh, Scotland; died November 5, 1879, Cambridge, England.

1832 The idea of the telegraph occurred to Samuel F. B. Morse while returning from Europe on the packet ship *Sully.*

(June 17)—William Crookes, inventor of the Crookes tube, which he used to demonstrate the properties of cathode rays, was born in London, England; died April 14, 1919, London.

1837 (April)—Morse, in applying for a patent on the telegraph, described a new alphabet type that comprised the marking of dots and dashes instead of a zigzag line as previously used.

(November 10)—Amos Emerson Dolbear, inventor of "a mode of electric communication" for sending signals through "the ether of space" (1882), was born at Norwich, Conn.; died 1910, Boston, Mass.

1838 Carl August von Steinheil of Germany discovered the use of the earth-return later utilized in telegraphy, telephony, and wireless.

1839 Edward Davy (England), and Alexander Bain (England) in 1846, employed a code of dots and dashes. Bain's code was used in America over the Bain electro-chemical telegraph lines between New York and Boston and New York and Buffalo.

Alexandre Edmond Becquerel (France) discovered that a voltage is generated when light falls on one

of a pair of electrodes immersed in an electrolyte; it is called the Becquerel effect since he appears to have been the first to observe action of light in generating an electric current, or voltage.

1842 Alexander Bain, English physicist, conceived the basic principles of transmitting pictures by electricity, thereby solving the problem in its broadest aspects. He is identified as "the father of facsimile" because his electro-chemical recording telegraph established the basic elements.

1843 (March 3)—Congress passed a bill appropriating $30,000 for Morse to erect a telegraph line between Washington and Baltimore.

(August 5)—John Trowbridge, a pioneer in telegraphing without wires by induction, was born at Boston, Mass.; died February 18, 1923.

Samuel F. B. Morse conducted experiments in "wireless" communication by conduction across rivers, and concluded that "electricity could be made to cross a river without other conductor than the water itself."

The Morse Code was devised by Prof. Samuel F. B. Morse in collaboration with Alfred N. Vail.

2. *Discoveries That Led to Wireless*

1844–1894

In the roaring 40's the Morse telegraph began to click, and in the years that followed, such men as Edison, Fleming, De Forest, Tesla, Thomson, and Marconi came upon the scene bringing to the world ideas that would greatly extend the range of electric communications and enshrine their names in history. The trans-Atlantic cable linked the Old and New Worlds; microphones were built, and many new instruments were created. Electromagnetic waves were discovered that some day would no longer limit electric communication to a wire, but would enable signals to travel through space at the speed of light on the invisible waves predicted by Maxwell and first created by Hertz.

While these men were offering the world new and spectacular theories, Marconi was born; Braun discovered the principle of crystal detectors and constructed the first cathode-ray oscilloscope; Bell invented the telephone; and the prolific Edison discovered etheric force—he made the first phonograph and patented the telephone transmitter. Crookes demonstrated the properties of cathode rays, which in the far future would be so vital to a new science—television.

As the pioneers began to realize the potentialities of electricity over wires they were fascinated with the idea that it

might enable them to send messages on the ether waves which Maxwell said existed. Edison, in his work with the incandescent lamp, discovered "the Edison effect." It was the basic phenomenon of the electron tube, then still awaiting an inventor to apply the principle and invent the bulb in which the electrons could be generated and put to work.

As early as 1884, Nipkow invented a scanning disk which some day would show the possibilities of television. Yet, when he invented that disk, Marconi had yet to signal. Branly, seeking to discover why the nerves carry messages from the skin to the brain, invented the coherer, which was to be the first detector of the wireless waves, although it would be ten years before Marconi would take up the coherer and use it to detect his first messages. The inventors of this age were bidding for fame in directions far afield of wireless; nevertheless, they were laying the groundwork for electric signaling around the world.

1844 (May 24)—Morse telegraph circuit opened between Washington and Baltimore; first message, "What hath God wrought."

(July 10)—Henry Highton (England, 1816–74), took out a patent for a system of telegraphy based upon electricity; he described it as "telegraphy without insulation," in which he used bare wires sunk in canals and rivers and by conduction communicated about a quarter of a mile.

(October 23)—Edouard Branly, inventor of the coherer (first detector of wireless) born at Amiens, France; died March 24, 1940, Paris.

1847 (February 11)—Thomas Alva Edison, born at Milan, Ohio; died October 18, 1931, West Orange, N. J.

(March 3)—Alexander Graham Bell, inventor of the telephone, born at Edinburgh, Scotland; died August 2, 1922, Baddeck, Nova Scotia.

1849 John Walker Wilkins (England, 1827–1913), a pioneer in telegraphy, developed an electric telegraph instrument using an electromagnetic relay; he predicted that "telegraphing without wires might be a possibility."

(November 29)—John Ambrose Fleming, inventor of electronic valve detector, born at Lancaster, England; died April 19, 1945, Sidmouth, England.

1850 (June 6)—Karl Ferdinand Braun, who developed the cathode-ray tube and an early wireless system, born at Fulda, Germany; died April 20, 1918, Brooklyn, N. Y.

(August 27)—Augusto Righi, Professor of Physics at Bologna University, a pioneer in the study of electromagnetic waves and their optical properties, was born at Bologna, Italy; died June 8, 1920, Bologna.

Pierre Guitard (France) noticed that when air containing particles of dust was electrified, the particles tended to cohere into strings or flakes. This cohesion effect was used by S. A. Varley in his lightning protector (1866), which was used in telegraph systems; Prof. Calzecchi-Onesti of Italy, in 1884, observed a similar effect in a tube filled with brass filings.

1851 Continental Code, or International Code, was compiled at the first telegraph conference held in Berlin. It employed the best features of all codes known at that time, and 11 letters of the Continental Code were taken from the American Morse alphabet of 1844.

1853 Armand H. L. Fizeau (France) shunted a condenser across the terminals of the interrupter in an induction coil, thereby increasing the length of the spark and the coil's efficiency.

1856 Abbe Giacomo Caselli (Italy) sent designs by telegraph utilizing a cylinder covered with tinfoil on which the figures were drawn in insulating compound by a contact pin or needle traveling over the cylinder.

S. A. Varley of London patented an induction coil that was a forerunner of the alternating current transformer.

(December 18)—Joseph J. Thomson, discoverer of the electron, born at Manchester, England; died August 30, 1940, Cambridge, England.

1857 (February 22)—Heinrich Rudolph Hertz, discoverer of electromagnetic waves, born at Hamburg, Germany; died January 1, 1894, Bonn, Germany. Said Sir Oliver Lodge, "He effected an achievement that will hand his name down to posterity as the founder of an epoch in experimental physics."

(July 10)—Nikola Tesla, electrical inventor, born at Smiljan, Serbia; died January 7, 1943, New York.

1857 Heinrich Geissler, German physicist, built glass tubes to demonstrate effect of high voltage on different gases in a partial vacuum.

Leon Scott, French scientist, developed the phonautograph, earliest sound recording instrument, which used a stylus moved by a thin membrane to inscribe a curve of sound vibrations on a soot-covered cylinder of paper.

1858 A variant of the Morse code, a three-positional cable code employing the standard Continental alphabet, was invented and first used by Lord Kelvin.

(August 16)—First transatlantic cable was opened with exchange of greetings between President Buchanan and Queen Victoria.

1859 Julius Plucker (Germany) noticed rays coming from the cathode (negative terminal) of an electrical instrument, and called them cathode rays.

1861 Philip Reis (Germany) designed a make-and-break platinum contact microphone with which musical sounds but not speech were transmitted.

1865 Heinrich Daniel Ruhmkorff (Germany) made important improvements in the induction coil and it became known as the Ruhmkorff coil.

1866 (October 6)—Reginald A. Fessenden, American pioneer in wireless, born at East Bolton, Quebec; died July 23, 1932, Bermuda.

1867 James Clerk Maxwell (Scotland) outlined theoretically and predicted the action of electromagnetic, or ether, waves.

1872 (July 30)—First patent for a system of wireless was issued in United States to Dr. Mahlon Loomis of Washington, D. C., who in 1865 made a drawing to illustrate how setting up "disturbances in the atmosphere would cause electric waves to travel through the atmosphere and ground."

1873 Photoelectric property of selenium was discovered by Joseph May, an operator at the Atlantic Cable terminus on Valencia Island off Ireland.

(August 26)—Dr. Lee de Forest, inventor of the audion, or 3-element electron tube, was born at Council Bluffs, Iowa.

1874 (April 25)—Guglielmo Marconi was born at Bologna, Italy; father, Joseph Marconi (Italian), mother, Anna Jameson (Irish).

Karl Ferdinand Braun (Germany) showed that galena, copper pyrites, and other metallic sulphides offered higher resistance to the passage of a current flowing through them in one direction than in the other. Crystal detectors used in wireless were based upon this principle.

1875 Alexander Graham Bell invented the telephone.

Thomas A. Edison observed the phenomenon of "etheric force."

John Kerr (Scotland) discovered polarizing property of a solution of nitrobenzene when subjected to high voltage. The resulting Kerr cell was a vital part of early, large screen television projectors which used the mechanical scanning system.

1876 Edison built his laboratory at Menlo Park, N. J.

1877 First audible reproduction of recorded sound was accomplished by Edison, and he applied for a patent on a "phonograph or speaking machine."

(August 12)—Edison sent to his machine shop a free-hand drawing sketching his invention of the phonograph; he estimated it could be made for $18; it was a metal cylinder about 4 inches long and 4 inches in diameter. He applied for a patent covering his original concept in December.

Emile Berliner in Washington observed that the resistance of a loose contact varies with pressure and he applied the principle to microphone design.

Edison patented a telephone transmitter of a variable resistance amplifying type in which the resistance element was a button of solid carbon.

1878 (April 24)—The Edison Speaking Phonograph Company was incorporated in Connecticut with offices at Norwalk.

(September 8)—Edison went to Ansonia, Conn., to witness a demonstration of arc lighting by William Wallace, and became intensely interested; in next 9 years he took out 370 patents on various phases of electric distribution for light and power.

Sir William Crookes, English scientist, invented the Crookes tube and demonstrated the properties of cathode rays; he sealed a wire in each end of an evacuated glass tube and connected the wires to a

high voltage. The pinkish glow which resulted was the first known indication of cathode rays.

1878 Francis Blake designed a telephone transmitter utilizing a block of hard carbon and a vibrating diaphragm.

David E. Hughes in London designed an extremely sensitive inertia transmitter and revived the term "microphone." He was among those who helped to discover the phenomena upon which the action of the coherer depends; in experiments with the microphone he used a steel needle in loose contact with a piece of coke, which provided a self-restoring coherer.

1880 Jacques and Pierre Curie of France discovered the piezo-electric effect later applied to hold radio stations on their exact waves, thereby minimizing interference.

Julius Elster and Hans Geitel (Germany) experimenting with glass bulbs, either exhausted or filled with gases, containing an electrically heated wire and a metal plate, observed that "electrified particles" radiated from the wire in all directions.

1881 Western Electric Company was purchased by American Bell Telephone Company.

1882 (March)—Prof. Amos E. Dolbear was awarded a United States patent for wireless apparatus. He stated that "electrical communication, using this apparatus, might be established between points certainly more than one-half mile apart, but how much farther I cannot say."

a process for a matrix in wax as by direct electroplating, and pressing a flat disk record of hard rubber; in 1901 he developed a shellac composition record. From 1898 to 1901 Berliner and Eldridge K. Johnson of Victor Talking Machine Co. were partners in developing a practical phonograph and flat disk record.

1888 Columbia Phonograph Company organized by Edward D. Easton.

1889 (July 30)—Vladimir K. Zworykin, inventor of iconoscope, who also developed kinescope and other electronic devices, born at Mourom, Russia.

(November 23)—First nickelodeon was introduced by the Automatic Phonograph Company and placed in Palais Royal Saloon, New York.

1890 Professor Edouard Branly (France) developed the coherer, which was used by Marconi and others as the first detector of wireless waves. (Sir Oliver Lodge conceived the idea of using the coherer in place of the Hertz loop to detect the electromagnetic waves.)

Julius Elster and Hans Geitel (Germany) developed the first phototube—sensitive to visible light as well as ultra-violet radiation.

C. Francis Jenkins began search for new appliances needed for success of Nipkow television scanning disk.

1891 (April 5)—Nikola Tesla applied for a U. S. patent on "the Tesla Coil" and it (No. 454,622) was granted

on June 23, 1891; it was designed to produce "a current of very high potential and very high frequency."

1891 Nikola Tesla experimented with high frequency currents and discovered the principle of the rotary magnetic field, applying it in practical form to the induction motor.

1892 Sir William Preece signaled between two points on the Bristol Channel at Lochness, Scotland, by a system that employed both induction and conduction to affect one circuit by the current flowing in the other.

C. A. Stevenson (England) proposed that wireless telegraphic communication could be established between ships by coils of wire, "the larger the diameter the better to get induction at a great distance."

(April 15)—General Electric Company was formed through a merger of Thomson-Houston Electric Co. and Edison General Electric Company; Charles A. Coffin, first president of G.E.

(June)—A Royal Commission was appointed in England to investigate the practicability of electric communication between shore and lighthouses as well as lightships, especially of Sir William Preece's system of conductive transmission.

Said Sir William Crookes of electromagnetic waves: "Here is unfolded to us a new and astonishing world, one which is hard to conceive should contain no possibilities of transmitting and receiving intelligence."

1893 (February)—Nikola Tesla, in lecture before The Franklin Institute, Philadelphia, described a plan for wireless transmission of power.

International Electrical Congress at Chicago adopted the "henry" as the unit of electrical inductance—named in honor of Joseph Henry.

1894 (February 23)—Sir William Preece, addressing Royal Society of Arts, declared: "If any of the planets be populated with beings like ourselves, having the gift of language and knowledge to adapt the great forces of Nature to their wants, then they could oscillate immense stores of electrical energy to and fro, in telegraphic order, and it would be possible for us to commune by telephone with the people of Mars."

(June 1)—Sir Oliver Lodge lectured on "The Work of Hertz"; there was no reference to possible application of electromagnetic waves to communication.

3. *The Marconi Era*

1895–1914

Marconi, as a youth of 21, stalked upon the scientific stage in 1895 to startle the world with the announcement that he had flashed and received signals by wireless. Few believed him, but savants of science, aware of electromagnetic waves, realized that perhaps Marconi was right and they too began to test the theory of it all. But Marconi set a fast pace as he began to experiment along the coast of England, almost daily increasing the range of his new communication system. He beamed a message across the English Channel and he sent messages from ships and from shore to ships. He began to win world-wide recognition as Edison, Pupin, and other scientists applauded.

In 1901, in an early but dramatic climax of his career, Marconi flashed the first signal across the Atlantic. And at the turn of the century a galaxy of followers were coming into the field, among them Fessenden, Preece, Lodge, Poulsen, Rutherford, Fleming, and de Forest. These pioneers toiled in a virgin field of research and invention made potent by Thomson's discovery of the electron. Fessenden brought forth the high-frequency alternator and even transmitted music and speech. Fleming contributed the electronic valve detector and de Forest invented the 3-element electron tube, destined to become a heart that would put the

pulse into all radio. Not content merely to send dots and dashes, Korn and others tried to wireless pictures through the air. Ships everywhere were equipped with wireless and a law was enacted to require it.

When in 1912, the S. S. *Titanic*, proud new queen of the Atlantic, met disaster on her maiden voyage, the heroic role of wireless proved beyond all doubt the value of Marconi's immortal work. Wireless took on new world-wide significance as more powerful stations were built; it became daily routine to span the seas and continents with messages carried on the wings of wireless.

1895 Guglielmo Marconi sent and received his first wireless signals on his father's estate at Pontecchio, near Bologna, Italy. To control the electric discharge across a spark gap he used a telegraph key in the primary circuit of an induction coil; a coherer was used as the detector. The aerial comprised a metal cylinder, or elevated conductor, on top of a pole. One terminal of the "spark" discharger was connected to the metal cylinder, thus providing an elevated aerial discharge across the gap to the earth, since the other terminal of the induction coil (discharger) was attached to a metal plate on the ground. The aerial-ground was an innovation; experimenters up to that time had used the two rods of the Hertzian oscillator as an "aerial," but Marconi, by employing an elevated aerial and earth connection, increased the strength and range of the electric signals.

Captain (later Sir Henry) Jackson began wireless

experiments in the British Navy, using a coherer detector; a year later he sent signals between ships.

1895 (May 7)—Alexander S. Popoff at a meeting of the Russian Physicist Society of St. Petersburg, using Hertz apparatus and a coherer, claimed he had solved the problem of wireless; he reported he had sent a signal across 600 yards.

(November 8)—Wilhelm Conrad Roentgen, German scientist, using a Crookes tube in his laboratory at Wurzburg, discovered X-rays when he noted that a sheet of paper coated with barium platinocyanide continued to glow even after the tube was covered by black paper.

1896 (June 2)—Marconi filed application for his original and basic British patent on wireless telegraphy—No. 12,039—and the equivalent American patent, No. 586,193, was granted him on July 13, 1897; it was reissued on June 4, 1901, as No. 11,913.

(August)—Eldridge R. Johnson began making phonograph machines for the Berliner Gramophone Co., in his machine shop at Camden, N. J.; he registered the trademark "Victor" and in 1901 formed the Victor Talking Machine Company and featured in advertising the terrier listening to "His Master's Voice."

(December 12)—Sir William Preece in a lecture at Toynbee Hall, London, announced that Marconi, ". . . a young Italian electrician," had come to him a short time before with a system of telegraphy without wires dependent not on electromagnetic but

on electrostatic effects—electric waves of a high rate of oscillation that projected through space in straight lines.

1896 James Ambrose Fleming in his book, "Principles of Electrical Wave Telegraphy," noted that at beginning of 1896, although the notion of using Hertzian waves for telegraphy had been clearly suggested, no one had overcome the practical difficulties, or actually given any exhibition in public of transmission of intelligence by alphabetic or telegraphic signals by these means.

Marconi sent a wireless signal at Salisbury Plain, England, across a two-mile range.

Henri Becquerel, French physicist, presented proof of the existence of radio-activity and that led to discovery of transmutation of the elements. He was the first scientist to observe the phenomenon of radioactivity; while examining uranium salts he noticed that they spontaneously emitted, without exposure to light, rays of an unknown nature.

Frank L. Capps developed a spring motor to drive the phonograph at a constant speed.

Edison formed the National Phonograph Company.

1897 (May 11)—First wireless messages were exchanged across water by Marconi and George Kemp between Lavernock, on South Wales coast, and Island of Flat Holm, in Bristol Channel, a distance of 3½ miles.

(June 4)—Sir William Preece in a lecture at Royal Institution, London, said "Marconi has not dis-

covered any new rays; Columbus did not invent the egg, but he showed how to make it stand on its end; and Marconi has produced from known means a new electric eye, a new system of telegraphy that will be a great and valuable acquisition."

1897 (July)—The Wireless Telegraph Company and Signal, Ltd., was incorporated in England as the first commercial organization of its kind. In 1900, the name was changed to Marconi Wireless Telegraph Company, Ltd.

(July 20)—Marconi gave the first official demonstration of wireless between ship and shore, from Italian warship San Martino to San Bartolomeo; signals across 11 miles were recorded on a Morse inker on the ship.

After witnessing Marconi experiments in England, Professor A. K. H. Slaby of Berlin wrote, "I saw something quite new, Marconi had made a discovery. He was working with means the entire meaning of which no one before him had recognized."

Sir Joseph John Thomson demonstrated the true character of the electron as the smallest particle of the electrical structure of the atom.

Marconi on tug boat received wireless messages from Needles on Isle of Wight, 18 miles away.

Karl Ferdinand Braun, German scientist, constructed the first cathode-ray oscilloscope capable of scanning with an electron beam; he also devel-

oped the Braun wireless system and shared the Nobel prize for physics with Marconi in 1909.

1897 Prof. A. K. H. Slaby published a book, *Spark Telegraphy,* in Berlin; he described signaling over distances from 3 to 13 miles.

1898 (June 3)—First paid radio message was sent from the Needles, Isle of Wight station, by Lord Kelvin to Sir William Preece and Sir George Stokes. The message read: "This is sent commercially paid at Alum Bay for transmission through ether one shilling to Bournemouth and thence by Postal Telegraph fifteen pence to Cambridge."

(July)—Discovery of polonium was announced by Marie and Pierre Curie of France.

(July 20)—Kingstown regatta off Ireland was reported by wireless to a Dublin newspaper from the steamer *Flying Huntress.*

(August)—Lloyd's installed a wireless station on the northeast coast of Ireland; also at Rathlin Island Lighthouse and another at Ballycastle.

(October 14)—Dr. James Ambrose Fleming, writing in *The Electrician* said, "All honor is due Marconi for having been the first to bring prominently forward before official bodies and the public the possibility, and, indeed, the eminent practicability of using Hertzian waves for telegraphing between two places not connected by an electrical conductor."

(December)—Marie and Pierre Curie (France) announced discovery of a new radioactive substance

containing a new element, which they named radium.

1898 (December)—Marconi demonstrated practicability of wireless between South Foreland Lighthouse and East Goodwin Lightship, 12 miles apart.

1899 A theoretical treatise published by Arnold Sommerfeld, of Germany, described a surface wave guided by a cylindrical conductor of finite conductivity. (The idea was revived in March, 1950, when Dr. Georg Goubau, a scientist employed by U. S. Army Signal Corps, called attention to its applications to television.)

(March 27)—Marconi signaled by wireless across the English Channel for the first time.

(April 22)—The first French gunboat was equipped with wireless at Boulogne.

(April 28)—Steamer *R. F. Mathews* collided with East Goodwin Sands Lightship and flashed the first wireless call for assistance.

(April)—United States Army Signal Corps established wireless communication between Fire Island and Fire Island Lightship, a distance of twelve miles, and later between Governor's Island and Fort Hamilton.

(July)—Marconi wireless on H.M.S. *Alexandria, Europa* and *Juno* was used for the first time during British Naval maneuvers; messages were exchanged up to 75 miles.

1899 (September 21)—Marconi arrived in the United States for the first time to wireless bulletins of the America Cup races off New Jersey coast.

(November 15)—First information for a newspaper ever produced at sea, *The Transatlantic Times,* was transmitted from wireless station at Needles, Isle of Wight, and printed on S.S. *St. Paul,* when it was 56 miles distant.

(November 22)—Marconi Wireless Telegraph Company of America was organized; Augustus Treadwell, Jr., was named President on November 28.

Professor John Ambrose Fleming joined Marconi research staff.

1900 Sir Oliver Heaviside (died February 4, 1925) and Professor Arthur E. Kennelly (died June 18, 1939) suggested theory of "radio mirror" known as Kennelly-Heaviside surface, a reflecting medium in the upper levels of the atmosphere.

(February 8)—John Stone Stone applied for a U. S. patent on tuning, and it was allowed on February 2, 1902 (No. 714,756).

(February 18)—First German commercial wireless station was opened on Borkum Island.

(February 28)—S.S. *Kaiser Wilhelm der Grosse* was equipped with wireless and left port as the first seagoing passenger vessel to carry such service. Borkum Island heard it sixty miles away.

1900 (April 25)—Marconi International Marine Communication Company was incorporated.

(June)—Nikola Tesla, writing in *Century Magazine*, described the principle of radar—"a wave reflected from afar . . . We may determine the relative position or course of a moving object, such as a vessel at sea, the distance traversed by the same, or its speed."

(November 2)—Belgian ship, *Princesse Clementine*, plying between Ostend and Dover, was equipped with Marconi wireless, and a Marconi station was completed at LaPanne, near Ostend.

Michael Pupin invented the loading coil that improved long distance telephony.

Marconi filed application for his famed patent No. 7777 for a "tuned" or synchronized system of wireless; it was granted on April 26, 1900.

William D. Duddell of England found that an electric arc could be made to generate high frequency energy, in fact, to "sing"; he produced continuous oscillations at a frequency of about 10,000 a second.

(December)—Professor Reginald A. Fessenden first transmitted speech by wireless using a spark transmitter at Cobb Island, Va.

1901 Steamer *Lake Champlain* was first British merchant vessel to be fitted with Marconi wireless.

(January 1)—The barque *Medoro* was stranded and waterlogged on Ratel Bank; *Princesse Clementine*

happened to pass and sent a message to LaPanne station to send assistance.

1901 (February 11)—Wireless communication across 196 miles was established between Isle of Wight and the Lizard station.

(March)—Public wireless service was inaugurated between five principal islands of the Hawaiian group.

(June 15)—S.S. *Lucania* was first Cunard liner to sail equipped with Marconi apparatus; S.S. *Campania* was second, on September 21.

(September 28)—Professor Reginald A. Fessenden applied for United States patent on "improvements in apparatus for wireless transmission of electromagnetic waves, said improvements relating more especially to the transmission and reproduction of words or other audible signals." He contemplated use of an alternating current generator having a frequency of 50,000 cycles a second.

(November 26)—Marconi, accompanied by his two assistants, Kemp and Paget, sailed from Liverpool on S.S. *Sardinian* to prepare for transatlantic test between Poldhu on the southwest tip of England, and St. John's, Newfoundland, where they landed on December 6.

Sir John W. Barry, Chairman of Eastern Telegraph Co., and Francis Bevan of Anglo-American Telegraph Co., at annual meeting quoted early statements by Sir William Preece and Sir Oliver Lodge: "Submarine cable enterprise has nothing to fear in

a commercial sense from competition of etheric telegraphy; . . . it is manifest that wireless cannot compete with cable methods in point of secrecy or certainty."

1901 British Victor Talking Machine Company began using noted opera singers, and in 1903 under the name "Monarch" marketed recordings of celebrated European singers; in 1904 Victor released its first "Red Seal" list of artists.

DeForest Wireless Telegraph Company was organized.

(December 12)—Marconi, with two assistants, P. W. Paget and G. S. Kemp, at St. Johns, Newfoundland, picked up the first transatlantic wireless signal, the letter "S" sent from the transmitter at Poldhu.

1902 (January 13)—Marconi honored by American Institute of Electrical Engineers at dinner, Waldorf-Astoria, New York, in celebration of first transatlantic signal; among the guests were Alexander Graham Bell, Elihu Thomson and Steinmetz.

(February 10)—First patent on "FM," or frequency modulation, was applied for by Cornelius D. Ehret, of United States, and was issued on March 28, 1905.

(February)—Marconi on S.S. *Philadelphia* enroute to Canada received messages from Poldhu and recorded them on tape up to 1551 miles.

(June 25)—Marconi introduced the magnetic detector and conducted tests on board the Italian cruiser *Carlo Alberto*.

1902 Electrolytic detector was introduced by Professor R. A. Fessenden.

The National Electric Signaling Company was formed with Fessenden's wireless patents as its backbone.

Fessenden shifted his wireless experiments from Roanoke Island, North Carolina, to Old Point Comfort, Virginia; early in 1903, using a spark transmitter, he sent wireless telegraph signals from Old Point Comfort to Cape Charles, about 25 miles.

Western Union Telegraph Co., operating more than 1,000,000 miles of telegraph lines and two transoceanic cables, reported gross revenue of $29 million; Postal Telegraph Co., with 266,000 miles of wire lines and four cables (Commercial Cable) gross of $10 million.

(July)—Marconi on board Italian cruiser *Carlo Alberto*, visited St. Petersburg and demonstrated his wireless apparatus to Russian officials as he established wireless communication between Russia and Britain for the first time.

(July 14)—Marconi on Italian cruiser *Carlo Alberto*, at Cape Skagen, received a message from Poldhu, 800 miles distant, and from Kronstadt, 1600 miles.

(December 17)—First west-east transatlantic wireless messages were sent by Marconi from Glace Bay to England.

1903 Valdemar Poulsen of Denmark applied "the singing arc" to wireless transmission; he produced con-

tinuous oscillations at a frequency of 100,000 a second, and in 1904 transmitted voice over appreciable distances.

1903 Message from President Theodore Roosevelt to King Edward of England sent via station WCC, South Wellfleet, Cape Cod, was received at Poldhu.

First ocean daily newspaper instituted on board S.S. *Campania*, with dispatches supplied by wireless.

(August 4)—Germany called a special international wireless conference in Berlin and proposed that all coastal stations be required to accept wireless messages regardless of the system they used. Marconi interests opposed but five years later all coastal stations were open to all senders.

First high-frequency alternator built by General Electric Company was based on specifications by Fessenden; it was a 10,000-cycle machine. (In 1906 a second alternator was built to operate at 80,000 cycles, and Fessenden used it to broadcast music and speech from Brant Rock, Mass.)

1904 (February 1)—CQD was adopted by the Marconi Company as the wireless call of distress.

(April 28)—John W. Griggs was elected President of the Marconi Wireless Telegraph Company of America.

Fessenden at Schenectady, N. Y., conducted radiophone experiments over a few hundred feet, using a miniature high-frequency alternator; from there

he went to Brant Rock, Mass., for further experiments.

1904 (August 15)—Great Britain passed a Wireless Telegraph Act.

Wireless apparatus was displayed as one of the marvels at St. Louis World's Fair.

De Forest patented the phonofilm—sound on film aimed to produce talking movies.

Fessenden moved his wireless experiments from Old Point Comfort to Brant Rock, Mass., where he continued development of the high-frequency alternator and a heterodyne "beat" receiver.

(November 16)—Professor John Ambrose Fleming, of England, applied for a British patent on the two-element thermionic valve detector. It was granted as No. 24,850 and was assigned automatically to the British Marconi Company under his consulting contract. U. S. Patent No. 803,684 was granted on April 19, 1905.

1905 Marconi patented a horizontal directional transmitting aerial and predicted that he would soon be able to reach the Antipodes more easily than nearby places.

Dr. Albert Einstein, through his theory of relativity, laid the foundations of a better understanding of the fundamental sources of energy in the universe; he conceived that matter is itself convertible into radiant energy. Einstein set up the equation $E = mc^2$,

in which m is mass in grams, c is the speed of light in centimeters (30 billion centimeters a second) and E is energy in ergs.

1905 Edison's phonograph company secured Metropolitan Opera stars for its recordings, and featured "Diamond Disk" records.

(May 4)—Judge William K. Townsend, U. S. Circuit Court in action of Marconi Wireless Telegraph Co. of America vs. DeForest Wireless Telegraph Co., declared, "Marconi was the first to describe and the first to achieve the transmission of definite and intelligible signals by means of the Hertzian waves . . . Other inventors, venturing forth on the sea of electrical movement, met the rising tide of Hertzian waves and allowed them to roll by without appreciating that this new current was destined to carry onward the freight and traffic of the world commerce . . . Marconi, daring to hoist his sail and explore the unknown current, first disclosed the new highway."

Tungsten filament patents of Just and Hanaman purchased by General Electric Co., and Dr. W. D. Coolidge filed for a patent on ductile tungsten; it was granted in 1912 as U. S. Patent No. 110,8505.

The New York Times received eye-witness wireless reports of naval battle off Port Arthur in Russo-Japanese war.

1906 Ettore Bellini and Alessandro Tosi of Italy pioneered in the development of radio direction finders.

1906 Rignoux and Fournier, French physicists, used selenium cells to construct an artificial retina. Each cell was linked by wire to a shutter that opened when light actuated the cell.

Telefunken arc system of wireless telegraphy was developed and covered a distance of 25 miles.

Lee deForest invented and applied for a patent on the 3-element vacuum tube with a filament, plate and grid; he called it "the audion." He also connected the "B" battery in circuit with the plate and filament, thereby increasing the effectiveness of the tube as a detector and amplifier.

(November)—Macrahanish, Scotland, picked up Fessenden radiotelephone talk at Brant Rock, Mass. Signals sent to Scotland by 500-cycle spark apparently carried the voice, possibly because the spark aerial was coupled in some way with the radiotelephone transmitting aerial.

General H. C. Dunwoody discovered the rectifying properties of carborundum crystals and Greenleaf Pickard discovered similar properties of silicon, thus leading to development of crystal detectors.

(December 11)—Wireless telephone demonstration by Fessenden at Brant Rock, Mass.; attended by Dr. Arthur Kennelly of Harvard and Prof. Elihu Thomson.

(December 24)—Fessenden's broadcast of phonograph music and speech, using the high-frequency alternator at Brant Rock station, was picked up by

ships off the Virginia coast. (Fessenden patent No. 706,747 described as "the first patent issued for voice transmission by electromagnetic waves.")

1906 Speech was transmitted by Fessenden between Brant Rock and Plymouth, Mass., by wireless using high-frequency alternator.

1907 Coherer was replaced by the crystal, magnetic, thermal, and electrolytic detectors.

(January 15)—Patent No. 841,387 granted Dr. Lee de Forest (application filed Oct. 25, 1906) including broad claims covering the audion, or 3-element electron tube, as an amplifier; grid electrode audion patent No. 879,532 (filed on January 29, 1907) was granted on February 18, 1908.

United Wireless Telegraph Company was organized with assets transferred from the American de Forest Wireless Telegraph Company.

Lee de Forest demonstrated wireless telephony between a Lackawanna ferry and the Hoboken and Manhattan terminals.

Arthur Korn sent a picture of President Falliéres of France by wire from Berlin to Paris in twelve minutes.

Boris Rosing (Russia) and A. A. Campbell-Swinton (England) separately and simultaneously published methods of electrical image reproduction using electromagnetic means of scanning.

(October 17)—Commercial wireless service began between Clifden, Ireland, and Glace Bay, Nova Scotia.

1907 (October 30)—Sir John Wolfe-Barry, presiding over stockholders meeting of the Western Telegraph Co., Ltd., remarked, "As far as I can judge, I do not look upon any system of wireless telegraphy as a serious competitor with our cables. Some years ago I said the same thing and nothing has since occurred to alter my views."

1908 (February 2)—S.S. *St. Cuthbert* on fire off Sable Island was sighted by S.S. *Cymric*, from which a newspaper correspondent sent story by wireless to *The New York Times* and *Chicago Tribune.*

(February 3)—Marconi transatlantic wireless stations were opened to the public for transmission and reception of Marconigrams between England and Canada.

(February 18)—Dr. Lee de Forest was granted patent No. 879,532 on the 3-element electron tube, which he called the "audion"; application for patent filed on January 29, 1907.

(June)—A. A. Campbell-Swinton in a letter to *Nature* magazine, entitled "Distant Electric Vision," suggested that the photoelectric effect, discovered in 1873, was the key to electric vision.

Fessenden constructed a high-frequency alternator with an output of 2.5 kilowatts and with a frequency of 70,000 cycles a second.

U. S. Army Signal Corps conducted radiotelephone experiments over 18 miles between Sandy Hook and Bedloes Island; Telefunken apparatus with 10

electric arcs supplied 550-volt direct current and a carbon microphone was used; odd bits of conversation and phonograph music were heard occasionally.

1908 International Radio Telegraphic Conference at Berlin proposed SOS as wireless distress call instead of CQD.

Poulsen developed an arc transmitter that covered 150 miles on the first test.

1909 (January 2)—Junior Wireless Club, Ltd., organized with W. E. D. Stokes, Jr., as president. Name of organization changed to Radio Club of America in 1911; Frank King, first president.

(January 23)—S.S. *Republic* collided with S.S. *Florida* off New York; Jack Binns, the wireless operator of the *Republic*, sent the CQD and summoned assistance, thereby proving the value of radio in time of disaster at sea; call letters of *Republic* were MKC.

(September 5)—Wireless message sent from Indian Harbour, Labrador, by Robert E. Peary, to *The New York Times* said, "I found the Pole, I reached it on April 6, 1909."

Guglielmo Marconi and Karl F. Braun, who developed the cathode-ray tube, shared the Nobel Prize in physics.

1910 (January 7)—Steamship *Puritan* caught in ice in Lake Michigan flashed SOS and tugs went to the rescue of fifteen passengers.

1910 (January 13)—Enrico Caruso and Emmy Destinn sang in de Forest radiophone (arc transmitter) broadcast from backstage of the Metropolitan Opera House. It was picked up by S.S. *Avon* at sea and in Bridgeport, Conn. Forty years later de Forest remarked: "I used the arc because I had yet to discover that the audion would oscillate."

(January 30)—"Television on the Way" headlined article in Kansas City *Times* reporting on experiments by M. Georges Rignoux and M. Fournier at La Rochelle, France. They asserted, "We hope soon to transmit the colors as well."

(April 23)—Marconi transatlantic America-Europe service was opened.

(June 24)—United States Radio Act made it unlawful, after July 1, 1911, for any passenger ship carrying more than 50 persons, including passengers and crew, plying between ports more than 200 miles apart, to leave port in United States unless wireless equipped and with a skilled operator. The Act as amended in 1912 specified two operators on constant watch, and scope of the Act was extended to cargo vessels.

(July 10)—Wireless played its first "detective" role when Captain Kendall of S.S. *Montrose* approaching Canada was notified by Scotland Yard that two fugitives, Dr. H. H. Crippen and Ethel le Neve, were on board.

(September 9)—Patent application on single-control tuner was filed by John V. L. Hogan; issued as patient No. 1,014,022 on January 9, 1912.

1910 Marconi sent wireless messages from Ireland to Buenos Aires.

S.S. *Principessa Mafalda* received signals from Clifden, Ireland, across 4000 miles by day and 6735 at night.

Godfrey Isaacs was appointed Managing Director of British Marconi Company.

1911 King George V and Queen Mary on way to India aboard H.M.S. *Medina* kept in close touch with London by wireless and on November 15 received the first Court Circular dispatched by wireless.

(July 1)—Department of Commerce organized radio division to enforce Act of June 24, 1910.

Radiotelephone covered 350 miles between Nauen, Germany, and Vienna, Austria.

1912 Frederick A. Kolster, of the Bureau of Standards, developed a decremeter to make direct measurements of radio wavelengths. (Kolster died July 24, 1950, at San Francisco.)

(February)—Marconi Company procured Bellini-Tosi patents, including the direction finder.

Dr. Irving Langmuir concluded that a pure electron discharge was necessary to make de Forest 3-element tube effective as an amplifier, and he developed a high vacuum tube to prove his contention.

Dr. Harold D. Arnold, AT&T physicist, suspected that instability of the de Forest audion was caused

by gas ionization, and that the defect could be remedied by increasing the vacuum. He also proposed oxide-coated cathode instead of tantalum filament as used by de Forest.

1912 De Forest, working in Federal Telegraph laboratory at Palo Alto, Calif., discovered the 3-element tube could also be used as an oscillator to generate electromagnetic waves; he called it the "ultraaudion."

De Forest instituted new experiments with 3-element tubes in cascade and obtained greatly increased amplification.

(February 3)—First Australian Commonwealth wireless station was opened.

(April 14)—S.S. *Titanic* disaster proved the value of wireless at sea. Seven hundred lives were saved; call letters of *Titanic* were MGY; wireless operators were John G. Phillips and Harold Bride.

(May 13)—Institute of Radio Engineers formed by merger of The Wireless Institute and the Society of Wireless Telegraph Engineers. Robert H. Marriott was first president of I.R.E.

United Wireless Telegraph Company bankrupt and its assets were acquired by British and American Marconi Companies, thereby gaining control of 400 ship wireless installations and 17 land stations previously controlled by United Wireless.

(July 5)—International Radio Telegraphic Conference in London approved regulations to secure uniformity of practice in radio services.

1912 United States Naval Radio Station NAA opened at Arlington, Va.

Marconi patented "the timed spark system" by which exceedingly long waves could be employed (14,000 meters and longer).

R.M.S. *Mauretania* was first British merchant ship equipped with a radio direction finder.

(July 23)--Act approved by United States Government extending Act of June 24, 1910, to cover cargo vessels and requiring auxiliary source of power, efficient communication between wireless cabin and bridge, and two or more skilled wireless operators in charge of apparatus on certain passenger ships.

(August 13)--United States Government approved Act licensing radio operators and transmitting stations.

(October)--De Forest demonstrated use of electron tubes in cascade as telephone repeaters, and in 1913 AT&T purchased telephone repeater rights in the triode for $50,000.

1913 United States and French Governments cooperated between Arlington and Eiffel Tower to procure data for comparing velocity of electromagnetic waves with that of light.

Tests between the U. S. Navy's Fessenden equipped station at Washington and cruiser *Salem* revealed superiority of heterodyne reception developed by Fessenden.

(June)--Radiotelegraph Act of Canada passed by Parliament at Ottawa.

1913 Station POZ, Nauen, Germany, sent a message 1550 miles.

Dr. William David Coolidge developed a "hot" cathode-ray tube and made useful developments in X-ray tubes.

(September)—Prince Albert, ruler of principality of Monaco, sailed into New York habor on his yacht *Hirondelle* equipped with a wireless piano.

(October 9)—SOS from S.S. *Volturno* on fire at sea brought ten vessels to the rescue; 675 passengers and crew were saved.

(October 29)—Edwin H. Armstrong filed application for a patent on the regenerative, or "feed-back" circuit; patent No. 1,113,149 was granted on October 6, 1914.

(November 12)—Safety at Sea Conference was held in London and wireless received major consideration.

(November 24)—Wireless tests were made on Delaware, Lackawanna & Western Railroad between Hoboken and Buffalo.

1914 Direct communication was established between WSL, Sayville, on Long Island and POZ, Nauen, Germany, and between Tuckerton-Elvise.

Laws were formulated by foremost maritime nations requiring vessels of certain size and grades to carry wireless apparatus and operators.

1914 United States District Court, Eastern District of New York, in opinion handed down by Judge Van Vechten Veeder, upheld validity and priority of Marconi's patents.

Motor lifeboats of S.S. *Aquitania* were equipped with wireless, marking a new departure in the application of radio to safety of life at sea.

(March 15)—Two Italian warships off Sicilian coast received radiophone messages from Clifden, Ireland, 1750 miles distant and from Rome, 300 miles. While 45 miles apart officers of the ships conversed by radiotelephone. As a result, Marconi predicted, "the day is not far off when the human voice will cross the Atlantic."

(March 20)—Dr. Lee de Forest filed an application for a patent on the regenerative or "feed-back" circuit; the patent No. 1,507,017 was granted on September 2, 1924. He also filed an application on the external type of "feed-back" on September 23, 1915, which became patent No. 1,507,016, also granted on September 2, 1924.

(April 15)—Memorial was unveiled at Godalming, England, in honor of "Jack" Phillips, chief operator of ill-fated *Titanic*, who died at his post.

(May 29)—S.S. *Empress of Ireland* collided with Norwegian collier, *Storstad*, in fog on St. Lawrence River and flashed SOS; rescue ships rushed to the scene; 1023 were lost out of 1467 persons aboard, but without wireless it was believed few would have been saved.

1914 (June 28)—Wireless carried the news of the assassination of Archduke Francis of Austria, that touched-off World War I.

(July 28)—Wireless from France and Germany flashed the news that the German army had invaded France.

(July 30)—The British First Fleet, which had just left Portland following a naval review at Splithead, was recalled by wireless and ordered not to disperse.

(August 1)—Britain advised Berne that wireless telegraphy, except on British warships, would be suspended on all vessels in waters around the British Isles.

(August 4)—German wireless stations flashed "War declared on England; make as quickly as you can for a neutral port." Seven hours later Britain declared war on Germany.

(August 4)—Wireless message from Nauen, Germany, told *Kronprinzessin Cecile*, 850 miles off Irish coast, to dash for a neutral port with the $10,000,000 gold on board. It surprised residents of Bar Harbor, Maine, by arriving there several days later.

(August 8)—S.S. *Mauretania* bound for New York was warned by wireless to change her course immediately for Halifax.

(August 16)—British Expeditionary Force landed in France; Japan declared war on Germany, August 23.

1914 (September 24)—California-Honolulu wireless circuit was opened by the Marconi Wireless Telegraph Company of America.

(October 6)—Edwin H. Armstrong was issued patent No. 1,113,149, covering regenerative circuit known as the feed-back or self-heterodyne circuit; application for patent was filed on October 29, 1913.

Marconi turned his attention to adapting radio to warfare, including short waves, secret communication, direction finders, and "narrow-casting" by the use of parabolic reflectors and radio beams.

4. *Radio During World War I*

1915–1919

The outbreak of World War I put unprecedented demands upon radio scientists to rush developments that would extend radio services across the war zones of the oceans and to the battlefronts. Before long, radiotelephone from New York was heard in Paris and in Hawaii. New impetus was given to the possibilities of using short waves previously considered as the "graveyard of wireless" because of their seeming ineffectiveness. But with the electron tube coming into action a realization of the possibilities of short-wave communication became more and more apparent.

When the war ended in 1918, it was evident that the radiotelephony, electron tubes, and short waves were destined to play vital roles in the future of radio. Aircraft flew across the Atlantic for the first time equipped with radio. With wireless capable of talking and singing, chiefly because of wartime developments of electron tubes and microphones, it became apparent that many of the devices of old were to be relegated to the archives of the past and that dots and dashes would be supplemented by a means of mass communication to be known as the radiophone, or broadcasting.

1915 (January)—American Radio Relay League of radio amateurs formed by Hiram Percy Maxim.

(January 25)—First transcontinental telephone wire line officially opened by AT&T between New York and San Francisco.

(February 20)—Panama-Pacific Exhibition at San Francisco was officially opened by President Wilson at Washington, by means of a wireless signal.

(March 3)—Major Edwin H. Armstrong read a paper at meeting of Institute of Radio Engineers on "Some Recent Developments of the Audion Receiver," which described the feed-back circuit and how the audion functioned.

(May 7)—SOS flashed by S.S. *Lusitania* sunk by the German submarine U-20 off the coast of Ireland; 1195 lives were lost, including 124 Americans.

Radio direction finders used by British War Office to locate and follow movement of Zeppelins and German warships.

(May)—Marconi intrigued by General Electric demonstration of high-frequency alternator, and as result a tentative agreement was drawn up whereby Marconi Companies would have exclusive rights to its use while GE retained exclusive manufacturing rights. The first 50-KW alternator was installed at Marconi station, New Brunswick, N. J., and transatlantic tests began in July, 1917.

(May 12)—Monument in Battery Park, New York,

was unveiled in honor of wireless operators who lost their lives at posts of duty.

1915 (May 22)—Marconi predicted "visible telephone" as he sailed from New York for Rome upon request of King Victor Emmanuel because of Italy's entry into World War I.

Dr. F. A. Kolster at the Bureau of Standards developed a movable coil type radio compass.

(July 8)—U. S. Government has Navy personnel assigned to operate the receivers and for censorship at the German wireless station, Sayville, L. I. Charles E. Apgar, radio amateur and owner of station W2MN, Westfield, N. J., had recorded coded messages from the Sayville station informing submarines of neutral ship movements. Apgar died at age 85, on August 17, 1950.

(July 27)—Wireless communication was established between United States and Japan via relay through Honolulu.

(July 28)—American Telephone and Telegraph Company, working in conjunction with Western Electric engineers at Arlington, Va., succeeded in telephoning by radio to Paris, 3700 miles, and to Hawaii, 5000 miles.

(August)—David Sarnoff, Assistant Traffic Manager of Marconi Wireless Telegraph Company of America, proposed a "radio music box" and outlined the future possibilities of public broadcasting as well as its popular appeal.

1915 J. J. Carty, Chief Engineer of AT&T, said, "The results of long distance tests (radiotelephone) show clearly that the function of the wireless telephone is primarily to reach inaccessible places where wires cannot be strung."

1916 Determination of the difference in longitude between Paris and Washington with assistance of radio which had been in progress since 1913 was completed. The result, expressed in terms of time as 5 hours 17 minutes and 35.67 seconds, had a probable accuracy of 0.01 second.

Marconi assigned C. S. Franklin, engineer, to reexplore use of short waves; Marconi pointed out that he believed wireless "had perhaps got rather into a rut by confining practically all researches and tests to waves of some thousands of feet in length."

(May 30)—Radio direction finders enabled British to detect movement of German warships at Wilhelmshaven and in North Sea, and Grand Fleet went out to meet them in Battle of Jutland; it was first use of radio direction finders in a major strategical operation.

(June)—Marconi semi-continuous "timed disk" transmitter equipment was installed at Carnarvon, Wales. It was called the "Rock Crusher," and it sent the first message directly from Carnarvon to Australia.

(September)—David Sarnoff, Assistant Traffic Manager of the Marconi Wireless Telegraph Company of America, in a memorandum to E. J. Nally, Vice President and General Manager, revived his recommendation of 1915 suggesting the manufacture of

"radio music boxes" and said it was reasonable to expect sales of a million such "boxes" within a period of three years after they were placed on the market.

1916 (September 20)—De Forest "gas detector" of wireless waves described as "utterly useless" in decision of District Court, Marconi Wireless Telegraph Company of America *vs* De Forest Radio Telephone & Telegraph Company.

(November 5)—President Wilson and Mikado of Japan exchanged radiograms at opening of trans-Pacific circuit.

(November 7)—De Forest experimental radiophone station opened at High Bridge, N. Y., election bulletins were heard by wireless amateurs within a radius of 200 miles.

(November)—Station 2ZK, New Rochelle, operated by George C. Cannon and Charles V. Logwood, broadcast music between 9 and 10 P.M., daily, except Sunday.

1917 E. F. W. Alexanderson designed 200-KW high-frequency alternator making world-wide wireless possible.

(April 6)—United States declared a state of war existed with Germany; all amateur wireless stations in the United States were closed.

(April 7)—President Wilson directed the U. S. Navy to take over all wireless stations in the United States and its possessions, not already under control of the Army.

1917 German submarines eluded Allied listening posts by use of short waves (75 meters).

(June 2)—Wireless "becomes of age" in England; twenty-one years had passed since the registration of Marconi wireless patent No. 12,039 in 1896.

1918 Charles A. Hoxie installed high-speed wireless recorder at Naval radio station NBD, Otter Cliffs, Me., to copy messages from Lyons, France.

Radiotelegraph and radiophone conclusively proved their tremendous importance in warfare during World War I.

Progress toward continuous-wave radio as distinct from damped waves was marked, chiefly because of the electron tube as a generator of undamped oscillations. Wireless telephony also forged ahead.

High-power radio station built by the United States was opened at Croix d'Hins, near Bordeaux, and was called the Lafayette station.

Erection of a high-power station near Buenos Aires was begun to communicate directly with North America.

Application of wireless to ships continued and at the end of the year between 2500 and 3000 vessels in the British Merchant Marine carried transmitters and receivers.

(April)—High-power station LCM was opened at Stavanger, Norway. The signal was clearly heard in the United States.

1918 (July 31)—United States Government took over all wireless land stations in the country, with exception of a few high-power transmitters which remained under control of commercial organizations.

(September 22)—Sydney, Australia, heard wireless from Carnarvon, Wales, 12,000 miles. Confirmation of dispatches sent by cable at the same time arrived several hours later.

(November 11)—Wireless from France and Germany announced signing of the Armistice, ending World War I.

1919 (February 8)—Major E. H. Armstrong filed application for superheterodyne patent which was granted on June 8, 1920.

(February)—Spanish decree specified that all sailing vessels of 500 tons or more and carrying fifty or more passengers must be wireless equipped.

The "spark" and "arc" era in radio transmission began to give way to the electron tube.

President Wilson went to Peace Conference in Paris while wireless on board the U.S.S. *George Washington* maintained communication with shore; spark and arc transmitters were used.

(May)—U. S. Navy NC-flying boats used radio on transatlantic flight; NC-4 succeeded in reaching Lisbon, Portugal and Southampton, England.

(June 14-15)—Alcock and Brown flew from Newfoundland to Ireland in first nonstop transatlantic

flight; no radio on board, although it was rumored a radio direction finder on board guided them to land near the Clifden, Ireland, wireless station.

1919 Expenditure of $500,000 authorized by AT&T for wireless development, including a $360,000 marine transmitter at Deal Beach, N. J., and a receiving station at Cliffwood, N. J.

(June 30)—There were 2312 ship stations licensed by the United States, an increase from 1478 since June 30, 1918, chiefly due to number of vessels built for war.

(July 4)—President Wilson, returning from Peace Conference on board U.S.S. *George Washington*, made July 4 address to crew and his voice was heard in a broadcast to shore; 126-meter wave; reception was indistinct.

British dirigible *R-34* crossed Atlantic from Scotland equipped with an electron tube transmitter, arrived July 7 at Mineola, L. I., after 108-hour voyage.

(August 24)—United States Signal Corps broadcast service of Trinity Church at Third and D Streets, Washington, D. C.

British Parliament passed bill specifying that all merchant vessels of 1600 tons or more under English flag must carry wireless. This made permanent a temporary war measure.

Radiophone linked England and Canada by use of electron tube transmitters.

1919 (October 17)—Radio Corporation of America was formed; a charter was granted under the corporation laws of the State of Delaware; Owen D. Young, Chairman of the Board; E. J. Nally, President.

(November 20)—Business and property of the Marconi Wireless Telegraph Company of America were acquired by Radio Corporation of America.

(November)—Station 8XK, Pittsburgh, operated by Frank Conrad, started private broadcasting. (Later KDKA.)

Total radio manufacturing business in United States estimated at $7,000,000 (commercial and amateur equipment).

(December 19)—Major E. H. Armstrong described development of superheterodyne circuit to Radio Club of America.

5. *Opening of the Broadcasting Era*

1920–1929

The "radio music box" developed along with the radiophone during World War I attracted amateur wireless operators when wartime restrictions were lifted, and through their efforts broadcasting began. It started in Pittsburgh, and spread as a "craze" across the land. "The Electronic Age" was evolving. Everything in radio was under change as the electron tube began to supplant the high-frequency alternators and spark transmitters; crystal detectors also gave way to the wondrous tubes which could not only detect but amplify and oscillate.

Broadcasting opened a new chapter in American life. By 1926, when nation-wide network operations began, homes throughout the country were within the sound of a single voice. Sports, drama, opera, and voices of distinction from the musical world took to the air in sound, as did the President of the United States, the national political convention orators and election campaigners.

Almost overnight it occurred to the broadcasters that here was a new mass medium of advertising and as a result commercial sponsorship of radio was introduced. New stations went on the air at a fast and furious pace and new inventions were heralded almost daily as broadcasting continued

to grow and to become a great industry and a new service to the public.

Before long, programs were being picked up from across the seas and broadcasting became international as it reached nation after nation and people everywhere. New laws were legislated to guide its growth. People in the news became known to millions of Americans by the sound of their voices from Coolidge to Al Smith, from Lindbergh to Byrd, from Al Jolson to Bob Hope.

Sound was so successful in encircling the earth that scientists accepted the challenge of television. If a song could go around the earth and a portrait across the sea as a radiophoto, then why not a picture in motion? Before long a face televised in London was seen 1000 miles at sea, and one was reported seen across the Atlantic in 1928. A year later Zworykin demonstrated the first all-electronic television receiver with his famous kinescope, or picture tube. And he put it to work in tandem with his iconoscope—the electronic eye of the camera—to complete the all-electronic system.

The magic touch of electronics seemed to be everywhere. The phonograph was electronized and combined with radio; the silent pictures became talkies. Radio had not only encircled the earth but by short waves fliers over the North Pole and the South Pole flashed the news of their winged explorations. The impact of the radio-electronic evolution was reaching millions of people, bringing them entertainment, education and news with split-second precision.

1920 (January 14)—Greece passed a law that made carrying wireless equipment obligatory on all Greek merchant ships of 1600 gross tons or over, or having 50 persons on board including the crew.

1920 (January 25)—High-power station LPZ was opened at Mont-Grande, Argentina.

(February 29)—High-power stations under United States Government control during World War I were turned over to RCA, and commercial long-distance radio communication service was inaugurated between the United States and foreign countries.

(March 1)—First messages opening commercial service over RCA transatlantic circuits, since RCA's organization in 1919, were sent between New York and London. E. J. Nally, President of RCA, opened the service with greetings to Godfrey Isaacs, Managing Director of Marconi Wireless Telegraph Company, Ltd., who responded in a message of reply.

A tract of land covering ten square miles was acquired by RCA on Long Island at Rocky Point and Riverhead for the construction of a "Radio Central," dedicated to world-wide communication.

American radio amateurs reorganized their forces, now reinforced many thousands of times by war-trained radio men, and began to turn their attention to radiotelephony and short waves.

Installation of 200-KW Alexanderson high-frequency alternators for international communication began at Bolinas, Calif., Marion, Mass., and Kahuku, Hawaii.

First commercial radio link connecting to land telephone line was put into operation between Santa Catalina Island and California mainland; distance 31½ miles.

1920 Marconi new automatic SOS alarm was demonstrated at Chelmsford, England.

(July 21)—S.S. *Victorian* equipped with radiophone sent telephone messages to Chelmsford station in England, over a distance of 600 miles.

(July 22)—S.S. *Victorian* picked up a concert from Chelmsford, 900 miles distant; and three days later over 1530 miles; *Victorian* broadcast phonograph records over its radiotelephone.

(August 20)—Radiophone station 8MK (became WWJ, July 7, 1922) opened by Detroit *News* (broadcasting license issued October 13, 1921).

(November 2)—Station KDKA, Pittsburgh, broadcast the Harding-Cox election returns.

1921 (January 2)—First religious service broadcast by KDKA from Calvary Episcopal Church, Pittsburgh, Pa., was initial outside pick-up of a broadcast. Dr. E. J. VanEtten was the Minister.

(January 15)—Herbert Hoover's address on "European Relief" was broadcast by KDKA from Duquesne Club, Pittsburgh, Pa.; it was his first broadcast.

(January)—200-KW Alexanderson alternator system was installed at Tuckerton, N. J.

(March 19)—Three members of President's Cabinet, Andrew W. Mellon, James J. Davis, and John W. Weeks, made their first broadcasts over KDKA, Pittsburgh, Pa.

1921 (April 11)—First boxing contest to be broadcast was over KDKA, featuring Johnny Ray *vs* Johnny Dundee at Motor Square Garden, Pittsburgh, Pa.

(May 9)—First theatrical program broadcast by KDKA from stage of Davis Theatre, Pittsburgh, Pa.

(June 1)—Station WJZ, a 100-watt transmitter, was licensed at Newark, N. J.

(July 2)—Dempsey-Carpentier fight was broadcast from Boyles Thirty Acres in Jersey City, N. J., by a temporarily installed transmitter operated on 1600 meters, call WJY, at DL&W Railroad terminal building in Hoboken, N. J., Major J. Andrew White announced.

Professor Edouard Branly was awarded Nobel Prize for Physics because of his radio research work, and invention of the coherer, the first detector of wireless waves.

(August 4)—First broadcast of tennis featured Davis Cup matches at Allegheny Country Club, Sewickley, Pa., over KDKA.

(August 5)—National League baseball game at Pittsburgh was broadcast by KDKA; a wire linked the ballpark with the transmitter.

(August 30)—First annual convention of American Radio Relay League was held in Chicago.

(September 27)—Station WBZ opened at Springfield, Mass.

1921 (October 1)—Station WJZ officially opened at Newark, N. J., as the first broadcaster in the metropolitan area. First program featured World Series bulletins.

(November 5)—President Harding formally opened RCA "Radio Central" on Long Island by sending a radiogram addressed to all nations.

(November 11)—Burial services for the Unknown Soldier at Arlington National Cemetery, and President Harding's address carried over telephone wires for loudspeaker reproduction at Madison Square Garden, New York, and the San Francisco Civic Auditorium where crowds assembled.

(November 11)—Station KYW went on the air in Chicago.

(December)—Paul Godley went to Ardrossan, Scotland, and heard twenty-seven radio amateurs in the United States make history in their field by transmitting across the Atlantic on power outputs ranging from 50 to 1000 watts.

(December 14)—Broadcasting station WDY, licensed September 19, 1921, opened at Roselle Park, N. J. (continued until February 15, 1922, when it was amalgamated with WJZ, previously opened at Newark).

Experiments in radio communication with automobiles conducted by Detroit Police Department.

1922 First ship-to-shore two-way radio conversation was established between Bell system's station at Deal Beach, N. J., and S.S. *America*, 400 miles at sea.

1922 S.S. *Gloucester* off the New Jersey coast talked to Bell system's station at Deal Beach, N. J., which relayed voices by wire to Long Beach, Calif., and then by radiophone to the Catalina Islands.

(February 20)—Station WGY, Schenectady, went on the air.

(February 27)—First Annual Radio Conference, pertaining to broadcasting, held in Washington, D. C.

(May 21)—*The New York Times* instituted a Sunday page of radio news and programs.

(May)—Broadcasting stations in United States totaled 80; July, 196; August, 227; December, 569, according to U. S. Department of Commerce.

(May)—500,000 to 700,000 radio sets in United States, according to *Radio Broadcast Magazine.*

(June 20)—Marconi demonstrated to Institute of Radio Engineers his radio beam system of communication that utilized reflectors to concentrate radio energy in much the same way that a searchlight casts a beam of light.

(June 28)—Major Edwin H. Armstrong announced his super-regenerative circuit.

(July 25)—Station WBAY of the American Telephone and Telegraph Company, 500 watts, 360 meters, commenced operation.

1922 (August 16)—Station WEAF opened for service on 360 meters with transmitter atop Western Electric Building, 463 West Street, New York. (WBAY was closed and its operations transferred to WEAF.)

(August 28)—First commercial broadcast over WEAF was sponsored by the Queensborough Corporation, 10 minutes for $100.

(October 15)—For the first time in history high-power 20-KW vacuum tubes were used in RCA transmitters handling traffic between New York, England, and Germany.

(October 27)—First network broadcast, WJZ, New York, WGY, Schenectady, featured the World Series.

(October 28)—Princeton-Chicago football game at Stagg Field, Chicago, was broadcast by WEAF, New York, as first field broadcast over long lines; then followed Yale-Brown game on November 4 from Yale Bowl; Harvard-Princeton on November 11, from Cambridge, Mass.

(November 3)—Major General James G. Harbord elected a Director of Radio Corporation of America; November 17, elected President of RCA effective January 1, 1923.

(November 11)—*Aida* from Kingsbridge Armory, New York, was the first remote control pick-up of opera.

(November 17)—President Harding speaking at Madison Square Garden broadcast through WJZ with Western Union lines linking microphone with transmitter.

1922 (November 22)—First broadcast by New York Philharmonic-Symphony Orchestra.

(December 15)—British Broadcasting Company formed; Lord Gainsford, Chairman. BBC became British Broadcasting Corporation in 1926 with Sir John Reith, Director-General.

(December 22)—W. H. Rankin, advertising executive, spoke over WEAF on the subject of "Advertising and Its Relation to the Public." Reports on reception were so encouraging that an advertiser (Mineralava) sponsored Marion Davies, motion picture star, on WEAF twice a week for 10 minutes.

1923 (January 1)—Major General J. G. Harbord became President of Radio Corporation of America.

(January 1)—1,500,000 to 2,500,000 radio sets in United States.

(January 1)—Retail value of radio receiving sets and components (used in building home receivers) in 1921 and 1922 estimated to total $100,000,000.

(January 4)—Telephone lines connected WEAF, New York, with WNAC, Boston, for a "network" broadcast.

(January 14)—Bell System made transatlantic use of "single sideband voice transmission"; first commercial short-wave transatlantic single sideband radio telephone circuit opened in 1928.

1923 (March 2)—Professor L. A. Hazeltine described his invention of the neutrodyne circuit at Radio Club of America meeting.

(March 4)—Station KDPM, Cleveland, Ohio, picked up short waves from KDKA, Pittsburgh, and thereby staged the first rebroadcast program.

(March 20)—Second Annual Radio Conference was held in Washington, D. C.

(March 23)—C. Francis Jenkins transmitted pictures of President Harding, Vice-President Coolidge and Governor Pinchot of Pennsylvania, by radiophoto from Naval Radio Station, Washington, D. C., to Philadelphia.

RCA commenced development of a radio relay on medium frequencies (300–3000 kilocycles) at Belfast, Me., for automatic relaying of multiplexed transatlantic signals to RCA main receiving station at Riverhead, N. Y.

(April 11)—Musical show *Wildflower*, starring Edith Day, broadcast by WEAF from stage of Casino Theatre, New York.

(April 18)—Group engaged in broadcasting met in Chicago to discuss organization of National Association of Broadcasters; first meeting held in New York, October 11, 1923. NAB was incorporated under laws of Delaware, October 31, 1927, and operated until 1938 with Honorary President and a Managing Director; Neville Miller, first paid President, 1938–1944, followed by Harold Ryan.

1923 Increased radio traffic to and from ocean liners led to installation of high-speed transmitters and automatic reception.

(May)—Wireless telephone transmitter was installed on S.S. *Olympic.*

(May 15)—Station WJZ moved from Newark to New York—Aeolian Hall on W. 42nd Street.

(June)—First multiple station network with WEAF, New York; WGY, Schenectady; KDKA, Pittsburgh; and KYW, Chicago, were linked together by telephone wires.

(June 21)—President Warren G. Harding spoke on "The World Court" from St. Louis as he began the western tour that ended in his death at San Francisco. Stations WEAF, New York; WCAP, Washington; KSD, St. Louis, broadcast his address.

(July 12)—Willard-Firpo heavyweight fight in Jersey City broadcast by WEAF; Firpo won.

(August 1)—Station WRC was opened at Washington, D. C.

(August 31)—Wilson-Greb fight broadcast by WEAF from Polo Grounds, New York.

American and French amateurs established two-way communication across Atlantic on 100-meter wave.

(September 14)—Dempsey-Firpo fight in New York

was broadcast by WJZ; Dempsey won in the second round.

1923 (October)—World Series—New York Giants-Yankees broadcast by WEAF; Graham McNamee, announcer.

(October 2)—Broadcast concert from station WOC, Davenport, Iowa—"Out Where the West Begins," picked up in New York with "sensational clearness" and voice of announcer "so distinct it seemed to be in the next room."

Charles Proteus Steinmetz declared "there are no ether waves—radio and light waves are merely properties of an alternating electromagnetic field of force which extends through space."

(November 10)—Woodrow Wilson's Armistice Eve address was broadcast by WEAF, New York; WCAP, Washington; WJAR, Providence; his only public address after retiring from the White House.

(November 12)—First broadcast of a series of ten concerts by New York Philharmonic Orchestra from Carnegie Hall over WEAF.

(November 28)—First broadcast from St. Paul's Chapel, Columbia University, over WEAF, New York.

Wireless controlled airplane made flight without a pilot at the Etampes Aerodrome in France. Flights were also made with a pilot using a gyroscopic stabilizer and special steering motors controlled from the ground.

1923 International Commission for Aerial Navigation agreed, as a general principle, all aircraft engaged in public transport should carry radio equipment.

(December 4)—Opening of Congress broadcast for the first time.

(December 6)—President Coolidge's message to Congress was broadcast but did not carry beyond the westerly part of Texas; stations in the network were: WEAF, New York; WCAP, Washington; WJAR, Providence; KSD, St. Louis; WDAF, Kansas City; WFAA, Dallas.

(December 10)—Harding Memorial Address by President Coolidge broadcast from the White House by WEAF, New York; WCAP, Washington; WJAR, Providence.

Donald B. MacMillan in Arctic region used short waves from his ship, the *Bowdoin*, to communicate with Chicago, New York, and other cities.

(December 24)—Trinity Church Christmas Eve service broadcast for first time by WEAF; also Trinity chimes at midnight on December 31.

(December 29)—First transatlantic broadcast on 1600-meter wave featured dance music from Savoy Hotel, London, to Houlton, Me., then by wire to WJZ, New York, for rebroadcast.

(December 29)—Dr. V. K. Zworykin filed original application for patent on an iconoscope; it was issued on December 20, 1938, as No. 2,141,059. He actually had a complete television system operating on 60

cycles and showed a rough pattern on the face of the cathode-ray tube to Otto Schairer, H. P. Davis, and S. M. Kintner; also showed them the kinescope, picture tube of the system.

1923 (December 31)—A radio program broadcast from Pittsburgh over KDKA's short-wave outlet on 3000 kilocycles (100 meters) was received by the British Broadcasting Company and retransmitted over the seven-station BBC network.

1924 (January 9)—Station KGO, Oakland, California, went on the air.

A powerful station at Monte Grande, Argentina, was opened for communication with New York, Paris, and Berlin.

(February 1)—Hazeltine Corporation was formed: "primarily a patent holding corporation and particularly interested in development of the radio art through the purchase, commercialization and improvements of patents."

(February 5)—England rebroadcast a short-wave program sent across the sea by KDKA.

(February 6)—Funeral services for Woodrow Wilson at National Cathedral, Washington, D. C., were broadcast by WEAF, New York; WCAP, Washington; WJAR, Providence.

(February 8)—General J. J. Carty addressing the Bond Men's Club spoke from Chicago over a telephone line extending from San Francisco through New York to Havana and the talk was broadcast by

7 stations: WEAF, New York; WCAP, Washington; WJAR, Providence; WMAQ, Chicago; KPO, San Francisco; KLX, Oakland; and PWX, Havana. This was the first use of transcontinental circuits for broadcasting.

1924 (February 12)—National Carbon Company introduced the Eveready Hour on WEAF network—as the first network sponsored program.

(February 22)—First Presidential talk from the White House featured Washington's Birthday address by President Coolidge.

(February 23)—Calcutta picked up KDKA, Pittsburgh, program relayed from London.

(March 7)—Dinner of M.I.T. Alumni picked up by WJZ from Waldorf-Astoria Hotel and relayed from WGY, Schenectady, N. Y., on 90 meters to KDKA, Pittsburgh, Pa., which retransmitted program on 98 meters to 2AC in Manchester, England, for rebroadcasting.

(April 22)—President Coolidge's address to the Associated Press, Waldorf-Astoria, New York, broadcast.

(May 30)—Marconi, using short waves, talked from his yacht *Elettra* off England to Australia.

(May)—H. C. Harrison of Western Electric Company was granted a patent on electrical recording of sound, thereby greatly increasing the tone quality of phonograph recordings; the records were called "electrical transcriptions"; in March, 1925, a contract was signed with the Victor Talking Machine Company for commercial use of the invention.

1924 A phonograph known as the Orthophonic was introduced by Western Electric based upon a system of electrical recording developed by Bell Telephone Laboratories in addition to the Orthophonic sound apparatus that included a 6-foot logarithmic horn folded within the cabinet.

(June)—Republican National Convention in Cleveland, Ohio, was broadcast by stations in 12 cities, extending as far west as Kansas City; Democratic Convention at New York in July was also broadcast. Stations broadcasting the Republican Convention were: WEAF and WJZ, New York; WCAP and WRC, Washington; WNAC, Boston; WJAR, Providence; WGY, Schenectady; WGR, Buffalo; KDKA, Pittsburgh; WJAX and WTAM, Cleveland; WLW, Cincinnati; WGN and WLS, Chicago; KSD, St. Louis; WDAF, Kansas City. The Democratic Convention station list was the same, with the addition of WDBH, Worcester; WMAF, South Dartmouth; WSB, Atlanta; and WMAQ, Chicago.

(June 6)—KDKA, Pittsburgh, announced that it had transmitted short-wave signals to points as far distant as South Africa, and had supplied KFKX, Hastings, Nebraska, and KGO, San Francisco, with the same program simultaneously.

(July 6)—First radiophoto transmitted by RCA across the Atlantic was of Charles Evans Hughes, sent from New York to London, where it was radioed back across the sea and recorded in New York.

(July)—British Government and Marconi Wireless Telegraph Co. planned to link the Empire by a radio beam system.

1924 Marconi in lecture before the Royal Society of Arts described his short-wave beam system.

(September 12)—National Defense Day ceremonies, featuring addresses by Secretary of War Weeks and General John J. Pershing in Washington, were broadcast by radio stations covering practically the entire country, including the Pacific coast.

(September)—Marconi using the 32-meter wave in daylight talked by voice with Syria, 2100 miles away, from his yacht *Elettra* in the Mediterranean.

(October)—Zeppelin *ZR-3* (renamed *Los Angeles*) crossed Atlantic equipped with wireless.

Wireless "lighthouse" was established on an island in the Firth of Forth, Scotland. The wireless energy concentrated by reflectors flashed a beam that ships within a 100-mile area could detect to determine their position in fog.

(October 6)—Third National Radio Conference was held in Washington, D. C.

(October 11)—Cape Town, Africa, intercepted a program from KDKA and rebroadcast it.

(November 3)—Campaign speech of President Coolidge on the eve of election was broadcast coast-to-coast.

(November 30)—Radiophotos were sent by RCA from London to New York in six minutes; pictures of President Coolidge; Dowager Queen Alexandra;

Secretary of State Hughes; Austen Chamberlain, Secretary of Foreign Affairs; the Prince of Wales, and others.

1924 (December)—Signature of Herbert Hoover, then Secretary of Commerce, transmitted via radiophoto by C. Francis Jenkins, from Washington to Boston.

(December 15)—Station KOA, Denver, went on the air.

1925 (January 1)—Victor Talking Machine Company made its first broadcast through WEAF and thirteen other stations; singers were John McCormack, tenor; Lucrezia Bori, soprano.

Commercial applications of short waves progressed as transatlantic traffic was handled on channels from 20 to 105 meters.

(January 31)—Broadcasting service furnished from the United States to Canada for first time by the addition of CNRO, Ottawa, to WEAF network.

Trend toward high-power broadcasting led to locating transmitters outside thickly populated areas in order to minimize interference.

Experiments were conducted at Pittsburgh and Schenectady with 50-KW transmitters for broadcasting.

Three-meter waves were generated at Technical Physical Institute at Jena, Germany, with a power of about 100 watts.

1925 (March 4)—Coolidge inaugural was broadcast by twenty-one stations from coast to coast.

(March 12)—First rebroadcast of a European program by an American station; signals from Chelmsford, England—station 5XX on 1500 meters—were picked up at Belfast, Me., relayed by short wave to Riverhead, L. I., and to RCA laboratory in Van Cortlandt Park for WJZ, New York, to rebroadcast. Big Ben, atop the House of Parliament, was heard in New York as it struck midnight in London.

(April)—Radio "shadowgraphs" were demonstrated by John L. Baird in Selfridge store, London.

(May 7)—Facsimile messages, maps, and pictures were radioed by RCA from New York to Honolulu, 5136 miles, by the Ranger radiophoto system.

(June 13)—Mechanical television apparatus using a rotating scanning disk was demonstrated by C. Francis Jenkins between Anacostia Naval Air Station and his laboratory in Washington, D. C.

(July 4)—Second National Defense Day program found telephone wires uniting broadcasting stations from coast to coast.

Nichols and Schelling of Bell Telephone Laboratories suggested a theory to account for fading of radio, which they believed was caused by earth's magnetic field's effect on wave propagation.

United States Naval Radio Research Laboratory at Bellevue, D. C., and Carnegie Institution confirmed Heaviside-Kennelly theory.

1925 L. A. Gebhard at U. S. Naval Research Laboratory, Anacostia, D. C., completed development of radio transmitting equipment embodying the electronic "pulse" principle, later used in radar.

1926 (January 26)—S.S. *President Roosevelt* successfully used radio compass in blinding snowstorm to find S.S. *Antinoe* in distress on the Atlantic.

(February 23)—President Coolidge signed the Dill-White Radio Bill.

(April 20)—Picturegram of check was sent via RCA from London to New York where it was honored and cashed.

(April 30)—RCA inaugurated transatlantic radiophoto service; the first picture, showing the speakers' table at the Pilgrim Society dinner in London, was radioed to New York for publication in *The New York Times* the next day.

(May 1)—Commercial point-to-point radio facsimile service opened by RCA, Marconi, Cables & Wireless, Siemens, Telefunken, and Reichpost between New York and London; April 18, 1932, New York-Berlin; August 8, 1932, New York-Buenos Aires; May 15, 1929, New York-San Francisco; October 16, 1934, London-Australia; January 1, 1937, London-Buenos Aires; June 9, 1930, Berlin-Buenos Aires.

(May 1)—RCA sent first picture across Atlantic on commercial basis; a letter from Radio Exhibition Corp. addressed to the Prince of Wales; rate $95 for 4¼ x 6¼ inches.

1926 (May)—Byrd and Bennett in plane *Josephine Ford* flew to the North Pole from Spitzbergen carrying a 44-meter radio transmitter.

(May)—Dirigible *Norge* sailed over the Arctic and sent the first wireless messages from North Pole.

(May 11)—American Telephone & Telegraph Company formed Broadcasting Company of America to handle the broadcasting activities of WEAF until November 1, 1926.

(July 1)—Station WEAF was purchased by RCA from the Broadcasting Company of America, Inc., to which the American Telephone & Telegraph Co. had sold, transferred, and assigned the station; RCA assumed control on November 15, 1926.

Radio receiving sets having complete alternating current, or light socket, operation were introduced by RCA for home use.

(August)—Sound pictures were initiated by the film *Don Juan*, produced by Warner Brothers with the musical score synchronized on disks.

(September 9)—National Broadcasting Company was organized as a service of RCA with the aim "to provide the best programs available for broadcasting in the United States." Twenty-four stations comprised first NBC network, which began operation on November 15, 1926. M. H. Aylesworth was first president of NBC.

(September 23)—Dempsey-Tunney fight in Philadel-

phia was broadcast by long and short waves to all parts of the world; J. Andrew White announced.

1926 World Series was broadcast by WJZ network; New York Yankees *vs.* St. Louis Cardinals.

(December)—The Blue Network was established by RCA-NBC with WJZ as the key station.

(December 15)—Dr. E. F. W. Alexanderson in St. Louis demonstrated an advance in television by showing his multiple light-brush system and new projector.

Edison Phonograph Company released 12-inch phonograph disks capable of playing 22 minutes of music on each side, and these 40-minute disks were called "Long Playing Records."

1927 "Static ceases to be a problem in the short-wave art," stated H. E. Hallborg, RCA engineer, speaking at a meeting of the Institute of Radio Engineers.

(January 1)—Initial NBC coast-to-coast hook-up used a 4000-mile network to broadcast football game in Bowl of Roses, Pasadena, California.

(January 7)—Radiotelephone circuit was opened between New York and London. Adolph S. Ochs, publisher of *The New York Times*, talked with Geoffrey Dawson, editor of *The Times* of London. Said Mr. Ochs, "who now has the temerity to say that prayers are not heard in Heaven?"

(January 7)—Philo Farnsworth filed his first application for a patent covering an electronic television system including a dissector tube.

1927 Automobile radio sets introduced by Transitone.

(January 21)—First coast-to-coast broadcast of opera *(Faust)* was heard from Chicago Civic Auditorium.

(January 27)—United Independent Broadcasters organized to establish a radio network.

(February 3)—John L. Baird described his television system at Glasgow, Scotland.

(February 22)—First coast-to-coast (50-station hookup) presidential broadcast and first from the floor of Congress; Washington Birthday address by Calvin Coolidge at joint session of Congress.

(March 2)—Federal Radio Commission was appointed; Rear Admiral W. H. G. Bullard, John F. Dillon, Judge E. O. Sykes, O. H. Caldwell, and H. A. Bellows.

(April 5)—Columbia Phonograph Broadcasting System, Inc., formed; name changed to Columbia Broadcasting System on November 19.

(April 6)—NBC Pacific Coast network established.

(April 7)—Wire television was demonstrated between Washington, D. C., and New York; and radio television between Whippany, N. J., and New York by Bell Telephone Laboratories. Secretary of Commerce Herbert Hoover and President Walter S. Gifford, AT&T Co., were principals in the wire demonstration.

1927 (April 16)—Demonstration of television by radio—both image and sound on the same frequency band by a single radio transmitter—between Whippany and Bell Telephone Laboratories in New York.

(May 20)—Radio broadcasts featured the news that Charles A. Lindbergh in monoplane *Spirit of St. Louis* had taken off from Curtis Field, L. I., for Paris; he landed at Le Bourget Field in 33½ hours.

(June 11)—Guests at Massachusetts Institute of Technology dinner in New York saw radiophotos arrive from London and Hawaii.

(June 11)—Arrival of Charles A. Lindbergh in United States after historic flight to Paris was broadcast by 50 stations, the largest network assembled up to this time.

(June 29)—Plane *America* with Byrd, Balchen, Acosta, and Noville hopped off for Europe with radio equipment on board; made forced landing at Ver Sur Mer, France, 43 hours later.

(August 20)—Airplane *Dallas Spirit* in tailspin over Pacific on way to Hawaii flashed SOS on 33-meter wave which was picked up by *The New York Times'* receiving station, 3500 miles away.

(September 18)—Columbia Phonograph Broadcasting System went on the air with a basic network of sixteen stations.

(October 6)—Premiere of *The Jazz Singer*, featuring Al Jolson and produced by Warner Brothers, was

first time an actor delivered spoken dialogue from the screen. When *The Jazz Singer* was released only 100 theaters were wired for sound.

1927 (October 17)—Marconi predicted at Institute of Radio Engineers that short waves were destined to play a vital role in radio progress and television.

(December 31)—Radiomarine Corporation of America was organized to operate radio service for ships at sea.

1928 (February 8)—Mrs. Mia Howe in London was televised by Baird and was reported seen in Hartsdale, N. Y., as the first television face to cross the Atlantic.

(February 29)—Prof. Carl Stormer, Norwegian physicist, and Jorgen Hals, a radio engineer at Oslo reported reception of radio echoes from beyond the orbit of the moon. Commented Dr. Lee de Forest, "imagination totters and reason reels with these calculations and the possibilities they portend."

(March 7)—Passengers on S.S. *Berengaria,* 1000 miles distant, saw face of Dora Selvy televised in London.

(April)—Detroit put into operation the first police municipal radio system.

(April 4)—NBC received its first television station construction permit.

(April 4)—RCA Photophone, Inc., was organized for development and distribution of sound motion picture recording and projection equipment.

1928 (July 12)—Televising of outdoor scenes without use of artificial light was accomplished at Bell Telephone Laboratories.

(July)—Color television demonstrated by John Logie Baird of England, using a 3-spiral scanning disk at transmitter and receiver.

(July 28)—*Lights of New York* was the first all-talking picture and ran 5 reels. Then came *Singing Fool* starring Al Jolson.

Professor Leon Theremin (Russian) introduced the "Theremin," an "ether wave," or electronic musical instrument.

(August 11)—Herbert Hoover was notified of his nomination for the Presidency while 107 stations were linked with the microphones at Palo Alto, California.

(August 22)—Governor Alfred E. Smith televised by General Electric Company, Schenectady, as he received notification of Democratic presidential nomination at State Capitol, Albany. Images over W2XAD (21 meters); voice over WGY (370 meters).

(September 11)—A one-act melodrama, *The Queen's Messenger*, was televised at Schenectady.

Radio became important in commercial aviation as U. S. Government began to install radio range stations as aids to navigation of mail-carrying planes.

(October 29)—U. S. Supreme Court reversed ruling of lower courts in Armstrong-de Forest feed-back

patent cast (patents No. 1,507,016–17) and awarded priority to Dr. Lee de Forest. The issue was reopened six years later and on May 21, 1934, the U. S. Supreme Court decided again in favor of de Forest.

1928 (November 13)—Dr. V. K. Zworykin was granted patent No. 1,691,324 related principally to color television. (Filed July 13, 1925.)

(December 23)—First permanent coast-to-coast network was established by NBC.

1929 (January 3)—William S. Paley, elected president, Columbia Broadcasting System.

(January 3)—RCA Communications, Inc., was organized as a separate company—wholly-owned subsidiary—of Radio Corporation of America, instead of a department of RCA.

(February 1)—Band concert from Queens Hall, London, was broadcast as the first scheduled internanational rebroadcast.

(February)—While D. W. Griffith broadcast at Schenectady he was televised on short waves (31 meters) and was reported seen on experimental receiver in Los Angeles, California.

(March)—RCA acquired the Victor Talking Machine Company.

(May 15)—First photo-radiogram from San Francisco to London was sent over RCA transcontinental circuit to New York for relay to London on May 17.

1929 (May 16)—RCA opened a commercial radio circuit from San Francisco to New York.

(May 23)—Application was filed for original Espenschied-Affel patent on the coaxial cable used as a wide-band long distance transmitting medium. Application mentioned that one objective was the use of such a conductor for television transmission.

(June)—Thanksgiving service at Westminster Abbey for recovery of King George was rebroadcast in United States.

Screen-grid tube permitting greater sensitivity of receiving set with fewer tubes was developed by Dr. A. W. Hull of General Electric Company (introduced commercially for radio receivers in 1932).

(June 27)—Television in color was demonstrated by Bell Telephone Laboratories over wire from one end of a room to the other.

(August)—Dr. August Karolus of Germany contributed an electrochemical light valve or "shutter" to television so that more powerful illumination could be used.

(August 12)—Parachute jumper equipped with NBC 25-pound, 2-watt pack transmitter, leaped from plane at Roosevelt Field to test the possibilities of such apparatus.

(August 15)—Brokerage offices established on several ocean liners were supplied Wall Street service by wireless.

1929 (October)—General Motors Radio Corporation was organized with RCA, General Electric, and Westinghouse in partnership. (In 1931 liquidation of GMRC began with operation completed in February, 1933.)

(November 18)—Radio handled efficiently and expeditiously greatly increased volume of transatlantic communications when earthquake snapped twelve cables on bed of North Atlantic.

(November 18)—Dr. V. K. Zworykin demonstrated his kinescope, or cathode-ray television picture tube, in a receiver at a meeting of the Institute of Radio Engineers at Rochester, New York.

(November 29)—Short-wave radio from Little America, Antarctica, announced that Byrd flew over the South Pole. Bernt Balchen piloted the plane.

(December 20)—First international program from Germany, was broadcast from Koenigswusterhausen by short wave and rebroadcast by stations in United States.

(December 25)—Programs in an international exchange between United States, Germany, England, and Holland were broadcast

Technical improvements in the phonograph resulted in sale of 65 million records and a gross of $125,000,000 in a year.

6. *Radio-Television Advances in the 30's*

1930–1939

The early 30's glowed with indications that television eventually would far surpass sound radio, although the images were fuzzy and flickered. Equipped chiefly with scanning disks that whirled the old mechanical television system into operation, pioneers rushed to stake their claims only to realize that eventual success of the art would come through an all-electronic system. The 30's might well be described as a decade of television pioneering.

As the race for television quickened, time was moving on in the annals of wireless—as indicated by the fact that Marconi celebrated the thirtieth anniversary of the first transatlantic signal and several years later his life closed and radio tolled his requiem across the hemispheres. His legacy to the world was a system of electric communication endless in its possibilities.

As the 30's drew to a close, international broadcasting had achieved such progress that the voices of Roosevelt, George V, Chamberlain, Mussolini, Hitler, and others echoed around the world along with the novelty sounds of Mt. Vesuvius, voices from the Zeppelin *Hindenburg* over the Atlantic, broadcasts from a balloon in the stratosphere,

and all the world heard King Edward VIII as he dramatically renounced his throne. The first coronation of an English King and Queen was broadcast and televised; Roosevelt's radio "fireside chats" were front-page news. Hitler broadcast his "steel and blood" speech and many of the sounds on the air after that were ominous.

1930 (January 3)—David Sarnoff was elected president of Radio Corporation of America.

(January 16)—Television on 6′ x 8′ screen was shown by RCA at RKO-Proctor's 58th St. Theatre, New York; pictures transmitted from W2XBS, 411 Fifth Ave.

(January 21)—King George V welcomed delegates to the London Naval Conference and was heard in his first world-wide broadcast.

(February 18)—Drawing of rectangular design was sent by television to Australia and flashed back to Schenectady without losing its identity.

(March 1)—Dr. Charles B. Jolliffe was appointed the first Chief Engineer of the Federal Radio Commission.

(March 11)—Arrival of Byrd Antarctic Expedition at Dunedin, New Zealand, and two-way conversation between members of the expedition and friends in New York were heard in a rebroadcast throughout the United States.

1930 (March 26)—Marconi on his yacht, *Elettra*, off Genoa, pressed a wireless key that flashed a signal opening an Electric-Radio Exhibition at Sydney, Australia, 9000 miles distant.

(April 6)—John L. Baird televised "abbreviated vaudeville" in London.

RCA began extensive research on FM transmissions between New York and California.

(April 9)—Two-way wire television, in which speakers at ends of 2-mile line saw each other as they conversed, was demonstrated by Bell Telephone Laboratories in New York.

(April)—U. A. Sanabria showed television images on a two-foot screen in his Chicago laboratory.

(April 30)—Two-way conversation was radiophoned between Marconi aboard his yacht near Italian coast and friends in New York.

The pentode and super-control tubes for broadcast reception were introduced.

(May 22)—Television was seen on six-foot screen at Proctor's theater, Schenectady.

(June)—S.S. *America*, off Fastnet Light, Ireland, approximately 3000 miles from New York, picked up facsimile messages from United States.

(June)—Plans announced for $250,000,000 Radio City, to be built by John D. Rockefeller interests on Manhattan Island.

1930 (June 10)—John Hays Hammond, Jr., described his patent for a television "eye" for airplanes, enabling pilots to "see" through fog and darkness to make safe landings.

(June 30)—First round-the-world broadcast, Schenectady to Holland, relayed to Java, Australia, and back to point of origin in less than a second.

Marconi Sounding Device Company introduced an Echometer, an electronic echo-sounding device, to give mariners continuous and reliable indication of the depth of water under a ship.

(July 20)—Play, *The Man with a Flower in His Mouth,* televised in London while dramatic critics watched.

(June 24)—Scientists of U. S. Naval Research Laboratory, Anacostia, D. C., working on a high-frequency blind-landing system for aircraft at Bolling Field, noticed that periodically the pattern of waves picked up showed considerable interference only when a plane passed through the zone of radio activity created by the transmitter some distance away. This led to plane detecting—radar!

(July 30)—Television station W2XBS opened in New York by National Broadcasting Company.

(July 30)—Religious program in Nidaros Cathedral, Norway, in celebration of 900th anniversary of introduction of Christianity in Norway, was rebroadcast in United States.

1930 (September 14)—Provisional President Uriburu of the Argentine Republic addressed American people by radio from Buenos Aires.

(December 6)—Direct radio communication was established with China by opening of RCA circuit between San Francisco and Shanghai.

(December 14)—Philo T. Farnsworth informed Federal Radio Commission he had succeeded in narrowing wave band required for television to 6000 kilocycles width.

(December 25)—Japan was heard in first American rebroadcast from the Orient with Premier Hamaguchi as the speaker.

1931 (January 1)—Benito Mussolini, Italian Premier, was heard in the United States for the first time in an international broadcast over short-wave station in Rome.

(January 11)—Caesium photoelectric cells that "see red" were introduced by Bell Telephone Laboratories to clarify the images.

(February 12)—Pope Pius XI addressed the world in an international broadcast inaugurating Vatican City station HVJ. This was the first time the Pope's voice was heard on the radio in America.

(March 16)—WEAF, New York, and WTIC, Hartford, and also WJZ, New York, and WBAL, Baltimore, began operations on identical frequencies by a new method of carrier frequency synchronization.

The plan was proposed to overcome the shortage of broadcast channels.

1931 (March 31)—Micro-waves (18 cm.) carried voices across the English Channel between Dover and Calais.

(April 26)—Television station W2XCR went on the air in New York, opened by Gimbel Brothers.

(April 29)—Representatives of new Spanish Republic broadcast greetings to the United States from Madrid.

(May 15)—Program originating in Bangkok, Siam, was sent by short wave to United States and rebroadcast for pleasure of Siam's King visiting in New York.

(May 23)—First practical coverage of a news event by radio from plane was jointly demonstrated by Radiomarine Corporation of America, Eastern Air Transport, and New York *World Telegram.* Army maneuvers at Ossining were described by commentator picked up by Radiomarine station on 127 meters and relayed to *World Telegram.*

(May 25)—Argentine Independence Day celebration was rebroadcast in United States.

(June 3)—English Derby at Epsom Downs was televised for the first time by John L. Baird.

(June)—Empire State Building, world's highest skyscraper, was selected as the site for RCA-NBC television station that would use quasi-optical waves.

1931 (July)—Back-pack portable transmitter weighing only 25 pounds and operating on 5 meters was used for first time by NBC in covering the National Open Golf Championship, Toledo, Ohio.

(July)—Velocity microphone, introduced by RCA, became the standard of the broadcasting industry.

(July 21)—Experimental television station W2XAB opened in New York by Columbia Broadcasting System, began operation atop Chrysler Tower; call changed to WCBW on July 1, 1941; changed to WCBS-TV on August 29, 1946.

(August 21)—Vienna Philharmonic Orchestra was rebroadcast in America by WJZ.

(September 13)—Mahatma Gandhi, "India's man of destiny," explained the political and economic plight of his country to America in a rebroadcast from London.

(September 13)—First application of frequencies above 30,000 kilocycles to commercial service anywhere in the world was made as a result of joint research by RCA and Mutual Telephone Co., in Hawaiian Islands, for telephone interconnection of the Island group; the system was linked with the United States on December 23, 1931.

Lawrence A. Hyland at Anacostia Naval Air Station discovered that rebounding radio waves could reveal presence and location of an airplane in the sky.

(September 18)—Long-playing phonograph record, 33⅓ rpm, capable of reproducing programs of 15

minutes duration was demonstrated by RCA and made commercially available.

1931 (September 24)—U. A. Sanabria demonstrated television on 10-foot screen at Radio-Electrical World's Fair in New York.

(October)—Professor Jacob Papish and Eugene Wainer of Cornell University discovered element No. 87 in mineral samarskite. It was described as being similar to caesium and it offered prospects of increasing the sensitivity of photoelectric cells.

(October 22)—Television on 10-foot screen was shown at the Broadway Theatre, New York, with 1700 attending the opening performance. A wire link was used between the television camera in the Theatre Guild Playhouse and the Broadway Theatre.

(October 27)—Marconi experimented on the Ligurian coast near Genoa with 50-centimeter waves.

(October 30)—RCA television transmitter atop Empire State Building opened for experimental field tests; pictures were 120-line, 24 frames.

(November)—Television images from Chicago were picked up at unemployment relief bazaar at Ottumwa, Iowa, 250 miles away.

(November)—Dr. E. F. W. Alexanderson sent television across his laboratory on a beam of light instead of on a radio wave or wire.

(December 12)—Thirtieth anniversary of first transatlantic wireless signal was celebrated by a world-

wide broadcast featuring tributes to Marconi from fifteen nations and insular possessions.

1931 (December 25)—*Hansel und Gretel* was broadcast from the Metropolitan Opera House as the first radio presentation by that organization. Combined networks of WEAF and WJZ were linked with the microphones.

1932 (February)—Delegates and radio observers at World Disarmament conference at Geneva were heard in rebroadcasts from Switzerland.

(February 22)—World-wide tributes to Washington on Bicentennial of his birth were heard in America, including address by President Paul Doumer of France at American Club in Paris.

(March)—Radio broadcasting facilities were mobilized to aid search for kidnaped Charles A. Lindbergh, Jr., and to flash bulletins.

(March)—Charles F. Jenkins described a new television principle. Images said to be 3600 times brighter than heretofore, appeared on a sensitized emulsion of "an animated lantern slide." Incoming signals quickly changed the surface from opaque to clear, equivalent to light and shade, thereby "painting" an everchanging pattern, corresponding to the scene at the transmitter.

(March 13)—German Presidential election returns, Paul Von Hindenburg *vs.* Adolf Hitler, were rebroadcast in United States.

1932 (May 14)—New York, Paris, London, Berlin, Washington, and ships at sea joined in program commemorating Samuel F. B. Morse centennial; Marconi spoke from London.

(May)—Unidirectional microphone introduced by RCA found wide use in film recording, broadcasting, and television.

(May 23)—Cuba linked four stations to form its first national radio network covering the island.

(May 25)—Field tests of 120-line television were made by RCA at Camden with signals relayed by radio from New York through Arney's Mount, N. J. Receiver was all-electronic; a rotating disk was used for scanning at the transmitter, and the light source was a 150-KW arc.

(June)—Republican and Democratic National Conventions were broadcast from Chicago, Ill.

(July 21)—King Albert of Belgium broadcast to America on Belgium Independence Day.

(August 1)—Prince of Wales and President LeBrun of France were heard in America as they spoke at dedication of Franco-British War Memorial at Thiepval.

(August 17)—Prof. Auguste Piccard broadcast to America before taking off in his balloon for the stratosphere, and again on his return, to describe his record-breaking 10-mile ascent.

1932 (August)—Basic research work on apparatus and techniques later applied to the locating of ships and planes by radar was instituted by Radio Corporation of America. Demonstrations held for U. S. Army Signal Corps at Sandy Hook, N. J., detected presence of ships. Transmitter beamed a continuous wave across the harbor entrance and a ship entering the beam produced reflections which were detected by a nearby receiver.

(September 22)—William Beebe, in his air-tight bathysphere, broadcast as he was lowered 2200 feet into the ocean off Bermuda.

(October 27)—Theodore Roosevelt, Jr., speaking to America from Manila, made the longest political campaign speech in history to date (in point of miles).

(November 9)—Governor Franklin D. Roosevelt made his first radio address as President-elect, thanking the electorate.

(December 10)—Rebroadcast of first program direct from Java was clearly heard in the United States.

1933 FM transmissions carried on by RCA between Rocky Point and Riverhead, Long Island, on 461 megacycles.

(March 4)—President Roosevelt's inaugural was broadcast internationally.

(March 12)—President Roosevelt's first "fireside chat" on banking moratorium was broadcast.

1933 (April 4)—Dirigible *Akron* disaster off New Jersey coast was described by Lieut. Commander Herbert V. Wiley, only surviving officer.

(May 7)—President Roosevelt's second "chat" on "Progress of the Administration" was broadcast.

(July 24)—President Roosevelt's third "chat" on his stewardship and Farm Relief was broadcast.

(September 22)—Marconi arrived in New York on 86th transatlantic trip. (Sailed from San Francisco to Japan, November 2.)

(October 22)—President Roosevelt's fourth "chat" on his stewardship was broadcast.

(November 11)—NBC studios were dedicated in Radio City, New York.

(November 20)—Broadcasters maintained two-way communication with U. S. Army stratosphere balloon while radio audience throughout the country listened in.

1934 (April 25)—Dr. V. K. Zworykin of RCA Laboratories outlined a new application of television described as "A Flying Torpedo with an Electronic Eye."

(May 1)—WLW, Cincinnati, Ohio, began operation of 500,000-watt transmitter; licensed for 50,000 watts regularly and 450,000 watts experimentally.

(June 9)—President Roosevelt signed Communications Act decreeing end of Federal Radio Commis-

1935 (May 7)—Plan to spend $1,000,000 for field television tests was announced by RCA.

(May 22)—President Roosevelt delivered his message vetoing Patman Bonus Bill at joint session of Congress, which was broadcast.

(June 13)—Braddock-Baer fight broadcast from Long Island City; Braddock won in 15 rounds.

(July 1)—Anning S. Prall reappointed for 7-year term on FCC. (Died, July 23, 1937.)

(July 2)—Sounds of Mt. Vesuvius, Italy, were broadcast to America for first time through microphone suspended over the crater's rim.

(September 13)—Haile Selassie, Emperor of Ethiopia, broadcast a special message on Italo-Ethiopian situation from Addis Ababa to listeners in the United States.

(September 24)—Louis-Baer fight in New York was broadcast to record-breaking audience, with Clem McCarthy and Edwin C. Hill, announcers; Louis won in fourth round.

(October 2)—Premier Mussolini's broadcast to Italian nation on Italo-Ethiopian situation was rebroadcast throughout United States.

(October 27)—Most comprehensive international program to date, "Youth Sings Across Borders," was rebroadcast throughout America with pick-ups from 31 countries.

1935 (November 6)—A frequency modulation system was demonstrated on 2½-meter wave by Major E. H. Armstrong.

Dr. Hideki Yukawa of Kyoto University predicted mathematically the "mesotron" or "meson."

(November 11)—Captain A. W. Stevens and Capt. O. A. Anderson in stratosphere balloon *Explorer II* reached altitude of 72,395 feet (13.7 miles) and talked by radio with China Clipper off California; also with London through NBC facilities.

(December 7)—Hollywood studios of NBC, described as "one of the most complete and advanced broadcasting units in the world," were opened.

1936 (January 3)—President Roosevelt addressed joint session of Congress with meeting held at night so the nation might listen.

(January 21)—Death of King George V of England was flashed around the world by radio while London's tolling bells were heard afar, as were his funeral service and memorial ceremonies.

(March 1)—King Edward VIII broadcast his first message to the British Empire. It was his 76th time on the air.

(March 1)—First television circuit called a "see-line" linked Berlin and Leipzig, and the 186-mile "wire" was opened to public.

(April 24)—Television outdoors was demonstrated by RCA Victor, Camden, N. J., with local firemen

as the actors. Broadcast was on 6-meter wave across a mile.

1936 (April 30)—New form of electrical "waveguide"—transmission of ultra-high frequency radio waves through a hollow pipe—was reported by Bell Telephone Laboratories and Massachusetts Institute of Technology.

(May 6)—Broadcasts were conducted from Zeppelin *Hindenburg* during its first trip to United States.

(May 27)—Broadcasts conducted from British liner *Queen Mary* on maiden voyage en route to New York.

Tests to demonstrate the value of television in air reconnaissance began at RCA Laboratories.

(June 4)—Public television demonstrations started in Los Angeles by Don Lee Broadcasting System.

(June 10)—RCA demonstrated facsimile ultra-short-wave radio circuit connecting New York and Philadelphia with automatic relay stations located at New Brunswick and Arney's Mount, near Trenton, N. J.

(June 10)—Bell System first provided coaxial cable for television use between NBC studio, Radio City, and transmitter at Empire State Building.

(June 11)—Complete 2-way radio relay system using frequencies above 30,000 kilocycles for commercial operations was demonstrated by RCA between New York and Philadelphia.

1936 (June)—Record-breaking hook-up handled National Political Conventions; Republicans at Cleveland, June 9, nominated Alfred M. Landon and Frank Knox for Vice President; Democrats at Philadelphia, June 23, nominated Franklin D. Roosevelt and John N. Garner for Vice President.

(June 23)—Federal Communications Commission held a hearing on the future of television and ultra-short waves.

(June 29)—Million-dollar television field tests of RCA got under way from atop Empire State Building.

(July 7)—Radio manufacturers saw television demonstrated from RCA-NBC station at Empire State Building. Radio artists and films were used in the show.

(August)—Olympic games at Berlin were broadcast internationally through an elaborate short-wave hook-up and a 40-nation radio-switchboard.

(August 15)—Seven-mile television show was staged in Philadelphia by Philco from station W3XE on 6 megacycles; pictures 7½″ x 10″.

(September 6)—President Roosevelt in his eighth "fireside chat" discussed the mid-west drought situation.

(October)—Radio was used extensively in Roosevelt-Landon national political campaign, with more than $2,000,000 estimated spent for time on the air.

1936 (November 2)—Television broadcasts went on daily except Sunday schedule in London, 9-10 A.M.; 3-4 P.M.

(November 3)—Coast-to-coast hook-ups broadcast national election bulletins.

(November 6)—Television was demonstrated by National Broadcasting Company with 250 guests as spectators at "live" talent and film performance; screen 7½" x 10".

(November)—National Broadcasting Company celebrated tenth anniversary with foreign radio executives as guests.

(November)—First regular high-definition service from BBC Alexandra Palace television station began, using alternately Baird intermediate film system on 240 lines and Marconi-Electrical Musical Industries all-electronic system on 405 lines. British adaptation of the iconoscope was called "the Emitron" as developed in the Electric & Musical Industries, Ltd. Laboratories (a Super-Emitron was used for outdoor pickups by BBC in November, 1937).

(December 1)—President Roosevelt's address at Pan-American Peace Conference, Buenos Aires, was broadcast world-wide; also events associated with the conclave.

(December 1)—Coaxial cable of AT&T opened for tests between New York and Philadelphia.

(December 10)—News of King Edward VIII's abdication was broadcast world-wide from London.

1936 (December 11)—King Edward VIII as David Windsor broadcast his farewell to the British people following his renunciation of the throne.

(December 12)—King George VI's first proclamation to the Empire was read on the radio by the heralds.

(December 24)—Pope Pius XI broadcast Christmas message to the world from the Vatican.

1937 (January 6)—President Roosevelt's message to Congress was broadcast internationally.

(January 7)—Crown Princess Juliana's wedding was broadcast from the Hague.

(January 20)—President Roosevelt's second inaugural was broadcast internationally.

(January 25-28)—Broadcasters mobilized for emergency service in Ohio-Mississippi Valley flood disaster.

(February)—NBC Symphony Orchestra was formed with Arturo Toscanini, conductor.

(February)—British Broadcasting Corporation abandoned Baird intermediate film system using optical camera pick-up method of television and adopted all-electronic Marconi-EMI system of 405 lines.

(February 11)—Television of 441 lines was demonstrated by Philco Radio & Television Corp. in three-mile test across Philadelphia.

1937 (March 9)—President Roosevelt broadcast his ninth "fireside chat" on reorganization of the Judiciary.

(May 6)—Dirigible *Hindenburg* crashed and burned at Lakehurst, N. J.; eyewitness account by Herb Morrison and Charles Nehlsen of WLS, Chicago, who happened to be on the scene, was recorded and later broadcast.

(May 12)—Coronation of George VI and Queen Elizabeth was first event of its kind to be broadcast; also first telecast of its kind, and was seen by 50,000 televiewers over 7500 square-mile area.

(May 12)—Electron projection "gun" demonstrated at IRE convention by V. K. Zworykin and R. R. Law of RCA Laboratories projected television pictures on 8′ x 10′ screen.

(June 8)—Total eclipse of the sun, the longest in 1200 years, was vividly described on radio from Canton Island, South Pacific, and from Peru.

(June 22)—Braddock-Louis fight at Chicago was broadcast by WEAF-WJZ networks.

(July)—Radio joined in search for Amelia Earhart plane lost in mid-Pacific.

(July 17)—Frank R. McNinch and T. A. M. Craven appointed by President Roosevelt as members of FCC to replace the late Anning S. Prall and Dr. Irvin Stewart, resigned.

(July 20)—Guglielmo Marconi, inventor of wireless, died in Rome of a heart attack; age 63.

1937 Said Sir Ambrose Fleming: "Marconi was eminently utilitarian. His predominant interest was not in purely scientific knowledge per se, but in its practical application for useful purposes."

(September 28)—FCC authorized radio facsimile tests on regular broadcast channels during early-morning hours.

(October 1)—Associate Justice Hugo L. Black broadcast to the nation in defense of charges he was, or had been, a member of the Ku Klux Klan.

(October 12)—President Roosevelt broadcast his tenth "fireside chat" on condition of nation as he observed it while on a western tour.

(October 14)—Television on 3′ x 4′ screen was demonstrated by RCA to Society of Motion Picture Engineers between Empire State Building transmitter and Radio City.

(October 15)—Federal Communications Commission adopted "open door" policy regarding ultra-short waves, and opened up 10 to 300,000 kilocycle spectrum for various services and experimenters.

(November 9)—Movies transmitted over coaxial cable between New York and Philadelphia were 240-line texture.

(November 14)—President Roosevelt broadcast his eleventh "fireside chat" on "The Unemployment Census."

1937 (December 6)—U. S. Court of Appeals for District of Columbia held that broadcasting stations are not public utilities; that economic competition should be considered in granting new facilities in given localities.

(December 12)—Mobile television station appeared on the streets of New York, operated by the National Broadcasting Company.

(December)—What was probably the first application of radar principles to aviation was achieved by RCA through equipment built and installed on its own plane in connection with research on collision prevention apparatus.

(December 25)—King George VI broadcast Christmas greeting to the Empire; Arturo Toscanini directed first of a series of ten concerts by the NBC Symphony Orchestra.

1938 (January 3)—President Roosevelt read his message to Congress, and over 350-station hook-up.

(January 27)—FCC allocated band of twenty-five ultra-high frequencies for non-commercial educational broadcasting.

(January)—Two pulse radars, one beaming energy ahead and the other to the ground, were installed on a plane by RCA engineers as a radar altimeter to warn of mountains, of other planes and altitude.

(February 20)—Chancellor Hitler in 3-hour broadcast reviewed Germany's past and looked defiantly

to the future, warning other nations "hands off" in a "steel and blood" speech.

1938 (February)—Shoran (SHOrt-RAnge-Navigation), a radio system for high-precision position finding in aerial navigation, was conceived by Stuart W. Seeley, of RCA Laboratories. Application for a patent was filed April 13, 1940, and the patent was issued as No. 2,405,238 on August 6, 1946.

(February)—Television images from London on ultra-short waves were picked up at Riverhead, L. I., badly distorted or "scarred."

(February)—High-powered pulse radar equipment was in operation at U. S. Naval Research Laboratory, Anacostia, D. C., and planes were detected at a range of 50 miles.

(March 14)—Hitler's coup of Austria was subject of numerous world-wide broadcasts.

(April 14)—President Roosevelt broadcast his twelfth "fireside chat" on relief and other problems.

(June 6)—FCC opened hearings on superpower and new rules for broadcasting.

(June 7)—Scenes from current Broadway play, *Susan and God,* were telecast by NBC, starring Gertrude Lawrence, produced by John Golden.

(June 22)—Louis-Schmeling fight at Yankee Stadium was broadcast by 146 stations of NBC. Louis won in first round, 2 minutes and 4 seconds.

1938 (June 24)—President Roosevelt broadcast his thirteenth "fireside chat" assailing campaign of defeatism in Congress.

(July 10-14)—Howard Hughes' round-the-world flight made extensive use of radio, and broadcasters followed the plane with broadcasts and bulletins.

(September 10)—Eduard Beneš, President of Czechoslovakia, in world-wide broadcast address from Prague, pleaded for peace.

(September 12)—American networks devoted 90 minutes to Hitler's speech at Nuremberg, while all the world listened, wondering if he would declare war on Czechoslovakia.

(September)—Sudeten crisis in Europe resulted in numerous short-wave broadcasts by European leaders and commentators.

(September 25)—Ignace Jan Paderewski, pianist, in Switzerland broadcast for first time to the United States.

(September 26)—Hitler in world-wide broadcast from Berlin attracted vast audience awaiting a possible declaration of war.

(September 27)—Prime Minister Neville Chamberlain in emotional international broadcast announced Britain ready to fight any nation seeking to dominate the world by force. As "a man of peace to the depths of my soul," he pledged every effort to preserve peace.

1938 (September 29)—Four-Power communiqué read on the air from Munich, temporarily averted war and the world breathed a sigh of relief, as a month of dramatic war mobilization broadcasts ended.

(September 30) — Prime Minister Chamberlain stepped from plane at Heston airdrome on return from meeting Hitler at Munich, and announced he had gained "peace for our time"; the scene was telecast in London area.

(October 10)—New "absolute" radio altimeter was demonstrated by Bell Telephone Laboratories in New York; radio waves projected from plane toward the earth were reflected from buildings and other objects on the ground, measurement of time elapsed between transmission and reception was translated into feet on a dial.

(October 20)—RCA announced at Radio Manufacturers Association meeting that television sets would be offered to the public in April, 1939, as feature of the New York World's Fair.

(October 30)—Dramatic broadcast *War of the Worlds,* by H. G. Wells, featuring Orson Welles, caused mass hysteria among radio listeners, led to believe "a gas raid from Mars" was actually striking America.

(November 12)—Frank R. McNinch, Chairman of FCC, in broadcast declared censorship of radio "impracticable and definitely objectionable."

1938 (November 14)—FCC opened radio-network "monopoly" probe of broadcasting.

(December)—Radar tests began aboard the battleship *New York.*

(December 13)—Farnsworth Television & Radio Corp. was formed as a manufacturing company with E. A. Nicholas as president; Philo T. Farnsworth's notable invention was the image dissector tube, an electronic scanner for television.

1939 (January 4)—President Roosevelt broadcast his annual message to Congress.

(January 17)—Major Edwin H. Armstrong demonstrated FM radio on 7.5 meters across New York; the 40-KW transmitter W2XMN was located at Alpine, N. J.

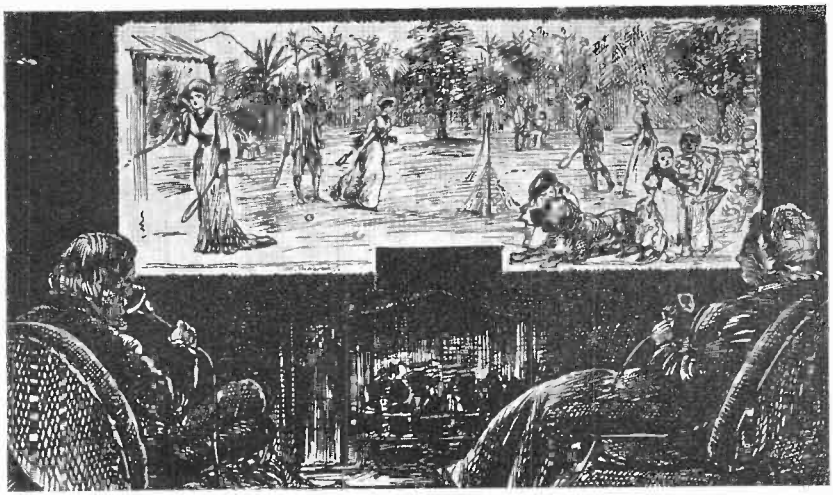
(January 21)—Bermuda Clipper *Cavalier* sent SOS at sea and sank in ten minutes; radio summoned rescuers who saved 10 of the 13 people aboard.

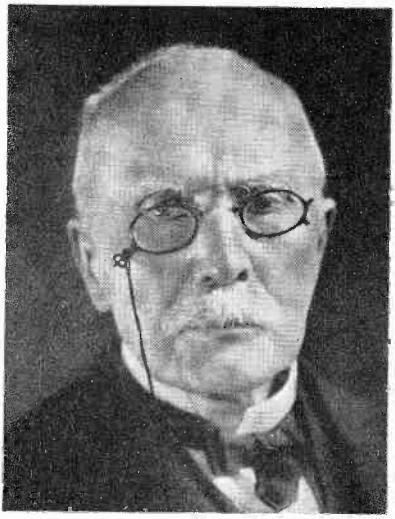
(January 24)—Mayor LaGuardia of New York in police car joined in two-way conversation with Lord Mayor of London in his coach on the streets of London.

(January 29)—"Rhumbatron," or Klystron system of ultra-short waves, developed by Russell H. Varian and Sigurd Varian at Stanford University, succeeded in generating powerful waves reported under perfect control, even on micro-wave channels.

In 1882, Albert Robida, a French artist, portrayed a prediction he made for 1952—he foresaw an Alpine mountaineer picking up music from Paris by means of "a photo-operagraph".

In 1879, artist George Dumaurier, inspired by Edison's "telephonoscope" (which would transmit light as well as sound), made this prophetic illustration of television for Punch's Almanac. He described it as "an electric camera-obscura over the mantel-piece".



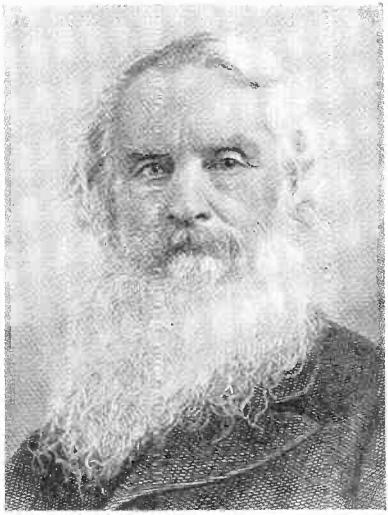


Edouard Branly invented the coherer, the first detector of wireless waves.

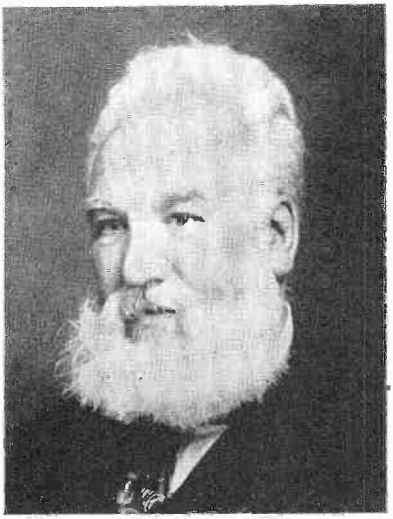
Sir William Crookes invented the Crookes tube, which led to applications of cathode-rays.

J. J. Thomson, English physicist, discovered the electron and in 1897 demonstrated its true character.

Reginald A. Fessenden, pioneer American inventor in wireless and radiotelephony.



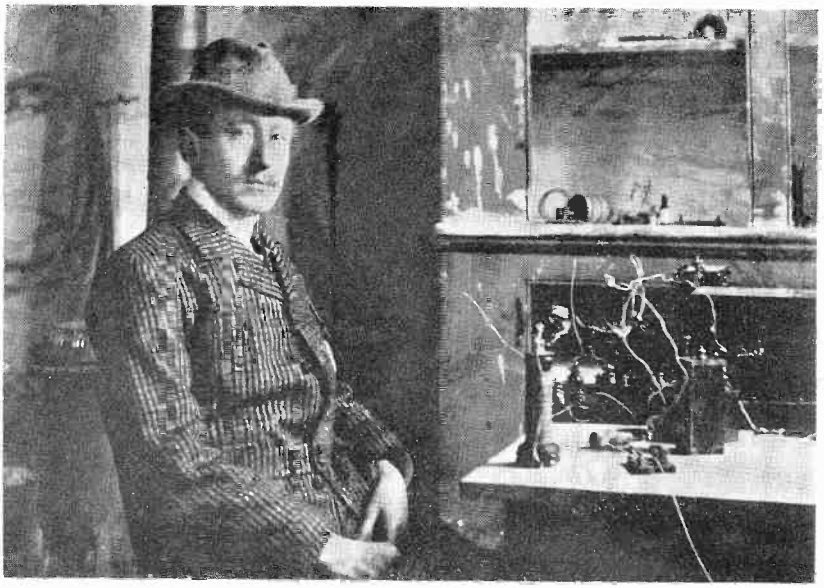
Samuel F. B. Morse invented the telegraph in 1836 and opened a new era in communications.



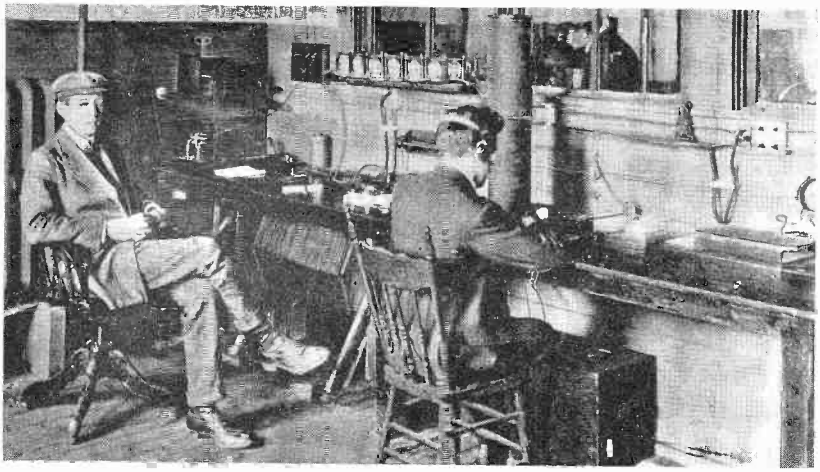
Alexander Graham Bell invented the telephone in 1876; now the world has 65 million phones.

Heinrich Hertz, in 1886, was the first to produce, detect and measure electromagnetic waves.

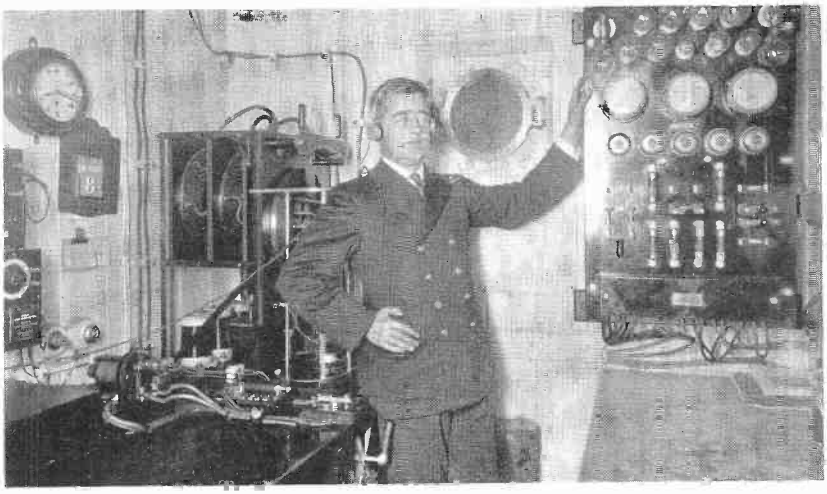
James Clerk Maxwell, Scottish physicist, in 1867 theoretically predicted existence of "the ether".



Guglielmo Marconi and the receiving apparatus with which he picked up the first transatlantic wireless signal on December 12, 1901, at St. John's, Newfoundland.

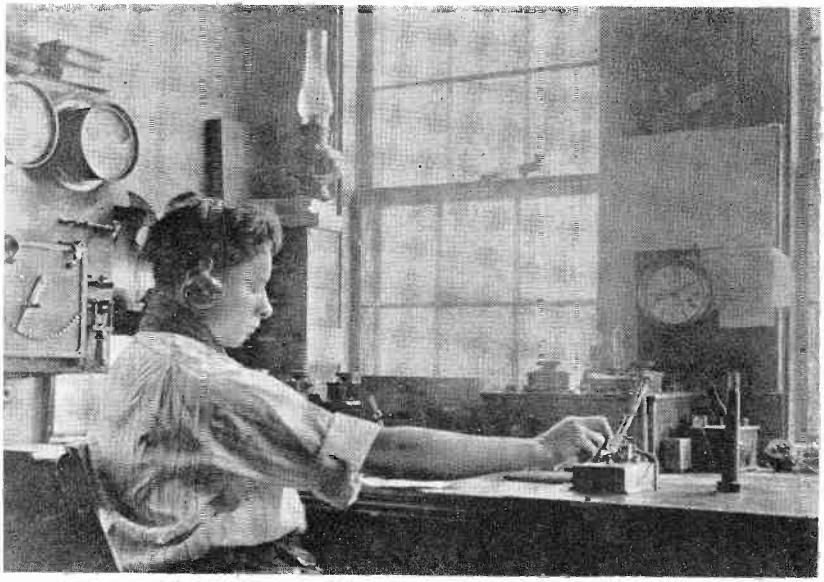


Marconi (left) sent the first west-east transatlantic messages from his station at Glace Bay, Nova Scotia, to England on December 17, 1902.

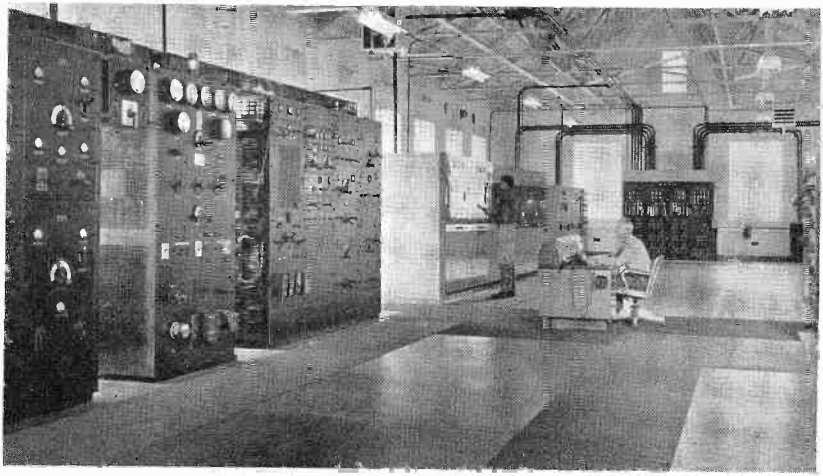


Wireless on board the S.S. Adriatic, prior to World War I, featured spark transmitters and the magnetic as well as crystal detectors.

Electron tubes and many other scientific developments led to great improvements in shipboard radio as revealed by Radiomarine's streamlined installation aboard the S.S. America.

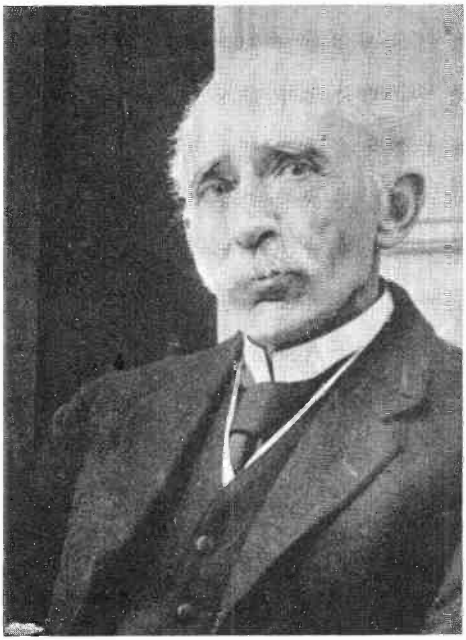


Outgoing transatlantic liners flashed goodby and incoming ships within a 100-mile range were greeted through the Marconi spark station at Siasconset on Nantucket Island, where David Sarnoff was the operator in 1908.

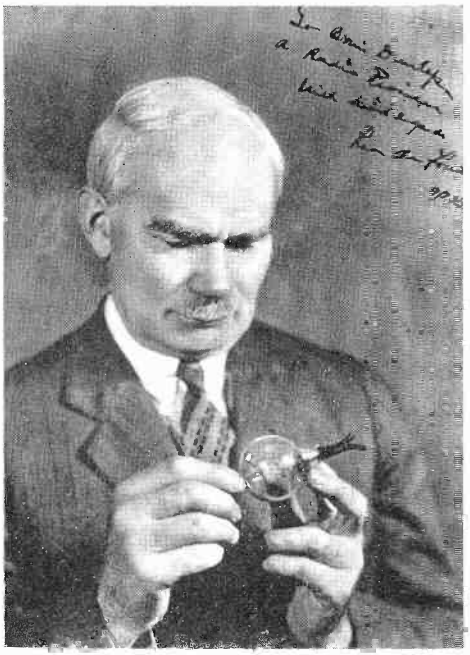


Great have been the changes in shore-to-ship radio since 1908 as shown in this picture of the modern Radiomarine station at Chatham, Mass. Its transmitters can communicate with ships anywhere on the Atlantic.

Thomas Alva Edison's inventive genius contributed greatly to the advance of radio; his discovery in 1883 of "the Edison Effect"—a curious electronic phenomena inside of a vacuum tube—was a clue that led to invention of the radio electron tube.

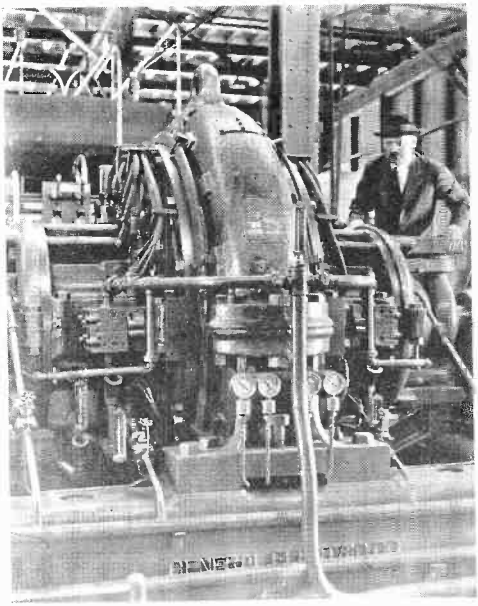


John Ambrose Fleming, English physicist, invented the first electronic detector of wireless waves in 1904. He called it "the valve detector," and in 1929 he won knighthood for his "valuable services in science and industry."



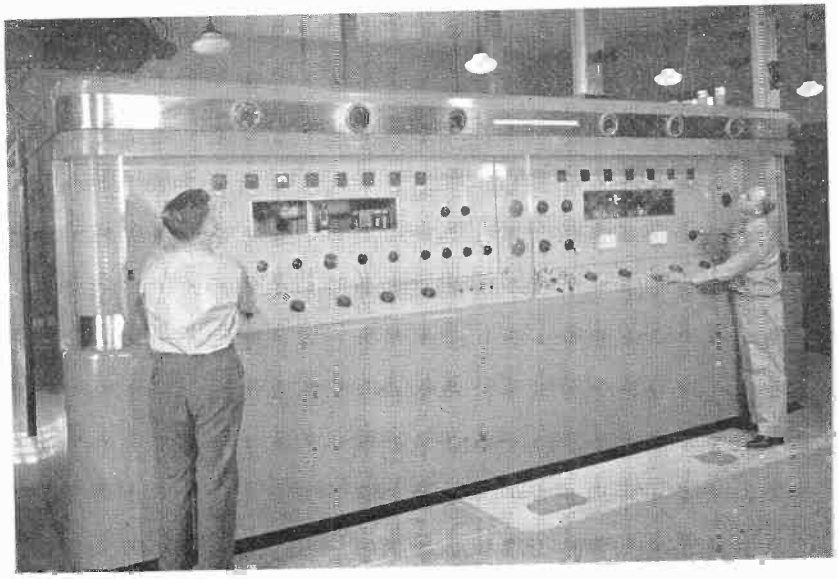
Dr. Lee de Forest, invented the 3-element electron tube in 1906, and named it "the audion." As a detector, amplifier and oscillator (generator of radio waves) it made possible radiotelephony and broadcasting, and revolutionized the art of electric communications.

Dr. Vladimir Kosma Zworykin invented the iconoscope, electronic "eye" of the television camera; he also developed the kinescope, or television picture tube, for the receiver.



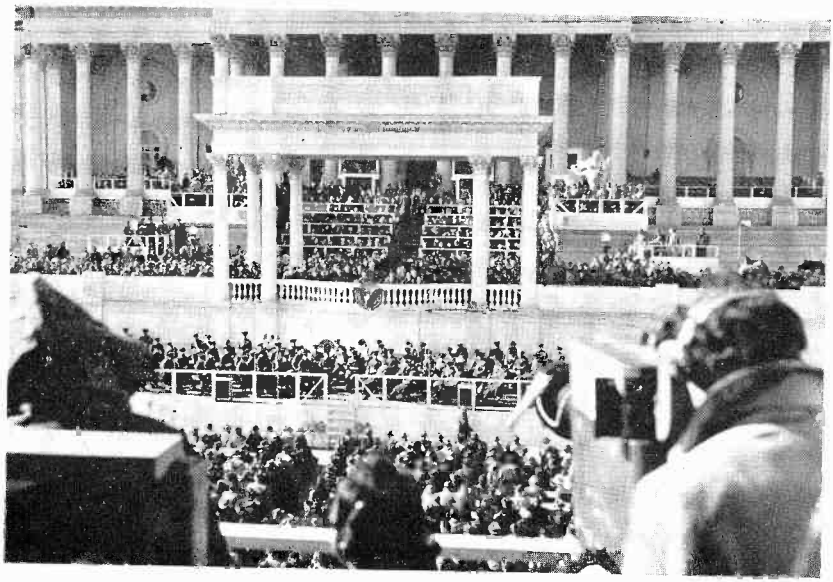
Dr. E. F. W. Alexanderson contributed to the advance of world-wide wireless when he developed the high frequency alternator, which became the "driving force" in overseas communication during World War I.

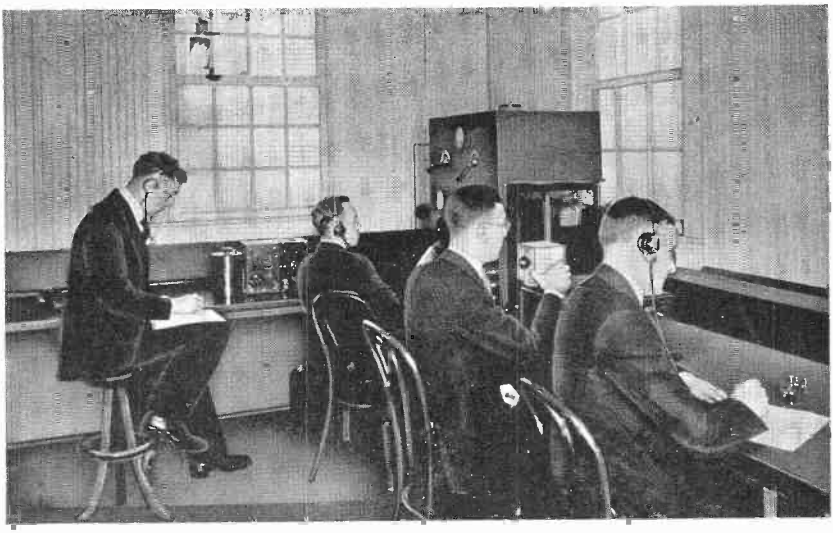
High-power electron tubes greatly improved world-wide radiotelegraphy and such installations as RCA's "Radio Central" at Rocky Point, Long Island, have largely replaced the old high-frequency alternators.



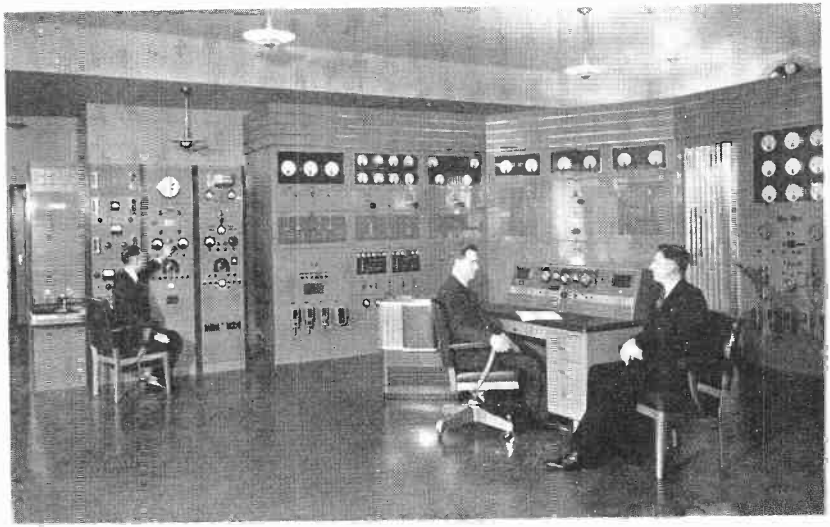
The first attempt to "broadcast" by a President of the United States was made on July 4, 1919 when Woodrow Wilson addressed the crew of the U.S.S. George Washington at sea.

President Truman's inauguration on January 20, 1949 was the first event of its kind to be televised; 34 stations in 16 cities from Boston to St. Louis comprised the network that reached 14 States.



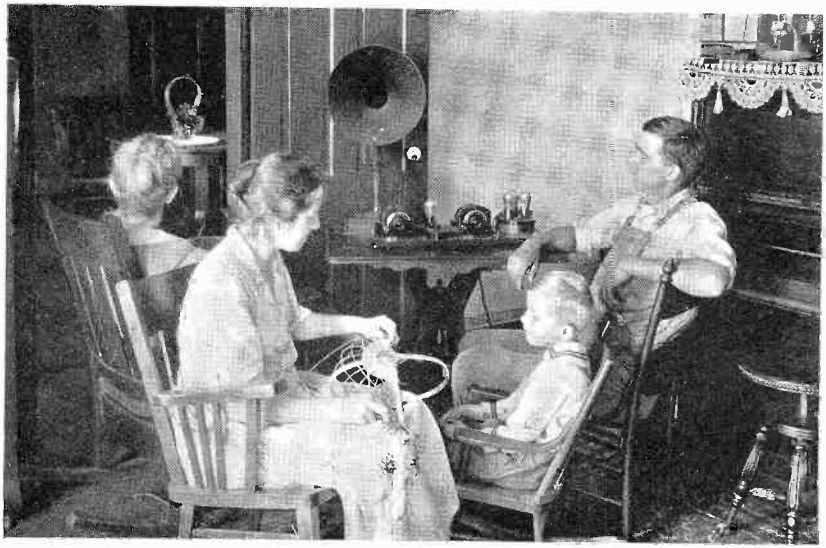


When station KDKA, Pittsburgh, went on the air in 1920 as "the pioneer" in public broadcasting, the equipment was relatively simple.

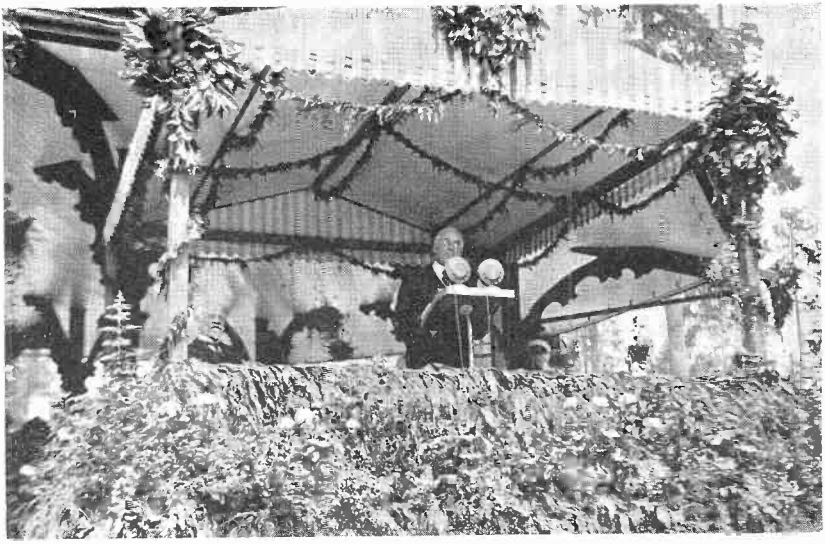


The control room of a modern broadcasting station—such as WNBC, New York—reveals how electronic apparatus has been streamlined since the pioneer broadcasters took to the air in the early Twenties.

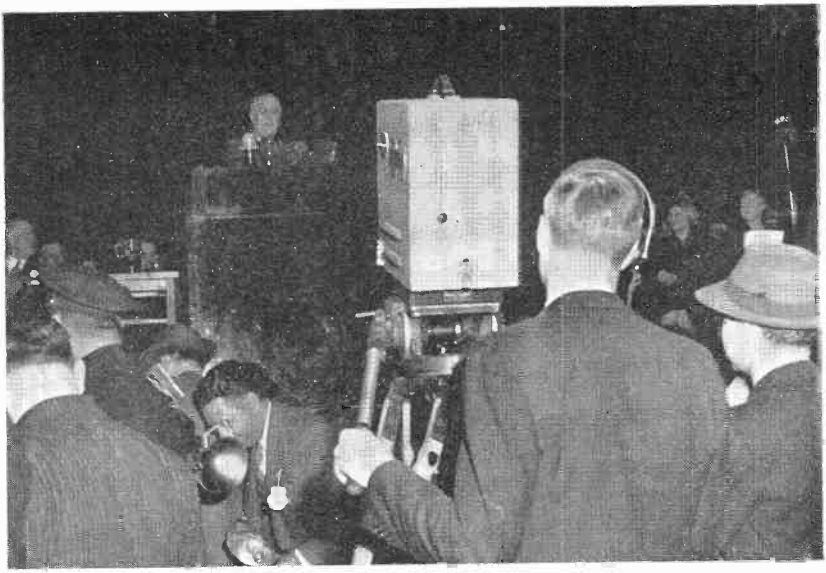
Soon after the advent of broadcasting, the one-tube receiver, called the "Aeriola," came as a great advance over the crystal detector set. Several years later new electron tubes and the loudspeaker enabled families to listen without earphones.



The gooseneck horn adopted from the early phonograph gave radio listeners a loudspeaker in 1923 and brought an end to earphone reception.



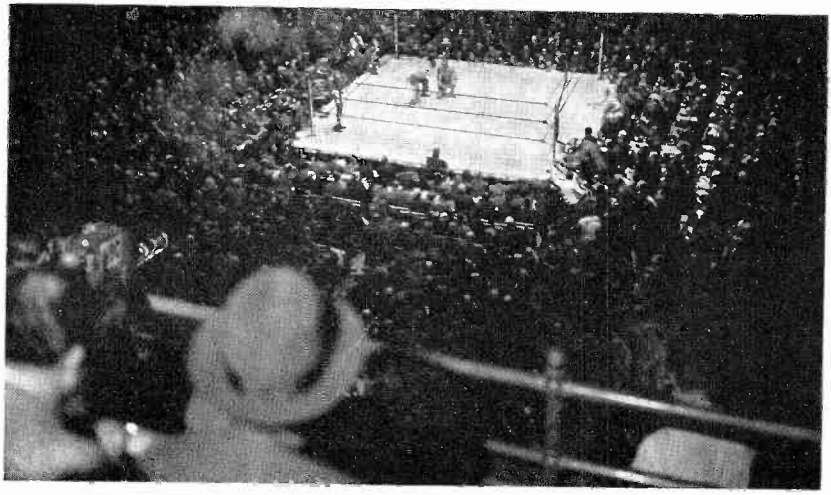
Warren G. Harding was the first President to use radio broadcasting to reach the people, in 1922.

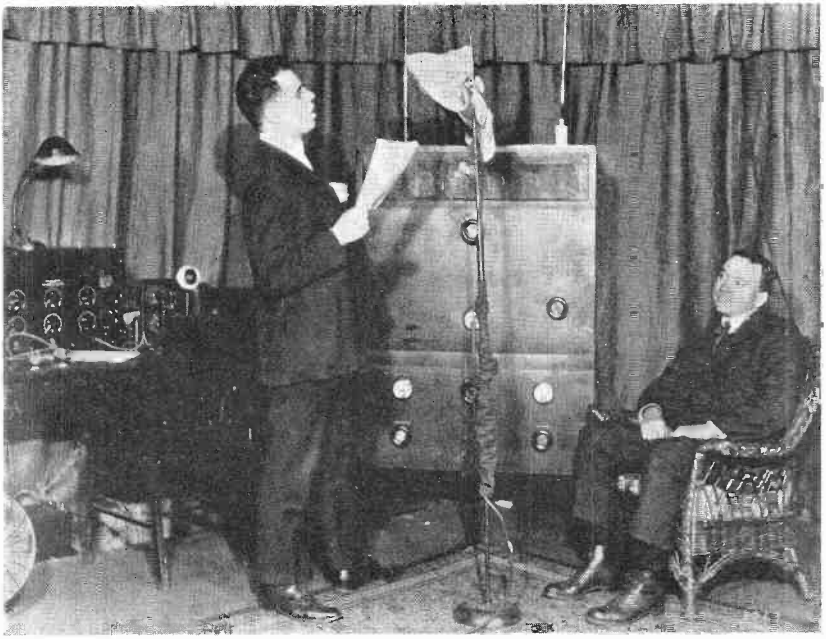


Franklin D. Roosevelt, at the New York World's Fair in 1939, was the first President to be televised. He is shown here in a later telecast at Madison Square Garden.

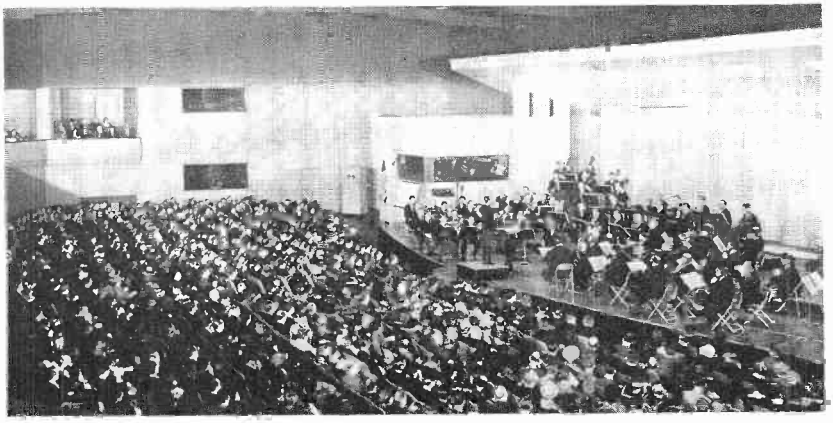
Through this temporary station erected by RCA at Weehawken, N. J., in 1921, the Dempsey-Carpentier "Battle of the Century" was broadcast blow-by-blow from the ringside at Boyles Thirty Acres, Jersey City.

Twenty-seven years after the broadcast of the Dempsey-Carpentier fight television cameras were at the ringside of the Louis-Walcott bout in Madison Square Garden.





Broadcast studios in the early Twenties were largely improvised rooms with the walls draped with heavy curtains, and the transmitter as well as the control apparatus was located in the studio.



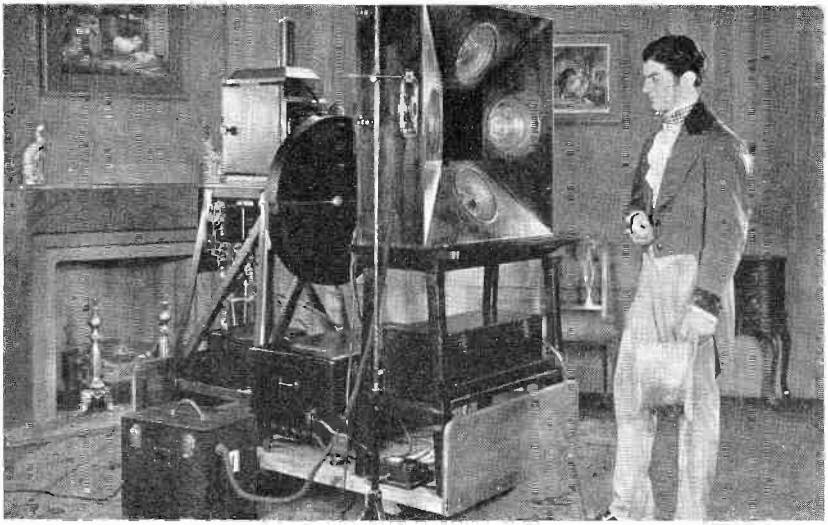
For many years Studio 8-H in Radio City, New York, was the largest radio studio in the world. In 1950 it was converted for television.

For radio to handle an orchestra or string quartet in 1925 was quite a feat, and to avoid the presence of the microphones from disturbing the musicians the "mikes" were concealed in the lamp shades in the WGY studios at Schenectady, N. Y.

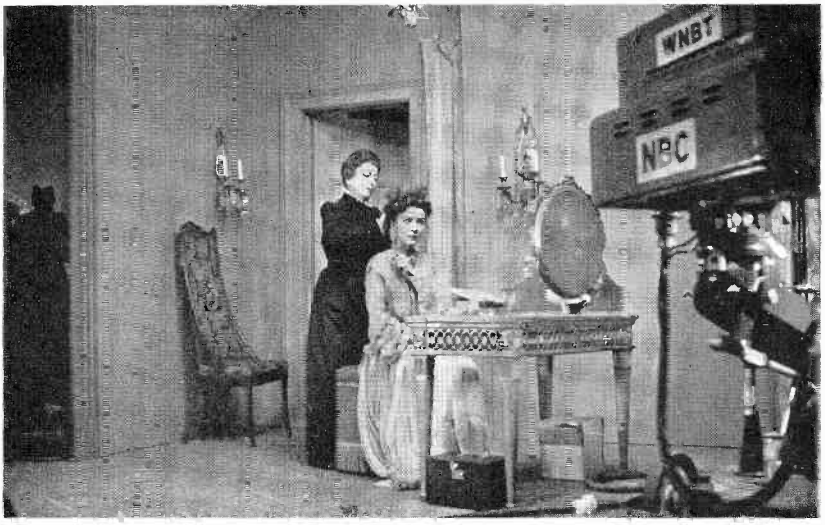
Maestro Arturo Toscanini conducting the NBC Symphony Orchestra in a nation-wide broadcast, a feat that was believed impossible in the early Twenties when it was miracle enough for a lone violinist to broadcast.

The old spy melodrama "The Queen's Messenger" telecast from Schenectady in 1928 revealed that a new theatre for the home was in prospect.

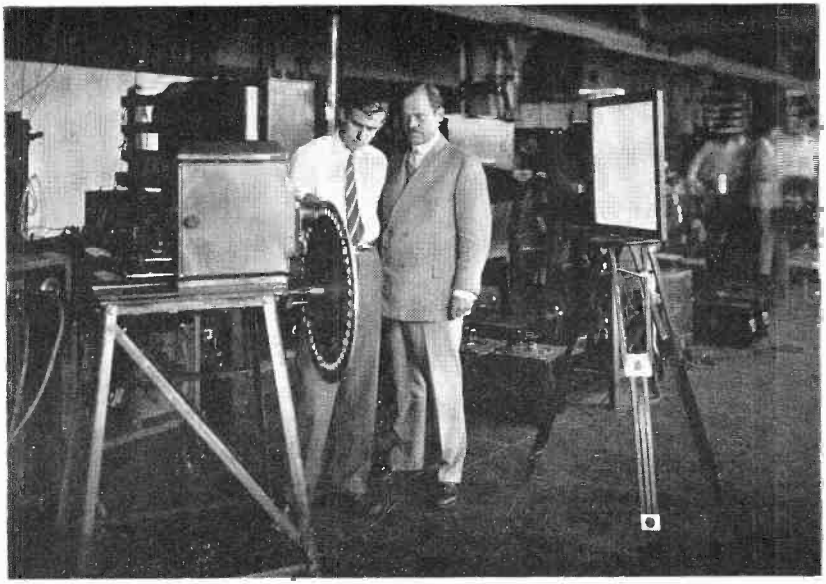
Television looks upon no play as too complex to televise whether Shakespeare or musical comedy; here the camera scans Rostand's "Cyrano de Bergerac."



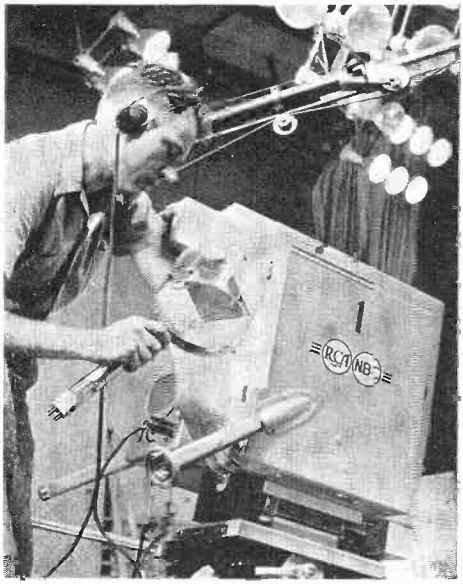
Television in the late Twenties used the mechanical scanning disk and the "camera" had large bulbous electric "eyes." Then RCA scientists developed the all-electronic system featuring cameras with electronic "eyes."



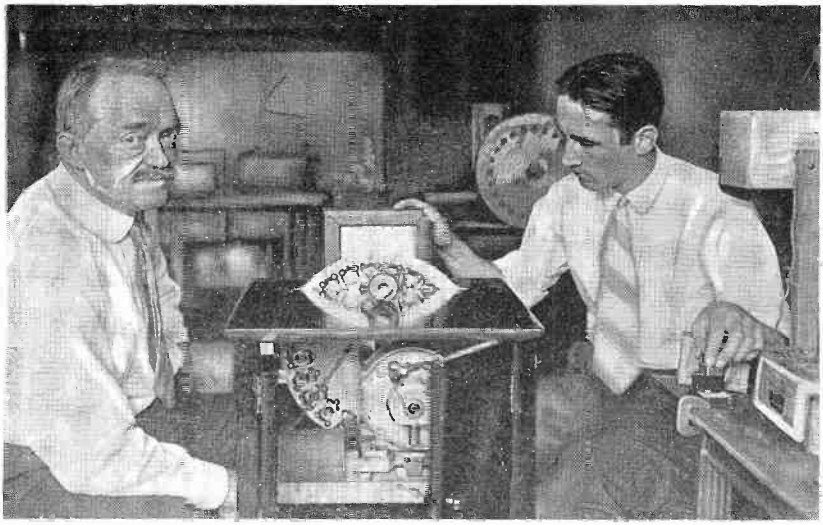
The television camera greatly transformed by electronics is far more sensitive and flexible than the "cameras" of the Twenties; here, as of 1949, a scene from "Rebecca."



In 1927, the hopes of Dr. E. F. W. Alexanderson (right) and Ray D. Kell, as television pioneers, rested in the mechanical scanning disk.

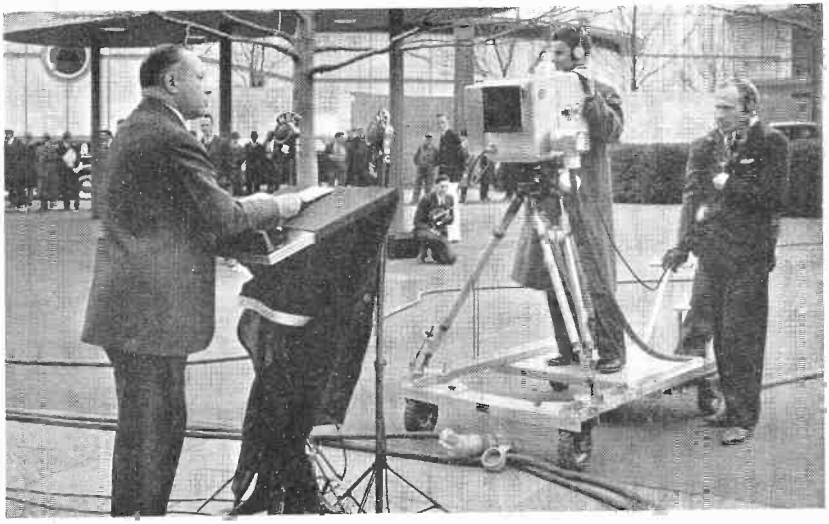


The iconoscope, when put into the camera, gave television an electronic "eye."



Charles Francis Jenkins, one of America's pioneers in television, demonstrated this mechanical scanning disk receiver in 1925; tiny lenses festooned the rim of the whirling disk.

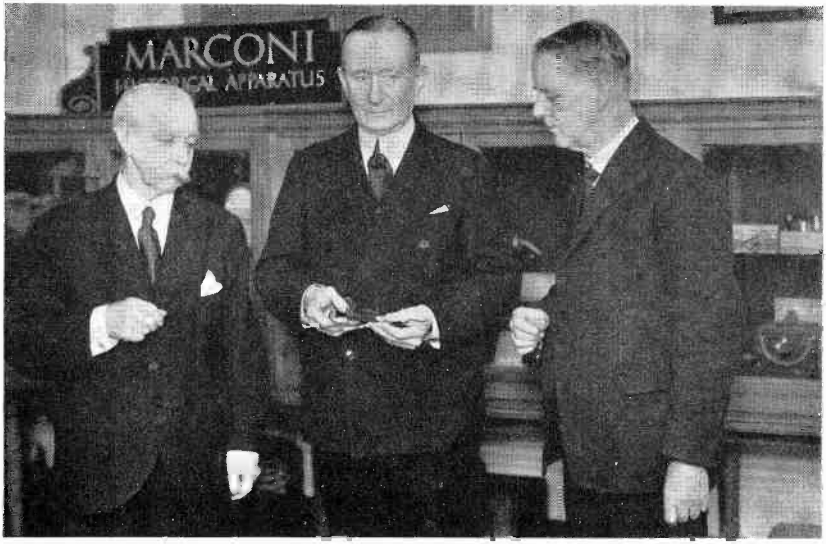
In 1929, Dr. V. K. Zworykin demonstrated the first electronic television receiver using the kinescope, or picture tube, which he developed together with the famed iconoscope, "eye" of the camera.



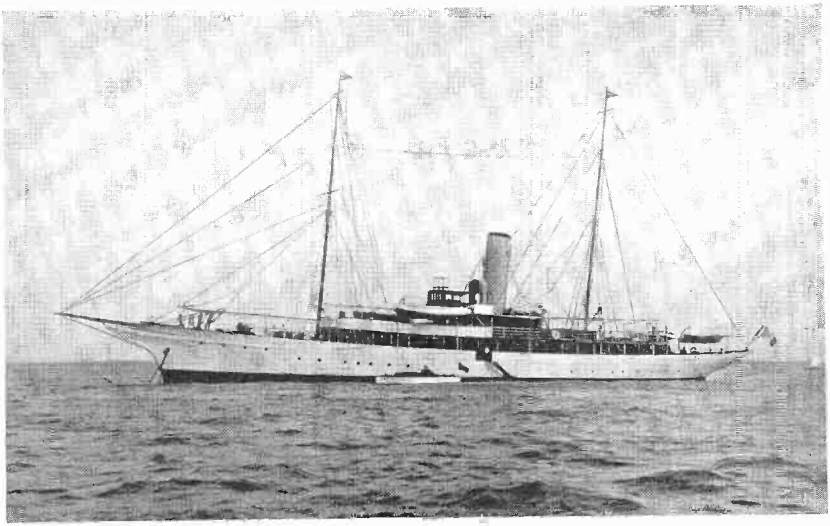
David Sarnoff, then President of the Radio Corporation of America (now Chairman of the Board), launched television as a new industry at the New York World's Fair in April, 1939.

The popular television set, first introduced by RCA for public use at the New York World's Fair in 1939, featured a picture reflected from the top of the kinescope to a mirror on the underside of the cabinet's uplifted lid.

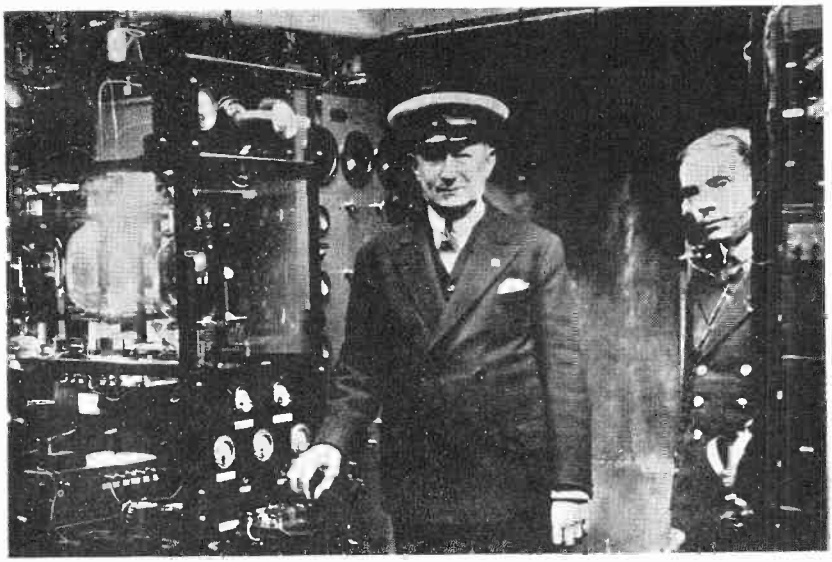
Marconi (center) with his two assistants G. S. Kemp and P. W. Paget at St. John's, Newfoundland, where on December 12, 1901 they picked up the first transatlantic signal from Poldhu on the southwest tip of England.



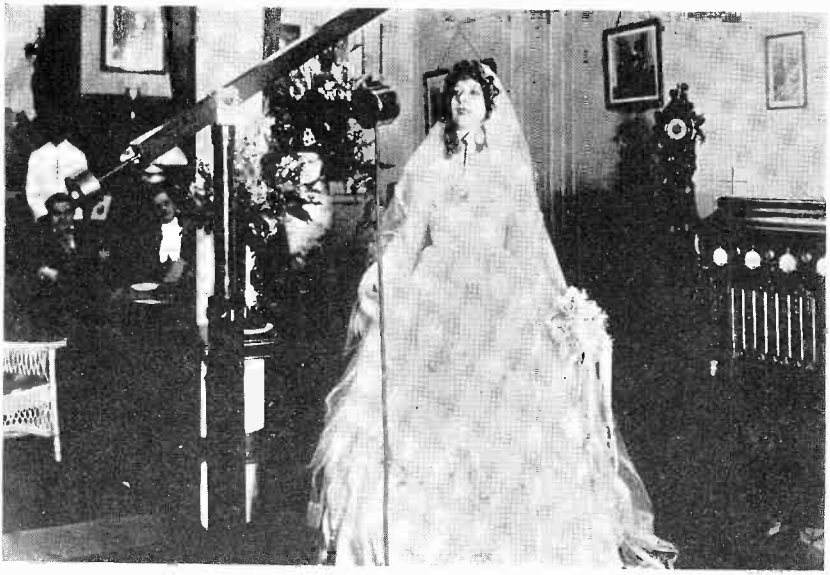
Thirty years later in 1931, G. S. Kemp, Guglielmo Marconi and P. W. Paget met in London to observe the 30th anniversary of the first transatlantic signal.



Marconi's floating laboratory, the yacht Elettra.



It was front page news in 1930 when Marconi on his yacht Elettra in the Mediterranean established wireless telephone communication with Australia. Said Marconi, "I know how this thing works, but what I would like to know before I die, is why it works."



Olga Petrova, noted actress, performed before the microphone in 1921 in a living-room studio designed to create a more informal atmosphere for artists.

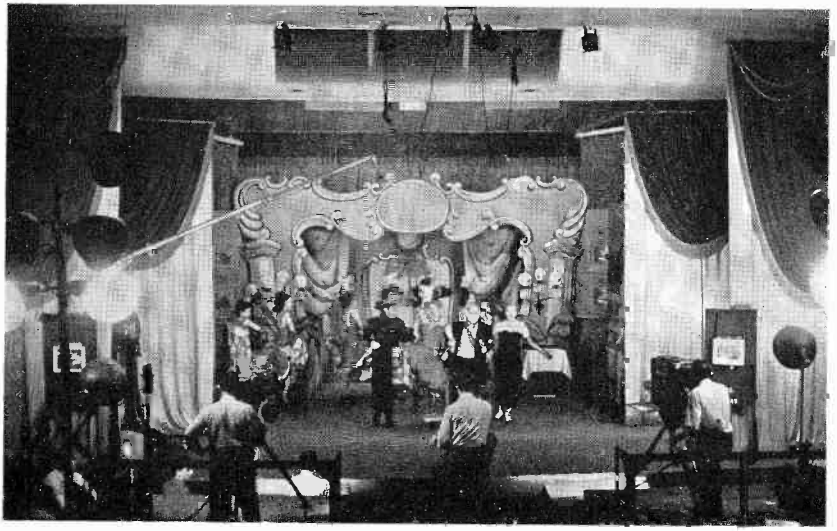
Kyle MacDonnell, singer and actress, before the television cameras in 1949; the microphone on a boom, Hollywood-style, is unseen by the TV audience.

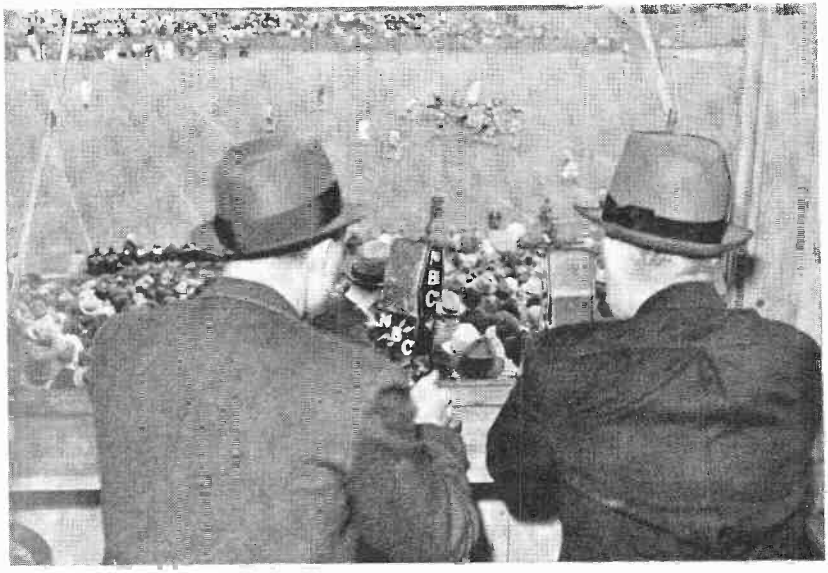
When the French liner Normandie was ablaze in 1948 at her pier in New York, Graham McNamee, one of radio's pioneer announcers was rushed to the scene with a knapsack transmitter which relayed his description by short waves to NBC's main station (then WEAF), for broadcasting.

British children brought to America for safety during World War II, held dramatic two-way transatlantic conversations with their parents in England.

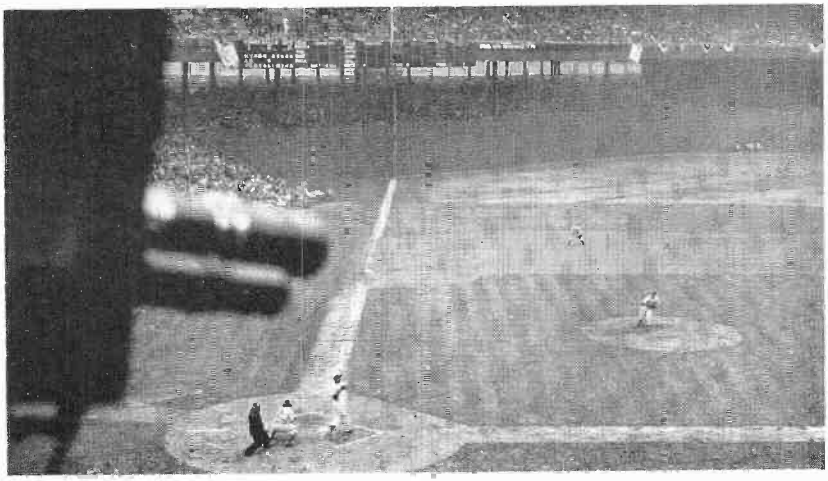
Weber and Fields, noted comedy team in the Twenties brought enjoyment to a vast audience, yet their funny costumes and laugh-provoking antics went for naught since only the words of their act could be picked up and broadcast.

Television has opened a new era for the comedian; he can use every prop at his command to put across his personality, jokes and gestures, as illustrated by the Milton Berle show.





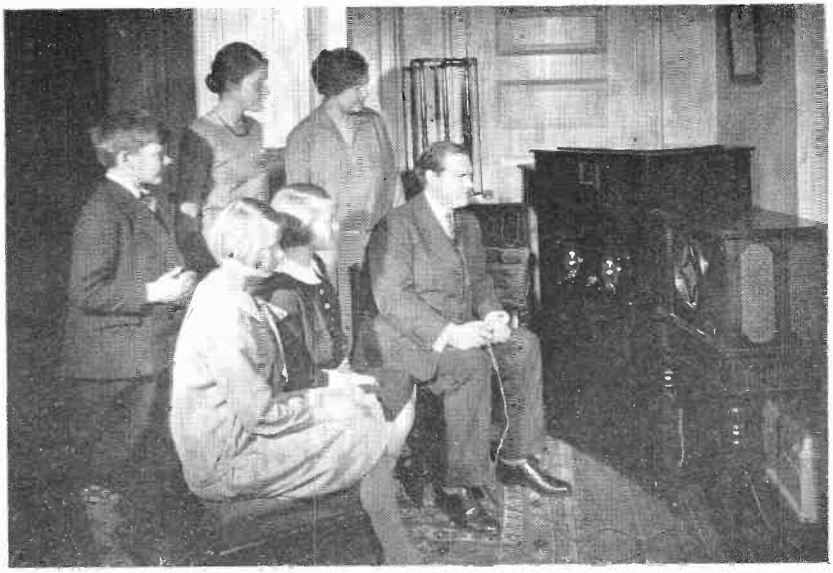
Great was the day when announcers took the microphone into the field of sports to broadcast play-by-play descriptions of the games.



The television camera scans the sports arena, baseball diamond and football gridiron, enabling millions of sports fans to eye-witness every play.

War news was at the forefront of broadcasting from 1939 to 1945; here H. V. Kaltenborn, news commentator, is seen at the microphone.

In the postwar period, television newsreels were supplemented by such commentators as John Cameron Swayze.



Dr. E. F. W. Alexanderson in 1928 gave his family a glimpse of television at their home in Schenectady, N. Y.—a miracle despite the small size of the picture that was whirled into view by a mechanical scanning disk.

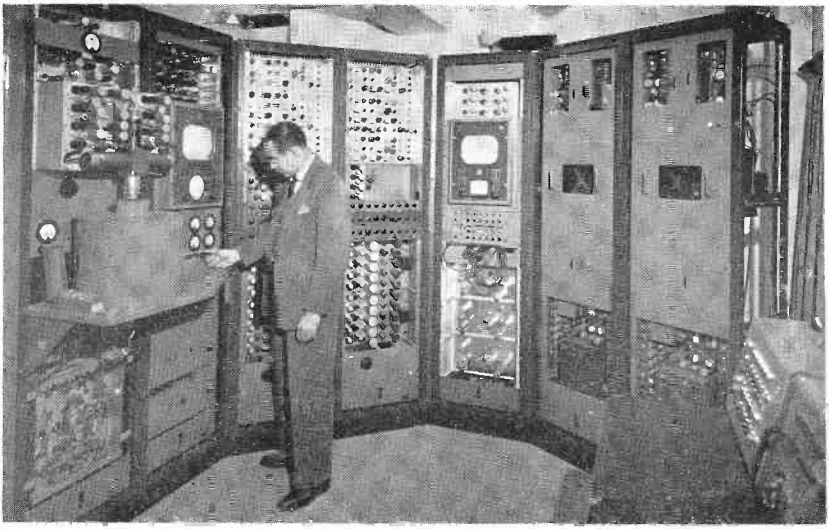
Television—the new theatre in the home as the curtain went up on the second half of the 20th century.

A diminutive pick-up tube called the Vidicon, developed in RCA Laboratories, makes possible small television cameras ideal for a multiplicity of industrial and educational purposes.

The RCA electron microscope—a by-product of television research—opens to view the submicroscopic world of the infinitesimal for it permits magnifications up to 200,000 diameters.

Radar: Ra-radio; d-detection or direction-finding; a-and; r-ranging, added a new dimension to direction finding and navigation at sea and in the air during World War II. (U. S. Navy Photo.)

Radio direction finders first came into general use during World War I and, since that time, have been developed for service on small craft as well as on ocean liners and airplanes.



Color television was much in the news as the second half of the 20th century dawned; here Ray D. Kell, RCA research engineer, adjusts the color transmitter installed during 1949 in Washington, D. C., for public demonstrations and field tests.

All-electronic color television receiver, demonstrated by RCA for the first time publicly in March 1950, introduced a new direct-view color picture tube.

1939 (February)—Wheeler-McNinch bill was introduced proposing a 3-man Federal Communications Commission.

(February)—Senator Wallace H. White offered a bill to revamp the FCC into an 11-man Commission.

Said Lord Rutherford: "We should fittingly honor Maxwell as the great pioneer of radio communication, for he not only had the genius to foresee that electric waves must be produced, but had given (in 1864) the complete theory of their generation and propagation long before their existence had been suspected by science. . . . He had enormous perseverance and powers for work."

(March 2)—Radio was used for first time to announce the election of a Pope, Pius XII.

(March 12)—Coronation of Pope Pius XII was broadcast internationally, marking first ceremony of its kind on the air from Vatican City.

(March 15)—Hitler led German troops into shattered Republic of Czechoslovakia and marched into Prague; broadcasters turned the microphone on Central Europe again. Germany broadcast the announcement "Finis Czechoslovakia" and that German troops would occupy the whole of Bohemia and Moravia.

(March 22)—Operation at Israel Zion Hospital, Brooklyn, N. Y., televised for first time by American Television Corp. for benefit of students and nurses in auditorium 500 feet from operating room.

1939 (March 26)—Mussolini on 20th Anniversary of founding Fascisti movement invited France to discuss colonial issues, chiefly Jubiti, Tunisia, and Suez Canal.

(April 27)—Hitler in world-wide two-hour broadcast replied to President Roosevelt's peace message with "No."

(April 30)—Opening ceremonies of New York World's Fair were televised by NBC, including President Roosevelt as first Chief Executive to be telecast. RCA television receivers with screen 8″ by 11″ were made available for public purchase.

(May 8)—Duke of Windsor, speaking from Verdun, France, broadcast a world-wide plea for preservation of peace; his first public utterance by radio since his abdication.

(May 9)—President Roosevelt, in his first transcribed address under government auspices, described radio as "free as the press" except for such regulations necessary to prevent confusion on the air.

(May 17)—King George VI set foot on Canadian soil and broadcast greetings to America from Quebec.

(May 17)—Columbia-Princeton baseball game at Baker Field was telecast by NBC as a "first" from the diamond.

(May 20)—Standard telephone cable pairs, properly balanced, were used successfully as local pick-up channel for television broadcast of six-day bicycle race at Madison Square Garden, New York.

1939 (May 23)—Submarine *Squalus* sank off New Hampshire coast; broadcast bulletins and interviews described dramatic rescue by means of a diving bell.

(May 24)—Television Committee of FCC recommended deferring action on adoption of television standards and in the meantime advocated a study of public reaction to television.

(May 24)—English Derby was televised to five London theaters which, charging $2.50, were jammed to capacity; screen 15′ x 20′.

(May 26)—Associated Press lifted ban on use of AP news in sponsored broadcasts under definite rules.

(May 29)—Engineers at Schenectady announced that they were looking-in on New York telecasts through a receiver in Heldeberg Mountains, 130 miles from Empire State Building.

(June 1)—Nova-Baer 11-round fight at the Yankee Stadium was on the air as first telecast of an American prizefight; Sam Taub announced through NBC station.

(June 7)—Improved television camera tube called "orthicon," introduced by RCA, was designed to give greater clarity and depth to the pictures.

(June 10)—King George VI and Queen Elizabeth were televised at New York World's Fair.

(June 10)—New York's tumultuous welcome to King George and Queen Elizabeth was radioed around the world by record-breaking hook-up.

1939 (July 10)—NAB in convention at Atlantic City adopted code of self-regulation, effective October 1.

(July 13)—NBC applied to FCC for an FM station, and was the first of the major networks to do so.

(July 27)—James L. Fly nominated to chairmanship of FCC by President Roosevelt, to succeed Frank R. McNinch, resigned; Fly took office September 1; resigned November 13, 1944.

7 *Radio-Television in World War II*

1939–1945

Day after day, almost hour to hour, broadcasts from around the globe told of one crisis after another as pleas for peace failed and declarations of war were broadcast from nation after nation. Television development for civilian use came to a standstill and every phase of the radio industry was geared to serve "the Arsenal of Democracy" on land, sea, and in the clouds. Voices made history in the air. A climax in the world tragedy came on December 7, 1941, when radio flashed the news of the Japanese attack on Pearl Harbor.

From that hour the ether pulsed with war; historic messages by Roosevelt and Churchill were broadcast to every corner of the earth, and there was war talk on almost every wavelength. Every day communiqués from Eisenhower's headquarters, from the African desert, from Anzio beachhead, from MacArthur in the Philippines, right on up to May 7, 1945, when radio carried the news that Germany had surrendered unconditionally; and on August 14, Japan surrendered and President Truman broadcast that World War II had ended.

1939 (August 24)—World crisis stirred many broadcasts: Chamberlain's message to Parliament; Pope's peace plea; reading of peace plea of Roosevelt to Italy; message to the world by Lord Halifax, British Foreign Secretary.

(August 26)—Brooklyn Dodgers-Cincinnati Reds game at Ebbets Field was televised as first big league game to be seen on the air.

(August 31)—Radiophone communications with Europe were cut off as Britain put on clamp of censorship.

(September 1)—Broadcasts announced German invasion and bombing of Poland.

(September 3)—England and France declared war on Germany. Prime Minister Chamberlain broadcast the declaration; followed by Daladier of France. King George VI broadcast a message to the Empire and President Roosevelt declared for peace and neutrality.

(September 3)—War ended civilian television service in London, the BBC announced.

(September 3)—President Roosevelt, in his fourteenth "fireside chat," addressed the nation on U. S. neutrality.

(September 21)—President Roosevelt addressed a special joint session of Congress on revision of the Neutrality Act.

1939 (September 30)—First college football game was televised by NBC in New York, Fordham-Waynesburg.

(October 6)—Hitler addressed Reichstag and broadcast terms of peace acceptable to Germany.

(October 17)—Telecast from NBC in New York was picked up by television receiver in a plane 20,000 feet over Washington, D. C., 200 miles away.

(October)—First contracts for U. S. Navy radar service equipment were let to Radio Corporation of America, and beginning in 1940 units were installed on U. S. Naval vessels.

(November 8)—WQXQ, New York, a pioneer FM station owned and operated by John V. L. Hogan, first went on the air. (It was purchased, together with WQXR, by *The New York Times* on February 1, 1944.)

(November 15)—United Fruit Company sponsored first program over international short-wave radio through NBC stations WNBI and WRCA.

(November 15)—FCC liberalized its rules on television by hanging out an "amber" light before a "green" one.

(December 1)—Portable television equipment was demonstrated to FCC by RCA to supplement motor truck mobile stations.

(December 16)—Fashion show at Waldorf-Astoria was telecast; entertainers and guests at tables were scanned by the camera.

1939 (December 17)—Scuttling of the German battleship *Graf Spee* was described in dramatic broadcasts from Montevideo.

(December 19)—Scene in front of Capitol Theatre and interviews in lobby were telecast at premier of movie *Gone With the Wind.*

1940 (January 1)—Total radio sets in the United States numbered 45,300,000; 743 broadcasting stations were on the air.

(January 1)—Nine experimental FM stations were on the air in the United States.

(January)—FCC announced it was preparing to shift the frequencies of about 90 per cent of broadcasting stations in United States in accordance with Havana Treaty to clarify North American radio.

(January 11)—NBC opened FM station W2XWG atop Empire State Building.

(February 1)—Members of FCC at Schenectady saw telecast pictures from New York rebroadcast through automatic radio relay across the upstate capital area. Distance 130 miles; called "first television network" comprising stations WNBT, New York, and WRGB, Schenectady.

(February 6)—Color television, produced by electronic and optical means, was demonstrated to the Federal Communications Commission by RCA at Camden, New Jersey. No mechanical or rotary parts

were used. Three orthicon cameras were used with a color filter on each one—red, blue, and green. At the receiver three kinescopes were utilized, one with fluorescent material sensitive to red, the second to blue, and the third to green. Through a system of mirrors all three were superimposed so that the observer saw the picture in natural colors. There was no limit to band width since transmission was over a closed circuit; 120 fields per second, 441 scanning lines.

1940 (February 14)—605-line television pictures, on horizontally polarized waves, 24 frames per second and reception on loop antenna (in set) were demonstrated by Philco at Philadelphia.

(February 15)—Broadcast Music, Inc. (BMI) began a campaign to build independent music source with $1,250,000 supplied by broadcasting stations. (BMI established as permanent organization at NAB Convention August 5, 1939, at San Francisco.)

(February 25)—Hockey, Rangers-Canadiens, was telecast for first time from Madison Square Garden.

(February 28)—FCC approved limited commercial television as of September 1. (Order rescinded March 22.)

(February 28)—Basketball was telecast for first time; Pittsburgh-Fordham; NYU-Georgetown, at Madison Square Garden.

1940 Compact transmitter and camera designed specially for aircraft were developed by RCA engineers for airborne television.

(March 2)—Intercollegiate track meet was telecast for first time, at Madison Square Garden, with remarkable clarity as camera followed runners around the track.

(March 3)—Play, *When We Are Married,* was featured in 1½-hour telecast performance of a current Broadway play, from NBC studio at Radio City.

(March 6)—New York was telecast from an airplane while televiewers saw the panorama of the city and its landmarks; Schenectady also looked in.

(March 10)—Metropolitan Opera stars in tabloid version of *Pagliacci* telecast opera for first time at Radio City.

(March 18)—FCC reported that 22 FM experimental stations were authorized.

(March 21)—ASCAP announced proposed new contract for broadcast stations and networks, boosting estimated royalties from $4,500,000 to $9,000,000.

(March 24)—Religious services telecast from Radio City for the first time were seen at Lake Placid through Schenectady relay.

(March 24)—Edouard Branly, inventor of the coherer, the first detector of wireless waves, died in Paris in his 95th year.

1940 (March 25)—U. S. Supreme Court gave FCC power to license new broadcast stations without regard for economic injury to existing stations.

(April 12)—President Roosevelt announced Administration would exert every effort to prevent television to come under monopolistic control; he advocated a competitive set-up.

(April 19)—Opening game, Giants-Dodgers, was telecast from Ebbets Field.

(April 25)—Ringling Brothers, Barnum & Bailey Circus, was telecast from Madison Square Garden.

(April)—Allen B. DuMont Laboratories, Inc., granted construction permit for television station W2XWV, New York; first program broadcast on June 28, 1942; call changed to WABD in 1943.

(May 7)—Television on 4½′ x 6′ screen was demonstrated by RCA at stockholders' meeting.

(May 10)—Radio flashed news that Germany had invaded Belgium, Holland, and Luxemburg.

(May 10)—Neville Chamberlain broadcast his resignation as British Prime Minister.

(May 16)—President Roosevelt delivered a message to Congress on National Defense.

(May 20)—FCC gave "green" light to FM broadcasting by authorizing full commercial operation beginning January 1, 1941.

1940 (May 21)—Television 441-line pictures using a frequency band of approximately 2,700,000 cycles transmitted over coaxial cable from New York to Philadelphia and return, a distance of about 200 miles.

(May 26)—President Roosevelt broadcast his fourteenth "fireside chat"; topic "America's Defense Condition and Needs."

(May 27)—FCC by unanimous vote relegated television back to experimental existence, scrapping rules announced in February which would have permitted "limited commercial operation."

(June 7)—Lenox R. Lohr resigned as NBC president after 3½-year tenure since January 1, 1936, to become president of Chicago Museum of Science and Industry.

(June 10)—Italy's entrance into the war and Germans 25 miles from Paris caused a busy day in international broadcasting.

(June 14)—Radio announced "German army is inside Paris"; Germans began broadcasting over Paris stations.

(June 17)—Marshal Pétain of France broadcast that the French had capitulated to the Germans.

(June)—To test the usefulness of television at sea RCA installed receiving sets on board the S.S. *President Roosevelt* and, while the ship was enroute to and from Bermuda, television pictures broadcast from New York were viewed clearly 250 miles at sea.

1940 (June 21)—Historic broadcast by observers at Compiegne described Hitler and staff handing Armistice terms to French plenipotentiaries at the "armistice car."

(June 22)—FCC issued text of rules governing FM broadcast stations, authorizing commercial operation, effective January 1, 1941.

(June 24)—Republican Convention at Convention Hall, Philadelphia, telecast through New York via coaxial cable linking cameras with NBC transmitter at Empire State Building; Wendell Willkie nominated with Charles McNary for Vice President.

(June 27)—GOP Convention telecast from New York picked up in Tulsa, Okla., about 1800 miles; a new overland record for ultra-short waves.

(July 12)—Niles Trammell was elected president of NBC after two years as executive vice president and after having served as manager and vice president of Central Division in Chicago since 1928.

(July 15)—Democratic Convention, which nominated Franklin D. Roosevelt and Henry Wallace for Vice President, broadcast from Chicago; films were rushed by plane to New York for telecast by NBC.

(August 29)—Television in color by means of a mechanical method, developed by Peter Goldmark, engineer, was announced by Columbia Broadcasting System.

(August 30)—Plant investment in broadcasting stations for 1939 was placed by FCC at $64,425,000.

1940 (September 10)—Re-allocation of frequency assignments of 777 broadcasting stations in the United States in accordance with Havana Treaty, was announced by FCC, effective March 29, 1941.

(September 12)—Average weekly wage of $45.96 for 19,873 full-time employees in broadcasting was disclosed in FCC survey.

(September 24)—Defense Communications Board was created by President Roosevelt to plan relationship of communications in national defense. Board members were James Lawrence Fly, Chairman, FCC; Rear Admiral Lee Noyes, Navy; Major General Joseph O. Mauborgne, Army; Assistant Secretary of the Treasury Herbert E. Gaston, Coast Guard; Assistant Secretary of State Breckinridge Long.

(October 27)—In an outstanding dramatic narrative, Lynn Fontanne repeated her stirring broadcast of Alice Duer Miller's poem *The White Cliffs.*

(October 28)—President Roosevelt was televised at Democratic Rally, Madison Square Garden.

(October 29)—Record-breaking daytime audience listened to drawing of numbers in draft for military service.

(October 31)—First construction permits for commercial FM broadcast stations were issued by the FCC.

(November 2)—Republican rally was telecast from

Madison Square Garden, featuring Wendell Willkie, GOP candidate for the Presidency.

1940 (November 5)—Election returns were telecast for first time by National Broadcasting Company.

(November)—Alfred L. Loomis suggested basic idea of air navigation system which was later developed by the Radiation Laboratory of the Massachusetts Institute of Technology into loran (LOng-RAnge-Navigation). The first loran system, consisting of four stations, was placed in operation on October 1, 1942, between Delaware and Nova Scotia.

(November 15)—Upwards of $2,250,000 was reported spent by major political parties for purchase of radio time during presidential campaign.

(December 23)—Plans for formation of a Latin-American network, to begin September 1, 1941, with 39 standard and 25 short-wave stations, were announced by CBS.

(December 26)—Attorney General Jackson announced new criminal anti-trust litigation against ASCAP, BMI, NBC, and CBS, growing out of music controversy.

(December 29)—President Roosevelt broadcast his fifteenth "fireside chat"; topic, "The Present Emergency."

1941 (January 1)—Total radio sets in the United States numbered 51,000,000; 802 broadcasting stations were on the air.

1941 (January 1)—Twenty-five commercial FM stations and 32 experimental FM stations were on the air in the United States.

(January 20)—President Roosevelt's third inaugural was broadcast by more than 500 stations.

(January 24)—RCA demonstrated to FCC: Home television receiver with 13½″ x 18″ translucent screen; television on theater screen 15′ x 20′ in New Yorker Theatre; pictures automatically radio-relayed from Camp Upton, Long Island, to New York; also facsimile multiplexed with frequency modulation sound broadcast.

(January 27)—Broadcasting time sales in 1940 estimated at $207,956,000, an increase of 21 per cent over 1939.

(February 20)—Television pictures in color were first put on the air by NBC from transmitter at Empire State Building; field sequential mechanical system was used, on a 6-megacycle channel, 441 lines, 120 fields, 60 frames.

(March)—Ray C. Wakefield appointed a member of Federal Communications Commission succeeding Thad H. Brown. (Wakefield died Sept. 29, 1949.)

(May 1)—RCA-NBC made successful tests with first projection-type color television receiver using mechanical methods.

(May 2)—FCC authorized commercial television effective July 1.

1941 (May 3)—FCC released report on Chain Broadcasting and new regulations.

(May 9)—RCA staged large-screen (15′ x 20′) television for Motion Picture Distributors and press at New Yorker Theatre, featuring Overlin-Soose fight in Madison Square Garden.

(May 21)—Television 441-line pictures with an effective wave band width of 2,700,000 cycles transmitted over coaxial cable for about 800 miles by looping coaxial units in the Stevens Point, Wisc.–Minneapolis cable.

(May 27)—President Roosevelt, in his sixteenth "fireside chat," proclaimed an unlimited emergency and pledged defense of the hemisphere and freedom of the seas, in a broadcast made in 15 languages.

(June 2)—Senate Interstate Commerce Committee opened hearings on White Resolution to undertake a study of radio broadcasting as it would be affected by FCC new rules for "Chain Broadcasting."

(June 16)—Applications filed by NBC with FCC for licenses to operate commercial television stations in New York, Philadelphia and Washington.

(June 27)—First advertising rate card for television issued by NBC quoting $120 an hour from 6 to 11 P.M. daily, and $60 an hour between 8 A.M. and 6 P.M., effective July 1.

(June 30)—FCC reported that 49 FM stations were in broadcast service.

1941 (July 1)—Commercial operation of television began with 21 stations licensed in the country, including WNBT, the NBC station in New York, which instituted service with four commercial sponsors.

(July 8)—First radiophotos ever received from Moscow picked up by RCA Communications, Inc., appeared the next morning in papers throughout the country.

(July 28)—New RCA "Alert Receiver" turned on and off by inaudible signal from broadcast transmitter, also rings bell, lights electric lamp, or blows siren to summon listeners, demonstrated for use in Civilian Defense.

(August 8)—Ground broken for RCA Laboratories, Princeton, N. J.

(September 11)—President Roosevelt warned totalitarian powers that U. S. Navy guns are "at the ready" to guarantee freedom of the seas.

(October 12)—Supply, Priorities and Allocations Board announced ban on all non-defense building affecting new radio station construction and power increases.

(October 29)—NBC and CBS signed new agreement with American Society of Composers, Authors and Publishers, thus returning ASCAP music to the radio networks.

(November 1)—Clifford J. Durr appointed to FCC; term expired in 1948.

1941 (November)—120,000 FM receivers were in public use, with production estimated at about 1500 sets a day according to the FCC.

(November 15)—Cornerstone laid for RCA Laboratories, Princeton, N. J.

(November 18)—American radio networks ended broadcasts from Berlin because of censorship.

(November 19)—*The New York Times* announced that effective December 1, it would broadcast 5-minute news bulletins on the hour over WMCA, thus ending the last vestige of the idea that broadcasting was injurious competition to the press.

(December 7)—News flashed by radio at 2:19 P.M., EST, that Japan had attacked Pearl Harbor, Hawaii, at 1 P.M., EST.

(December 7)—Amateur radio stations in United States closed by order of FCC.

(December 8)—President Roosevelt's war message to Congress and declaration of war broadcast worldwide on record-breaking hook-up; war declared on Japan at 4:10 P.M., EST.

(December 9)—President Roosevelt delivered his seventeenth "fireside chat" on Japan's attack and the United States declaration of war.

(December 10)—Dr. Frank Conrad, broadcast pioneer at KDKA, died in Florida.

1941 (December 11)—President Roosevelt's message to Congress asking for declaration of war on Germany and Italy, broadcast as it was read in the House and Senate, followed by announcement of the vote for war—3:05 P.M., EST.

(December)—Teleran (TELEvision-Radar-Air-Navigation), a new system of navigation and safety control, was devised by Loren F. Jones of RCA, and announced in 1945.

(December 19)—President Roosevelt set up wartime Director of Censorship for radio and press; Weather Bureau banned all weather broadcasts.

(December 25)—First direct radiotelegraph circuit, between United States and Australia, opened by RCA.

(December 26)—Prime Minister Winston Churchill's historic address to joint session of Congress, broadcast internationally.

1942 (January 1)—Manila's four broadcasting stations destroyed to avoid capture by Japanese.

(January 2)—Twenty-five commercial FM stations and 20 experimental FM stations were on the air in the United States; approximately 400,000 FM receivers.

(January 6)—President Roosevelt's annual message to Congress broadcast; calling for 60,000 planes, 45,000 tanks and an expenditure of $56,000,000,000. He said the United States would carry war to the foe.

1942 (January 9)—Blue Network Company, Inc., formed as a wholly-owned subsidiary of RCA, to operate the Blue Network, thus divorcing it from NBC, in accordance with FCC order.

(January 16)—Office of Facts and Figures (Office of War Information) designated by President Roosevelt as clearing house for Government broadcasts. (Elmer Davis appointed head of OWI on June 13, 1942.)

(February 9)—S.S. *Normandie* afire at pier in New York was described by Graham McNamee over a nation-wide radio network.

(February 13)—War Production Board warned radio manufacturing industry that it must be converted 100 per cent to war production within four months, and that manufacturing of civilian radios must stop.

(February 23)—President Roosevelt in eighteenth "fireside chat" discussed "geography" of the war.

(March 7)—War Production Board ordered radio manufacturers to discontinue making radios and phonographs for civilian use after April 22.

(March 14)—War Production Board ordered lowering by 70 per cent amount of shellac to be made available, thus curtailing manufacture of phonograph records.

(March 20)—First direct radiophoto circuit between Australia and United States opened by RCA.

1942 (April 17)—War Production Board ordered radio tube manufacturers to discontinue within 7 days production of 349 types of radio tubes to save critical materials, men, and machine hours for war purposes.

(April 28)—President Roosevelt in his nineteenth "fireside chat" discussed the war situation.

(May 22)—Television schedules in New York, both NBC and CBS, curtailed to 4 hours a week because of the war.

(June 24)—First direct radiophoto circuit opened by RCA between New York and Cairo, Egypt.

(June 25)—James C. Petrillo, President of American Federation of Musicians, notified phonograph record and transcription companies that from August 1, 1942, members of AFM would not play or contract for recordings, transcriptions, or any other form of mechanical reproduction of music.

(June 30)—All domestic radiotelegraph circuits closed by Government order.

(July 14)—Broadcasting industry declared "essential" under Selective Service System by Maj. Gen. Lewis B. Hershey; broadcasting cited as one of 34 essential wartime activities.

(September 7)—President Roosevelt in twentieth "fireside chat" discussed "Inflation and Stabilization of Prices."

1942 (September 27)—RCA Laboratories dedicated at Princeton, N. J.

(October 12)—President Roosevelt in his twenty-first "fireside chat" reported on his war-survey tour of the country.

(October 21)—First broadcast ever permitted direct from House of Parliament, London, featured Prime Minister Churchill, General Jan Smuts, and David Lloyd George.

(November 1)—U. S. Government, through OWI (Office of War Information), took over operation of short-wave broadcasting stations.

(November 7)—AEF invaded French Africa; President Roosevelt spoke in French on short waves and assured France of United States' aims to free it from Nazi yoke; Vichy regime in France broke relations with the United States.

(November 16)—First radiophoto from Sweden received in New York by RCA.

(December 29)—RCA announced consolidation of RCA Manufacturing Company with Radio Corporation of America to be known as "RCA Victor Division," effective December 31.

1943 (January 5)—First shells equipped with radio proximity fuses were reported fired by U.S.S. *Helena* in Pacific combat actions.

1943 (January 26)—Radio announced historic Roosevelt-Churchill meeting in Casablanca to map war strategy.

(March 9)—American Broadcasting System, Inc., formed by Edward J. Noble to acquire and operate the Blue Network. Name changed to American Broadcasting Company, Inc., on June 15, 1945; Mark Woods, first President.

(April 27)—Army-Navy joint announcement lifted restriction on use of word "radar" and reported it as one of radio's greatest contributions to the war as vital offensive-defensive weapon.

Word "radar" came into the news; it was coined by Commander (later Captain) S. M. Tucker of the U. S. Navy.

(May 6)—91.1 per cent of families in United States reported they owned home radios, although 4.2 per cent out of order, according to *Life* magazine survey.

(May 10)—U. S. Supreme Court decision supported order to enforce Chain Broadcasting Regulations promulgated by FCC on May 2, 1941.

(May 26)—Navy released first information on radar.

(June 15)—FCC "Chain Broadcasting Regulations" went into effect.

(June 17)—Lord Beaverbrook, British Minister of State, broadcast urgent appeal for radio volunteers to operate "radiolocation" radar apparatus.

1943 (June 17)—Army-Navy "E" Flag presented to RCA Laboratories.

(July 1)—E. K. Jett appointed to FCC; resigned December, 1947.

(July 25)—Rome radio announced Mussolini and Fascist Cabinet ousted.

(July 30)—Blue Network Company sold by RCA to Edward J. Noble for $8,000,000; approved by FCC on October 12, 1943.

U. S. Supreme Court upheld decision of Court of Claims declaring the Fleming valve patent invalid; it had expired by that time and had gone unchallenged during its patent life.

(September 8)—Gen. Dwight D. Eisenhower announced from United Nations radio station at Algiers that a secret military armistice had been reached with Italy; an hour and 15 minutes later, Premier Pietro Badoglio confirmed the armistice over Rome's radio. These were the first historic proclamations of their kind ever broadcast, and radio flashed the news around the world.

(September 15)—Radio Technical Planning Board organized to formulate plans for the technical future of the radio industry and services, including frequency allocations and systems standardization, in accordance with the public interest and the technical facts; to advise government, industry, and the public of its recommendations with such planning restricted to engineering considerations.

1943 (September 21)—Radiophoto circuit to Switzerland opened by RCA.

(October 8)—Merger of Western Union-Postal Telegraph Co. went into effect under a formula approved by the FCC.

(October 13)—Radio flashed news that Italy declared war against Germany.

(November 4)—Year-round cooperation given by broadcasting industry to war information campaigns exceeded $103,000,000, according to OWI estimates.

(December 17)—Wartime census of radio receivers by Office of Civilian Requirements revealed that approximately 32,500,000 American families had one or more radio sets, or 89 per cent of all families in country.

(December 24)—President Roosevelt reported from Hyde Park on his meetings with Churchill at Casablanca and with Churchill, Stalin, and Chiang Kai-shek at Teheran.

1944 (January 17)—Television Broadcasters Association, Inc., formed with Allen B. DuMont, President.

(February 1)—RCA opened Europe-to-U. S. radiotelegraph service from Italy; first all-American-owned and operated commercial radio station in Europe.

(February 1)—*The New York Times* purchased WQXR and WQXQ, New York, for approximately $1,000,000 from John V. L. Hogan.

1944 (February 7)—Broadcast advertising in 1943 reached a total of $233,900,000 net time sales, or 21.8 per cent ahead of the 1942 high. Gross time sales totaled $307,191,000 as compared with $254,800,000.

(March)—Eighty-four per cent of people in U. S. live in electrically lighted homes according to survey of the 20th Century Fund.

(March 1)—Bell System informed NBC of tentative plans for intercity coaxial cable facilities by which a television network could be connected; coast-to-coast possibly by 1950, depending upon duration of war.

(March 3)—81st Anniversary of U. S. Army Signal Corps, grown from a Civil War $2,000 item in the Army budget to more than $5,500,000,000 in 1941; from 100 men to more than 300,000.

(April 23)—Broadcast from Anzio beachhead through station JJRP via RCA at Naples, described as "first time in history that a broadcasting station has been erected and put into operation this close to the front line."

(April 30)—"The American Broadcasting Station" went on the air in England with primary object "to project the American point of view" to Europe.

(May 8)—Radio Technical Planning Board's sub-committee on proposed new television standards recommended postwar assignment of ultra-high frequencies for experiments in transmitting more detailed images and pictures in color.

1944 (May 23)—White-Wheeler Bill presented for consideration by the Senate Interstate Commerce Committee containing amendments to the Communications Act of 1934. Action was postponed indefinitely by Senator Wheeler, Chairman of the Committee, because of wide-spread objections from the radio industry.

(June 4)—Radio from Italy flashed news that American 5th Army had entered Rome.

(June 5)—President Roosevelt in 15-minute, world-wide broadcast discussed the fall of Rome to the Allied forces.

(June 6)—Radio from Berlin at 12:30 A.M., EWT, flashed that Allied invasion of Europe had begun; Communiqué No. 1 from General Eisenhower's headquarters at 9:32 A.M., British wartime (3:32 EWT) read: "Under the command of General Eisenhower Allied naval forces, supported by strong air forces, began landing Allied armies this morning on the northern coast of France"; NBC's first invasion flash was on the air at 12:41 A.M., EWT.

(June 6)—President Roosevelt on the radio led the nation in "D-Day Prayer."

(June 13)—Direct radiotelegraph service was established between New York and Rome by RCA.

(June)—Broadcasts reported German robot bombs attacking England.

National political conventions were broadcast from Chicago; GOP in June, Democratic in July. Films of

conventions were flown to New York for NBC telecasts. Republican ticket: Thomas E. Dewey and John W. Bricker; Democratic: Franklin D. Roosevelt and Harry S. Truman.

1944 (July 11)—Professor Charles W. Geer of the University of Southern California applied for a patent on a pyramid surface (unmasked direction type) 3-color television kinescope screen and patent No. 2,480,848 issued on September 6, 1949, was assigned to Technicolor Motion Picture Corporation.

(August 5)—Dr. Alfred N. Goldsmith applied for a patent on a three-gun color television system using pyramidal surfaces (of the unmasked directional type), three-color television kinescope screen, and the necessary associated circuits and keystone-correction means. Patent No. 2,481,839 issued on September 13, 1949, was assigned to RCA.

(August 5)—Dr. Alfred N. Goldsmith arranged for a patent on a color television system using one or three guns and a tricolor target on which vertical strips of red, green, and blue phosphors are scanned horizontally with circular or elliptical scanning beams to produce a tricolor image; this was covered by patient No. 2,431,115 issued November 18, 1947 and assigned to RCA.

(August 14)—Invasion of Southern France was flashed by NBC at 6:09 A.M., EWT.

(August 25)—Paris radio station in patriot hands announced Paris liberated from the Nazis; NBC resumed news broadcasts directly from Paris.

1944 (August)—Interest of railroads in radio was greatly increased to improve efficiency, speed operations, and insure safety, as indicated by all-time peak of applications filed with FCC for use of two-way equipment.

(September 16)—Direct radiotelegraph communication between New York and Paris, suspended since June, 1940, by German occupation, was re-established by RCA.

(September 28)—FCC began hearings on radio wave allocations for aviation, FM, television, and other services.

(October 22)—Radio achieved split-second coverage of General Douglas MacArthur's return to the Philippines; ship with complete radio facilities relayed press and broadcasting traffic.

(August 5)—WEAF-FM was granted a commercial license by the FCC.

(November 2)—Chairman James L. Fly resigned from the Federal Communications Commission, effective November 15.

(November 7)—Roosevelt-Dewey election returns were telecast by 3 stations in New York, NBC, CBS, and DuMont; also widespread coverage by nationwide broadcasting.

(November 11)—RCA Victor and Columbia Recording Company capitulated to Petrillo demands to terminate recording strike and accepted provisions

for payment of royalties into private AFM fund estimated at $4,000,000 per year.

1944 (November 16)—Paul A. Porter was nominated by President Roosevelt to Federal Communications Commission; served until February 25, 1946.

(December 1)—RCA observed its 25th Anniversary with Major General Harry C. Ingles, Chief Signal Officer of the Army; Rear Admiral Joseph R. Redman, Director of Naval Communications, and Brig. General David Sarnoff praising radio's role in the war.

(December 11)—First Annual Conference of the Television Broadcasters Association was held in New York; J. R. Poppele elected President.

Marconi's yacht *Elettra,* captured by Germans, was later sunk during combat in Adriatic Sea.

1945 (January 1)—Broadcasting stations in United States totaled 943 with 730 affiliated with networks as follows: NBC, 149; CBS, 143, MBS, 244; ABC, 194.

(January 16)—FCC issued report tentatively allocating the postwar radio spectrum from 25,000 to 30,000,000 kilocycles; television to have 6 channels from 44 to 88 megacycles; and 7 from 180 to 216 megacycles; experimental television from 480 to 920 megacycles.

(January 20)—Roosevelt's fourth inaugural was broadcast from south portico of the White House.

1945 (February)—American broadcasts resumed from Luzon and Manila as American forces drove out the Japanese.

(February)—Broadcast advertising in 1944 reached a new high as revealed by estimated net time sales of $285,100,000; a gain of 25 per cent over 1943.

(February 7)—Manila is retaken—announced over NBC by Bert Silen, announcer, liberated from Santo Tomas by American Army.

(February 12)—Radio announced that an 8-day meeting of Roosevelt-Stalin-Churchill had been held at Yalta in the Crimea.

(February 19)—War Shipping Administration announced "it would have been impossible to keep 4000 U. S. merchant ships sailing without radio assistance"; radio credited with recruitment of 10,000 men in 1944.

(March 1)—President Roosevelt, sitting before a battery of microphones at a joint session of Congress, reported on the Yalta Conference.

(March 4)—Radio communication between United States and Belgium restored by reopening of RCA circuit; Holland circuit reopened on March 5.

(March 14)—Charles R. Denny appointed to FCC succeeding T. A. M. Craven; resigned October 31, 1947.

(March 15)—RCA demonstrated to the press a pro-

jection-type television receiver for the home; screen 18″ x 24″.

1945 (March 15)—Percy Wright Paget, a Marconi associate who assisted in reception of first transatlantic signal in 1901, died at Leytonstone, England.

(March 21)—Nine commercial television stations were operating in the United States: 3 in New York City; 2, Chicago; 2, Hollywood; 1, Schenectady; 1, Philadelphia; 112 applications for television were pending before FCC on March 5.

(April 12)—News of President Roosevelt's death at Warm Springs, Ga., was flashed world-wide by radio; American networks canceled all commercial programs, NBC made the announcement at 5:51 P.M., EWT.

(April 13)—President Truman addressed joint session of Congress in world-wide broadcast.

(April 14)—Radio detonator which sets off land mines by means of selected radio frequencies, having a range of 8 miles on land, 20 on water, was demonstrated by Army Service Forces at Fort Myer, Va.; also a radar-controlled anti-aircraft searchlight.

(April 14)—Funeral of President Roosevelt described by announcers after White House ceremonies, and same procedure followed after burial at Hyde Park on the morning of April 15.

(April 16)—President Truman addressing joint session of Congress called upon the Nation for complete

unity and reiterated United Nations' goal of unconditional surrender for Germany and Japan.

1945 (April 16)—RCA radiophoto circuit opened between New York and Paris.

(April 17)—Radio relay link opened by Philco between Washington and Philadelphia with relays located at Arlington, Va.; Odenton, Md.; Havre de Grace, Md., and Honeybrook, Pa.

(April 19)—Sir Ambrose Fleming, inventor of the valve detector, died at Sidmouth, Devon, England.

(April 25)—United Nations Conference on International Organization at San Francisco opened with a world-wide broadcast in which President Truman sounded the keynote: "If we do not want to die together in war, we must learn to live together in peace."

(April 28)—U. S. Army Signal Corps sent a 9-word radio-teletypewriter message completely around the earth in 9½ seconds; previous record was 3½ minutes on May 24, 1944.

(April 28)—False reports spread that Germany had surrendered.

(April 28)—Broadcasts reported Benito Mussolini executed by Italian Partisans, near Dongo on Lake Como, Italy.

(May 1)—Broadcast from Hamburg reported Adolf Hitler died in Berlin.

1945 (May 2)—Commercial and personal message radiotelegraph service to Italy restored by RCA.

(May 2)—Radio announced that Berlin had fallen and all German armies in Italy had surrendered.

(May 7)—Radio flashed Associated Press report that Germany surrendered unconditionally to Allies at 8:41 P.M., EWT, May 6, at headquarters of General Eisenhower, Reims, France.

(May 8)—President Truman, King George, Prime Minister Churchill, General Eisenhower participated in world-wide V-E Day broadcasts.

(May 30)—FCC reported 403 applicants from 41 states for FM stations awaiting go-ahead priorities signal; Ohio led with 36. On this date 46 commercial FM stations were operating regularly.

(June 13)—William H. Wills, former Governor of Vermont, appointed by President Truman to be a member of FCC succeeding Norman S. Case (took oath of office July 23); died March 6, 1946.

(June 19)—General Dwight D. Eisenhower was greeted by New York in city-wide celebration broadcast world-wide; NBC also telecast films of Washington and New York celebrations on day of the event.

(June 26)—World Charter signed by delegates of 50 nations at United Nations Conference, San Francisco; President Truman's address broadcast internationally.

1945 (June 27)—FCC announced allocation of frequencies to the various classes of non-governmental services in the radio spectrum from 10 to 30,000,000 kilocycles, including the bands for television and FM.

(July 16)—Construction of new antenna begun atop Empire State Building for RCA field tests of 288 megacycle transmitter.

(July 16)—Justin Miller named President of National Association of Broadcasters, effective October 1.

(July 25)—Radiotelegraph service restored between United States and Germany by opening of RCA station in Berlin; direct RCA circuit opened to Vienna on July 30.

(August 6)—Radio news flash from White House announced atomic bomb developed in United States completely destroyed Hiroshima, Japan.

(August 7)—Radio flash from Moscow and Washington announced Russian declaration of war on Japan (3 P.M., EWT).

(August 10)—Japan broadcast offer to surrender.

(August 8)—News broadcasts reported atomic bomb had been dropped on Nagasaki, Japan.

(August 14)—Max Jordan, NBC representative at Basel, Switzerland, scored a world-beat at 4:18 P.M., EWT, when he broadcast: "Within approximately two hours from now the White House in Washing-

ton will have the complete transcribed text of the Japanese reply to the last message of the Allies in relation to their demand of unconditional surrender . . . the general impression in diplomatic quarters (is) that Japan has accepted the terms of the Allies in principle, and that the war is over."

1945 (August 14)—World War II ended; President Truman announced at 7 P.M., EWT, that Japan had surrendered.

(August 15)—Report issued on "Radar" by Joint Board on Scientific Policy revealed how it works and disclosed its wartime performance.

(August 17)—Radio industry, marshalling 550,000 workers in 1600 factories, produced more than $7½ billion of military radio-radar and communications equipment since 1941, according to War Production Board.

8. *Radio-Television Postwar*

1945–1950

The postwar era opened with many of the wartime voices stilled forever. There remained the formal signing of the document of surrender of the Japanese aboard the U.S.S. *Missouri* in Tokyo Bay as the final chapter in five years of the most hectic broadcasting the world had ever known. Radio had performed an outstanding task and its scientists had, through radar, proximity fuses, radio controlled missiles, shoran, loran, airborne television, radio relays, and a multiplicity of electronic developments contributed greatly to victory—and now these inventions might be harnessed into peacetime service.

Again, civilian television came to the forefront with new electronic cameras, new electron tubes, and all sorts of developments that opened the way for a new postwar industry and a great new service to the American people. Ultrafax—a combination of television and radio facsimile—flashed at the rate of a million words a minute—was demonstrated for the first time.

The "Age of Television" had dawned and new vistas were opened to people everywhere, for in their own living rooms, they could see far beyond the horizon; they eye-witnessed the United Nations in session, Congress in action, and President Truman inaugurated. Network television began to

spread from the East into the Middle West, gradually moving westward across the Great Plains and Rockies, eventually to reach the Pacific coast and bring all the country within the range of a camera's electronic eye. Yet the world would never let the scientists be content with this great achievement in itself. Almost before they had perfected television in monochrome the cry went up for color.

Quickly, in the spirit of the pioneers, the research men and engineers picked up the challenge with the same ingenuity that their predecessors did in turning dot-and-dash wireless into broadcasting, and then sound broadcasting into television. As the calendar turned to 1950, television was a great industry; millions of people were looking-in as the scientists continued to triumph not only in monochrome pictures, but in color. These modern Rembrandts made a palette of the sky and spread electronic pigments on fluorescent canvases. New corridors in the radio spectrum were opened as a gallery of pictures that everyone might see.

Radio, indeed, through television artistry was proving more and more its kinship to light as it extended man's range of vision. People, continents apart, would be brought face-to-face and would see eye-to-eye the wonders of the world mirrored in the heavens by television.

1945 (August 20)—War Production Board lifted wartime controls permitting unlimited output of radio sets.

(August 21)—FCC lifted wartime ban on one amateur radio band; remainder of channels were freed as of November 15, permitting 60,000 amateur stations to resume operations after 4½ years of wartime silence.

1945 (August 24)—RCA purchased wartime plant at Indianapolis, Indiana, from the U. S. Navy, for manufacture of television receivers.

(August 29)—RCA Victor first offered vinyl plastic records to the public.

(August 30)—General Douglas MacArthur's arrival in Japan described in broadcasts.

(August 30)—Direct radio communication established between United States and Japan through RCA.

(August 30)—American occupation forces took over Radio Tokyo.

(August)—"Stratovision" plan based upon the use of stratoliners equipped with television transmitters forming a network at altitude of 30,000 feet proposed by Westinghouse as a radio relay means of covering the country. Programs from the ground would be picked up by the planes for rebroadcast, each plane having a service range of about 200 miles.

(August 31)—Office of War Information abolished by executive order signed by President Truman.

(September 1)—Formal signing of document of surrender of Japanese on board U.S.S. *Missouri* in Tokyo Bay described in world-wide broadcast; President Truman spoke from the White House; General Douglas MacArthur and Admiral Chester W. Nimitz from U.S.S. *Missouri* via electrical transcriptions—time 9:30 P.M., EWT.

1945 (September 9)—Films of Japanese signing surrender documents on board U.S.S. *Missouri* telecast by WNBT, New York.

(September 15)—FCC reported 513 applications on file for FM stations; 129 for commercial television; 265 for new AM stations.

(September 18)—Army's success in war with "proximity fuses"—a miniature radio sending and receiving station in the nose of shells—was revealed. Radio waves reflected from targets, as in radar, are fed into a thyratron tube which acts as a switch to detonate the charge at the most formidable position to inflict maximum damage.

(October 5)—Value of radio and radar equipment delivered for war purposes from July, 1940, through July, 1945, totaled about $7,680,000,000, according to the War Production Board.

(October 10)—Admiral Chester W. Nimitz telecast a message over WNBT to wounded service men in hospitals in the New York area.

(October 11)—FCC held hearing to promulgate rules and regulations and standards of good engineering practice for television; CBS announced success in color television broadcasts over New York and that sample color receivers would be available early in 1946.

(October 22)—Western Union opened ultra-short wave radio relay system between New York and Philadelphia, as developed by RCA; heralded as

revolutionary step in electric communications, eventually dispensing with thousands of telegraph poles and thousands of miles of wire from coast-to-coast.

1945 (October 23)—President Truman, at joint session of Congress, appealed for universal military training in a broadcast heard world-wide.

(October 25)—Super-sensitive television camera tube called "Image Orthicon," developed by RCA, demonstrated by NBC in candlelight, thereby solving major problems in illumination of television programs and outdoor pick-ups. The tube also was demonstrated in total darkness with the scene "illuminated" only by infra-red rays.

(October 27)—President Truman seen for the first time on television at Navy Day celebration in Central Park, New York; it was the first time a President was on a TV network and it comprised WNBT, New York; WRGB, Schenectady and WPTZ, Philadelphia.

(November 3)—Applications for FM stations total 667; nearly 23 per cent from newcomers in the radio field; 96 applications from newspapers; 505 applications from AM broadcasting interests.

(November 13)—Prime Minister Clement R. Attlee of Britain heard in a world-wide broadcast as he addressed a joint session of Congress, Washington, D. C.

(November 15)—FCC announced 131 applications filed for licenses to conduct proposed railroad radio service.

1945 (November 15)—RCA television sets priced from under $200 and up to $450 would be on the market in six months, Frank M. Folsom, Executive Vice President in Charge of RCA Victor Division, announced.

(November 15)—All elements of a satisfactory television system were available and the art "ready to go," Dr. C. B. Jolliffe, Vice President in Charge of RCA Laboratories, said, with industry producing annual income from 1 to 5 billion dollars in the offing.

(November 21)—New rules and engineering standards for television announced by FCC, giving New York City channels for seven stations.

(November)—Harvard Radio Research Laboratory announced development of the "Resnatron" designed to generate from 30 to 50 KW on frequencies of 700 megacycles.

(November)—Teleran, a complete new system of air navigation and traffic control, combining television and radar techniques, was announced by RCA.

(December 1)—Army-Navy game at Philadelphia telecast by WNBT, New York, using coaxial cable for inter-city connection; 525-line images.

(December 8)—Admiral Ernest J. King reported radar was developed to a point where at the end of the war optical control of the firing of all weapons, except the pistol and rifle, had been practically

abandoned. At Okinawa, during Kamikaze attacks, every anti-aircraft gun in the fleet was controlled by radar.

1945 (December 13)—Latest improvements in black-and-white television, color television, and color pictures in 3 dimensions were demonstrated by RCA in a "progress report" to the press at RCA Laboratories, Princeton, N. J. The color system was mechanical; the black-and-white all-electronic.

1946 (January 1)—RCA purchased electron tube plant at Lancaster, Pa., from the U. S. Navy, for manufacture of television picture tubes.

(January 9)—Construction of $24,500,000 Dallas-Los Angeles 1500-mile coaxial cable by Bell Telephone System for multiple telephone calls and television, was approved by FCC.

(January 9)—Frank Stanton elected President of Columbia Broadcasting System; William S. Paley, Chairman of the Board.

(January 10)—U. S. Army Signal Corps at Evans Signal Laboratories, Belmar, New Jersey, beamed a radar signal to the moon and picked up "echo" in 2.4 seconds; radar frequency was 111.6 megacycles. Round-trip distance of the signal was 477,600 miles.

(January 24)—Weather Bureau announced plans for use of Rason instruments at 75 weather stations in United States, Alaska and Caribbean area to determine weather conditions at high altitudes through visual observation made possible by radar and

radiosonde equipment carried aloft by helium-filled balloons.

1946 (February 1)—Color television produced by mechanical system of filters demonstrated to the press by Columbia Broadcasting System; films and still pictures were telecast on 490 megacycles from transmitter atop Chrysler Building.

(February 11)—Net time sales of broadcasting were $310,450,000 in 1945, an increase of 7.3 per cent over 1944; gross for 1945 was $411,547,628 as estimated by *Broadcasting-Telecasting Magazine.*

(February 12)—First telecast from Washington to New York via coaxial cable featured General Eisenhower laying wreath at Lincoln Memorial; also scenes in front of the Capitol.

(March)—Opening sessions of UN Security Council, Hunter College, New York, were televised by WNBT.

(March 21)—Airborne television as developed during the war by RCA and NBC, in cooperation with U. S. Navy, U. S. Army Air Forces, and National Defense Research Council, was demonstrated at Anacostia Navy Air Station with television-equipped planes over Washington, Annapolis, Mt. Vernon, and Baltimore.

(March 21)—Rosel H. Hyde appointed to FCC to fill vacancy caused by death of W. H. Wills.

(March 25)—Opening of United Nations Security Council in New York televised with Secretary of

State Byrnes and Governor Dewey of New York as speakers.

1946 (April 1)—Seven commercial television stations were operating in the United States: 3 in New York City; 1, Chicago; 1, Schenectady; 1, Philadelphia; 1, Washington. Fourteen experimental stations were licensed and 141 applications for television stations were pending before the FCC as of March 1.

(April 4)—David Sarnoff proposed that the principle of "Freedom to Listen" be established on a world-wide basis, and that the United Nations conduct a system of international broadcasting.

(April 19)—Color television pictures sent over coaxial cable between Washington and New York by CBS.

(May 2)—NBC and Zenith Radio Corp. granted individual construction permits to build television stations in Chicago, Ill.

(May 16)—FCC approved NBC application to build a television station at Cleveland, Ohio.

(May 20)—Number of radio-equipped homes in United States increased from 28,847,000 in 1940 to 33,998,000 in 1945, according to U. S. Census Bureau.

(May 25)—President Truman's address at joint session of Congress asking temporary emergency powers to break strikes against the Federal government was broadcast nation-wide.

1946 (June 7)—Television broadcasting resumed in London for first time since war closed the Alexandra Palace station on September 1, 1939.

(June 14)—John Logie Baird, Scottish television pioneer, died at Bexhill, Sussex, England.

(June 19)—Louis-Conn heavyweight championship fight at Yankee Stadium televised by NBC. Louis won by knockout in eighth round. Via coaxial cable Washington observers saw the telecast; also broadcast in Philadelphia and Schenectady. Said the Washington *Post:* "Television looked good for a 1000-year run."

(June 30)—Airborne television, radio-controlled robot planes, and automatic television cameras were used at Bikini atom bomb test, which was described in world-wide broadcasts.

(September 17)—Postwar television receivers introduced by RCA.

(October 1)—FCC announced a total of 37 television commercial stations licensed and operating, or recipients of construction permits; 21 applications pending.

(October 22)—R. L. Snyder (RCA) applied for a patent on a color kinescope using a 3-color slot-type screen.

(October 30)—Color television pictures on 15″ x 20″ screen produced by all-electronic means were demonstrated publicly for the first time by Radio Cor-

poration of America at RCA Laboratories, Princeton, N. J. A simple radio-frequency converter was announced that enabled black-and-white receivers to reproduce in monochrome the programs of color television stations operating on high frequencies. This would make it possible in the future to introduce all-electronic color without causing obsolescence of black-and-white television receivers.

1946 (November 18)—First contract signed over television via coaxial cable between New York and Washington, D. C., negotiated between DuMont Laboratories, owner of stations WABD and WTTG, and Chevrolet Motor Division of General Motors Corp.

(December 1)—66 FM stations in operation; 564 authorized by FCC; 307 applications pending; 65 per cent of all established AM broadcasting stations had applied for FM licenses.

(December 9)—FCC held hearing on petition of Columbia Broadcasting System to establish commercial standards for color television in 480 to 920-megacycle band.

(December 16)—Color television demonstrated to FCC by Allen B. DuMont Laboratories featured a tube called Trichromoscope on which picture was viewed directly.

(December 16)—FCC at Tarrytown, N. Y., viewed CBS color television images broadcast from Chrysler Building, New York.

1947 (January 1)—National Association of Broadcasters reported 34,800,000 families in United States own

radio sets; 7,000,000 auto radios; also 41 per cent of broadcast time devoted to music; drama, 16 per cent; news and commentary, 13 per cent.

1947 (January 3)—Congress televised for the first time as 80th Congress opened; pictures were seen in Washington, Philadelphia, and New York areas which were linked by coaxial cable.

(January 6)—President Truman televised as he delivered message before joint session of Congress.

(January 7)—NBC signed contract with New York Giants for telecast of home games in 1947.

(January 8)—Bill introduced by Senator Pepper to authorize broadcasting of the proceedings of Senate and House of Representatives.

(January 29)—RCA demonstrated simultaneous electronic color television system at hearing of FCC held at Princeton, N. J. Film and live talent were broadcast over ½ mile on 520 megacycles; power 50 watts, channel width 14.5 megacycles.

(February 6)—Dr. Albert Rose of RCA Laboratories awarded 1946 Morris Liebmann Memorial Prize for research on television camera tubes, especially the image orthicon; the 1947 Liebmann Prize went to J. R. Pierce of Bell Telephone Laboratories for development of traveling-wave tube.

(February 16)—Radio from Little America reported Rear Admiral Richard E. Byrd flew over South Pole and dropped flags of United Nations.

1947 (February 17)—U. S. Department of State began broadcasts directed to Russia.

(February 27)—"Blue baby" operation televised by RCA at Johns Hopkins University was witnessed by several hundred doctors and nurses assembled before 10 television receiving sets in hospital auditorium.

(February)—American Telephone & Telegraph Company reported that service over coaxial cable system was expected to begin by end of summer; also that about three years would be required to complete proposed New York-Chicago radio relay system; New York-Boston system, utilizing 7 intermediate hilltop relay stations along 200-mile route, would be in experimental operation by summer of 1947.

(March 7)—Dr. V. K. Zworykin appointed Vice President and Technical Consultant of RCA Laboratories Division.

(March 7)—Edward M. Webster nominated by President Truman as a member of FCC; confirmed by Senate March 18; reappointed in 1949.

(March 12)—President Truman televised as he addressed joint session of Congress urging financial and economic aid to Greece and Turkey.

(March 18)—FCC denied petition of Columbia Broadcasting System to establish commercial standards for color television stations.

(March 31)—Broadcast advertising gross time sales for 1946 estimated by *Broadcasting-Telecasting*

Magazine at $424,077,000; net $325,890,000, a rise of 7.2 per cent over 1945.

1947 (April 30)—All-electronic color television on 8′ x 10′ screen as developed at RCA Laboratories demonstrated by Dr. V. K. Zworykin at The Franklin Institute, Philadelphia, Pa.

(May 1)—Estimates indicated that there were about 44,100 television receivers in the U. S.: New York, 30,000; Philadelphia, 4,000; Schenectady, 600; Chicago, 2,400; Washington, 1,500; Detroit, 2,000; St. Louis, 600; Los Angeles, 3,000.

(May 5)—WRC-FM, Washington, was granted special temporary authority by the FCC to operate on the air on interim commercial basis.

(May 8)—Major General Harry C. Ingles, Chief Signal Officer of the Army (retired), elected President of RCA Institutes; elected President of RCA Communications, Inc., on September 5, 1947.

(May 14)—RCA Exhibition Hall opened in Radio City.

(May 14)—Survey by CBS indicated 39,900,000, or 93 per cent of all homes in United States, radio equipped.

(May 15)—International Telecommunications Conference opened at Atlantic City, N. J.; concluded October 2.

(June 9)—First demonstration of American television in Europe conducted by RCA at Milan (Italy) Fair,

and on July 12 at Vatican, where Pope Pius XII was televised for first time.

1947 (June 18)—Robert F. Jones nominated by President Truman to be member of FCC to succeed Ray C. Wakefield; confirmed by Senate July 11.

(June 23)—RCA announced development of Ultrafax, or radio-mail system, that has a potential for handling a million words a minute and capable of transmitting 50,000-word novels from New York to San Francisco in 60 seconds by high-speed photographic process.

(June 27)—Television station WNBW of National Broadcasting Company opened in Washington, D.C.

(July 11)—Lieut. General J. G. Harbord retired as Chairman of the Board of RCA and was named Honorary Chairman; David Sarnoff was elected Chairman of the Board as well as President of RCA.

(July 16)—Color pickup camera for three-color electronic color television, using the simultaneous system, was demonstrated to members of FCC and others at RCA Laboratories. Studio and outdoor pickups were shown with a picture brightness of 8 foot-lamberts; pictures were projected on 7½′ x 10′ screen and on a home-receiver screen 11″ x 14″.

(July 19)—Dr. Alfred N. Goldsmith applied for a patent on a 3-gun color television system using a "masked-target" color kinescope and dot-like screen; application No. 762,175 assigned to RCA was a continuation in part of his application No. 548,239 filed on August 5, 1944.

1947 (August 20)—Lieut. General J. G. Harbord, Honorary Chairman of the Board of RCA, died at his home, Rye, N. Y.

(September 8)—Surgical operations at New York Hospital televised and viewed on screens at American College of Surgeons Congress, at Waldorf-Astoria Hotel, New York.

(September 12)—Speaking at UNESCO meeting, Chicago, Ill., David Sarnoff declared "Freedom to Look" as important as "Freedom to Listen" because international television is "nearer than most people may realize."

(September 13)—NBC announced that in cooperation with Eastman Kodak Company a special camera had been developed to photograph television images directly from the kinescope screen, thus opening the way for syndication of television programs, and provide records of television events.

(September 15)—Sixty-eight television stations licensed by FCC; 12 applications pending; 13 stations on the air with regular program service.

(September 19)—Board of Directors of National Association of Broadcasters approved a new code of standards from broadcasting industry designed to curb excessive commercialism on the air.

(September 22)—Robot C-54 plane operating with "mechanical brain" on a radio beam completed 2400-mile Atlantic flight from Newfoundland to England.

1947 (September 30)—World Series telecast for the first time featured New York Yankees-Brooklyn Dodgers; sponsored by Ford Motor Co. and Gillette Safety Razor Co. for $65,000 over stations in New York, Philadelphia, Washington, and Schenectady; estimated total audience 3,962,000.

(October 5)—President Truman's address on world food crisis broadcast world-wide and televised by 7-station hookup as first video pickup of a Presidential address direct from White House.

(October 7)—Gross receipts of $310,790,000 were reported to U. S. Treasury by 638 broadcasters for year 1944; net income was $67,491,000.

(October 9)—Charles R. Denny, Jr., resigned as Chairman of FCC to join NBC as Vice President and General Counsel. Elected Executive Vice President of NBC on July 2, 1948.

(November 8)—New television relay opened between South Bend and Chicago; carried Army-Notre Dame game to estimated audience of 175,000 persons served by Station WBKB, Chicago.

(November 9)—Theatre Guild presented St. John Ervine's drama *John Ferguson* as first in a series of plays on NBC television.

(November 9)—St. John's Church, St. Louis, telecast pontifical high mass for first time over KSD-TV; Cathedral of Sts. Peter and Paul telecast mass, December 21, over WPTZ, Philadelphia.

1947 (November 13)—Radio relay system between New York and Boston opened by Bell System for experimental telephone and television use; 7 hilltop relay stations employed.

(November 17)—President Truman delivered message on "Relief for Europe" before joint session of Congress, which was telecast along Atlantic Seaboard and broadcast world-wide.

(November 20)—Wedding of Princess Elizabeth and Philip Mountbatten, Duke of Edinburgh, broadcast world-wide and televised in London; BBC used for the first time an experimental "CPS" (cathode potential stabilization of the mosaic) emitron camera tube. Films flown to New York were telecast on the following day.

(December 5)—Louis-Walcott 15-round fight at Madison Square Garden telecast to estimated audience of one million along Atlantic Seaboard from Washington to Schenectady; Louis won on decision.

(December 10)—Television programs recorded off receiver screens on 35-mm. film by Paramount Pictures, Inc., were shown at Television Broadcasters Association meeting in New York; recordings could be used for simultaneous theater projection.

(December 26)—Wayne Coy, Radio Director of the Washington *Post*, appointed by President Truman as Chairman of FCC; confirmed by Senate on January 30, 1948; Coy succeeded Charles R. Denny, resigned.

1947 (December 31)—Ewell Kirk Jett resigned as member of FCC to become director of the radio division of the Baltimore *Sun* papers; George E. Sterling appointed to succeed him on FCC.

1948 (January)—37,600,000 families in United States owned one or more radio sets; 94 per cent of all families.

(January)—Successful tests on FM channels 88 to 108 megacycles completed by RCA in transmitting most powerful FM signals ever radiated on FM channels; effective radiated power was more than 300 kilowatts; a pylon antenna was used at experimental station W2XSR, Camden, N. J.; tests began in June, 1947.

(January 1)—FCC reported 17 television stations on air; 65 construction permits issued; 66 applications for licenses on file.

(January)—Broadcasting stations (AM) totaled 1621 and (FM) 374; in comparison in 1922 there were 30 (AM) broadcasting stations and in 1923 the total was 556; in January, 1946, 940.

(January 27)—President Truman signed Mundt-Smith Bill, giving statutory authority for the first time to the "Voice of America."

(January 29)—RCA announced development of the 16-inch metal-cone kinescope, or television picture tube, expected to be in production during 1948 for use in 1949 television receivers.

1948 (February 9)—Net time sales in broadcasting for 1947 amounted to $356,690,000, an increase of about $25,000,000 over 1946, according to *Broadcasting-Telecasting Magazine.*

(February 22)—Trinity Church service telecast for the first time; it was the first program of its kind to be televised in New York from interior of a church during a religious service.

(March 18)—American Federation of Musicians signed contract with network broadcasters that lifted ban on use of musicians in television.

(March 20)—NBC Symphony Orchestra, Arturo Toscanini conducting an all-Wagnerian program, and Philadelphia Symphony Orchestra, Eugene Ormandy conducting, were telecast for the first time.

(March 22)—Firestone concert on the air as first program simultaneously broadcast on NBC standard broadcasting, FM, and television; such a broadcast called a "simulcast."

(March 24)—Stuart W. Seeley, RCA engineer, awarded Morris Liebmann Memorial Prize of Institute of Radio Engineers for "his development of ingenious circuits related to frequency modulation."

(April 3)—Beethoven's "Ninth Symphony" played by NBC Symphony Orchestra, Maestro Arturo Toscanini conducting, was telecast as well as broadcast; estimated TV audience, 370,000.

(April 22)—Clifford Durr resigned as member of Federal Communications Commission.

1948 (May 15)—Applications for television station licenses totaled 247; 26 stations on the air and 72 construction permits outstanding.

(May 16)—162,181 television receivers were shipped to 21 states and District of Columbia in 1947, according to Radio Manufacturers Assn.; during first quarter of 1948, 118,027 TV sets were manufactured, making total since war 300,000.

(May 24)—Frieda B. Hennock appointed by President Truman to the FCC for 7-year term; confirmed by Senate on June 20, 1948, and took office July 6.

(June 15)—Station WPIX, *Daily News*, New York, began regular program service on TV Channel 11.

(June 18)—Columbia Records introduced new long-playing 33⅓ rpm microgroove record providing up to 50 minutes of playing time on one record.

(June 21)—Republican National Convention, Philadelphia, telecast by TV network: WPTZ, Philadelphia; WNBT, WPIX, WCBS, WABD, New York; WATV, Newark; WTVR, Richmond; WNBW, Washington; WRGB, Schenectady; WBAL, Baltimore; and WBZ, Boston. Daily reels of kinescope recordings, or film résumés, were sent by plane to: KSD, St. Louis; WBEN, Buffalo; WWJ, Detroit; WLWT, Cincinnati; WTMJ, Milwaukee; KSTP, St. Paul; WEWS, Cleveland; KDYL, Salt Lake City, and W6XAO, Los Angeles; estimated TV audience 10,000,000. Thomas E. Dewey nominated on third ballot; Earl Warren for Vice President. 1500 broadcasting stations also handled the event, reaching estimated audience of 62,000,000.

1948 (June)—International Convention for Safety of Life at Sea specified that all ships of 1600 tons and over engaged on international voyages be fitted with radio direction finding apparatus (effective January 1, 1951).

(June 23)—Stratovision equipped plane 25,000 feet above Pittsburgh picked up telecast of Republican National Convention from station WMAR, Baltimore, and retelecast; viewers as far distant as Zanesville, Ohio, and Niagara Falls, N. Y., saw the plane's relayed telecast.

(June 25)—Louis-Walcott fight at Yankee Stadium telecast by 7-station NBC hook-up: New York, Boston, Schenectady, Baltimore, Washington, Philadelphia, and Richmond; Louis won in eleventh round; estimated TV audience, 6 million.

(June 25)—Theater-size television images of Louis-Walcott fight were projected on 20′ x 15′ screen of Fox Theatre, Philadelphia.

(June 30)—FCC affirmed a previous ruling that a radio station may not censor the content of a political broadcast, no matter how libelous, and station may not be sued for damages; speaker is completely liable.

(June 30)—Transistor, a non-vacuum device, demonstrated by Bell Telephone Laboratories for use in place of conventional electron tubes in radio receivers, and as amplifiers on telephone lines as well as on coaxial cable.

1948 (July 1)—NBC and CBS announced withdrawal from international broadcasting of "Voice of America," which State Department would be solely and exclusively responsible for, effective October 1, 1948.

(July 12)—Democratic National Convention, Philadelphia, telecast by same stations that handled GOP Convention in June. Harry S. Truman nominated; Alben Barkley, Vice President.

(July)—Rate of growth of television stations closely paralleling that of both broadcasting stations and sound movie installations.

(July 14)—NBC announced that effective September 26 recorded repeat programs for Pacific coast stations would be acceptable in place of live repeat programs, the practice followed in the past.

(July 16)—First regular service of FM broadcasting for riders in city transit vehicles was introduced in Covington, Ky., where 100 receivers were installed on Green-Line buses.

(July 22)—Radio receiving set licenses in Britain total 11,200,000; television receiver licenses, 49,200.

(August 1)—U. S. Air Force, in an experiment, projected television images onto a 40′ x 52′ screen at the Monmouth, N. J., County Airport, as a feature of Air Force Day.

(August 5)—FCC announced it planned to study legality of all "giveaway" jackpot programs under Federal lottery laws.

1948 (August 10)—WJZ-TV, American Broadcasting Company, Inc., began operation as the sixth television station in New York City.

(August 29)—Battle maneuvers on aircraft carrier, U.S.S. *Leyte*, off Long Island, about 26 miles from New York, telecast via WNBT, New York.

(September 11)—600,000 television receivers in use; New York, 245,000; Philadelphia, 56,000; Chicago, 34,000; Los Angeles, 28,000; Washington, 16,000; Baltimore, 14,000; Boston, 13,000.

(September 12)—Niagara Falls televised for first time by Station WBEN, Buffalo, with cameras on Canadian side; program was the first radio-relayed out of Canada to United States.

(September 20)—FCC held hearing on feasibility of opening 475-890 megacycle band for commercial television.

(September 20)—Mid-western television network opened by NBC, linking St. Louis, Chicago, Milwaukee, Toledo, Detroit, Cleveland, and Buffalo by coaxial cable and radio relays operated by Bell System.

(September 30)—FCC announced no additional licenses for new television stations would be issued for at least 6 months while a study was made to decide whether certain changes should be made in engineering standards and channel allocations.

(October 1)—638 FM stations on the air, including

20 non-commercial educational; also 389 grants not yet on the air, and 80 applications pending.

1948 (October 6)—750 radio stations and 19 television stations broadcast World Series, Boston Braves *vs* Cleveland Indians.

(October 7)—Television set on B. & O. train traveling from Washington to Jersey City, using special antennas, picked up World Series telecast.

(October 9)—First telecast from Yale Bowl, featured Yale-Columbia football game via a 2-hop radio relay installed by NBC between New Haven and New York.

(October 15)—Broadcasting interests represented in 28 of 41 television stations on the air; newspaper ownership represented in 14; motion picture interests in 2.

(October 21)—First public demonstration of RCA Ultrafax—1 million words a minute—held at Library of Congress, Washington, D. C.; transmission from TV station WNBW at Wardman Park Hotel.

(November 2)—Truman-Dewey election featured an all-night telecast by 42 stations and was broadcast world-wide.

(November 16)—Wayne Coy, Chairman of FCC, speaking before Rotary Club, Chicago, Ill., heralded television as "most powerful, most effective and the most profitable medium for mass merchandising yet devised." He said 45 television stations were on the

air and estimated 400 stations and a coast-to-coast network in another 2 years; 1000 in 7 or 8 years.

1948 (November 29)—Verdi's *Otello*, first full-length telecast direct from stage of Metropolitan Opera House, was carried by American Broadcasting Company television hook-up: New York, Boston, Philadelphia, Baltimore, and Washington.

(December 2)—FCC set up Ad Hoc Committee to make impartial engineering study of wave propagation in the uhf and vhf regions. The Committee was instructed to study field intensities, effect of terrain on propagation, and tropospheric effects. The Committee report was issued May 31, 1949.

(December 3)—Frank M. Folsom, Executive Vice President in Charge of the RCA Victor Division, was elected President of Radio Corporation of America, effective January 1, 1949. David Sarnoff continued as Chairman of the Board and Chief Executive Officer.

(December 14)—American Federation of Musicians signed a contract with major phonograph record companies and lifted the ban on phonograph recording; Samuel R. Rosenbaum appointed sole trustee of the Union's welfare fund.

(December 31)—Standard (AM) networks and stations earned total of $407,000,000 in 1948 according to FCC; in addition $621,500 earned by 77 FM stations affiliated with AM stations and $1,126,208 reported by 89 of 107 FM stations without affiliation with an AM outlet.

1949 (January 1)—National Association of Broadcasters estimated broadcasting industry's 1948 revenue 6.5 per cent higher than 1947, from $374,086,000 to $398,560,000.

(January 1)—Fifty-one commercial television stations operating in 29 metropolitan areas with 17,565,000 families within 40-mile radius; 73 construction permits outstanding; 310 applications for television stations pending; 90 television set manufacturers.

(January 1)—1864 standard broadcasting stations on the air in the U. S.; 267 construction permits authorized; 687 FM stations on the air.

(January 10)—75 million radio sets in U. S., according to FCC Annual Report; 37 million, or 94 per cent, of all American families have radio sets.

(January 10)—A new distortion-free system for reproduction of recorded music in the home, including a new type of phonograph record player, demonstrated by RCA Victor; operates at 45 rpm; records of vinyl plastic 6⅞ inches.

(January 11)—East-Midwest TV networks linked by coaxial cable including 32 stations in 14 cities.

(January 20)—President Truman's inauguration was the first event of its kind to be telecast; 34 stations in 16 cities from Boston to St. Louis were in the television network which reached 14 states; estimated audience, 10 million.

(January 24)—Net revenue of radio broadcasting industry passed $402 million in 1948, according to

estimate of *Broadcasting-Telecasting Yearbook*, a gain of $25 million over 1947. Television sponsors estimated to have spent $10 million for time and talent in 1948.

1949 (February 17)—International Telephone & Telegraph Co. signed agreement to purchase Farnsworth Television & Radio Corp.; stockholders approved in vote on May 4.

(March 4)—Dr. James Rowland Angell, Educational Counselor of the National Broadcasting Company and former President of Yale University, died at New Haven, Conn., age 79.

(March 4)—A. Atwater Kent, a pioneer in radio manufacturing, died at Hollywood, Calif., age 75. The Atwater Kent Manufacturing Co. at Philadelphia began production of radio sets in 1923 and in 1936 Kent sold his plant and retired from the radio field.

(March 6)—Dr. Edwin H. Colpitts, a pioneer engineer in telephone and radio, died at Orange, N. J., age 77. He retired from Bell Telephone Laboratories in 1937. He held 24 patents, notably a vacuum tube circuit known as "the Colpitts oscillator."

(March 31)—Winston Churchill speaking at M.I.T. Convocation, Boston, Mass., was seen on television from Boston to St. Louis, while his address also was broadcast by three of the major networks. He described radar as "a third unmeasured sphere," and added: "This radar, with its innumerable variants and possibilities, has so far been the handmaiden

of the air, but it has also been the enemy of the submarine, and in alliance with the air may well prove its extermination."

1949 (April)—Sixty-one commercial television stations in operation; 59 construction permits outstanding; 320 applications pending; 116 manufacturers making television sets.

(April)—M. H. Aylesworth, former president of NBC, predicted in a *Look Magazine* article that "Radio Is Doomed." He said, "Within 3 years the broadcasting of sound, or ear radio, over giant networks will be wiped out. Powerful network television will take its place."

(April)—Wayne Coy, Chairman of the FCC, speaking at NAB Convention, Chicago, said: "There is grave financial risk in starting a new aural radio station. . . . I see television as the dominant medium of broadcasting in the future. . . . A new force unloosed in the land. . . . An irresistible force. . . . A technological discovery that the people want and demand."

(April)—182,361 television sets produced in March; 118,938 in February; 121,238 in January, according to Radio Manufacturers Association.

(May 5)—FCC issued its first permit for experimental television ultra-high frequency operation with a satellite of WNBT, New York, to be erected by RCA-NBC at Bridgeport, Conn.

(May)—Kentucky Derby telecast for first time by station WAVE-TV Louisville, Ky.

1949 (June 6)—Surgical operations at Atlantic City Hospital televised in color by CBS for viewing at American Medical Association Convention; camera was standard image-orthicon with color disk; receiver (direct view) utilized a color disk revolving in synchronism with color disk in camera; images transmitted by microwave relay from hospital to Atlantic City Convention Hall; preview demonstration was held at University of Pennsylvania, Philadelphia, on May 31.

(June)—Total advertising expenditures in 1948 estimated at $4,830,700,000 of which $2,756,300,000 was national and $2,074,400,000 local. Newspapers, $1,749,600,000 or 36.2 per cent; radio, $596,900,000 or 12.4 per cent; magazines, $512,700,000 or 10.6 per cent.

(June 23)—Walcott-Charles fight in Chicago shown on theater-TV screens in New York Paramount and Brooklyn Fabian-Fox Theatres; Fabian-Fox used RCA instantaneous projection equipment; Paramount used intermediate film—storage system, processing from kinescope to projector in less than a minute. Fight fed from WNBT to both theaters via microwave.

(July 1)—Total of 2801 broadcasting stations on the air in the United States, including 2002 standard broadcasters, 727 FM and 72 television. Seventy-seven manufacturers were making TV sets of which 1,860,000 were in use.

(July 26)—Experimental VHF color television 6-megacycle transmissions begun by CBS, New York, on Channel 2, three hours daily for 30 days; 345-line

screen. Similar tests announced by WMAR-TV, Baltimore, from August 17–19.

1949 (August 19)—FCC announced that after October 1 it would not permit broadcasting of radio or television "give-away" programs, described as advertising "lotteries," or "jackpots"; FCC contended they were in violation of the U. S. Criminal Code section under lotteries.

(August)—NBC estimated 2,150,000 TV sets in United States: New York, 720,000; Philadelphia, 205,000; Chicago, 170,000; Los Angeles, 169,000; Boston, 113,000; Baltimore, 69,600; Cleveland, 67,500; Washington, 55,700.

(August 25)—RCA informed the FCC it had developed a new high-definition, all-electronic dot sequential color television system operating on 6-megacycle channel and completely compatible with present black-and-white sets. No adapter needed by black-and-white receivers to pick up color programs in monochrome; converter enables them to see color programs in color.

(September 18)—Field tests of RCA all-electronic, completely compatible color television system began in Washington, D. C., over Station WNBW on 6-megacycle channel; pictures 525 lines.

(September 26)—FCC began hearings on proposals for color television and opening 42 ultra-high frequency channels for black-and-white TV. (Hearing on color concluded May 26, 1950.)

1949 (October)—World Series, New York Yankees *vs.* Brooklyn Dodgers, broadcast by 740 radio stations and 51 television stations; 20,000,000 viewers estimated to have seen the games by television.

(October 5)—WOR-TV, owned by General Teleradio, Inc., a subsidiary of Bamberger Broadcasting Service, New York, began operation.

(October 6)—FCC witnessed CBS demonstration of color television, Washington, D. C., in 6-megacycle channel, using a motor driven disk of 3 colors revolving before the camera lens and a similar disk in front of the receiver's 7-inch picture tube. Scanning was at rate of 405 lines, 144 fields a second.

(October 7)—Joseph H. McConnell, Executive Vice President of RCA, was elected President of National Broadcasting Company, Inc.; Niles Trammell, President of NBC since July, 1940, became Chairman of the Board.

(October 10)—FCC witnessed demonstration in Washington, D. C., of RCA new all-electronic high-definition, completely compatible color television system, operating in 6-megacycle channel; scanning rate, 525 lines.

(October 10)—Puppet show, "Kukla, Fran and Ollie" was televised by color cameras in Washington and fed to the NBC-TV network; it was the first regular television program to be seen simultaneously in color (in Washington, D. C.) while viewers in other cities on the network viewed the show on standard receivers in black-and-white.

1949 (October 11)—Station WOR-TV, New York, began broadcasting service.

(October 15)—Eighty-seven television stations were operating on regular schedules in the United States.

(November 3)—Dr. Hideki Yukawa, of Kyoto University, was awarded Nobel prize in physics for his mathematical prediction of the "mesotron," or "meson," in 1935.

(November 21)—FCC held comparative tests of color television with RCA and CBS participating in Washington, D. C.

(December 29)—Television experimental transmitter operating as a "satellite" ultra-high frequency station was put into operation by RCA-NBC at Bridgeport, Conn., to pick up telecasts from WNBT, New York, for rebroadcast.

1950 (January 1)—40,500,000 telephones in the United States; 60 per cent of the world's total; approximately 160 million telephone conversations held in this country every business day.

(January 1)—Ninety-eight television stations on the air in United States; 24 cities were connected by coaxial cable and microwave relays; 2045 (AM) broadcasting stations were on the air, and 201 others had construction permits; 728 FM stations were in operation.

(January 1)—Estimated 2,837,500 television sets manufactured in 1949, bringing total in use to about

4,000,000 sets; radio sets produced in 1949 estimated at 9,680,733.

1950 (January 9)—A regular schedule of color television program broadcasts was instituted over NBC station WNBW, Washington, D. C.

(January 23)—NBC and Empire State, Inc., announced plans for erection of a 217-foot multiple-antenna mast for five television stations and three FM stations atop the 1250-foot Empire State Tower, in New York. Stations are WNBT, WJZ-TV, WABD, WCBS-TV, WPIX, and WNBC-FM, WJZ-FM and WCBS-FM.

(February 1)—Net revenues from sale of broadcast time in 1949 estimated by *Broadcasting-Telecasting Magazine* $429,000,000, an increase of 3 per cent over 1948; television station revenues for 1949, $25,000,000, an increase of 300 per cent over 1948; gross time sales of the four television networks in 1949 totaled $12,294,513, according to Publishers' Information Bureau.

(February 9)—FCC granted authority to Zenith Radio Corporation to test "pay-as-you-see," or "phonevision" system on a 90-day limited commercial basis in Chicago, Ill. (Zenith disclosed development of phonevision on July 3, 1947.)

(February 23)—FCC held comparative tests of three color television systems: Radio Corporation of America, Color Television, Inc., and Columbia Broadcasting System at Laurel, Md.

1950 (March 3)—Development of the world's largest radio transmitting tube with a rated continuous output of 500,000 watts announced by Radio Corporation of America.

(March 23)—Color kinescopes (direct-view type) demonstrated by RCA to members of the FCC, Washington, D. C.; one tube utilized a single electron gun and another three electron guns.

(April 6)—New transmission development to make color television programs produced by RCA all-electronic system available over coaxial cable networks, as well as over radio relays, was demonstrated to FCC by RCA; picture sampled at 2.4 megacycles, instead of 3.6 mc. sent through cable, separated into three colors at other end, then resampled at 3.6 mc., and transmitted.

(April 15)—40,700,000, or 95 per cent of families in United States, owned 86,000,000 radio sets.

(April 17)—Maestro Arturo Toscanini and the NBC Symphony Orchestra began a nation-wide tour playing 21 concerts in 20 cities (tour ended, May 27).

(May 3)—Testifying before the FCC, David Sarnoff, Chairman of the Board of RCA, stated that color television had advanced technically to a point that justified setting of standards on a regular commercial basis; he recommended standards be based on the RCA all-electronic, completely compatible system operating on the 6-megacycle bandwidth.

(May 10)—Overseas teleprinter exchange service "TEX" (Telex) opened between New York and

cities in Holland by RCA and Netherlands Postal Telecommunications Administration.

1950 (May 16)—Patent No. 2,508,267 on a 3-color direct-view television picture tube was issued to Allen B. DuMont Laboratories, Inc. (Filed October 26, 1945, Henry Kasperowicz, the inventor.)

(June 25)—Radio and television stations broadcast the news that the Republic of Korea was being invaded by Communists of North Korea; meetings of the United Nations Security Council were televised.

(June 27)—World-wide broadcasts flashed news that President Truman had ordered United States air and naval forces to fight in aid of South Korea's Army.

(July 19)—President Truman on radio and television appealed to American people to refrain from hoarding and profiteering in period of expanded defense mobilization resulting from Korean situation.

(August)—UN Security Council meetings related to Korean situation televised from Lake Success.

(August 7)—All-electronic color television transmission demonstrated by RCA over coaxial cable between Washington and New York.

(August 17)—Four registered trade names: Iconoscope, Kinescope, Orthicon and Acorn (tubes) were presented by RCA to the public domain.

1950 (August 17)—First television received in London across English Channel from a portable transmitter in Calais, France, commemorated centenary of first cross-channel cable on August 27, 1850.

(September 1)—President Truman in world-wide broadcast and on television gave a "Report to the Nation" on Korean war and economic effects of expanded defense production.

(September 1)—FCC issued its "First Report" on color television and announced that it was withholding a final decision on color television standards provided manufacturers would build bracket-standard receivers for a non-compatible system.

(September 1)—First Mexican television station opened in Mexico City; call letters XH-TV.

(September 1)—Radio amateur stations in United States totaled 84,000.

(September 1)—New York-Chicago radio relay system opened by Bell System provided a television channel in each direction; 35 relay points used on the 838-mile route.

(September 27)—Ezzard Charles-Joe Louis 15-round fight televised over 31 stations and broadcast from Yankee Stadium; TV audience estimated at 25 million. Charles won unanimous decision.

(October 1)—Television production for first eight months of 1950 totaled 4,146,602 sets and radio sets,

8,750,865. Television sets in United States totaled 8,000,000.

1950 (October 1)—Forty-seven television stations linked for inter-city network service by extension of co-axial cable westward to Memphis, Kansas City, Omaha and as far south as Jacksonville, Fla.

(October 1)—Cuba's first television station CMQ, operated by Havana's Union Radio, went on the air.

(October 4)—World Series, Yankees *vs.* Phillies broadcast by 750 stations and telecast by 77-station network extending as far west as Omaha. Television rights sold for $800,000 and radio rights for $175,000. TV audience estimated 38 million; radio 27 million.

(October 11)—FCC adopted standards for incompatible field sequential color television system and authorized commercial operation commencing November 20, 1950.

(October 16)—FCC resumed hearings on frequency allocations for television stations in VHF and UHF bands, preparatory to lifting of "freeze" order in effect since 1948.

(November 1)—United States had 107 television stations, 2,160 radio broadcasting stations, 677 FM stations, 8,900,000 television receivers and 86,000,000 radio sets.

Members of Former Federal Radio Commission

February 23, 1927–July 10, 1934

Admiral W. H. G. Bullard, Pennsylvania	*March 15, 1927–November 24, 1927 (Deceased)*
Orestes H. Caldwell, New York	*March 15, 1927–February 23, 1929*
Eugene O. Sykes, Mississippi	*March 15, 1927–July 10, 1934 (Deceased)*
Henry A. Bellows, Minnesota	*March 15, 1927–October 31, 1927 (Deceased)*
Colonel John F. Dillon, California	*March 15, 1927–October 8, 1927 (Deceased)*
Sam Pickard, Kansas	*November 1, 1927–January 31, 1929*
Harold A. Lafount, Utah	*November 14, 1927–July 10, 1934*
Ira E. Robinson, West Virginia	*March 29, 1928–January 15, 1932*
General C. McK. Saltzman, Iowa	*May 2, 1929–July 19, 1932 (Deceased)*
William D. L. Starbuck, New York	*May 2, 1929–February 23, 1934*
Thad H. Brown, Ohio	*January 21, 1932–July 10, 1934 (Deceased)*
James H. Hanley, Nebraska	*April 1, 1933–July 10, 1934 (Deceased)*

Former Members of Federal Communications Commission

Hampson Gary, Texas	*July 11, 1934–December 24, 1934*
Anning S. Prall, New York	*January 17, 1935–July 23, 1937 (Deceased)*
Irvin Stewart, Texas	*July 11, 1934–June 30, 1937*
Frank R. McNinch, North Carolina	*October 1, 1937–August 31, 1939 (Deceased)*

Eugene O. Sykes, Mississippi	*July 11, 1934–April 5, 1939 (Deceased)*
Thad H. Brown, Ohio	*July 11, 1934–June 30, 1940 (Deceased)*
Frederick I. Thompson, Alabama	*April 8, 1939–June 30, 1941*
George H. Payne, New York	*July 11, 1934–June 30, 1943 (Deceased)*
T. A. M. Craven, District of Columbia	*August 21, 1937–June 30, 1944*
Norman S. Case, Rhode Island	*July 11, 1934–June 30, 1945*
James Lawrence Fly, Texas	*July 1, 1942–November 13, 1944*
William H. Wills, Vermont	*July 1, 1945–March 6, 1946 (Deceased)*
Paul A. Porter, Kentucky	*December 21, 1944–February 25, 1946*
Charles R. Denny, District of Columbia	*March 30, 1945–October 31, 1947*
Ewell K. Jett	*February 15, 1944–December 31, 1947*
Ray C. Wakefield, California	*March 22, 1941–June 30, 1947 (Deceased)*
Clifford J. Durr, Alabama	*November 1, 1941–June 30, 1948*

Members, Federal Communications Commission

Albert Wayne Coy, Chairman *(Term 1947–1951)*
Paul Atlee Walker, Vice Chairman *(Term 1946–1953)*
Frieda Barkin Hennock *(Term 1948–1955)*
Rosel Herschel Hyde *(Term 1946–1952)*
Robert Franklin Jones *(Term 1947–1954)*
George Edward Sterling *(Term 1948–1957)*
Edward Mount Webster *(Term 1947–1956)*

Presidents, Institute of Radio Engineers

R. H. Marriott	*1912*
G. W. Pickard	*1913*
L. W. Austin	*1914*
J. S. Stone	*1915*
A. E. Kennelly	*1916*
M. I. Pupin	*1917*
G. W. Pierce	*1918*
G. W. Pierce	*1919*
J. V. L. Hogan	*1920*
E. F. W. Alexanderson	*1921*
R. Fulton Cutting	*1922*
Irving Langmuir	*1923*
J. H. Morecroft	*1924*
J. H. Dellinger	*1925*
Donald McNicol	*1926*
Ralph Bown	*1927*
A. N. Goldsmith	*1928*
A. H. Taylor	*1929*
Lee de Forest	*1930*
R. H. Manson	*1931*
W. G. Cady	*1932*
L. M. Hull	*1933*
C. M. Jansky, Jr.	*1934*
Stuart Ballantine	*1935*
Alan Hazeltine	*1936*
H. H. Beverage	*1937*
Haraden Pratt	*1938*
R. A. Heising	*1939*
L. C. F. Horle	*1940*
F. E. Terman	*1941*
Arthur Van Dyck	*1942*
Lynn P. Wheeler	*1943*
Hubert M. Turner	*1944*
W. L. Everitt	*1945*
Frederick B. Llewellyn	*1946*
Walter R. G. Baker	*1947*

B. E. Shackelford	*1948*
Stuart L. Bailey	*1949*
Raymond Guy	*1950*

Presidents, National Association of Broadcasters

Eugene F. McDonald, Jr. (WJAZ)	*1923–1925*
Frank W. Elliot (WHO)	*1925–1926*
Earle C. Anthony (KFI)	*1926–1928*
William S. Hedges (WMAQ)	*1928–1930*
Walter J. Damm (WTMJ)	*1930–1931*
Harry Shaw (WMT)	*1931–1932*
J. Truman Ward (WLAC)	*1932–1933*
Alfred J. McCosker (WOR)	*1933–1935*
Leo J. Fitzpatrick (WJR)	*1935–1936*
Charles W. Myers (KOIN)	*1936–1937*
John Elmer (WCBM)	*1937–1938*
Mark Ethridge (WHAS)	*1938 (3 Mos.)*
Neville Miller	*1938–1944*
J. Harold Ryan	*1944–1945*
Justin Miller	*1945–1950*

Presidents, Radio Manufacturers Association

H. H. Frost	*1924–1926*
A. T. Haugh	*1926–1927*
C. C. Colby	*1927–1928*
H. H. Frost	*1928–1929*
H. B. Richmond	*1929–1930*
Morris Metcalf	*1930–1931*
J. Clarke Coit	*1931–1932*
Fred D. Williams	*1932–1934*
Leslie F. Muter	*1934–1938*
A. S. Wells	*1938–1940*
J. S. Knowlson	*1940–1942*
Paul V. Galvin	*1942–1944*