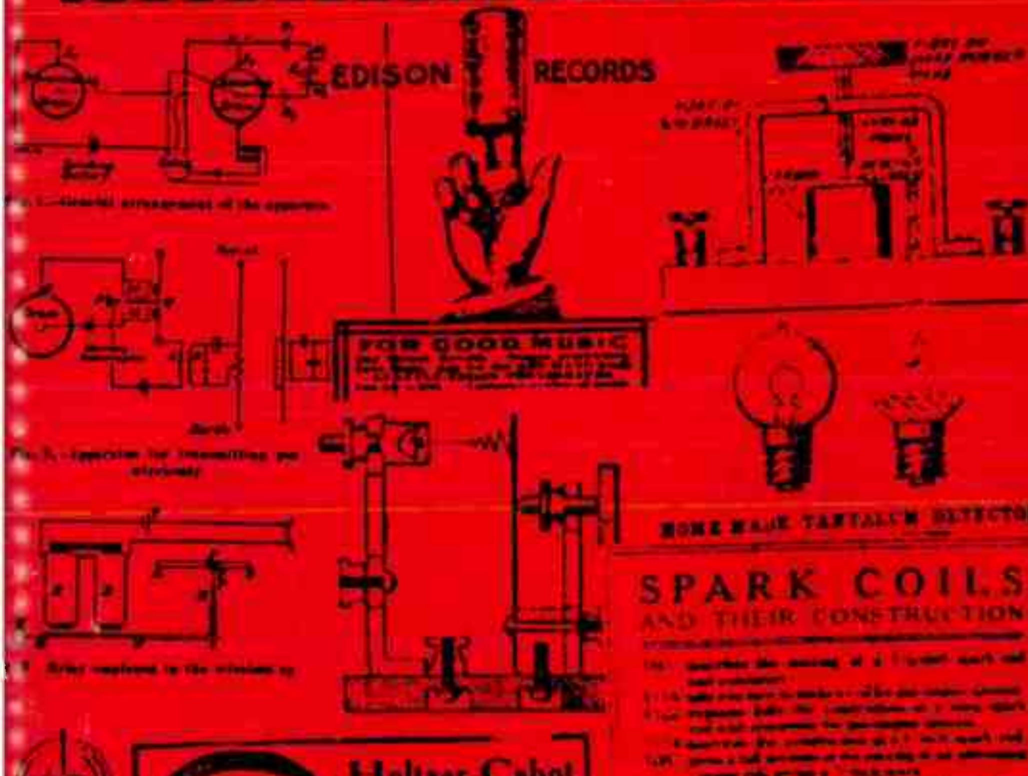
RADIO'S FIRST TWO DECADES



ISBN 0-9602310-4-8

COLOGNE PRESS

Fiction can be spellbinding. Non-fiction, hardly ever. Except, when we first read the out-of-print book RADIO FROM START TO FINISH we called it spellbinding.

Maxwell, Hertz, Marconi, Fessenden, DeForest, Edison, Fleming, Armstrong and those other wireless pioneers who did so much to advance the science of radio...it's all in this book.

Whether you can still remember the days of KDKA's beginnings, or how to construct a spark gap transmitter; or whether you are of a newer generation, the story of radio's early days makes for fascinating reading. We decided it to be a good idea to republish the book.

Inquiry of Harper & Row, parent organization of Crowell Co., cleared the way for republication by Cologne Press. We opted for the first half, now titled RADIO'S FIRST TWO DECADES.

We are pleased to bring you this journey back in time. Keep in mind, as you read, the material was first published in 1942.

RADIO'S FIRST TWO DECADES
consists of selections from
RADIO FROM START TO FINISH,
originally published by the
Thomas Y. Crowell Co. It is
reproduced by permission of
Harper & Row Publishers, Inc.

Cologne Press
Quality Family Books

RADIO'S FIRST TWO DECADES

Dealer inquiries invited;
quantity discounts available.

COLOGNE PRESS
P.O. Box 682
Cologne, New Jersey 08215
U.S.A.

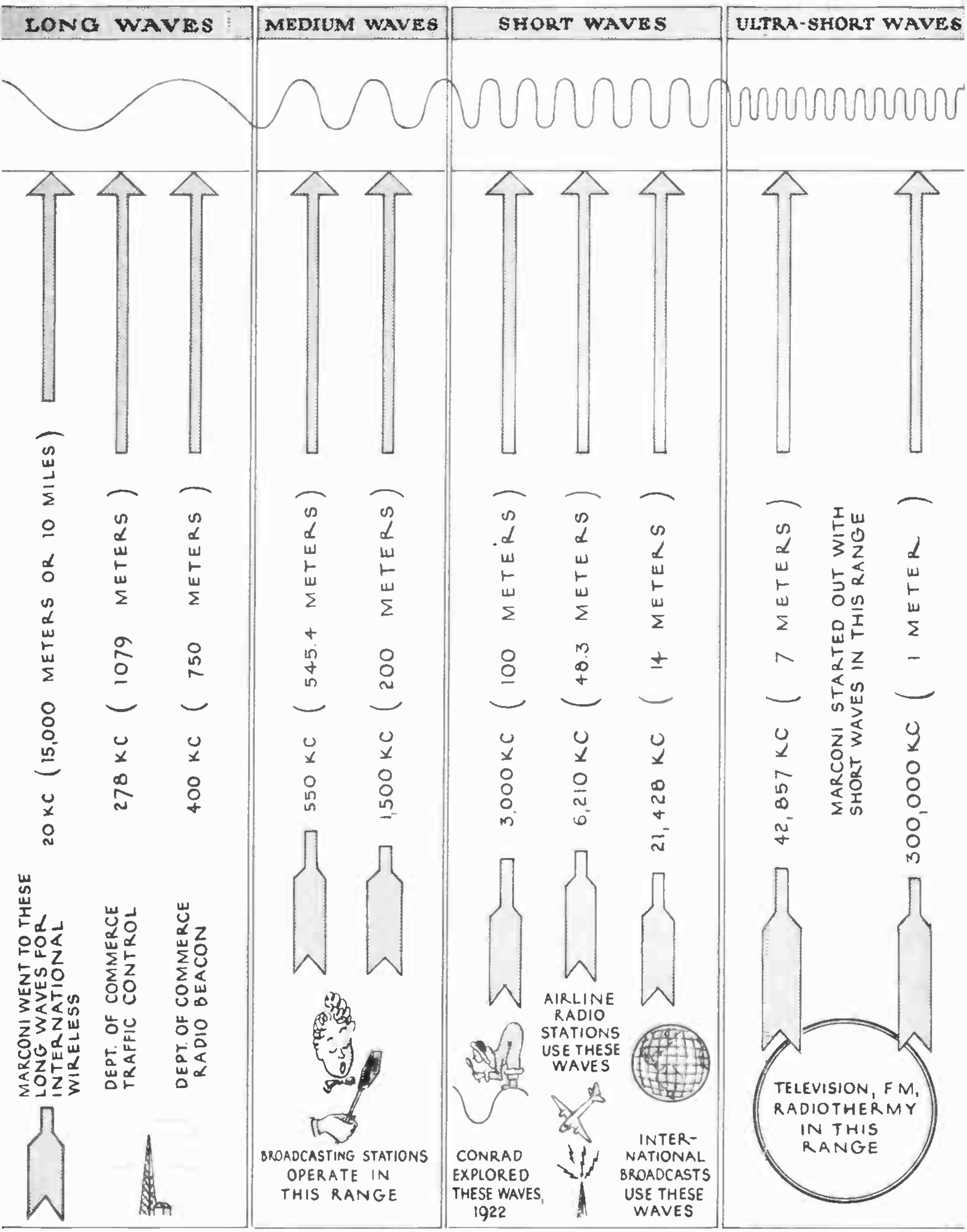
International Standard Book No.

ISBN 0-9602310-4-8

CONTENTS

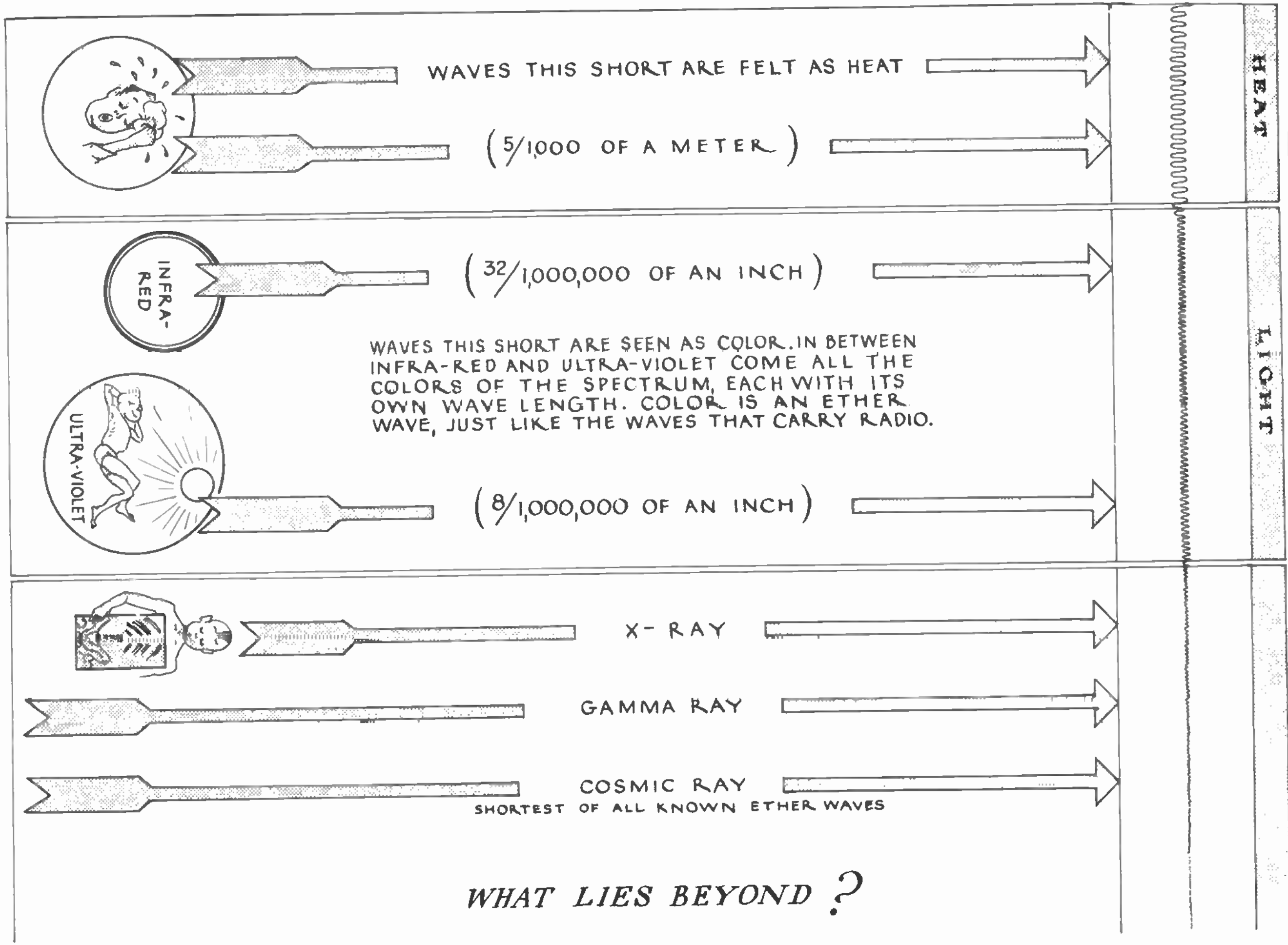
Published in 1987

THE ETHER



The ether ocean is an immense and marvelous sea. An electric discharge can set it in motion, and the resultant waves will travel around the world. In the last fifty years man has explored much of the ocean. He has generated waves of varying lengths, all the way from waves fifteen or more miles in length down to waves a fraction of a meter long. He has found different uses

OCEAN



for the different waves. This chart shows what has been explored. Much remains to be discovered, especially in the ultra-short-wave region. (See pages 149–151 for an explanation of this chart.)

THIS book is about radio as it is operated today—about the men who run it, the desks they occupy, the things they do, and the rewards they receive. There is a brief history of radio's beginnings, so that the reader will know how the world of broadcasting came to be, and a quick glimpse into what lies just ahead. The book is written for the young man (and young woman, too) who is curious about what lies behind the dial of his home receiver and who may some day go to work for a local station or a network.

For exceptional cooperation the author wishes to thank Mel C. Wissman and Robert Kelly of WWJ, Detroit; Leo Fitzpatrick of WJR, Detroit; Frank Mullen, vice-president of NBC; Lewis Titterton, manager of NBC's Script Division; Miss Frances Sprague, NBC Librarian; and Leif Eid, NBC Press Division.

I

Radio's Beginning

THE President of the United States sits in the White House and talks into a microphone. His voice, transformed into tiny electrical signals, scurries over special telephone wires to five hundred radio stations. From these stations the signals climb tall masts and leap out into space, spreading outward in all directions until they find the aerials of your radio set. Inside the set, the signals again become voice, and you sit comfortably in your chairs and listen.

While this is happening, those selfsame signals are traveling to tall antennae along the coast, where they take off with the speed of light for Europe, Africa, South America, Australia, and Asia. Today, because of the high development of broadcasting, five continents may listen simultaneously to the voice of one man.

There are nine-hundred-odd radio stations in the United States, more than half of them members of four large networks. Other countries have similar webs, and continent is joined to continent by short wave. It is over this highly organized system that a President or a Prime Minister addresses the planet.

Radio today is an important part of our lives. We throw a switch and turn a knob and listen to a drama, an orchestra, a comedian. We tune in on a World Series ball game or a championship boxing match. We hear a radio reporter talking from half way round the world, bringing us first-hand information from a foreign capital.

We rely on radio to provide a part of our information and entertainment. Ships and airplanes depend on radio for weather information and flight instructions and Arctic explorers talk to their homelands by radio. Armies in the field maintain contact with headquarters, and ships of a fleet speak to each other over the invisible waves of the thing scientists call "ether."

Today, we know much about the invisible ocean called the "ether." We know that it fills all space, and even exists in solids such as earth and rock and wood. Ether can be made to undulate in waves, just as waves are created in a pond when a pebble is tossed into it, except that the "pebble" that sets the ether in motion is a discharge of electricity.

Ether waves vary in length, just as water waves vary all the way from great ocean swells to tiny ripples. There are ether waves ten or fifteen miles from crest to crest, once used for trans-oceanic wireless messages. There are shorter waves of a few hundred meters in length, used for commercial broadcasting, and waves fifteen or twenty meters long used for short-wave broadcasting between continents.

If ether waves are short enough we feel them as heat, and when they become a tiny fraction of an inch long they are manifest as light and color. Go even smaller and you have the X-ray, used to combat cancer. All of these are ripples in that substance called "ether," which is unseeable, yet is all around us.

So this book, while it is a story of men and their triumphs, of wireless and broadcasting, is really a story of the ether ocean. It is a map of the explored areas and a hint of the unexplored. The chart at the beginning gives you an idea of the immensity of the ocean and the many ways in which it serves mankind. A fuller explanation of what we know about the ocean will be found in Chapter Fifteen.

Guglielmo Marconi, with his homemade wireless sending device developed in 1895. From a contemporary photograph. *Photo from The Bettmann Archive.*

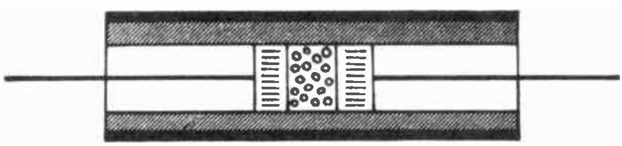
The story of Radio begins in 1895, in the gardens of an Italian banker near the pleasant city of Bologna. In that cheerful setting, the banker's son, a young man named Guglielmo Marconi, performed an experiment of considerable importance to all of us.

He stood by a strange-looking piece of equipment. From it a long wire extended into the air. Another wire connected the apparatus to the earth. Convenient to his hand was a Morse telegraph key, and when he pressed the key, a spark leaped across a small gap in a coil of wire.

More than a mile away was another apparatus, also with a wire extending into the air. Between the two sets there was no connecting wire. Only space. Yet, when Marconi pressed the key of the first apparatus, an electrical signal reached the wire of the second. It traveled down this wire into a small glass tube containing nickel and silver filings, and here an odd thing happened.

The filings, jumbled in the tube, arranged themselves in order. They "cohered," making the little tube a good conductor of electricity. It permitted a current to pass from a battery to a Morse inker, a device for printing dots and dashes on tape.

So, whenever Marconi, in his father's garden, pressed a key, code characters were imprinted on tape more than a mile away. The world's first practical wireless messages were taking wing.



Branly's coherer. Marconi used this to detect wireless signals. When wireless waves passed into the tube, the jumbled filings arranged themselves and permitted a current to pass through.

Guglielmo (Italian for "William") Marconi was born in Bologna, April 25, 1874. His schooling at Leghorn and the University of Bologna wasn't particularly technical, but he was living at a time when scientists everywhere were finding out new and startling things about the behavior of electricity.

In the Marconi home at Villa Griffone there was a large technical library. Guglielmo as a boy, because of ill health, received part of his schooling at home, and therefore had lots of time to spend in the library. Like another great inventor, James Watt, who also suffered ill health as a youth, Marconi substituted books and science for the normal outdoor sports of the average boy. He studied chemistry, steam engines, the life and work of Benjamin Franklin, and everything else of a scientific nature he could find.

One day he built a static aerial on the roof of the house, so wired that when enough electricity was collected a bell would ring. Marconi's father proudly encouraged his precocious son, and so did a famous friend, Professor Augusto Righi of the University of Bologna, who was an investigator into the ether waves by which wireless messages are carried.

So it is plain that Marconi was like any boy of today who tinkers in his basement with electrical and chemical sets. He was a boy indulging in a hobby. One day when Guglielmo was vacationing in the Italian Alps he came across an article in a scientific magazine stating that a German scientist had sent sparks across a room without the aid of wires. Marconi thought for a moment, and said:

"If you can send sparks across a room, why can't you send them across the Atlantic?"

From that moment on, Marconi dedicated his life to wireless. Famous men in Paris, London, and Berlin were also interested in the subject, but they weren't having any great luck with their experiments, probably because they were only devoting part time to it. Other and weightier matters claimed their interest. But that wasn't true of Marconi. Marconi was just young enough and ambitious enough to be interested in radio and nothing else. He had something the great men lacked. He had singleness of purpose.

So it was that this keen-eyed young Italian, just turned twenty-one, was the first man to put wireless telegraphy on a practical basis.

Of course Marconi wasn't the "inventor" of wireless any more than James Watt was inventor of the steam engine or Robert Fulton inventor of the steamboat. No invention springs to life overnight. What we call an "invention" is the final advance in a series of hard-won battles fought silently and patiently by many men in many places.

Before Marconi, there was a Scotchman named James Clerk Maxwell, born in Edinburgh on June 13, 1831. Clerk Maxwell was a precocious youngster, nicknamed "Dafty" by his schoolmates at Edinburgh Academy. At the age of fourteen he was writing papers that commanded the respect of scientists. From the very beginning of his schooling he took an intense interest in such subjects as chemistry, magnetism, and light.

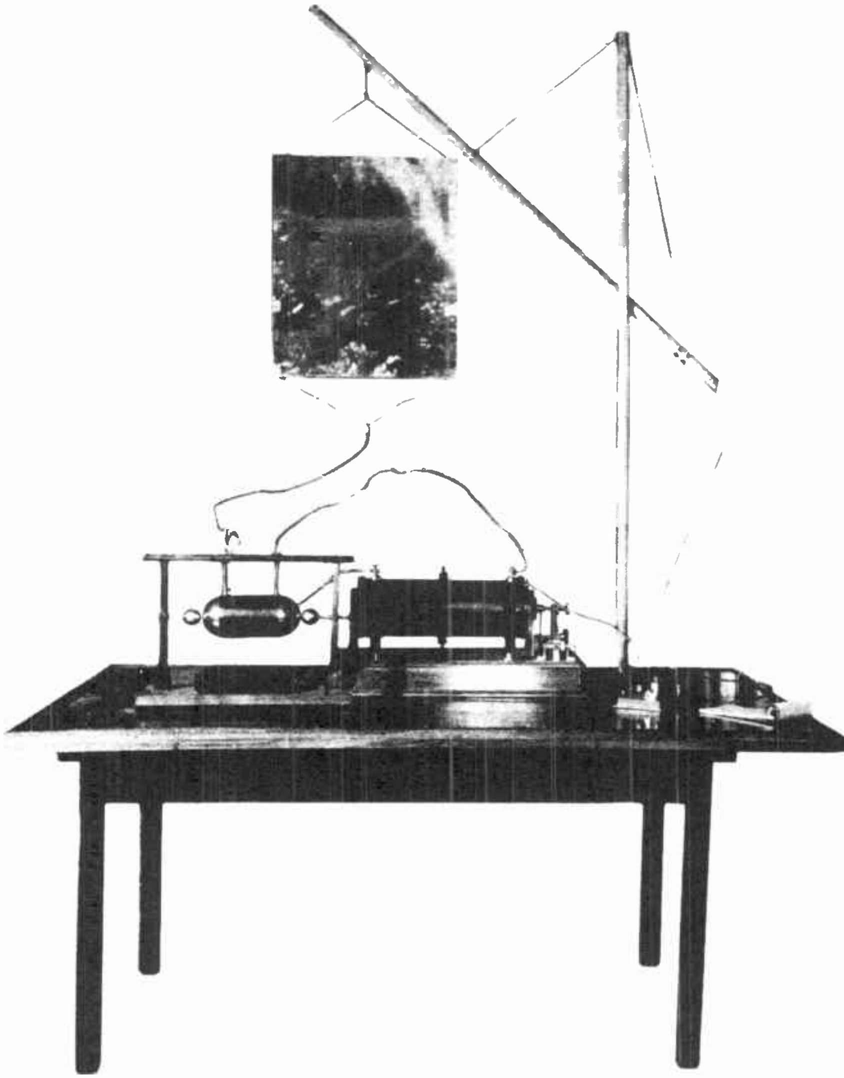
He went on to Cambridge, won honors, and became a lecturer at Trinity College. When he was only twenty-five he was appointed professor of natural philosophy at Marischal College in Aberdeen, and his tireless mind busied itself with such varied matters as color and vision and heat, and what the Rings of Saturn are made of. Apparently there wasn't any behavior of nature that Dafty Maxwell wouldn't investigate. You and I are likely to take for granted the fact that we can see colors. Not Maxwell. He wanted to know the "how" of all things. In 1871 he was appointed professor of experimental physics at Cambridge, a high honor for a man of forty.

Maxwell exercised the same kind of intelligent curiosity on electricity and magnetism. He proposed the startling idea that electricity was like light. Both, he said, traveled through space at the rate of 186,000 miles per second. They traveled in waves, like the waves that ripple outward on a pond, when you toss a stone into it. The "pond" in which these waves traveled he called "ether."

He thought of the universe as an immense ocean of ether in which all the heavenly bodies are swimming. Ether wasn't air. It existed outside of air; it existed in a container from which air had been exhausted. It was of such a nature that it existed in walls and other solid objects in the earth.

The light that reached us from the sun was nothing more nor less than successive ripples of this unseeable ether, said Maxwell. And electricity, traveling through space from one electrical device to another, was also waves in ether.

Maxwell didn't originate these ideas completely out of the blue. Others had believed in the wave theory of light. Maxwell



Replica of Marconi's first radio transmitter operated on his father's estate at Bologne, Italy, 1895. *Photo from Monkemeyer Press Photo Service.*

was indebted to all the experimenters who came before him. But Maxwell summed it all up. He reduced it to mathematics and presented the world with formulas by which men could predict the behavior of electricity in space. He said, for instance, that electrical waves could be reflected just as light could, and later this was found to be true. His work clarified the understanding of people, eliminated false theories, and brought together many seemingly unrelated happenings into a single system.

But Maxwell didn't have time to prove his ideas by experiment. His revelation was given to the world in 1873, and a few years later, when he had reached the age of forty-eight, his great mind was stilled.

The man who was to prove Maxwell's theory of electrical waves in ether was a young German high school teacher named Heinrich Rudolph Hertz.

This thoughtful, unassuming young man, whose experiments were to mean so much to the future world of radio, was born in Hamburg on February 22, 1857. His father was a successful lawyer, a man who spoke many languages well, and who loved to read classical literature. Young Heinrich Hertz was brought up in a tolerant, intellectual home that was friendly to the spirit of inquiry.

What is even more important, Heinrich's grandfather, a prosperous merchant, had a well-equipped physical laboratory in his home. Heinrich was introduced to the fun of laboratory work at an early age.

At that time, Germany was in a period of great industrial growth, and like most of his friends Heinrich planned on a career of engineering. He attended the Hamburg grade schools, spent a year with an engineering firm at Frankfort, another year in the army, and in November, 1877, went to Munich to study surveying and construction. All this time, he had been carrying on an inward struggle between engineering and pure science, and at Munich he made his decision. There were laboratories in Munich, and the sight of them was too much for him.

James Clerk Maxwell, who proposed the theory that light and electricity travel in waves through ether. *Photo by Brown Brothers.*

He wrote his parents that he wanted to study mathematics and physics. His parents, who undoubtedly wanted him to be a successful engineer, one of the builders of the new Germany, wrote back that if he wanted to study physics, then that was what he should study. It was lucky for the world of radio that they let him have his way.

With high enthusiasm, Hertz plunged into the maze of mathematics that is the foundation of all science. After a year in Munich he went to the University of Berlin, where he studied under the great Hermann von Helmholtz, one of the formulators of the law of the conservation of energy. He became von Helmholtz's assistant, and it was at this time that his thoughts were directed toward the startling ideas of Clerk Maxwell.

What was the nature of electricity? Did it travel in waves? Was it similar to light as Maxwell said? These thoughts he carried with him to the university of Kiel where he lectured in physics, and in 1885 to Karlsruhe, where he became professor of experimental physics at the technical high school. At that time he wrote in his diary: "Thought about electromagnetic rays. Reflected on the electromagnetic theory of light. Hard at Maxwellian electromagnetics in the evening. Nothing but electromagnetics."

The high school laboratory at Kiel had two coils of wire, each with a small spark gap in it. One of these coils was connected to a source of current. One day Hertz noticed that when a spark leaped across the gap in the one coil, a similar spark appeared at the gap in the other, even though there was no wire connection between the two.

For the next two years, Hertz followed up this interesting behavior. In the school laboratory, with homemade equipment, he caused wireless waves to travel a distance of forty feet. This was the experiment that Marconi later read about, in the Italian Alps.

By means that we could understand only if we were trained scientists, Hertz showed that these waves actually did travel with the speed of light through the "ether." He built curved mirrors six feet high and showed that electrical waves could be reflected, exactly as Maxwell had predicted. He built large prisms made of pitch, passed electrical waves through them, and showed that the waves were refracted, much as light is refracted.

Hertz brought the ether waves of Maxwell down into the real world. He verified Maxwell's laws and added more laws of his own. He built the first transmitter and first receiver. When Hertz finished his work, it was only a question of time before wireless and broadcasting would become a part of our lives.

Hertz himself had no idea that this would happen. When someone asked him if his waves would ever be used for wireless telegraphy or telephony he replied that he didn't believe it would be practical.

He didn't live long, or he might have seen for himself the marvelous future in store for his discovery. On January 1, 1894, when he was only thirty-six, yet the recognized equal of such great men as Maxwell and von Helmholtz, Heinrich Rudolph Hertz died.

So, when Marconi, on his father's estate near Bologna, sent wireless waves a distance of more than a mile, in 1895, he owed much to those who went before. He was employing waves defined by Maxwell and demonstrated by Hertz. His detector, that little tube of filings that obligingly cohered under the influence of ether waves, was the work of Professor Edouard Branly of the Catholic Institute of Paris, and his telegraph key and inker were Samuel F. B. Morse's. Marconi inherited the findings of all these men and every other scientist who had advanced the cause of electricity.

But for the rest, Marconi owed much to his own resourceful mind. Until he hit upon the idea of connecting transmitter and receiver to the ground and raising antennae into the air, his range was limited. After these significant improvements, wireless was to stretch out its invisible feelers, year by year, until one day the Atlantic would be conquered.

2

Marconi Spans the Ocean

THE story of how Marconi established wireless as an international service in a half dozen years is the story of a week-by-week struggle for distance, more distance, and yet more distance.

In the summer of 1896, with his invention far enough advanced to merit attention, he went to England. Marconi's mother was Irish, and the boy himself had received part of his education in England, so that the country and its language weren't unfamiliar to him. England was the world's money capital. English scientists, among them Sir Oliver Lodge and Sir William Crookes, were working on the problem of wireless. Marconi felt that England, rather than his native land, would give him the backing he needed.

He went directly to Sir William Preece, technical director of the British Post Office, and demonstrated his wireless in the rooms of the London Post Office. Preece himself had experimented with wireless, and what Preece saw in this first demonstration convinced him that this unruffled young Italian, just old enough to be finishing college, was working along the most practical lines so far known.

Marconi and his assistants, G. S. Kemp (left) and P. W. Paget, on the day they received the "S" signal, the first wireless message to be sent across the Atlantic, from Poldhu, Cornwall, to St. John's, Newfoundland, in December, 1901. *Photo by Brown Brothers.*

Under the supervision of the British Post Office Marconi set up his equipment at Salisbury Plain, and that first year attained a distance of almost two miles. The battle for distance had begun.

The following spring he filed a patent for "signaling through space without wires." The word *wireless* wasn't yet in use. At that time, by painstakingly improving his equipment, he had sent messages four miles over land and nine miles across the Bristol Channel.

Progress was swift. In June, 1897, he returned to Italy and installed a shore wireless station at Spezia that successfully communicated with a warship twelve miles at sea. Also in June Sir William Preece reported the progress of wireless to the Royal Institution in London, and his words, reprinted in the *London Engineer*, announced to the world that a new age in communication was under way.

On July 20, 1897, the Wireless Telegraph and Signal Company was formed in England with Marconi as chief engineer, and now the new form of message sending began to find its commercial uses. Lloyd's Corporation of London asked Marconi to install equipment in two lighthouses on the North Irish Coast, seven and one-half miles apart. The equipment was put in, the keepers taught to operate it, and the first practical use of wireless was successfully launched.

Up until this year, 1897, when a ship put out to sea it was swallowed up in a vast, mysterious unknown until it arrived at a port. There was no way on earth of getting in touch with it. If it sank, nobody knew how or why.

So it was natural that ships should eagerly welcome the new invention and become its first customers. Marconi wireless sets were installed in ships and at shore stations throughout 1897 and the years following.

One battle Marconi had to win before his wireless could become reliable, and that was the battle of tuning. This meant, simply, that the transmitter had to be so devised that it would send out waves of a single length, rather than jumbled waves of varying lengths. If that could be accomplished, then distance and clarity would be improved, and nearby stations would not interfere with each other.

Marconi called it "syntony." In his struggle for syntony he was helped greatly by Sir Oliver Lodge, and on April 26, 1900, he applied for a patent covering this important development.

Everyone is familiar with tuning now. When we turn a dial on our radio sets to get a certain station, we are tuning the set to receive a certain wave length. Tuning permits several stations to broadcast from the same town without interfering with each other. So this indispensable phase of broadcasting goes back to the earliest days of wireless. It goes back, in fact, to the first experiments of Hertz in the high school laboratory at Karlsruhe, for at the beginning Hertz discussed the matter of tuning.

Meanwhile, the struggle for distance went on. Antennae climbed higher and higher into the air. Circuits were changed and improved, and the range increased to twenty, twenty-four, and thirty miles. Yacht races and regattas were reported by wireless from tugboats following the races to stations on shore. A wireless set was put up for Queen Victoria's personal use.

On March 27, 1899, Marconi sent wireless messages across the English channel from Dover to Boulogne, and France and England were connected by the rapid vibration of waves in ether.

Then, the following month, there happened what was certain to happen sooner or later. In a fog off the English coast, the steamer *R. F. Matthews* got off course and rammed the Goodwin Sands lightship. There was a wireless set on the lightship, and the operator began tapping out messages for help. They were received on shore. Men put out in boats, rowed twelve miles to the scene of disaster, and saved all lives. It was the first marine disaster in which wireless had come to the rescue, and if there had been any public resistance or skepticism before the event, it disappeared now.

"Do you think?" a newspaper man asked Marconi at this time, "that New York, say, and Paris can ever be connected by wireless?"

'I see no reason to doubt it," the twenty-four-year-old Italian replied. "What are a few thousand miles to this wonderful ether which brings us light every day across millions of miles?"

Light, reaching us from the sun as vibrations in the untouchable ether. Electricity, traversing the world as vibrations in ether. A new concept. A dazzling one, filled with magnificent promise. Marconi by now was sending messages over a hundred miles and he saw no reason why the distance might not be two thousand miles, just as well as a hundred.

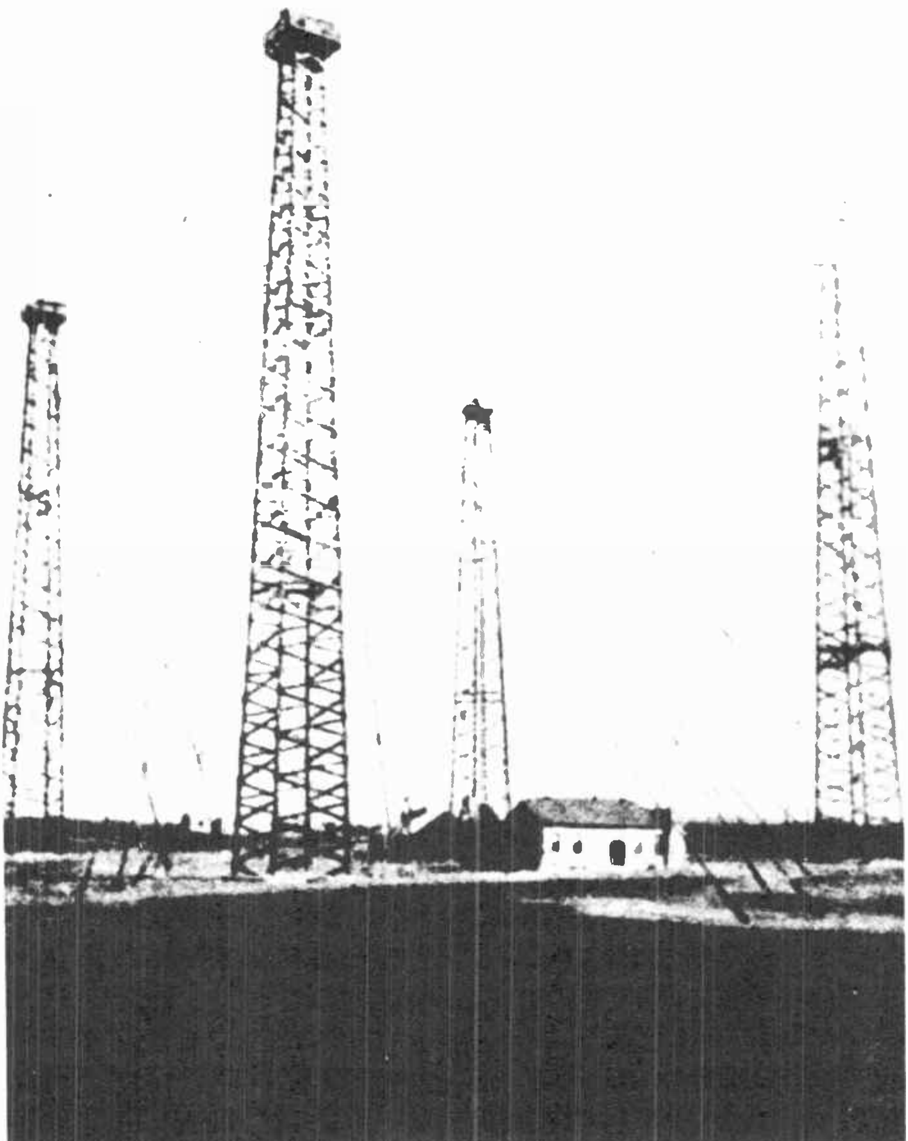
In 1901 Marconi decided to try to send signals across the Atlantic. At Poldhu, Cornwall, on the southwest tip of England, he erected a ring of twenty masts, each 200 feet high, to support an immense aerial from which his transatlantic signals would be launched. But before he could put his equipment to the test, a gale wrecked the aerial.

When Marconi looked at the wreckage he showed no despair, no sign of irritation. He merely said to his assistant, P. W. Paget: "Well, it shall be put up again."

With the new aerial he had no difficulty in sending messages to Ireland and there seemed no reason to wait longer. With his helpers, Paget and G. S. Kemp, he sailed on the *Sardinian* for Newfoundland and arrived at St. Johns on Friday, December 6.

For this first experiment, the trio didn't want to go to the expense of erecting permanent aerials at the receiving end. The important thing was to get a wire high into the air, and they felt that a kite would do this satisfactorily. Since height was important, they selected the old military barracks on the rocky eminence of Signal Hill, outside the city, for their station.

Finally, on December 12, the pioneers succeeded in raising a



Marconi's station at Poldhu, from which the "S" signal was sent. *Photo by Brown Brothers.*

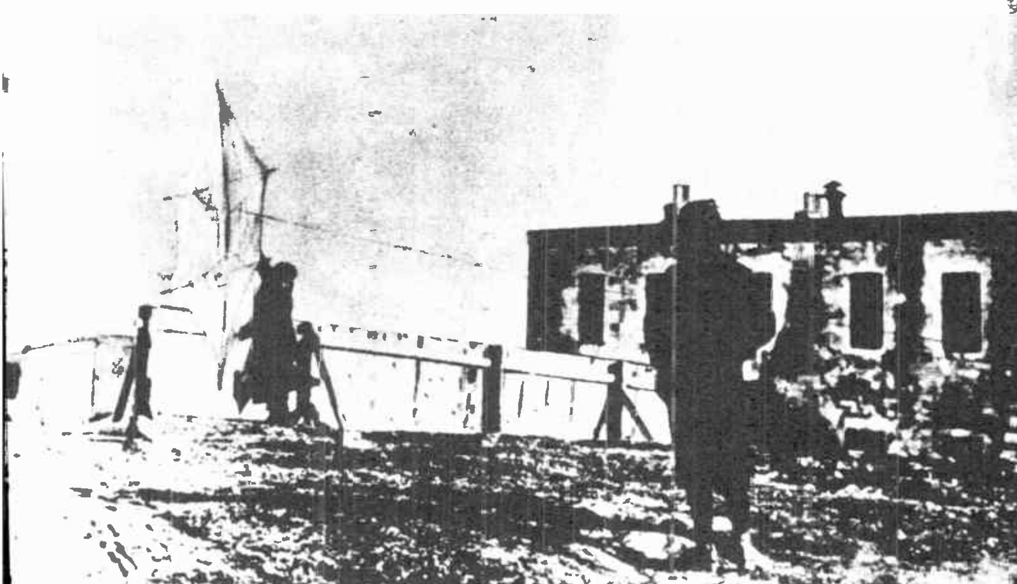
kite-borne aerial four hundred feet into the air. Marconi had already arranged for Poldhu to send signals at specified times each day. The signal was to be the letter "S," which in the Morse code was three dots. The sound, if it reached Newfoundland at all, would be something like: "dit—dit—dit." Each day, for three hours, from 11:30 until 2:30, St. Johns time, Poldhu was to send this signal.

Poldhu went into action. The dynamo whirred and began producing current. An operator pressed down a three-foot-long wooden lever three times. Sparks leaped from the knobs of big Leyden jars, the room flashed with light, and the powerful 20,000-volt current surged up the aerials and went leaping into the ether.

In Newfoundland, Marconi sat with headphones on his ears, waiting for those invisible signals to reach the thin wire dangling from his kite. If all went well, those signals, grown a little weak from the long trip, would travel down the wire to his little glass tube of silver and nickel granules. These granules, under the influence of Hertz's waves, would obligingly arrange themselves in order and permit a current to pass into Marconi's headset, giving him three short buzzes.

For an hour Marconi listened in patience, but nothing happened. We know now that Marconi didn't pick the best time of the day. Night would have been better, because wireless signals travel farther at night, when they are not weakened by daylight. We know that his sending current was not of the best kind. It was a spark, which started out strong and died away. One day, it would be replaced by a steadier kind of current that maintained its strength evenly, but Marconi had no such current then. Nor was his detector, the little glass tube that he had adapted from Branly's coherer, the most sensitive of detectors. Far better ones were to be invented, some day.

But luck was with Marconi. The variable and capricious conditions that govern radio reception must have improved, because at



Marconi's "Flying Antenna," at Newfoundland. The kite (left) was used to raise the aerial four hundred feet into the air. *Photo from Monkemeyer Press Photo Service.*

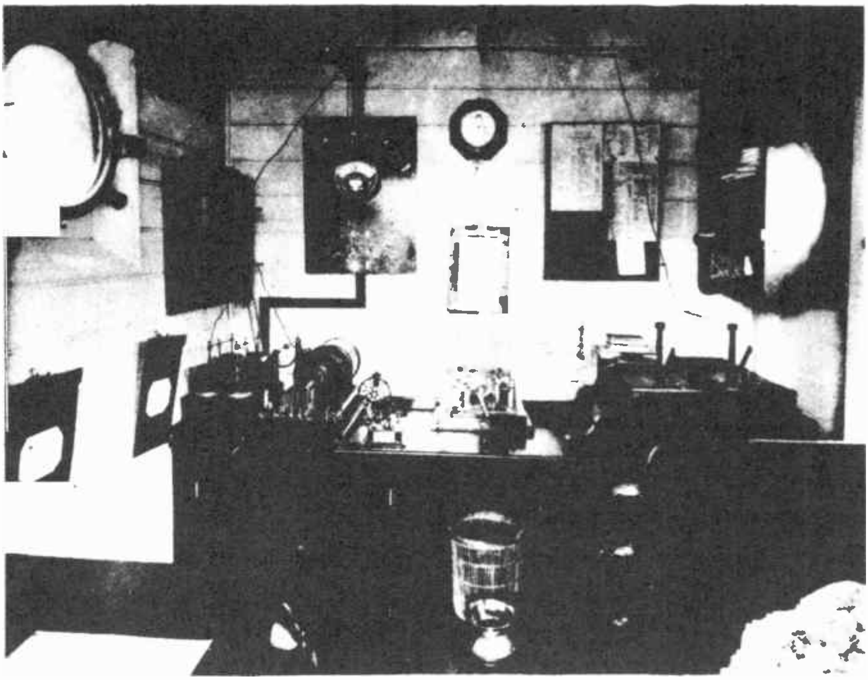
12:30 Marconi heard three faint clicks. He handed the headphones to his assistant, and said:

"Can you hear anything, Mr. Kemp?"

Mr. Kemp heard them, and for the first time in history messages had been sent without wires across an ocean. Starting from a point in Cornwall they had broadened out in all directions, growing weaker as they traveled, until they found a thin wire hanging from a kite in Newfoundland, 1700 miles away.

Not until the next day, Friday, December 13, after he had again heard the signals, did Marconi announce his triumph to the world. People everywhere were thrilled. Sir Oliver Lodge felt that the world was on the verge of some great universal discovery that would unlock the treasure chest of all knowledge.

But the Anglo-American Cable Company wasn't exactly



Wireless room on the *Republic*, from which the first SOS was sent out. *Photo by Brown Brothers.*

pleased. This firm, which had exclusive rights for telegraphic service from Newfoundland to all points outside, was afraid of this upstart competitor. Its directors warned Marconi to stay out. Rather than go to court, the twenty-seven-year-old inventor decided to establish his first New World station at Glace Bay, Nova Scotia.

From this first transatlantic conquest, the growth of international wireless was rapid. Small stations with high antennae became a familiar sight along many coasts. Ships were equipped with wireless rooms and operators were added to their crews, and space messages were to save lives in such sea disasters as the sinking of the *Republic* and the *Titanic*.

Marconi lived to see wireless grow into radio, and radio grow into the worldwide broadcasting of voice and music. He bought a yacht that he named *Elettra* and used it for a floating laboratory. He was decorated and honored by many governments and universities.

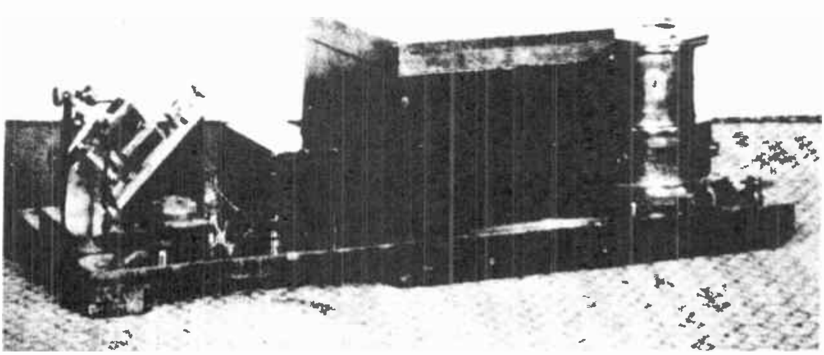
Through it all he remained quiet and unassuming, never more distressed than when his Poldhu wireless blew down, never more triumphant than when, in Newfoundland, he handed the earphones to his assistant to listen to the first transatlantic signal, merely saying: "Can you hear anything, Mr. Kemp?"

Marconi died in 1937, leaving behind him a world of radio, and instant worldwide communication.

But at the time his wireless sets were being installed in ships, early in the century, voice radio was impossible. Before there could be such a thing as broadcasting, new discoveries would have to be made. Marconi's equipment was able to send and receive the simple dots and dashes of the Morse code. A short burst of power sufficed for a dot, and a longer burst of power for a dash.

Before the inflections of voice and the tones of music could be transmitted through the ether, something besides intermittent bursts of power would be needed. There would have to be a constant, uniform stream of ether waves.

Transmitters capable of carrying voice and detectors capable of capturing it would have to be invented.



Marconi coherer, the first detector. About 1898. *Courtesy of Radio Corporation of America.*

3

The Human Voice Takes Wings

THE Old World gave us wireless.

The New World gave us radio.

The first man ever to impress the human voice on ether waves was Canadian-born Reginald A. Fessenden.

In the late nineties, when Marconi was stretching his dot-dash wireless signals to ten, fifteen, and twenty miles, the tall, rugged Fessenden was professor of electrical engineering at Western University in Pittsburgh. He had never had a technical education himself, but in the library of Bishop's College in Lennoxville, Quebec, he had come across the scientific magazines in the college reading room, and these had turned his mind toward electricity. After college, as a young man of twenty, he had worked in Edison's laboratory in Llewellyn Park, New Jersey. To make up for his lack of engineering training, he had spent his nights studying electrical theory and analytical mechanics. So thoroughly did he educate himself that he was to become one of our foremost electrical inventors.

Fessenden's contribution to radio was two-fold. First, he knew that if anything beside dot-dash was to be transmitted through space, something better than a spark transmitter would be

Reginald A. Fessenden, the first man to transmit the human voice by wireless. *Photo by Brown Brothers.*

needed. To understand this, we must discuss for a moment just what sets the ether in motion.

The current that performs this service is not direct current, but alternating. In all radio transmission, alternating current is the carrier.

A spark, leaping across a gap, creates alternating current, but it is of the unsteady kind. It starts with a surge and dies away. Engineers call it a "damped" wave. It is a poor chariot for conveying speech.

We're all familiar with the alternating current in our electric lights at home. We know that it alternates (call it oscillates if you wish), or goes from negative to positive and back again 120 times per second.

Fessenden wanted this kind of a current for his radio transmitter, but he wanted it much faster. Hertzian waves are oscillations, but they're extremely rapid. They alternate from negative to positive twenty thousand to many billions of times per second.

So, if Fessenden was to find the kind of current that would carry speech, he had to get away from spark. He had to have a current that would oscillate rapidly and steadily.

He set his sights at 100,000 oscillations per second. He wanted to build a generator that would produce this kind of current at a steady, even pace. He planned to connect this generator to the antennae, let the rapidly vibrating current climb the wires and leap into the ether. Given this kind of horse—strong and constant and swift—he felt sure that speech could be carried through the ether without the distortions and fading that a spark transmitter would cause.

The trouble was, that no such generator—or alternator—had ever been built. The fastest alternator of the day would only produce around 5,000 oscillations per second. Much of Fessenden's labor was to be devoted to the production of the kind of current he wanted. It was to be heart-breaking, disappointing, tireless labor.

Fessenden's second contribution to radio was at the receiving end. He wanted to improve on the crude coherer. He wanted a sensitive detector that would snare Hertzian waves out of the air and so modify them that the tiny speech currents would be made manifest in a telephone receiver.

Fessenden, then, was the persistent pioneer who was to start wireless on its way from telegraphy to telephony.

He achieved his detector first. While still at Western University he did much experimenting with many kinds of detectors, and he finally perfected a device that he called a "liquid barretter." This was a glass bulb containing a wire. The end of the wire was in contact with a solution of nitric acid. It was the acid that had the ability to so modify the rapidly vibrating signals from the ether that speech would come through.

This was not to be the final detector. A vastly better one was to come along later. But the liquid barretter was much the most sensitive device to date. Part of Fessenden's battle was won.

His struggle for a sending current was much sterner. By this time his devotion to wireless resulted in an appointment as wireless research head for the United States Weather Bureau. He left Pittsburgh and went to Cobb Island, Maryland, where he set up experimental stations.

There, he won his first minor victory in the sending of speech. He transmitted voice between two fifty-foot masts a mile apart. This was in 1900, just five years after Marconi had sent dot-dash a distance of a mile on his father's estate in Italy.

The result was imperfect. A loud buzzing noise almost drowned out the voice. His transmitter was of the spark variety. But men, listening keenly with earphones at the receiving end, distinctly heard the inflections of voice. For the first time, human speech had been sent through space, without wires.

By this time, Fessenden's fame was such that a company was formed around him called the National Electric Signaling Company. Its twin objectives were to compete for the rapidly growing wireless business, as well as to develop wireless telephony.

So, with ample financial backing, Fessenden renewed his quest for a high-speed alternator. He went to various companies. He suggested his own designs and modified the designs of others. He tore down and build up, only to meet with one disappointment after another.

Meanwhile his company had built a wireless station at Brant Rock, Massachusetts, and another at Machrihanish, Scotland, and on January 1, 1906, conducted a two-way exchange of dot-dash messages across the seas. This was the first conquest of the ocean since Marconi. All this time, Fessenden's liquid barretter was being installed on many ships in place of the coherer, and the stage was being set for the first actual broadcast in history.

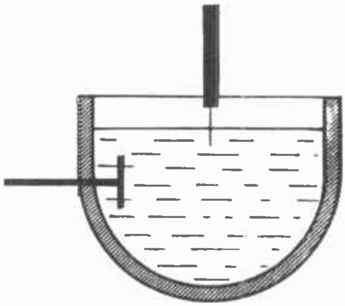
Finally Fessenden's hunt for a sending current was rewarded with partial success. In the fall of 1906, General Electric delivered to Brant Rock an alternator capable of delivering 50,000 cycles. This was just half what Fessenden wanted, but in the light of his previous disappointments he was content. The machine was the work of Dr. Ernst F. W. Alexanderson.

With this new kind of sending current, Fessenden experimented with wireless telephony between Brant Rock and Plymouth, eleven miles away. He also sent conversations to a radio-equipped fishing schooner a dozen miles offshore.

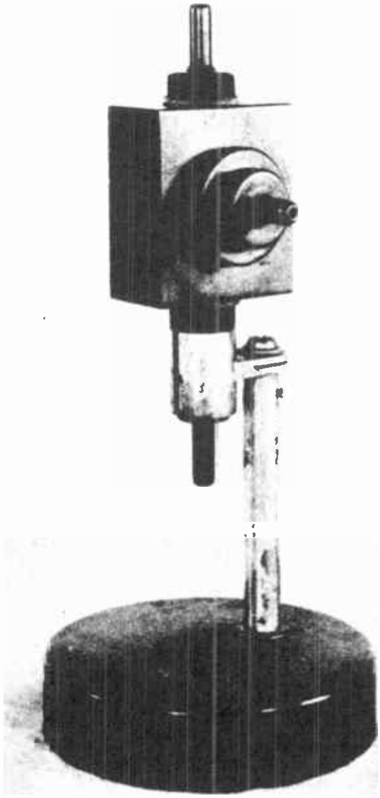
By December, 1906, he felt that his equipment was reliable enough for a demonstration. He sent a letter to the editors of a telephone journal and such foremost scientists as Dr. A. E. Kennelly and Professor Elihu Thompson, inviting them to hear a demonstration of wireless telephony.

The demonstration—the first real broadcast in history—took place on Christmas Eve. In the small station at Brant Rock notable men gathered, eager and interested, but entertaining a healthy doubt.

In the small room they saw Alexanderson's alternator. The microphone was an ordinary telephone transmitter. It would turn



Fessenden's liquid barretter. This first sensitive detector of radio signals consisted of a fine platinum wire dipped into a dilute acid solution. It could reduce the high-frequency radio waves to low-frequency waves within the range of the ear.



A later Fessenden barretter. *National Electric Signaling Company Photo, Courtesy of RCA.*

Fessenden's voice into electrical signals and these signals, borne on his steady, swiftly oscillating current, would travel in widening waves to the world's first broadcast audience.

This audience, Fessenden knew, would be small. Here and there, ships at sea were equipped with his liquid barretter. In radio rooms, behind the bridges of freighters and liners, radiomen would be sitting with headsets covering their ears. Here and there, on land, were amateurs at their homemade receivers, listening for anything that might arrive through the ether. Most of them would expect nothing but Morse code signals from ships and shore stations.

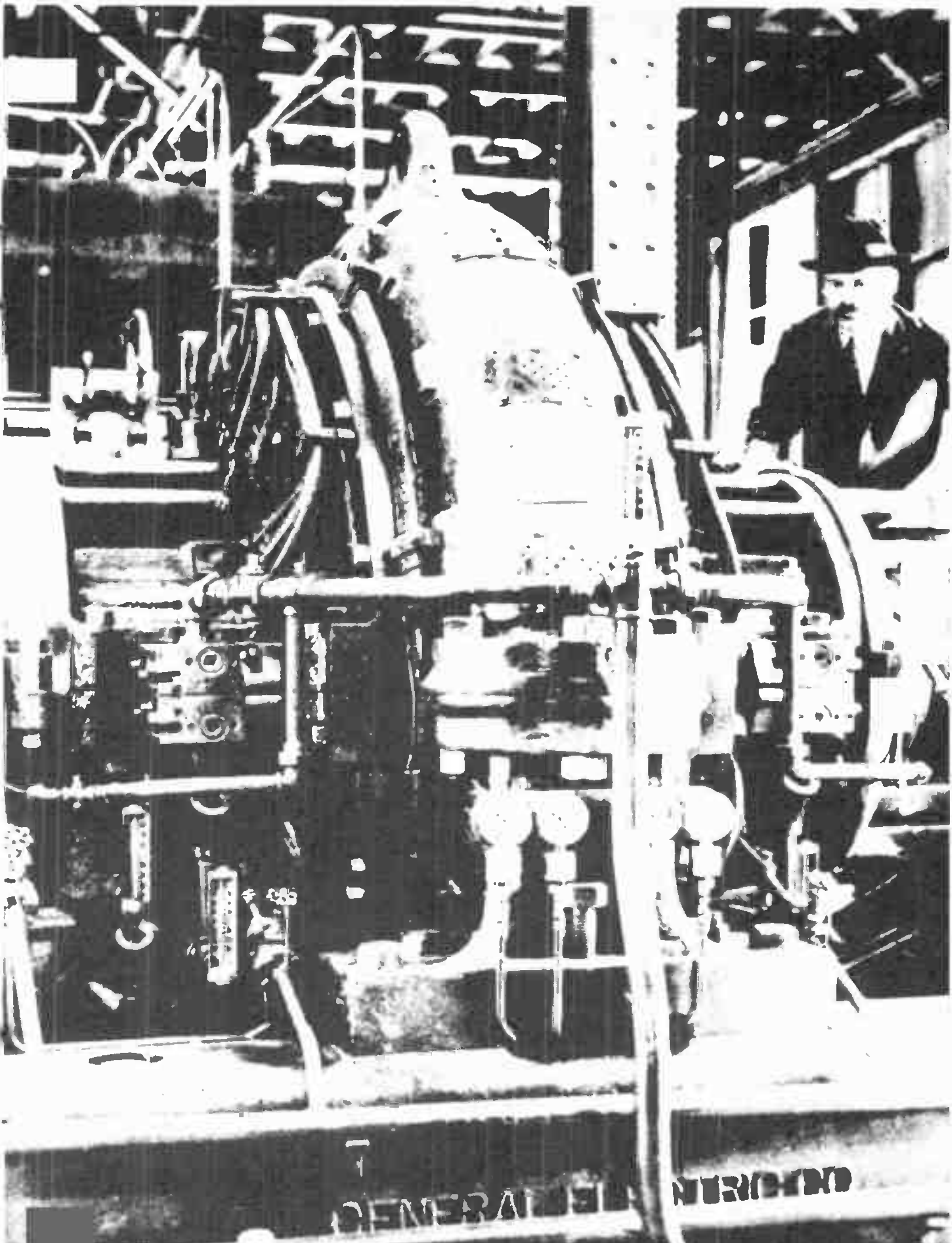
Early in the evening, Fessenden began his program by sending out the "CQ CQ" of the Morse code. Wireless operators at sea and on shore, hearing the familiar buzz, listened for the code that normally would follow. But something far different from code was to come through.

The tall scientist at Brant Rock began speaking into his microphone. He gave a brief talk, identifying himself and telling what was to follow. When he had finished, an assistant started up a phonograph record of Handel's Largo, aiming the horn at the telephone transmitter.

A violin solo played by Fessenden himself followed—Gounod's "O, Holy Night." Says Fessenden: "I played it through, then sang one verse, though the singing wasn't very good." The program ended with the words, "Glory to God in the highest and on earth peace and good will to men."

A few of the intended listeners had been warned, and these men weren't surprised. But the others, those who expected perhaps a distress call in dot-dash, were unnerved. The sound of voices and music, coming faintly and clearly to them through their earphones, was an uncanny experience.

A man's voice. Music! The sound of a violin! These things, arriving out of invisible space, were a miracle. Operators, forgetting rank and salutation, yelled to ship's officers to come and lis-



Dr. Ernst Alexanderson watching the operation of his alternator, which was capable of creati
the rapidly oscillating Hertzian waves. *Photo by Brown Brothers.*

ten. Headsets were passed from man to man. Little groups stood crowded around radio tables, silent and awed.

That first broadcast of history, a typical little variety show of the air, was received hundreds of miles from Brant Rock. Letters trickled in to Fessenden reporting the reception of his program. Encouraged by his success, the scientist repeated his broadcast on New Year's Eve, and in the following months succeeded in establishing wireless telephony between Brant Rock and New York, about two hundred miles distant; and later with Washington, five hundred miles away.

Fessenden wasn't thinking of any such a strange art as broadcasting at that time. He was thinking only of establishing a telephone system without wires. He visualized two-way conversations for a fee. Perhaps he thought the telephone company would find a use for his service between island and mainland, or between wilderness points where it was inconvenient to lay wires. Or as a sort of branch service leading off from the main routes of the telephone lines. He had no idea of establishing a studio where a few people would entertain and millions would listen. Nobody at the time had any such notion.

It's a little strange, when you think of it, that after such a promising start, broadcasting was to wait fourteen years more before making its bow.

But the fact is that Fessenden's sending current was still inadequate to the job. His alternator did this: it created a carrier wave with a frequency of 50,000. Perhaps at times he achieved as high as 80,000 oscillations per second.

But if you will look at the newspaper listing of stations in your locality, you will notice that one station is rated, say, at 750 kilocycles. This means that the carrier wave of that station oscillates not a mere 80,000 times per second, but no less than 750,000 times! Farther down the list you'll find a station operating at 1400 kilocycles. Its carrier wave vibrates at 1,400,000 times per second.

Each station has a different "wave length" or "frequency," which permits all of them to broadcast at the same time without interfering with each other.

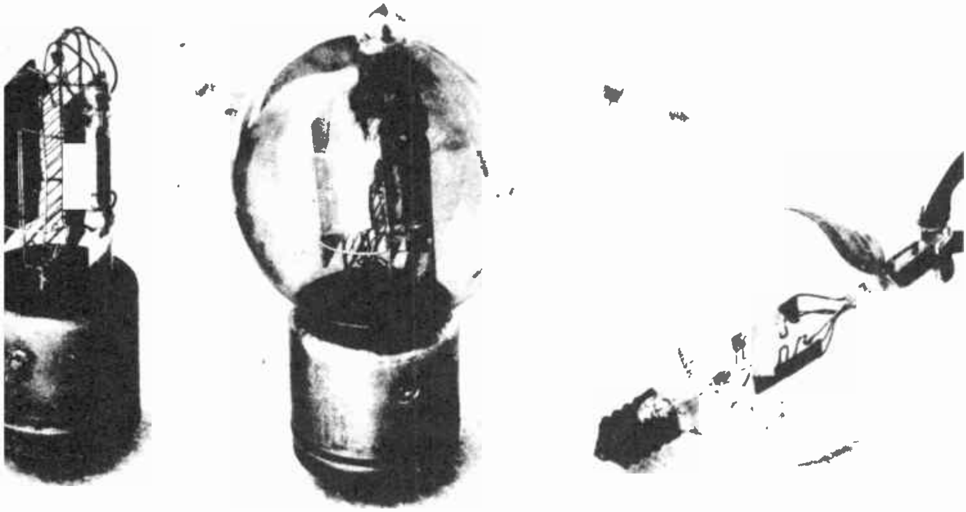
Nobody in the wireless world of 1906 had equipment that would conveniently create currents of this kind. Some new device had to come along. A key mechanism that would obligingly generate waves of any frequency desired.

The alternator wouldn't do it. There is a limit to which mechanical rotating devices can be made to whirl. There was nothing on the horizon that would do it, as far as anybody knew then.

Fessenden's great service to radio was in outlining what needed to be done before voice could be transmitted. He had created a sensitive detector, capable of reproducing voice tones. He had made a start toward developing a steady, high-frequency transmitting current. He had gone as far as he could.

Until a magic something came along, broadcasting would have to wait.

And that brings us to the story of Lee DeForest.



The Lee DeForest audion tubes. *Photo by Brown Brothers.*

4 · Radio's Magic Tube Appears

THE little device that was to act not only as the ideal receiver but also the perfect transmitter for voice is known as the audion, or the vacuum tube. This simple combination of glass and wire, a literal jack-of-all-trades of radio, was developed by Lee De-Forest.

DeForest was born in Council Bluffs, Iowa, August 26, 1873. When he was six years old, his father, a Congregational minister, was made president of a school for Negroes in Talladega, Alabama. Young Lee, a Northern boy in the South during the bitter generation following the War Between the States, was both taunted and shunned by white boys of the town. Left to himself, he turned to "invention." He "invented" model windmills, steamships, even an airship. He made a crude play locomotive out of a barrel, and he even constructed a farm gate that a driver could open without getting down from his wagon.

His father wanted him to become a minister, but Lee was eager to be nothing less than a great scientist. He wanted to keep on "inventing." He was a strange youngster, fiery, poetic, eager for fame and riches. The world was full of new and exciting things. Railroads. Gas engines. Dynamos, telephones, electric lights. DeForest was thirteen when Hertz demonstrated his ether waves. By the time he was ready for college, scientists everywhere were experimenting with these waves. Lee wanted to be in the forefront of the marvelous scientific age, a leader in the parade.

Lee won his point with the family, and after working his way through Mount Hermon Preparatory School in Massachusetts, entered the Sheffield Scientific School in Yale.

His grim determination to let nothing swerve him from his chosen career showed itself in 1896, during his senior year at Yale. That year, his father died from a fall. His mother came to New Haven to run a rooming house for students, and Lee was faced with the decision of whether to get a job to support his mother or take postgraduate work. After a night or two of struggle, he decided, with his mother's consent and encouragement, to continue his education.

In his graduate work, DeForest specialized in wireless waves. The years immediately following graduation were up-and-down years for the ambitious young doctor of science. He held a job with Western Electric in Chicago at eight dollars a week, and taught school part time. At night, in lunch hours, and even during his working hours, he fought with the problems of wireless. At that time Marconi was making his fight for distance, and DeForest knew, just as Fessenden knew, that wireless needed a better detector than the Branly coherer.

DeForest developed an arrangement called a "responder," and later another detector involving the use of a liquid, much like Fessenden's liquid barretter. In those days men with money were eager to invest in wireless. It was an era of wireless promotion. So, in the first year of the new century the DeForest Wireless Telegraph Company was formed.

Like all companies that attempted to compete with Marconi, this one was due to fail. After some four or five years of disappointing progress, a new kind of detector called the crystal detector arrived on the radio scene. DeForest's backers decided to have done with DeForest's inventions. They adopted the crystal detector and got rid of DeForest.

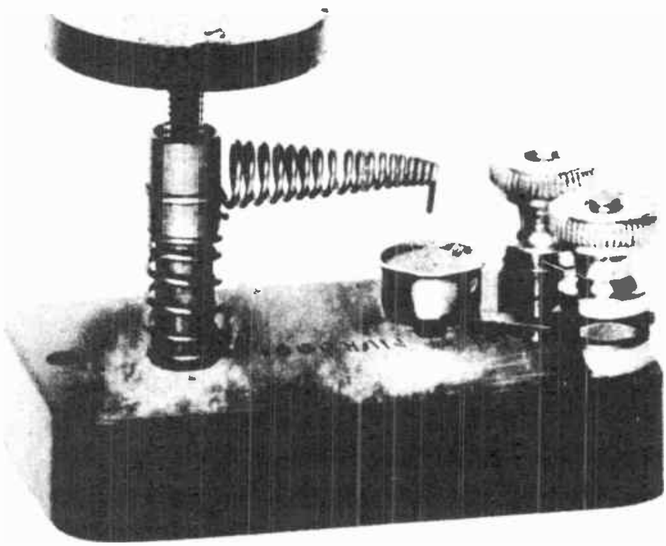
The crystal detector was a sort of magic stone. In 1906, General H. C. Dunwoody of the United States Army discovered that carborundum, when connected to an aerial, had the ability to catch silent signals out of the air and convert them into sound. At the same time G. W. Pickard learned that other substances such as galena and silicon could do the same thing.

For many years, amateurs were to use these small pieces of crystal for their radio sets. They would move the point of a wire over the surface of the stone until they found exactly that part of the surface that would give the clearest signals. Well into the 1920's, thousands of amateurs relied on crystal sets. Students would study Mathematics and English in college, wearing earphones, while faint signals from the ether scurried down their aerials, passed through their crystals, and were translated miraculously into the tiny but clear tones of a piano or an orchestra.

The crystal was never to be entirely satisfactory because there was no feasible way to amplify or strengthen the signals that came through it. Yet its arrival was providential because it set the footloose DeForest on a new line of study.

The thirty-three-year-old scientist fitted up a small laboratory and went hunting again for a better detector, but this time along a different path.

Two years before, in England, J. Ambrose Fleming had patented a detector that came to be called the Fleming valve. It looked very much like an ordinary electric light bulb. It contained a wire filament that glowed and became hot when the switch was turned on, like any light.



An early crystal detector. *Courtesy of Radio Corporation of America.*

But in addition to a filament, the bulb contained a metal plate. Many years before, Thomas Edison had discovered that some kind of an unknown current would pass from the filament of his early lamps to the side of the glass, darkening it. He didn't understand what it could be, so out of curiosity he sealed in a small metal plate. When he turned on the light and the filament began to glow, his gauges showed that current was passing through the vacuum inside his bulb from the negative filament to the positive plate.

This was something new. As far as he knew, the current should merely travel around the filament and out again. Instead, a side current of some kind was leaping across space.

Edison couldn't define it, because the science of electricity wasn't far enough advanced. Later, when experimenters discovered that an electric current was a stream of fast-traveling particles called electrons, each electron 1/1800 the mass of a hydrogen atom, they knew what happened inside Edison's bulb. They knew that the hot metal was throwing off a stream of electrons, and that this stream was traveling over to the plate.

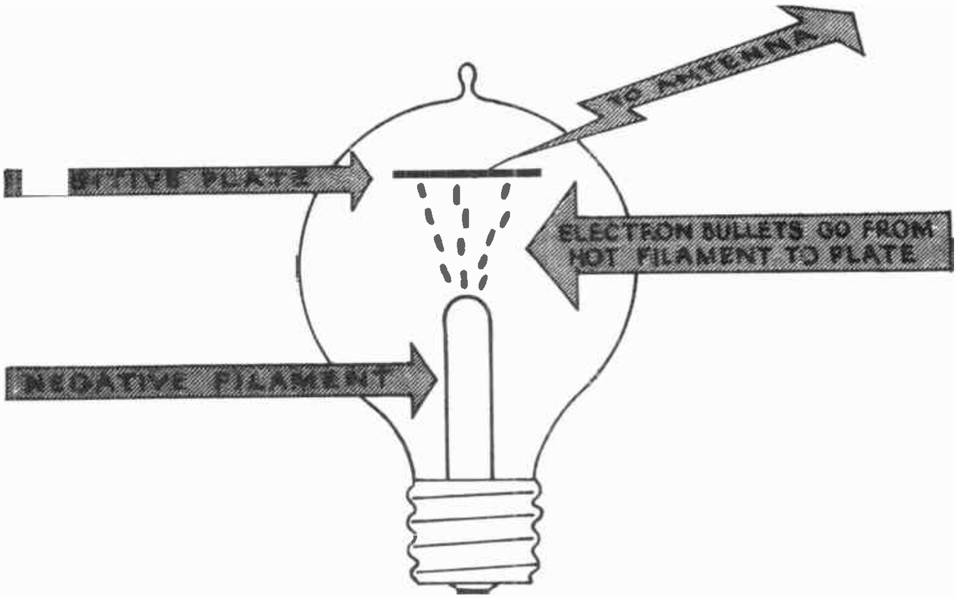
When wireless came along, Fleming wondered if this Edison bulb couldn't be used to detect wireless signals. So he attached the plate to an aerial and the filament to the ground. His hopes were realized. The convenient little glass tube performed as he hoped it would. (See diagram for explanation.) He called it a "valve" because by means of the tube, the waves from the ether had the power to control a local current, just as a tap controls the water in a pipe.

This is the detector that DeForest turned to in 1906. It wasn't good enough as it stood, so DeForest set about improving it.

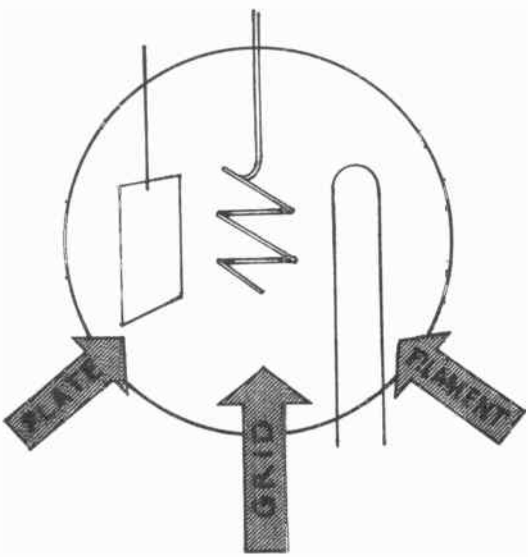
He tried various things, but one day in December he bent a piece of wire into the shape of a tiny gridiron and inserted it in the bulb as a third element. This "grid" he attached to the antenna. So now he had, inside his glass tube, a negative filament that became hot and threw off electrons. He had a positive plate on the receiving end. And he had a "grid" in between.

This little grid acted as a sensitive control of the stream of electrons going from filament to plate. The grid took its orders from the antenna. It imparted these orders to the tube current. No matter how strong the tube current, the sensitive grid could control it.

DeForest called his invention the audion and applied for a patent on it January 29, 1907. When the talents of the audion were fully explored, here's what men discovered it could do:



Fleming's valve. Fleming adapted Edison's bulb to act as a detector of radio signals. Edison had learned that a hot filament throws off a stream of electrons to a plate sealed inside a bulb. So Fleming attached the plate to the antenna. Thus the alternating impulses of the Hertzian waves (successive positive and negative charges) came down the wire to the plate inside the bulb. The negative Hertzian charges tended to stop the flow from filament to plate. The positive charges increased the flow. Thus the valve eliminated half the charges (the negative), reducing the frequency of the Hertzian waves by half. A bulb that does this is a detector of radio waves. Upon Fleming's adaptation of an old discovery of Edison's, the entire development of modern vacuum tubes and the broadcast industry depended!



DeForest's audion was Fleming's valve with a bent wire, called a "grid," placed between filament and plate. The grid, connected to the aerial, sensitively controlled a current passing from filament to plate.

It could detect radio signals better than any device ever invented.

It could amplify these signals to any volume required, millions of times if necessary.

It could change alternating current to direct current.

It could—and this is most important for the future art of broadcasting—*generate* high-frequency current of the kind needed to agitate the ether.

In Chapter Three we mentioned the kinds of carrier wave used by your local stations—radio waves vibrating with frequencies of 750,000 per second, or 1,400,000 per second. This marvelous tube could generate these frequencies. In fact it could generate frequencies of five or ten millions if necessary.

DeForest's audion does all the above duties for us now. It provides the ether-borne vehicle that brings us all our radio programs. It is found in all our home receivers, detecting these signals, and amplifying them so that they will actuate our loud speakers.

It does more than that. It has found a useful place in talking movies, long-distance telephoning, airport radio beacons, and wirephotos. In fact wherever electric current needs to be sensitively controlled, or amplified, or changed from alternating to direct current, the audion is the vital element. Someone has said that the audion has fathered billions of dollars of new industry and it has only made a start. This is true.

The marvelous abilities of the tube weren't discovered all at once, nor did DeForest himself know what a miracle he had performed. All he knew was that he had a better detector.

The fact that the audion could not only detect radio waves but could also generate them was the work of Edwin H. Armstrong.

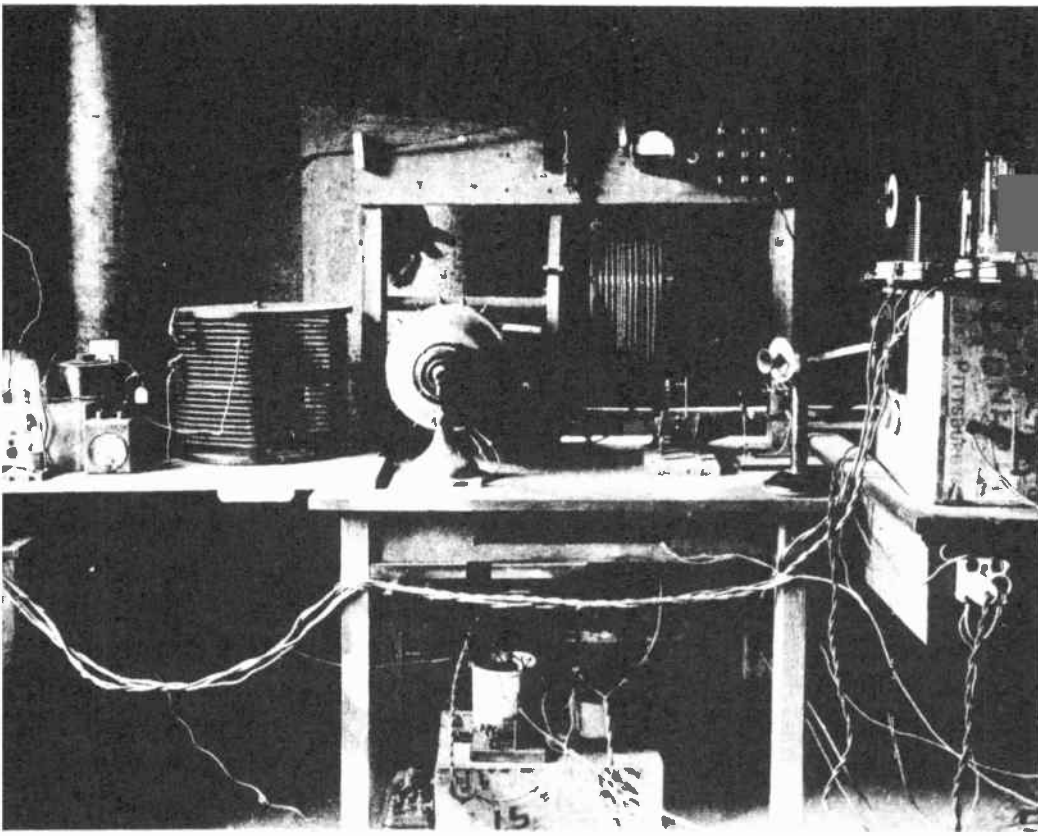
In 1910 Armstrong was a student at Columbia under the noted Professor Michael Pupin. Already, as an amateur tinkering with a homemade radio set, he had hooked up Fleming valves and later DeForest audions. With unusual curiosity and persistence, he tried to discover just how the audion worked. He didn't believe that the inventor himself fully understood it.

While trying various hookups and alterations, he noticed one day a curious whistling noise that made him think that the tube was not only receiving high-frequency waves, but also generating them. Careful experiment proved that he was right. By his discovery, he had revealed the audion as the ideal broadcasting transmitter.

Other men, too, contributed to the perfection of the audion. Dr. H. D. Arnold of the research department of American Telephone and Telegraph Company, and Dr. Irving Langmuir of General Electric worked independently on it, and discovered that the tube would work better in a high vacuum. DeForest had left a certain amount of gas in his audion under the mistaken idea that the gas was necessary to make it function properly. Today, the gas or air is removed. The tubes are vacuum tubes.

DeForest sold his audion to the American Telephone and Telegraph Company in 1913, for $50,000, reserving the right to make and sell them himself. He equipped the United States Navy with the audion for telephoning from ship to ship.

He went to Paris and staged a broadcast from the Eiffel Tower and his voice was heard as far away as Marseilles, a distance of five hundred miles. Back in New York, in 1910, from a little room in the Metropolitan Opera House, he put the famous tenor, Enrico Caruso, on the air, and a scattering of listeners heard it. Amateurs bought the audion and incorporated it into their sets. The stage was slowly getting set for broadcasting.



Station 8XK, the first broadcasting station, in the home of Dr. Frank Conrad in Pittsburgh. Later 8XK became the famous KDKA. *Photo by Brown Brothers.*

5 · Broadcasting Begins

WE begin to see, now, how a new art like broadcasting takes shape. First, there is a scientist like Maxwell to gather the existing knowledge about electricity and organize it into a set of laws. Then a great experimenter like Hertz to test those laws. After that, a whole series of venturesome, resourceful men like Marconi, Fessenden, and DeForest to take hold of a discovery and harness it to the use of mankind.

When World War I came along, the United States was ready for broadcasting. The equipment was far enough advanced so that the voice could be sent and received. There was a growing body of amateurs eager to pick up anything that came to them from the air.

Men's minds, too, began to envision broadcasting. In 1916, a young man named David Sarnoff, a rising executive with the American Marconi Company, proposed to his superiors that regular musical and talking entertainment be given by the company. He felt confident that a "radio music box" could be manufactured for seventy-five dollars, complete with amplifying tubes and a loudspeaking telephone. He was certain that in a few years' time several million of these sets could be sold. Far-seeing men were dimly sensing that something new in public entertainment was just over the horizon.

During the war years, the government had to take all amateurs off the air, since it wasn't advisable to permit irresponsible people with their own transmitters to send out messages that might conflict with Army or Navy wireless messages. Even receiving sets were sealed up for the duration, so that any development toward broadcasting had to wait.

Yet World War I advanced the art of radio. The United States communicated with the American Expeditionary Force in France by means of wireless. Edwin H. Armstrong, who had become an officer with the Signal Corps in France, developed the most sensitive receiver yet invented, in his effort to catch the weak signals of German wireless.

One day a German submarine, its crew dead, was washed up on the beach in England. In the submarine was a German code book, giving the British the ability to translate all German wireless instructions to her fleet. In a German cruiser sunk by the Russians another code book was found. So the British, instead of attempting to prevent German orders by setting up "interference," calmly allowed the enemy to send out messages with utmost freedom—

and then translated those messages to discover the movements of undersea raiders.

After the war, something else happened to set the stage for nation-wide broadcasting. The government didn't like to think of a foreign company having a monopoly on wireless communication. President Wilson and his advisers knew that the Marconi Company, British controlled, might own all facilities for sending space-borne messages.

So, with government urging, the General Electric Company bought out the American branch of the Marconi Company and set up the Radio Corporation of America. Then General Electric's chief rival, the Westinghouse Company of Pittsburgh, bought up all the wireless patents that were still available, and set up its own company to engage in wireless.

Neither company was thinking of broadcasting. They were thinking of code wireless and radio telephony. They were thinking of selling phone calls and messages between private parties.

But sometimes what the managers plan and what the public wants are entirely different. The war produced thousands of radio fans. Operators off ships, wirelessmen in the Signal Corps, discharged from the service, went back to their homemade sets. Some of the venturesome ones built transmitters as well as receivers. Every such amateur sender was a broadcasting station in the making.

Take for instance Lester Spangenberg whose story is told in Alfred P. Morgan's *The Story of Electricity*. After a year as radio expert in the U. S. Navy, Spangenberg set up his own station, W2ZM, in Lakeview, New Jersey. Within reach of his transmitter were several hundred amateurs with receiving sets. He talked to them and they replied with postcards and letters. Early in 1920, entirely for the fun of it, Spangenberg and his friends sent out piano music, phonograph records, and banjo solos. They did this night after night. Their telephone microphone was in the living room near the piano, their transmitter tubes on the second floor, and their aerial on the roof of Spangenberg's home.

Out in Detroit, an amateur sender in 1920 was building up listeners and laying the groundwork for what was to become WWJ, the first newspaper-owned radio station.

The most important step came in East Pittsburgh, where the Westinghouse Company was doing laboratory work in telephony. The man in charge of this work was Dr. Frank Conrad.

Dr. Conrad set up one station at the East Pittsburgh plant, and another in the garage of his home, several miles away. Between the two he sent code messages and voice conversations. His two sons, Francis and Crawford, helped him.

As we have stated, Conrad and his chiefs weren't trying to develop broadcasting. Westinghouse intended to inaugurate a regular service from shore to ships, whereby ships would get the day-by-day news of the world. This, the company thought, might yield enough revenue to justify money spent in experimentation.

So Dr. Conrad and his helpers talked at one station and listened at the other, changed hookups, redesigned parts, and did all the things experimenters do to improve their equipment. Letters came in from amateurs in the Pittsburgh area. Some of these writers asked Dr. Conrad to go on the air at regular intervals, so that they would know when to listen. Because their reports were valuable to him, he promised to broadcast for an hour on Wednesday and Saturday evenings, starting at 7:30.

Mostly he played phonograph music. Now and then he gave out baseball scores and newspaper headlines. His sons brought in neighborhood talent to fill the time with piano music, songs, and recitations. Experimental Station 8XK was building an audience.

In the summer of 1920, a Pittsburgh department store offered ready-built receiving sets to people interested in listening to Dr. Conrad's broadcasts. With the publication of this advertisement, the Westinghouse officials began to see which way the wind was blowing.

Harry P. Davis, vice-president of the company, realized suddenly that radio wasn't a matter for private conversations. Rather it was a way of spreading publicity from a single point to a wide audience. It was a means of tossing out news or entertainment in

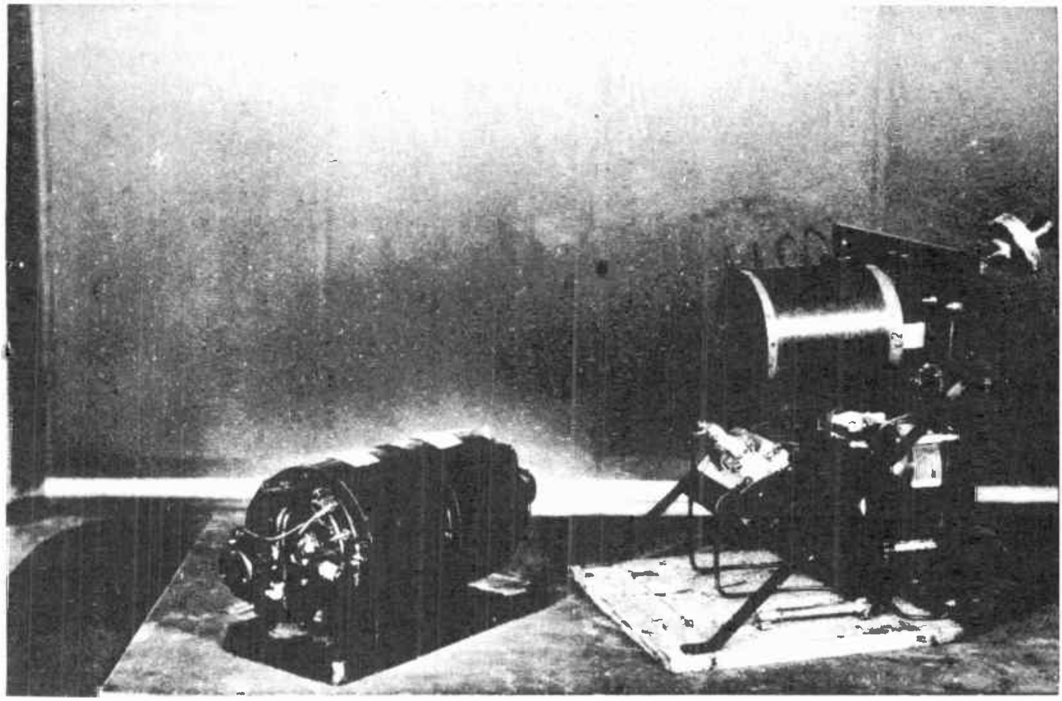
The first important broadcast: station KDKA reporting the Harding-Cox election returns, November 2, 1920. *Courtesy of Westinghouse Electric & Manufacturing Company.*

all directions, to anyone who would listen. And judging by the demand for radio parts, many people wanted to listen.

So Mr. Davis called a meeting of department heads and proposed that Westinghouse broadcast the returns of the 1920 Presidential election. Station 8XK went to Washington for a license and became KDKA. A shack was erected on the roof of the factory's tallest building. Inside were the transmitter equipped with a half dozen DeForest tubes to provide the radio waves, and a telephone mouthpiece for microphone.

The company hastily built and distributed inexpensive receiving sets to a selected audience. A Pittsburgh newspaper was enrolled to telephone election returns to the studio.

So it was that on November 2, 1920, for the first time in history, men and women gathered round radio sets and listened to a radio announcer giving out election bulletins. Out of invisible space came the returns from Maine and California, telling that Warren G. Harding was defeating Governor Cox of Ohio for the presidency of the United States. Probably somewhere between five hundred and a thousand listeners heard this first important radio program. The broadcasting era was begun.



A small generator and a transmitter mounted on a board. That was enough, in the early 1920's. Compare this with the equipment of a broadcasting station today! *Courtesy of The Detroit News.*

6 · Broadcasting Grows

IMMEDIATELY after the election broadcast of November 2, 1920, KDKA established a one-hour-a-day schedule from 8:30 to 9:30 in the evening.

For a while, the chief program item was phonograph music. Those first audiences weren't particular. Anything that came through the air was fine. But as spring, 1921, approached, KDKA decided to improve its programs by broadcasting the company band. Their first concerts were held in an auditorium, but fans complained that the reception wasn't good. There were echoes and reverberations. Since the weather was now becoming warm, the band was moved to a factory roof and the unpleasant noises disappeared.

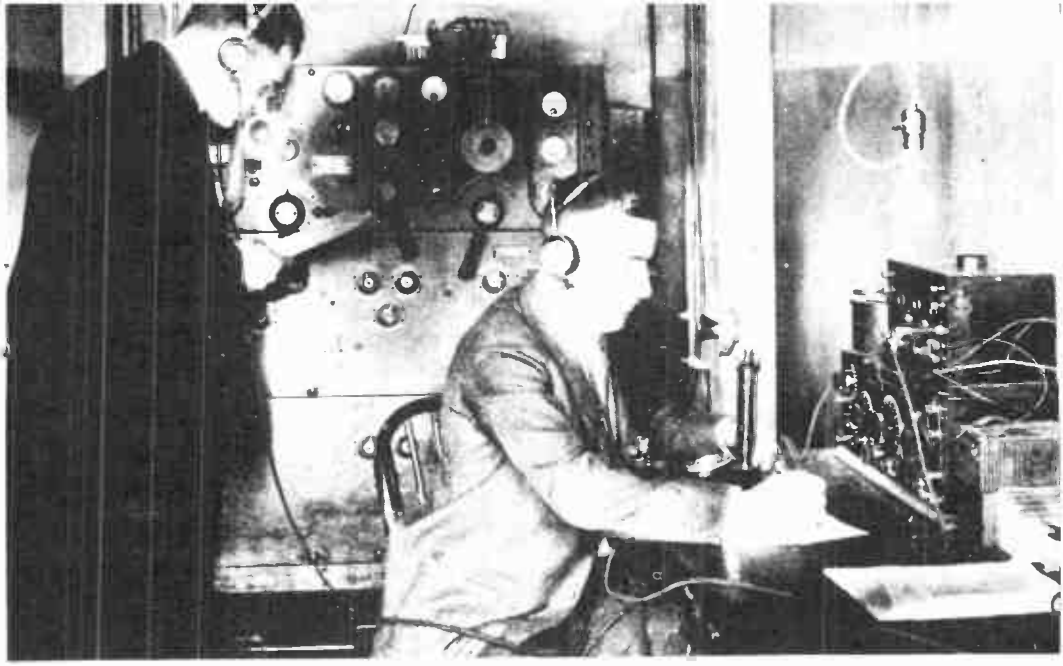
The rains came and the station pitched a tent, and the reception was even better. One day a storm blew the tent down, and the band was faced with the necessity of going back to a hall. But since a hall had already proved to be unsatisfactory, the resourceful managers pitched a tent inside one of the largest rooms available. The result was good.

Eventually, to duplicate the indoor tent, KDKA built a studio and lined it with burlap. Groping in the dark, the pioneers were arriving at the modern broadcasting studio with its walls specially designed to prevent echoes and give clear acoustics.

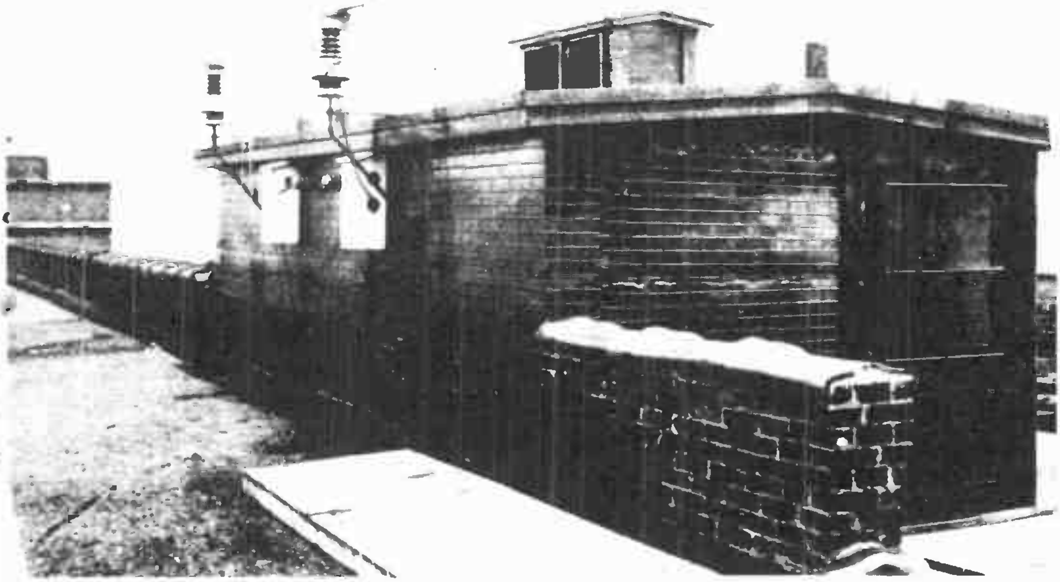
In its first few months of operation, KDKA pioneered another type of program. They staged broadcasts from the Calvary Episcopal Church of Pittsburgh. Three microphones were placed in the auditorium for preacher, choir, and organ, and the result was highly satisfactory. Thus the first broadcast originating outside a studio was held.

For many months, KDKA had the field to itself, but in the fall of 1921 other stations began to appear. WJZ, a Westinghouse station, went on the air from Newark, New Jersey, on October 1, 1921. Another Westinghouse station, WBZ, started up almost exactly the same time in Springfield, Massachusetts. In New York the Radio Corporation of America obtained a license for Station WDY, October 1, 1921, and began broadcasting the January following.

Before these full-fledged stations came into existence, however, RCA established a station for a single day, for the purpose of broadcasting the heavyweight boxing match between Jack Dempsey and Georges Carpentier on July 2, 1921. David Sarnoff, now general manager of the RCA, called on Major J. Andrew White, editor of *Wireless Age,* to conduct the broadcast.



RCA's first venture in broadcasting: station WJZ was established for a single day, July 2, 1921, in Hoboken, New Jersey. *Courtesy of Radio Corporation of America.*



WBZ in Springfield, Massachusetts, was another of the very early broadcasting stations. *Courtesy of Radio Corporation of America.*

Major White and his assistants worked fast. The fight was to be held in Jersey City, so they appropriated a nearby shack belonging to the Lackawanna Railroad for their transmitting station. They worked all night, until early dawn, to get their equipment ready.

Then Major White and one man proceeded to the outdoor arena, to set up their microphone. Their work done, they sat through the early hours of the morning in a drizzling rain, getting soaked to the skin. They had nothing to eat. They had given up their tickets at the gate and didn't want to take a chance on leaving the arena.

Finally, after endless hours, the fight started and Major White began his blow-by-blow description. Word came from the transmitting station that everything was all right. The broadcast was "coming through." It almost didn't. The tubes at the transmitting shack became overheated. One of them exploded and had to be replaced. But something like two hundred thousand people heard the broadcast. Radio's audience was growing.

The first broadcast of a World Series was given by WJZ in October, 1921. Out at the park, a sports writer watched the game and telephoned a play-by-play description to the studio. There an announcer received the account and relayed it over the microphone in his own words. To give the audience the impression that the broadcast was coming directly from the park, the announcer had placed a group of factory workers on the roof outside the studio window, to cheer every time the announcer signaled. To imitate the crack of bat meeting ball, the announcer broke a match stick close to the microphone. In this way, it seems, sound effects were born.

As might be expected, those first stations were small affairs. KDKA began its existence in a wood shack and a tent. The Newark station, WJZ, was installed in a part of the ladies' rest room at Westinghouse's eastern factory. It was just about the size of a small living room. Microphones and a switchboard were installed

A WORLD EVENT
—A CALL FOR YOU

Amateur Radio Will Earn a New Place in History on July 2nd.

YOU'LL BE NEEDED! YOU ARE WANTED!

The greatest international sporting event in the history of the world, the Dempsey-Carpentier boxing match on July 2nd, will be voice-broadcasted from the ringside by radiophone on the largest scale ever attempted.

The co-operation of amateur radio operators has been provided for and is required to make the unprecedented undertaking successful.

Through the courtesy of Tex Rickard, promoter of the big fight, voice-broadcasting of the event is to be the means of materially aiding the work of the American Committee for Devastated France and also the Navy Club of the United States. These organizations will share equally in the contributions secured by large gatherings in theatres, halls and other places. The amateur radio operators of the country are to be the connecting link between the voice in the air and these audiences. There are no restrictions. Any amateur who is skilled in reception is eligible, whether or not he is a member of any organization.

Will you help?

Tex Rickard believes you will, the American Committee for Devastated France believes you will, and the Navy Club believes you will.

Now—once again—will YOU help?

Nearly 200,000 people heard the broadcast of the Dempsey-Carpentier fight on July 2, 1921. *Courtesy of Radio Corporation of America.*

1922 saw the beginning of operatic broadcasting. *Courtesy of National Broadcasting Company.*

and the walls hung with red drapes.

In such settings as these, the operatic artists and Broadway stars of 1922 made their bows over the air. In most instances they performed free of charge, for the novelty of the experience and whatever publicity value there might be.

As programs developed, all the problems of a new industry cropped up. A Metropolitan soprano sang over WJZ and her voice was so loud that the tubes gave signs of blowing out. During her solo the engineer kept moving the microphone farther and farther from her, until she was at one end of the small room and the mike at the other, and still the tubes were in danger. Later, engineers would be able to reduce a singer's volume with the simple turning of a knob, but at that time no such control existed.

On another night, also at WJZ, a pair of cats set up terrific howling outside the studio window, and scores of letters poured

Miss Vaughn de Leath, "The Original Radio Girl." First at WJZ, Newark, New Jersey, 1921.
Courtesy of Radio Corporation of America.

in to the station asking what kind of "interference" noises had afflicted the program. It sounded, said the letters, like an army of cats. To which the station replied that it not only sounded like cats, it was cats.

When RCA established station WDY late in 1921 the studio designers did a little better job of it. The studio was hexagonal in shape, finished in draperies of blue and gold, with Oriental rugs on the floor. Over this station, in 1922, the comedian Eddie Cantor made his radio bow, and like many entertainers who get inspiration from the response of a live audience, he was distressed at the silent impersonal nature of the microphone. He couldn't believe that anyone could actually hear him.

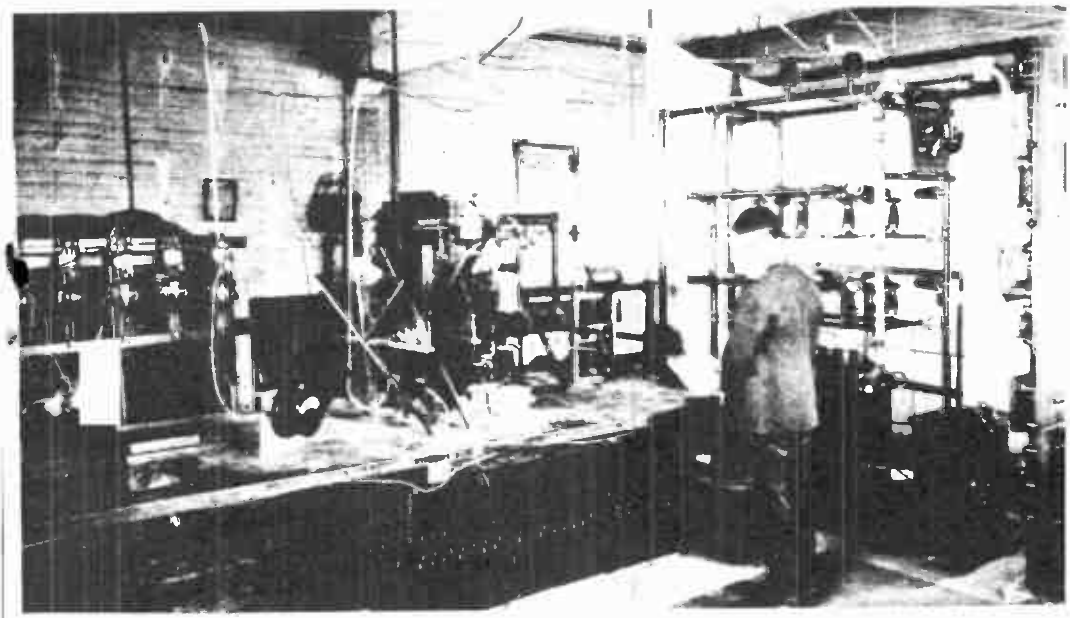
Toward the end of the program he asked his listeners to send in a dime for a certain charity. The shower of dimes that arrived in the mails convinced him that beyond the microphone there was, actually, an audience of listeners.

In February, 1922, Ed Wynn made his air appearance on WJZ, and the lack of an audience so bothered him that he turned to the announcer and said that he couldn't go on. So the announcer hastily rounded up everyone he could find from other parts of the building and crowded them into the studio. Very soon their chuckles and applause restored the comedian's confidence and he finished in triumph.

In February, 1922, KYW started up in Chicago with broadcasts of the Chicago Opera. In the same month, WGY was opened at Schenectady. The number of stations was increasing, the audience was becoming nation-wide, and troubles were arising.

One of the troubles was interference. At that time, most stations were broadcasting on the same wave length, which was around 360 to 400 meters. Wherever two stations close to each other went on the air at the same time, the listeners ran into the annoyance of hearing two programs coming from the loudspeaker in a confusing jumble. To avoid this difficulty stations broadcasting from the same area had to split up the time between them.

Station WDY, Roselle Park, New Jersey, 1921. *Courtesy of Radio Corporation of America.*



Station WGY, Schenectady, New York, 1922. *Courtesy of Radio Corporation of America.*

Later, as DeForest's miracle tube was improved, and government regulation stepped in, stations were to be assigned their own channels, well enough separated so that interference was reduced almost to the vanishing point. Eventually 110 radio channels were to be established.

Another trouble was cost. Stations were spending thousands of dollars a week and there was no return. The only ones making money were the manufacturers of sets and parts. England was to solve this trouble by establishing government-controlled radio and charging an annual fee to every set owner.

The same plan was discussed for the United States, but in the summer of 1922 came a promise of revenue from an entirely different source from that used by England.

Late in August, the American Telephone and Telegraph Company's New York station, WEAF, just opened, learned of a real estate development just getting under way. One of the station's managers suggested to the real estate promoters that a ten-minute radio program might help sell lots.

Five ten-minute programs went on the air, for which the real estate company paid approximately five hundred dollars. The next month several companies bought short programs. The sponsored program thus had its start, in the early days of broadcasting, and station managers began to see how they could pay the enormous costs of running a studio.

Late in 1922, radio took another long step forward. In those days, stations were not connected with each other by telephone lines. A program originated in a small studio and went out into space, to be picked up by anyone within range. Since the transmitting power wasn't great, the range was relatively small. So, if an important broadcast was staged in New York, there was no way for another city to enjoy it. Radio stations were separate little islands, entertaining their own inhabitants.

Then station WEAF in New York wanted to broadcast the Princeton-Chicago football game from Stagg Field, Chicago. The program was successfully carried from Chicago to New York by telephone wire and put on the air from WEAF's transmitter. The date of the historic event was October 28, 1922.

Later that fall Station WNAC in Boston suggested to WEAF in New York that the latter send one of its programs by telephone wire to Boston, so that both stations could broadcast the program simultaneously. This important experiment occurred on January 4, 1923. On that evening WEAF put on the air five minutes of saxophone music. The music traveled to Boston over a telephone wire and took the air at WNAC.

The result of these early attempts was encouraging. Bell Telephone engineers learned that land wires would have to be improved if more linked programs of this kind were to be put on, and they got busy in their laboratories. Two years later, twenty stations were webbed together by telephone wires for a speech by Calvin Coolidge, and network broadcasting came very close to reality.

The early years of the 1920's were the years of a radio boom. In 1920 KDKA was alone in the field. By the end of 1922 there were some six hundred licensed stations. Beginning quietly enough with the election broadcast from East Pittsburgh in November, 1920, the radio age swept the nation like a forest fire.