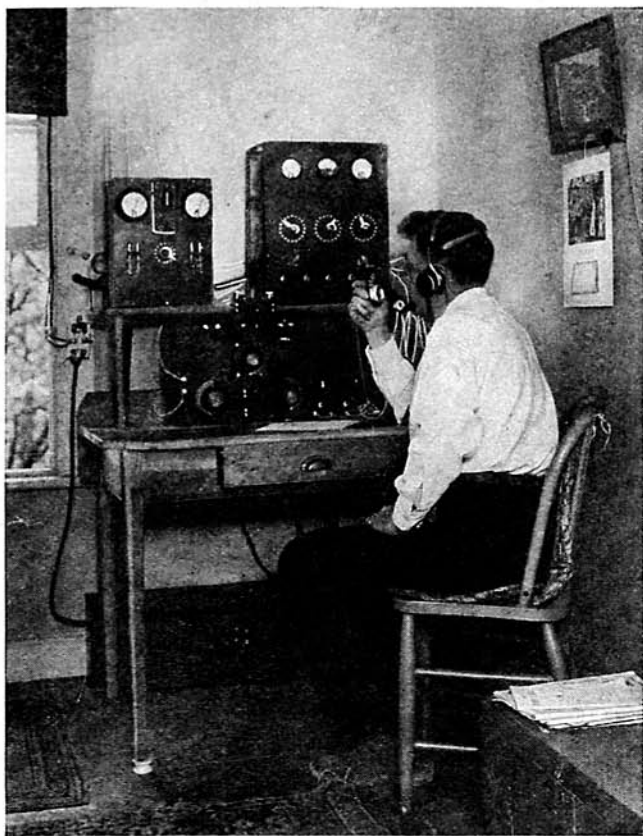


Twelve Years of

1919

*From a small
ateurs transmitting
graph records to a
ers, to the present
when radio is
manent utility, a dozen years have
packed with discoveries,*

By Capt. Robert



It was in amateur stations such as this that broadcasting of music started in 1919. The photo shows the vacuum tube transmitter equipment used by William Andrew Mackay at that time. The receiver shown below the transmitter is one of the first three-circuit tuners

MIRRORING the developments of radio for the past twelve years, RADIO NEWS has recorded the progress of radio virtually from the "stone age" of reception, when the crystal receiver intrigued the imagination up to the presentation of moving pictures via the ether.

Further than merely acting as an historian of radio progress, RADIO NEWS pioneered in the various departments of broadcast progress and has had the enviable distinction of crystallizing in workable form such developments as television, synchronization of two or more stations on the same wavelength, and the introduction of the first radio musical instrument. Direct outgrowths of these experiments are the huge radio organ and the Theremin, to say nothing of the impetus lent to a host of developments of the so-called infant industry, by the progressive spirit of radio's pioneer magazine.

In the short space of 12 years, radio has grown from an industry doing less than \$2,000,000 gross business a year to a national institution, one of the country's leading industries, with a cash turnover of more than \$500,000,000 for 1930.

RADIO NEWS was in existence before the first broadcasting station went on the air, for the first issue made its appearance in June, 1919, and KDKA, the world's first station, was not put into operation until November 2, 1920.

But radio in various forms, particularly that of wireless telegraphy, traces back as early as 1865, when James Clerk Maxwell, Scotch physicist, propounded the theory that light consists of electro-magnetic waves in the ether and that other waves, similar but invisible, exist. Twenty-two years later Heinrich Hertz, German electrical investigator, proved the existence of the radio waves through his famed experiments.

The next big impetus that wireless communications received was from Guglielmo Marconi, who in 1894 commenced his

experiments with Branley's coherer, a crude device for the detection of minute high-frequency currents. He also was the first to use the antenna-ground system of transmission at about this same time.

Four years were devoted to these experiments, which were proven successful in 1898, when a message was sent through the air for a distance of about 14 miles. The distance was increased to over 200 miles in 1901 when a message was successfully sent from Cornwall to the Isle of Wight. It was on December 14 of this year that the historic three dots were transmitted over the Atlantic Ocean by him. This sensational demonstration was made in conjunction with John Hunter Tennant, until recently managing editor of the *Evening World*; Joseph Pulitzer, the elder, and Marconi. It was the outgrowth of a bet, and these men, always far-sighted, proved to a sceptical world that long-distance wireless communication was an actuality.

On this occasion Raydon Jones drew a cartoon which was published on December 16 thirty years ago, visualizing the potentialities of the new form of communication. He showed it used in a newspaper office, receiving bulletins on sports and world events; sending calls for help to ships at sea; stock reports to Morgan on his yacht and for other means of communication. About the only things he did not foresee was the broadcasting of music and television.

All this time the apparatus had been of the crudest sort—entirely unlike the highly developed equipment which we now know. Even the crystal detector, that good old standby of early broadcasting days, did not make its appearance until 1906. Credit for this device must be given to Pickard and Dunwoody, for inductive coupling to Sir Oliver Lodge, and for an improved form of electric arc, capable of generating frequencies up to 30 kilocycles, to Poulsen of Denmark. About this time, Fleming, another British scientist, devised a two-element vacuum tube, and in 1906 Dr. Lee De Forest interposed a third element, the grid, between the plate and filament, giving us the three-element vacuum tube to which radio broadcasting, as we know it, owes its existence.

Radio telephony existed commercially as long ago as 1915, when the vacuum tube was used in the transatlantic communications both as oscillators

"RADIO is still such a youthful industry, viewed from the standpoint of its enlarged service through broadcasting, that the observance of a twelfth anniversary is an event of significance. It shows a career contemporaneous with the great growth of radio, and, perhaps, a vision of the tremendous industrial expansion which, twelve years ago, lay just ahead. I am glad to extend felicitation to the RADIO NEWS on the completion of its twelfth year.

"Undoubtedly there is much that may still be told about radio. We look toward the coming years with a conviction that new services of public value will spring from the further development of this industry. I congratulate the RADIO NEWS and its staff on the past service rendered by this magazine. I believe that an equally splendid opportunity lies ahead."

DAVID SARNOFF.

Radio Progress

*beginning, with am-
music from phono-
few thousand listen-
state of the industry
recognized as a per-
elapsd and these years have been
inventions and developments*

1931

Scofield Wood

and modulators, and when they were replacing the high-frequency oscillator for use in radio telegraphy. The oscillator had been produced by Armstrong, Goldschmidt and Fessenden about 1910.

In these early days of radio communication, however, the maximum power obtainable from a tube was 25 watts, while today 20 and even 50 kilowatts are not unusual as standard equipment for broadcasting stations. Along the lines of reception, four-element or screen-grid tubes and five-element tubes or pentodes have also been developed.

The war gave radio its next big impetus, that form of communication being ideally suited to keeping planes in touch with the ground. It was almost immediately after the war that radio got its start, though as early as 1906 Fessenden had transmitted a Christmas Eve program. Whether or not anyone received it is a moot question.

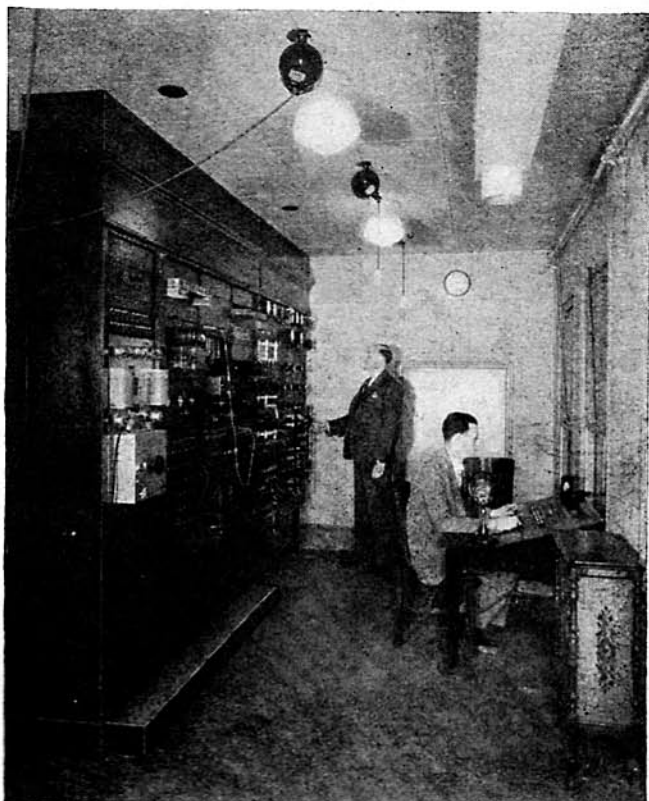
However, shortly after the outbreak of the war, the British government requested Westinghouse to carry on some radio research for them. Transmission and reception was a branch, and in order to undertake it, it was necessary that experimental stations be built and operated. The Government issued permission and 2WM and 2WE came into existence.

The same organization, which controlled the International Radio Telegraph Company, was even then operating the several ship-to-shore stations owned by it, and the large investment tied up in this enterprise caused them to seek some means of realizing a profit from it. Dr. Conrad, one of the scientists of the company, had been consistently experimenting with voice

transmission, occasionally sent out programs of phonograph music, talks and so forth over his station, 8XK.

Then a newspaper carried the advertisement of a Pittsburgh store offering for sale radio receivers which would enable one to tune in 8XK. This gave Westinghouse officials the idea that radio should be developed as a publicity medium rather than a straight communication service, and early in 1920 plans for operating KDKA were made.

This station opened in November of that year, and its first broadcast was of the election returns when Harding was elected President. The first audience consisted of amateurs, and few people who already had sets and the officers of the company, who were given receivers.



The control equipment of a modern station, showing the complicated panels and switches. The scene is in the control room of the Times Square studios of the National Broadcasting Co. At the switchboard is W. S. T. Redfern and at the monitor table Richard Stoddart

KDKA then went on a schedule that called for a daily broadcast between the hours of 8:30 and 9:30 p.m.

Old KDKA's first studio was a rough wooden shack built on the roof of one of the taller buildings. It housed, in one room, the transmitter, the phonograph (which supplied most of the program material), the announcers and whatever artists could be gathered. But room resonance marred the programs, so with the coming of summer the artists were moved out of doors, with a tent over them. This was fine until winter came again, and then the tent was moved into a large room. Thus the problem of resonance was overcome in the construction of radio's first indoor studio. Later the tent was removed and the room's walls hung with burlap to deaden the sound.

In these early days the crystal set, costing from \$15 to \$25, was the usual thing. The one-tube sets were too expensive for the average purse, considering how slightly better they were than crystal sets. But soon the regenerative receiver made its appearance. One of these, the MR-6, made by De Forest, was sold for approximately \$150 without accessories. It consisted of a honeycomb-coil tuner and two stages of audio-frequency amplification. About this time Radiola came out with a model that resembled a small table model phonograph with lid and concealed horn. It operated on four WD-11 tubes.

Accessories were a luxury in these days, too. The little horn on which a head-set could be clamped, sold for \$12.50. Rather tricky grid leaks and filament rheostats cost as much as \$2.50 each, and when the 201A type tube came out it was worth whatever the dealer could get for it. A "bonus" price of \$10 was not exceptional.

Despite the high cost of listening in, radio grew by leaps and bounds. In September, 1921, WBZ opened at Springfield, Mass., WJZ went on the air from Newark on October 12, and KWKY of Chicago opened on November 11 of the same year. Programs were on the air! All that one had to do was buy the equipment in order to listen in, and as (Continued on page 86)



David Sarnoff
President, Radio Corp. of America

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Merchandising Radio Service

(Continued from page 85)

question: "What about the sets I have sold in the past, and on which I must render service?" The answer, of course, is that we shall be glad to handle this service on a mutually profitable plan that allows the dealer a given percentage of the total bill to his customers. Working on this basis, the dealer makes a clear profit by simply turning the call over to us. We are enabled to handle all extra work in this manner by virtue of the fact that we have a volume of business exclusively service. For the same reason we are able to employ a better class of servicemen, and to keep them occupied during the working hours of the day. This is something that the dealer, in most cases, has been unable to do, because he does not have sufficient work at all times for his service crew.

"We also have some dealers who cannot be convinced that the 90-day guarantee system is profitable. In such in-

stances we handle all service work with him on the same basis that we handle the extra service for our guarantee dealers.

"In summary, our service station in making the delivery, installation and maintenance charge of \$4.50 is working on a very close margin but has the following good points:

"First—We secure new customers who at the end of the guarantee period will be required to pay list prices for parts and service.

"Second—Installations mean the sale of antennas that we would not get otherwise.

"We believe that this system will increase our volume of business steadily. It is our duty to treat our customers fairly, to work very closely and honestly with our dealers so as to maintain, at all times, his good will and confidence."

Which leaves nothing to comment aside from an emphatic editorial "Q. E. D."

Twelve Years of Radio Progress

(Continued from page 25)

other stations opened during the summer of 1922, the radio rage spread throughout the entire country.

Since that time radio has become the most universal of all forms of entertainment. It stretches from churches to night clubs, with interludes on the theatrical

trousers as to whether or not it bordered upon the sacrilegious raged, but the program was enthusiastically hailed and became a regular feature.

In 1921 remote control was inaugurated on a far larger scale than this. The same station broadcast the Johnny Dundee-



A group picture of the orchestra and artists on an NBC commercial hour

and concert stages, schools, lecture platforms, sports events. Incidentally, most of the techniques which we accept as a matter of course were once tremendously sensational. For example, the first church broadcast, which came from the Calvary Episcopal Church, was hailed as a "daring experiment" when it made its debut on January 2, 1921, over KDKA. Con-

Johnny Ray fight on April 11; on May 9 the first program to originate on the stage of a theatre; on August 4-6, the Davis Cup matches; and on August 5, a play-by-play account of a ball game. WJZ presented a World's Series game shortly after it opened, and KYW's first program was a broadcast of the Chicago Civic

(Continued on page 88)

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AERIAL OF THE FUTURE Post-paid

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THE METAL MONSTER, by Otis Adelbert Kline. Relatively speaking, man has delved only an infinitesimal distance below the surface of the earth. What is deep in the bowels of the earth, what comedies or tragedies might be enacted there, or what strides in development might be found, are all absorbing subjects for speculation for geodetic science students.

CLEON OF YZDRAL, by P. Schuyler Miller. The captivating principle of life, for all we know, may be nothing but an energy form, as light, heat, electricity, or matter. In other words—a disturbance in space or ether. As such, it may well be found combined with any other energy form—light as well as matter, and with a resulting intelligence. This story is a parallel to "Through the Vibrations."

THE STOLEN CHRYSALIS, by J. Rogers Ulrich. Our older readers will remember the author of "The Moon Strollers." Our new readers will be quick to appreciate Mr. Ulrich's work.

THE RAID OF THE MERCURY, by A. H. Johnson. Here is an entirely new slant on the possibilities in the future for air travel. Won't the car-thieves have a hard tussle when the world becomes air-conscious?

Other unusual scientific fiction

Twelve Years of Radio Progress

(Continued from page 86)

Opera Company, direct from the stage of the Opera House.

However, it was not until Jack Dempsey fought Georges Carpentier in Jersey City on July 2, 1921, that a real ringside blow-by-blow description was broadcast. At this time, Major J. Andrew White was at the ringside with a telephone. He phoned the word picture of the battle to J. O. Smith at Hoboken, who repeated it into a microphone, sending it out over the

to them, and which they knew were to be taken from them as soon as they definitely established their usability.

Tremendous interest in radio was aroused by the international tests conducted in 1923 under the auspices of the American Radio Relay League, Paul Godley supervising. Godley went to Androsan, Scotland, and listened in on the experimental transmissions of such eminent American amateurs as Major Armstrong



A photograph of the staff of "old WEAF," then located at 195 Broadway. Among them are Leslie Joy (extreme left), Graham McNamee (second from left), Phillips Carlin (second from right) and G. W. Johnstone (extreme right). They all now hold executive positions with the National Broadcasting Company. Kathleen Stewart, the favorite pianist of radio listeners for many years, is shown at the extreme right

station operated for experimental wireless dispatching by the D., L. and W. Railroad.

Two years later the first broadcast from a moving train was made on the Easter Special coming down from Cornell. Despite the passage of the train over bridges and through the tunnels, the 150-meter wave was well received by the listening amateurs. The broadcast was a description of the countryside, as it flashed by, interrupted by occasional musical selections by the glee club. Its announcer was the writer of this article.

It was to the amateurs largely that the progress of broadcasting is due, but the poor amateur seldom got a break from the authorities who regulate activities. In the earliest days when 360 meters was the only wave on which regular broadcasting stations operated, one could tune down below 200 meters and hear the hams putting on amateur talent and shows of their own. There were phonograph records, little dramas and musical entertainment, much of which was really quite noteworthy. Then the Department of Commerce relegated them to the short waves and, banning entertainment, limited the scope of their efforts to code and voice. They bowed to the decree with the time-honored philosophy of the pioneer and pushed on to explore the new realms open

of regenerative, superregenerative and superheterodyne fame; Johnny Grinan, Dick Richardson, the Princeton boy who had one of the few operator's licenses during the war; J. O. Smith, the first amateur to instal continuous wave in place of spark; Ralph Waldo Emerson Decker, and a host of others. To these men and the sensational work which they did is due a great amount of credit for the popularization of radio. Most of them are still trail-blazing on the short waves, and are taking a lively interest in television.

At first an interesting laboratory experiment, radio had by this time been recognized as an advertising as well as an entertainment medium. Manufacturers of nationally advertised products made use of its facilities to push their products, and in order to secure listeners for their spoken advertisements, surrounded their appeals with attractive programs. Competition between sponsors, each endeavoring to offer the most attractive broadcast, resulted in huge sums of money being spent for talent.

In order to get the utmost value out of each dollar spent on the artists, a given program was sent out over two or more stations instead of only one.

At the same time the use of higher
(Continued on page 91)

Twelve Years of Radio Progress

(Continued from page 88)

power began to be considered, but it was not until New Year's night of 1926 that the first superpower station went on the air. This was WJZ, and the man responsible for its use of high power was David Sarnoff. The use of superpower has been of tremendous importance in the popularization of radio. It has made reception far better by improving the signal-to-static ratio, and consequently superpower is being adopted by all the big stations which can get permission to use it.

Broadcasting Chaos

That brings to mind the time when the authority of the Department of Commerce failed and chaos resulted. This was in 1925, when stations abandoned the appointed waves and time to which they had been assigned and used their own judgment as to what bands, powers and hours they would utilize for their broadcasts. Inasmuch as all wanted waves toward the upper end of the broadcast spectrum, wanted to be on the air full time, and wanted to use as much power as they could push through their antennas, the chief result was a howling heterodyne which marred nearly every program. To overcome this evil the Federal Radio Commission was formed.

Ever since it was found that there were more stations which desired to broadcast than there were channels to accommodate them, some means of straightening out the difficulty has been sought. Limitation of power and of time on the air has been used as the most practical means for eliminating cross-talk and heterodyning, but how effective it really is is realized by every listener who has a sensitive set and whose reception of locals is marred by the signals of DX stations.

For years experiments have been conducted with the idea of synchronizing stations so that two or more will be enabled to operate on the same channel, using adequate power. Until last year no great success was made along these lines, but now WFAF synchronizes with WTIC, and WJZ with WBAL very successfully.

Even as broadcasting has grown, so have vacuum tubes developed and circuits improved, and along with the betterment of receiver design the improvement of transmitters has kept pace.

Set Building

In 1924 set building was perhaps at its height. A survey conducted among the licensed amateurs of America revealed that it was apparently the custom to build a set, use it for about three weeks and tear it apart to use the parts for another one.

It was in this year that one of the most popular circuits made its debut. This was the three-circuit tuning, a simple regenerative set with an aperiodic primary. Shortly thereafter it was superseded by the neutrodyne and other forms of tuned-radio-frequency receivers, which retained their popularity until the advent of the -24 type tube. This tube, known as the

"screen-grid tube," and the modern power tubes were radio's next big step as far as reception was concerned. Also the perfection of various types of a.c. tubes, which enable the listener to do away with all batteries, simply plugging in on the electric light lines, were developments which made the batteryless set possible.

During this entire period, C. Francis Jenkins and a new army of experimenters had begun work on telephoto (still) and television (moving) pictures. Various means of producing the former include the use of a radio controlled airbrush, an air jet providing heat to a thermo-sensitive paper, a light beam on a photo-sensitive paper, an ink bar, a stylus working through carbon and similar devices. All these have been used commercially to greater or lesser extent.

Television

Television, too, has been receiving particular attention of late years. Thus far the majority of the experimenters have concentrated their efforts on apparatus in which a scanning disc and glow tube are used. Other experimenters have discarded the scanning disc and used the cathode-ray tube instead. But even though television is a branch of radio, it is a subject far too large to be included in the scope of this article, and so we must leave the other wonderful developments to be written at a later date.

A Vacuum Tube Voltmeter

(Continued from page 90)

scale. On the high range scale about 2 microamperes were in the grid circuit when the applied a.c. voltage was 13 volts.

In order to investigate the wave-form error of this particular V. T. voltmeter, the plate current was plotted against the square of the applied a.c. voltage. If this curve is a straight line, we will expect the reading of the voltmeter to be free from wave-form error.¹ The low range curve gives a straight line from about 20 microamperes on up, so we can feel that the voltmeter is free from error due to wave-form over most of its scale. In the case of the high range or reflex type, the curve is not straight until we have reached about 100 microamperes, or one-half scale.

¹ See Terry, "Advanced Laboratory Practice in Electricity and Magnetism."

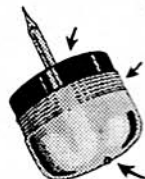
The Values Employed

R1.....	50,000 ohm variable resistor
R2.....	50,000 ohm variable resistor
R3.....	15 ohm rheostat
R4.....	50,000 ohm fixed resistor
r1, r2, r3....	wire wound resistor of about 60,000 ohms
A.....	0-200 microammeter
V.....	0-8 volts voltmeter

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