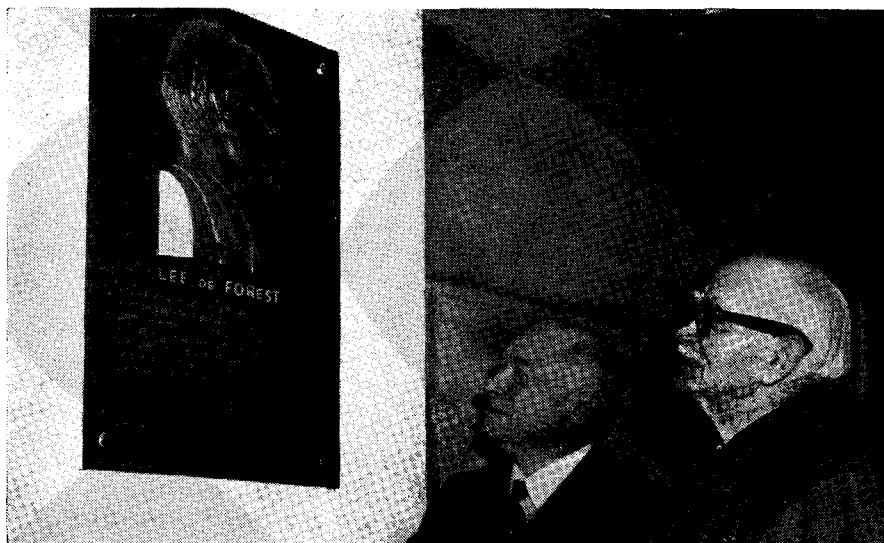


problem in Chicago, he lived one winter on \$10 a week, earned by translating French technical papers. In his hall bedroom, cluttered with apparatus, he went barefoot whenever possible in order to save shoe leather, and in his diary of that period there appears the wry comment that if he stood up as much as possible, his trousers "might last until Spring." On another page the entry is less cheerful: "Oh, the loneliness, the difficulties," he wrote. "I am dwelling in a new realm. No precedents. No apparatus. No co-workers. All things to be tried out and tested."

One difficulty, at least, was resolved when he arranged to teach three hours a week at the Armour Institute of Technology in exchange for the use of its electrical laboratory. There, with the help of a young telephone operator, Edwin Smythe, he finally completed an automatic detector of wireless signals that was a distinct improvement over the one then in use. Jubilant, he proposed to the Associated Press that he cover the impending race (1901) off Sandy Hook between the yacht *Columbia* and Lipton's *Shamrock II*, but was informed that the AP had already made a contract with the Marconi Company.

Undaunted, and armed with what he felt to be the better device, De Forest promptly signed a similar agreement with the Publishers' Press Association, and hurriedly set about to rent a shop, buy materials, and build the necessary equipment. As usual, his own funds were low, but the advance of \$1,000 from a kindly-disposed business acquaintance provided him with capital to set up shop as the American De Forest Wireless Telegraph Company and prepare to challenge the established Marconi firm. On the big day, both wireless firms reported the race from separate tugs in the Atlantic. Unfortunately, it had occurred to neither that they ought to operate on different wave lengths, with the result that they jammed each other's signals and nothing got through. The newspapers had to get their story by the time-honored method of wigwag.

Efforts to promote his new company brought De Forest to the attention of the *Providence Journal*, which in 1903 hired him to set up a wireless station on Block Island to furnish it with up-to-the-minute news. The Navy, impressed by the results, asked him to report on naval maneuvers. England invited him to inaugurate a wireless service between Wales and Ireland, and in Shantung he set up a station from which the Russo-Japanese naval war was reported. The title, "Father of Radio," by which he has been known for a quarter



—New York Herald Tribune.

Dr. De Forest (right) with David Sarnoff looking over a plaque with the following inscription: "LEE DE FOREST . . . This building stands on the site of the old Parker Building destroyed by fire in 1908. In his small laboratory on the top floor of that building Dr. Lee De Forest in October 1906 invented the grid 'audion' or three-electrode vacuum tube on which our electronic era has been founded. . . . De Forest Pioneers, November 12, 1956." The site (229 Fourth Ave., New York) is now occupied by the Muzak Corp.

WE STILL are all somewhat too close to the career and contributions of that eminent scientist and inventor, Dr. Lee De Forest, to be able adequately to appraise and praise him for what he has accomplished and for what he has caused to spring into being. Much time must elapse before we shall have that full historical perspective which will permit us to understand fully the fundamental changes in our civilization brought about by his work. And this is one index of the magnitude of his accomplishments.

Even the man on the street knows that De Forest created the first three-electrode vacuum tube—called by him the "audion"—a euphonious and prophetic name. For many audio, or acoustic, arts have stemmed from this tube in its developed forms. Consider this outline list of some triumphs in the field of sound which were brought into being by the audion. The tube amplifier, which enables any desired volume of sound to be produced, was one of them. This led to the well-known public-address systems so beloved of political figures and after-dinner speakers. It also led to the tube amplifiers which brought us transcontinental and transoceanic telephony.

And it spawned the radio and television transmitters which variously promote safety of life at sea and in the air and also enliven our entertainment hours in the home. Highly complex and effective receivers for sight and sound programs, in black-and-white and color, were built around the tube—that eclectic brainchild of De Forest.

And in the realm of industry, the electron tube has given birth to a host of useful devices such as controllers, computers, intrusion-prevention systems, and automation equipment. Who today could justly evaluate the social significance of such potent agencies as these?

Radar, which guards our shores from attack and protects our ships and planes from collision, is based on complex tubes which find the audion in their earliest lineage.

Nowhere has there been a more elegant and artistic application of the audion and its successors than in the fields of music recording and reproduction. Whether as fine grooves in the disc record or as magnetic changes in the magnetic tape, the faithful recording of music and its exquisitely accurate reproduction would have been retarded for many decades if De Forest had not offered the world his audion.

Without the extremely powerful amplification capabilities of the tube, the disc or tape phonograph arts would have remained at what we today would regard as inacceptably low levels. High-fidelity sound, and even convincing stereophonic sound, are built on the foundation stone of the tube.

To some men it is given to offer humanity substantial benefits. But to only very few men does fate grant the boon of offering mankind a major scientific and technical breakthrough of transcendent human value. Lee De Forest will be numbered among these latter immortals.

—ALFRED N. GOLDSMITH,

past president of the Institute of Radio Engineers, past president of the Motion Picture & TV Engineers, fellow of many acoustical societies.

century, was not coined in time to blaze from the eight-foot electric sign that flashed his company's name before visitors to the 1904 World's Fair in St. Louis. But De Forest, then only thirty-one, was riding high, worth a million dollars in stock in a company that was preparing to rival Western Union and Postal Telegraph with a network of wireless receiving stations across America.

A YEAR later his company, expanded beyond its resources, had collapsed, his wireless detector had been successfully challenged in the New York courts, and De Forest himself was left with a few hundred dollars in cash—plus a half-formed hunch about a way to trap the wary electron. Shortly before, an English scientist named Fleming had converted Edison's filament bulb into a vacuum tube capable of detecting wireless waves, but without the power to amplify them. Some third element, De Forest suspected, was needed to bridge the gap between the filament and the metal plate in order to control the flow of electrons.

After experimenting with bits of tinfoil and metal strips, he finally twisted a piece of platinum wire into a series of hairpin curves, inserted it into the tube, and shortly thereafter filed with the U.S. Patent Office an application on an "improvement in space telegraphy"—a three-element (triode) vacuum tube, which became the foundation of today's multi-billion dollar electronics industry, and has been called "the greatest single invention of the twentieth century."

Armed with this, De Forest reorganized his firm and set about fulfilling contracts to install the first high-powered radio stations for the U.S. Navy at five of its largest bases in this country. His old phonograph, too, played its part in this pioneer phase of radio broadcasting. "One day early in 1907," he recalls, "I hooked up my old hand-crank machine to a transmitter in my laboratory in the old *Parker Building* and, using a carbon mike pickup activated by air-columns between the phonodiaphragm and the mike, I 'disc-jockeyed' the first radio broadcast of recorded music. The record was the 'William Tell' Overture, and the broadcast was heard by a few ships' operators in the Brooklyn Navy Yard."

In 1910, De Forest also made possible the first broadcast of "live" music when he erected a temporary transmitter on top of the Metropolitan Opera House to carry the voice of Caruso singing the Siciliano from "Cavalleria Rusticana." The great tenor sang into a microphone placed

on a table, and the small antenna limited the broadcasting radius to only a few miles. At De Forest's home a young reporter was among the guests gathered to listen to the history making event. When it was over, he asked the inventor for a statement on which to base a story. Surprised, his host replied, "Why not simply write about what you've just heard?" "Oh, I will," said the reporter, "but it's not easy to get this sort of thing into the papers." After the boy had gone, De Forest's friends persuaded him that he'd been too sanguine in predicting that such a thing would be an ordinary occurrence "in just a few years." To placate them, he called the newspaper and said, "Better make that twenty-five years, son." "I made it 100 years," the boy answered. "And the copy desk made it 150." Actually, it was little more than a decade before De Forest's "too sanguine" prediction had become reality.

Meanwhile, public disbelief continued to harass him. Once he was haled into court, where the prosecutor, waving before the jury a dubious looking small glass bulb, said, "The defendant claims that this ridiculous gadget will someday transmit the human voice across the Atlantic." De Forest was let off with a sharp reprimand, and not long afterward his "ridiculous gadget" beamed the voice of an American Tel&Tel engineer from Arlington, Va., to a specially built receiver erected atop the Paris Eiffel Tower.

Today, from his own eyrie on the top floor of a large storage warehouse where, with his machinist, William Royale, he continues experiments sponsored jointly by the Lee De Forest Foundation and the Bell Laboratories, De Forest can look out over a city that accepts as commonplace the scientific advances he foresaw nearly half a century ago. In an era of gaslight, he was brashly predicting a time when we would sit in radiant-heated, air-conditioned homes and speak with friends halfway around the world, put a favorite record on a turntable, listen to a Metropolitan Opera broadcast, or watch the World Series from an easy chair—miracles made possible by his bit of twisted wire.

With all this, his restless imagination is still plunging far into the future. Television, recording, international broadcasting, radar, are only the first mileposts, he feels, in an era of limitless power. "Fifty years ago," he says, "it took a lot of imagination to see yourself holding a telephone conversation with someone in Europe. Today, the same kind of imagination is needed to believe we may one day send out radio waves to inhabited

planets and receive decipherable signals in return. Back in the 1920s, I spent ten years and my entire fortune developing sound on films. All the while I was working, the studio heads kept telling me, 'We don't want talking pictures. The public doesn't want them. They'll never be anything but a flash in the pan.'

"In 1934 I patented the rotating beam, now in universal use in radar reception. But radar itself hadn't yet been invented, so I sold my patent for a very small sum. In the 1920s and 1930s," he continued, "the big companies could acquire patents that threatened the *status quo* and shelve them until a change became mandatory. This is not so common today, because the whole direction of thought is forward. Companies realize that since production in industry has become so interlocking, a technological advance in any direction benefits them all, so they tend to think less in terms of individual competition than of the industry as a whole. An example is the invention of the LP disc, a process which Columbia Records might have controlled exclusively, but chose instead to share it with the entire industry, thus tremendously enlarging the market for all companies, including itself."

WITH a lack of financial luck not uncommon in inventors, De Forest was never able to capitalize successfully on any of his more than 300 inventions, and in 1936 he filed a petition of bankruptcy, listing debts of \$1,000,000 as against assets of \$390. His reward, however, has come from knowing that his work has moved the human race a little further along in its unending struggle toward whatever dimly sensed goal. The true researcher, he feels, works in the spirit of the great explorers, and his weapons are turned against the barriers of ignorance and superstition.

One of the most potent forces in this fight is the easier exchange of ideas made possible by the various communicative media that owe their existence to his tiny twist of wire. Partly because of it, also, man is fast gaining control over the physical conditions that dictate his mode of life, and consequently his mode of thought. Once this is achieved, De Forest believes that man's potentials for creative accomplishment are virtually unlimited. He will exchange his tribal thinking for a world viewpoint, communicate with all peoples in a common language and, through an intelligent use of such potentially civilizing agencies as television and recorded sound, he will come to learn that the pursuit of knowledge is the most absorbing passion man can entertain.



Muzak Headquarters—recording music programs on 4,800-foot magnetic tapes.

MUSIC TO HEAR BUT NOT TO LISTEN TO

By STANLEY GREEN

IF IT is true, as S. J. Perelman has recently alleged, that we are all on "The Road to Miltown," it is equally true that science and industry are combining to make the journey as comfortable as possible. Even music, once renowned for inspiring man to deeds of valor, has taken its place alongside air-conditioning, sound-proof ceilings, indirect lighting, contour chairs and the coffee-break as a commodity designed to help us meet the tensions of our daily lives in a calm and relaxed atmosphere.

It is the impulse that has put "Muzak" into the language, and evoked a variety of competitors. Like "Victrola" for "phonograph," Muzak has become almost a generic term to describe any system of music piped into a public place or place of business. One of the attractions that has caused people (who could get, for nothing, something similar from the radio) to pay for Muzak's services is its freedom from commercials or advertising. Appropriately enough, its financial control since the early 1940s has been held by Senator William Benton, previously famous for his association with the advertising firm of Benton and Bowles.

Rumor is that he bought control, for not much more than \$100,000, on the advice of economist Beardsley Rummler. Wartime production problems highlighted the need for increased efficiency, to which music-for-industry (provided by Muzak) made its contribution with the blessing of the U.S. War Production Board. Benton is also chairman of the board of the Encyclopedia Britannica; Harry Houghton, Muzak's president, is one of its directors.

Appropriately, also, the Muzak Building (so named on the facade) is located on New York's Fourth Avenue just above Union Square in close proximity to a central office of the New York Telephone Company. For by far the largest amount of servicing in the New York area is done through special telephone circuits, to minimize loss of sound quality in the transmission. The pioneer work in such transmission was done as far back as 1911 by George Squire (later Chief Signal Officer of the Army) who patented a system for utilizing regular electric power circuits. However, intrusive noise was always a serious inconvenience, and it was not until the early 1930s that a scheme for using telephone circuits was developed. By 1935 the plans were sufficiently advanced for a year's work to be invested in cre-

ating a musical backlog through recordings made specifically for the purpose. It is this backlog (mostly of experience, for few of the original arrangements are still in use) plus the steady accretion of more experience and more recordings each year, that has given Muzak its unique place in a field where competition might have been abundant.

Of itself 229 Fourth Avenue is not distinguished from other venerable buildings nearby which had had similar modernization (save for the plaque shown on page 53). As one enters the lobby, however, music begins to lap at the ears, and it accompanies the elevator operator's "Going Up?" to whatever floor one elects. Muzak's premises are thoroughly Muzaked, for Administration, for Sales, for Management, for Public Relations. The nerve center of the operation is a spacious room with banks and banks of tape recorders. Each is fed from a sound proof studio in which an operator (almost invariably female) transcribes selections from 16-inch vinyl records, according to a schedule sheet before her. Muzak's library of 49,000 selections (of which about 7,500 are in use at any one time) is recorded on these 16-inch disks for convenience, and accessibility: any band can thus be juxtaposed to a band from another disk for flexibility in programming.

Programs are made up on three eight-hour reels to comprise a twenty-four hour sequence. One set of each is shipped to each one of the seven different Muzak central offices around the country. Each office, in turn, has about twenty franchisers, each servicing the subscribers in its area. It is estimated that 50,000,000 Americans, in some way or other, hear Muzak daily. The reels are passed from one central office to another, along a kind of pony express circuit. When each area has heard the original sequence as created in New York, the reel is shipped back and erased. If the tape itself has not been subject to accident, it can be reused. "Quality control" of Muzak tapes is an involved, costly, highly discriminating business.

The nerve of the nerve center is a man named Donald O'Neill, who can readily claim to have more experience in creating music programs for mass consumption than any man alive, for he has been at it since 1937. A model of Muzak's calming influence, Mr. O'Neill becomes somewhat animated at the use of such terms as "mood music" and "background music." "All music has mood and all music can be played in the background," he asserts. "That's not the point. We don't sell music, we sell programming. We believe that the