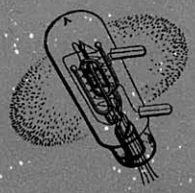
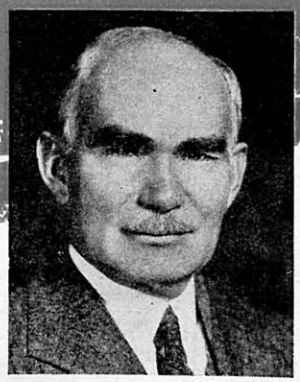
MILESTONES IN THE RADIO INDUSTRY



Lee de Forest



Dr. Lee de Forest, "The Father of Radio," reviews historical developments which have made possible the miracles of modern radio.

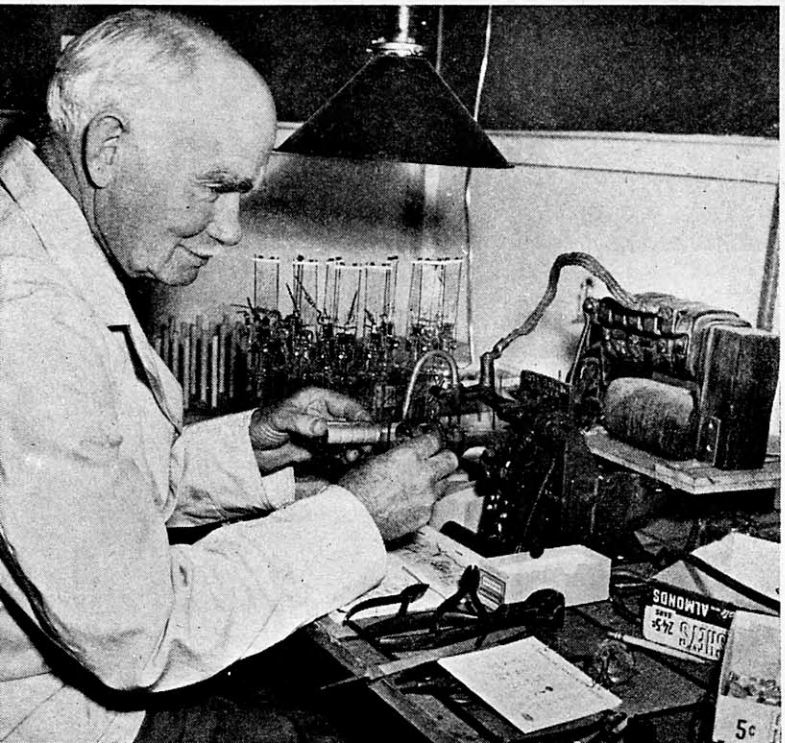
Born Council Bluffs, Ia., 1873. Holds Ph.B., Yale Univ., 1896, Ph.D., 1899, Sc.D., 1919; D.Eng., Lewis Inst., 1937. Am. Wireless pioneer; inventor of radio tube, detector, amplifier, and oscillator, permitting world-wide wireless, long-distance telephony, broadcasting, talking motion pictures, television, etc. Called Father of Modern Radio, Father of Broadcasting. Awarded Cross of Legation of Honor, Elliott Cresson, John Scott, I.R.E. Medal of Honor.

FROM where I sit today one needs a long-focus binocular to view the developments which have taken place in radio since that distant era when I began to grow with the industry.

I can recall the early beginnings of wireless, with its crude equipment, hard for the modern radio engineer to visualize, the four-tuned circuit system, open spark gap transmitters, and electrolytic detectors. Later the crystal detector made its appearance, lacking wave-meters and the sorely needed decremeters. Refinements appeared in the form of the quenched and rotary gaps, with 500-cycle generators; and the Audio detectors, the first variable condensers or inductance variometers for really sharp tuning.

It was on the Pacific Coast that undamped wave transmissions from the Poulsen arcs of the Federal Telegraph Company were used, with "compensation frequency" keying, using the Logwood tikker as a detector. In 1912, also in California, the Audion amplifier, with one, two, or three stages in cascade, was first employed. The first successful high-speed wireless telegraph, using the Poulsen wire telegraphone which incorporated the advantages of fast recording and slow reproduction, took place in this year. A punched tape was used at the transmitter, an early advance which was later discontinued and is only now beginning to be found useful again.

Dr. de Forest in his Los Angeles laboratory, assembling parts of a radio tube used by the U.S. Navy for short-wave diathermy machines.

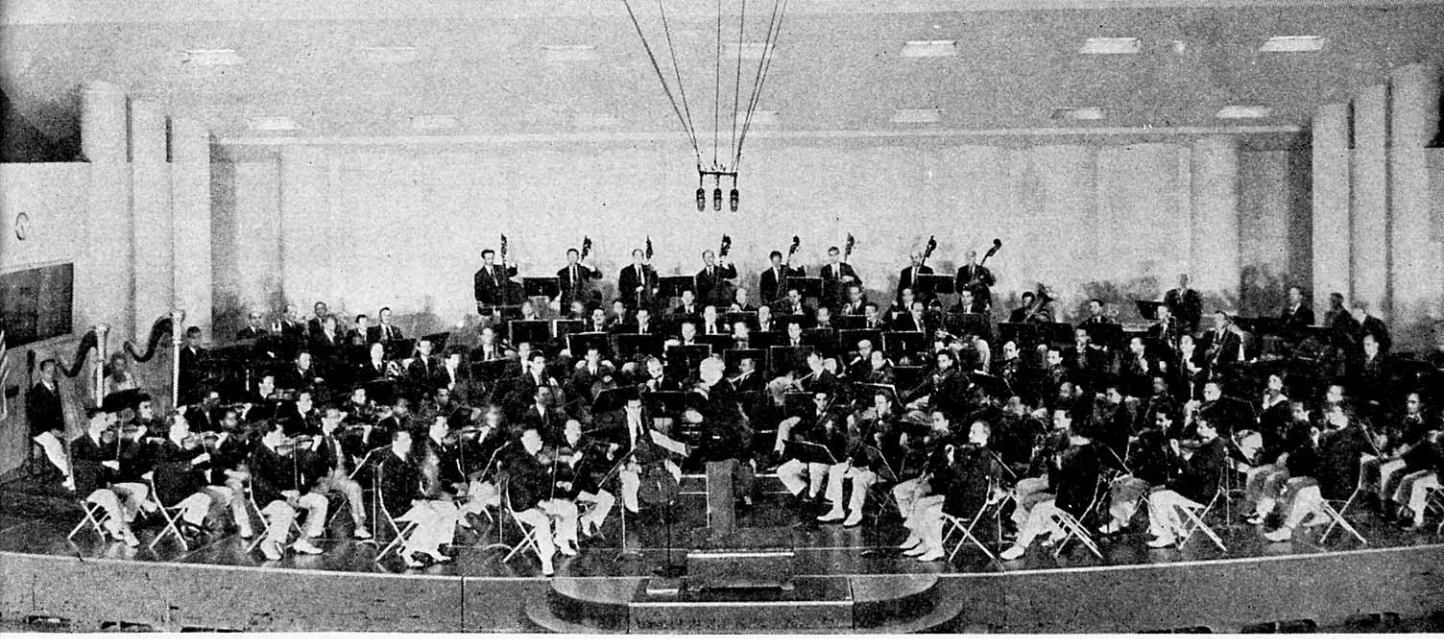


About this time, the telephone company realized that radio must be part of their future planning, and intensive development work was begun by them and the De Forest Company to improve the Audion all along the line; refined, high-vacuum amplifiers, "large" transmitter tubes of 250 watts or more, the all-essential feedback circuits, and new and better production methods necessitated by the growing demands of the first World War, were subject to this development work.

For a period of eight years, high-powered arc transmitters, with a few examples of the Alexanderson high-frequency generators, had to meet the growing demands of our military and commercial communication organizations for transoceanic telegraph service to Europe, then later to China and Japan.

In all of this development work, ever since 1904, with the exception of the powerful high-frequency transmitter generators of Telefunken, America continued to lead the world in wireless, and later radio developments. With the awakening of the profession to the undreamed of possibilities of the grid tube (paced by the keen eagerness of the American Ham to explore the fascinating new fields thereby opened), radio really began to function, to come into its own, and to grow apace.

Beginning in 1915 and 1916, the fragmentary broadcast service at Highbridge, New York, with its cult of listeners, began to expand, at times reaching as far west as Cleve-



Maestro Arturo Toscanini and his Symphony Orchestra in a nationwide broadcast from station WEAF, world's largest studio, Radio City, N. Y.

Station WEAF studio on opening day, August 16, 1922, an interesting comparison with the modern studio depicted above.

land. The first real news broadcast, the Presidential election of November, 1916, came just before the government clamped its ban on all but military and other necessary radiotelegraph services. The first World War, like the war today, hastened the technical development of radio and multiplied greatly the number of trained radio operators and engineers.

Thus, a small stage was well set for the debut of an instrument, utterly new in human annals, which was destined to grow up with mushroom speed. The public's acceptance of radio demanded the concomitant expansion of the new radio industry which was destined to make appear primitive and amateur all that had preceded radio broadcasting.

Throughout the Twenties, this unprecedented development surged along all of the known and some new engineering lines; the design and perfection of hundreds of types of electron tubes, together with the development of intricate machines and processes for the quantity production of such tubes, the use of hundreds of novel techniques which evolved with the demands of new millions intrigued by the new modes of learning, thinking and living which radio encouraged, was stimulated.

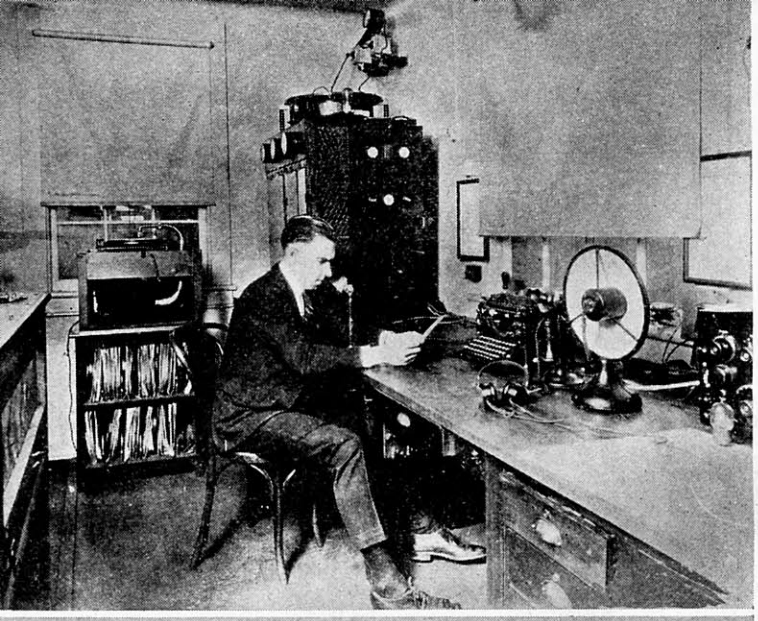
Prompt to appreciate the value of this new medium, our Government early took effective means to protect the protagonists and their public by issuing rational licenses to broadcasters, limiting the wave-bands and requiring precision-tuned transmitters. In fact, the public was protected from the whims of the broadcaster in all respects except that pertaining to the type of program which was permitted on the air. Program restrictions seemingly contrary to the American Bill of Rights, were not imposed, thus allowing the program sponsor to moronize the American public to his heart's content.

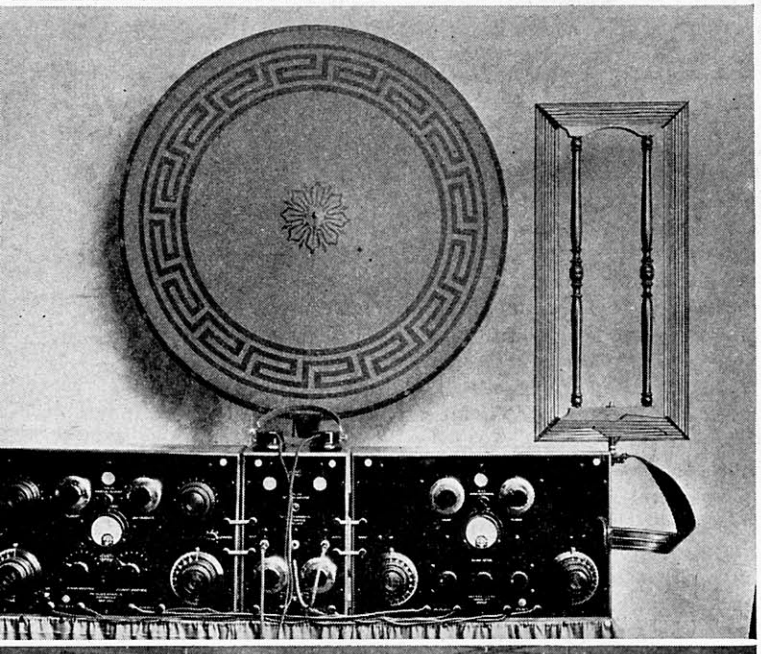
The enormous possibilities of radio broadcasting in the role of educating and elevating the cultural tastes of the listening public remain too little appreciated in practice by those who now direct the policies and destinies of radio.

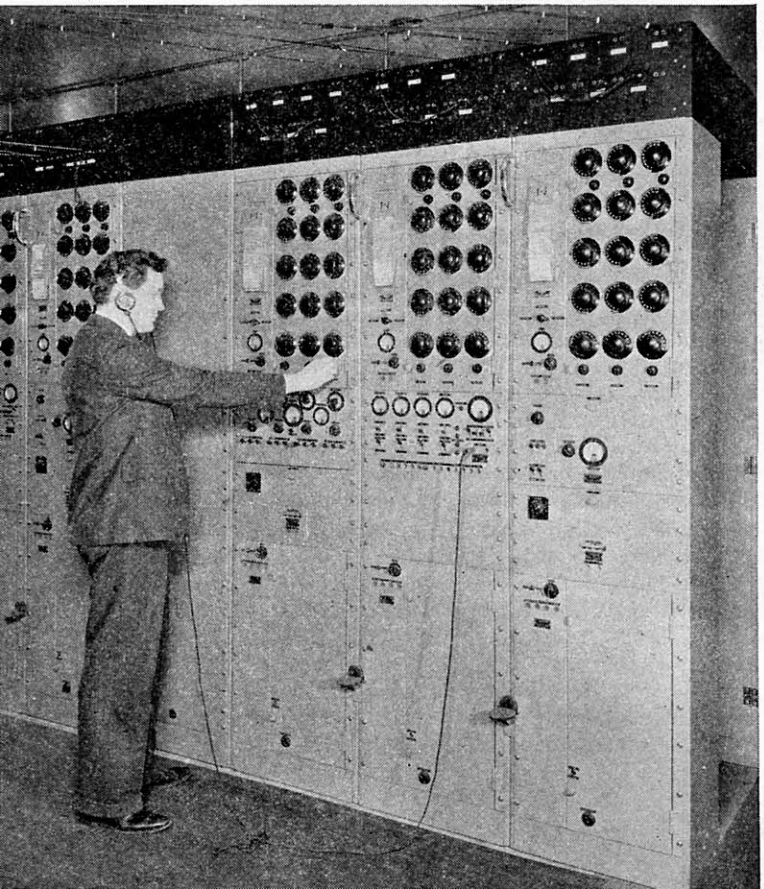
This war has revealed in an impressive manner, the gigantic power of radio broadcasting and short-wave transglobal communication. Here at last we witness, in daily demonstration, the potent ability of radio to spread political propaganda, to acquaint the beleaguered masses with the message from across their verboten frontiers that their slow salvation is on its resistless march, keeping hopes alive and readying the uprisings which will substantially aid the invasion. To friendly or neutral lands, our daily programs are gradually working to remove ancient antagonisms, suspicions inherent between strangers, and thus inevitably forwarding that distant dawn of mutual global understanding and civilized cooperation. Such was radio's predestination, now being realized.

Early in the annals of broadcasting, second in importance only to the development of the electron tube, came the knowledge of the unique precision control of frequencies by the piezo crystal. The debt which today's radio owes to those pioneers, Drs. Cady and Pierce, is perhaps too little appreciated considering the importance of their work. The value of their work is emphasized today by the fact that millions of frequency controlling crystals are being ground out monthly by a score of busy factories to meet an ever insatiable demand.

The outstanding radio development of the Thirties was the amazing engineering triumph of television, which added a new dimension to radio. The refinement of the cathode beam tube, and its twin sister, the Iconoscope, brought the 525-line picture to the point of well-nigh photographic fidelity to the few prewar screens. These developments and the now feasible projection tubes stand ready to give us a revolutionary form of entertainment and education which surpasses all that we have witnessed in broadcasting during its third decade.







This era embraces advances in long coaxial networks, automatic relay stations which permit live spectacles to be spread over wide areas. Rating next to television in importance was the introduction of frequency-modulated broadcasting, not hindered, but enormously stimulated by the demands of our military communications. The original, intricately complicated circuits for FM transmitters have now been largely supplanted by greatly simplified circuits, notably those of the General Electric Company, so that in the postwar period, we may expect nationwide application of this method of transmission to all metropolitan and small urban districts.

Television and FM together have opened up entirely new sections of the ultra-high-frequency spectrum and an immense amount of research in these engaging studies has resulted.

The war has also brought into being, through radar requirements, a knowledge, already profound, of the decimeter and centimeter range of wavelengths, harking back to Hertz and Rayleigh, Lodge and Bose, for useful applications of the Maxwellian field equations in the design of reflectors, wave guides, and resonance chambers, so that now, by utilizing the cathode beam as an indicator, we can accurately measure time in fractional microseconds, and distances from 100 miles to a few feet instantaneously, measure altitudes, ground speeds, as well as direct searchlights, gun fire, and robot planes. Postwar blind landings will become routine; collision with mountains and between planes and vessels, inexcusable.

The study and development work undertaken on the Promethean electron tube and the cathode ray of television was chiefly responsible for the intensified knowledge leading up to engineering of new equipment in the late Thirties. From this work came the electron-multiplier, the electron microscope which has already revealed heretofore unknown regions of nature, and the atom-smashers such as the Cyclotron of Lawrence and the Betatron of Kerst. These instruments provide the entering wedges to the synthesis of the elements and ultimately will provide an exhaustless source of atomic energy before wastrel man has squandered all of our present fuels.

Beginning with short-wave diathermy apparatus and techniques, engineers have developed in recent years high-power radio oscillators. This equipment has been introduced to industry and is being used on such a scale that already the kilowattage in industrial heating applications far exceeds the generated power of all of the world's communication transmitters. Its uses for smelting, brazing, soldering, and tempering operations embrace a degree of refinement and accuracy impossible with the old, classic methods. The plywood industry and plywood construction are being rapidly remade by virtue of kilocycle heating, with an economy of time aggregating years during a single working year.

Radiothermics is entering the field of chemistry, the culinary and domestic field and as yet there seems to be no limit to its application, useful or benign.

Thus has radio developed in less than half a century, from its humble beginnings to its position in the forefront of science today.

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1 An early 500-watt radio transmitter, WJZ, built by Westinghouse in 1921. Ray Guy announcing.

2 Kennedy model 110 Universal receiver. Note the magnetic type speaker and rotatable loop antenna.

3 Diversity receiving system at RCA's receiving center, Riverhead, L. I., used for transatlantic service.