Recent Developments In Radio

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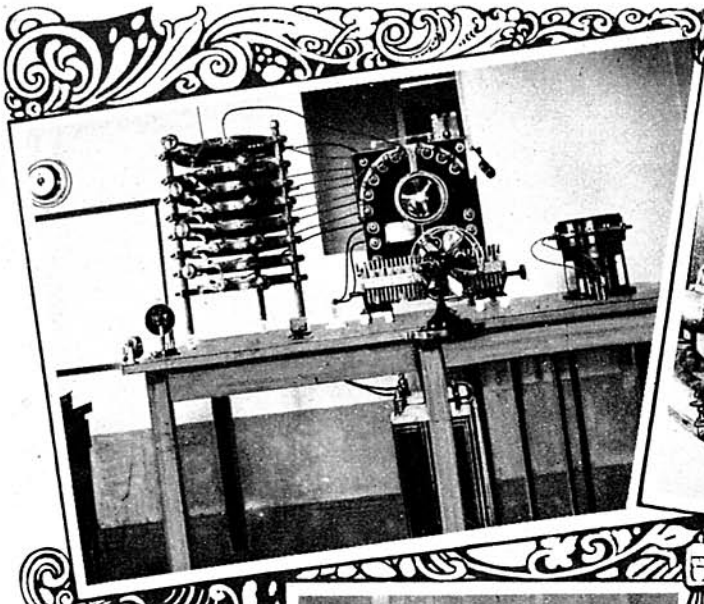
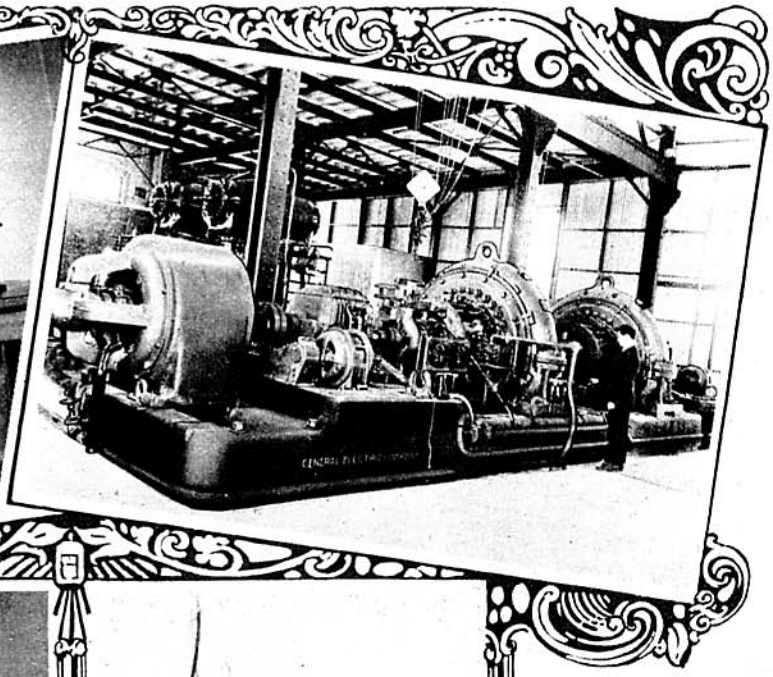
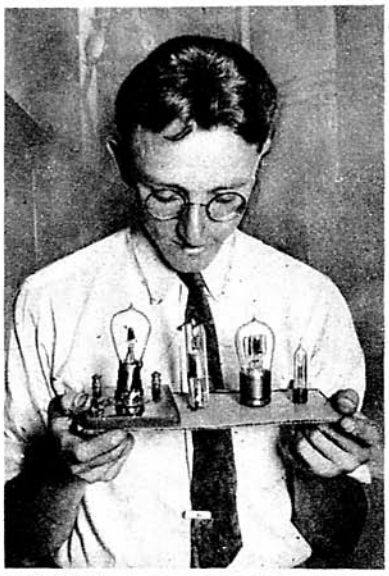
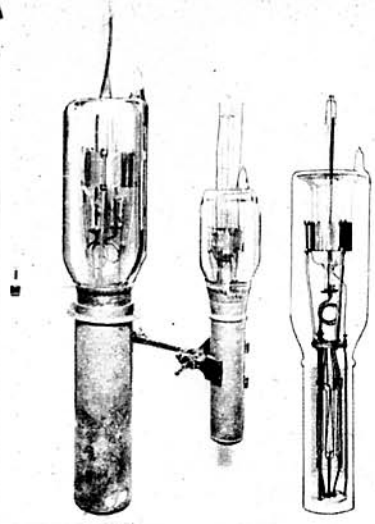




Great Strides Have Been Taken, Particularly in the Design of Vacuum Tubes. The Board Held by the Man Includes, First, the Fleming Two-Element Vacuum Tube Followed by a Three-Element Audiotron, a Radiotron and, Finally, One of the Latest Types of "Peanut Tubes." Further On We Have Three Large Transmitting Tubes of the Type Used Today. The First One Is Of One Hundred Kilo watts Capacity and Two of These Can Do the Same Amount of Work as the Giant Alternator Pictured Directly Above. Note Its Size In Comparison With the Peanut Tube In the Same Photo.





Above, and to the Left, Is a Photo of a Complete 2 K.W. Quenched Spark Transmitter of the Type Used by the Navy. These Are Slowly Giving Way to the More Efficient Vacuum Tube Transmitters. Directly Above is a Photo of the Interior of One of the High-Powered Trans-Atlantic Stations. The Picture Shows mainly the Huge High-Frequency Alternators. These, As Well, Are Being Scrapped To Be Replaced by the Vacuum Tube.

WHEN the average man or woman hears the word "Radio" nowadays, he or she immediately thinks of the radio telephone and its recent phenomenal development. Many laymen are still under the impression that the radiophone is a brand new invention, which has only just been developed in 1921. The average layman also has an idea that the radio telephone and the radio telegraph are entirely different things, and have nothing in common.

In the first place, the radio telephone is not a new development. It was first invented by Valdemar Poulsen, the Danish Edison, over fifteen years ago. Later, the American, Dr. Reginald A. Fessenden, also produced a radio telephone of his own, taking out many patents in connection with it. Even in 1915, the radio telephone had been developed to such an extent that words spoken at Arlington, Va., at Eiffel Tower station, Paris, France, and Honolulu, Hawaii, were distinctly heard. Any one who had the proper receiving instruments at that time, or even in Poulsen's time, could have listened in and heard what was going on, even at that early stage of the radio telephone.

Broadcasting in scheduled programs, as we understand it today, however, has come into use extensively only since about 1921, and from that time on the public at large became interested. It should be noted, however, that the radio telephone and the radio telegraph are of the same family, just as the wire telephone and the wire telegraph work along similar principles. Indeed, the similarity of the radio telegraph and radio telephone is greater than that of their wire cousins. The radio telephone and the radio telegraph both make use of invisible waves set up in space; these are very similar to sound waves, which we all know. Sound waves and radio waves are fundamentally the same, except that the length of the waves varies. Radio waves are rather short, whereas sound waves are much longer. The longer the wave for a given power, the easier it is for it to cover greater distances. If you drop a small pebble into a pond, this will give rise to small waves. These do not travel very far. If, however, you look at one of the great swells in the ocean, you can realize why such a wave, being much longer, will naturally cover a greater distance. So much for the wave part.

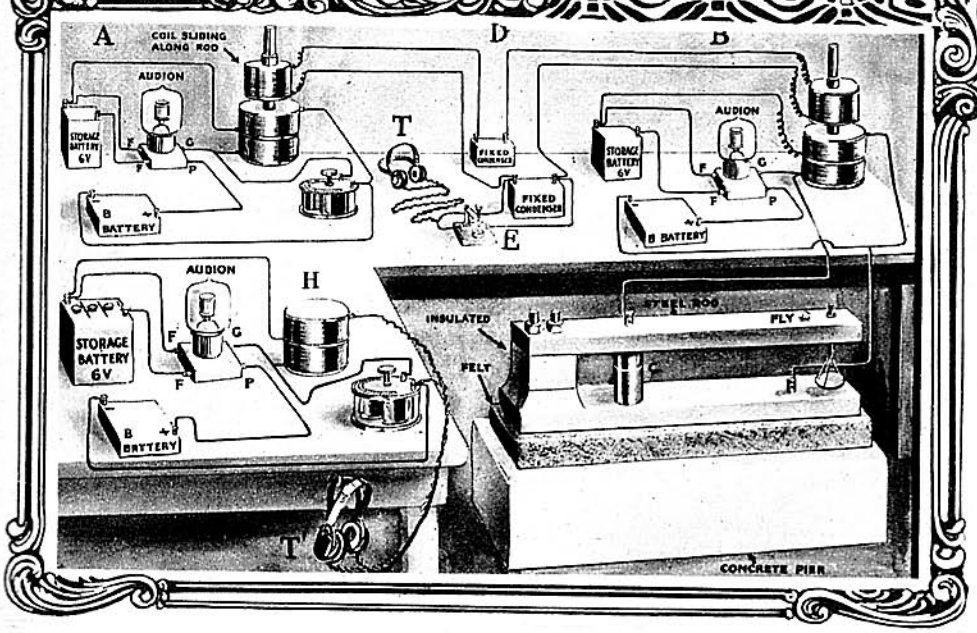
Coming back to the radiophone, in which there is so much interest centered at the present time, we might state that at this time of writing there are over 600 broadcasting stations sending out regular schedules, in the United States. These stations vary from those of great power to the ones of small power, and nearly every large city in the United States today has one or more broadcasting stations. Great centers, such as, for instance, New York, Chicago, or San Francisco, have a great many stations, thus for instance, Los Angeles, has no less than 19 broadcasting stations. All of these operate on either a 360- or 400-meter wave-length at present, and if you have a good long distance vacuum tube receiver (and know how to tune it well) you can enjoy yourself every night by picking from the air dozens of stations scattered all over the country, bringing to your ears lectures, opera, jazz, songs, weather reports, market reports, and what not. The daily papers are publishing the programs of nearby stations, and a good vacuum tube receiver has no trouble in bringing in all of these stations, so that you can hear them over the whole house.

There is hardly a residence today in our large cities that does not have its radio outfit—good, bad, or indifferent, and the time is at hand when a house without its

radiophone will be a curiosity, just as is the home without its piano or phonograph today.

There is no question that, as far as broadcasting is concerned, the United States leads the world today. In England, for instance, the radiophone craze has just begun, but there is still chaos over there, and stations are only now beginning to work. In England, moreover, all broadcasting stations are more or less Government-controlled, and each receiving outfit must be licensed, a thing not known in the United States, where every one may stick up a wire on his roof and receive to his heart's content without paying a nickel for the service. In France there are only a few radiophone broadcasting stations, the Eiffel Tower being the most powerful one, but Argentina and Japan are of interest, where there are stations now being erected that will broadcast, and a few that are already operating. In all other countries, the effort so far has been rather feeble, but there is no question but that during the next few years radio broadcasting stations will dot the entire world, and it will be possible for a man to tune in to

Apparatus Capable of Measuring Two-Millionths Of An Inch. Queer As It May Seem, a Fly Walking On the Long Bar Will Bend It Sufficiently To Register In the Apparatus. The Vacuum Tube Is Responsible For This.



Compact Type of Vacuum Tube Transmitter Used On Aeroplanes. Power For the Tubes Is Derived From a Propeller-Driven Generator. This Is Another Case In Which the Vacuum Tube Plays An Important Part.

Copenhagen or to Cape Town in South Africa, if he is so inclined.

But what is behind all of this wonderful development? What developments were necessary to bring the present-day radiophone to the commanding position it now holds?

The art of radio today is a great Science by itself, and becomes greater and more powerful each and every day. Its ramifications are of such a nature as to astonish the layman who has not paid much attention to this young giant. As a matter of fact, the really big inventions in radio are hardly ever heard of by the public. But these inventions, bordering on the magical, should be known better by the "man in the street," as they will mean much to his every day life during the next decade.

We are all familiar with Marconi's original "thunder factory," where an operator pressed a key and a vivid, blue-white crashing spark was sent over a metallic gap with a thunder-like noise. This was in the days when radio was young, but even now, when you remember these blue sparks, it suddenly comes to you that it is rather seldom that you see them. Just the same, you know that the radio traffic, be it telegraph or telephone, goes on. But where is the spark?

It was soon found, after Marconi produced this spark, which produced the waves that were shot out into space, that these methods were wasteful. Only a small percentage of the energy was radiated by the aerial wires. The rest went up in heat. After the spark had been in use for some years, a German invented a sort of noiseless spark, technically called a "quenched spark." Here the spark leaped between metallic discs, separated from each other a few hundredths of an inch. Unless you put your ear close to such a quenched spark gap, as it is technically called, you could no longer hear the noise. Not only was the noise done away with, but the efficiency of the apparatus was increased a good deal.

After the quenched spark, came the Goldsmith and Alexanderson Alternators, machines that sent out the waves without any spark at all. This was another great improvement, and a great deal of energy was saved in the process. Still, with these generators, it was necessary to use large machinery in order to operate them, as they were nothing less than dynamos, in disguise.

So radio matters stood until about 1907, when a revolution in radio occurred. This revolution was due to a little glass bottle, invented by the American, Dr. de Forest, and called the Audion, or, as it is termed today, the Vacuum Tube. This little tube wrought havoc with all pre-conceived notions in radio and, as a matter of fact, threw the entire industry into an upheaval, which, however, was most beneficial. Years before Dr. de Forest, when as a matter of fact he was still wearing short pants, Edison had discovered the so-called "Edison Effect." The Edison Effect was demonstrated with two incandescent lamps in one; in other words, an electric lamp bulb having two filaments that did not touch anywhere, instead of a single filament.

Edison observed the curious fact that when these filaments were lit up by separate batteries, a current could be made to pass from one filament to the other, although they were not physically connected, but, on the contrary, were enclosed in a glass bulb which contained no air; a vacuum, in other words. Dr. de Forest made use of this principle with some modifications, and also enclosed in the tube still a third element, a piece of wire bent to and fro, which he termed the "Grid," due to its resemblance to its kitchen-utensil namesake. It was immediately found that such a tube, properly made, became tremendously sensitive to radio waves—so much so, in fact, that where heretofore we were using thousands of horsepower to bridge a given space with radio waves, only a fraction of the same power is now required to bridge the same gap, thanks to this tube.

It was soon discovered that the sensitivity could be increased into the billions by using a quantity of such tubes connected together in a certain fashion. In technical terms, we use one tube as a "detector," and the balance of the tubes as "amplifiers." In other words, a weak signal, that is, totally inaudible, can be magnified to such an extent that the sounds come roaring out from a horn with ear-splitting intensity. But that is not all.

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44th C. W. Bailey, 346 Clinton St., Toronto, Ont., Can.
45th S. H. McNeill, Smith's Falls, Ont., Can.
46th J. Fassett, care Acadia Sugar Refinery, Woodside, Dartmouth, N. S., Can.
47th A. B. Mann, Stewiacke, N. S., Can.
48th G. W. Griggs, 298 Dalhousie St., Brantford, Ont., Can.
49th G. W. Young, Ridgeway, Ont., Can.
50th H. R. Ryckman, 517 Nelson St., London, Ont., Can.
51st G. A. Sandoz, Emscote Cottage, Francklyn St., Halifax, N. S., Can.
52nd A. E. Goyo, 313 Monmouth Rd., Town of Mount Royal, Montreal, Can.
53rd Bert MacLeod, R. R. No. 2, Cornwall, Ont., Can.

A New Use for Loud Speakers

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Eight transmitters were supplied with the system, usable at any point in the big setting. By means of a control switch in the switchboard house, the director can be connected to any point at once. In the control room is a monitor horn, by which the operator can instantly detect the condition of the apparatus, and 12 Western Electric 6A horns, connectable in multiple, are distributed at the important points. These are specially designed for this type of work. Three are in multiple over the big replica of Notre Dame Cathedral, the rest in and about the old buildings on the Paris streets reproduced in the setting.

Seven circuits lead off the volume control switchboard for the 12 horns and any number may be connected for any special needs. In the control house is a potentiometer control ranging over 24 points to regulate distance of carrying. Each reproducer has in addition a rheostat control.

The volume indicator in the control house is an innovation in this type of system. It operates on a new principle, and is in effect a galvanometer showing 15 points on proper regulation.

A field telephone set enables the director on the scenes to talk back to the switchboard in case of any derangement of the apparatus.

The first three steps of amplification are single, and the fourth or final is a "Push-Pull" arrangement—in effect power amplification.

Radio messages can be received by use of a Radio Receiver, and amplified over the board and broadcast in the same manner as the director's messages are transmitted. A loop antenna is used for this.

The uses of the set on the picture lot are manifold. Most important, of course, is the work of directing the mob scenes, one director in the tower overlooking the action being able instantly to direct any part of the crowd. It is also used similarly for paging players on the big lot.

The "inspirational music," a valued adjunct to acting for films, is also broadcast for the crowds of players over the apparatus. In fact, the set has made possible for the first time in film history the use of music for mob scenes. Radio concerts between waits are given the crowds of actors, too, thus strengthening morale and creating an esprit de corps that alone has saved a small fortune in the big picture, according to Wallace Worsley, director, and Lon Chaney, star of the production.

Recent Developments In Radio

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Dr. de Forest had used his invention for a few years only, when it was found that if this tube were reversed it could be used for transmitting purposes, instead of for receiving. In other words, the Vacuum Tube can be made to send out powerful radio

waves as well as receive waves. The transmitting tube, therefore, takes the place of the old Marconi Spark Gap, and the more recent Alexanderson Generators. Indeed a tube recently constructed by one of our great electrical companies handles over 1,000,000 Watts, and does not take up much more space than an ordinary desk drawer. But this tube can handle sufficient energy to throw radio waves across continents and oceans. Already our big trans-Atlantic stations, which comprise many acres of ground to house their machinery, are doomed on account of this new monster tube. The future radio station power plant will be located in a small room less than 10 feet square, instead of so many acres. And, best of all, a Vacuum Tube handles the energy with much greater economy than the Generators did before.

The versatility of this tube, which has often been called "Aladdin's Lamp" quite appropriately, does not stop here. For instance, when a man in New York picks up his telephone receiver and asks for a friend in San Francisco, he little realizes that he could not do so at all were it not for the Vacuum Tube. Without this it would be impossible to speak over such great distances. Only the perfection of the Vacuum Tube makes the long distance wire telephone possible.

You would not think it possible to measure 2/1,000,000 of an inch. This, however, can be done readily by means of the Ultramicrometer, an instrument that would not have been in existence without the use of the Vacuum Tube.

Imagine a bar of steel, 10" long, and ½" thick. If a fly hops upon this rod, the small weight of the fly will depress this heavy rod a sufficient amount so that it can be measured on the Ultramicrometer—a thing almost impossible to conceive, but true, nevertheless.

In the latter part of 1922, the War Department sent a radio message to an airplane aloft, and this message came out in the form of a tape with the words typed upon it in plain English. In other words, the order was given by radio and the message was typed in intelligible words, in ordinary characters that everyone could understand. The operator made his reply likewise, from the airplane, and the message was received in the War Department on a printed strip, in the English language. All of this has been accomplished thanks to the wonderful Vacuum Tube.

We do not stop here, however. John Hays Hammond, Jr., has repeatedly demonstrated that he can control an airplane from the ground entirely by radio, without the necessity of having an operator aboard. In other words, it is possible today to send a radio-controlled airplane over the enemy's lines or fortifications, and drop bombs at will. All of this can be directed by radio from the ground, at a distance. Again the Vacuum Tube makes this possible.

Recently the Navy Department sent out a battleship on which there was not a human being aboard. Impossible as it seems, the battleship was entirely controlled by radio, from shore, and it was not possible for the maneuvering "enemy" ships to stop the operation of this radio-controlled vessel. All the controls were made by radio. Thus the ship was steered, made to go in a circle, reversed and run backwards. The oil fuel was fed into the furnaces by means of radio control, and there was not a time when the huge monster was not in full control by its distant operator.

There is no question but that in the future we shall have such radio-controlled monsters and their uses are not entirely confined to the sea, because the United States Army has already experimented with radio-controlled tanks, which can be sent out into the enemy's lines without a human being on board to guide them. Again it is the frail little

Vacuum Tube that does the work, as without its use there would not be any radio-controlled airplane, battleship, or tank.

During the war the Vacuum Tube had its fire baptism, and some of the greatest inventions in radio really were made during that time.

Before the war we used aerials, generally; that is, overhead wires, in order to receive radio messages. During the war, the so-called "Loop, or Indoor Aerial" was developed to a wonderful degree. Although the Loop, which is nothing but a wire wound on a square frame, was known before the war, it was never used much. At that time, when it was not possible to use aerials, the loop aerial came into use more and more, and it is now only a question of time when all outdoor aerials will disappear.

The great advantage of the loop type or indoor aerial is that it has directional qualities. By this is meant that if you have a loop receiver and Chicago is broadcasting a concert, you turn the loop so that its edge, or narrow side, points toward Chicago. You will then receive the music or entertainment with maximum intensity.

This quality is made use of in the Radio Compass. When the captain of a ship, nowadays wishes to know what his position is at sea, he does not make any lengthy calculations, as he used to do of yore. He picks up his telephone and calls down to "Sparks," the Radio Operator on board the ship. and utters these few laconic words: "What is our position?" Immediately "Sparks" gets in touch with the nearest land station. There are usually two such stations which receive the call. The distance between these two land stations is known exactly to the land operators. By means of well-known triangulation methods, the position of the ship is ascertained accurately within a few yards, in less than three minutes from the time the call comes in from the distant ship. The land operator of the compass station then radios back to the ship and gives the ship its exact location, exact within a few yards, as mentioned above. In other words, a captain nowadays, if he is in a fog, or during the night, when he has no means for direct observation, can, within a few minutes, ascertain the exact position of his ship. This is not a theory or a dream, because it now happens several hundred times each and every day, all over the world.

Another surprising development of radio is sending pictures from a distance. This is not a new invention either, as it has been known for the last 15 years, but the use of the Vacuum Tube has made the invention commercially practical, and it is not uncommon these days to have pictures sent from France to America by radio, within a few minutes. The Frenchman, Belin, who has made a specialty of such picture-transmission, has achieved remarkable results. The principle is quite simple: Each station, either receiving or sending, has a revolving cylinder upon which the picture, properly prepared, is wrapped. A stylus then travels over the picture, making contacts on certain parts, and these contacts are translated into radio waves, and are shot out to any distance required. At the other end a similar stylus actuates upon a cylinder, and in a few minutes the picture has been assembled, and can then be reproduced by the regular process. Thus it is possible today, by means of such a machine, to radio important photographs or pictures across land and sea in the short space of a few minutes.

Another surprising new use for radio has been found recently in mining. By means of radio waves it is now possible to accurately locate ore or coal deposits. The principle is simple: Radio waves pass through solid substances as easily as light passes through a solid glass block. As long as we have only plain earth or sand, the radio waves travel through such strata without much difficulty. If, however, the waves

encounter ores or coal veins, they are obstructed or deflected. An observer at the other end can readily tell whether the signals are coming through strongly or faintly, and if they do come faintly he will know that the waves have been obstructed. By using a certain index and by actual observations it can be calculated not only as to whether the substance is ore or coal, but the depth and horizontal contour of the valuable deposits can be ascertained by radio as well.

Hetterby's Set

(*Continued from page* 136)

Jessica cried, "Come on, Sam, we'll go right down to the electric shop and get what you need this very minute, and I'll help you wind the wire and everything, and we'll be hearing a really truly radio program before we have to put the cat out and lock up the house for the night!"

So she went away laughing, dragging Sam by the arm and making him hurry. They turned down toward the main street and that was the last we saw of her for almost a week. Then we happened to meet her on the street one day and mother asked her how she liked the radio.

"Well, we haven't got it quite ready to work yet," she said a little soberly. "Sam decided he'd have one a little better than yours. When we went down to the electric shop he saw a—a something or other; I don't know whether it was what he calls a grid-leak or a vernier or what; maybe it was a different sized wave-length—and the electric shop man explained a different way to make a radio set, so Sam is making that kind. It takes a little longer, but Sam says it will be ever so much better."

After that we used to see Jessica every now and then and we always asked how the radio set was getting along, but it was never quite ready to use. She was just as cheerful and hopeful as ever, and just as sure Sam would have the set ready to use in a day or two, but Sam was always discovering something new and better to put in his set, and then he had to tear the set all apart and begin over again. One week he would discover a new quick-acting vernier rheostat or a new style tubular grid-leak and he would junk everything and begin again, and the next week he would hear of a new filament bulb that was built like a link of bologna sausage, with terminals at each end, and he would decide not to have a crystal set but a tube set, and he would junk everything and begin again. Or he would hear of somebody's brand new pretzel-curve spider-web winding and throw away all his variometers and vario-couplers, and start in on a new set. He was always just about ready to go ahead and finish the set and put up his aerial, but ten minutes later he would hear of a new sort of something or other or a new kind of circuit somebody in New Zealand or Timbuctoo had invented, and he would junk everything and begin again.

About a year and a half after Jessica and Sam had first come to our house to see father's radio, Jessica's first baby was born—a fine eight-pound boy. For the first week Sam called the boy Steinmetz Hetterby; the second week he called him DeForest Hetterby; the third week he called him Atwater Kent Hetterby. And I believe that boy never did get an actual hold-fast name until he was twenty-one and chose one for himself—we all called him "Bub" up to the time he was twenty-one, because Sam was everlastingly getting interested in some new radio appliance and naming the boy after its inventor. There was one awful week during which the boy hid in the attic and wept day and night because his father had decided his name was to be Modulated High-Frequency Electromagnetic Voltage Het-