BELL LABORATORIES RECORD

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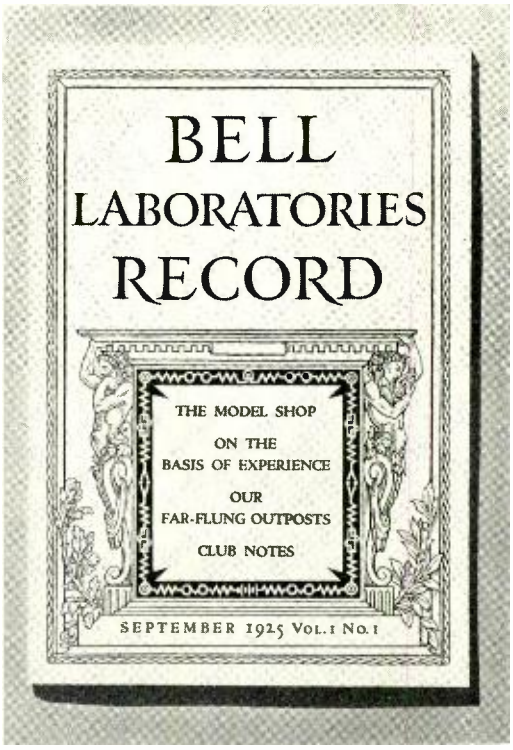
The first quarter-century

PAUL B. FINDLEY
Editor

Ten years ago this month, the leading article in the RECORD had to do with the magazine itself—its reasons for existence, its founding, its aims. Now, at the quarter-century mark, it is fitting to review the magazine's history, particularly during the past decade when many of the earlier ideas and hopes of its editors have come into fruition.

Because the RECORD is a part of its era, it has chronicled momentous events, has been molded by what it chronicled. World War II began quietly enough; although the Laboratories were at work on military projects as early as 1939, they were for the most part highly classified. The first reference to the war was an article on saving critical materials in September, 1941. In the December issue appeared an account of the Aircraft Information Center installed in a nearby central office for which the PBX group had furnished a number of new circuit designs. A footnote carried the first of a long series of congratulations from the military, this one being for technical assistance on a mobile information center built by the Western Electric Company at Hudson Street.

In September of the following year (1942) appeared a general article on the effect of the war on us which noted that "A member of the Laboratories must sometimes appear to his friends as not doing his part in this war for he can tell them no particulars of his work." This is apparent in technical articles for that volume. And yet the Laboratories' substantial contributions were recognized in the Army-Navy Production Award, chronicled in the October, 1942, issue—the first of four such awards. And at least an intimation of the



Volume One, Number One. This cover design, by Thomas M. Cleland, was used on the RECORD *for thirteen years. It was printed in dark ink on yellow paper.*

The first "sine wave" cover appeared in September, 1937, and was used until August, 1943, when it was replaced with a photographic cover. The "sine wave" remained on the rear cover until October, 1946.

work we were doing was a statement in the June, 1943, issue on radar, and a picture of a sealed box containing a radar tube used in a South Pacific naval battle.

By the end of 1943 the tide of secrecy was turning. Laboratories developments were reaching the fighting fronts in quantities, and capture by the enemy was inevitable. The M-9 Electrical Gun Director, one of the Laboratories' most imaginative and effective contributions to the war, having been exhibited to members of the Laboratories and the press in November of that year, was described in the January, 1944, issue. "Spiral 4", a four-channel carrier system, was in the December 1943 issue. The 1945 volume started off with the tank service radios, SCR 508, 528 and 538. Soon followed articles about wire laying by airplane, military telephone instruments, and the naval battle announcing system. Toward the end of the year came the AN/TRC6 radio system for backbone military networks; it was the first Bell System pulse modulation system. The Information Center system, a full sized mobile version of that noted for 1941, was described in November, 1945.

With the war over, security was relaxed and many of our developments were declassified. The 1946 volume was full of radar, rockets, spiral-4, tubes, telephones; and of such auxiliaries as the School for War Training, pre-production, the Fastax camera. In 1947 were described our work in submarine detection, the optical proximity fuse, and radars for airplanes and navy fire control.

Running through these seven volumes a reader interested in telephony would find substantial progress in smaller systems and details. He would read of twin-channels on a single radio sideband, of the new availability of tremendous supplies of lodgepole pine for poles, of molybdenum permalloy, of automatic TWX switching. He would hear of the birth of Type-M carrier for rural lines, of two-way mobile telephone service, of radio lenses. And in the last two and a half years the pageant would be really impressive: Alpeth-sheathed cable, nationwide toll dialing, teletypewriter networks with automatic switching, No. 5 crossbar, the Transistor, the V3 repeater. He would be intrigued by many clever details: vibrating reed selectors for vehicle telephones, high-precision oscillators, fine-wire grids for electron tubes, visible speech, studies in the nature of information.

From its earliest issues, the RECORD had concerned itself with activities of Laboratories people, but only as those activities were related to the Laboratories; business trips, technical speeches, or affairs sponsored by the Bell Laboratories Club. There are now a few exceptions: community leadership is recognized by noting the responsible posts held by members of the Laboratories; and engagements and wed-

The editorial staff of BELL LABORATORIES RECORD *gathers in a periodic conference. Left to right, A. R. Brooks, Murray Hill Representative; P. B. Findley, Editor; J. D. Tebo, Manfred Brotherton and P. C. Jones. Mr. Findley is also Advertising Manager of the Laboratories, assisted by Mr. Brotherton. Mr. Jones is also Associate Editor of the* BELL SYSTEM TECHNICAL JOURNAL.

dings are noted. This latter practice began in the August, 1943, issue; it was an outgrowth of a feature, "We See By the Papers, that . . .", started in December, 1942, in which news of engagements and weddings was occasionally found. All war-connected activities such as service in the Armed Forces, the Civil Defense and the Red Cross, and blood donations were covered.

Although a few items about men on military leave had already appeared, the war really began for the RECORD in September, 1941, with a section in the News Notes captioned "National Defense, Military and Naval Items". It had news items, pictures, and letters from service men, the first of a flood which grew to several pages in 1945. The February, 1942, issue had a long article on our wartime activities which were not under "classification" by the military. In May, 1942, appeared the first of many lists of men in service; it contained 150 names. Some of their experiences were hair-raising; hours afloat in a life-vest after a ship was torpedoed; a parachute jump from a crippled airplane, a visit to the Anzio battlefront. Pressure of war news brought about a few casualties of its own; the feature, "Chosen by Lot," a series of biographies started in January, 1942, was dropped after November, 1943; and the biographies at 25 years of service, long a feature, were shortened as of April, 1943, and dropped after the following September.

In appearance, the RECORD has undergone a good many changes although its most conspicuous characteristic – page size—has remained unchanged through twenty-five years. Its original yellow cover persisted until September, 1937, when it was replaced by a brown cover with white

Interviewing is customary for all editors. Here Helen McLoughlin, Assistant Editor, is discussing with Harold Schmitt, General Service Manager at West Street, the Fastax camera article on page 412 of this issue.

lines representing a wave pattern. In January the colors of this design became blue with white lines; in July, 1943, appeared the first pictorial cover—The National Emblem—and from the next month on the front cover has carried a photograph with the single exception of September, 1945, which bore the triumphant eagle. Inside, the use of photographs has expanded with the development of the art, notably faster emulsions and the flash bulb. The staff itself has pioneered in the use of the 35-mm. camera—December, 1936—and the press graphic camera whose pictures were first used in November, 1940.

Readers of the RECORD have long since formed their own opinions of its merits; however, it is interesting to note that independent experts have thought well of the magazine. The first award was by the National Safety Council in December, 1940; another was by the House Magazine Institute in 1941. Awards were received from the International Council of Industrial Editors in 1946, 1948, 1949 and 1950.

Like their fellow members of the Laboratories, the staff of the RECORD believe in being known by their work, and except for the masthead* seldom let their names appear. On a twenty-fifth anniversary it is however, proper to mention by name those who have helped in the molding, as well as the editing, of the magazine. Philip C. Jones joined the staff in 1927 and has since carried the principal load of preparing—and sometimes writing or rewriting—technical articles for publication. He has been assisted by others at various times, among whom note should be taken of Franklin Hunt, who entered the department in 1935, moved to Murray Hill in 1942 (still working part time for the RECORD), and retired in 1948.

Although his principal work is the Laboratories' advertising, Manfred Brotherton has written articles for the RECORD and edited others. J. D. Tebo entered the staff as a science editor during the past year. R. Linsley Shepherd became news editor in 1934, and A. R. Thompson had charge of design and makeup from the beginning until 1942, when war work absorbed all his energy. At that time Mr. Shepherd took over makeup, and Mrs. Helen McLoughlin was added to the staff to ensure the coverage of personal features and news related to women employees as well as men. In April, 1946, Frank V. Vitullo, an experienced designer of publications, was consulted on restyling the magazine, and continues to advise on its appearance.

Skill, however, must have direction; and that direction was once set down in these words:

"As their typical reader the editors visualized an engineer or scientist who followed the professional journals for detailed in-

*Inside the front cover.

formation regarding his chosen field, but whose general interest in related fields would lead him to read articles attractively presented and of not-too-great difficulty. Non-technical readers, it was hoped, would find in the opening paragraph of each article something worth remembering about current advances in the art. Literary style was to be consistent with the excellence of the Laboratories' scientific and technical work."

The quotation is from the RECORD of September, 1940, and we of the editorial staff have hewed rigorously—some authors would say "vigorously"—to the line before and since. The marginal reader has been our chief concern—that reader who might be encouraged by skillful presentation to read a little farther, perhaps even to the end of a technical article. For the really interested reader we proposed to publish enough to tell him *what* was done, and *why*, and in a general way *how*.

Next to the reader, our concern has been for the author and his associates. Because personal satisfaction is one of the important rewards for a job well done, we have been zealous to inquire about those whom the narrator should mention and those others whose contributions should get a nod of approval via the picture-caption.

Laying out the News Section of an issue of the RECORD. *Associate Editor R. Linsley Shepherd (right) with consultant Frank V. Vitullo, a designer of publications.*

Progress of the magazine during twenty-five years is the best evidence that plans were, and are, sound. Originally distributed to Laboratories people only, the magazine now goes to engineering and plant people in the Bell System, to libraries, to engineering and scientific institutions, to science writers, and to many others. Its total distribution is now over 16,000 copies, of which about 1150 go outside the United States.

As the RECORD enters its second quarter-century, the editors take grateful thought of the hundreds of authors who have written its articles; of the other hundreds whose work has been chronicled. They are the heroes of our saga; we are only the bards.

THE AUTHOR: Some thirty-five years ago, a batch of proofs and a few back issues of a magazine were handed to PAUL B. FINDLEY with the words "The printer is waiting for the dummy." That was his introduction to the mechanics of publication; it came during an interlude when, having had four years with Bell of Pennsylvania, he sought his fortune elsewhere as editor, copywriter and advertising manager. Reentering the Bell System via A T & T and Western Electric, he became one of the earliest members of the Publication Department. Editor of the RECORD since its inception, he is now senior among Bell System editors.

While an undergraduate at Princeton (B.S. in 1909; E.E. in 1912), Mr. Findley began his interest in photography; in World War I he studied radio at Pittsburgh and Yale. He is a member of the A.I.E.E., I.R.E., and the National Association of Science Writers.

Angus S. Hibbard— Pioneer telephone executive and inventor

R. B. HILL
General Staff

At a conference held by the American Bell Telephone Company in Boston in 1885, a paper was read by a young man named Hibbard, describing the methods he had followed in building toll lines in Wisconsin. This paper, and the man who read it, created such a favorable impression on Theodore N. Vail, General Manager of the American Bell Telephone Company, that Hibbard was called to New York in September, 1886, to become General Superintendent of the American Telephone and Telegraph Company. This company had been formed during the previous year, with Edward J. Hall, Jr., as General Manager, to construct and operate long distance lines connecting the territories of the various Bell operating companies. At this time, the company's first line, between New York and Philadelphia, had been completed but not yet opened for service.

Angus S. Hibbard was born in Milwaukee, Wisconsin, on February 7, 1860, the son of William Bowman Hibbard and Adaline (Smith) Hibbard, both of whom were born in North Hadley, Massachusetts, and whose families had later settled in the west. He was educated in the Milwaukee Academy, and was for a short time a student at Racine College. After spending a year in the general offices of a railroad company, he was made chief clerk to Charles H. Haskins, Superintendent of the Northwestern Telegraph Company at Milwaukee in 1878. Haskins, as agent of the Bell Telephone Company—a predecessor of the American Bell Telephone Company—began the introduction of telephones in Wisconsin.

Such was Mr. Hibbard's aptitude for the telephone business—only a year old in 1878—that when the Wisconsin Telephone Company was formed in 1881, he was made its General Superintendent. At this time, life was very rugged in the heart of the lumbering country, and plenty of nerve, as well as the ability to improvise, were required in the construction and operation of telephone exchanges. Mr. Hibbard completed his first exchange, at Wausau, in six weeks. During the next five years, he had charge of the construction of more than fifty exchanges, as well as numerous short toll lines, and had some very interesting experiences.

When Mr. Hibbard was called to New York at the age of twenty-six, the offices of the A T & T were on the fifth floor of the Smith Building at 15 Cortlandt Street, New

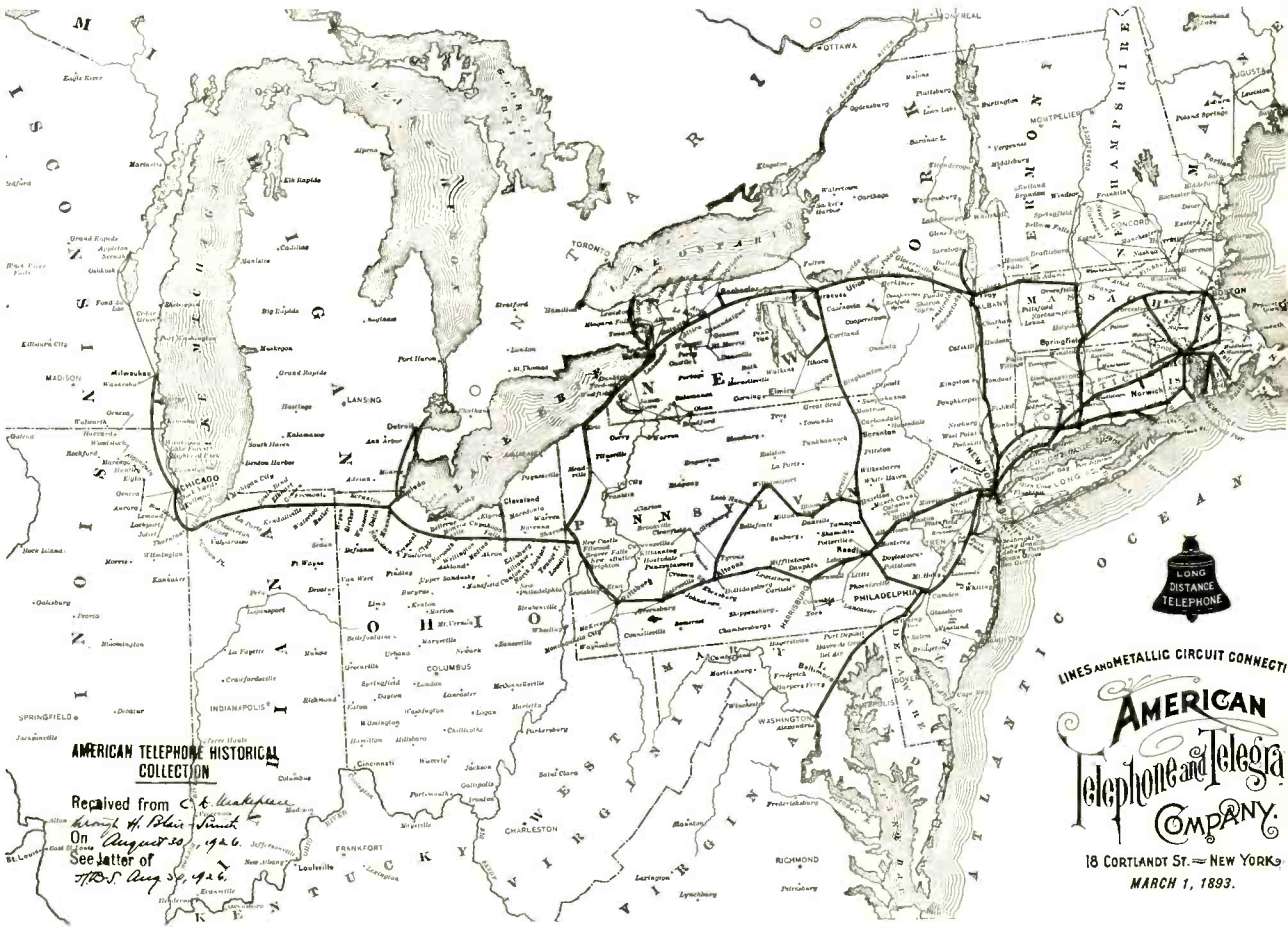


Fig. 1—Lines of the American Telephone and Telegraph Company as of March 1, 1893.

York City, while the operating room was on the second floor of a building at 140 Fulton Street, which is still standing (across the street from Whyte's Restaurant). In 1887, both the general offices and the operating room of the A T & T were removed to the new eight-story building of the Metropolitan Telephone and Telegraph Company, at 18 Cortlandt Street, where they remained for many years.

During the seven years that Mr. Hibbard held the position of General Superintendent of the Long Distance Company, its lines were extended northward to Boston, Albany, and Buffalo; westward to Chicago and Milwaukee; and southward to Washington, D. C. Their extent as of March 1, 1893, is shown in Figure 1. From the start, only the highest grade of construction was employed: very heavy poles, set about 45 to the mile, sunk six feet in the ground, and strongly braced. The metallic circuits were all of hard drawn copper and were carefully balanced against induction and crosstalk. The high quality of transmission which they furnished set an example that did much to hasten the conversion of the exchange and toll lines of the local operating companies from a grounded to a metallic circuit basis. The strength of the long distance lines was amply demonstrated by their behavior under severe weather conditions, notably the famous blizzard of March, 1888, which completely disrupted telegraph and local telephone service along the eastern seaboard. During this storm not a single pole belonging to the A T & T broke or fell, and communication between New York and Philadelphia was not interrupted.

The first use of the long distance tele-

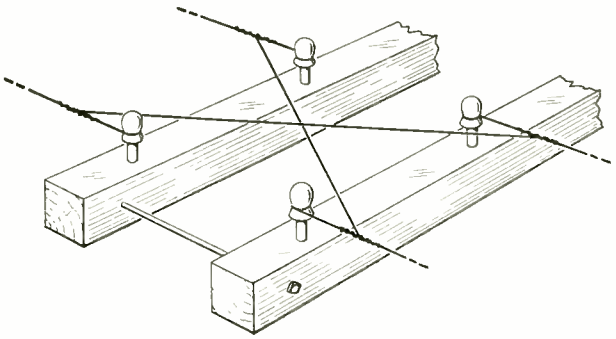


Fig. 2—Early type of "point" transposition employing four insulators on a double crossarm.

phone in transmitting election returns was made during the presidential election of November, 1888, and due to the careful preparations made by Mr. Hibbard, the reports were received at political headquarters and newspaper offices in many eastern cities well in advance of those transmitted in the usual manner.

The story goes that during his early period of service with the A T & T, Mr. Hibbard was overburdened with work and had to put in long hours at his desk. Accordingly, he felt justified in applying to Mr. Hall for an increase in salary. The latter was not impressed, and told Mr. Hibbard that his work must be poorly organized. "If you can come to me sometime," said Mr. Hall, "and tell me that you have nothing to do, you may get an increase in salary." Mr. Hibbard said nothing further at this time, but at a later date, when Mr. Hall mentioned that he was going uptown to pick out a carriage, Mr. Hibbard asked to go along. When Mr. Hall reminded him of the fact that he was supposed to be overburdened with work, Mr. Hibbard replied that his work was so well organized that he had nothing to do right then. Shortly afterward he got a raise in salary.

While he was General Superintendent of the Long Distance Company, Mr. Hibbard made several inventions, two of which are worthy of special mention—the double transposition insulator, and the first practical form of central office distributing frame.

When the transposition system for open wires was invented by J. A. Barrett in 1886,* "point" type transpositions were employed—that is, the wires were transposed at the pole and ran parallel throughout the span. At first, four insulators were employed on a double crossarm, the transpositions being made by dead ending and cross-connecting with jumper wires as shown in Figure 2. In 1889, Mr. Hibbard devised a double transposition insulator—two insulators mounted one above the other on a single pin which extended through a hole in the top of the lower insulator as shown in Figure 3. The transposition could thus be made with two double insulators mounted on a single crossarm, the wires being dead ended and cross-connected as before as shown in Figure 4. This method remained standard until the early 1900's.

In 1890, Mr. Hibbard designed the first practical form of distributing frame for making cross-connections between the line and switchboard cables in a central office, employing a compact structure of vertical, transverse, and longitudinal iron pipes or bars. The cables leading up from the cable vault were terminated on one side of the frame, while those leading down from the switchboard were terminated on the other side of the frame. Connections between the two sets of terminals were made by bridle or jumper wires, which made vertical and

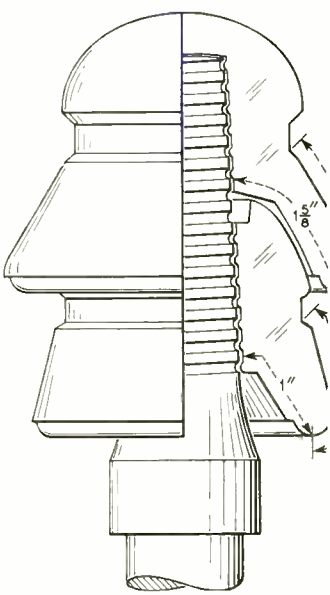


Fig. 3 – Hibbard double transposition insulator of 1889.

* Record, *July*, 1949, *page* 255.

horizontal runs through the framework according to certain definite rules. In this way, the jumper wires, regardless of the position of their terminals on the frame, could be changed in any desired manner to effect a redistribution of the lines at the switchboard, without disturbing the cables or the connections at the switchboard.

The Hibbard distributing frame was covered by United States patent No. 453,863, issued on June 9, 1891. With subsequent improvements, it found wide use in Bell System manual exchanges.

Mr. Hibbard was a member of both the

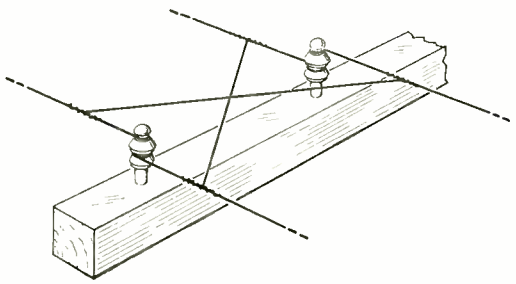


Fig. 4—"Point" transposition employing two of the Hibbard double insulators on a single crossarm.

Cable and Switchboard Committees, which were formed of executives and engineers of the parent Bell Company, the Bell operating companies, and the Western Electric Company. These committees met at intervals, beginning in the year 1887, to study the requirements of the operating companies and to make recommendations regarding the development of improved types of cables and switchboards to meet those requirements.

Mr. Hibbard was also the originator, in 1888, of the Blue Bell sign, which was adopted in 1889 and has ever since been the standard emblem of the Bell System. The first design is shown in Figure 5.

In 1893, Mr. Hibbard left the Long Distance Company to become General Manager of the Chicago Telephone Company, predecessor of the Illinois Bell Telephone Company, where he remained until 1911, as Vice President after 1903. During this period, in addition to fulfilling his executive duties in a very able manner, Mr. Hibbard found time to make two very

Fig. 5—First design of the Blue Bell sign adopted in 1889.

important inventions—interrupted alternating-current machine ringing, and the first practical four-party full-selective signaling system.

In 1895, Mr. Hibbard invented the interrupted alternating-current machine ringing system for "B" switchboard positions, in which the ringing of the called subscriber's bell started automatically when the operator inserted a plug in the jack, and continued intermittently, by means of a commutator arrangement, until the call was answered, when it was automatically discontinued. This system, which has been widely used in Bell System common battery exchanges, was covered by United States patent No. 542,052, issued on July 2, 1895.

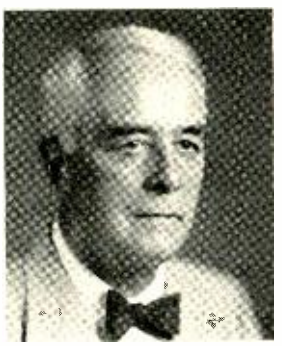
It was also in 1895 that Mr. Hibbard invented the first successful four-party full-selective signaling system, in which each subscriber on a party line heard only the ringing of his own bell. In this arrangement, two oppositely biased polarized bells were connected from either side of the line to ground; the ringing was accomplished by the use of plus and minus currents supplied by two central office generators, one with its positive pole grounded and the other its negative pole. This gave four ringing combinations, because a current sent out in a predetermined direction over either side of the line operated the bell adapted to respond to that direction of current, while the other bell on that side of the line remained unresponsive, since the current that operated one bell assisted the biasing spring of the other to prevent its armature from oscillating. With various subsequent im-

provements, this system, which was covered by United States patent No. 555,725, issued on March 3, 1896, has found a wide application in party line service.

In 1911, Mr. Hibbard transferred to New York to assist in establishing the combined telephone and telegraph service planned by Mr. Vail after the purchase of control of the Western Union Telegraph Company. This plan met with criticism, and after discussions with the Federal Administration was abandoned.

Mr. Hibbard retired from active service in 1915, and returned to Chicago, where for many years he maintained an active interest in civic and social affairs, and his hobbies of music and outdoor sports. In 1941, he published his book "Hello—Goodbye," a colorful and very readable story of the author's telephone career during the first thirty-five years of Bell System history.

Mr. Hibbard died in Chicago on October 21, 1945, at the age of 85.



THE AUTHOR: ROGER B. HILL received a B.S. degree from Harvard University in 1911 and entered the Engineering Department of the American Telephone and Telegraph Company in August of that year. For several years thereafter he was engaged principally in appraisal and depreciation studies. When the Department of Development and Research was formed in 1919, he transferred to it, and since then has been largely concerned with studies of the economic phases of development and operation. He has been a member of the staff of Bell Telephone Laboratories since 1934, first in the Outside Plant Development Department and later in the Staff Department. In addition to his work on the economic side of the telephone business, Mr. Hill has exhibited a great interest in the early history of the telephone art, and has assisted with the preparation of several books and articles dealing with that subject.

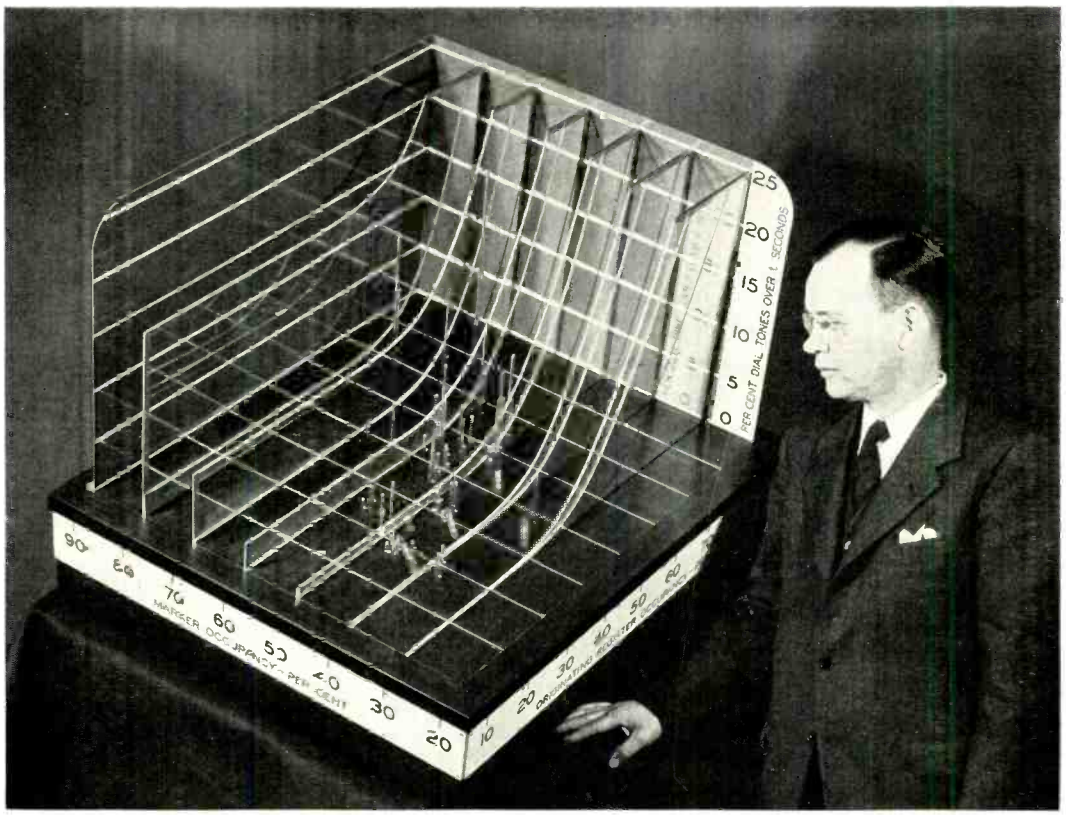
This Month's Cover

The apparatus shown on the cover of this issue was devised by W. L. Bond specifically for Transistor studies. It consists of four micromanipulators arranged symmetrically around a plastic block. The micromanipulators are used to enable the placement of four metal contact points on a crystal of germanium, which may be seen on the top of the block. A microscope is provided as an aid in accurately placing the contact points.

This apparatus has been used by J. R. Haynes and W. C. Westphal in their investigation of the velocity of drift and mean lifetime of holes* and electrons. When used for this purpose the contact point on the left was made an emitter and the point on the right a collector, as in a Transistor, the other two points being used as voltage probes. Holes or electrons were injected from the emitter point and the relative number which succeed in arriving at the collector point as well as their transit time in a known electric field was observed using suitable circuits. The mobility and lifetime of the injected holes or electrons may be calculated from this information and a knowledge of the distance between the emitter and collector.

Studies of this nature are laying a foundation of a new engineering science of Transistor electronics.

*A "hole" is a spot in the germanium crystal lattice from which an electron is missing. When voltage is applied, holes move in the crystal in the opposite direction to that of conduction electrons, and therefore behave like positive electrons.



Three-dimensional traffic chart

How quickly a subscriber receives dial tone after lifting his handset depends on the extent to which the markers and originating registers in his central office are being used at the time. Using probability theory, this dial tone interval can be calculated for any combination of values of percentage marker and register occupancies, which measure the relative amount of time these circuits are being used. Actual dial tone intervals found from tests in a central office can be expected to fall above or below the calculated values by random amounts. To show the variations of dial tone intervals with marker and register occupancies, and the correspondence between observed and calculated values for the first No. 5 crossbar office* at Media, Pennsylvania, this three-dimensional luminous chart was devised. It was first exhibited over a year ago by M. B. McDavitt, Director of Switching Development.

Calculated values are indicated by the upper edges of lucite sheets, each of which represents the dial tone interval for one value of marker-occupancy and all values of originating register occupancy from 10 to 90 per cent. There are two such lucite sheets for each of six values of marker occupancy. One sheet of each pair is for a dial tone interval of 1.5 seconds, and the other for a dial tone interval of 3 seconds. Colored lights concealed in the base of the structure shine through the lucite sheets and become evident only at the upper edges—thus giving the appearance of colored lines in space. Yellow light is used for the 1.5 second sheets and red for the 3 second sheets. The results of test data taken in Media are shown by the tips of lucite rods similarly lighted, and thus may be compared with the calculated values.

* RECORD, March, 1949, page 85.

Equipment arrangements for No. 5 crossbar markers

W. B. GRAUPNER
Switching Equipment

In the No. 5 crossbar system, a single marker performs the functions of both the originating and terminating markers in the No. 1 crossbar system. In addition, it establishes a connection between the subscriber lines and the registers that give dial tone and record the digits dialed. The equivalent connection was performed by the line link and sender link controllers in the No. 1 system. The No. 5 marker is therefore considerably larger than either of the No. 1 markers.

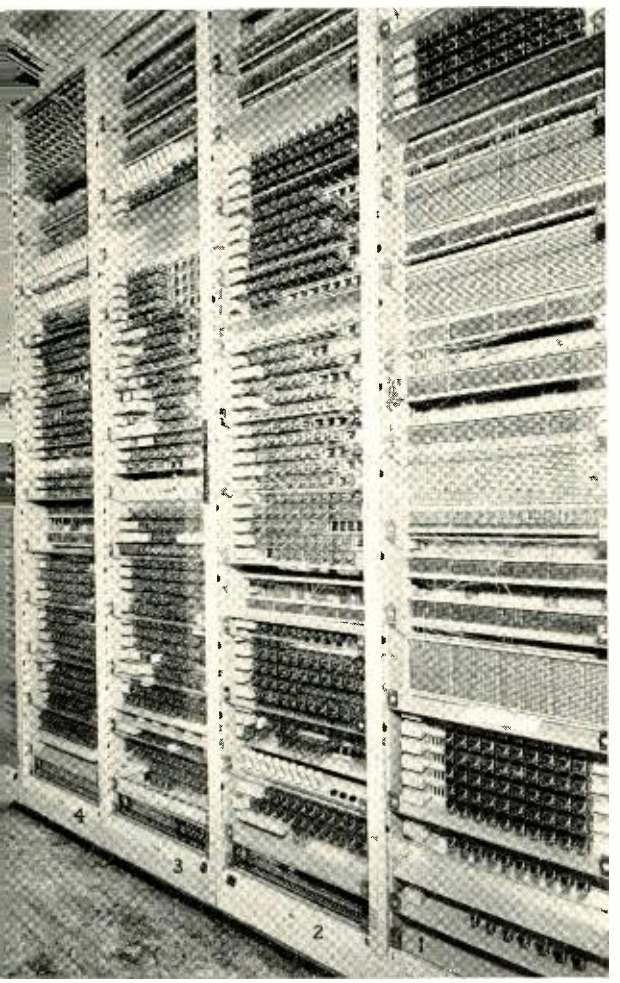


Fig. 1—One of the markers in the Media office.

As with all other No. 5 crossbar equipment, the marker has been arranged on standardized frames of a size that can be conveniently handled in the shop and by the installer. Each frame is completely equipped, wired, and tested in the factory so that the installation effort is reduced to erecting and interconnecting frames and making the necessary tests to assure satisfactory operation. To aid manufacture and job engineering, the marker was designed so that associated circuit functions can be assembled in small standardized units apart from the frames with their common equipment and wiring. These standard units, with whatever optional features are needed, are then arranged on standard frames as required for a particular installation.

In grouping together associated operating features, care was taken first to segregate into small equipment units those functions whose equipment was of a repetitive or multiple nature. A relatively high demand is thus developed for these units, and the number required for each particular marker can be readily furnished initially or added as an office expands. Each of the marker frames is equipped to its capacity with those functional units having the closest association, not only for better operation and maintenance but also for economical wiring and testing in the shop.

One of the markers for the Media office is shown in Figure 1 where the bays are numbered from right to left for convenience of reference. Two frames, each having two bays, are required for each marker. One frame, bays 3 and 4, has the common control functions and line, trunk, and junctor identification and selection functions; the

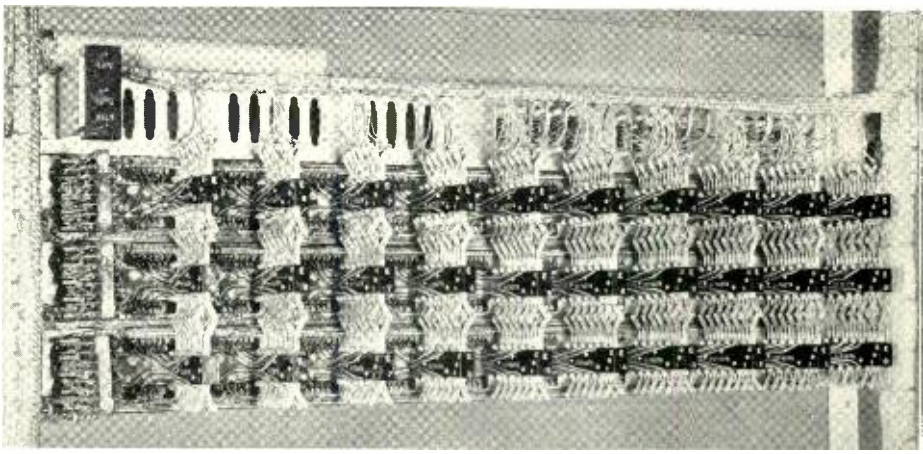


Fig. 2—Trunk test lead connector frame in the Media office.

other frame, bays 1 and 2, has the translator, route relay, and other call completing functions. An additional single bay frame, bay 5, is common to a number of markers and accommodates the relay units which connect the trunk test leads from the trunk link frame to the marker. Space is provided on this bay for 480 relays which may connect 80 or 40 routes from ten trunk link frames to six or twelve markers or 40 routes from twenty trunk link frames to six markers. When an office has more than 80 routes and six markers as an example, more than one bay of this kind is required. In the photograph, relays are provided for only fifty routes and three markers. Another single bay frame, bay 6, provides space for the class of service relay units and cross-connection fields for four markers. A third single bay frame may sometimes be required to provide route relays in addition to the 100 mounted on one of the two bay frames. Each of these five shop wired frames has terminal strips at the top of the frame for the connection of interframe switchboard cables which are run by the installer.

Each of the various functional units is equipped for one or more figures of the marker circuit. The use of unit construction makes it relatively easy to omit optional units which are not required for a particular installation. Any unit which is not furnished initially may easily be added at a later date by connecting to it leads which are already in the universal frame local cable.

One of the novel features of the No. 5 marker is the use of transparent front covers on all the bays. These are evident in the photograph only by the rectangular lift plates at the bottom corners of each cover. How clearly these covers allow the operation of the relays to be observed is evident in the photograph. When adjustments or addition of equipment are required, the covers of all the bays are readily removed by lifting and tilting out.

Another novelty in the No. 5 marker is the use of 275 and 276 (mercury) relays*—evident near the bottom of bay 2, at the middle and near the top of bay 3, and three-quarters way up on bay 4. These relays must be mounted with their axes not more than thirty degrees from the vertical. To avoid the use of hinged mounting plates, which have been employed previously for apparatus that had to be mounted vertically, a sloping mounting plate was designed that will hold the relays within the required angle of the vertical, and yet permit their ready removal from the vacuum tube sockets into which they plug. These mounting plates accommodate either fifteen or thirty mercury relays—a single row being provided for the former unit and a double row for the latter. A single row shelf is evident near the bottom of bay 2, while a double row shelf is evident at the top of bay 3.

It was desired to have faster operate time than could be obtained with multicontact relays used in the No. 1 crossbar marker, and so lighter and smaller U-type relays are used in the No. 5 marker. In some cases, this means that a greater number of relays will be required, but this is offset by the faster

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action and more uniform mounting arrangements. To obtain particularly fast action time for some operations, the marker employs a large number of relays with 14-ohm windings; each relay requires a high wattage 90-ohm resistor in series with its winding. Instead of being mounted on their associated functional units, these resistors are provided on separate units, having twelve resistors on a plate. A number of these units are mounted together at the top of the frame. Resistors can be assigned at random from this pool to relays located anywhere on the frame, and relays may be changed or added without changing the equipment layout of the unit. In Figure 1, these resistors may be seen at the top of bay 4.

When the number of markers in an office is increased, an additional relay for connecting the trunk test leads for each route must be added to the multiple of the relays for the working markers. Since exceptional precautions must be taken to avoid interrupting the operation of important common control equipment such as markers, a special method of adding these relays was designed. The arrangement is shown in Figure 2. A vertical lead running down the rear of bay 5 connects the relays for the same route in all the markers. If there were only three markers in the office originally, there would be only three rows of these relays, each column of three relays representing the same route in the three markers. The vertical multipling lead is furnished by a newly designed "Y" shaped terminal strip for each relay of each row. The two ends of this terminal strip slightly overlap the two-inch mounting plate, and in doing so come in contact with the terminals in the row above. A brief application of the soldering iron to these terminals connects them together, and thus completes the multiple connection. To add a unit of relays, it is necessary only to mount the unit with the relays and terminal strips in place, and solder the terminal strips to the ones immediately above, with which they will be in contact.

In the No. 1 crossbar system, decoding generally was based on two- and three-digit office codes. The No. 5 crossbar system, however, provides for one-, two-, or three-digit codes or a combination of these. To simplify the assignment and use of these codes, a cross-connecting field is provided in the No. 5 marker, and changes in the type of code require merely a change in the jumpers.

The local circuits for each marker are fused on three panels at the bottom of the two double-bay frames. However, a common alarm is provided, and the one fuse alarm lamp is at the base of one bay so as to be centrally located with respect to the four bays. A fuse guard lamp, to indicate that a fuse has been removed and the marker made busy, is placed next to the alarm lamp. These lamps may be seen in the small black rectangular plate near the left at the bottom of bay 2. An alarm release key is grouped with the miscellaneous circuit jacks and lamps in the vertical jack panel about half way up the column between bays 2 and 3. Test and telephone jacks are multipled to appear in every other upright for maintenance convenience.

Each marker frame—either one bay or two bay—is completely equipped, wired, and tested in the factory so that the installation

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effort is reduced to erecting and interconnecting frames and making the necessary tests to assure satisfactory operation. The two double-bay frames of each marker are placed adjacent to one another with the single bays common to a group of markers generally located central to the frames they serve. To assure greater security and continuity of service in cases of wiring or power failure, marker frames are generally associated with battery feeders and multiple cables in two groups, one group containing the even numbered markers and the other the odd numbered markers. To permit the cables of these two groups to be run in separate cable racks, and to obtain more direct cable runs, the markers in an office are located in two lines facing each other, with even markers in one line and odd markers in the other.

Switching center of the Ford 81C1 system. Rows of reperforator - transmitters mounted two to a machine cabinet are at left and right. In the extreme rear is the control board.

Automatic Teletypewriter Switching System for Ford

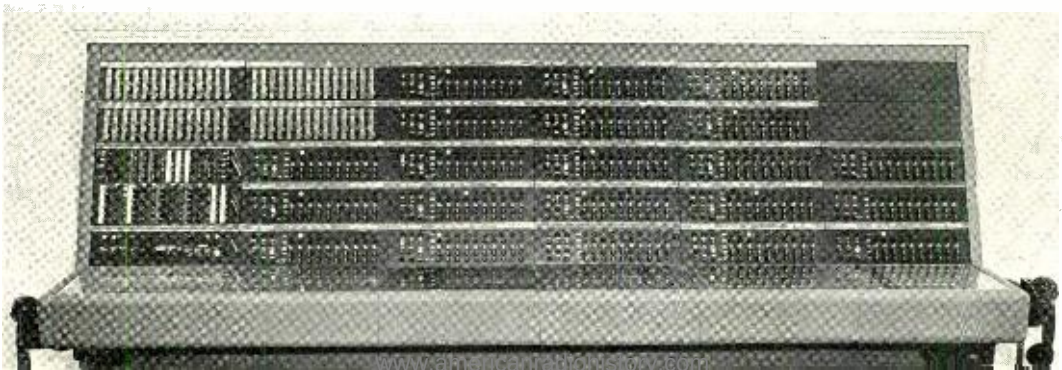
The fifth 81C1 automatic teletypewriter switching system for Bell System private wire customers was placed in service on May 15 for the Ford Motor Company.

The Ford system includes the switching office at Dearborn, Michigan. This office is the largest 81C1 office yet installed. It interconnects 19 multi-station full-duplex lines requiring 21,000 miles of wire facilities. These lines serve 59 sending and receiving stations located in 44 cities spanning the country from Seattle and Los Angeles in the west, and Dallas and Jacksonville in the south, to New York and Washington in the east. Also included in the system are 16 local sending and 25 local receiving stations located in the Dearborn and Detroit area.

An average of 14,000 messages of about 40 words each are originated each day at stations connected to the system. About 17 per cent of these messages are multiple address messages.

Because of the size of the system, considerable specific engineering was done by Long Lines with the advisory services of W. M. Bacon and G. A. Locke of the Laboratories' Telegraph Engineering.

Control board of the Ford system. The 21 identical panels control one line each. Lighted lamps indicate outlying stations transmitting.



Background noise in Transistors

H. C. MONTGOMERY
Physical Research

In any transmission device there is a limit to signal level below which background noise becomes troublesome. This may be set by external disturbances picked up by the device; cross talk in telephone lines is a familiar example of such a limitation. Or, it may be set by noise sources inherent in the device itself; hissing shot-noise in a sensitive radio receiver typifies this sort of limitation. The Transistor* is no exception, and when used in a high-gain circuit a steady rushing sound can be heard in the background. This noise, which is generated in the Transistor, has several characteristic properties which differentiate it from other common types like thermal and shot noise.

The spectrum gives considerable information about a noise. Usually this is in the form of a curve displaying how the noise power per cycle bandwidth varies with frequency. A typical Transistor noise spectrum is shown in Figure 1 where it will be noted that the noise is greater at low frequencies and less at high frequencies, being very nearly in inverse ratio to the frequency. One consequence of this type of spectrum is that each octave in the frequency range contains the same noise power; for a typical Transistor the noise power is about 10^{-10} watts per octave. Thus the noise power between 50 and 100 kilocycles is the same as that between 20 and 40 cycles, or between 0.1 and 0.2 cycle, if we are willing to extrapolate the spectrum to such a low frequency. Another consequence is that if we were to assume the same spectral law all the way to zero frequency, the amount of power would be infinite. We conclude that at some low frequency the spectrum flattens off or drops again, a consideration that is really academic since the inverse-frequency type of spectrum could continue down to 10^{-20} cycles and the total noise power would be only one-millionth of one per cent of the d-c power supplied to the Transistor. At this inconceivably low frequency one cycle would occupy over one trillion years.

An oscillogram of Transistor noise is shown in Figure 2, taken in a band from 30 to 1500 cycles. For comparison, an oscillogram of thermal noise is shown for the same band. It is seen that the Transistor noise has relatively more low frequency disturbance.

Often the disturbing effect of noise in an amplifier is expressed by giving a "noise figure," which is defined as follows. Noise figure is the ratio of the noise output of a given amplifier to that of a perfectly quiet but otherwise similar amplifier which merely amplifies the thermal noise inherent in the generator to which it is connected. A typical noise figure for a type-A Transistor is 60 db

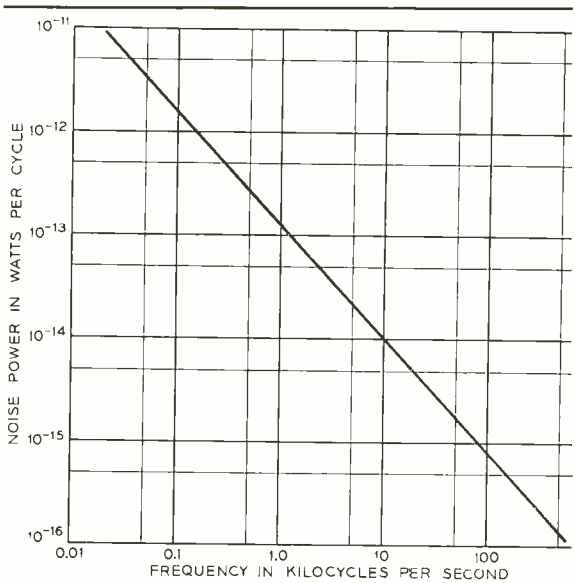


Fig. 1—Typical spectrum of Transistor noise, showing the noise power in watts per cycle bandwidth at various frequencies.

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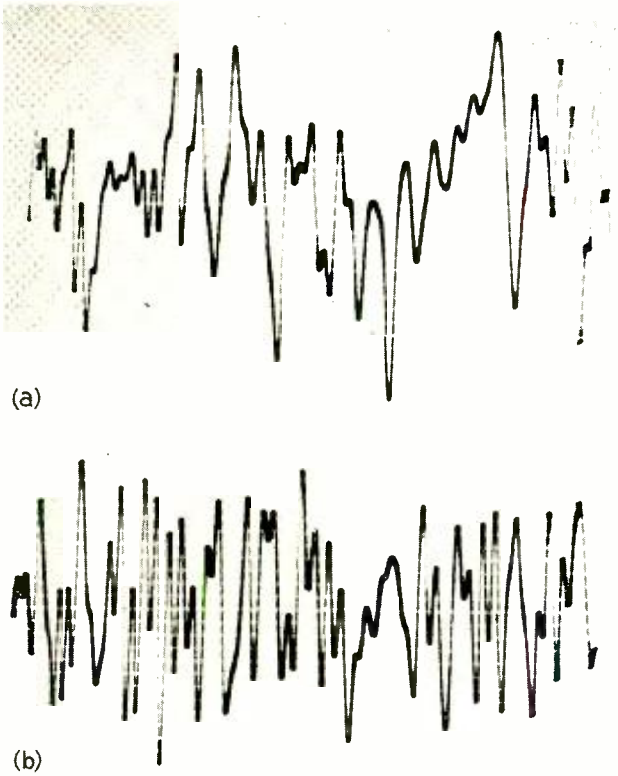

Fig. 2—Oscillograms of Transistor noise, (a), and thermal noise, (b), for a band from 30 to 1500 cycles. Each oscillogram covers an interval of about 1/30th second. The Transistor noise has been amplified about a thousand times, the thermal noise a million times.

at 1000 cycles. There is considerable scatter among individual units, and 1000-cycle noise figures as low as 45 db and as high as 70 db are not uncommon. The noise figure varies with frequency in the same way as the spectrum of Figure 1, averaging about 80 db at 10 cycles and 30 db at 1 megacycle.

Another useful index of noise performance of an amplifier is the ratio of the maximum undistorted signal output to the noise output. For an average type-A Transistor used as a single stage amplifier this range is about 80 db for a band from 100 to 3000 cycles, or about 75 db for a band from 10 cycles to 1 megacycle.

Figure 3 is a cut-away view of a type-A Transistor showing the emitter, collector and base, to which external connections are made. In common applications of the Transistor, the emitter and collector are given separate d-c bias with respect to the base, and the amount of noise produced in the output circuit depends on the bias. For a fixed emitter bias the output noise voltage increases with increase in d-c collector voltage as shown for two different specimens by the curves in Figure 4. As is evident from the curves there is considerable variation from one unit to another. It is often possible to secure some improvement in noise figure by operating at a reduced collector bias voltage, but beyond a certain point losses in gain will prevent any further improvement. The emitter bias also affects the noise but only to a minor extent.

In some circuit problems it is useful to know how much noise appears at the different terminals of the Transistor. There are three open-circuit noise voltages which could be measured, one between each of the three possible pairs of terminals, emitter-base, base-collector, and collector-emitter. Measurement of any two of these voltages, together with the statistical correlation between them as indicated below, makes it possible to calculate the third. Alternatively, measurement of all three noise voltages en-

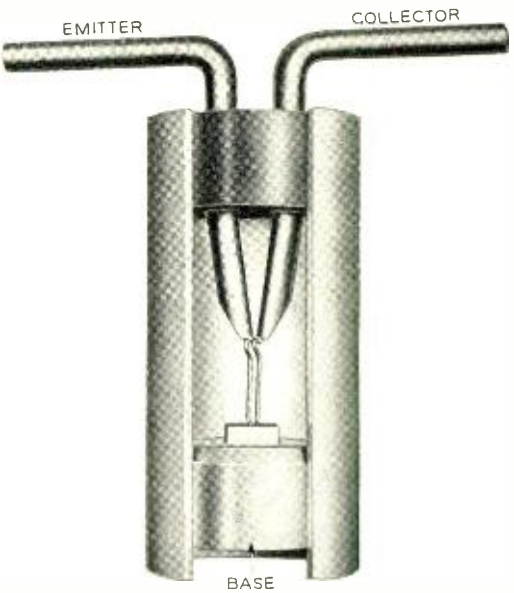

Fig. 3—Cut-away view of a type-A Transistor, showing the block of germanium and the two "cat-whisker" connections to its surface. The entire height of this Transistor is about half an inch.

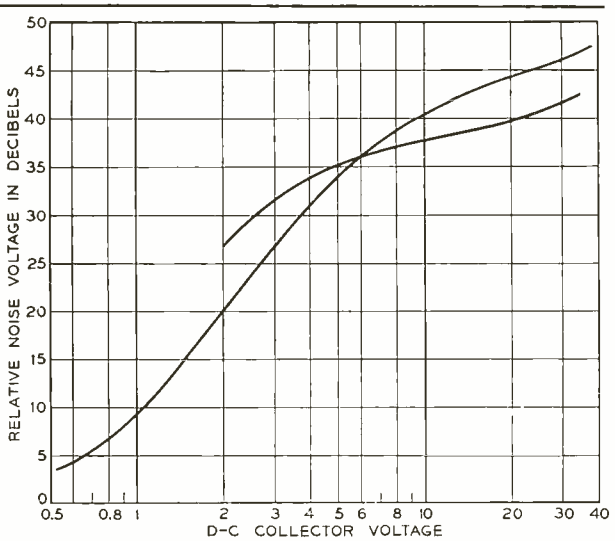

Fig. 4—Noise output of a Transistor increases roughly in proportion to the collector bias voltage.

ables one to calculate the correlations between any of them. These relations, which apply to any three-terminal device, are very simply shown in the triangle diagram of Figure 5. Each side of the triangle represents the rms noise voltage between one pair of terminals. The cosine of any included angle, with its sign reversed, equals the statistical correlation between the noise voltages corresponding to the adjacent sides.

Emitter-base noise voltage in the Transistor is generally less than one per cent of the collector-base noise voltage. However, because of the relatively large voltage gain through a Transistor, there are many circuit arrangements in which the emitter-base noise voltage contributes about as much to the total output noise as the much larger collector-base noise voltage. From the triangle diagram it is readily seen that because the emitter-base noise voltage is so small, the other two noise voltages must be very nearly equal to each other.

Causes of the noise in a Transistor are not well understood. It seems likely that part of it arises in the contact between the metallic "cat whisker" and the germanium wafer. A very similar type of noise which exists in light contacts between carbon granules has been extensively studied in connection with telephone transmitters. Proper fabrication can greatly reduce, if not completely eliminate this source of noise. It seems fairly cer-

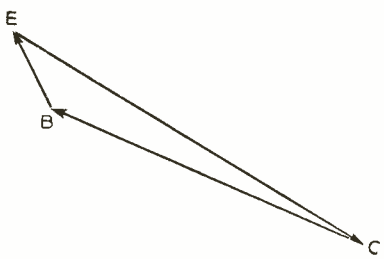

Fig. 5—Noise voltages between the three possible terminal pairs always form a triangle whose angles are indicative of the correlation between the various voltages. The relative size of the emitter-base noise voltage is exaggerated.

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tain that there is another source of noise within the germanium itself. Recent studies have shown that very pure samples of germanium in the form of single crystals exhibit the same type of noise when a direct current passes through them.

The present Transistor has a range above background noise which is entirely adequate for many applications. In other cases the noise is a substantial limitation. Some progress in reducing noise has already been made since the introduction of the type-A Transistor. New methods of fabrication and a better understanding of the basic physics of semiconductors will undoubtedly lead to further improvements in performance. In return, it seems likely that study of the noise in Transistors and semiconductor material will aid in the understanding of conduction processes in semiconductors.

New Impedance Bridge Measures Small Resistance Increments

An inductance bridge was recently constructed for use in the development of submarine cable such as the new Key West-Havana submarine cable, especially for making precise measurements of inductance, resistance and resistance increments of short cable specimens. An unusual feature of the bridge is provision for measuring increments of a-c resistance over d-c resistance as little as 0.0001 ohm. Large blocks used as test terminals with a short-circuiting plug, make it possible to attain this order of precision. The Maxwell bridge circuit employed uses a conductance standard for measurement of resistance. This utilizes high-valued resistors in parallel circuits, so that there is no contact resistance problem in the bridge standards.

Specifications of this bridge are as follows:

Frequency:	0.2 to 150 kc
Inductance:	0.001 to 111.1 microhenries
Resistance:	0.0001 to 11.1 ohms
Accuracy:	± 0.2 percent over most of the range

This bridge measures increments of a-c resistance over d-c resistance as little as 0.0001 ohm.

Message register operation in No. 5 crossbar

F. K. LOW
Switching Development

A feature of the No. 5 crossbar system* is the use of cold cathode gas-filled tubes to perform certain operations. Large numbers of them are employed for operating subscriber message registers in offices where these are required. Owing to the differences in the trunking plans of the two systems, the d-c method of control employed for registers in the No. 1 crossbar system was not practicable with the No. 5 system. Accordingly, an unusual type of control circuit utilizing cold cathode tubes has been developed to fit the simplified plan of the latter system.

Telephone message registers have been used for many years with certain classes of subscriber lines to indicate the number of calls completed. They are small magnetically operated counters that are operated once for each call completed, and in some cases once for each unit charge a call entails. Although automatic message accounting is being made available for the No. 5 crossbar system, it will be employed in general only in the larger areas where many outlying offices at varying distances result in a wide range of charges. In many offices there will continue to be a need for message registers, and circuits for operating them on both single and two-party lines are thus included in the No. 5 crossbar system, as they were in the No. 1 system.

If the method employed for operating the message registers in the No. 1 crossbar system were used in the No. 5 system, however,

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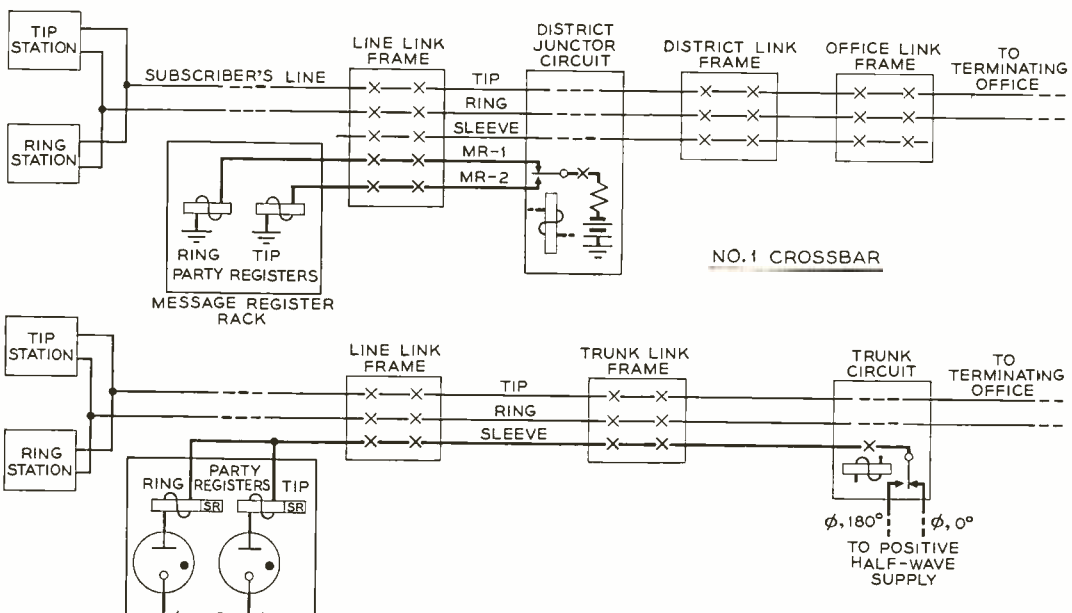


ig. 1—Simplified circuit indicating method of operating message registers: above, in the No. 1 crossbar system; below, in the No. 5 crossbar system.

the crossbar switches on the line link and trunk link frames would have had to be equipped with five sets of contacts at each of the crosspoints instead of three. In the

Instead of using extra leads for operating the message registers, the sleeve lead is made to do double duty. Besides being used for operating the hold magnets of the crossbar

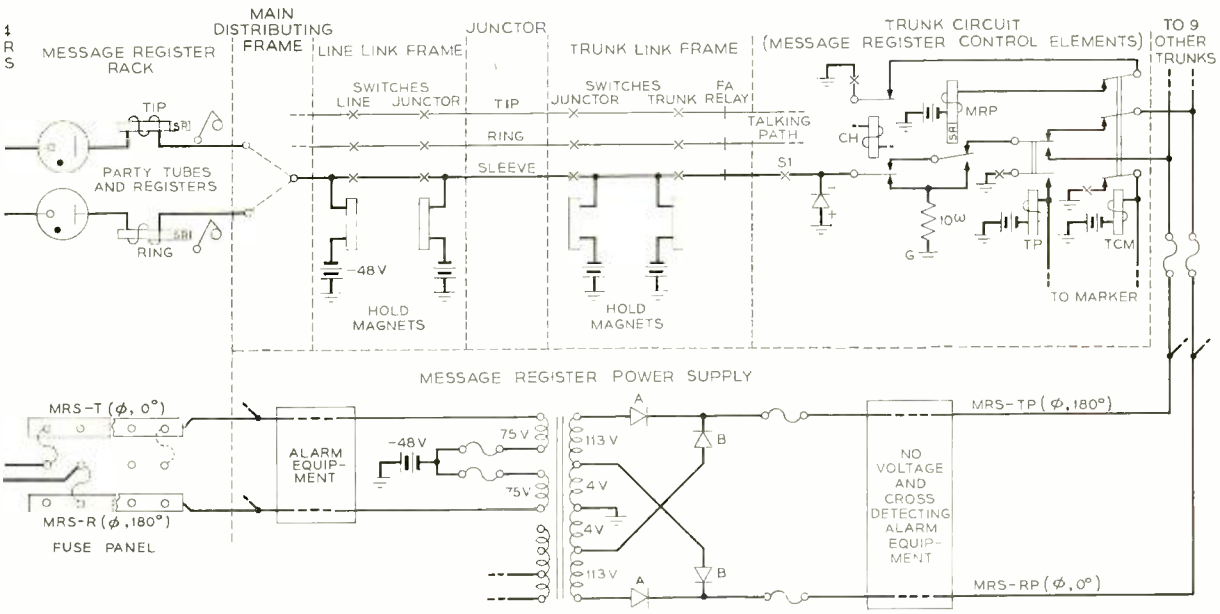


Fig. 2—Message register operating circuit in the No. 5 crossbar system.

No. 1 system the registers are operated from the district junctor circuits over two leads—one for the two possible registers associated with a two-party line. These leads pass through the line link frames to reach the registers, and thus the crossbar switches on these frames must have two sets of contacts in addition to the three for the tip, ring, and sleeve conductors. This is indicated in the upper diagram of Figure 1.

In the No. 5 crossbar system, on the other hand, the message-register operating voltages are applied in the trunk circuits as indicated in the lower diagram of Figure 1, and the leads over which the registers are reached pass through the trunk link as well as the line link frames. If the method of the No. 1 system were employed, therefore, the crossbar switches on the trunk link as well as on the line link frames would have to be equipped with five sets of crosspoints instead of three. This has been avoided by a method of operating the message registers that requires no additional crosspoints on any of the switching frames.

switches and giving busy indications to the marker, it is also used for operating the message registers through 413A cold-cathode gas-filled tubes. The two registers associated with the line are both connected to the sleeve lead, but because of the cold-cathode tubes in series with them neither will operate on the potentials applied to the sleeve lead for operating hold magnets or giving busy or idle indications to the marker. They will operate only when a properly phased half-wave ac voltage is applied to the sleeve lead in the trunk circuit. Two voltages are made available for applying to this sleeve lead. They are alike in magnitude but differ in phase by 180 degrees. Each of the two registers on a line will respond to only one of these voltages, and a relay in the trunk circuit connects the proper voltage to the sleeve lead under control of the marker.

Which party has originated the call, and which register should thus be operated after the call is answered, is determined by substantially the same means in both the No. 1 and No. 5 crossbar systems during the first

phase of the call, when the line is connected to the dial pulse receiving equipment (not shown in Figure 1). When a call is originated by a tip station, a d-c path to ground is provided while for a call from a ring station there is no d-c path to ground. Message register control circuits in both the No. 1 and

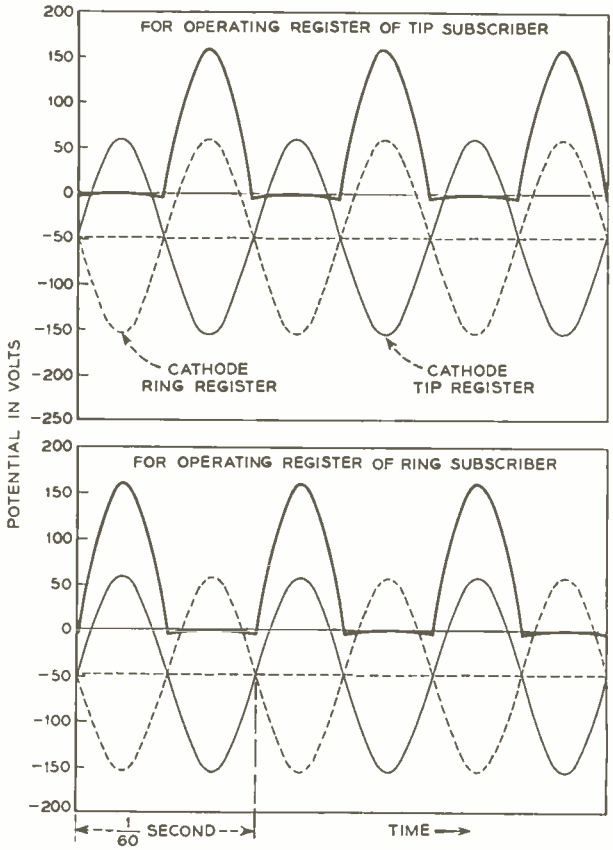


Fig. 3—Voltages applied to the gas-filled tubes associated with the message registers. Heavy lines: anode voltage; solid-light lines: cathodes of tubes for the tip register; dashed-light lines: cathodes of tubes for the ring register.

No. 5 systems use this difference to determine whether it is a tip or ring party that is calling.

Standard sheet metal frames are used for mounting the registers and their associated cold-cathode tubes as shown in Figure 5. Each frame accommodates five hundred registers and tubes. A locking bar is fastened along one upright of each frame, and a key is required to open or remove the lucite covers from the message register frame.

The method of operating registers is achieved as follows:

The detailed plan of operation of the new message register circuit is indicated in Figure 2. Each message register is connected between the sleeve lead of the circuit with which it is associated and the anode of a gas-filled tube—a 413A. In Figure 2 only the two registers associated with one line are shown, and they both connect to the sleeve lead of that line. The cathodes of the gas filled tubes for all the registers connect to a 75-volt rms a-c supply with a negative 48-volt bias. As indicated in the diagram, there are two of these supplies, equal in voltage but differing 180 degrees in phase. The tubes for all tip subscribers connect to one supply and those for all ring subscribers to the other. The voltage on the cathodes of the tubes is indicated by the dashed and light solid curves of both the diagrams of Figure 3. Since a 75-volt rms sine wave has a peak value of 106 volts, these curves swing from -154 to $+58$ volts.

When a line is not in use, its sleeve conductor is connected to -48 volt battery through its holding magnet on the line link frame, and thus this voltage appears on the anode of all tubes while the lines are idle. This voltage is indicated by the light dashed horizontal lines in Figure 3. The gas tubes will not ionize and pass current unless the anode is about 200 volts more positive than the cathode, and thus under these conditions, no current passes through the tubes.

When a call has been placed and the line is connected to a trunk by operation of the crossbar switches, the sleeve is held grounded in the trunk circuit. This increases the anode voltage from minus 48 to 0, indicated by the light solid horizontal lines of Figure 3, and the peak voltage across the tube thus becomes 154. This is still too low to ionize the tube, however.

To operate a message register, the trunk circuit momentarily connects to the sleeve lead for that line one or the other of two positive half-wave supplies. These are derived from the same source that supplies the cathode voltages by the method indicated in the lower part of Figure 2. These two voltages have the same peak value of 165 at the supply transformer, but a drop of about 5 volts across the rectifiers A reduces it to

about 160 volts at the register. Rectifiers A block the negative half cycle, but a tap on the winding for the voltage of the opposite phase connected through rectifiers B supplies a voltage of about 5 volts peak during the suppressed negative half cycle. The resultant voltage applied to the sleeve conductor—and thus to the anodes of both tubes of that line—when a tip subscriber is to be charged is shown by the heavy curve in the upper part of Figure 3, and that applied for a ring subscriber to be charged is shown by the heavy curve in the lower diagram. These two heavy curves are identical in magnitude but differ in phase by 180 degrees.

From the lower curves of Figure 3, it will be noticed that the voltage on the anode of the tip party tube is never more than 154 volts above the cathode, and thus the tube does not pass current. The voltage on the anode of the ring party tube, however, rises to 314 volts above the cathode every half cycle. As a result, this latter tube passes current and the ring subscriber register is operated. While a tube is passing current, there is a drop of about 70 volts across it, and thus the voltage across the register is reduced by this amount. This is indicated in the diagram of Figure 4 for the operating cycle of the ring subscriber. The shaded area on this diagram is a voltage-time graph per cycle for the ring register, and is proportional to the energy per half cycle that is available to operate the register. No current will start to flow until the voltage across the tube is about 210 volts, which is assumed to be the ionizing voltage for this particular tube. At this moment—as soon as current is passing—the voltage across the register becomes 140. Following the sine wave, it then increases to 244 volts and then drops to 0. About a hundredth of a second later, during the next positive half cycle, a similar spurt of current will flow through the register, and these spurts of current recurring every sixtieth of a second operate the register and, because of the copper sleeve that is placed around its core, hold it operated as long as the anode voltage is applied.

This operate current for the register is applied by the trunk using the circuit indicated at the upper right of Figure 2, which shows the conditions after the line has been connected to the trunk but before the register is operated. If a charge will be required for the call in progress, relay TCM will have been operated by the marker, and in turn will have operated relay MRP. Whether it is a tip or ring subscriber that is calling will also have been determined by the marker, and if a tip subscriber is calling, relay TP will be operated; if a ring subscriber is calling, or if it is a single party line subscriber, TP will not be operated.

After the called subscriber has answered, and a charge is to be made for the call, relay

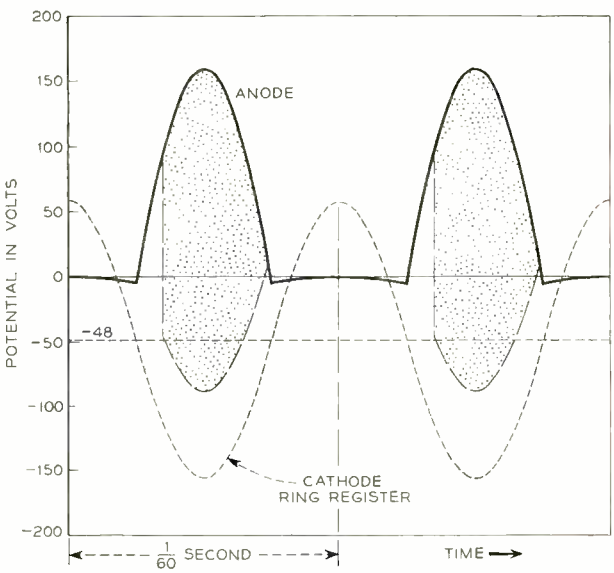


Fig. 4—Enlarged diagram of about two cycles of the voltages shown in Figure 3.

CH is operated. This transfers the sleeve lead from the holding ground at G to lead MRS-RP of the power supply through front contacts of MRP and TCM and a back contact of TP. This establishes voltages on the registers for this line as indicated by the lower curves of Figure 3, and the message register for the ring subscriber will operate while that for the tip subscriber will not.

The circuit to the winding of relay MRP is opened when CH operates, and since MRP is a slow-release relay, the message register operating current is applied only during the release period of this relay, which is ample time to operate the register. After the release of MRP, the sleeve lead is returned to its normal holding ground at G. While the message

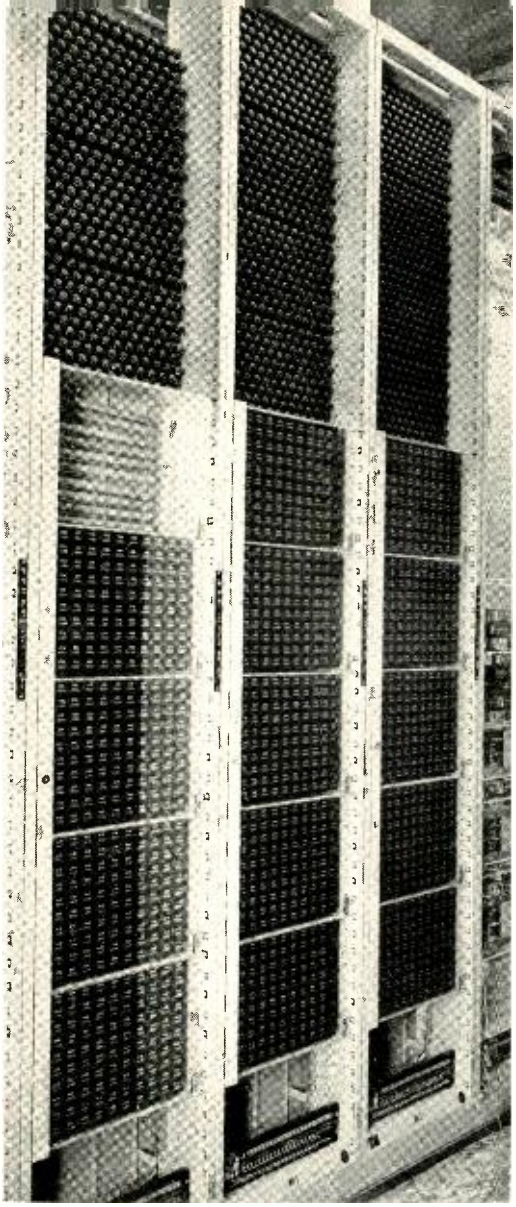


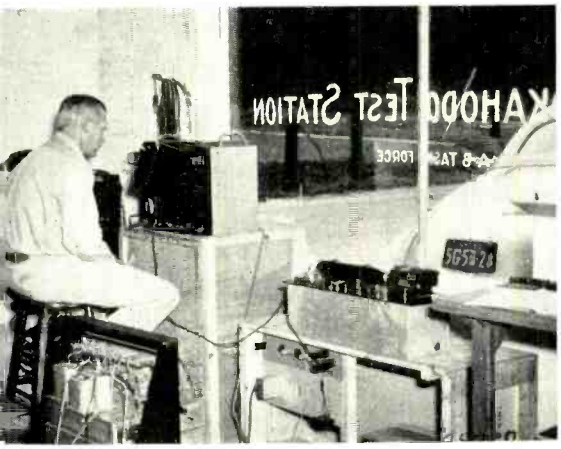
Fig. 5—Message register equipment.

register is being operated, the hold magnets are held operated from ground at the center tap of the transformer in the lower part of Figure 2. The varistor shown in the trunk circuit keeps the hold magnets operated while the sleeve lead is being transferred to the anode power supply by the operation of CH and while it is being transferred back to the hold ground by the release of MRP. It also prevents an undesirable negative discharge of the holding magnets from being impressed on the gas tubes during this switching.

At the end of the call, the trunk circuit removes the sleeve ground, thus releasing the crossbar switch hold magnets. Where they are required, trunk circuits may also be provided with equipment for timing the duration of conversations and for advancing the message register an additional step after each measured time interval. In such cases, a motor driven contact controls the relays that apply the operating voltages for the message registers.

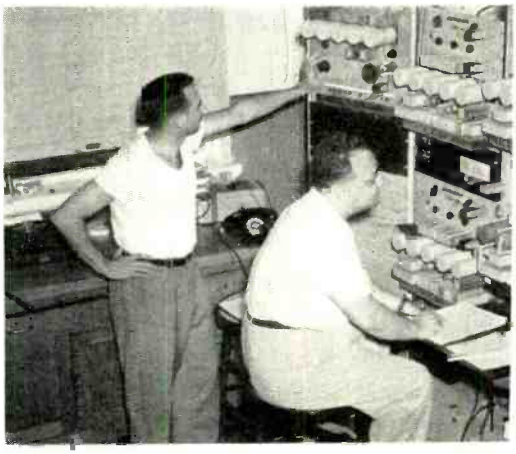
A special fuse panel at the bottom of the message register frame, evident in Figure 5, provides either tip or ring party voltage to each group of twenty-five tubes and permits changing the assignment of any group from tip to ring supply without recabling or restamping. This is done by providing one lead to carry the superimposed a-c supply to each tube group. This lead may be connected to either tip supply or ring supply by connecting its associated fuse to either the tip supply bus bar or ring supply bus bar of the fuse panel as shown in Figure 2.

THE AUTHOR: F. K. Low joined the installation department of Western Electric in 1921 after having studied electrical engineering at the University of Oklahoma and the Milwaukee School of Engineering. Following three years service in connection with various panel dial office installations, he transferred to West Street where, in the Local Systems Circuit Laboratory, he worked with problems relating to dialing and other local system pulsing circuits and with the development of the tandem office call announcer machine. During the war he participated in the development of microwave frequency and power measuring devices. Since 1947 he has been in charge of a group designing improved signaling features for local crossbar systems.



nterior of the Hamokahodo test station showing . M. Hawekotte engaged in examining wave forms static pulses.

Front view of the Hamokahodo test station showing, left to right, engineers R. M. Hawekotte, C. W. Irby, J. L. Doncourt and M. T. Dow.



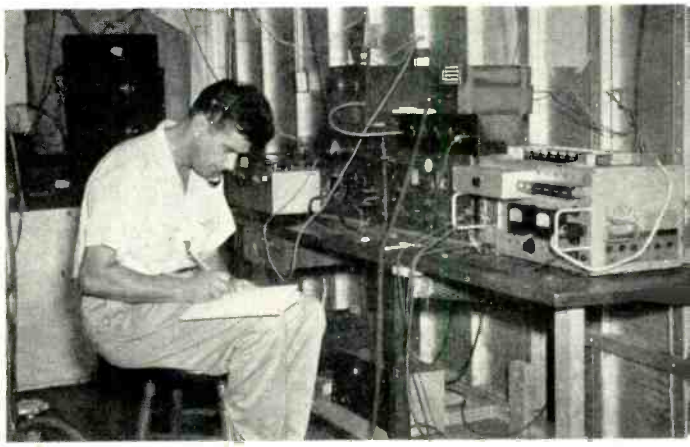
Test equipment in the A T & T repeater station at Madison. Left to right: L. A. Weber, and S. Korba.

THUNDER IN THE SOUTH

Most citizens avoid thunder storms if possible, but two groups of Laboratories engineers have deliberately sought them out during the last three or four months in one of the most popular breeding areas. In Madison, Fla., in the northern part of the state some hundred miles west of Jacksonville, these engineers have been making studies and recordings of static as it is picked up by open wire lines and by a loop antenna.

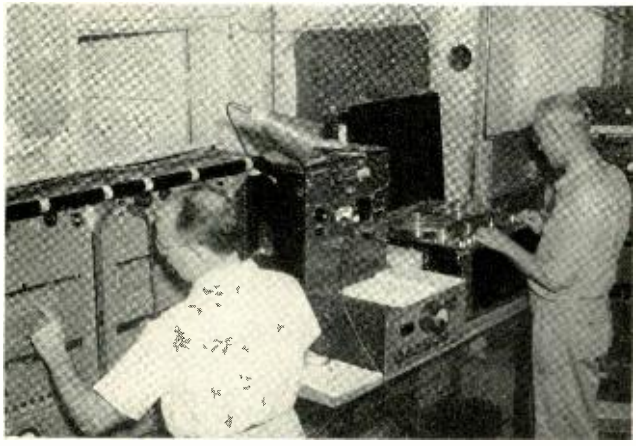
Government records show that thunder storms appear more frequently in this region than in any other in the country, and thus to get the most information in the shortest time, it was this area that was selected. Madison is on the route of the open wire toll line between Jacksonville and Thomasville, Ga.,

'he test truck, with its loop antenna on the roof for sts, was stationed 5 miles east of Madison.



Interior of the test truck that was used for direct measurements of static—J. L. Doncourt, recording data.

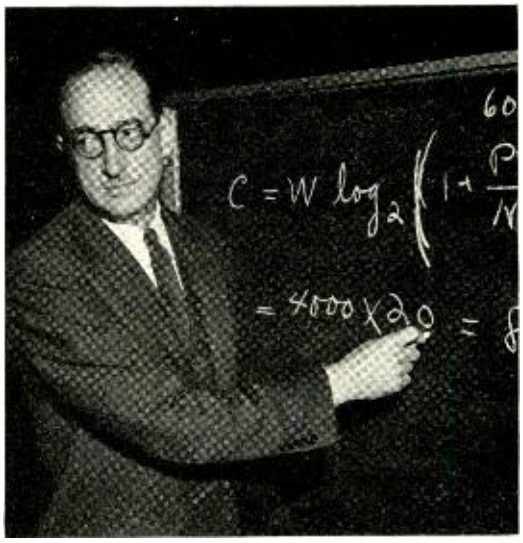
some fifty miles in a northwesterly direction. An equipment group, consisting at the time the accompanying photographs were taken of C. I. L. Cronburg, Jr., S. Korba, A. C. Velie, L. A. Weber, used the section of the line from Madison to Thomasville, and made their tests from the A T & T repeater station. The other group, or "noise group" as it was called, including J. L. Doncourt, R. M. Hawekotte, M. T. Dow and C. W. Irby, used the fifty mile section from Madison to Lake City in the east, and carried on their studies in an abandoned garage just opposite the repeater station. This temporary laboratory was christened Hamokahodo test station from the names of the group that set it up: HAwekotte, MOntfort, KAhl, HOchgraf, and DOncourt. Besides the four of the noise group who have been in Madison all summer, L. Hochgraf,



Checking noise recorders in the Hamokahodo test station. Here we see C. W. Irby at the left and M. T. Dow at the right.

H. Kahl, and L. R. Montfort, were in Madison for a few weeks in the beginning to help set up the equipment. In addition to these two points of test, studies were also carried on from a test truck with a loop antenna, which was stationed some five miles east of Madison.

Nearly every afternoon a thunder storm would show up and keep the test groups busy until it wore itself out or passed on. Storms were not always so considerate in selecting their time of arrival, however. Occasionally one would show up in the middle of the night, but regardless of time, none could be missed. The bigger they were, the more important it was that their disturbances be recorded. The data gathered will provide basic information for the development of future transmission systems.



Ralph Bown, director of research, talking before a meeting of employees of the Pacific Company in San Francisco. While there he also addressed a joint meeting of the A.I.E.E. and I.R.E. and a meeting of the Electric Club.

A Visit to Beinn Bhreagh

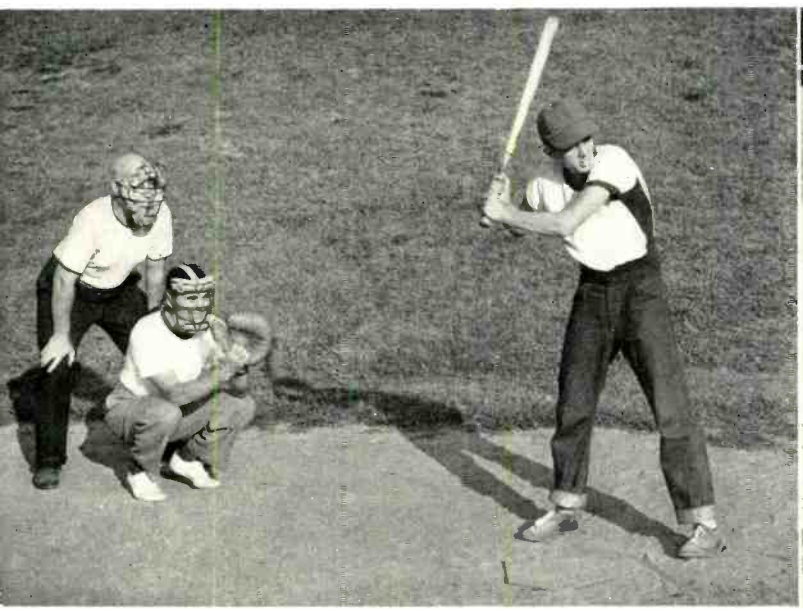
On July 11 and 12, during their vacations, O. E. Buckley and H. S. Osborne, chief engineer of the A T & T, with their wives were guests of Dr. and Mrs. Gilbert Grosvenor at Beinn Bhreagh,* the former summer home of Alexander Graham Bell, near Baddeck, Nova Scotia. The inventor of the telephone spent a large part of his time there in the latter years of his life. It was there that he conducted research into a wide range of subjects, particularly experiments with kites and other studies of the fundamental principles of heavier-than-air flying machines. Among his assistants in this work, who became famous in aviation, were Glenn Curtis, Lieut. E. A. Selfridge, F. W. Baldwin and J. A. D. McCurdy. Mr. McCurdy, who is now Lieutenant-Governor of Nova Scotia, made the flight at Baddeck which was the first flight with a heavier-than-air machine in the British Empire. He was among the guests who visited Beinn Bhreagh while the Buckleys and Osbornes were there.

The house at Beinn Bhreagh holds many mementos of the extensive travels of the Bells and the Grosvenors. A large boulder with a bronze plate located on a high eminence on the property marks the grave of Dr. and Mrs. Bell, and is the mecca of many visitors to Cape Breton Island.

* Scottish Gaelic for "Beautiful Mountain."

Twilight Game of West Street Softball Teams

The diamond at Stevens Institute of Technology Ball Field in Hoboken is the scene of fast games these summer evenings. Shown in the accompanying photographs are a general view of the field, above; Stephen Bakirtzis pitching for the Messenger team below, right. J. F. Hurley, umpire and J. Klieber, catcher, keep an eye on John Rea, who is at the bat for the Messengers below. Right, coworkers and wives of the men watch the game from a hillside. In the first row, left to right, are R. J. Dreiss, M. Wovna, H. T. Burger and G. B. Clark; second row, Lettie Broome, Rita Tornvall, Rose Wilkins, J. P. Wasko and R. Pruneau; third row, Dorothy Madoule, Lee De Vita and Mary McDermott.



Engineers study a development model in the projection room of the high-speed camera laboratory.

The High-Speed Camera Laboratory

The Fastax, a high-speed motion picture camera, was developed in the Laboratories and has been used successfully for fifteen years as a tool for the study of rapid action in telephone and other mechanical and electrical developments. These studies have been of great value to engineers, in that the equipment may be studied in ultra-slow motion, although operated at its normal functioning speed at the time the pictures are taken. These pictures are to the mechanical engineer what the oscillograph is to the electrical engineer. By use of the Fastax, he can see the rapid, complicated motions of his equipment; he can measure velocities, accelerations and deformations. He is able to project the film as a motion picture or to view it frame by frame to measure and plot the relative motions of the various details involved.

Fastex and other motion picture camera work carried on in the high-speed camera laboratory are the responsibility of F. M. Tylee, a member of the Photographic Group in the General Service Department.

Four-Way Co-Operation Brings Quick Result

To fill an unanticipated Government request, the Long Lines Department urgently needed a special kind of filter. Similar equipment had been built some years ago, and specifications for its components were on file at the Laboratories and at Hawthorne. The very day that Long Lines telephoned the information to the Laboratories, it was relayed to Hawthorne by A. J. Christopher in the form of a list of 90 different kinds of capacitors to be made up. On the next day, F. J. Hallenbeck of Transmission Networks gave Kearny the necessary information on circuit changes. Meanwhile some three dozen filters of a similar type were being taken out of Long Lines' plant and sent to Kearny. By the time they had been stripped of unwanted apparatus, the new capacitors were on hand, and in seven working days from the original request the filters were reassembled, tested and returned to Long Lines.

Murray Hill Men's Chorus

The Murray Hill Men's Chorus, assisted by Harry Geetlein at the piano, made its Murray Hill debut at the July meeting of the Life Members' Club. This group is composed mainly of men recently transferred from Graybar-Varick to Murray Hill. Present members include, B. H. Carmer, Jr., T. R. D. Collins, R. D. Ehrbar, M. O. Fichter, J. J. Jansen, R. H. Klie, A. R. Kolding, S. Korba, R. N. Larson, H. P. Lynch, R. W. Marshall, L. A. Meacham, Director A. R. Rienstra, D. C. Weller and W. H. Yocom.

F. M. Tylee operating the Fastax camera.

Organization Changes

In keeping with organizational re-alignments of technical departments into switching and transmission areas, a number of changes were made in the organizations reporting to M. H. Cook, Director of Apparatus and Systems Engineering, effective on the first of July. The group at Murray Hill is headed by H. J. Delchamps, Director of Specifications and

Drafting. His staff includes L. E. Parsons, specifications engineer with A. A. Carrier (transmission apparatus), G. Sawyer (station apparatus) and F. S. Wolpert (outside plant); and W. A. Bischoff, drafting and records engineer, with H. Anderson (apparatus drafting), L. H. Bachmann and A. Zitzmann (transmission systems drafting) and R. V. Rice, records, files and services.

The New York groups, under the personal charge of Mr. Cook, with the title of Director of Systems and Drafting, will report to J. W. Woodard, Specifications Engineer, and R. G. Koontz, Standards and Drafting Engineer. Mr. Woodard's organization will include D. O. H. Weston (switching apparatus specifications), W. H. McAuliffe, (apparatus coding), and W. H. Sellew, (methods and reports). Reporting to Mr. Koontz are C. R. McIver, (drafting and standardization), D. S. Myers, (standards and services), H. E. Marting, (Bell System Practices), and E. B. Wood, (special studies).

When Sir Joseph J. Thomson visited the United States twenty-seven years ago, he was interested in the Laboratories, and a number of displays were arranged for him. He showed particular interest in the 10-kw water-cooled power tube, which had recently been used in transatlantic telephone tests. Pictured with him is the late Dr. Frank B. Jewett, then a Vice President of Western Electric in charge of these Laboratories.

J. J. Thomson Volumes Now in Library

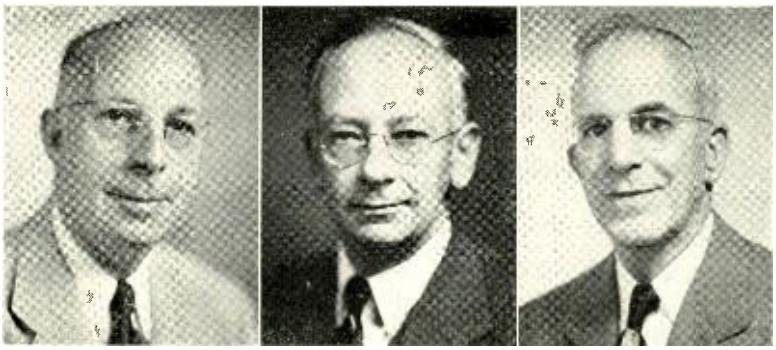
Books which once were in the personal collection of the late Sir Joseph J. Thomson, British physicist famed for his research on the electron and the atom, have recently been acquired by the Technical Library and placed on its reference shelves at Murray Hill.

Fifty-nine volumes of the *Royal Society Philosophical Transactions,* covering the years 1884-1930, have been obtained from a Cambridge, England bookseller, W. Heffer & Sons, Ltd. The Library had for some time been interested in filling out its files of the *Transactions* to meet reference needs of the technical departments. When it was announced that additional volumes were for sale, they were ordered; it was then learned that they were from Sir Joseph's library. The Library's set is now complete from 1884 to date.

Sir Joseph, who was President of the Royal Society for several years, died in 1940 after a brilliant career which gained him a world-wide reputation. In his research laboratory at Cambridge University, he investigated the conduction of electricity through gases, determined the charge and mass of the electron, and made many other significant contributions. In 1906 he won the Nobel Prize in Physics, and two years later he was knighted. His work on the atom was once said to have "hinted at the dawn of a new era in science."

O. E. Buckley, greeted by H. E. Peabody, president of the Bangor Rotary Club. While on vacation Dr. Buckley addressed the Club on July 25 on trends in the communication field.

RETIREMENTS



KENNETH B. DOHERTY LEON T. WILSON THOMAS C. RICE

Among those retiring from the Laboratories are K. B. Doherty and T. C. Rice with 43 years of service; J. J. Catogge, 39 years; Thomas McLaughlin, 30 years; Prescott May, 29 years; L. T. Wilson, 26 years; and Pietro Fratello, eight years of service.

KENNETH B. DOHERTY

Under the Laboratories' mandate to render research, development, and engineering services for the Bell System, we have a responsibility to operate efficiently, to keep track of our jobs, and to meet schedules. So there is a great deal of "business" to be done along with our technical work and many of us have made careers in these ancillary lines of work. One such man is Ken Doherty, who on joining the Laboratories in 1907 took care of scheduling trips of field inspectors. Soon he was given charge of certain correspondence and in 1914 became executive clerk to E. B. Craft, chief engineer of Western Electric. One of his responsibilities was to receive the young engineers from Hawthorne's training course, get them settled in New York and brief them in the local organization.

For a year during World War I Mr. Doherty worked for the Navy at New London, where he acted as liaison with the Laboratories and also handled local purchasing for the Navy's under-water sound laboratory. Returning, he was put in charge of office services, which included files, transcription, telegraph, and the like. Later, the Library was added, along with the collection of development models.

In 1926, he became commercial service manager, in charge of a group which handled orders, estimates and costs for the entire Laboratories. At that time the Laboratories turned out a good deal of products, for example numerous transoceanic radio sets for Long Lines.

With the coming of World War II and its flood of war projects, many of them classed as "restricted," "confidential" or "secret," care had to be taken that people should be admitted to the Laboratories to discuss them only when authorized by the military department concerned. Outstanding scientists and engineers of this country and of our allies were often concerned in these projects, and a courteous reception to visitors was always important. Mr. Doherty was well suited to this work, and in 1942 he was transferred to Publication, to handle it. From then until retirement he has met thousands who wished to see and talk about military projects, has reviewed their credentials and has worked closely with the Army, Navy and Air Force on security matters.

A native of the Hudson River Valley, Mr. Doherty plans to return there from Pompton Lakes where he and his wife have lived. He refuses to make any plans—says he has been the slave of plans, his own as well as others'—for all his life to date; now he will be free to enjoy leisure.

LEON T. WILSON

With a degree from Yale (Ph. B., 1915), graduate work there in physics and electrical engineering (E.E., 1919) and radio experience in the Signal Corps, Leon T. Wilson entered A T & T in 1923 in the Department of Development and Research. His first assignment was the study of open-wire line losses in preparation for the wide use of type-C carrier. One outcome of this study was the adoption of an all-metal pin, to remove the wood of the earlier pin from the concentrated field inside the insulator. Each pair of pins was bonded to keep high-frequency potential out of the the wooden cross-arm.* Much of this experimental work was done at the Phoenixville Test Station.

After coming to the Laboratories with his department in 1934, Mr. Wilson continued his

*RECORD, *November*, 1937, *page* 95.

high-frequency line loss studies, particularly as to the effect of ice on the wires, and developed a simple method for computing the loss from various thicknesses. During World War II he worked on the airplane laying of telephone field wire, the quickly-built telephone line, and some radar projects. More recently he has made studies of envelope delay on carrier circuits which have helped to make these circuits available for telephotograph transmission.

Mr. Wilson and his wife have a summer home at Canadensis, Pennsylvania, which he is preparing for year-round living. They have one son, also a Yale man, and a daughter who like her mother is a design school graduate. Having done consulting work as a graduate student, Mr. Wilson may do some of it in retirement.

Thomas C. Rice

After he had learned a good deal about the telephone business by working for both Bell and independent companies in Nebraska, Tom Rice joined Western Electric at Chicago in 1916 as a member of the Inspection Branch. In 1923, while in New York for conferences with our inspection people he was persuaded to remain; eventually he had charge of investigating complaints about defective apparatus. This work continued until 1942, when pressure of war work dictated his transfer to preparing specifications for apparatus used in military equipment. He specialized first on materials and finishes, then on meters, and finally on networks. After the war he continued this work, moving to Murray Hill last year.

The Rices are definitely a Bell System family—one son, Ralph, is at Murray Hill in charge of specification and drawing files for apparatus and transmission systems, and a daughter, Beverly, once was in Publication and is now married to D. H. Wenny of Metallurgical Processing. Mr. Rice is quite properly proud of his long record in the Laboratories Bowling League, during which he has slaughtered a third of a million pins; and of his well equipped shop where he inlays wood and makes model airplanes and steam engines. Continuing these activities will, he thinks, assure him plenty to do in retirement.

Joseph J. Catogge Prescott May

Joseph J. Catogge

A veteran of the historic Newark semi-mechanical offices is J. J. Catogge, who joined Western Electric's installation forces in 1911. Coming to West Street in 1916, he worked on the development and testing of teletypewriter apparatus and during World War I instructed Signal Corps men in its operation.

Early in 1923 he was sent to Canada to install and test multiplex printing telegraphs for the Canadian Pacific Railways. These involved multiplex regenerative repeaters on the Eastern circuit from Montreal to Halifax and the Western circuit from Winnipeg to Vancouver. Late in 1923 he transferred to the group engaged in the development and testing of train-dispatching and of remote-control power-switching equipment. Six years later he transferred to the Toll Systems Development Department where he remained until 1940, working on TWX switchboard development. Then he transferred to the toll testing equipment group where he prepared circuit standards and drawing key sheets. During World War II he did similar work on radar test equipment. From the war's end until his retirement Mr. Catogge carried on work in circuit standards and key sheets as applied to telegraph circuits.

Thomas McLaughlin Pietro Fratello

Prescott May

During his twenty-nine years in the Laboratories, Prescott May has done a good many different jobs. Of all of them he has gotten the

most satisfaction from his latest one, in which he built up the catalog files at Murray Hill from less than a hundred volumes to the 2000 mark. And he remembers also with satisfaction the months he spent at Lawrenceville in 1929-30 when he was Purchasing's representative in the Laboratories group which made the initial installation in the short-wave trans-atlantic station there.

After graduation from Boys' High School in Brooklyn, Mr. May had several commercial jobs before entering the Laboratories in 1921. After a couple of years in Methods, he transferred to Purchasing, and in 1936 to Research Service. In 1940 and 1941 he had charge of office service for the New York Plant, and was in Commercial Relations until 1946 when he moved to Murray Hill Service.

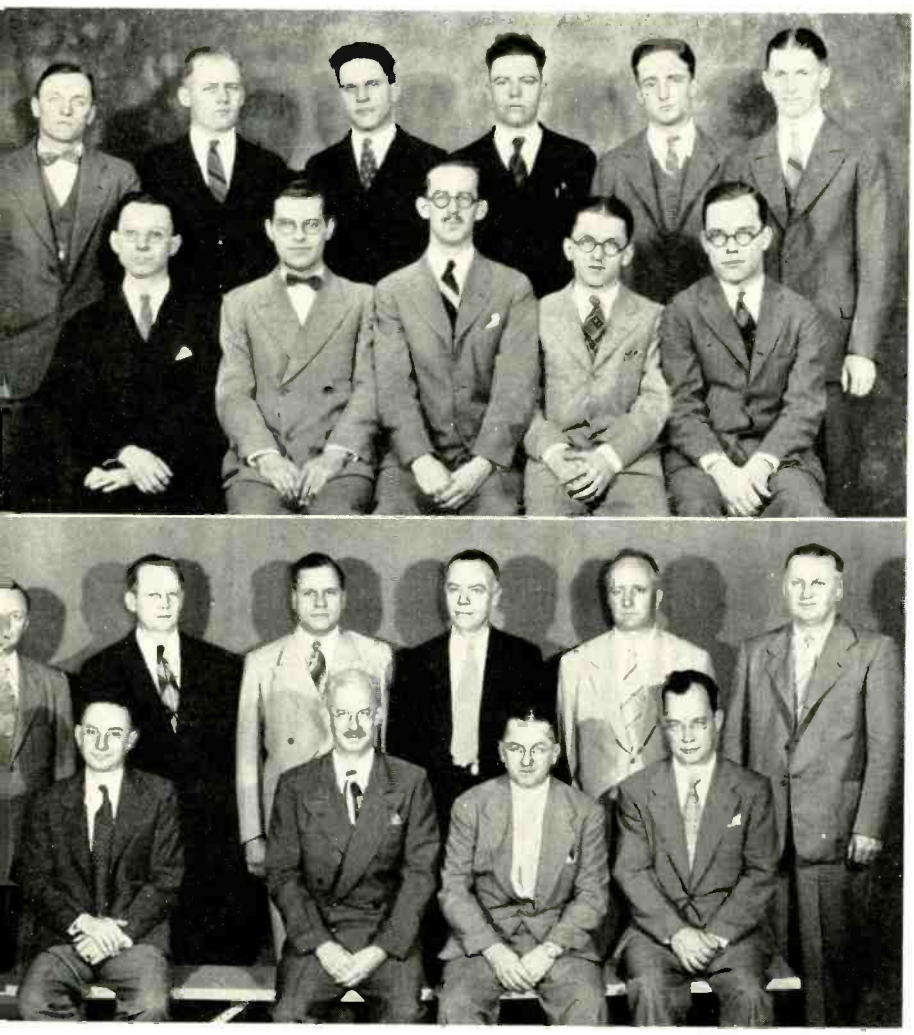
The Mays will move to a house they have just bought in Middlebury, Vermont. They think a town with a college in it will be a good place to live, particularly because their daughter and her husband graduated there. Always fond of young people, they hope to have a couple of undergraduates from Middlebury College live with them.

Thomas McLaughlin

Entering the Laboratories in 1920 as a carpenter's helper, Mr. McLaughlin two years later became a millwright's helper and in 1936 a millwright. In recent years he has become well known as the man who comes around with his little box to repair door checks. His other duties were to make locker keys and repairs to leather machinery bolts. Now at sixty-five, he has retired for a well-earned rest.

Pietro Fratello

When Pete Fratello's son left the Laboratories to go to war, Pete came to work as a



Members of the D & R student course class of 1925—as of then and upon their 25th reunion in July. Front row: J. W. Emling, F. A. Leibe who resigned in 1940 and is not in the lower photograph, K. G. Van Wynen, L. A. Dorff and M. B. McDavitt. Rear: A. P. Jahn, T. A. McCann, H. N. Meisenheimer, F. F. Shipley, D. Mitchell and R. P. Booth.

building service hand. Long ago he had spent six years here with Western Electric, so the place seemed like home. After the war Mr. Fratello remained until he reached retirement age. He is well known to many here.

Having worked, in Italy and here, since he was ten, Mr. Fratello intends to work no more and enjoy a well earned rest. He and his wife will not lack for company for their two daughters are with them in Brooklyn.

Archery Club News

Bell Laboratories Archery Club is congratulating its Murray Hill member, I. H. Baker, who won the National Flight Championship at Lancaster, Pennsylvania, in August. It is the second time Mr. Baker has won the title.

The West Street group will hold activities on Wednesday, September 27, and each Wednesday thereafter, from seven to ten p.m. in the Washington Irving High School Gym. Club equipment is available for beginners. Friendly competition in the form of novelty shoots will follow initial practice sessions.

Using a new policy the Club will charge 75 cents per shooting session, but not more than $1.50 for four sessions a month.

Instruction will be given by Dr. C. N. Hickman, retired member of the Laboratories and a figure in the world of archery, and by Mrs. Ruth Miller, director of an archery school in Vermont, who has demonstrated her skill during archery exhibitions at West Street.

We See by the Papers, that

Croakers—On a Summer night the joyous medley of frogs and toads singing in nearby swamp or forest sounds pleasant to our ears. A recent study now makes it possible for our eyes to trace the various musical patterns evolved by different species. It should interest those *Globe* readers who were writing letters to the editor a few weeks ago about the early Spring frogs.

The Bell Telephone Laboratories have an instrument to convert the sounds of human speech into pictures. Using phonograph records made at Cornell, they have produced pictures of 26 frog and toad calls. Ralph K. Potter, director of transmission research at the Laboratories, reports the results in the *Scientific American*.

Like music transcribed on paper, the pictures show the pitch of the calls, the tempo and the dynamics. They prove that each species recorded follows a distinctive musical pattern of its own.

Mr. Potter notes certain curious facts that appear from a study of the pictures. Some frogs make sudden shifts in pitch similar to those of human yodeling. The spadefoot toad produces a melancholy effect by starting its call on a high pitch, then rapidly lowering it. And a frog often suffers from a catch in his throat—like any miserable human with sniffles.

The evolution of distinctive musical patterns among the various species of frogs and toads is yet another instance of the orderly processes of Nature. It indicates why she is a never-failing refuge for those perplexed by the confusions of our man-made world.—*Boston Morning Globe*, May 11, 1950.

Florence Rosol and Betty Munzing, Summit operators, visit J. A. Hornbeck's laboratory during their visit to Murray Hill.

Summit Operators Visit Murray Hill

Two operators from the Summit exchange, eager to visit their biggest customer, spent a day at Murray Hill recently, touring the laboratories and meeting some of the people whose voices they have known for several years. They were accompanied by a photographer, who recorded their visit for the *New Jersey Bell* magazine.

In the acoustics building, the novel features of the Arnold Auditorium were demonstrated for them, and they showed special interest in the free space room. They saw the new 500-type handset, explored the crystal-growing laboratories, witnessed a television demonstration, and heard an explanation of the Transistor. They also watched our digital

computer in operation, received instruction in splicing cable, and saw how telephone poles are treated to resist attacks by fungi. Before leaving, the two girls enjoyed a "busman's holiday" visit to the Murray Hill PBX, where they met the operators with whom they talk every day.

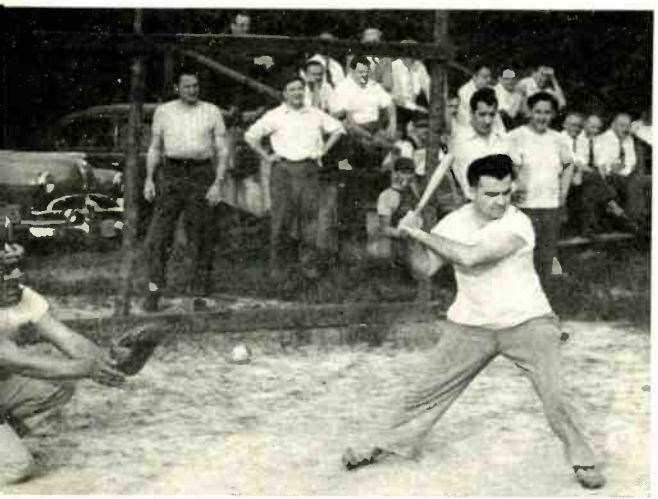
The picture-story record of their visit appears in the September *New Jersey Bell*.

Stamp Club News

The Bell Laboratories Stamp Club at West Street is continuing its highly successful educational series and special luncheon talks at meetings held during noon-hour on Mondays in the conference dining room. Speakers for the coming month will be G. B. Joslin, retired, who will give Part II of a talk on *U. S. Commemoratives* on September 11 and C. D. Hanscom who will speak on *Identification of Color* on September 18. The following week, September 25, S. R. Bray will journey down from Connecticut to talk on *Behind the Scenes in the Post Office*. Mr. Bray is the father of Parnel Bray, Stamp Club news correspondent. E. A. Thurber, the speaker for October, has selected *Perforates and Imperforates* as his subject.

During July the speakers at the Stamp Club were Walter Kuhn, who spoke on *War Items*, and M. A. Specht, who reviewed the book, *The Nineteenth Century Postage Stamps of the U. S.*, by L. G. Brookman. G. B. Joslin, retired, spoke on the subject of *U. S. Commemoratives, Part I*.

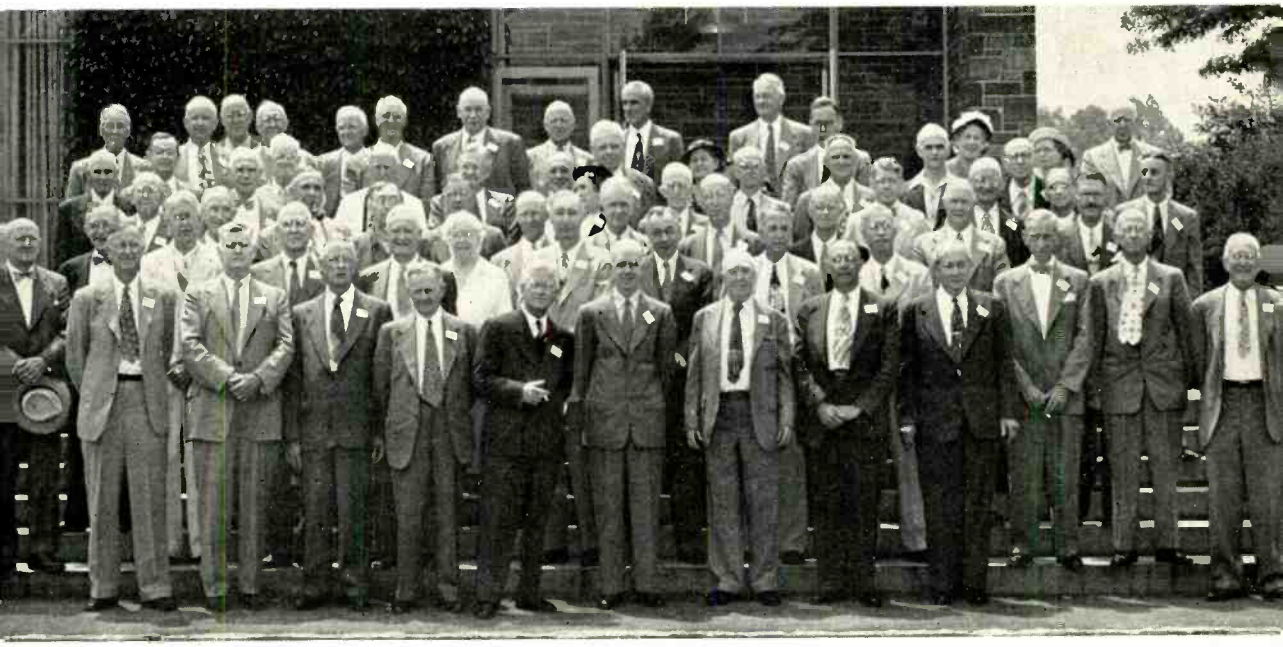
During the meetings in August, there was one informal luncheon meeting. On August 14, Max Esternaux spoke on the *Foreign New Issue Service*. On the following Monday, J. M. Watson spoke on *Meters*. For the final meeting Julian Blanchard gave a talk on *The Freedom Stamp and Its Historical Background*.



Area Management Outing and Ball Game

Area Management personnel of New York and Murray Hill participated in an inter-area ball game and outing at Touchon's Grove, Watchung, New Jersey, on June 30.

The ball game ended in a 5-5 tie, and was called because of darkness. Pictures of the game and outing, taken by S. O. Jorgensen, include (above) F. N. Maguire batting, and A. J. Maldonato catching for the Murray Hill Area Management team. Above, right, A. E. Bausmith, left, and W. J. Fullerton, right, prepare cold drinks to be served with sandwiches. Enjoying refreshments (right) are J. Hoagland, O. J. Mohni, K. Haller and C. G. Erb.



The Life Member Club of the Pioneers met at Murray Hill, Thursday, July 20, 1950, for their first summer meeting. Many members who spend the winter in the South were able to attend. M. J. Kelly talked on current activities in the Laboratories to the 64 members who were present. The Murray Hill Glee Club and the Murray Hill Popular Orchestra provided entertainment.

NEWS OF THE TELEPHONE PIONEERS

At a recent meeting of the Chapter Executive Committee of the Frank B. Jewett Chapter, Telephone Pioneers of America, the fall entertainment program was discussed and various plans were considered. It was the general feeling that social activities suitable for the entire chapter being subject to so many limitations, more prominence should be given to parties sponsored by the locality councils. Accordingly, the fall events are now being planned by the council entertainment committees under the direction of Harold Schmitt in New York and A. R. Brooks in New Jersey. They expect to make definite announcements as soon as the details of the events have been worked out.

Because the Chapter is divided into councils, there are now two operating committees for each major activity. Where no joint effort is required, these committees will function separately but at other times they will coordinate the efforts needed. To assist in this, each member of the Chapter Executive Committee has been assigned to a definite subject as follows: *Finance,* J. F. Kearns; *Entertainment;* F. A. Korn; *Hobbies,* A. G. Jensen; *Membership,* C. H. G. Gray; *Publicity,* J. W. Quinn; *Women's Activities,* Dorothy Storm.

T. J. Murtha and G. W. Pfarrer have been appointed Finance Representatives for the New York and New Jersey Councils, respectively; A. J. Daly, Chairman of the New York Membership Committee; and D. R. Brobst, chairman of the same committee for New Jersey.

The "Package Party" which the New York Council held on July 20 was attended by fifty people. It consisted of a trip by special coach from West Street to the Mayfair Farms Restaurant in West Orange where the group had dinner. Following that, they left by coach to see *Roberta* at the Paper Mill Playhouse. On the return trip to New York by coach, a community sing was held. Two other "Package Parties" are being sponsored by the New York Council.

The New Jersey Council is sponsoring a theater party on October 4 when the Pioneers will see *Maytime* at the Paper Mill Playhouse. It is anticipated that the entire theater will be occupied by the Frank B. Jewett Chapter, Telephone Pioneers of America, and their guests.

Tickets for the "Package Parties" and for the theater party on October 4 may be obtained from Mary Ressler in New York; A. J. Akehurst or W. J. Abbenseth in Murray Hill; B. Leuvelink in Whippany; E. Van Horn in Holmdel; and H. L. Downing in the Allentown Laboratories.

Drill and Fill—Can Anything Be Done About It?

Dr. M. H. Manson
Medical Director, A. T. and T. Company

In this country, the average person is lucky to reach age 16 without having seven teeth attacked by caries or decay.

The Council on Dental Health of the American Dental Association points out that there is still no one way to prevent tooth decay and no single factor can control the disease completely. On the other hand, the Council states that enough is known about proper care of the teeth to reduce the prevalence of decay greatly if everyone took the following common-sense precautions:

EARLY AND FREQUENT EXAMINATION

For adults, periodic visits to the dentist—as frequently as he recommends—are necessary in the control of caries because a cavity usually begins in a small hidden area which the toothbrush does not reach. Deposits of food regularly removed by the dentist as a part of his treatment and care, plus personal cleansing, can make the old saying come true, "A clean tooth never decays."

EARLY TREATMENT OF CAVITIES

Small cavities — sometimes found to be mere spots—can be repaired early with a minimum of expense and discomfort. Your dentist also can help you eliminate other conditions, such as bleeding gums or sore mouth, possibly from jagged, uneven teeth. These may be possible sources of mouth cancer later.

Scientific evidence now seems to support strongly the fact that teeth decay primarily because of the action by certain acid-forming bacteria on the tooth substance. The enamel, which is constantly bombarded by these bacteria, is dissolved and eventually destroyed. The effectiveness of fluoride treatment of adults' teeth is still being investigated. There is no proof that the use of chewing gum, mouth washes, vitamin tablets, tooth paste or powder containing fluoride prevents dental decay. Fluorine is a poison and self-treatment is dangerous.

HOME CARE OF THE MOUTH AND TEETH

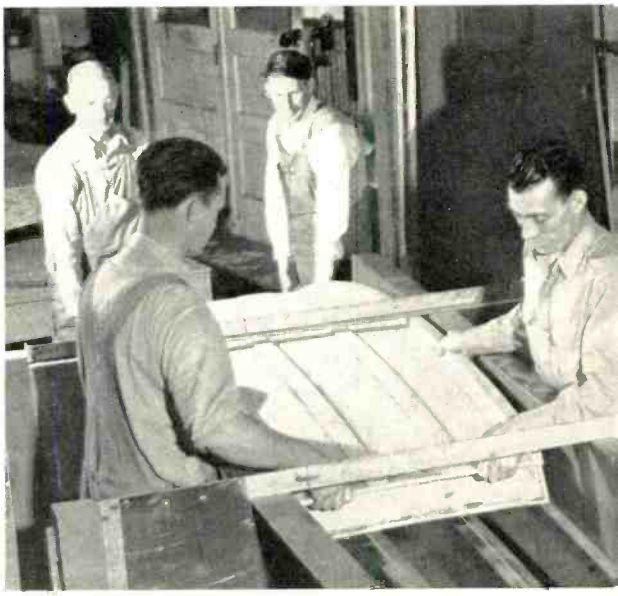
While brushing the teeth is no guarantee against decay, brushing at the right time does help. This means directly after meals, particularly when sugar and other sweets are eaten. Any method of brushing which removes foreign material from all areas is satisfactory. A toothbrush which is badly worn or has been broken and matted bristles cannot do a good job on your teeth. In fact, two brushes used alternately are recommended.

There is no definite proof of the complete effectiveness of ammoniated dentifrices. Because there is promising evidence of their value in providing partial immunity to tooth decay, they are recommended for home care of the mouth and teeth.

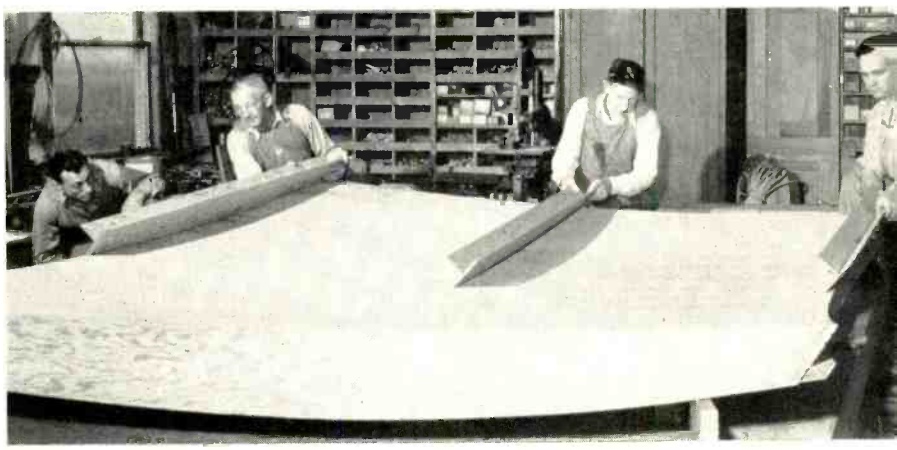
Once the teeth have formed food can have no effect on the structure of the teeth. Well balanced daily meals, which include liberal amounts of vegetables and fruits, milk and other dairy products, contribute to healthy gums and soft tissues in which teeth are imbedded. Carbohydrates, especially sugars, influence tooth decay most. A decrease in the consumption of syrups, jams, jellies and candy is recommended by most dentists as a practical aid in lessening the amount of acid-forming bacteria.

If you follow these suggestions, you will help your dentist help you preserve your teeth and your health.

J. Morrell, left, and W. E. Thomsen, right, assemble a section of the reflector for an experimental plywood horn-reflector microwave antenna. The section is removed from the jig after glueing and the reflector lower surface is coated with copper foil.



One of the steps in the construction of an experimental plywood horn-reflector antenna for microwaves. Left to right, W. E. Thomsen, C. A. Davison, O. E. Larsen, and J. Morrell removing a section of the reflector surface from a metal jig.



Constructing an experimental plywood horn-reflector microwave antenna in the Holmdel Shop. Left to right, J. Morrell, W. E. Thomsen, O. E. Larsen, and C. A. Davison check the curved surface of the reflector before cementing copper foil on it.

West Street Chorus

Fall rehearsals for the West Street Chorus will begin on Wednesday, September 6, at 5:30 p.m. in the auditorium. The chorus will present a noon-time concert of folk music and light classics early in November, in addition to the Christmas program of songs and carols.

New singers are especially invited to join the chorus at the first rehearsal. The group needs more voices, both men's and women's. Rehearsals are held for one hour each Wednesday under the direction of R. P. Yeaton.

Whippany Girls Open Bowling Season

Twenty members of the Girls' Bowling League at Whippany will open their 1950-51 season on September 13 at Herrmann's Bowling Alleys in Morristown, New Jersey. Patricia Muenther is chairman for the coming season, Ann Harris, secretary, and Betty Riley, treasurer.

Mary A. Douglas
1885 - 1950

Mary A. Douglas, first lady of the Laboratories during 1949, died quietly on Sunday, August 6, at Misericordia Hospital in New York. Miss Douglas celebrated fifty years of Bell System service last October and was retired in January of this year when she reached her sixty-fifth birthday.

Her life had been singularly free of sickness and her attendance record almost perfect until two years ago when she underwent two operations. She returned to work, however, and held up well under the excitement and parties attendant upon her anniversary and retirement. Following her retirement she made weekly visits to the Laboratories until June when she entered the hospital for an operation from which she never recovered.

Miss Douglas wound coils for half a century in the Development Shops Department and, until her jubilee, was almost unknown to her fellow-workers in other departments. She emerged into the public eye as a woman whose graciousness and modesty endeared her to all who came to know her.

She was honored by the Laboratories at a luncheon given by O. E. Buckley and his staff, by the Telephone Pioneers at their open house celebration at Murray Hill, by her department in a farewell dinner, and by the Intercommunications Group at their annual communion and breakfast in the Spring. At the time of her anniversary, F. B. Jewett and Leroy A. Wilson wrote her personal notes which she treasured.

Miss Douglas' life was a happy one, selfless and full of a spirit of service. The work which she did at her Development Shops bench was thoroughly creative; in her own words, "she always liked to come to work here" at the Laboratories. Her deep, abiding faith and tranquility of spirit overflowed to the people and the place where she worked.

An outstanding contribution to her world was the training Miss Douglas gave her niece and nephews, who now are making their own way. In her last days she felt that her early devotion to them was repaid many times over by their loving care.

News Notes

C. E. SHANNON of Mathematics Research will be the featured speaker at a Symposium on Information Theory to be held at the Royal Society, London, during the second week of this month. Other well-known workers in the field will address the conference.

Information theory presents several new viewpoints in the transmission of intelligence. Error-detecting codes, for instance, give additional information: the message has been received correctly. Redundancy—the excess of signals beyond those barely necessary to transmit information—is important in making the most efficient use of channels, which in the case of radio are growing scarcer every day.

Dr. Shannon, who is one of the pioneers in this field, has accepted a number of invitations to visit research groups while overseas.

H. V. RANTZEN, Director of Telecommunications at United Nations, with R. W. Griffiths and J. Connolly of the Graybar Electric Company, visited R. A. MILLER and L. B. COOKE at the Murray Hill Laboratories to discuss audio facilities problems.

H. M. OWENDOFF went to Portland, Oregon, in connection with the initial installation and cut-over of regulated frequency power supply which was developed to provide a power supply with accurate time keeping qualities for time-of-day announcing machines.

S. E. CHURCH's article on *Behavior of Resistors at High Frequencies* appeared in the June issue of *TV Engineering*.

H. C. HART and A. G. DOUVAS were at the Patent Office in Washington relative to recent patent matters.

F. W. CUNNINGHAM and A. F. HUGHES attended conferences in Washington on July 6 with members of the Bureau of Ships and with the Bureau of Aeronautics.

W. STUMPF spent July 6 and 7 in Burlington attending conferences on the preparation of instruction books.

A. K. BOHREN and J. B. BISHOP attended a conference at the Glenn L. Martin Company in Baltimore.

W. L. BOND has written an article enitled *A Double-Crystal X-Ray Goniometer for Accurate Orientation Determination* in the August 1950 *Proceedings of the IRE*.

F. A. POLKINGHORN's return from Japan is noted in a short item in the *Proceedings of the IRE* for August 1950.

J. A. POTTER visited the Power Equipment Company's plant at Detroit in connection with the production of newly designed rectifiers.

N. V. MANSUETTO witnessed the installation in Madison, Milwaukee, Hartland and Watertown, Wisconsin, of trial equipment.

W. H. BRATTAIN spoke on *Semi-conductor Surface Phenomena* and K. G. MCKAY on *Bombardment Conductivity in Germanium Barrier Layers* at a conference of the Solid State and Physical Electronics Groups.

PROFESSOR R. P. BELL of Balliol College, Oxford, visited Murray Hill on June 5. Professor Bell, a Fellow of the Royal Society, is well known for his work in reaction kinetics and has received the Meldola Medal of the Institute of Chemistry. At a conference in the course of his visit, he spoke on *The Concept of Incomplete Dissociation in Reaction Kinetics.*

RECENT SPEAKERS before the International Relations Group at Murray Hill were DR. STEPHEN PENROSE who spoke on *America and the Arab World* and PROFESSOR FILMER S. C. NORTHRUP who spoke on *Contemporary World Problems and Methods for their Solution.*

"Telephone Hour"

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

September 4	*John Charles Thomas*
September 11	*Bidu Sayao*
September 18	*Lily Pons*
September 25	*Zino Francescatti*
October 2	*Ferruccio Tagliavini*
October 9	*Igor Gorin*
October 16	*Polyna Stoska*
October 23	*Jussi Bjoerling*
October 30	*Jascha Heifetz*

Men's Bowling League

The opening of the Laboratories men's bowling season for 1950-51 was marked by a conference in the West Street lounge. Officers of the League are, left to right, M. J. Wean, Chairman of Group B; J. Wolek, Chairman of the Substitute Committee; G. W. Schuell, Secretary-Treasurer of Group C; W. J. Seeger, Jr., General Chairman; H. J. Keefer, General Secretary-Treasurer; E. V. Paholek, Secretary-Treasurer of Group A; F. P. Balacek, Chairman of Group A; J. W. Johnson, Chairman of Group C; and R. C. Fischer, Secretary-Treasurer of Group B.

Sweetheart of Theta Beta Chapter

Catherine Panettiere of Quality Assurance was recently elected 1950-51 "Sweetheart of Theta Beta Chapter" of Alpha Phi Delta fraternity at New York University. Miss Panettiere received the award and a plaque bearing the fraternity's coat of arms and an inscription at the initiation dinner.

A graduate of Lawrence High School on Long Island and New York University, Class of 1948, she received a bachelor of arts degree in statistics. Miss Panettiere had been with the Port Authority before joining the Laboratories earlier this year. In the Quality Assurance Department, she is one of a group engaged in analyzing inspection results. Her particular work is on central office equipment.

News Notes

G. M. Bouton was at the Anaconda Wire and Cable Company at Marion, Indiana, to discuss cable sheath problems.

H. B. L. Gould has written an article on *Magnetic Cores of Thin Tape Insulated by Cataphoresis* which appeared in *Electrical Engineering*, June, 1950.

A. H. Schirmer attended a meeting of the National Fire Protection Association in Atlantic City in connection with revision of the National Electrical Code.

V. T. Callahan discussed automatic diesel engine designs with the General Motors Corporation's engineers at Detroit. He also conferred with engineers of the Kohler Company at Sheboygan, Wisconsin, upon designs for new small automatic gasoline sets which are to be used on secondary routes of the TD-2 radio relay system.

D. E. Trucksess attended the Washington *Symposium Upon Improved Quality Electronic* Components sponsored by the A.I.E.E., I.R.E. and the R.M.A.

A. A. Currie of the Military Electronics Department received an M.S. degree from Stevens Institute of Technology. He specialized in Electrical Engineering.

C. Kittel spoke to the University of Pennsylvania Physics Colloquium on *Recent Experiments in Paramagnetic and Ferromagnetic Resonance.*

A. C. Ekvall and W. R. Neisser visited Allentown to discuss design problems in connection with the 425A network. Mr. Neisser and R. E. Sherman attended the Monmouth Section I.R.E. meeting to hear a talk on printed circuit techniques and applications.

WHO AM I?

I am more powerful than the combined armies of the world.

I have destroyed more men than all the wars of the nations.

I am more deadly than bullets, and I have wrecked more homes than the mightiest of guns.

I steal in the United States alone over $500,000,000 each year.

I spare no one, and I find my victims among the rich and the poor alike, the young and the old, the strong and the weak. Widows and Orphans know me.

I loom up to such proportions that I cast my shadow over every field of labor, from the turning of every grindstone to the moving of every railroad train.

I massacre thousands upon thousands of wage earners in a year.

I am everywhere—in the home, on the streets, in the factory, at railroad crossings, on the sea.

I bring sickness, degradation and death, and yet few seek to avoid me.

I destroy, crush and maim; I give nothing but take all.

I lurk in unseen places, and do most of my work silently. You are warned against me, but you heed not.

I am your worst enemy.

You may have guessed my name by now. Were you right? *Turn to page 426.*

IN THE COURSE of a visit to the Murray Hill Laboratories, Dr. Warren S. McCulloch, professor of psychiatry at the College of Medicine, University of Illinois, addressed a group of engineers on *The Cybernetics of the Central Nervous System.*

L. PEDERSEN attended the Symposium on Improved Quality Electronic Components in Washington. He also attended the fourth annual convention of the Armed Forces Communications Associated in New York City and Fort Monmouth, New Jersey.

O. E. BUCKLEY has recently accepted appointment to the Committee to Visit the Department of Physics, at Harvard University, for the academic year 1950-51.

W. T. READ, JR. is the author of an article on *Stress Analysis for Compressible Viscoelastic Materials* in the July, 1950, issue of the *Journal of Applied Physics.*

G. H. WANNIER presented an invited paper at the A.A.A.S. Gordon Research Conference on Chemistry and the Physics of Metals at New Hampton, New Hampshire. The paper was entitled *Solid State Theory and Metallic Binding.*

C. KITTEL addressed the Chemical Colloquium at the University of Michigan, Ann Arbor on *Microwave Resonance Experiments on Organic Free Radical Compounds.*

SEVERAL MEMBERS of the Laboratories participated in the summer sessions at the University of Michigan, Ann Arbor. J. R. PIERCE gave four lectures on *The Wave Theory of Traveling Wave Tubes and Electron Wave Amplifiers* during July. J. A. BECKER lectured on *The Theory of Semiconductor Rectifying and Amplifying Devices* during July and August. During the *Symposium on Theoretical Physics* C. KITTEL gave a series of nine lectures on *Quantum Theory of Ferromagnetism.*

H. W. HERMANCE, T. F. EGAN and C. W. MATTSON demonstrated various techniques, now under development for cleaning sequence switches, to a group of representatives of the Illinois Bell Telephone Company, Bell Telephone Company of Pennsylvania, New York Telephone Company, A T & T and the Laboratories. The demonstration was held in the Lombard office in Philadelphia. Progress was reported and general discussion of this project was held there on July 25, with G. H. DOWNES presiding.

J. R. BOETTLER visited the New Jersey Zinc Company at Palmerton, Pennsylvania, to discuss powder metal processes.

B. S. BIGGS, G. N. VACCA and C. V. LUNDBERG conferred at Point Breeze on telephone cords.

G. H. WILLIAMS' visit to the C. & D. Battery Company in Conshohocken, Pennsylvania, was in connection with new battery jars.

R. BURNS addressed the Lehigh University Product Design Seminar on *Engineering Properties of Rigid Plastics.*

W. O. BAKER attended the A.A.A.S. Research Conference on Polymers at New London, N. H.

W. E. CAMPBELL attended the Gordon Research Conference on *Current Trends in Analytical Chemistry,* held at New Hampton, N. H., where he led the discussion on electro-analysis of metal surfaces and presented a prepared discussion on *Statistical Methods in Analytical Chemistry.* He was appointed chairman for the 1951 conference which will feature methods of trace analysis.

W. W. BRADLEY and U. B. THOMAS conferred at the C. & D. Battery Company in Conshohocken, Pennsylvania, on battery problems.

Engagements

*Mary Anderson—Fred E. Horn
*Sylvia Anderson—Raymond Dahl
*Betty Bonin—Jack Pearthree, Jr.
*Joan Burke—Charles H. Leissler III
*Eleanor Fischer—Richard L. Barkey
*Evelyn Holi—Peter Lillo
*Janet Marceau—Al Alleva
*June Marky—Stanley Rohrbacker
*Elizabeth Scott—Richard F. Howarth

Weddings

*Irene Croce—Vincent Giacobbe
*Ann Flynn—John Lynch
*Joyce French—Jean de Jorna
*Rozaria Georgianni—Michael Primeggia
*Lois Jack—W. Stanley Meseroll, Jr.
*Virginia Kingsley—Thomas J. Hill
*Mary Kitchell—Robert A. Stokes
Dorothy McComb—*William Robertson
*Iris McLean—Ronald E. Samuels
*Jennie Mercadante—Frank G. Ajello
*Virginia Olan—Raymond C. Allen
*Regina Pease—James A. Harkins
*Eunice Whitley—Richard Costello
Doris Zito—*Robert H. Granger

*Members of the Laboratories. Notices of engagements and weddings should be given to Mrs. Helen McLoughlin, Section 11A, Extension 296.

The answer to "Who Am I?" on page 424:

I am CARELESSNESS

W. W. MUMFORD, C. C. CUTLER, C. F. QUATE, D. J. BRANGACCIO and S. D. ROBERTSON attended the eighth annual Conference on Electron Devices held June 22-23 at Ann Arbor, Michigan. During the meeting Mr. Mumford discussed the temperature effects on his fluorescent microwave noise generator. Mr. Cutler and Mr. Quate made contributions in the fields of travelling wave tubes and noise in electron beams.

J. L. GARRISON visited Haverhill in connection with transformer and Transitor amplifier packages for special apparatus.

L. W. STAMMERJOHN conferred at Haverhill on magnetic type frequency generators.

W. Y. LANG made tests at the plant of the Teletype Corporation in Chicago.

W. M. BACON visited the Teletype Corporation on July 12 in connection with telegraph switching problems.

J. C. DAVENPORT and E. H. GILSON conducted noise tests at several toll centers in the Southern Bell Telephone Company's territory. Mr. Davenport, Mr. Gilson and P. A. JEANNE visited Windham, New York, and Danville, Virginia, in connection with noise problems due to induction from multi-grounded neutral power circuits.

J. M. DUNHAM and G. B. ENGLEHARDT made measurements on coaxial cables at Point Breeze.

W. C. BALL and P. A. JEANNE visited Philadelphia to discuss, with representatives of the Pennsylvania Railroad and Westinghouse Electric Corporation, inductive coordination matters.

R. S. CARUTHERS, K. E. GOULD and L. PEDERSEN visited the Northwestern Bell Company in connection with open-wire carrier problems.

P. W. BLYE, R. S. CARUTHERS, L. L. EAGON, P. G. EDWARDS and W. L. GAINES participated in a carrier transmission conference in Milwaukee, attended by representatives of most of the Operating Companies.

E. H. GILSON joined N. A. NEWELL and G. A. PULLIS in Milwaukee in tests to determine the effect of 60-cycle induction on 1600-cycle signaling circuits.

L. C. ROBERTS participated in tests of carrier telegraph circuits between Minneapolis, Minnesota, and Grantsburg, Wisconsin, with engineers of the Northwestern Bell Telephone Company and the Wisconsin Telephone Company. Mr. Roberts was at Key West testing the operation of telegraph over the Key West-Havana cables. Long Lines engineers at Key West and Havana took part in the tests. He was also at Madison, Florida, in connection with securing records of lightning interference with telegraph on open-wire lines.

R. W. FRIIS, with engineers of A T & T and the C & P Company, visited the terminals and intermediate repeater stations of the Richmond-Norfolk radio relay system which uses Philco 6000-mc equipment.

H. N. WOLF and W. H. BENDERNAGEL supervised the start of installations in Philadelphia, Harrisburg and Lewistown, of the 2600-cycle voice-frequency tone-signalling trial.

R. H. ROSS conferred with engineers of the General Electric Company at Fort Wayne on new designs of large 400-cycle motors.

R. A. MILLER attended the I.R.E. Standards Committee meeting in New York.

September Service Anniversaries of Members of the Laboratories

45 *years*

G. W. Weaver

40 *years*

V. H. Heitzmann

35 *years*

A. R. Bonorden
H. D. Peckham
P. W. Sheatsley

30 *years*

A. A. Hansen
F. L. Hollingworth
W. A. Krueger
M. K. Kruger
F. R. Lamberty
H. K. Leicht
T. N. Pope
W. G. Sawyer
H. W. Schaefer
G. T. Scheeler
G. F. Schmidt
A. E. K. Theuner
G. P. Wennemer
C. F. Young

25 *years*

E. H. Backman
W. M. Bishop
A. W. Clement
M. H. Cook
V. M. Cousins
Joseph Curran
Frank Frohner
J. E. Greene, Jr.
Edmund Ley
A. H. Lince
Doren Mitchell
L. A. Morrison
F. A. Polkinghorn
N. F. Schlaack
F. W. Webb
F. T. Wood

20 *years*

R. H. Badgley
M. M. Bower
D. M. Chapin
R. L. Dietzold
C. F. Edwards
W. B. Ellwood
R. R. Galbreath
B. D. Holbrook
V. L. Holdaway
J. A. Hole
S. B. Ingram
C. L. Luke
J. W. Mackay
C. O. Mallinckrodt
R. S. Plotz
A. L. Robinson
Thomas Smith
C. F. Spahn
G. W. Willard

15 *years*

W. S. Ballantyne
V. J. DeLucca
W. B. Groth
K. A. Josephson
R. J. Koechlin

10 *years*

D. R. Barney
Syvert Dalane
H. D. Hagstrum
D. W. Jones
Lottie Kozak
F. W. Krech
H. L. Smith
W. B. Tulek
E. F. Walther
J. A. Weller

"Wouldn't you like a pair of those to use at Murray Hill, Dad?"

News Notes

W. W. HALBROOK's and A. F. POMEROY's visit to Winston-Salem concerned waveguide standards and the production of waveguide components for a relay system.

E. K. EBERHART, with engineers of A T & T and Western Electric, visited the Yellow Springs, Maryland, repeater station on the TD-2 New York-Washington radio relay system.

J. H. RILEY conferred with the Bard Parker Company, Danbury, on the production of waveguide directional couplers for the TD-2 radio relay system.

C. W. SCHRAMM visited Indianapolis and Sacramento in connection with the revision of precision measuring equipment in the L1 coaxial carrier amplifier service centers at those two locations.

W. KEISTER gave a talk on *Automatic Control in Telephone Switching* before the Pittsburgh Section of the I.R.E.

A. J. BUSCH, R. L. LUNSFORD, J. MESZAR and F. A. KORN visited Hawthorne to discuss switching problems. They also visited the Illinois Bell Telephone Company in Chicago to discuss recent installations of central office equipment.

A. E. BACHELET's and R. A. JENSEN's visit to Philadelphia concerned the alarm system of the TD-2 project.

L. A. WEBER visited Florida in connection with signaling arrangements for type-O carrier.

J. BAUMFALK visited the Paterson toll office in connection with toll switchboard trunk circuits for operation with the new Paterson crossbar tandem office.

A. C. KELLER, C. A. LOVELL, H. O. SIEGMUND and H. M. KNAPP conferred at Hawthorne on relay developments and manufacturing.

J. R. IRWIN studied contact performance at the Media No. 5 crossbar office.

D. H. GLEASON and V. F. MILLER were in Philadelphia in connection with maintenance procedures on sequence switches.

E. ST. JOHN visited Centerbrook, Connecticut, in connection with special apparatus.

F. F. ROMANOW attended the American Standards Association meeting of the Sectional Committee on Acoustical Measurements and Terminology held at Penn State.

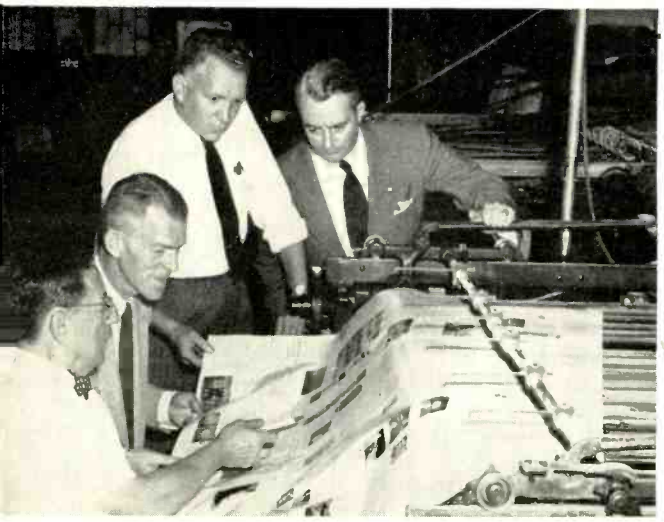
H. M. SPICER observed the operation of the power control equipment at several stations along the New York-Boston route of the TDX radio relay system. He also visited the factory of the Superior Electric Company at Bristol, Connecticut, to discuss motor driven voltage controls.

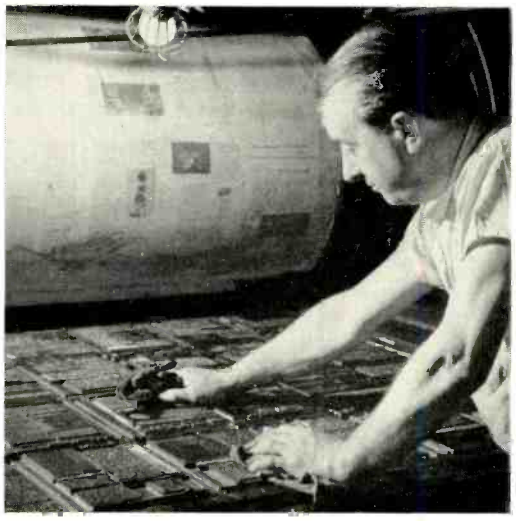
R. E. POLK visited Indianapolis in connection with manufacturing problems on the U1 receiver.

R. R. STEVENS went to Indianapolis to confer with the Western Electric organization on transmitter production.

A. F. BURNS observed the production at Haverhill of new power plants to be used with key equipments.

"All equipped with telephones so that the minute you catch anything you can call up your friends and start bragging."





THE 300th ISSUE OF THE RECORD GOES TO PRESS

The August issue of the RECORD completed twenty-five years of publication. Accompanying photographs show a few steps in its printing, now being done in New York City by Charles Francis Press, Incorporated.

The examination of a press sheet for defects in printing and for uniformity of color is shown at the left, above. Left to right are Jacob Kiefer, press room superintendent, R. L. Shepherd, associate editor, F. P. Peecook, plant superintendent, and C. J. Coons, account executive. For high-quality work, the forms must be wiped out regularly to keep halftones clean and sharp, as James Satrina, feeding machine operator, is doing on a 32-page form, above, right. After the press sheets are folded the resulting signatures are collated and stapled on a gang stitcher, below, left. At the right, below, the completed BELL LABORATORIES RECORDS are being trimmed by Joseph Goeller.