BELL LABORATORIES RECORD

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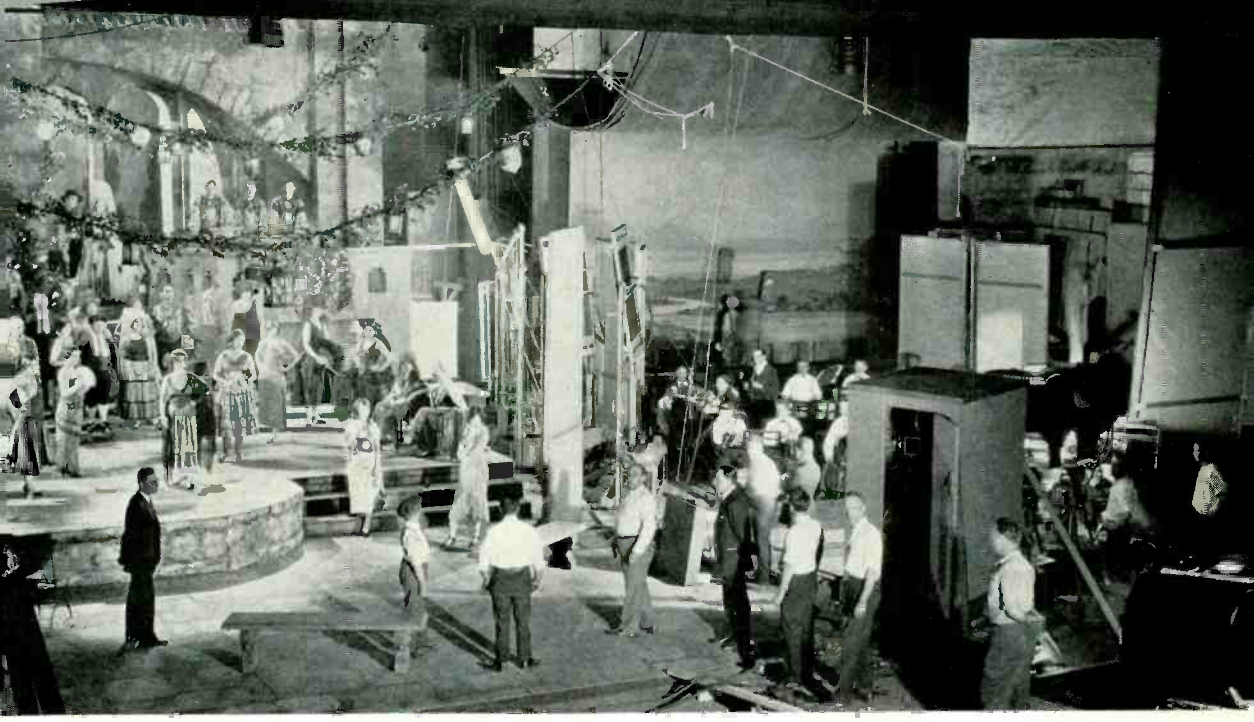


Madam, Will You Talk?

By STANLEY WATKINS
Publication Department

"Madam, will you walk?
Madam, will you talk?
Madam, will you walk
and talk with me?"
—From an old song

IT MUST seem strange to those who are young enough never to have seen a movie without sound to realize that it is but twenty years since the first successful presentation of movies with sound took place.

The first successful presentation. Not by any means the first attempt or even the first public showing, for since the invention of motion pictures in the last century attempts had been made to wed them with sound. The writer saw his first "singie" in a London "Picture Palace" a few years after the turn of the century, quite innocent of the fact that, a score of years later, he was to have the good fortune to play a part in the transformation of the motion picture industry. The commercial failure of these early efforts can be laid to the fact that, for a new form of entertainment to be put across successfully, two things must be brought together. The first of these is technical performance good enough to be acceptable in comparison with the existing arts, and the

The photograph at the top of the page was taken by Warner Bros in the Manhattan Opera House studio. The set for a "short" featuring Anna Case; showing camera booth and mercury lamps later discarded in favor of incandescents because of electrical interference. Sam Warner (with coat on) near the booth. In front of him Herman Heller, director of the premiere features.

Phonograph recording the old way. Acoustic pick-up, performers crowded together, special types of instruments, and orchestra limited in size

second is courage and imagination on the part of the producers and backers to insure an adequate presentation to the public. When the successful introduction of sound into the movies took place, the first of these requirements was fulfilled by the Western Electric Sound System, the second by the Warner brothers.

The interest of the Bell System in the recording of sound is a perennial one. In fact it goes back to the System's founder, since Alexander Graham Bell was a co-inventor of the use of "wax" in making phonograph records. As a part of the study of sound, the ability to record it has been a necessary accomplishment of Bell Telephone Laboratories quite apart from any directly practical applications there might be. These usually present themselves in due course, and in this case a commercial outlet arose in the following manner.

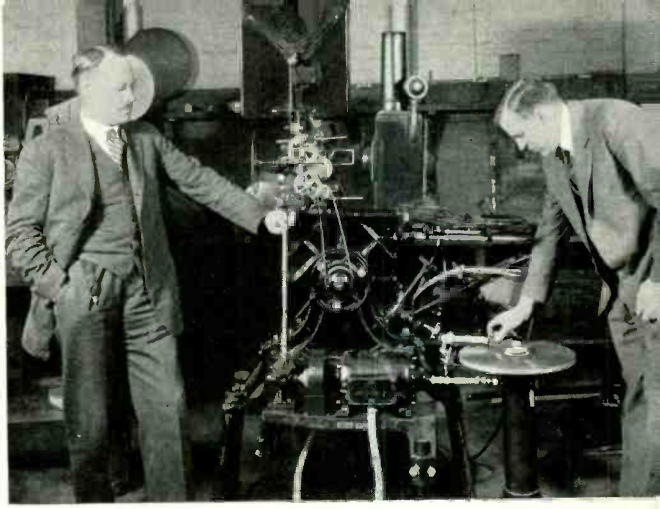
In the early Twenties the phonograph industry was suffering from the competition of the new broom, radio. The fight was an uneven one as long as the quality of the recording was limited to the possibilities of the old acoustic method. The radio broadcasting technique with its sensitive microphone pick-up allowed the artists freedom of action, permitted the use of full symphony ensembles, and made possible great improvement in quality through an ever-increasing knowledge of the use of studio acoustics. In the Laboratories, recording research had been going on for some time in two groups, one headed by I. B. Crandall experimenting with sound on film, the other under J. P. Maxfield with sound on disc. As this latter method was in line with the experience and facilities of the phonograph industry, it was decided that the development of electrical recording on disc should be pushed rather vigorously and recordings made for demonstration to the industry. The major phonograph companies quickly showed interest and in 1925 Columbia and Victor signed contracts within a few weeks of each other to install it in their studios.

From an engineering point of view, the Laboratories' main contribution to the development of electrical recording was to bring to bear on the problem the skills and methods acquired in the process of improving the art of communication. After all, an electrical recording system is a telephone system in which the receiver transmits its vibrations to a recording stylus instead of to the ear drum. The methods of design are those of the transmission engineer and the skills are those developed in the search for the most perfect microphone and the most perfect receiver. The condenser microphone of E. C. Wente was already in being and the "rubber line" recorder was produced by a brilliant piece of work on the part of H. C. Harrison and E. L. Norton. These instruments, with the amplifiers which were the outgrowth of the telephone repeater, formed a system whose quality was on a par with that of the best contemporary radio.

Throughout the development of the Laboratories' sound system and its adoption by the phonograph and motion picture industries, major credit is due two men: E. B. Craft and H. D. Arnold. The arts of communication owe much to Arnold for his insistence that the highest attainable quality be aimed at in all developments, sacrifices for commercial reasons being made afterwards, if at all. Craft with his unconquerable enthusiasm inspired those of us who had the good fortune to work under him, even when the going was not smooth and when the enterprise did not meet with wholehearted support in all quarters.

Outside of the phonograph industry the possibility of other applications of the new recording method arose. A set of records was made to provide a running commentary to a Bell System motion picture entitled "The Audion," an animation explaining the workings of the vacuum tube. In order to play the records in time with the film, a somewhat crude but adequate method of synchronization was used. Two revolution counters were mounted side by side, one connected to the motion picture machine, the other by a flexible shaft to the record turntable. The motion picture operator could keep the two counters reading alike to within about a second by means of a rheostat on the picture machine. This was close enough for a commentary.

The Audion film with its records was exhibited by Craft at Woolsey Hall, New Haven, on October 27, 1922. The occasion remains very vivid to the writer who, since his voice had been used in making the records, was induced to sit up in the organ loft during the performance with a microphone to carry on in case the reproducing system should go on strike. Through some last-minute change in lighting or what-not, he was unable to see what was happening on the screen, so it is as well that the electrical system worked. There might otherwise never have been any talkies!



H. M. Stoller (left) and H. Pfannenstiehl with the first commercial model of the disc record attachment for the motion picture projection machines

This experimental use of sound with a motion picture was so favorably received that it was decided to attempt the making of a real talking picture, accurately synchronized and the subject recorded and photographed at the same time. The early attempts at coupling sound and scene had always suffered from the fact that the two could not be simultaneous. It is difficult to get a satisfactory picture of an actor when he has his head in a horn as was required by the acoustic method of recording, and so you took his picture first and recorded the sound as nearly as possible in step afterwards. The solution of the synchronizing problem reflects much credit on H. C. Harrison, H. M. Stoller, H. Pfannenstiehl, and co-workers. The great difficulty was in keeping "flutter," or non-uniform speed of rotation, out of the disc turntable. The phonograph people did it by using weight-driven recording machines, but in the talking picture system the machine had to be driven by motors and through gears.

In the spring of 1923 the Laboratories' first real "talkies" were made at 463 West Street. The performers in these first pictures included J. P. Maxfield, T. L. Dowey, C. R. Sawyer, G. H. Stevenson, and the writer, but not even this could discourage

Alexander Graham Bell's contribution to recording included the development of the "wax" disc, here examined by E. L. Norton, D. G. Blattner (in front), J. P. Maxfield, A. C. Keller and H. C. Harrison

The Warner Theater as it appeared in August, 1926.
Photo by Warner Bros

Craft, who decided that the results warranted making some pictures with professional talent for demonstration purposes. Musicians and a camera man were engaged and a series of short subjects "shot" in Room 1109, where now most appropriately sits W. C. F. Farnell, the guardian of all the Bell System's famous firsts. Room 1109 is not large, as movie studios run, but there is a convenient roof outside the window. With the camera in a little shed on this roof, there was just enough room inside for lights, artists, and a director.

A projection room had in the meantime been improvised somewhere on the tenth floor and visitors began to arrive, motion picture executives and financial men. Among them was Sam Warner, who came at the urging of Nathan Levinson, then Western Electric's west coast representative for public address and broadcasting matters. Sam Warner saw at once that the turning point in the movie industry had come and brought in his two older brothers. The fourth brother, Jack, who was producing their pictures in Hollywood, stayed on the job, probably feeling that he might as well finish the pictures already started, just in case. Harry M. Warner, the eldest and head of the firm, was as enthusiastic as his brother Sam after the demonstration, being particularly struck with a little orchestra number from which he visualized the making of synchronized musical scores to accompany the feature pictures so that, even in the smallest theaters, music composed especially for the picture and played by a great symphony orchestra would be heard.

In the meantime Western Electric had licensed Walter J. Rich to form a company to exploit the sound movies commercially. Rich and the Warners took to one another at first sight and jointly formed the Vitaphone Corporation. By the summer of 1925 plans were under way for making a program of features with which to open at the Warner Theater on Broadway. Production was to start at the old Vitagraph studios in Flatbush, and a small band of Laboratories' engineers found their way there and began installation of recording gear. One of the glass-roofed stages was selected and sound-absorbing material—old carpets from the property room—hung up. In a nearby room the amplifiers, recording machines, monitoring loudspeaker, and recording staff were installed.

There were minor difficulties. Shooting had to be sandwiched between the arrivals of the trains at the Avenue M station which was very close, and a long pole was kept handy for discouraging the pigeons that sat on the roof girders and cooed appreciatively during emotional scenes. Nevertheless, some of the subjects recorded in these circumstances came out reasonably well and one was even used at the opening performance. It was clear, however, that the production plans, which now included a 107-piece orchestra and some large sets, transcended the possibilities of Flatbush and, after Sam Warner and the writer had visited all the likely facilities in the metropolitan area short of Madison Square Garden, the Manhattan Opera House was leased and production started on the grand scale.

The Opera House was void of pigeons, but other nuisances manifested themselves from time to time. When Reinald Werrenrath was to be recorded in a woodland setting, a resourceful member of the technical staff brought in a boxful of field crickets for sound effects and some of them escaped. Entomological note: crickets are difficult to locate and sing loudest when the director says "Quiet."

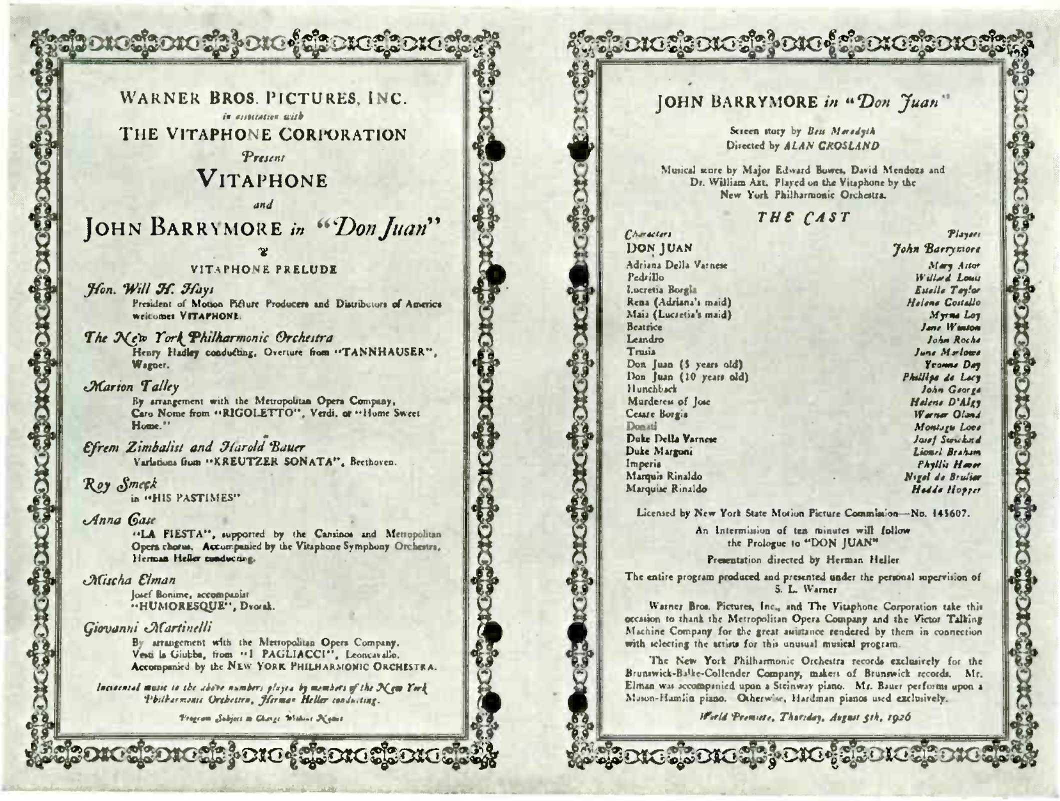
Technical advances made during the production of the premiere features included improvement in playing back from the wax record, which has always been a difficult matter, quieting of the camera (this was enclosed in a soundproof booth on wheels which could easily be moved by eight strong men), extension of the monitoring position out to the neighborhood of the set, and the transfer of recorded material from one record to another, known as dubbing. At the same time the reproducing system was not neglected. J. L. Reynolds produced the "fader" for going smoothly from one record to the next. A remarkable emergency feat of design and production engineering by A. L. Thuras, E. C. Wente and D. G. Blattner resulted in making available in record time an electromagnetic loudspeaker with adequate power capacity for theater use. As the dimensions of the undertaking increased, the operating and development functions were separated, and the writer, with a group of Laboratories' engineers, went on leave of absence to form the engineering department of Vitaphone in May, 1926.

On August 6 the premiere took place. Extraordinary precautions were taken to avoid technical mishaps and everything went smoothly. A special edition of *Variety* hailed it as Broadway's record sensation and the silent picture became obsolete overnight. It was not, however, until a year later when Al Jolson in *The Jazz Singer* introduced singing and speech for the first time in a full-length feature that the rest of the motion picture industry capitulated. The two brief bits of spoken dialogue in this picture had not been planned in the script, but were uttered quite unexpectedly by Jolson, and the first of them, prophetically enough, was the ejaculation: "Wait a minute! Wait a minute! You ain't heard nothin' yet!"

Becoming convinced that it was now "sound or sink," the big producers signed license contracts and the orders for studio recording equipments came in. Western's manufacturing department went into production at an unprecedented speed—five studio equipments wanted at once—the order changed to ten before the ink was dry—fifty equipments under way before the first order was weeks old. To the credit of designers and manufacturers be it said that this equipment, turned out under great pressure and involving highly precise workmanship, remained the standard of quality for many years. In the theater field a similar state of affairs arrived as the exhibitors scrambled to get sound equipment before the supply of silent pictures dried up or the public demand for sound closed their box offices. The talking picture as we now know it did not spring into being at once. First there were "Sound Pictures"—musical accompaniment only, then "Talking Pictures" like *The Jazz Singer*, followed by "All Talking Pictures," and finally "100 per cent All Talking Pictures."

At the end of 1926, Electrical Research Products Incorporated—ERPI—was formed as a subsidiary of Western Electric to handle extra-telephonic matters. ERPI

The synchronized camera used for the first Vitaphone productions being studied by Stanley Watkins, H. C. Humphrey, C. R. Sawyer and A. C. Millard



WARNER BROS. PICTURES, INC.
in association with
THE VITAPHONE CORPORATION
Present
VITAPHONE
and
JOHN BARRYMORE *in* "*Don Juan*"

VITAPHONE PRELUDE

Hon. Will H. Hays
President of Motion Picture Producers and Distributors of America welcomes VITAPHONE.

The New York Philharmonic Orchestra
Henry Hadley conducting, Overture from "TANNHAUSER", Wagner.

Marion Talley
By arrangement with the Metropolitan Opera Company, Caro Nome from "RIGOLETTO", Verdi, or "Home Sweet Home."

Efrem Zimbalist and Harold Bauer
Variations from "KREUTZER SONATA", Beethoven.

Roy Smeck
in "HIS PASTIMES"

Anna Case
"LA FIESTA", supported by the Cansinos and Metropolitan Opera chorus. Accompanied by the Vitaphone Symphony Orchestra, Herman Heller conducting.

Mischa Elman
Josef Bonime, accompanist
"HUMORESQUE", Dvorak.

Giovanni Martinelli
By arrangement with the Metropolitan Opera Company. Vesti la Giubba, from "I PAGLIACCI", Leoncavallo. Accompanied by the NEW YORK PHILHARMONIC ORCHESTRA.

Incidental music to the above numbers played by members of the New York Philharmonic Orchestra, Herman Heller conducting.

Program Subject to Change Without Notice

JOHN BARRYMORE *in* "*Don Juan*"

Screen story by *Bess Meredyth*
Directed by *ALAN CROSLAND*

Musical score by Major Edward Bowes, David Mendoza and Dr. William Axt. Played on the Vitaphone by the New York Philharmonic Orchestra.

THE CAST

Characters	*Players*
DON JUAN	*John Barrymore*
Adriana Della Varnese	*Mary Astor*
Pedrillo	*Willard Louis*
Lucretia Borgia	*Estelle Taylor*
Rena (Adriana's maid)	*Helene Costello*
Maia (Lucretia's maid)	*Myrna Loy*
Beatrice	*Jane Winton*
Leandro	*John Roche*
Trusia	*June Marlowe*
Don Juan (5 years old)	*Yvonne Day*
Don Juan (10 years old)	*Phillipe de Lacy*
Hunchback	*John George*
Murderess of Jose	*Helene D'Algy*
Cesare Borgia	*Warner Oland*
Donati	*Montagu Love*
Duke Della Varnese	*Josef Swickard*
Duke Margoni	*Lionel Braham*
Imperia	*Phyllis Haver*
Marquis Rinaldo	*Nigel de Brulier*
Marquise Rinaldo	*Hedda Hopper*

Licensed by New York State Motion Picture Commission—No. 143607.

An Intermission of ten minutes will follow the Prologue to "DON JUAN"

Presentation directed by Herman Heller

The entire program produced and presented under the personal supervision of S. L. Warner

Warner Bros. Pictures, Inc., and The Vitaphone Corporation take this occasion to thank the Metropolitan Opera Company and the Victor Talking Machine Company for the great assistance rendered by them in connection with selecting the artists for this unusual musical program.

The New York Philharmonic Orchestra records exclusively for the Brunswick-Balke-Collender Company, makers of Brunswick records. Mr. Elman was accompanied upon a Steinway piano. Mr. Bauer performs upon a Mason-Hamlin piano. Otherwise, Hardman pianos used exclusively.

World Premiere, Thursday, August 5th, 1926

The program of the opening performance in the Warner Theater

granted the licenses to producing companies and theaters, and supervised and serviced all installations in studios and theaters. Its engineering department carried out the kind of development work called for by the changing methods of movie production and the growing pressure of competition. ERPI presided over a scene of growth and change: film replacing disc; the freeing of motion picture technique from the shackles of early sound cautiousness—having made the movies talk it was necessary to allow the talkies to move; wholesale theater conversions reaching a peak of more than twenty installations a week; and the rise of many competing sound systems and the fall of some. Talking pictures were soon being made for industrial, medical, and educational purposes.

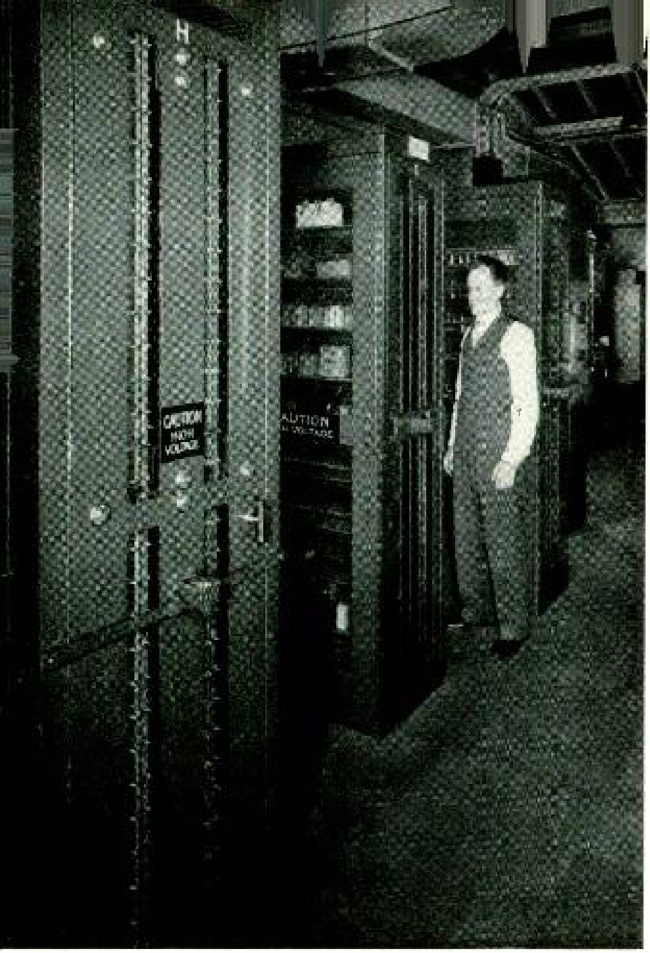
ERPI crossed the oceans, bringing Western Electric Sound to Europe, and to such far places as India, Japan, South Africa and Australia. In England, the company equalled its American record for high-speed conversion of theaters. Studios were equipped in England, France, Spain, Italy and other countries.

In 1937 ERPI stopped supplying sound reproducing equipment to domestic theaters and licensed others to manufacture such equipment. At that time the theater servicing business of ERPI in the United States was sold to a group of its employees who formed Altec Service Corporation. In 1941 ERPI was merged into Western Electric and became the Electrical Research Products Division of that company, continuing to carry on its licensing functions and remaining active in the sound recording equipment field. It maintains a laboratory in Hollywood for carrying on engineering and design of recording equipment furnished to studios, calling upon Bell Laboratories for fundamental development.

One of the biggest things that happened to talking pictures after their launching came about without the public's being conscious of it, namely the conversion to sound on film. It was a foregone conclusion that this would ultimately take place and, as has already been mentioned, the development of sound recording on film was being carried on alongside that of sound on disc in the Laboratories. However, although the status of film recording was such that it might possibly have been used from the start, disc recording had one great advantage at the time in having at its disposal forty years of experience in the commercial processing of the discs, whereas the past experience in the developing and printing of motion pictures was not much help when it came to processing the sound track. It was necessary, before sound on film could be adopted, not only to introduce sensitometric methods into the film processing plants but to persuade the film technicians to change their methods even in handling the picture, in order to get the best results in the combined print. The credit for managing this delicate matter, as well as for working out the new film recording and processing techniques, belongs to Donald MacKenzie, while E. C. Wente again came forward with a major contribution in the form of the electromechanical light valve.

The quality of the sound of motion pictures is not always maintained at the highest level possible. The processing of the sound film is not always faultless, the studio microphone pick-up does not always conform to the principles of acoustic control laid down so convincingly by Maxfield, but, by and large, the sound system has taken its place beside the camera as an artistic tool capable of meeting the director's most exacting demands. And the Laboratories can take just pride in the Western Electric Sound System. Although ERPI and Western Electric withdrew from the domestic theater equipment business on September 1, 1937, about twenty-five per cent of the theaters in the country still use Western Electric Sound Systems installed before that date. Western Electric recording is used in the studios of most of the major motion picture producers, including Paramount, M-G-M, 20th Century-Fox, Universal, Columbia Pictures, and a dozen or so others among which are the Movietone, Paramount and Hearst newsreel companies.

THE AUTHOR: Stanley Watkins was born in England and received engineering degrees in 1908 from London University and from the Imperial College of Science where he taught physics and electrical enginering for the next three years. In 1911 he joined the Western Electric Engineering Department where he worked on development of such devices as ringing systems, public address systems, and, during World War I, anti-aircraft directors and gun ranging systems, before shifting in 1919 to electrical recording. In 1922 he began work on experimental talking pictures and in 1925 was in charge of the Laboratories' group which installed and operated the first commercial sound picture recording system in the Vitaphone Studios at Flatbush. In 1926 he took a year's leave of absence from the Laboratories to become chief engineer of the Vitaphone Corporation during the period when the opening program of sound pictures was prepared and presented. He became director of recording engineering for Electrical Research Products Incorporated in 1927 and was responsible for the layout of sound studios and their recording installations in Hollywood and New York. The years from 1929 to 1936 he spent in England and on the continent as European technical director of ERPI, becoming also a Director of Western Electric Limited with responsibilities that included supervision of engineering, recording, installation, maintenance, merchandising, and local manufacturing departments. In 1937 he returned to the Laboratories where he has since worked on such projects as the Voder, which was displayed at the New York World Fair's Bell System exhibit of which he was an assistant manager; experiments in visible speech; and research on disc recording. World War II brought him back to electrical gun directors, this time to write textbooks and organize instruction courses in their use.



Capacitor Life Testing

By J. R. WEEKS
Transmission Apparatus Development

THE capacitor—essentially two metal sheets separated by a thin layer of dielectric—forms an indispensable part of nearly every communication and electronic circuit. If this critical link fails, it usually does so without giving any previous warning; a single failure may completely interrupt a circuit. So tests which can insure adequate capacitor life are a matter for constant study at the Laboratories in the process of engineering the capacitors of the Bell System.

It has been known for many years that dielectrics such as impregnated paper deteriorate when subjected to continuous potentials and the rate of deterioration rapidly increases as both the applied voltage and operating temperature increase. Internal electrolytic action is the usual mechanism of deterioration and ultimate failure. To achieve a good design, it is necessary to choose materials and operating stresses (volts per inch of dielectric thickness) so that only a negligibly small portion of a group of capacitors will fail within the life span of the circuit or equipment in which they are used. Although one might characterize the life of such a design as "indefinitely long," this would be a misnomer. Actually if service were continued for an additional period, the failure rate would eventually become excessive and all of the capacitors would fail.

Groups of capacitors follow various mortality patterns, depending on the materials employed and their sensitivity to electrolytic deterioration. The failure patterns commonly found in paper capacitors representative of a high-quality product are illustrated in Figure 1. As shown in this figure, the spread between the initial failure and the complete failure in groups of capacitors of the same kind is extremely large, even though every effort is made to control the uniformity of the materials and processing treatment. The time interval to points of 5 per cent failure occurs in one-third to one-tenth of the time required for 50 per cent failure. Moreover, the time interval for the initial failure is one-quarter to one-twentieth of the time required for 100 per cent failure.

If materials could be obtained which were inherently uniform in their mechanical, electrical, and chemical characteristics, and further if capacitor manufacturing processes could be devised which would result in a highly uniform product, it would be economical to design capacitors so that no failures would occur until after they had operated for their normal life span, after which the entire group would fail in a relatively short time. Such designs would not need to employ the relatively large safety margins now necessary and would in general be smaller and might be much cheaper. This ideal condition for materials and manufacturing procedures has not yet been realized.

To design on the basis of no failures under actual service conditions would in general involve unreasonably large size and cost. A study of accelerated life test data and the nature of the failures has led to the conclusion that a more reasonable and acceptable basis is to aim for about a 98 per cent performance over the normal life span of the equipment. On this basis, the average life of a group of capacitors will be three to ten times that required of the equipment.

From tests made on groups of capacitors of the same construction at various voltages and temperatures, the relation of the mortality curves to voltage and temperature can be determined and the expected life predicted for the actual operating conditions. A great amount of data has been accumulated over the past fifteen years, particularly on paper capacitors from which relationships between voltage, temperature and life have been established. For example, the life on direct voltage has been found to vary inversely as approximately the fifth power of the applied voltage for all the common types of paper capacitors. With the life thus critically dependent on the applied voltage, it is important for the capacitor engineer to know all the operating conditions, including estimates of the operation at abnormal voltages. The relationship between operating temperature and life is not as well established, but over the usual operating temperature range of 20 to 80 degrees C., present test data indicate that the life is halved for each 10 degrees C. increase in operating temperature. Hence it is essential to choose the proper design for high temperature operation or to locate the capacitors in the cooler parts of the equipment away from heat-producing components.

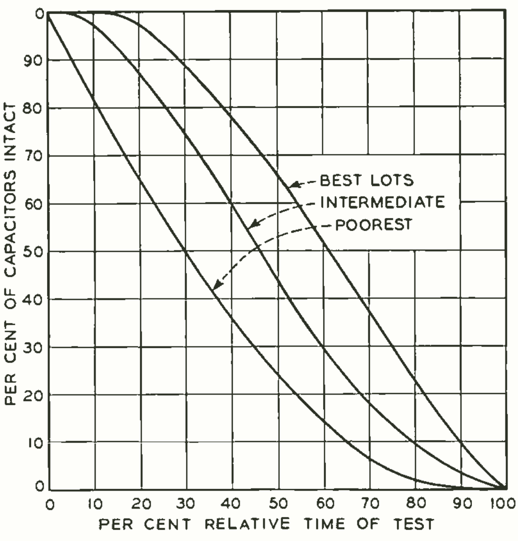


Fig. 1—Typical mortality patterns for impregnated paper capacitors of high quality under continuously applied voltage

With these relationships known, the probable life can be obtained by means of tests of relatively short duration—usually about two weeks—conducted under conditions which greatly accelerate the rate of failure. In a typical test, a group of twenty paper capacitors may be subjected to a life test at 1,000 volts d-c with the temperature held at 85 degrees C. for fourteen days with only one failure occurring. Then by using the fifth power rule it can be estimated that at least 95 per cent of the capacitors would be intact when operated continuously for fifteen years at 300 volts d-c and 85 degrees C. If operation were intermittent or if the maximum temperature occurred for only a small portion of the total operating time, the life would be much longer.

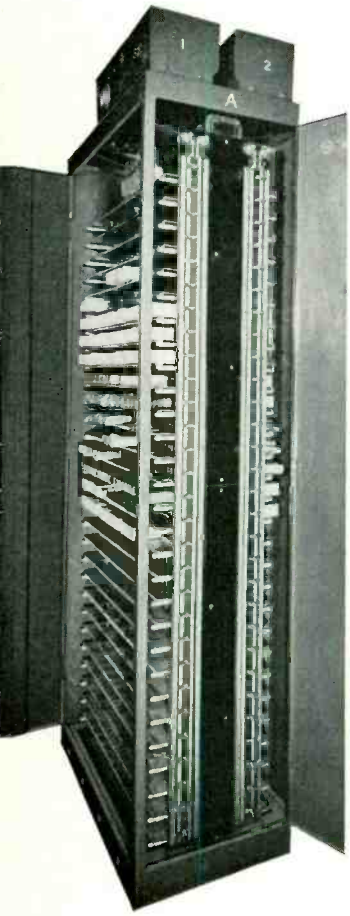
So valuable has the accelerated life test proved not only as a design tool but also as a check on manufacturing quality that the Laboratories has developed elaborate testing facilities capable of testing 10,000 capacitors at the same time. This equipment is arranged for testing individual groups of capacitors at thirty-five different test voltages on direct potentials up to 20,000 volts d-c and at ten test voltages on a-c potentials up to 11,000 volts at 60 cycles. Provision is also made for tests over the temperature range of —40 degrees C. to 110 degrees C. More than 30,000 capacitors have been individually tested over periods ranging from a few days to ten years since initiation of the program some fifteen years ago.

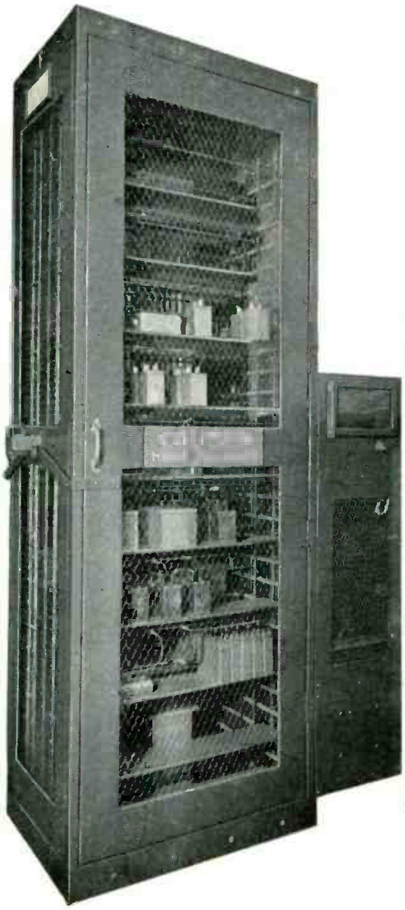
This systematic testing has disclosed the potentialities of dielectrics as well as defects and variables which often could not be foreseen. Interpreted in the light of chemical and physical theory, test results have yielded a steady stream of information for making capacitors capable of standing up under increasingly higher temperatures and voltage stresses. Notably the tests were used to reveal and evaluate the enormously destructive effects of heat on some capacitor types under direct voltage and of severe cooling on others.

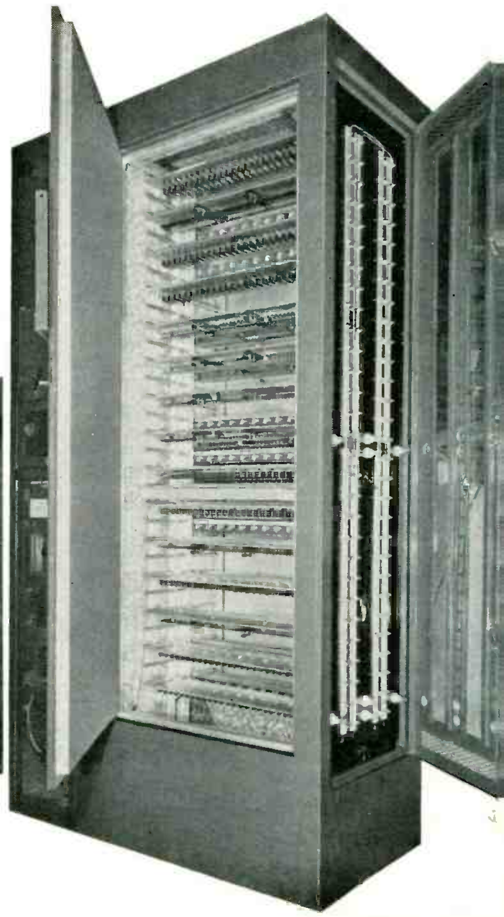
A typical cabinet used for testing large numbers of central office and station set capacitors at room temperatures on potentials up to 500 volts is shown in Figure 2. The cabinet in Figure 3 tests up to 6,000 volts d-c high-voltage capacitors used in radio and public address equipment. Voltages are supplied by full-wave rectifiers with well-filtered outputs. The cabinet in Figure 2 provides two voltages simultaneously through two separate rectifiers; that in Figure 3 involves four voltages which are obtained from a single rectifier by means of a potential divider. The capacitors are connected together in groups with a single fuse, it being impractical to fuse each one in view of the large number always on test. The fuses are located behind a glass panel on the front of the cabinet. For Figure 2, where paper capacitors tested have standardized terminals, the shelves for the capacitors are provided with spring contacts so that a capacitor needs only to be plugged in. In the other cabinets, due to the multiplicity of the sizes and terminal arrangements involved, the plug-in method of making a connection is not feasible and the capacitors have to be wired to the cabinet terminals. Daily inspection insures that short-circuited capacitors are promptly removed and the remainder in any one group restored to test. All cabinets are equipped with safety locks and short-circuiting devices in duplicate to insure that the voltage is off and all capacitors are discharged before the doors can be opened.

A typical cabinet for elevated temperature tests is shown in Figure 4. It differs from the room-temperature cabinets in that the side walls and doors are provided with

Fig. 2 (left)—Cabinet for life-testing large numbers of central office and station set capacitors. Fig. 3 (center)—Life-test cabinet for testing high-voltage capacitors on potentials up to 6,000 volts d-c. Fig. 4 (right)—Thermally insulated cabinet for life-testing capacitors at elevated temperatures while under continuously applied voltage





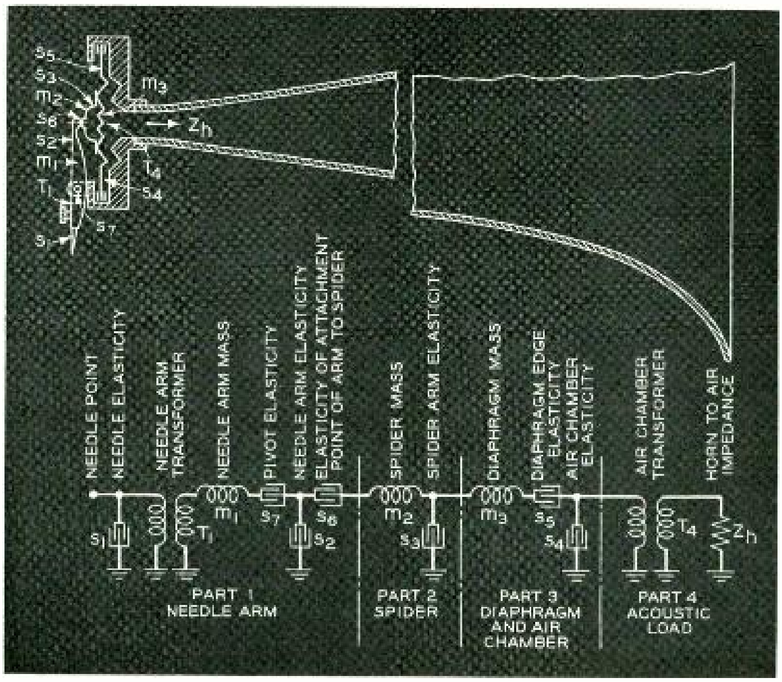


a thick layer of rock wool heat insulation. Thermostatically controlled hot air is circulated by means of a blower. A control mechanism holds the temperature constant to within plus or minus 2 degrees C. For special tests involving only a few capacitors, temperature-controlled boxes are available which are arranged to mount on the shelves of any of the room temperature cabinets and which utilize the power supply and safety devices of the larger cabinet. Capacitors in these boxes may be kept at subzero as well as elevated temperatures while under voltage. The general layout of the present life-testing room with its twelve cabinets is shown in the headpiece.

Most recent addition to the life-test equipment is one designed by the Chemical Laboratories and intended for very short-time test primarily to make a rapid evaluation of the quality of capacitor paper before its use in commercial capacitors. The failure process is accelerated about 1,500 to 1 by operating the capacitors at temperatures up to 130 degrees C. and under high-voltage simultaneously. This cabinet differs from the others in that each of its ten test positions is equipped with an individual circuit breaker and electric timer. It is thus possible to measure the exact time from the start of the test to the time of failure to within six minutes. In view of the very high acceleration used, life tests in this cabinet rarely last more than 200 hours.

When war came there was an unprecedented demand for capacitors for Western Electric equipment supplied to the Armed Forces and capacitors poured in from many different suppliers. At once a sieve was needed to weed out capacitors prone to failure. With the aid of these facilities, life tests were conducted on some 15,000 representative samples. Utilizing the vast body of data accumulated over the years, it was possible to set up accelerated tests to predict within two weeks or even a few days the probable life of a particular type or manufacturing lot under the expected operating conditions of tropical heat, arctic cold or of fluctuating temperature. Typical life test data made available to the Armed Services assisted materially in the formulation of life-test requirements for the AWS and JAN specifications prepared to insure adequate performance under the severe conditions of military service.

THE AUTHOR: After graduating from Sheffield Scientific School at Yale University in 1914 with the degree of Ph.B., J. R. WEEKS joined the student course of the Western Electric Company at Hawthorne. On completing this course, he transferred to the Research Department in New York where he worked on the manufacture of the vacuum tubes for the Arlington-Paris transatlantic radio-telephone studies. During World War I he served in the Signal Corps and received a commission just after the Armistice. Since 1920 he has been associated with the Apparatus Development Department. He was first occupied with studies of insulations, principally of rubber for submarine cables, and during 1923 assisted in laying and testing the submarine telephone cable between San Pedro and Catalina Island. He then engaged in the design of loading and retardation coils for filters and networks, and later transferred to the development of capacitors. During World War II he developed and supervised testing of capacitors of all types and varieties for the Armed Services.



Historic Firsts:

The Orthophonic Phonograph

IN 1877 Thomas A. Edison cut his first phonograph records, thus providing a new form for musical expression, and laying the foundations for an entirely new industry. It was a brilliant and useful invention, but the small amount of power in the original sound waves seriously handicapped this new art. At practical recording distance, the average power in ordinary speech sounds is much less than a millionth of a watt per square inch. With this extremely low intensity of power, a very large area had to be spanned by the mouth of a sound-gathering horn so that after transmission through the horn and a diaphragm and linkage of mechanical elements, it would be sufficient to force the stylus to cut the record. Even when this was done, many portions of the speech syllables and many of the harmonics were of so little power that they were unable to record themselves at all. For even the modest results obtained, the musicians and singers had to be crowded close to the recording horn, and the weaker strings had to be reinforced by artificial means. The problems to be solved in reproducing were about as great and of the same general character as in recording.

During the forty years following Edison's invention, many ingenious methods were devised to reduce the restrictions caused by the very limited power available. During the latter part of this period, however, a new science was rapidly developing; that of the electrical transmission of sound frequencies. The theory of electrical transmission over telephone lines, including those containing lumped inductances and capacitances,* had been worked out, and important new instruments were being developed. Those of particular value to the phonograph were a condenser microphone† to faithfully transform the sound to electrical waves, and a vacuum-tube amplifier to increase the very small output from the

*Record, *August*, 1943, *page* 445.
†Record, *July*, 1943, *page* 394.

microphone to the power needed for cutting.

The possibility of applying this new science and those new devices to sound recording and reproducing was recognized in the Laboratories at least as early as 1915. In a memorandum from H. D. Arnold to E. H. Colpitts dated June 7 of that year, Dr. Arnold pointed out that the new transmitters, receivers, and telephone repeaters should make it possible to cut records and reproduce from them with much better quality than had been obtainable with the methods used before.

Familiar with this new science and the instruments it had made possible, H. C. Harrison developed a recorder (Patents 1,678,116 and 1,663,884) in which the armature, the cutting stylus, the connecting shaft sections, and a rubber transmission line were combined as elements of an electromechanical network. He was able to use electrical transmission theory as a basis for this recorder because he recognized that in mechanical transmission systems, masses are analogous to electrical inductances as elements for storing kinetic energy. Similarly, compliances are analogous to capacitances as elements for storing potential energy. Mechanical resistance was provided by using a soft rubber rod in torsion. Such a rubber rod is a high-loss transmission line, and hence can be used as a mechanical resistance. At the armature, which is the coupling point between the electrical and mechanical transmission systems, the impedances of the two systems were matched.

With the completed recording system including a condenser microphone, an amplifier and the rubber-line recorder, the orchestra and singers could be in their usual positions for a concert, instead of crowded around a horn as for the earlier recordings. On the finished records, all the important components of the music were present with satisfactory volume range and a frequency range of five to six thousand cycles instead of the former three thousand.

With the problem of the recorder worked out, Mr. Harrison developed an acoustic phonograph (Patent 1,730,425). It was designed as a mechanical transmission system, beginning at the needle point driven by the undulation of the groove in the record. The compliances and masses were proportioned to transmit the full range of frequencies to the diaphragm, which as a mechanical-acoustic transformer transmitted the mechanical vibratory energy to the tapered acoustic transmission line of the horn. The horn was curved logarithmically and was given such a rate of taper that the full range of frequencies was transmitted, and such a length that the mouth was large enough to radiate the low frequencies. To secure a compact unit incorporating the comparatively long horn that such a design made necessary, the horn was folded back on itself so as to fit in a moderate space.

With the new records and this new phonograph, reproductions were obtained which approached the original rendition in quality. The matched transmission-line phonograph was announced publicly under the name "Orthophonic" on October 6, 1925, at a dinner given at the Waldorf by the Victor Talking Machine Company, who had been licensed under the Western Electric Company patents. Since then, a number of improvements and modifications have been made, and electrical reproduction is widely used to make the electrical recordings an adjunct of the radio, but in these and in the further extensions of sound recording and reproduction to motion pictures, many of the same underlying principles have been responsible for the high-quality reproductions obtained.

A Battery-Ground Pulse Repeater

By W. H. SCHEER
Switching Development

In step-by-step dial offices there are ordinarily no such devices as senders to store the pulses from the subscriber's dial and send them out as needed. The pulses operate the various selectors directly. This brings in no particular difficulty when the call is to a subscriber in the same office as the calling subscriber, but when the call has to be extended over a trunk to another office, the added resistance of the trunk may weaken and distort the pulses to such an extent that the selectors at the distant office may not operate properly. To avoid this difficulty, pulse repeaters* are associated with the originating end of each inter-office trunk. Relays in these repeaters respond to the subscribers' pulses and send out new pulses to the distant office. The repeater that has been in use for a number of years was designed to operate satisfactorily over trunks up to 1,200 ohms resistance, which covered most of the trunks used at that time. For the comparatively few trunks of higher resistance, pulse correctors were employed, which completely reformed the pulses.

With the increase in the number of dial offices in recent years, and the expansion of the dialing areas, there has also been a trend toward smaller cable conductors. As a result, the resistance of inter-office trunks has gone up. While few trunks exceeded 1,200 ohms some years ago, many of them do at the present time, and the number will undoubtedly increase. To use pulse correctors on all these high-resistance trunks would be expensive, and to avoid it, a new pulse repeater has been developed that will repeat pulses satisfactorily over trunks up to 2,000 ohms resistance.

When a call is to another subscriber in the same office, talking battery is supplied to both subscribers from the connector—the last switch in the chain. When the call is to another office, however, battery to the originating subscriber is supplied from the pulse repeater. This is one of several functions the repeater performs in addition to repeating the pulses. For supplying this talking battery and repeating the pulses, three relays are required. In the earlier type of circuit, these were connected as shown in Figure 1. The leads from the calling end of the line connect to two windings on the A relay, through which talking battery is supplied. The two condensers at the left block the flow of this direct current over the inter-office trunk, but readily pass the varying talking current.

When the repeater is seized, the A relay at once operates—operating relay B. Operation of A and B closes a connection to the outgoing trunk. Current flowing over this path operates a similar A relay in the distant office. When A of Figure 1 releases at the open interval of the first pulse, C is operated and establishes a direct low-impedance path for the flow of current from the A relay and battery in the distant office.

*Record, *January*, 1931, *page* 238.

†Record, *May*, 1929, *page* 361.

Each subsequent open circuit caused by the subscriber's dial then momentarily opens the trunk circuit and transmits the pulses to the distant office. Relays B and C are both of the slow release type and remain operated during pulsing. At the end of each sequence of pulses representing one digit, and at the completion of pulsing, A is held operated and thus holds B operated, but C releases because its ground connection is opened at A.

Associated with the A relay in the distant office is a similar slow release B relay which serves to hold the connection established while A is following the dial pulses. Successful repetition of the pulses depends, among other things, on this B relay at the distant office remaining operated during the open periods of the pulsing. Whether it will do so depends on the length of time that the distant A relay is operated during the closed periods of the pulses.

The operated period of the A relay at the distant office depends on the resistance of the trunk. If this is high, the time for the current to build up in the trunk and operate the distant A relay will be long, and there will be a relatively long delay between the operation of A at the calling office and the operation of A at the called office. As a result, A at the called office will be operated only a very short time before the next open period, and ground will be supplied to the B relay for an equally short period. After this, the core of B will not be sufficiently saturated to enable the relay to hold operated during the open periods of the pulses, and the call will be lost.

To insure that the B relay at the called office will not release during pulsing, even when trunks of resistance as high as 2,000 ohms are employed, the repeater circuit shown in Figure 2 was designed. Like Figure 1, this shows only the A, B and C relays of the repeater circuit; other relays, concerned with supervisory signals, are omitted from both drawings. The operation of the A, B and C relays during pulsing is the same as with Figure 1, but there the operation of C merely short-circuited the trunk to provide a low resistance path for pulsing. With the circuit of Figure 2, however, the operation of C removes a D relay, not shown in Figure 2, grounds the side of the trunk that has battery connected to it at the distant office, and connects battery to the side of the trunk that is grounded at the distant office. In this way the trunk is operated with battery at each end, and thus with much higher resistance in the trunk, the distance A relay will operate quickly, and its periods of operation during pulsing will be long enough to enable B to remain operated over the open intervals.

Besides supplying battery and repeating pulses, the pulse repeater must also provide for transmitting supervisory signals from the called to the calling office. After the called subscriber answers, relays at the called office reverse the battery connections to the trunk as an indication of the

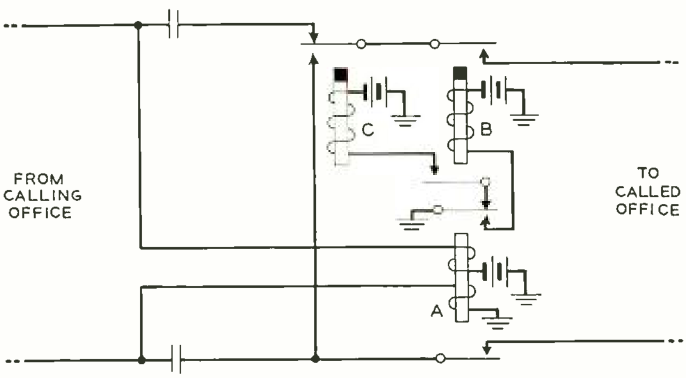


Fig. 1—Pulsing section of earlier type pulse repeater

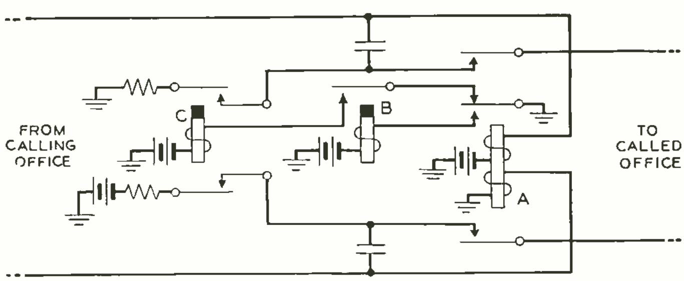


Fig. 2—Pulsing section of new pulse repeater for high-resistance trunks

The Author: W. H. Scheer majored in mathematics and physics at Doane College, and after graduating with an A.B. degree in 1929, at once joined the Technical Staff of the Laboratories with the Systems Development Department. He has worked on panel tandem, step-by-step switching, dial pulse repeaters, and relay problems. During the war he engaged in developments for torpedoes, but has now returned to Systems Development, where he is working on crossbar switching systems.

fact, and the pulse repeater must be capable of transmitting this signal back to the circuits at the calling office. With the earlier pulse repeater, this was effected by relays P and D, and coil E, which in Figure 3 are shown added to the circuit of Figure 1. A polarized relay, P, remains unoperated with the direction of current existing during the pulsing period. The reversal of battery at the called office after the subscriber has answered operates P, which in turn operates D. The operation of D reverses battery to the calling office and also adds a second winding of E in series with the winding of P, to increase the shunt impedance and improve the talking conditions of the circuit.

In designing the new pulse repeater, this part of the circuit has been considerably simplified by eliminating both P and E. In place of the D relay used before, an electropolar relay of the 251-type is used. Figure 4 shows the complete circuit for the new repeater, and is like Figure 2, but with relay D and an extra contact on C added. While C is operated during the pulsing period, the winding of D is disconnected from the circuit at M, but is connected when C releases at the end of pulsing. Relay D does not operate, however, until battery has been reversed at the called office. It then operates and reverses current to the calling office.

Since the new pulse repeater requires only four relays, two of the circuits can be mounted on the standard repeater plate that carried only one of the former circuits. One of these plates is shown under test in the photograph at the head of this article. Crosstalk between circuits is prevented by a magnetic shield mounted in the cover. In addition to securing a longer dialing range, the new design has the further advantage of greatly reducing the space required for the repeaters in the calling office.

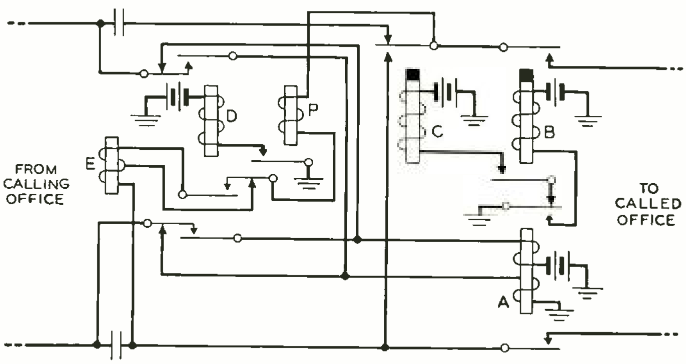


Fig. 3—Supervisory features of the earlier pulse repeater are shown at the left

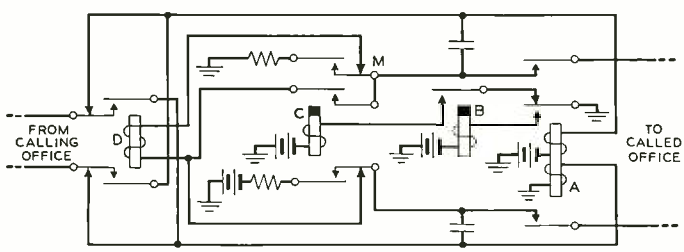


Fig. 4—At the left is the circuit for the new pulse repeater showing supervisory features

Polly Gets the Japs

By L. VIETH
Transmission Instruments Development

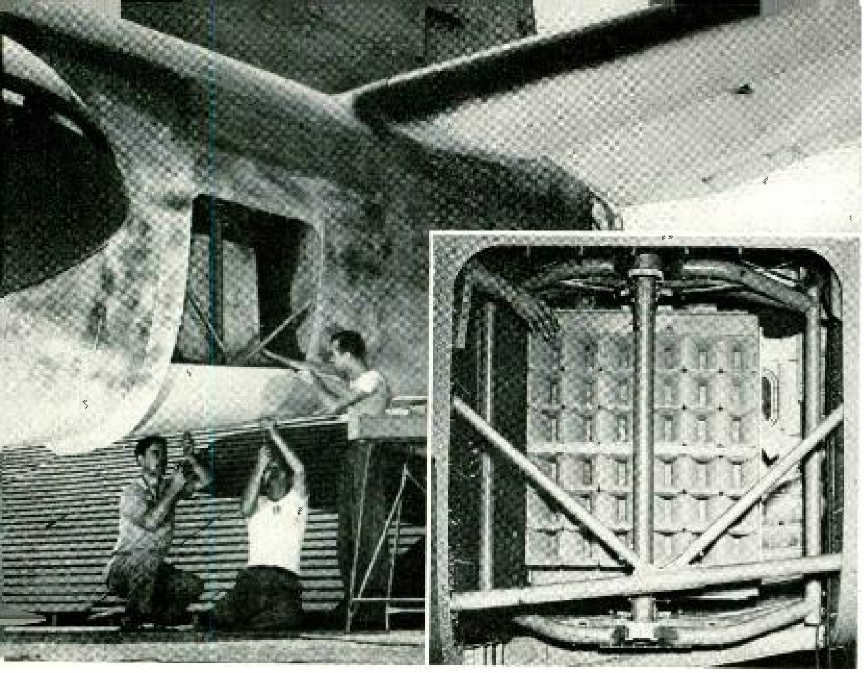
AFTER V-J Day, voices two miles up in the sky blasted the news of unconditional surrender to isolated Japs still holding out in jungles, caves and swamps on remote islands of their extensive stolen empire. This new airborne public address equipment was rushed to Japan to assist in the enormous task of disarming Jap fighting men and in directing civilian movements.

On May 14, 1945, the Navy ordered this airborne public address system, known as the "Polly Project," and requested that it be delivered within one hundred days for installation in three four-engine PB4Y-2's, as shown in the photograph above. Bell Laboratories completed the design and the Western Electric Company manufactured the equipments and made them ready for shipment within the short time of eighty-four days. They were 2,000-watt systems capable of being heard and understood on the ground from a height of 10,000 feet.

The Navy order was a direct tribute to an older "Polly" equipment delivered in the early part of 1944. This latter was a 500-watt system with a 5,000-foot ceiling, and was used successfully for battering down the Jap will to resist on Wotje, Saipan, Iwo Jima, and Okinawa in the last stages of the war. "Polly" was first directed at Jap ears on Wotje Atoll after months of training at Cherry Point, N. C., and Oahu Island in Hawaii. Flying at 2,700 feet, within machine-gun range, a twin-engine Ventura PV1 slowly circled the atoll, and then sounded off, saying: "Attention, Japanese soldiers of Wotje Atoll, attention!" A short news broadcast followed, then a selection of Japanese popular music, a short propaganda talk, and finally more news. The whole program took about fifteen minutes, and was given twice.

The first time this program was given, not one of the 5,000 Japs known to be isolated on that by-passed island could be seen. The next day, when the program was repeated, Japs gathered in little groups waving their arms wildly, obviously trying to guess what it was all about. That was the only time the "Polly" crew saw the Japs, because on the third occasion the Japs shot at them with everything they had. The plane was hit, and after that "Polly" never flew below 5,000 feet. At that height the speaking area covered on the ground was about three-quarters of a square mile.

Every day for two weeks the voice from the sky worked on the Japs. They were told to watch for an American landing craft which would land some day soon and pick them up. When the LCI beached on the atoll, only nine ragged Japs appeared for surrender. In subsequent campaigns, how-



Loudspeaker compartment in the body of a PB4-Y. One of the loudspeaker units is shown in the insert

ever, the bag of prisoners increased rapidly.

These sky programs emphasized straight news broadcasts to isolated Japs completely ignorant of the war's progress. Promises of good food, medical aid and fair treatment helped coax the Nips into surrendering. The broadcasts kept pointing out the futility of suicide or further fighting. "Killing yourself won't help Japan's future," bellowed the loudspeaker. On islands occupied by our forces, the Japs were ordered to report to a certain location. On bypassed islands they were told to wait for a landing craft.

After Wotje, "Polly" moved on to Saipan and Iwo Jima. Every day the flack grew thicker, a testimony to the threat of "Polly" to Jap morale, as verified by close questioning of Jap prisoners. "Polly" landed on Okinawa one month after the invasion. By that time the plane was so badly battered it soon had to be abandoned after first removing the equipment.

"The Western Electric equipment was even tougher than the plane," said one of the "Polly" crew. "It's amazing how it withstood terrific heat, coral, salt water, and high-pressure wear and tear without once going into a blink. Not even one tube had to be replaced."

"Polly" was especially effective when searching large areas for missing personnel. It systematically covered hundreds of little islands in the search for Lieutenant General Millard F. Harmon. Broadcasts directed the natives to report on the beach for questioning. They were asked from the sky if they had seen traces of the plane, floating wreckage or other evidence, and instructed to answer "yes" by standing up and waving their arms, or "no" by sitting down. In a few hours "Polly" covered all the islands—a three-day task by any other means.

As a result of these experiences, the Navy specified that the new "Polly" should be capable of operating at a height of 10,000 feet so that the plane would be out of range of machine-gun fire. This meant that a completely new system had to be designed which would have four times the power, and appreciably less weight per watt output.

The principal elements of the new "Polly" are a 2,000-watt amplifier, a loudspeaker capable of handling this power, microphones, magnetic wire recorder-reproducers and control panels. This system is powered from the plane's storage battery, eliminating a gasoline-engine-driven alternator required by the old "Polly." The amplifier consists of four separate 500-watt channels, which work into separate sections of the loudspeaker. Each of the four sections comprises a three-by-three assembly of nine horns, each horn being powered by two receiver units of the same type used in the Battle Announcing and Beachmaster Systems.* The four-channel arrangement provides reasonably good insurance against total failure, since the system will still function, although at a lower ceiling, as long as one of the channels remains in operation.

Microphones are provided for direct broadcasting, and in addition, two magnetic-wire recorders are provided to permit

*Record, *January,* 1945, *page* 193; *and July,* 1946, *page* 261.

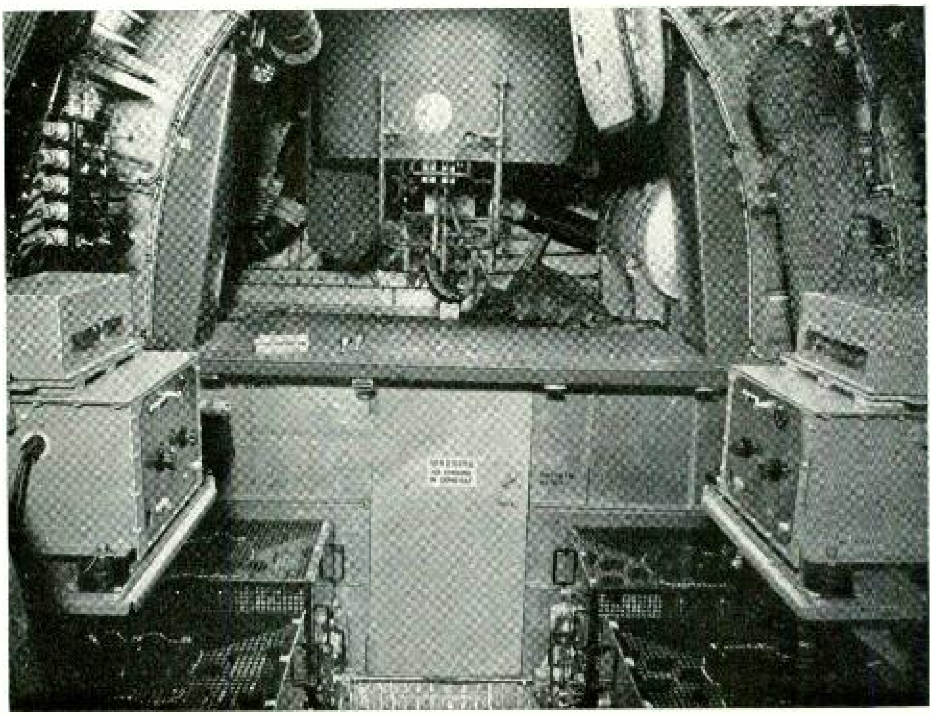
continuous broadcasting of previously prepared messages or the recording of information broadcast from the microphones. Two control panels are supplied to give the flexibility needed for switching from live to prepared broadcasts, and for connecting to the intercommunication system with which the plane is equipped.

"Polly" is capable of creating a sound intensity level in the speech range of about 131 db at a point on the sound axis 30 feet from the loudspeaker. The major part of the energy is radiated through a cone of 40 degrees.

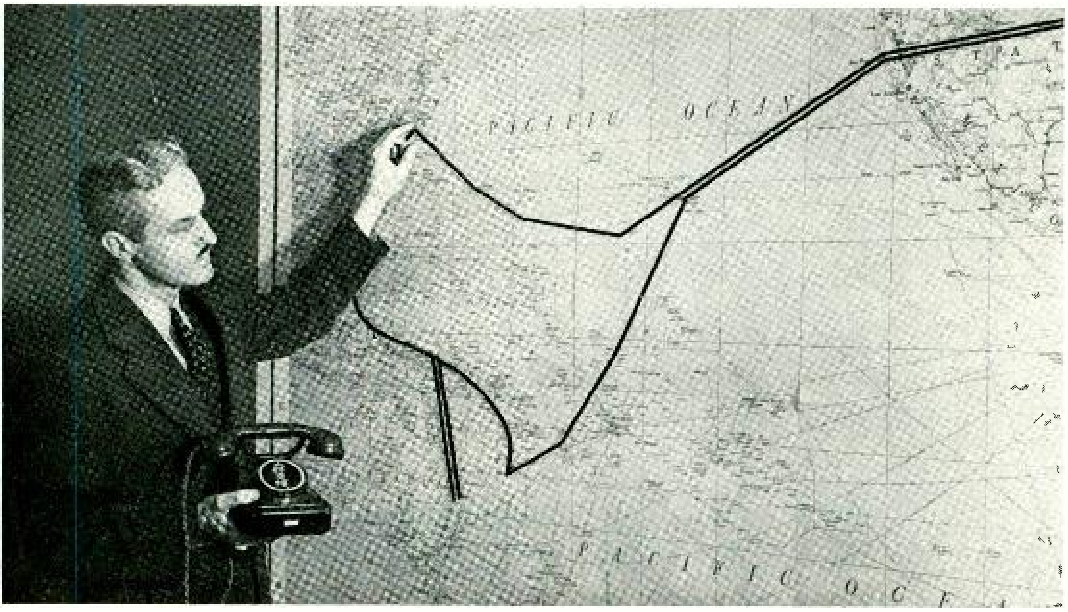
Bell Laboratories' engineers supervised the building of the equipments at the Western Electric Company and later cooperated in installing and testing the equipment in all three planes at the Naval Aircraft Modification Unit at Johnsville, Pa. Each plane took off for Guam and points west as soon as the final installation tests were completed.

Now that the war is over, broadcasting from the new "Polly" will seem like child's play in comparison with the hazards encountered by its predecessor. Such broadcasts were an important part of the task of organizing the capitulation of the many stranded Jap outposts.

THE AUTHOR: L. VIETH was associated with transmission instrument development and design from 1919, when he joined the Laboratories, until 1928, when he transferred his activities to the development of sound recording and reproducing instruments. He later spent several years developing coin relays and associated apparatus, but with increased activity in our defense program he returned to acoustic work. During the war he was occupied exclusively with the development of high-power public address systems.



Interior of the PB4-Y showing amplifiers (bottom, left and right), magnetic wire recorder-reproducers (center, left and right) and control panel (upper left)



Medal for Merit to R. I. Wilkinson for Service to Air Force

FOR exceptionally meritorious conduct, the Medal for Merit was presented to Roger I. Wilkinson on June 19 by Major General St. Clair Streett, commanding general of the Strategic Air Command. The citation, which was read by Colonel Harris Scherer, says in part:

"Mr. Wilkinson by virtue of his remarkable statistical insight, his extraordinary knowledge of theoretical electronics, and his devotion to duty in working night and day on the problem, isolated the causes of the failure of one part of the early warning radar defense system and devised new types of test equipment, established test standards, and recommended Standard Operating Procedures to correct the faults in the maintenance and use of the equipment. Mr. Wilkinson's zeal to overcome all difficulties, and his tact and perseverance, led to the adoption of the completed program in the Far East Air Forces, and the system worked with extraordinary effectiveness in later combat operations. Mr. Wilkinson's brilliant, tireless, and painstaking efforts have contributed immeasurably to the tactical effectiveness of the Far East Air Forces by greatly improving the air defense of our bases in the Southwest Pacific Area."

Roger Wilkinson left the United States in October, 1943, but the story really begins in England, when British scientists attached to radar units showed how helpfully they could apply their brains to other technical problems of their army. Teams of advisors were organized, and so favorable was the experience of our own Eighth Air Force that a similar procedure was authorized for all of our Air Forces. Accordingly, General Twining of the Thirteenth Air Force invited Dr. Robert L. Stearns, president of the University of Colorado, to recruit and lead such a team of operations analysts in the South Pacific theater. Mr. Wilkinson left our School for War Training to become the radar specialist; other fields represented were communications, meteorology, personnel fatigue, gunnery, ballistics, mathematics and statistics. The group, nine in all, assembled at Espiritu Santo; the next stop was at Guadalcanal, where Mr. Wilkinson met another Laboratories man, E. H. Sharkey, who was doing field engineering on an airborne radar bombsight.* One of Mr. Wilkinson's early problems was to readjust the fuse delay on the medium-altitude magnesium photographic bomb so that when dropped from low altitude it would explode

*Record, *December*, 1944, *page* 617.

before it hit the water. The answer: a parachute to slow the fall, and then a larger propeller to drive the fuse mechanism. Other studies on low-altitude radar bombing techniques based on analyses of past runs resulted in significant improvements in the probabilities of hitting the target ships.

Identification by radar of friendly planes was a real problem, for A-A gunners would all too often have to withhold their fire until the bombs began to drop lest they bring down one of their own ships. Operation of the electrical device (IFF) which gave back the identifying signal was dependent on assiduous squadron and signal repair company maintenance. After a lot of hard work toward this end—and not the least of it in developing an insistence on a final check just after take-off—satisfactory results were achieved.

As the campaign progressed, Mr. Wilkinson moved up with Air Force Headquarters, and at once found himself a ballistics expert. At Morotai, the Japs were so close to the air field that they were inside the minimum range of the 105-mm howitzers. He was asked to calculate firing tables for reduced powder charges which would drop shells in closer. Although a civilian, on Morotai he kept a carbine handy against nightly threats of invasion from both land and sea.

An example of what a civilian, free from local military loyalties, could do was demonstrated in Mr. Wilkinson's study on night fighter interception. The "kill" at Noemfoor and later at Morotai was not up to the Commanding General's* expectation. Mr. Wilkinson showed that a vigorous program of preventive maintenance of the airborne radars was essential. His analysis of hundreds of P-61 Black Widow performances also indicated that greatly increased practice was needed in daylight under closely simulated enemy interception conditions. Considerable diplomacy was necessary to get these ideas adopted, but the end result paid off gratifyingly well.

After sojourns at Leyte and Manila, during which Mr. Wilkinson assumed the duties of the chief of the operations analysis section in the Thirteenth Air Force, the war ended; and Mr. Wilkinson was asked to proceed to Japan to investigate electronic developments there. The following quotation from a recent Associated Press interview tells briefly what he found:

"During much of the war, concentrated development of radar was neglected under the Japanese psychology of offensive because the devices were considered primarily defensive.

"On surrender day," Wilkinson said, "the Japanese were three years behind the Allies in development of fire control and air radar devices because of faults in military policy and liaison. The Japanese utilized only about 10 per cent of available scientific talent for war purposes. Jealousies between the Nipponese army and navy added further handicaps.

"As an example, the army required one of the electronic centers to develop an entirely new radar device—including the design of new tubes—for a certain purpose, even though a satisfactory set already had been developed for the navy. In other instances, scientists on separate projects were not permitted to exchange information, and the military did not permit technicians to observe field operation of apparatus.

"Japanese electrical equipment," said Mr. Wilkinson, "was highly efficient, well designed, and workmanlike."

"The errors on the part of the military in Japan are now well appreciated by all Japanese ex-military, academic and industrial leaders,"

Major General St. Clair Streett presents the Medal for Merit to Roger I. Wilkinson

*This was General Streett, who had replaced General Twining in command of the Thirteenth Air Force.

From a transmitting antenna on the roof of the Yankee Stadium, its position indicated by the arrow, the microwave radio beam passes over a line-of-sight path down the canyon that is Fifth Avenue to the above receiver on the roof of the penthouse of Long Lines at 32 Avenue of the Americas

A microwave receiving antenna, forming part of the TE-1 radio television system designed for studio-transmitter links, was installed on the roof of the Long Lines Building to receive television signals of the Louis-Conn fight from a similar antenna on the roof of the Yankee Stadium

he added. "They would not make the same mistake again. Thus it would be folly to discount the potential ability of Japanese scientists, with proper leadership and organization, to make a creditable showing in inventing and building all kinds of electronic devices in competition with ourselves or any other nation."

During his quest, Mr. Wilkinson interviewed many scientists and military men and was frequently entertained. The night before his departure for the States (in November, 1945) Vice-Admiral Nawa, Chief of Navy Electronics research, gave a dinner in his honor. This was typical of the Japanese attitude, Mr. Wilkinson said.

Television for the Louis-Conn Fight

For broadcasting television pictures of the Louis-Conn fight on the night of June 19, the National Broadcasting Company used Bell System television cable circuits from the Yankee Stadium at 157th Street in the Bronx to their control room in Radio City. From the Radio City control room, the television signals were transmitted over the New York Telephone Company's coaxial cable to the Empire State Building for broadcasting, and also over video cable pairs to the coaxial room in the Long Lines Building at 32 Avenue of the Americas. After amplification here, the signals were sent over a coaxial circuit to Washington for broadcasting there, and were also available for monitoring receivers in the Long Lines Building and at 180 Varick Street.

As already mentioned in the RECORD,* a microwave radio system, the TE-1, has been developed for transmission between points such as Hollywood and Mount Wilson, and since there was a line-of-sight path down the Fifth Avenue canyon from the Yankee Stadium to the Long Lines Building, it was decided to operate the system between the Yankee Stadium and the Long Lines Building for further tryout and to act as a stand-by channel. The receiver installed on the roof of the penthouse of the Long Lines Building is shown in the accompanying photographs, and the transmitter with a similar antenna was mounted on the roof of the stadium. Output from the receiver was carried to the coaxial room on the second floor where it was amplified and then transmitted by cable to Radio City. There was no occasion to use this circuit during the fight, but transmission over it was compared to that over cable from Radio City and found to be just as satisfactory.

*RECORD, *April,* 1946, *page* 175.

Job Relations Training

With the expectation that group discussion under skilled leadership would be helpful to supervisors, the Personnel Department started a "Job Relations Training" course at the Laboratories last fall. A total of 533 technical and non-technical supervisors, including practically all of the executives of the Laboratories, received this training. The course was originally developed by the "Training Within Industry Service" of the War Manpower Commission and was used during the war for the training of a half million production foremen, supervisors and executives. Arrangements were made to have the course given by Dr. E. H. T. Foster, who has had extensive experience in educational and personnel work and who, during the war, was in charge of Training Within Industry in the New York area.

Each class consisted of ten members, both men and women, often representing different departments and having diverse interests. During the five two-hour sessions there were a series of short informal lectures by Dr. Foster, followed by discussion periods in which all class members participated. Each member presented the underlying facts of a personnel problem. The remaining members analyzed the problem and formulated the steps which they thought should be taken in handling it. The suggested plan was then compared with the method that had actually been used in handling the situation.

The text material for the course is all on a guide card, the two sides of which are shown at the bottom of this page. On one side are the four fundamental steps for handling a problem after the objective has been determined. On the reverse side are the foundations for good job relations. These ideas are not at all new, just good old-fashioned "horse sense," arranged on the card in convenient form for ready reference for supervisors.

At the close of this course, the members agreed that they had gained a much clearer understanding of supervisors' responsibilities and a better knowledge of the important aids available for obtaining and maintaining successful relations on the job.

HOW TO HANDLE A PROBLEM
Determine Your Objective

1—GET THE FACTS
Review the record.
Find out what rules and customs apply.
Talk with individuals concerned.
Get opinions and feelings.
Be sure you have the whole story.

2—WEIGH AND DECIDE
Fit the facts together.
Consider their bearing on each other.
What possible actions are there?
Check practices and policies.
Consider the objective, and the effect on individual, group, and production.
Don't jump at conclusions.

3—TAKE ACTION
Are you going to handle this yourself?
Do you need help?
Should you refer this to your supervisor?
Watch the timing of your action.
Don't pass the buck.

4—CHECK RESULTS
How soon will you follow up?
How often will you need to check?
Watch for changes in output, attitudes, and relationships.
Was your action helpful?

FOUNDATIONS FOR GOOD JOB RELATIONS

A Supervisor Gets Results Through People

LET EACH WORKER KNOW HOW HE IS GETTING ALONG
Figure out what you expect of him.
Point out ways to improve.

GIVE CREDIT WHEN DUE
Look for extra or unusual performance.
Tell him "while it's hot."

TELL PEOPLE IN ADVANCE ABOUT CHANGES THAT WILL AFFECT THEM
Tell them why, if possible.
Get them to accept the change.

MAKE THE BEST USE OF EACH PERSON'S ABILITY
Look for ability not now being used.
Never stand in a man's way.

People Must Be Treated As Individuals

Bell Telephone Laboratories
by courtesy of
Training-Within-Industry Service
War Manpower Commission

Organization Changes

Effective July 1, 1946, the Purchasing Department was transferred from General Service to the Commercial Relations Department, reporting to B. B. Webb, Commercial Relations Manager. Coincident with the move, Western Electric Order Service, heretofore part of Commercial Relations, was consolidated with the Purchasing Department, under H. W. Dippel, Purchasing Agent.

In order to bring together, under the Commercial Relations Manager, the ordering and procurement of all materials, equipment and apparatus, Order Service on Telephone Projects was also transferred from General Service to the Commercial Relations Department, where it was consolidated with Order Service on Government and Commercial Products work.

G. T. Selby was appointed Staff Manager, reporting to W. Fondiller, Assistant Vice President. General Methods and Office Standards, reporting to J. S. McDonough, Methods Supervisor, was transferred from General Accounting to the Staff Manager's Department. Mr. Selby for the present is continuing his duties related to Equipment Investment.

W. W. Schormann has been appointed Superintendent of

New Jersey Shops and W. B. Vollmer, Outside Shop Work Supervisor, reporting to H. C. Atkinson, Development Shops Department Manager.

Collegiate Degrees

Degrees recently conferred on members of the Laboratories are as follows:

H. W. ALLISON, Electronic Apparatus Development, M.S., Brooklyn Poly.

A. P. BESIER, Station Apparatus Development, M.S., Columbia University.

C. I. CRONBURG, Transmission Development, M.S., Stevens Institute of Technology.

E. A. KRAUTH, Commercial Products Development, M.E.E., New York University.

J. LEUTRITZ, JR., Chemical Laboratories, Ph.D., Columbia University.

A. LUDWIG, Switching Development, M.S., Stevens Institute of Technology.

B. C. MEYER, Transmission Apparatus Development, M.S., Stevens Institute.

F. A. PARSONS, Switching Engineering, M.S., Stevens Institute of Technology.

Pioneers Elect New Officers

D. A. Quarles was elected President, and Harvey Fletcher, Vice President, of the Frank B. Jewett Chapter of the Telephone Pioneers of America at the annual business meeting held on June 25 in the West Street Auditorium. R. J. Heffner and A. O. Jehle were reëlected as Secretary and Treasurer, respectively. Three new members of the Executive Committee, who were elected to serve until 1948, are P. W. Blye, D. F. Cronin, and J. J. Kuhn.

News Notes

O. E. BUCKLEY was the speaker at the 24th annual meeting and dinner of the Casper E. Yost Chapter 19, Telephone Pioneers of America, on June 6 in Omaha, at the invitation of R. J. Hopley, president of the Northwestern Bell Telephone Company. The subject of Dr. Buckley's talk was *A Visit at Bell Telephone Laboratories.* Earlier in the day he had addressed a

A lively interest in table tennis at Whippany Laboratories culminated in a spring contest, the outcome of which is shown in this picture. Top girl in the ladder is Elizabeth Engelman, followed by Helen Benz, Marion Leary, Virginia Davis, Joan Burke, Marie Dempsey, Fanny Nobile, Mary Guadagnini, Betty Engstrom, Barbara Losey, Joan Thomas, Ann Gwozdz, Alice Charlton, Rocci Soranno, Marilyn Miller, Ann Connell, Louise Fauross, Emily Sikora, Irene Smith group of Northwestern Bell Telephone executives at luncheon.

Dr. Buckley gave the Alumni Chapel address at Grinnell College on June 8 as part of the centennial celebration program. From Grinnell, Iowa, he went to White Sands, New Mexico, to take part in a meeting of the Advisory Committee of the Ordnance Department on Guided Missiles, and to witness a demonstration of the German V-2 rocket.

On June 26 at the annual A.I.E.E. meeting in Detroit, Dr. Buckley was elected a vice president of the Institute, representing the New York City District for the term of two years, beginning August 1, 1946.

D. A. QUARLES was in Detroit, where he attended the June 27 meeting of the A.I.E.E. Board of Directors and visited the Michigan Bell Telephone Company.

R. L. JONES went to the A.I.E.E. summer convention in Detroit to attend the Standards Committee meeting on June 25.

J. A. BURTON visited the Farnsworth Laboratories, Fort Wayne, in a consulting capacity; he also attended the meeting of the American Physical Society at Chicago.

HARVEY FLETCHER has been made a member of the Committee on the John J. Carty Fund of the National Academy of Sciences for a term of five years. Dr. Fletcher is also chairman of the American Physical Society nominating committee for election of officers for 1947.

W. P. MASON spoke on the *Application of Piezoelectric Crystals to the Measurement of the Properties of Liquids, Gases and Solids* at the Physics Colloquium at Notre Dame University.

W. L. BOND, ELIZABETH ARMSTRONG, P. P. DEBYE, L. H. GERMER, J. J. LANDER and R. D. HEIDENREICH participated in the meetings of the American Society for X-ray and Electron Diffraction from June 10 to 15 at Silver Bay, Lake George.

J. B. FISK, W. SHOCKLEY, H. C. MONTGOMERY, J. M. RICHARDSON, JOHN BARDEEN, R. M. BOZORTH, H. J. WILLIAMS, C. H. TOWNES and W. P. MASON attended the American Physical Society meeting from June 20 to 22 in Chicago. Papers presented by members of the Physical Research Department were *Atomic Polarizabilities and the Local Field in Alkali Halide Crystals,* by W. SHOCKLEY; *Electrostatic Potentials and Fields in Ionic Lattices,* by J. M. RICHARDSON and W. SHOCKLEY; *Investigation of Oxidation of Copper by Use of Radio-Active Cu Tracer,* by JOHN BARDEEN, W. H. BRATTAIN and W. SHOCKLEY; *Magneto-Resistance and Domain Theory,* by R. M. BOZORTH; *Magnetic Domain Patterns on Silicon-Iron Crystals,* by H. J. WILLIAMS; *Resolution and Pressure Broadening of the Ammonia Spectrum Near One cm Wave-Length,* by C. H. TOWNES; and *Variation of the Viscosity of Polyatomic Gases with Frequency,* by W. P. MASON.

K. K. DARROW gave a lecture on *Physics and the Public* before the inaugural meeting of the Canadian Association of Professional Physicists on June 1 in Toronto. Dr. Darrow was in Chicago from June 12 to 23, on the first part of his visit to serve as consultant to the Metallurgical Laboratory of the University of Chicago, and later to attend the American Physical Society meetings at which he was appointed its representative on the Council of the American Society for the Advancement of Science.

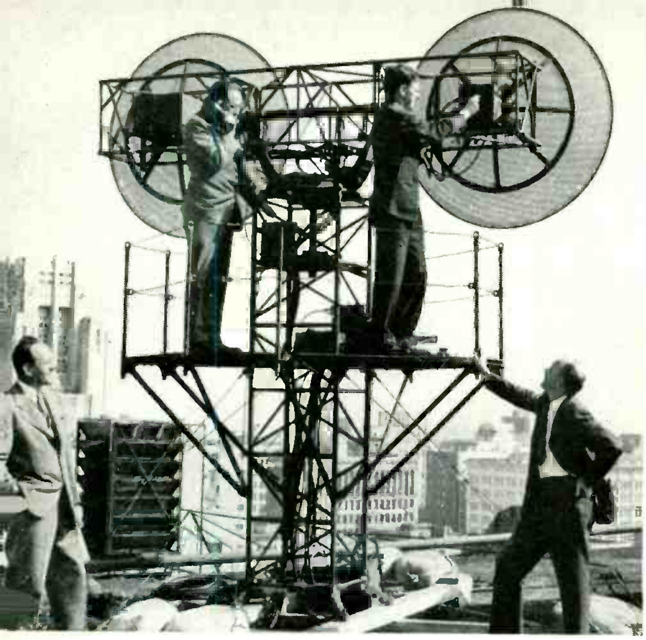
Dr. Darrow has also been appointed to the Committee on the History of Science in the United States which is a joint committee of the National Research Council and several similar organizations.

R. M. BURNS visited Hawthorne for discussions of paper and miscellaneous technical matters and with G. T. KOHMAN witnessed the assembly there of German capacitor manufacturing equipment.

W. E. CAMPBELL gave a talk, *The Theory of Oxidation and Tarnishing of Metals,* at the Spring Symposium on Surface Reactions held on June 7 in Pittsburgh by the Pittsburgh section of the Electrochemical Society. With F. HARDY, Mr. Campbell also attended the lubricant testing sections of the A.S.T.M. from June 24 to 26 at Buffalo, and participated in discussions in connection with the activities of Committee D2.

W. C. JONES, L. VIETH, J. R. POWER and T. H. CRABTREE attended a regional meeting of Western Electric Hearing Aid Dealers on July 3 in New York.

J. M. ROGIE and C. F. BENNER discussed tone control and potentiometers for hearing aids at the International Resistance Company, Philadelphia.



Microwave antenna array at the Los Angeles terminal of the Southern California Telephone Company's eight-channel radio system to Catalina. On the antenna platform are L. R. Montfort and Nean Lund

Members of the Laboratories who attended the fourth I.R.E. Electron Tube Conference at Yale included L. M. Field, A. V. Hallenberg, A. E. Bowen, J. B. Little, S. Millman, J. R. Pierce, J. F. Streib, L. R. Walker, N. Wax and J. B. Fisk, who presided over the session on *Magnetrons.* J. R. Pierce and L. M. Field presented *Traveling Wave Tubes.*

G. L. Pearson, W. Shockley and P. W. Foy were at the Bureau of Standards in Washington during June.

At the A.S.T.M. convention in Buffalo, papers were presented by L. H. Campbell on *Insulation Resistance of Plastics Exposed Outdoors;* and by A. P. Jahn on *Atmospheric Corrosion Tests of Corrosion-Resistant Steel Wires.*

J. B. Howard attended a symposium on plasticizers at Buffalo University.

G. N. Vacca and C. V. Lundberg conferred at Point Breeze on wire.

F. S. Malm, as a member of the Hard Rubber and Insulated Wire Committees, attended the A.S.T.M. meeting in Buffalo. Mr. Malm also discussed rubber problems with engineers at Hawthorne.

H. G. Wehe and W. H. Kamper visited the Peter J. Schweitzer Paper Company, Spottswood, N. J., on paper problems.

J. J. DeBuske, N. Lund, L. R. Montfort and J. A. Word have made installation tests at Los Angeles and South Catalina Island on a radio link between these points, using radio set AN/TRC-6. This equipment will be used by the Southern California Telephone Company in the first commercial application of a microwave radio-telephone system using pulse position modulation and time division.

C. J. Calbrick and R. D. Heidenreich discussed electron microscope and diffraction at the RCA Laboratories, Princeton.

H. E. Haring and V. J. Albano visited Northeast, Maryland, for the purpose of determining the applicability of geophysical methods to the study of cable corrosion.

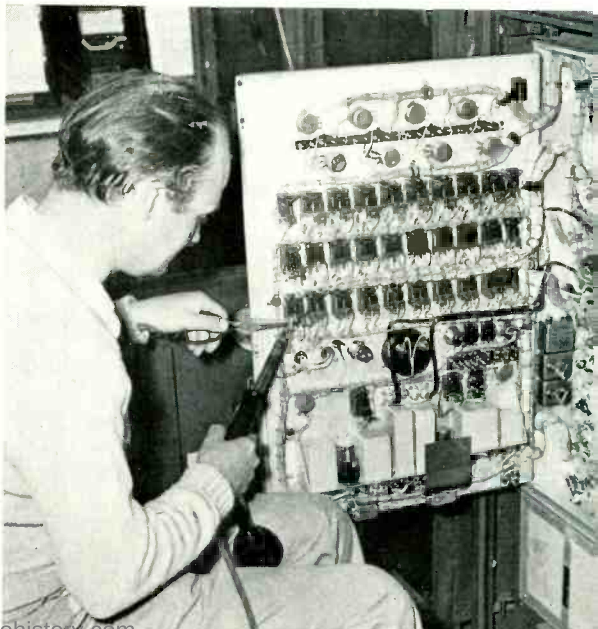
R. L. Taylor attended a symposium on Surface Reactions at the Mellon Institute of Industrial Research, Pittsburgh.

F. Hardy attended a conference at the Transoceanic Broadcasting Station, Lawrenceville, to discuss lubrication problems.

Ceramic problems of common interest were discussed by M. D. Rigterink and G. T. Kohman at the General Electric Ceramic Laboratories at Schenectady.

G. Q. Lumsden and J. Leutritz, Jr., at Montreal conducted a preliminary investigation in coöperation with the Bell Telephone Company of Canada on the use of greensalt for the treatment of northern pine poles. Mr. Lumsden and Mr. Leutritz have

J. J. DeBuske completes the final installation of the terminal equipment for the new Catalina to Los Angeles microwave system



August Service Anniversaries of Members of the Laboratories

40 *years*	30 *years*	M. S. Mason	Margaret Spindler	E. A. Hake
H. G. W. Brown	L. S. Armstrong	C. O. Parks	C. B. Swenson	M. E. V. Johnson
J. B. Draper	W. C. Beach	W. T. Pritchard	15 *years*	H. A. Kohler
C. D. Lindridge	S. I. Cory	Andrew Scaglione	Stanley Cunningham	R. F. Lane
W. B. Prince	Helen Hoar	W. E. Stephens	F. R. Dickinson	A. W. Lebert
George Rupp	J. M. Hudack	E. R. Taylor	F. G. Foster	Arline Linehan
	P. A. Jeanne		Hugh Kelly	J. C. Lozier
	O. H. Loynes	20 *years*	W. M. Knott	J. F. Madden
35 *years*	R. G. McCurdy	F. B. Anderson	G. E. Stowe	J. A. Morton
S. C. Cawthon	Stanley Terry	D. S. Bender	D. J. Wernert	T. A. Pariseau
A. B. Clark	Erich Von Nostitz	B. H. Carmer, Jr.	10 *years*	John Pasternak
R. E. Drake	O. J. Zobel	F. L. Crutchfield	A. A. Adamson	H. G. Petzinger
J. W. Foley	25 *years*	J. E. Fox	Mary Andrejcak	G. M. Richards
William Frees	C. N. Anderson	Sebastian Heid	J. R. Davey	F. C. Roeckl
J. W. Gooderham	G. H. Downes	Marjorie Hyde	H. W. Evans	C. W. Spencer
R. B. Hill	Alice Kavanagh	E. S. Pennell	R. B. Gibney	H. A. Stone, Jr.
Edward Vroom	B. F. Lewis	H. G. Romig	R. F. Graham	W. W. Tuthill
		Boyd Simpson		A. L. Williams
				Hans Wilms

returned from the annual inspection of the Gulfport, Miss., test plot. Wood treating plants at Pensacola, Gulfport, Fernwood, Atlanta and Spartanburg were visited to investigate problems arising out of the present creosote shortage.

R. H. Brandt, V. E. Legg, E. L. Chinnock, A. V. Lewis and L. R. Lowry participated in the Jersey Shore Amateur Radio Association "Field Day" program atop Crawford's Hill on June 22 and 23 at Holmdel. This hilltop, 380 feet above sea level, is part of the Holmdel Radio Laboratory.

H. T. Friis attended the first meeting of the new Scientific Advisory Board to the Commanding General of the Army Air Forces. Meetings were held on June 17 and 18 in Washington and from June 19 to 21 at Wright Field.

W. J. Brown, at Cleveland, discussed equipment for railway sound systems.

F. F. Romanow attended a meeting in Boston of the Subcommittee B on Fundamental Sound Measurements of the A.S.A.

L. J. Cobb and G. C. Porter visited Hawthorne in connection with the introduction of receiving testing equipment.

R. H. Nichols attended the Council of the American Otological Society where he presented a paper on *Physical Characteristics of Hearing Aids.*

F. L. Crutchfield and R. C. Miner studied station receiver problems at St. Paul. They were also at Hawthorne, where, with W. L. Tuffnell, they took up problems relating to the new operator telephone headset and the station handset receiver.

J. R. Power stopped at the Western Electric Company at Burlington, N. C., to inspect the new hearing aid shop and then, at Atlanta, attended a meeting of the Western Electric Hearing Aid Dealers.

At the 61st annual summer convention of the A.I.E.E., held in Detroit from June 24 to 28, papers presented by the following Laboratories men were: *Properties and Uses of Thermistors, Thermally Sensitive Resistors*, Parts I and II, by J. A. Becker, C. B. Green and G. L. Pearson; *Mica Capacitors for Carrier Telephone Systems*, by A. J. Christopher and J. A. Kater; and *Negative Resistance Effects in Saturable Reactor Circuits,* by J. M. Manley and E. Peterson.

V. F. Bohman conferred on step-by-step apparatus at Hawthorne.

C. C. Barber and M. Fritts, at Hawthorne, discussed design questions related to the current production of crossbar switches and, in particular, the introduction of a redesigned frame for the switch.

O. H. Danielson and R. V. Terry visited General Mills, Minneapolis, in connection with a Government project.

M. C. Wooley was in Hawthorne on various matters pertaining to condensers.

C. C. Houtz visited the Sprague Electric Company, North Adams, Mass., in connection with coupling capacitors for rural power-line carrier-telephone systems.

E. A. Potter attended a meeting of the R.M.A. Committee on Power Transformers for Radio Receivers.

A. L. Samuel, who recently joined the faculty of the University of Illinois, received the honorary degree of Doctor of Science from the College of Emporia, Kansas, on May 26. On the previous evening Dr. Samuel, with the assistance of P. L. Hammann, presented a lecture-demonstration on *Microwave Radar* at an alumni meeting. On May 28, before a joint meeting of the A.I.E.E. and I.R.E. in Kansas City, and on May 29 before a similar meeting in St. Louis, they presented a lecture-demonstration on *Recent Developments in Microwave Electronics.* In all three places the Airborne Search Radar was demonstrated.

Mr. Hammann, on June 7, spoke on *Microwave Radar* before the Rotary Club of Independence, Kansas, and on June 26 with the assistance of W. H. B. Perry gave a lecture-demonstration before the Morristown Rotary Club on *The Seeing Eye of the Fighter Plane.*

D. G. Blattner and A. W. Daschke discussed repair practices of meters at the GE West Lynn, Mass., plant.

G. A. Ritchie discussed keys at the Stromberg-Carlson Company in Rochester.

J. F. Baldwin and P. Neill were at Point Breeze for conferences on the 92 type switchboard jacks.

H. H. Staebner visited Point Breeze on cord development problems.

C. Shafer, D. T. Sharpe and M. W. Bowker in St. Louis discussed outside plant maintenance problems.

S. M. Sutton visited Point Breeze on matters relating to the installation of factory-made pulling-eyes in cables.

"The Telephone Hour"

NBC, Monday Nights, 9:00 p.m.

August 5	*James Melton*
August 12	*Ezio Pinza*
August 19	*Josef Hofmann*
August 26	*Maggie Teyte*
September 2	*Nelson Eddy**

*Broadcast from Hollywood.

H. M. Hagland went to Rochester in connection with a Quality Assurance Survey on the No. 506 PBX.

F. A. Korn discussed with Western Electric engineers at Hawthorne crossbar tandem and future switching problems.

M. A. Froberg and G. W. Meszaros worked with Long Lines engineers on the coaxial rectifier inverter at Bremen, Georgia.

H. T. Langabeer participated in tests at a computer power plant at Langley Field.

R. H. Ross investigated small motor problems at the John Oster Manufacturing Company, Racine, and at the Eicor Corporation, Chicago.

V. T. Callahan witnessed a gasoline engine installation at the Wisconsin Telephone Company plant in Green Bay.

P. T. Sproul, at Pittsburgh, assisted in establishing video loop facilities for Kaufmann Stores' 75th anniversary celebration.

B. H. Carmer and L. R. Cox participated in the initial installation and testing of new coaxial equipment at Richmond.

N. Knapp, Jr., has been at Dallas for the trial installation of coaxial equipment.

R. E. Dickinson conferred on radio control terminal at Wright's Automatic Machine Company, Durham, North Carolina.

V. H. Baillard investigated the splicing of coaxial conductors at Point Breeze.

D. T. Sharpe and M. W. Bowker witnessed trial installations of pressurized exchange cable systems at Bedford Village and Cuba, New York, and at St. Louis.

G. Q. Lumsden and D. C. Smith witnessed the replacement at Stamford, Conn., of a forty-year-old creosoted subway with a vitrified clay duct. Mr. Lumsden also inspected some salt-treated poles at Forestville in coöperation with engineers of The Southern New England Company.

R. H. Colley visited Minneapolis and Superior on problems related to the development and treatment of lodge-pole pine and northern pine poles. He also conferred on preservative methods at the Forest Products Laboratory, Madison, Wisconsin.

W. A. Shewhart attended a meeting in Washington of the N.R.C. Committee on Applied Mathematical Statistics.

L. A. MacColl spoke on *Servomechanisms* at a colloquium of the Sharples Corporation of Philadelphia.

C. H. HAMILL, accompanied by F. W. Berry and H. L. Bancroft of Western Electric, attended a quality survey conducted by W. F. VIETH and W. S. ENO of recovered and repaired teletypewriters at the Distributing Shops in New York and Philadelphia and at the Teletypewriter Repair Shops in Newark, Brooklyn and Detroit.

W. L. DAWSON and J. C. MORRIS represented the Laboratories in interference proceedings before the Primary Examiner at the Patent Office in Washington.

DURING the televising of the Louis-Conn fight on June 19 at the Yankee Stadium, C. N. NEBEL, in the NBC control room at Radio City, was responsible for the overall circuits, while H. C. HEY was assigned to the video network at the Stadium; A. F. MOTT, at the Long Lines building, 32 Avenue of the Americas; and R. W. GUTSHALL, at the Chesapeake and Potomac Telephone building in downtown Washington. At the toll networks in the Long Lines building in New York were R. J. SHANK and C. I. CRONBURG, and at the Washington toll, J. R. BRADY and F. W. GARLAND.

K. D. SMITH, G. R. FRANTZ and J. B. MAGGIO manned the microwave standby circuit at the receiving terminal in the Long Lines building and G. W. ATKINS the transmitter on the roof of the Yankee Stadium during the fight. J. J. STRODT, W. A. BLIKKEN and W. E. NORRIS assisted in the installation prior to the broadcast.

Obituaries

George F. Morrison, former member of the Plant Department who retired in 1938, died on June 29, 1946. Mr. Morrison joined the Western Electric Company in 1902 as Superintendent and Engineer of the Thames Street Building. When this building was sold five years later, he came to West Street as Chief Operating Engineer of the Power Plant. At the time the Western Electric Company moved its Manufacturing Department from New York to Chicago Mr. Morrison was concerned with the many building and operation problems in turning the manufacturing space into warehousing and repair shop areas. When the radio stations at Deal Beach and Green Harbor were erected, Mr. Morrison took charge of the layout of the grounds and much of the construction. Throughout the early growth of the Western Electric Engineering Department, and later the Laboratories, he took an active part not only in operating the building, but in converting it to meet the changing occupancy requirements. Later, as Outside Plant Superintendent, he negotiated real estate transactions and maintained relationships with various governmental agencies.

G. F. MORRISON
1872-1946

W. L. FILER
1888-1946

* * * * *

William L. Filer, Switching Development Engineer, with continuous service from 1906, died on June 24. Mr. Filer's earliest work was in central office installing and testing for the Western Electric Company, which took him throughout the West and Southwest. When he came to New York, he was assigned to the former Circuit Laboratory. In 1915 he was made supervisor of circuit work on special developments such as signaling systems, alarms and switchboards for non-associated companies. During World War I he was in charge of a group on Army and Navy work and in 1919 was given charge of local manual circuit work as well as PBX's and circuit work in connection with customers' orders. In 1922 he took over step-by-step circuit development; and slightly more than a year later all local central office circuit development, both manual and dial, was placed under his supervision. The community dial office, of growing importance to telephone service for small towns, was one of his major projects. During World War II, he supervised the circuit development for the Army's Air Warning Network and also did much work for the Civil Aeronautics Administration.






H. J. GLYNN — CAPT. SCHRAMM — LT. ROCK — V. G. CHIRBA — W. H. SCHWARTAU — J. P. MAHON

More Veterans Return

Hugh J. Glynn entered the Army in 1942 and was assigned to the 46th Troop Carrier Squadron as Supply Clerk after completing his basic training. His duties took him to the Bismarck Archipelago, Luzon, Southern Philippines and the Western Pacific theater of operations which involved traveling altogether 65,000 miles.

Capt. Charles R. Schramm served for over four years with the Field Artillery. A member of the 667th Field Artillery Battalion which he helped to train, he went overseas as an executive officer, fought through Belgium and Germany, finally becoming a unit commander. At the end of hostilities in Europe, Capt. Schramm was transferred to a new outfit to train men for the Pacific theater of operations. Later, after the peace was signed, he ran a civilian internment camp outside of Nuremberg until he was shipped home.

Lieut. Charles C. Rock served a short time in the Navy in 1941, returned to the Laboratories, was granted a leave to go to the N.D.R.C., and finally in 1942 entered service again for four continuous years of naval duty. After training at Ft. Schuyler, he worked for a time at Quonset Point on Project Sail and was then assigned to ASDEVLANT, a project on which he was responsible for the development and test of special airborne equipment.

Victor G. Chirba went to pre-radio school in Chicago and was later assigned to duty in the Great Lakes Naval Air Station.

William H. Schwartau served as an ETM 2/c on the destroyer *John A. Bole* on patrol in waters near China, Korea, Japan and Okinawa over a period of six months.

John P. Mahoney of the Photocopy Department did photostat work in an MP Battalion when he first went overseas. Later, after having fought with the 42nd Infantry Division, he stood occupational duty in Germany.

Lieut. William L. French's naval assignments were for the most part at Navy Yards in the United States, in connection with the repair and alteration of ships; however, he also served at Pearl Harbor and Peleliu.

Guerdon B. Herblin operated a mobile shop truck for the repair of heavy equipment for the 257th Combat Engineers for over a year in the ETO. He is now in the Development Shops Department at Graybar-Varick.

Capt. Walter S. Gunnarson of the Patent Department held a reserve commission of Lieutenant in the Field Artillery when he was ordered to duty in 1940 at Fort Bragg and assigned to troop duty with the 35th Division. Capt. Gunnarson was awarded the Bronze Star Medal for "meritorious service as battalion supply officer." As assistant S-3 officer in charge of Plans and Training, he was responsible for running the fire direction center, coördinating the fire of the batteries in battalion during combat.

William L. Rohr spent most of his two years in the Navy at Pensacola Naval Air Station doing electrical work on aircraft.

Bernard C. Guinter, with the Marine Corps, was an armorer and served throughout the Okinawa campaign. His ship was scheduled to take part in the original landing at Okinawa but was hit by a suicide plane which delayed their landing for several days.

Rudy P. Luttkus during his military service was assigned to Electronic Technician Schools in Chicago, Gulfport and Bellevue, Washington.

Capt. James H. Miller was given a direct commission in the Signal Corps in 1942 and was sent to England with an Electronics Training Group to

LT. FRENCH — G. B. HERBLIN — CAPT. GUNNARSON — W. L. ROHR — B. C. GUINTER — R. P. LUTTK






PT. MILLER F. W. GARLAND S. G. REED H. E. HENRIKSON F. R. MISIEWICZ COL. CLEMENT

study British radar equipment at the Military College of Science at Bury. Capt. Miller was assigned to British anti-aircraft batteries at Cardiff, Wales, for a time before returning to the States to study and later to instruct in fighter control radar equipment at the VHF School, Allenhurst, N. J. After transferring to the Air Transport Command, he was assigned to Grenier Field, Manchester, N. H., where he was responsible for B-17 airborne radio and radar maintenance and protection.

Frank W. Garland maintained, operated and repaired secret Signal Corps equipment at the Oakland Army Base for the 805 Signal Service Group with whom he trained at the B.T.L. School for War Training and at the Pentagon Building.

Stanley G. Reed was in New Guinea and the Philippines for a year and a half, first with the 4025 Signal Service Group operating and maintaining transmitters and later, on detached service with the Signal Corps School in Manila, instructing in radio repair.

Herbert E. Henrikson received specialized training at electricians' schools before being assigned to repair Labs developed fire-control gear at repair bases at San Diego and Norfolk.

Francis R. Misiewicz of Research Drafting was stationed at the Pearl Harbor Radar Maintenance School and at the Radio Matériel Office, Guam, in the radar, radio and sonar repair group during his sixteen months of foreign service.

Col. Andrew W. Clement entered upon active duty late in 1940 as a Captain of Coast Artillery. Shortly thereafter he was appointed a member of the Coast Artillery Board at Fort Monroe, Virginia, and served in this assignment until relieved in March, 1946. He was engaged in the study of Coast Artillery matériel problems and the analysis and test of radar, communications and allied equipment. In 1944, Colonel Clement conducted demonstrations of advanced types of radar and electronic fire-control equipment in Hawaii. Before returning to the mainland, he made a study of seacoast artillery matériel and operations in the Western Pacific. Colonel Clement was awarded the Legion of Merit in April, 1946, for his wartime services.

Phillip P. Crowe, upon entering the Army in April, 1943, served as an aviation cadet for nine months and was then assigned to various radar schools throughout the country.

Wayne F. Wilson spent eighteen months in the ETO, including two months in England and two with the Infantry in Germany. He was assigned to Paris and Nice and also studied for a time in the Bairritz American University.

Alexander E. Lawson, Jr., has returned after forty-two months of Army service. Mr. Lawson served five months in England and eleven months at Okinawa and in Korea, where he was with the 1st Engineering Special Brigade.

Flight Officer John P. Slickers, after being graduated as a navigator, was sent to B-29 Flight Engineering School; he was at Randolph Field for transition training when he was released from service.

Lieut. James M. Hoagland in nine months of Pacific duty with the 20th Air Force on Guam and Tinian flew two combat missions as a radar navigator and after the war instructed in radar at Guam.

John C. Pfaff instructed in Central Office Maintenance for over two years at Fort Monmouth be-

The Laboratories has employed 1,060 veterans of World War II

. P. CROWE W. F. WILSON A. E. LAWSON, JR. F/O SLICKERS LT. HOAGLAND J. C. PFAFF


R. E. HENNEBERG


W. H. TAPPEN


W. J. BEHAN


E. O. FUCHS


H. G. PETZINGER


M. V. SULLIV

fore taking Infantry and Artillery training and being shipped out. He was wounded while serving as an Infantry squad leader in the Rhine Valley and was awarded the Purple Heart; subsequently, he became a gunner with the 75th Anti-Aircraft Artillery until the war ended.

Robert E. Henneberg in three years of Army service spent one year in India with the 242nd Medical Maintenance Detachment on the outskirts of Calcutta, where he repaired such medical equipment as short-wave diathermy sets, X-rays and electrocardiographs.

William H. Tappen, during two and one-half years of military service, was assigned to the Technical Service Unit at the Frankford Ordnance Depot, where he assisted in the receipt, storage, issue and salvage of supplies.

William J. Behan fought with the 97th Division in Germany, was shipped home for a thirty-day furlough and then sent to the Pacific for occupational duty on Honshu Island.

Edward O. Fuchs held the rank AMM 2/c and was stationed for the most part in Florida, working on torpedo bombers and fighter planes.

Henry G. Petzinger has returned to the Murray Hill Shop following his discharge from the Army Ordnance Department. After several months of training at the Aberdeen Proving Grounds, where he also served as an instructor for a time, Mr. Petzinger was assigned to the Frankford Arsenal in Philadelphia as a toolmaker.

Warren C. Rouse, a member of the 805th Signal Service Company, studied at the Laboratories School for War Training and then maintained and operated Lab-designed communications equipment in the Pentagon Building before being assigned to similar work in Hawaii.

William R. Davis has returned after serving three and one-half years in the Marine Corps. He was a sergeant in a rifle platoon and participated in the occupation of the Marshall Islands, Saipan, Tinian and Iwo Jima. Mr. Davis also held the same rank in the Marine Corps in World War I.

Michael V. Sullivan trained at the Naval Research Laboratory, Washington, D. C., and remained there as an instructor in radio and radar.

John Scharf, a member of the 805th Signal Service Company, was assigned to operate and maintain secret Signal Corps equipment at the terminal in the Pentagon Building.

Robert E. Filler has returned to Murray Hill after three years of naval service. After preliminary training in fire-control equipment, he was assigned to sea duty and participated in landings in the Philippine and Borneo areas.

William A. Sumner of the Whippany Laboratory spent two years in the Army. After basic and preliminary training, he was assigned to the First Signal Radio Maintenance Team, where he worked as a Radar Repairman on airborne equipment.

Edward M. Kennaugh trained in radio repair fixed station work for over two years before being assigned to that work in France, Germany and Italy.

Leaves of Absence

As of June 30, there had been 1,052 military leaves of absence granted to members of the Laboratories. Of these, 777 have been completed. The 275 active leaves were divided as follows:

Army 128 **Navy 106** **Marines 9**

Women's Services 32

There were also 12 members on merchant marine leaves and 1 on personal leave for war work.

Recent Leave

United States Navy—James J. Kahn

W. C. ROUSE

W. R. DAVIS

J. SCHARF

R. E. FILLER

W. A. SUMNER

E. M. KENNAU