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Traffic Control for Crossbar Toll

By M. E. MALONEY
Switching Engineering

WHEN the word traffic is used, the idea of congestion is implicit. The provision of a runway for every airplane, a track for every train, a sales clerk for every customer, or a trunk for every telephone call would be economically preposterous. Good traffic control consists in furnishing the facilities needed to give good service at a reasonable price, and in planning for the disposition of overloads with as little delay as possible.

If the amount and destination of traffic is known beforehand, as airways traffic usually is, the problem, although not simple, can be handled by readying equipment and personnel. Telephone traffic, however, is invisible, and sometimes capricious. Local events, weather, market changes, and many other natural or social disturbances give rise to flurries that may snowball into serious congestion if not handled promptly. It is a truism to a traffic manager that two or three additional circuits or operators provided early enough in a traffic bulge can stop the pyramiding effect and do more good than dozens can later when a backlog of calls has built up.

In designing the crossbar toll system, therefore, it was decided to provide circuits that would indicate to the traffic force the load on various parts of the system at all times so that the number of operators at the

No. 4 board could be changed to meet varying conditions.

The traffic control features concerned with short and fortuitous overloads are provided by a calls-waiting signal, by busy indicators for senders and switched-in repeaters, and by means for temporarily augmenting trunk groups.

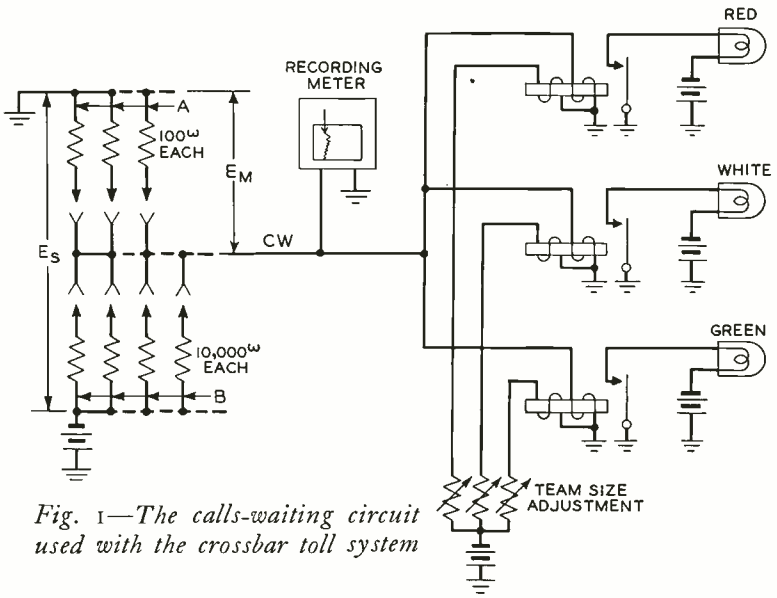

Fig. 1—The calls-waiting circuit used with the crossbar toll system

The calls-waiting circuit keeps a continuous record of the number of unanswered calls per position at the No. 4 board, and also controls warning lamps to indicate to the operators and the supervisory force when the calls are increasing. Both the warning lamps and the graphic meter that makes the continuous record are automatically controlled by signals from links that are trying to serve calls and from occupied positions. The actual number of waiting calls is not significant—it is the number waiting per occupied position that tells whether or not traffic is backing up. Also, a particular ratio—calls-waiting to positions occupied—does not have the same significance when only a few positions are occupied that it does when a large number are covered. This is because small groups of facilities, being inherently inefficient, have a margin of idle time when handling an average load, and can use this time to absorb an overload. Large groups are more efficient on average loads, which means that their idle time is small, and they cannot take the same percentage of overload that small groups can. As a result, the circuit cannot use the signals from the links and positions directly without doing some simple arithmetic. How it does this is shown in Figure 1.

In the network at the left, one of the resistances marked A is supplied for each position and is connected into the network whenever that position is occupied. The resistances marked B are associated with the link frames that connect incoming trunks to operators, and one is connected into the network whenever a call arrives on an incoming trunk and remains there until the call reaches an operator's position. The voltage to ground of the meter lead, E_M, is obviously some function of the number of resistances A and B.

If each A resistance is one hundred ohms, and P is the number of positions occupied, the resistance from lead CW to ground is one hundred divided by P, and if each B resistance is 10,000 ohms, and C is the number of calls waiting, the resistance from lead CW to battery is ten thousand divided by C. The total resistance from battery to

TABLE I

$$I = \frac{E_S}{\frac{100}{P} \quad \frac{10{,}000}{C}} = \frac{PC\,E_S}{100C + 10{,}000P}$$

$$E_M = I\frac{100}{P} = \frac{C\,E_S}{C + 100P} = \frac{C/P\;E_S}{C/P + 100}$$

and when C/P is small compared to 100

$$E_M = \frac{C/P\;E_S}{100}$$

TABLE II

Team Size	*Green*	*White*	*Red*
Under 5	1.0	2.0	3.0
5 to 10	.5	1.0	1.5
Over 10	.25	.7	1.0

ground (assuming that the meter and relays have such high resistance that their effect is negligible) is the sum of these two resistances, and the current flowing is E_S divided by the total resistance. The voltage E_M is equal to this total current times the resistance between CW and ground. If the number of calls waiting per positions, which is C/P, is very small compared to 100, the voltage E_M is approximately C/P $\times$ E_S or 100, as is shown by the simple calculations in Table I, and a voltmeter with the right range and a suitable scale will read C/P directly. In practice, C/P is so small compared to 100 that the error is negligible and smaller than the error introduced by the shunting effect of the meter and relays. The latter is noticeable when three or less positions are occupied, but tends to disappear as the team is enlarged. At ten positions, for instance, 100/P is 10 ohms, which is so much smaller than the resistance of meter and relays that the error is only about one per cent. With two positions occupied, the error is five per cent, which can be tolerated with a very light load.

The warning lamps at the right of Figure 1 are lighted when the corresponding control relays operate. The green lamp indicates a satisfactory load on the positions, and if it is extinguished for an appreciable time, the board may be over-manned. The white lamp indicates a small increase in load, and if it persists for some time the condition may be serious. Usually it is arranged to change from steady to flashing after it has been lighted for about half a minute. The red lamp indicates an immediate need for relief, and it flashes as soon as it comes on. Each of these lamps lights at a different value of C/P, but since the significance of this ratio depends on the number of positions occupied, as already noticed, provisions are made for changing the value of C/P at which the various lamps light in accordance with the number of positions occupied. This is accomplished by changing the bias current of the relays by the potentiometers labeled "Team Size Adjustment" for different numbers of occupied positions. Three steps are used: one when there are fewer than five operators at the board, one when there are from five to ten, and one when there are over ten. The settings of the potentiometers are controlled through relays by keys that are operated when the number of operators changes from one team size to another. The values of the ratio C/P for which the various lamps light for the three team sizes are shown in Table II.

A typical floor plan layout of part of an operating room is shown in Figure 2. The traffic supervisory panel, which contains the controls for the calls-waiting signals, the calls-waiting meter, and the green, white, and red lamps, is visible from the chief operator's desk, and multiple appearances of the lamps, with large beehive lenses, are installed at the head of the switchboard, where they are visible to the nearest supervisor. Multiples of these lamps may appear elsewhere in the operating room, if desired.

The graphic meter, on which the continuous record is made at the Philadelphia installation, is shown in use in the photograph at the head of this article; and Figure 3 is a close-up view of the top of the traffic supervisory panel. At the top left are the calls-waiting controls. The turn-button key la-

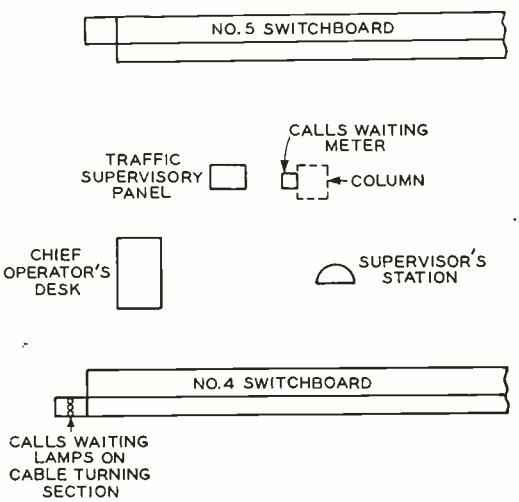

Fig. 2—Typical floor plan of operating room for crossbar toll system

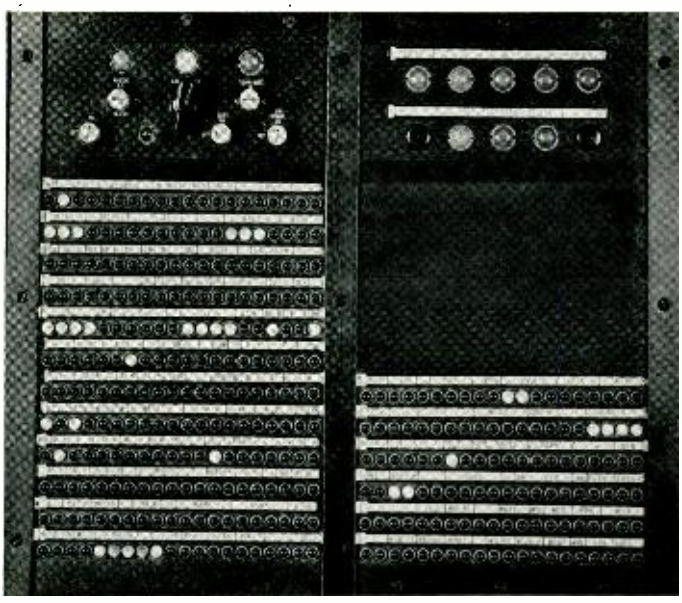

Fig. 3—Traffic supervisory panel for crossbar toll system

beled "CW Signal—Off-On" turns the entire circuit off and on. The "Team Size" key is set to A, B, or C in accordance with the number of working positions. The "Test" key, below to the left, cuts off the actual load circuits from the positions and links, and allows artificial values to be inserted for testing the operation of relays, lamps, and meter. These tests are controlled by the "Check" key at the upper left and the "Lamp Check" potentiometer in the center. With the check key at O, as shown, the meter on the adjacent column should read zero, while with the key at 1.5, it should read 1.5 calls. In the LPS setting, and with the lamp check knob in the full counterclockwise position, none of the lamps in the top row will light. The knob is turned until the green lamp lights and the reading at the meter indicates whether the lamp is coming in at the proper point for the team size selected. Turning the knob further will check the white and red lamps. At the lower left are a "Flash" key and lamp. Turning this key to "Off" suspends the flashing of the red and white lamps, and while in this condition the flash lamp is steadily lit as a reminder.

In the upper right of Figure 3 are the all-senders-busy and all-repeaters-busy lamps. As their names indicate, these light whenever all circuits of an associated group are busy. The lamps in the top row from left to right are for incoming dial senders, spare lamp, incoming key pulsing revertive and PCI, and step-by-step and call-announcer senders. In the bottom row are lamps for three groups of switched-in repeaters. Strictly speaking, there is nothing the traffic force can do quickly about the amount of equipment supplied, so the amount of good that these lamps do in the operating room might be questioned. Actually, they serve to call attention quickly to load bulges, and if during what was expected to be a quiet period the plant forces have taken some equipment out of service for trouble shooting, contact cleaning, or other routine maintenance, they can throw the idle equipment back into service quickly to handle the peak. Also, an undue number of all-busy lamp signals may point out a growing load before analysis of the long-term statistics shows it.

The lower portion of the supervisory panel contains signal lamps associated with overflow trunks. From an inspection of these lamps, congestion can be spotted and steps taken to put a group on delay working if

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THE AUTHOR: MARTIN E. MALONEY received the B.S. degree from Georgetown in 1923 and the E.E. degree from Cornell in 1927, and then joined the Technical Staff of the Laboratories. With the equipment development group, he first worked on trial installations and then on dial PBX's, but in 1932 he turned his attention to crossbar switching and later to automatic ticketing systems. Transferring to the switching engineering group in 1940, he worked on the crossbar toll system until he was transferred to work on projects for the Armed Forces late in 1941.

necessary. In Figure 3, all four of the overflow trunks are busy in the Chicago (CGO), Cleveland (CLEV), Richmond (RICH-V) and New York (NY #1 & 2) groups, three out of four in the Baltimore (BALT) group, and all three in the Atlanta (ATLA) group. The T and V following some of the city designations mean terminal and via. The former trunks are of a transmission grade suitable only for direct calls from an originating to a terminating switchboard, the latter must be used on all calls involving one or more switches.

If it is found that traffic tends to peak on a group for short periods, but the total amount does not justify enlarging the group, temporary relief may be obtained by a method known as assignment patching. This may be explained by reference to a simplified schematic, Figure 4. Assume that a group contains four trunks, which are shown with their test leads from the marker. The next test lead in hunting sequence can be cross-connected to a patching jack, which looks to the marker like a busy trunk because of a normal ground. When the group must be enlarged rapidly, a patch is made from this jack to a trunk jack of a spare trunk circuit. Circuit 4 then no longer tests busy, and the test leads extend to the new trunk. Before the patch is made, of course, the spare trunk circuit must be patched to the proper cable conductors, and the distant office notified to make similar arrangements. Some of the working trunks, as shown in Figure 4, may also have patch jacks so that they may be borrowed for assignment to other groups when necessary.

To provide a large number of spare terminals for each trunk group would make the number of trunk block relays excessive. Relief trunks in excess of the number of spare terminals provided can be added by jump-hunting,* although this would be resorted to only in emergencies. Jump-hunting usually requires some planning ahead, consultation with the traffic and plant departments in distant cities, and coördination of plant work in two or more localities. It is ordinarily used to provide facilities for large conventions, World's Series, and similar events where the need is foreseen. In an emergency the planning and coördination can be telescoped to give rapid relief by adding a large number of trunks.

*RECORD, *August*, 1944, *p.* 499.

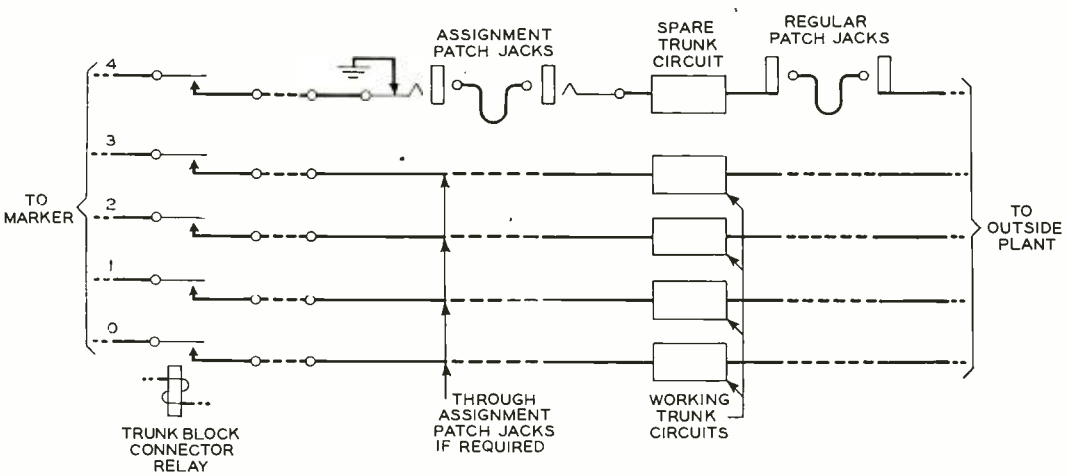


Fig. 4—Block schematic of arrangements for assignment patching

Instruction Manuals for the Army and Navy

By A. R. THOMPSON
Bureau of Publication

PUBLISHING is not the primary business of Bell Laboratories, yet in peacetime it regularly produced a large number of maintenance and operation manuals for the Bell System, and today it is one of the largest book concerns in America, aside from the United States Government. This is because it has undertaken to produce all of the instruction manuals needed for the many hundreds of different equipments made by Western Electric for the Army and Navy. For many months the Laboratories has been publishing new books at the rate of 400 a year, while the latest available figures for the country's two largest commercial book publishers show rates of 312 and 192.

The Laboratories differs from the commercial publishers in that it has to provide not only editorial, production, and clerical personnel, but authors as well. The authors are Laboratories engineers; about a hundred of them, at the present moment, are writing books. Most of them have had considerable experience in writing the Bell System manuals, but in writing for Uncle Sam they address a different audience. G.I. trainees have come from civil life through limited courses of training and lack the extensive background that could be assumed of a "BSP" reader. So the authors' present task is by no means an easy or a familiar one.

Another difficulty the Laboratories has in greater measure than most commercial publishers is the complexity of its material. Elaborate electric circuits, like those in radars, sonars, and directors, cannot be described in words alone. Schematics, wave shapes, and wiring diagrams have to be included in abundance, together with a multitude of photographs marked to give the identity of all the various circuit elements. Tabular descriptions, often in hundreds of pages, must be added to help the service maintenance forces order or replace or repair every one of the innumerable components that make up a complete equipment.

A third unusual difficulty—and perhaps the most formidable of all—is that, in almost every case, the subject of the instruction book is practically in the blueprint stage when the author starts to work. He must describe minutely the installation, operation, and maintenance of an equipment that has not yet been built, and constantly revise his material to cover changes in design. He must be accurate and clear, or vital apparatus will fail to function and lives may be lost. And he must work rapidly enough to provide at least a little time for the editor, book designer and printer to

finish a manual that can be packed *with the first equipment delivered to the Government.*

What happens to an instruction book from beginning to end would make a long story, and the tale would vary with the book. But the procedure can at least be suggested.

An instruction manual comes into the picture as soon as a new equipment is discussed between the Laboratories, Western Electric and the Government agency involved—for the equipment will be useless unless the user is told exactly what to do with it and how to take care of it. When the manufacturing contract is written, the manual is included at least by implication; usually it is referred to as a specific item, such as "instruction books per Specification RE-13A-547E." This specification, or whatever one is mentioned, will tell what types of books are needed (usually there are two or more); how many copies of each; how to write each book; and how to print it.

It is the function of the Laboratories to write and edit the manuscript, to prepare the illustrations, and to plan and supervise the printing. It is the function of the Western Electric Company to procure printing facilities and materials, to issue orders and pay the bills, and to maintain printing schedules. It is the function of the Government agency to provide full specifications, to review the manuscript and otherwise to make sure that its own requirements are fulfilled.

Before the war and during its early stages, books were generally written by members of the engineering groups that developed the equipments. Gradually, however, a large part of this activity has been turned over to other groups organized to specialize in this writing. In the Apparatus Development Department, for instance, a number of men under the direction of Francis A. Hubbard started their literary work by preparing a maintenance manual for the M9 Director; they have continued to write all director and computer instruction literature and have added a number of books on radar and similar equipments. In the Systems Development Department, much of the writing is done by a group headed by R. W. Burns. Probably the largest group of our wartime writers is the faculty of the Bell Laboratories School for War Training, directed by R. K. Honaman. Many of the men in these and similar groups are telephone engineers whose peacetime occupation has been interrupted by the war. Many are engineers borrowed from the associated telephone companies or hired temporarily from various branches of the electrical industry. To coordinate writing activities, an Instruction Manuals Committee has been appointed, which includes among its members a Western Electric representative.

While a book is being written, its illustrations—sometimes numbered in the hundreds—must be prepared. Many of them are standard schematics and wiring diagrams originally intended for manufacturing purposes; many others are drawings or photographs especially designed for the books. It is impossible to say just how many people have taken part in this phase of manual preparation. Probably most of the Laboratories' eight-hundred-odd draftsmen have done so at one time or another, and certainly the photo-retouchers on the company's payroll spend most of their time on material for instruction books.

The products of the authors and illustrators are brought together in the hands of one of the Laboratories' publishing groups. There are two of these groups, one in the Systems Department headed by F. T. Meyer, and one in the Bureau of Publication under the direction of the writer. The Systems group handles instructions for wire telephone and telegraph systems—an outgrowth of its normal occupation of preparing Bell System Practices—those informative manuals which A T & T distributes as part

Since joining the Bureau of Publication in 1925, Mr. Thompson has made an intensive study of typography and printing methods, fields in which his skill has been recognized by election to the presidency of the American Institute of Graphic Arts. During the war, he has been concerned exclusively with the editing and production of instruction manuals for the Army and Navy. A graduate of Hamilton College in 1920, he joined the Laboratories in the same year.

Editor J. R. Stanley confers with engineer L. A. Yost over an instruction manual for the Armed Forces

of its service to the Operating Companies—and "requirements" specifications which are basic to Western Electric manufacture. The Bureau of Publication cares for radio, radar, underwater sound, and other "non-telephonic" material; again an expansion of peacetime publications, in this case normally for the non-associate field. The line between the two groups is not sharply drawn: there are many exceptions in the type of material handled. So far as instruction book activity as a whole is concerned, the two should be considered as a single unit.

It is in these publishing groups that the work of the Laboratories parallels that of the commercial book houses like Macmillan and Doubleday, Doran. And it is here that the growth of this phase of Laboratories activity is most conspicuous. Four years ago one member of the Bureau of Publication handled Government instruction books as a part-time affair, sandwiched in between booklets, posters, issues of the RECORD, commercial instruction bulletins, and other miscellanea. Today these books require the full-time attention of forty to fifty people, many of them experienced specialists brought in for the duration from the commercial publishing and printing fields.

The function of the publishing groups is essentially the preparation of material for printing. Manuscripts are edited to a greater or less degree depending on their nature and the amount of time available; submitted to the Services for necessary approvals; and marked with instructions to the typist or typesetter. Illustrations are checked for quality and legibility, corrected if necessary, and marked for reduction to the size to be used in the printed book. Proofs of type and illustrations are "dummied up" into pages and turned over to the printer with complete instructions. And the printer is checked to make sure that his reproduction is accurate and of good quality. Security precautions are observed as they are required.

Working closely with the Laboratories' publishing department is a group of Western Electric purchasing specialists under the direction of H. H. Pruser. This group was set up early in 1943 to deal with the purchasing problems involved in a hugely increasing program in the face of a rapidly shrinking paper and printing market. A carefully drawn plan for purchasing during future months was made up and is continuously reviewed in close consultation with the Laboratories. As much information as possible is collected about each book in prospect: its size and contents, how many copies must be printed, what kind of paper and binding it should have, when the author expects to present his manuscript, and when the finished copies are needed. The purchasing group then plans their procurements of materials and facilities.

Since the middle of 1943, over a million pounds of paper have been purchased by Western Electric for Government manuals, to be added to hundreds of thousands of pounds provided by individual printers. More than a dozen different letterpress and offset printing houses, in New York, Philadelphia, Chicago, and other cities, are needed to keep the book deliveries synchronized with equipment schedules.

Major Problems of the Telephone Industry

Abstract of an address by Walter S. Gifford before the United States Independent Telephone Association at Chicago on October 11, 1944

AFTER expressing appreciation of the invitation to address the Convention, President Gifford said, "you, and we of the Bell System, are jointly responsible for the fact that our great country has the best telephone service in the world and we cannot do otherwise than help further this coöperative undertaking by exchanging ideas freely. In his address he

Urged, as a post-war objective, that the entire industry unite on a program for the extension of rural telephone service;

Restated his view that it would not be in the public interest for telephone companies to establish censorship over millions of telephone conversations in order to prevent use of the service for illegal purposes, by bookmakers or others;

Warned against the general use of devices by which telephone conversations are recorded without the knowledge of the telephone user;

Expressed confidence in the industry's future and the opportunities it will present for further achievement in the communications art;

Reviewed with pride the wartime record of the telephone industry and pledged a continued high standard of service.

"Prices for telephone service are very properly regulated," Mr. Gifford said, "but they must be adequate to pay all the costs involved in giving good service. These costs include, besides wages, salaries, taxes, depreciation and other expenses, the return on investment.

"We in the industry must convince regulatory bodies that it is against the public interest and against the interest of the telephone users in particular, to be so niggardly on this question of return that the financial soundness of the industry and its ability to secure the necessary funds for investment are weakened.

"We must compete for new capital as it becomes needed. To furnish telephone service requires a lot of physical equipment which must be paid for—thus the capital requirements are heavy and every added telephone means more capital investment. The telephone business must earn year in and year out enough so that those with capital to invest will want to put it into this industry."

* * *

On the question of rural service, Mr. Gifford cited the difficulty of doing the job at a price the rural customer feels he can pay.

"Here we have great distances to be covered with few customers," he explained. "Not only the construction required but the maintenance of equipment makes it difficult to bring the cost down so that the farmer, unless he is a fairly prosperous one, will cheerfully pay the price. Too many of them decide to do without the service. I say this in spite of the fact that rural telephone service is undoubtedly more highly developed in this country than anywhere else in the world. The point is that it is not developed as far as we in the industry would like to have it.

"As a post-war objective, I suggest that the entire industry unite on the problem of finding ways and means to furnish satisfactory telephone service for the farmer at a cost that more of them can afford. Fortunately, there are developments in sight that make it look as if this could be done."

* * *

The recording of telephone conversations was described as "a matter that may turn out to be of real concern to the entire industry.

"The war has stimulated the use of devices by which telephone conversations are recorded. There are a number of perfectly legitimate uses for such recordings. If, however, such a practice should become universal, it seems to me it would completely change the character of telephone com-

munications and would be against the public interest. When a person telephones he very properly expects his conversation to be private. I think consideration should be given to ways and means by which legitimate use of such recording devices may be continued but all other use discouraged."

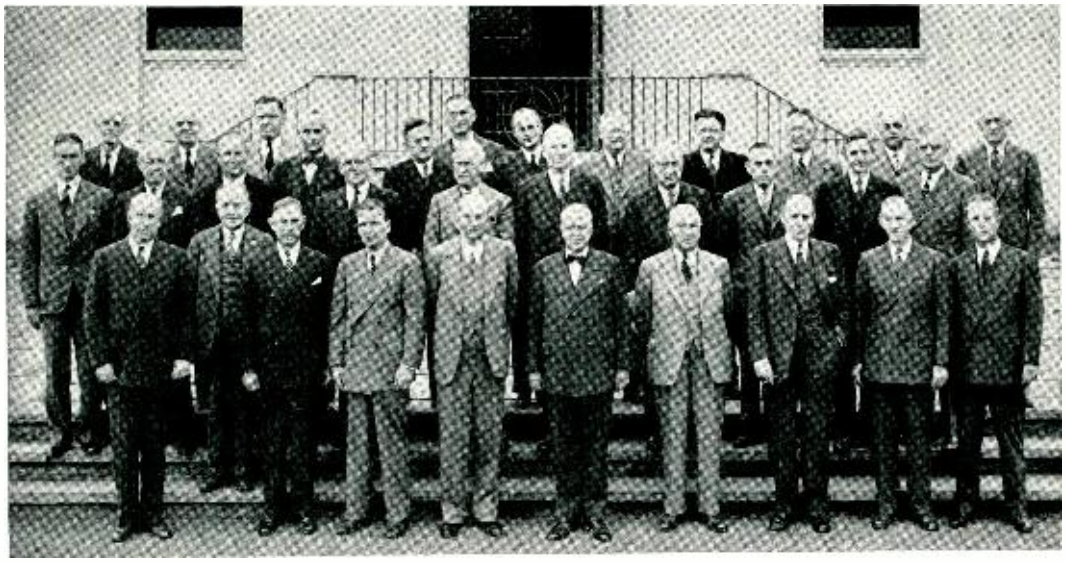
* * *

Because the progress of the telephone industry is founded on a basic human need, Mr. Gifford stated his belief that we have every ground for thinking that the years ahead will give as much opportunity for achievement as have the years since the telephone was invented. On the technical side, he pointed out, we already have useful new knowledge which we are only awaiting the end of the war to apply.

In reviewing the war job, he emphasized the fact that the industry was and is the custodian of a service absolutely vital to successful conduct of the war. He touched on the additional facilities installed for the Armed Forces and for the new industrial plants, and on the spectacular increase in toll and especially long distance service, and added:

"The problem was not merely to meet all essential needs for telephone service, but to meet them during a time when shortages of materials were becoming progressively more acute. Anticipating severe shortages of materials needed for war, the telephone industry voluntarily put into effect a broad conservation program which included substitution of less critical for more critical materials throughout the telephone plant. When the time came for the application and administration of Government orders framed to promote the utmost conservation of materials and manpower, the industry had already gained an experience which has been of great value in enabling us to coöperate most effectively in the Government's program.

"Progress made in past years, plus resourcefulness in the pinch, have brought about this two-fold result: the telephone service the Nation needs is being rendered, and the materials that had to be saved have been saved. Thanks largely to the development of modern telephone carrier systems, millions of miles of toll and long distance circuits have been provided—not all we need, to be sure, but a large amount nevertheless. In particular, the emergency narrow-band carrier channels which we have been able to establish—virtually making two circuits grow where one grew before—have added immensely to our long distance circuits. These circuits have given acceptable service to wartime users without requiring appreciable expenditure of materials."



Walter S. Gifford is the central figure of this group of Bell System presidents taken with Laboratories executives during a visit to Whippany and Murray Hill on October 6

For something over two years G. D. Edwards, Director of Quality Assurance, has been a consultant to the Secretary of War on loan from the Laboratories. Mr. Edwards made a complete study of procedures, and worked out a general plan and specific patterns for the incorporation of quality control principles in acceptance inspection of material procured by the Ordnance Department. He also made a similar study for the Signal Corps. In transmitting the citation shown, General H. F. Safford said: "The efficiency of our inspection operations has been greatly improved under your guidance."

No. 19

Citation

THE ORDNANCE DEPARTMENT

of the UNITED STATES ARMY

makes it known

G. D. Edwards

HAS RENDERED DISTINGUISHED SERVICE TO HIS COUNTRY IN THE STRUGGLE TO MAINTAIN THE FREEDOM OF ALL PEOPLE. BY THE EXERCISE OF HIS INITIATIVE AND INGENUITY HE HAS MADE A MARKED CONTRIBUTION TO THE WAR PRODUCTION PROGRAM.

L. H. CAMPBELL, JR., MAJOR GENERAL, CHIEF OF ORDNANCE

June 30, 1944

Headquarters—Army Service Forces now propose adoption of the Ordnance standard procedures for acceptance quality control by all of the technical services of the Army, and Mr. Edwards and H. F. Dodge were recently occupied full time for some months in the conduct of a series of instruction conferences for Army personnel throughout the country. Of this work, Major General Clay says in a letter to Dr. Buckley: "The success of the program to date is due in a large measure to the careful planning and preparation of texts as well as the thoroughly competent instruction by Mr. Edwards and the staff assisting him."

In World War I the Navy congratulated Mr. Edwards; the occasion, his work on anti-submarine devices; the signer, Franklin D. Roosevelt, then Acting Secretary of the Navy

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The Bell System and Communications for Railroads

In a recent statement submitted to the Federal Communications Commission, the A T & T made it clear that the Bell System stands ready to assist the railroads in any way it can in the field of railroad communications. For the past 20 years, the statement said, the Bell System has been actively interested in the development of radio and carrier communications systems for use in railroad operation and in providing telephone service that could be used to and from passenger trains.

Since 1925, engineers of the Bell System, in coöperation with various railroad companies, have made studies and have carried on tests of various forms of radio and carrier communication with a view of determining the practicability of their use in emergency train dispatching, in directing operations in freight classification yards and providing service with train passengers.

As a result of these studies and tests, it has appeared that it would be technically possible to establish workable systems of communication with trains.

In case a railroad wishes to consider the establishment of telephone service on trains in connection with the Bell System's general public exchange and toll service, the System will be glad to coöperate with the railroads.

At present the Western Electric Company is engaged almost exclusively in the production of communications equipment to meet war requirements. When the military situation permits, Western expects to be in a position to supply radio telephone or carrier equipment to railroads for use in communicating with trains. Such equipment will in all probability be available, if needed, for various uses, such as train dispatching systems, making up trains in yards, freight classification operations, front end to rear end communication and communication between crews of different trains.

Motion Picture Club

The current season of the Motion Picture Club opened on October 4 and will continue to May 9. Eleven meetings will be held in the Auditorium at West Street. The meetings will begin promptly at 5:45 o'clock and will conclude about 7 o'clock.

The Committee has decided that this year more attention would be given to the showing of films made by members of the Laboratories, and accordingly, the meetings to be held on November 15, January 24 and March 28 have been designated as members' nights. In order that these meetings might be successful in their purpose, it will be necessary for the members to coöperate with the Committee by submitting pictures to be shown. If you have any pictures which you would like to show, contact G. S. Mueller on extension 1060 at West Street, J. J. Harley on extension 521 at Murray Hill or A. L. Johnsrud on extension 97 at Whippany. They will welcome your early response so that the Committee will have ample time to view your pictures and arrange for their showing.

At the other meetings during the season pictures made by outstanding movie makers will be presented. Many of these enthusiasts are now busily engaged in making pictures for entry in the Annual Contest for the Maxim Trophy Award, conducted by the Amateur Cinema League. As these become available, the Club will endeavor to have them shown.

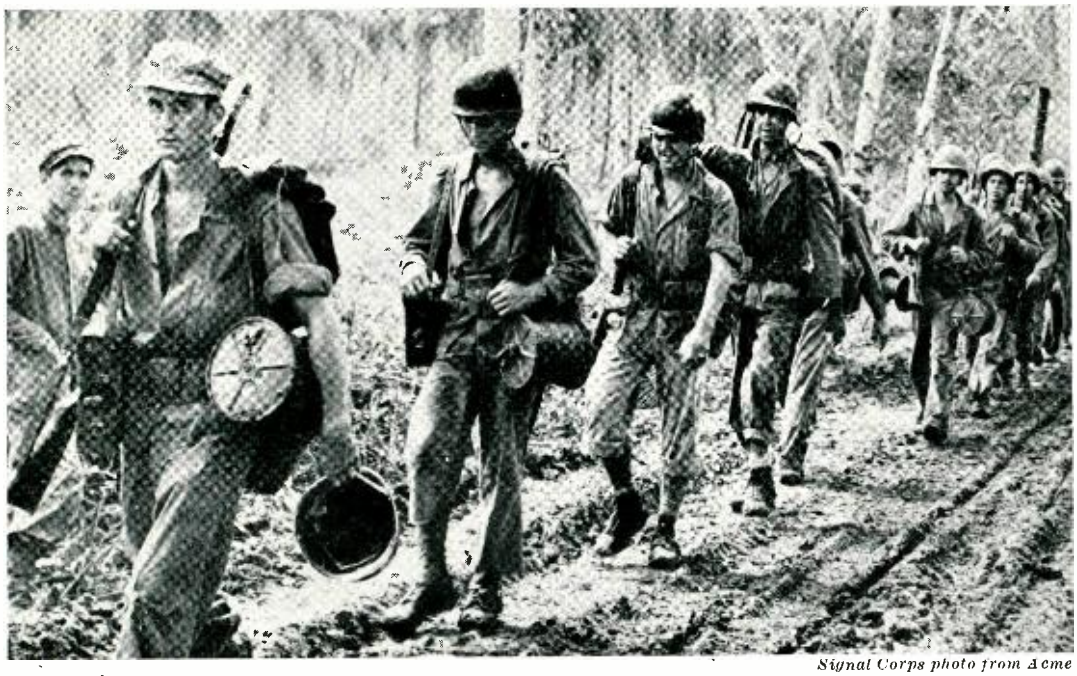
This year the Club is undertaking to promote an interest in amateur movies at Murray Hill and Whippany. At these locations Mr. Harley and Mr. Johnsrud will represent the Committee and render every assistance in arranging for local showings.

Brains of the Juggernaut

By Sgt. John B. T. Campbell, Jr.
Marine Corps Combat Correspondent

Saipan, Marianas Islands—If it were not for the field telephone and radio, modern artillery would be a brainless juggernaut as destructive to its friends as to its foes. The man who handles this nervous system of the Fourth Marine Division Artillery is Major John F. Mallard of Venice, Cal. He has been responsible for the laying of some 200 miles of telephone wire since our arrival on Saipan.

The importance of the telephone system can be estimated when it is considered that some 45 men have been killed and wounded putting in the lines for Major Mallard's artillery communications alone. If the toll had



Signal Corps photo from Acme

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Mary Tilton
Stella Ulias
C. Van Benschoten
P. Venneman
Angela Vetrone
E. G. Walsh
J. W. West
Natalie Wojtech

been many times as great, the lines would still have had to be laid, if American forces were to conquer this island.

Wire men, traveling usually in small parties, are favorite targets for snipers, who know their importance. Major Mallard, himself, killed a sniper who was firing upon him while he was directing his crew. The wire men also had to brave the storm of Jap artillery and mortar fire which rained upon us during our first 24 hours on this island. A lot of them were killed, but the lines went in.

"Home Fire Brigades"

Organization of every New York family into a "Home Fire Brigade" has been recommended by Greater New York Safety Council for protection against fires which in the first half of 1944 destroyed or damaged approximately 15,000 New York homes. Here is the way the Council assigns duties for "Home Fire Brigade" members:

Father: Check heating system for defects, clogged chimneys and flues, proximity of combustible material and hot ashes. Make necessary repairs and corrections. Shield fireplaces with screens. Replace frayed electric cords and have defective electrical equipment repaired. Check and recharge fire extinguishers regularly.

Mother: Check house from cellar to attic, especially closets and stairways, for accumulations of rubbish. Provide ample ash travs in every room in which smoking is permitted. Enforce the family rule: "No Smoking in Bed." Install a fire extinguisher in the kitchen, and learn how to use it.

Children: Help to remove rubbish and open cans of old paint. Put matches in metal containers. Check condition of batteries in family flashlight.

All: Remember, in case fire should start, first call the fire department by telephone or alarm.

According to Fire Department records, New York City averaged nearly 100 fires daily during the first six months of 1944. These fires cost more than $4,000,000. They brought death to 68 and injuries to 236.

ALVA B. CLARK, *Vice-President in charge of Systems Development. Since entering A T & T in* 1911, *Mr. Clark has been concerned with toll line transmission. With his group he came to the Laboratories in* 1934, *and in* 1940 *became Director of Systems Development*

Pirie MacDonald

REGINALD L. JONES, *Vice-President in charge of Staff. He entered the Research Department of the Laboratories in* 1911; *served as a captain in the Signal Corps; headed successively the Laboratories' inspection engineering, outside plant, and apparatus development*

DONALD A. QUARLES, *Director of Apparatus Development. After military service, he entered the Laboratories in* 1919, *apparatus inspection engineer in* 1924, *became Outside Plant Development Director in* 1929 *and Transmission Development Director in* 1940

MERVIN J. KELLY, *Executive Vice-President of the Laboratories and Director of Research. He joined the Laboratories in* 1918, *became Vacuum Tube Development Director in* 1930 *and Director of Research in* 1936

Blackstone Studios

CHARLES W. GREEN, *Assistant to Executive Vice-President. A major in World War I, he joined the Laboratories in* 1919, *and specialized in carrier communication. He was Bell System technical representative in Europe; returning in* 1939, *he became the Laboratories' Military Personnel representative*

ROBERT W. KING, *Assistant to the President. He entered the Bell System in* 1917; *was the first editor of the* Bell System Technical Journal; *for six years assistant technical representative of the Bell System in Europe; since* 1935 *assistant to Dr. Jewett*

Blackstone Studios

OTTO B. BLACKWELL, *Assistant Vice-President, A T & T. Entering that company in* 1906, *he became its transmission development engineer in* 1919. *With his department he came to the Laboratories in* 1934. *He became manager of staff departments in* 1935 *and Vice-President in* 1936

Director-Equipped Guns Against Ground Targets

Commenting on the 90-mm anti-aircraft gun, which is equipped with our M9 Electrical Director, an Army press release says:

"The 90-mm gun, which can be fired at distant ground targets in much the same fashion as a sniper's rifle, has proved an ideal dual purpose weapon. German prisoners have graphically described the most terrifying feature of the 90—its incredible speed. Enemy troops scarcely hear the crack of the gun before 23-pound high explosive projectiles are bursting in their midst.

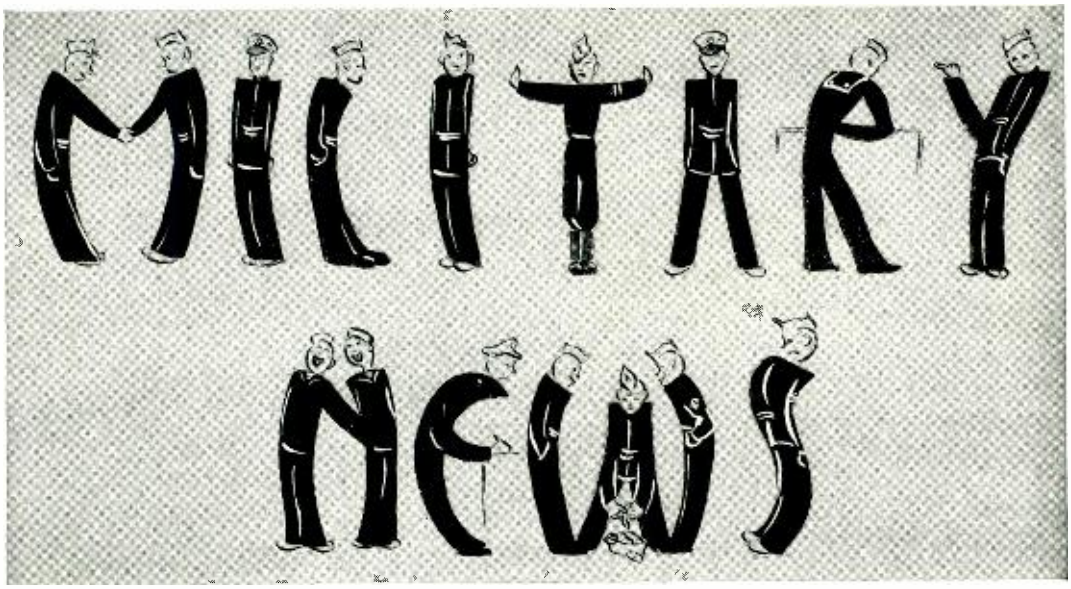
"The highly mobile nine-ton 90 can be towed by an eighteen-ton tractor at a cross-country speed of at least thirty-five miles an hour and can be placed in firing position in about four minutes. A good crew can get off about 20 shots a minute. A special sight and quadrant give it field artillery accuracy against ground targets, and a power drive rotates the gun from right to left in a matter of seconds. Gun crews, long accustomed to split-second timing, rarely miss a relatively slow moving enemy tank or armored vehicle."

Those who saw this gun demonstrated at Murray Hill can well appreciate the reference to the sniper's rifle, and to the speed of rotation to a new target. Considering that the Electrical Director was designed to track airplanes, the speed with which it will lay the guns on a fixed target is obvious.

HARRY S. SHEPPARD, *Staff Engineer, A T & T, reporting to Mr. Blackwell. He joined the Engineering Department of that company in* 1912; *reëntered in* 1919 *after teaching and war service; was Commercial Engineer and afterward Apparatus Staff Engineer in Bell Laboratories*

Converse Studios

MORRIS H. COOK, *Director of Specialty Products Development. He joined in* 1926 *the Engineer of Manufacture organization of Western Electric; in* 1933 *became manufacturing engineer assigned to station apparatus and in* 1941 *Superintendent of Manufacturing Engineering for the Hawthorne Special Apparatus Shops*



Lieut. Col. Ward St. Clair

Lieut. Col. Ward St. Clair is back in this country on sick leave after a year in the China-Burma-India theater of war. He visited the Laboratories recently while on leave from Rhoads General Hospital, Utica, N. Y.

Colonel St. Clair flew back to the States. He said the work there in the Theater Signal Office was interesting, but the living conditions and the climate were not pleasant. The heat was intense, usually with a cloudburst or sandstorm accompanying it. Most of the meat they had to eat was goat or mutton, with occasional water buffalo meat.

Lieut. Frank J. Fleischer

Lieut. Frank J. Fleischer visited the Laboratories on a recent leave. He has been on active sea duty in the Atlantic aboard a tanker for nearly three years. In January, 1942, his ship was torpedoed. He has made numerous trips to Africa, Italy, and was in on the invasion of France on D-day.

Major Emil Alisch

"We have been quite busy here in the Aleutians, but I cannot say that we are doing any more than our very small share of the job. Perhaps in many respects by comparison with other theaters this area can be termed an ideal locality. We are at a disadvantage with respect to climatic conditions, but one gets used to the weather after awhile. However, I feel I would rather have it in preference to the humid weather that you have been having in the city. There have been many stories written about the Aleutians, but for the most part would say that what I have seen in print has been pure fiction. There have been many writers through this area in the past few years and I am sure that these fascinating islands will be on the must list of the future vacationists and travelers.

"I have received the BELL LABORATORIES RECORD regularly and have not missed an issue. Each copy brings back happy memories. I must say that there are a lot of new faces appearing recently, but I am fully aware that I am the stranger now. I have noted that the third star has been added to the 'E' Flag and feel proud of the members that made this possible."

Robert H. Meuser

"We landed in Southern France on D-day (here). So far things have been going quite smoothly. We hit the shore on the 15th in quite a rush. The people are entirely different from those of Italy. The partisans here really get out and do something instead of just sitting back and talking about it."

Lieut. Arthur J. Nolan

"From New Jersey to New Guinea in a few short months—the saga of a former 4D

drafting assistant. New Guinea isn't such a bad place. We have constructed a wooden floor and wooden frame for our tent and have made a fairly livable place of it. Everything in the tent we have built ourselves, including three crude chairs I made. Since I am in a troop carrier outfit we have pretty good food. The planes in our own squadron fly food in from Australia every week for the use of our squadron. The place on Guinea where I'm located isn't as hot and muddy as other New Guinea spots. I'm with a swell bunch of pilots—friendliest bunch of boys I ever ran into. As one of the guys put it, there's a different attitude towards one another overseas than there is in the States. Overseas everybody has something in common—a desire to get home.

Lieut. John G. Phillips recently received his commission in the Army Air Forces at Sacramento, California

"I think I'm going to like the flying end of it, too. Arrived here a few weeks ago and haven't begun to fly yet but will begin in a couple of days. I'll be glad when I do because I haven't flown an airplane in two months and am getting stale and lazy as a result. Will be flying C-47's, sometimes called the 'Skytrain.' It's a twin engine transport plane with a wingspan of 95 feet that can carry a payload of 5000 pounds and 26 troops. It is a very excellent plane—flies very well, and all the pilots swear by it. I'll probably be co-pilot for the first several months.

"Am going to see Bob Hope, Frances Langford and Jerry Colonna tonight in a USO show they're putting on for the air corps personnel here. I saw Jack Benny and Carole Landis my first night on Guinea. It was a swell show.

"Since landing here I have been confused by two new types of currency. Australian currency, the basis of which is the pound, worth $3.20 U. S. money. The other, the Dutch East Indies currency, is less confusing because it is on the decimal system like our currency. A Dutch 'guilder' is worth 53 cents U. S. money. Then they have a Dutch quarter which is worth 13 cents and a Dutch dime which is worth 5.3 cents. We are paid in Dutch East Indies currency.

"This airstrip is quite the sight. There are demolished Jap planes all around the flying field. They were all strafed while on the ground and are pretty thoroughly shot up. There are lots of Zeros and Jap bombers around the airstrip. This morning I saw a Jap air raid shelter that is a takeoff on the New York subway system. A cave in the ground that is very extensive.

"The New Guinea natives are nice and agreeable. They salute every white man they see. I don't know who told them to do

Leaves of Absence

As of September 30, there had been 914 military leaves of absence granted to members of the Laboratories. Of these, 36 leaves have been completed. The 878 active leaves were divided as follows:

Army 506 Navy 279 Marines 29

Women's Services 64

There were also 17 members on merchant marine leaves and 27 members on personal leaves for war work.

Recent Leaves

United States Army

Richard I. Forrest
Harold W. Kowal
Eugene H. Sheehan

United States Navy

Peter A. Byrnes, Jr.
Ens. C. H. Doersam, Jr.
Sidney M. Geschwind
Maryrose Hanavan
John F. Kling
Donald A. Loughlin
John V. Moynihan
John T. O'Shea
Robert E. Poirier
Frank R. Santasier
Frank Sardinha
Evelyn E. Simmons

it, but they present a pretty comical version of a G.I. salute.

"The boat trip over here was long and boring. When we got near the New Guinea coast the natives rowed out to the boat and tried to swap cocoanuts and trinkets for cigarettes. Most of the natives are not barbaric but there are some regions of New Guinea where there are lots of headhunters. Transport pilots always fly out to sea around any dangerous jungle areas, because if you are forced down on the mainland your chances of survival, what with the presence of Japs and headhunters and crocodiles, aren't very good."

Richard E. Strebel

"The Navy has foreseen the need of highly trained men to service and repair the growing complex electronic equipment which is being developed and installed in ships, aircraft and on land. This Navy program now has the highest priority in choosing men with the necessary background. At present, only 20 per cent of the number who start the course complete it. This primary course consists of mathematics, electricity, electrical shop, drafting, mechanical shop, radio

LT. MARTIN P. HUGHES J. F. DALY

and radio mechanics. A passing mark is required in each subject every month to continue. I've found the training very interesting and instructive and of the highest standards. Of course all of this does not relieve the trainee of his military duties and training. Sleep is a rare and much desired pleasure.

"Practically every well-known electronic and radio company is represented in this school by its ex-employees and I've met many Western Electric Company men.

"I haven't worked with any Bell Lab equipment yet, but the equipment is well known and highly regarded in the secondary schools. At present I am building a single-tube superregenerative headphone receiver and a five-tube superheterodyne standard broadcast receiver.

R. E. STREBEL Clarksville, Ark. T. T. GANNON Atlantic

"There are about 150 Marines and 300 sailors taking primary training at this college, many of whom have seen service overseas and have participated in major engagements."

Lieut. Paul Mallery

"I am with the Signal Corps here in New Guinea. The first of this month I met my father here. We hadn't seen each other since July, 1941, so we both enjoyed it very much.

"He is in the ATS and arrived in New Guinea in April of this year. This is his third war, as he served with the 2nd New York Infantry in 1898, and with the Engineers in World War I. I doubt if there are many, if any, other Spanish-American War veterans in New Guinea."

Walter Farnham

"I am at Kwajalein in the Marshall Islands. It isn't too bad here. They must have had quite a battle here—there's hardly a tree standing and the ones that are are just stumps.

"I have finished my second mission. It isn't bad on the missions as long as the Japs don't get you. They are certainly fanatical and not to be underestimated. When they hit you, they hit you with everything they have—flak, fighters, etc. I've been over Truk—quite some place."

S. F. Lubniewski
Southern France

J. H. Riley
Hoffman Island, N. Y.

Lieut. Edward J. Bybel

"Being the assistant S-2 places me in charge of a battalion reconnaissance and survey. Since you simply don't point one of these big guns in the general direction of the enemy and fire, we run a survey with which, by trigonometrical formula and traverses, we can locate enemy targets accurately, making it possible to hit points, with our guns, up to ten miles away and in complete darkness. My job is to do that survey. The tough part is 'sweating out' the results. A wrong calculation may kill your own infantry or yourself. Therefore it gets a little nerve-wracking to listen to the whine of shells and know that if anything goes wrong I am responsible. But it's worth it all when, after a concentration of artillery fire lands, a doughboy turns to me and says, 'We're giving 'em hell, aren't we, sir?' Coming from a doughboy, that's a compliment."

Milton Dudeck

"I have finally been transferred to a training base for B-29 combat crews for training as a * * * mechanic doing maintenance and repair work. It does my heart good to see all this B.T.L. equipment, instruction manuals, and other references to B.T.L. In fact, the officers in charge here received their training at the Labs."

Lawson F. Cooper

"I am now assigned to the Radio Inspection Shop here at MacDill Field, Florida. After each fifty hours of flying time each plane (B-25) passes through the hangar for inspection. The radio equipment, some of which is very special, is inspected by a crew of two. It is their job to remove the equipment from the ship, check it thoroughly in the shops, correct any defects, and reinstall it in the shop. I am on one of these inspecting crews."

Stephen F. Lubniewski

"I have been overseas now for several months. Part of the time I spent in Italy—I am now in Southern France. I landed here on H+7 hours on D-day. We made a successful landing and most of us came through without a scratch. The French people gave us a real welcome and said they had waited a long time for us. We were treated with wine and food everywhere we went."

William R. Grant

"Down here in New Guinea my job is very exciting and interesting. Whether it is milling a casting or turning a piece in a lathe, I find everything worth while.

"A good deal of ingenuity is necessary over here. If you only knew the amount of 'on-the-spot' manufacturing I have done over here. Just to list a few: brushes for governed TTY motors from flashlight carbons; governor contacts for TTY motors from florins (Australian coins); flat springs from bailing bands; countless parts filed out of scrap metal and fitted by patiently filing and stoning with a hand-stone; and tension springs from the steel strands of field telephone wire.

"When a screw has its threads stripped, it is not thrown away. If it is over ¼" long we cut off the useless part and save the remainder. If the head breaks off any screw, we file a slot in its top and use it for a set-screw. When a nut is stripped, the hole is

G. A. Schiehser
Ft. Monmouth, N. J.

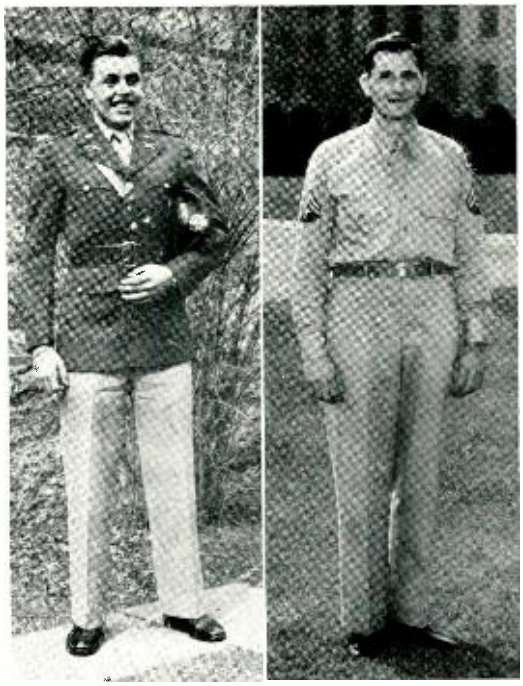
Warren Wilson
Ft. Benning, Ga.

drilled larger, and re-tapped to be reused. So you can see, we never waste or throw anything away.

"My work at 32 Sixth Avenue has helped me a lot. Back there I learned the importance of precision. The equipment I am working on is very familiar to me. This station I now have is run strictly 'Bell' by me. I keep very definite schedules for service and overhaul, and believe me—preventive maintenance really pays off.

"When I arrived at this new station, I was greeted by a pile of crates, reels of wire, and a lot of officers with ideas. My first job was to change the ideas of the officers. After a bit of persuasion, I finally got the 'green light' to go ahead—my way. I set this whole outfit up, and I mean it was fun. I can't tell you the amount of equipment, you understand. However, I can tell you it was the latest radio TTY. Also on the job were three land lines, TTY lines. These were a cinch, just simple direct lines between different headquarters. Also on the list was a complete set of * * * room equipment. I can't tell you what it was, but I can tell you it is closely associated with TTY. In three weeks I finished the station. It has been going now since April 15, the day of its completion. I have an excellent shop here, and I can handle almost any job except actually manufacturing the equipment.

"Last month we had a little tragedy here, and it rendered a complete * * * unit useless. The only solution was to completely rebuild it. It was called impossible, but that is one word Bell men like to hear. I started the task, and after completely tearing it down, I started from scratch to rebuild it. The entire wiring was useless, and many parts were damaged beyond repair. After I had it all apart and saw the extent of the damage, I realized why they thought it was 'impossible.' Well, the only thing to do was get going to rewire it. This proved to be a full-size project, and I learned those circuits backward and forward. The wiring completed, the next step was to rebuild its mechanical parts. I had to make one-half of the parts from salvaged scrap metal, the other half were either not too badly damaged or parts I was able to obtain new ones for. Fitting these home-made parts to work with factory-made parts was a job. The final day



Lt. R. F. McLaughlin (left), now somewhere overseas; W. H. Tappen (right) is stationed at the Frankford Arsenal in Philadelphia

came, and I tried her out. The first trial resulted in a failure—I made a mistake on a filter circuit. I fixed my error and tried it again. This time she clicked like she was made to originally. Now the unit is back doing its job to 'get that message through.'

"This station in New Guinea is very different from the one I had in Australia. Down there we thought we had troubles, up here we realize they were very minute compared to these. In Australia I had the opportunity to install a complete * * * circuit and system. When I arrived there, there were no such circuits in service. It meant cooperating with the Australian telegraph people (P. M. G., or Postmaster General). To use their carriers proved to be a major task. After ironing out the troubles, I was lucky enough to find a circuit that I could use. It is pretty hard to tell people in P. M. G. what you want, and not reveal your job. I used * * * * army * * * * * * switchboards. These were swell, except for a 15 to 30 per cent gain in marking bias. If the call went through three switchboards the bias was so bad that the circuit failed

completely. This bias trouble, I found out after two weeks' work, was being caused by the bias control circuit. The trouble was with the bridge circuit. It contains an unbalanced bridge circuit with a variable resistor in one leg of the bridge. This resistor was set wrong on every switchboard. I figured it out mathematically just how much resistance I should have and re-set all the resistors. The circuit then operated perfectly even through five switchboards."

Walter E. Lichte

"On a three-day pass I went to visit Baton Rouge. There I not only met someone from New York but also from Bell Telephone Labs. It was Corporal Grace Goodall, a Wac stationed at Harding Field, Baton Rouge. Looked mighty healthy and contented. The weather has been quite hot down here. Like to be remembered to all in Dept. 7521 and the girls in the restaurant."

Lieut. William J. Merchant

"I am responsible for the work of a group developing aircraft navigational aids in the Design Branch, Radio Division, Bureau of Ships, here in Washington. My duties have required considerable travel and flying and I have had many interesting experiences."

Philip E. Watts

"France is all right considering what she has been through. The cafés are open for business even though they may lack windows or part of the roof. In fact, all they seem to need to set up business is a sidewalk, chairs, tables, and a few bottles.

"I hope to see Paris one of these days, but the Boche seem to have taken everything worth taking there. The kids are great. We give them pieces of candy and in return they bring us apples and peaches."

F. W. Schwartz
From Pacific

T. J. Walsh
Sampson, N. Y.

Leonard M. Nielsen

"Up here in Greenland during July and August we've had some real nice days. If it hadn't been for all the mountain scenery and G.I. life I might have almost felt at home. I spend most of my spare time doing quite a bit of hiking and fishing. Outside of the post activities, we're pretty limited as far as amusements are concerned. We do have our own bowling alleys, recreation hall and movies, so that helps a lot. There aren't any towns or villages near, so I haven't seen very much of native life."

Lieut. John Marrero

"We are doing chemical warfare work here in Italy now. Our training has been very rigorous, or should I say rugged? However, the work is very interesting and we all enjoy the change. Of course the big change we are looking forward to is after V-day when we'll be going home."

Military News

Following are recent promotions: Colonel John M. Hayward; Lieut. Colonel

Lt. Col. Kobylarz
Wright Field

Capt. L. T. Miller
Maxwell Field, Ala.

Joseph A. Mahoney; Lieut. Colonel Albert G. Kobylarz; Major Joseph E. Fox; Lieut. Peter Wargo; S/Sgt. Herbert C. De Valve; Seamen 1/c R. F. Graham and C. B. Brown; Fire Controlman 2/c F. W. Schwartz; Electrician's Mate 1/c Sigmund Fronczak and Tech. Sergeant Charles T. Bolger.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LIEUT. RICHARD J. COMER is in a replacement training unit in Louisiana, flying B-26 medium bombers; LIEUT. LE ROY A. HOPPER is stationed at Scott Field, Illinois, where he is taking the Army Airways Communications System course in radio range.

GOTTFRIED O. VOIGT is working at the Naval Research Laboratories as a draftsman; ENSIGN PHILIP H. THAYER is also there, having been transferred from the Boston Navy Yard.

F. W. SCHWARTZ recently visited West Street after nineteen months in the Pacific

MAJ. J. E. FOX
Wright Field, Ohio

P. J. SMITH
Overseas

aboard a destroyer. He wore four campaign stars for action in the Solomons, Guam and Saipan.

DIETRICH WAGNER stopped at the Laboratories on his way from Fort Knox, Tennessee, to Camp Bowie, Texas. He is a radio repairman in a tank division.

LOUIS C. MUNCH returned to visit the Laboratories after eight months of active duty in the Pacific aboard a cargo supply ship. He was wearing campaign stars for action in the Marshall and Marianas Islands. After his thirty-day leave, he expects to be sent to school here in the States.

ERIC G. STRUBING visited West Street after completing his boot training at Sampson, N. Y.

LIEUT. COLONEL ALBERT G. KOBYLARZ visited the Laboratories recently. He is stationed at Wright Field where he is connected with AAF ground * * * maintenance activities.

SIGMUND FRONCZAK stopped at West Street while in New York on leave. While on sea duty he has seen such places as

D. K. WAGNER
Ft. Knox, Ky.

E. G. STRUBING
Great Lakes, Ill.

Sicily, Malta and Naples. During the beginning of the invasion of France they were bombarded by the Germans every night.

MARTIN J. CORLEY is stationed in New York at a Port of Embarkation Post Office.

ISABELLE KENNEDY of the Waves is working as a court reporter for the General Court Martial Board in Washington.

ARTHUR WRIGHT has been assigned as a clerk in a battalion headquarters at the Aberdeen Proving Ground, Maryland.

ROBERT R. CORDELL is on an island in the South Pacific. "Here there are no quaint towns, pretty flowers or beautiful scenery. We do have a pretty nice theater and that's a tremendous help."

LIEUT. CHARLES H. WILL is stationed in Washington where he is receiving training in equipment which the Laboratories develop.

WILLIAM G. SAUER is "back safe and sound, no hits, no runs, no errors. The Kraut is pretty smart but he knows he's licked."

ROBERT F. GRAHAM is taking boot training at Sampson, N. Y.; MARTIN C. NIELSON of the Army Communications Division is working in Washington.

MAJOR JOSEPH E. FOX is stationed at Wright Field, Ohio, as Assistant Officer of the Communications Branch of the Signal Corps' Aircraft Radio Laboratory, an Army Service Forces installation developing airborne radio equipment for the AAF.

JOHN P. SLICKERS has finished pre-flight training in Texas, and is awaiting shipment to either an advanced navigation or gunnery school.

CARL W. BACKMAN is in an Infantry Replacement Training Center at Camp

J. P. Reddington
Camp Lejeune, N. C.

Frank Sardinha
Bremerton, Wash.

Wheeler, Georgia. He will attend Officers' Training School when he has completed his basic training there.

Robert J. Seymour is now in France—"things are looking good here." John H. Devereaux, Charles A. Haas and Frank W. Garland are all at the Oakland Army Base in California.

Robert G. Kemple of the Marine Corps is on the island of Saipan "resting up after taking part in the Marianas Campaign."

John P. Houlihan is stationed at Camp Stewart, Georgia, after having returned from overseas service; Arthur Jackson is somewhere in New Guinea; Lieut. Robert I. Nolan and Peter H. Shearer are now overseas with New York post office addresses.

Philbrick M. Crouch is in England; Marvin Bracken is an aviation cadet at the Naval Training Base in Pensacola, Florida; Walter R. Schleicher is at Camp Crowder, Missouri.

Aviation Cadet Eugene Francois and Lieut. Kenneth E. Waters visited the Laboratories on recent leaves.

Francis R. Meehan is now at Keesler Field, Mississippi, where he is taking a course in aircraft mechanics. This school turns out men to be aerial engineers on B-24 Liberators. After graduation here, he will ship out and go to factory school at the Ford motor plant in Detroit, Michigan, where the B-24 is being put out. After six weeks of learning how the B-24 is made, he will go to a gunnery school for a six-week course. Then he expects to be assigned to a B-24 as aerial engineer.

John A. Zweig is with the Army Ground Forces in France; Harold V. Berlin is stationed in New Caledonia; Marie Vincent of the Waves is stationed at Anacostia, D. C.; Michael F. Griffin is on active duty in the Atlantic.

Joseph J. Emmons has been in France since D-day "helping to unload ships and keeping the supplies going to the boys at the front. I have seen quite a bit of action."

Daniel Walsh and K. F. McKenna are taking their boot training at Sampson, N. Y.

William J. McKee, stationed at Melbourne, Florida, says: "Take it from one who knows, don't ever believe the Florida Chamber of Commerce."

Elizabeth Fitzsimmons of the Waves is stationed in Jacksonville, Florida, as a Link Celestial Navigation Trainer Operator; Joan Schubert, Wac, has completed her basic training at Fort Oglethorpe and is now stationed near New York.

Frank Sardinha has been transferred from the Merchant Marine to the Navy. He recently visited West Street.

Captain Einar Reinberg is now overseas; Ensign Donald W. Mack received his Navy Wings and Ensign's commission recently. He is stationed at Shawnee, Oklahoma, as an aerial navigator and pilot.

Edward Fuchs is stationed at the Naval Air Station in Miami where his work deals mainly with the engines of the "Avenger" torpedo bombers.

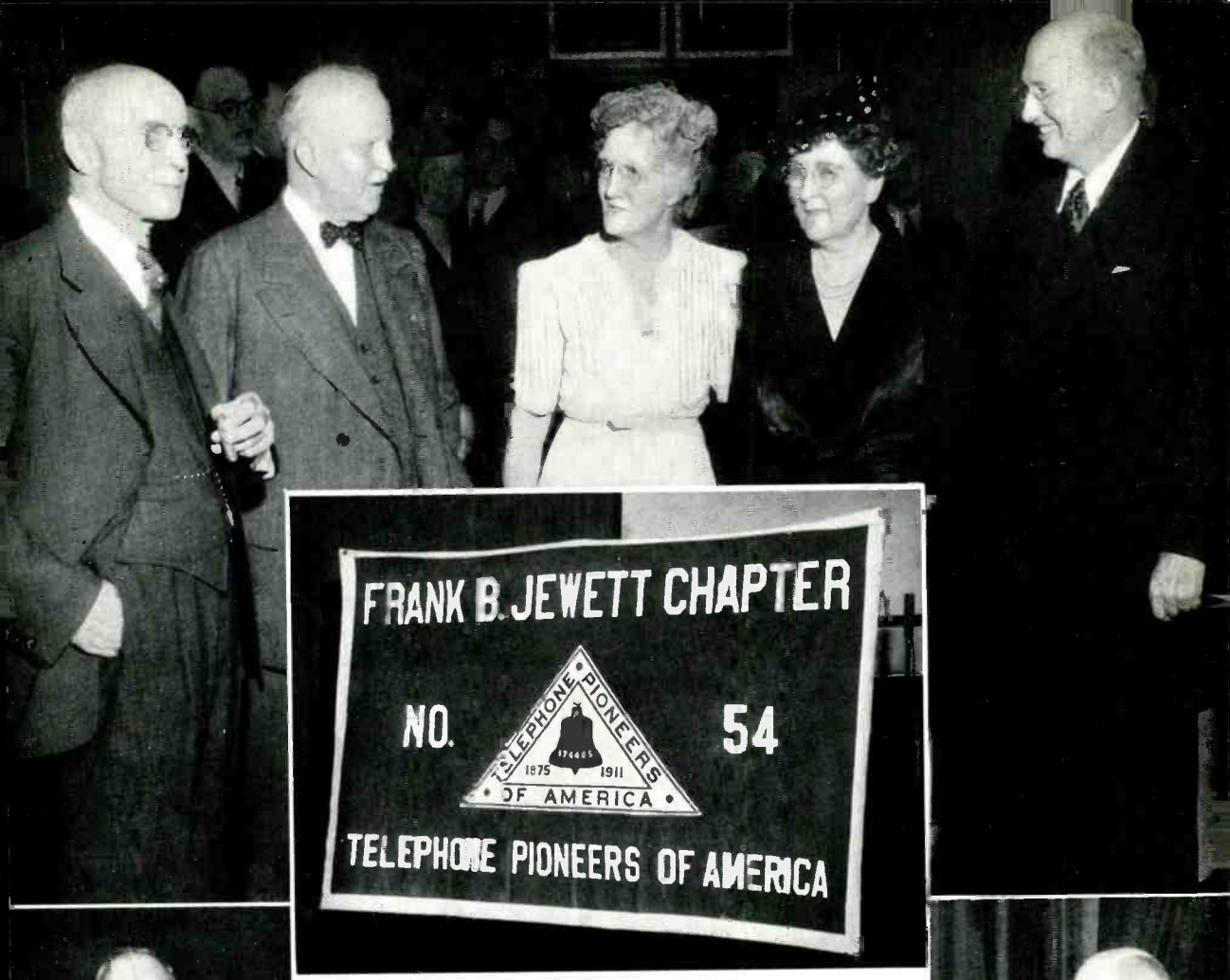
Lieut. Thomas G. Woods writes: "I am now in Australia, and have met several W. E. technicians here. If you can, say 'hello' to Bob Rooney for me, and tell him I just missed him here."

Lieut. Frederick W. Whiteside is stationed at Douglas Field, Arizona, where he is property accounting and property disposal officer.

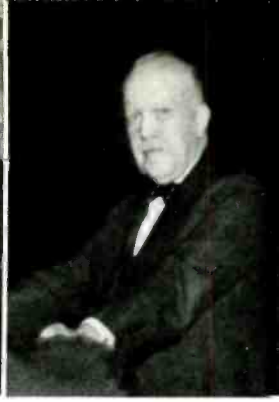
James M. Sullivan is now in France. "I am quite busy with some of our own Bell Lab designed equipment."

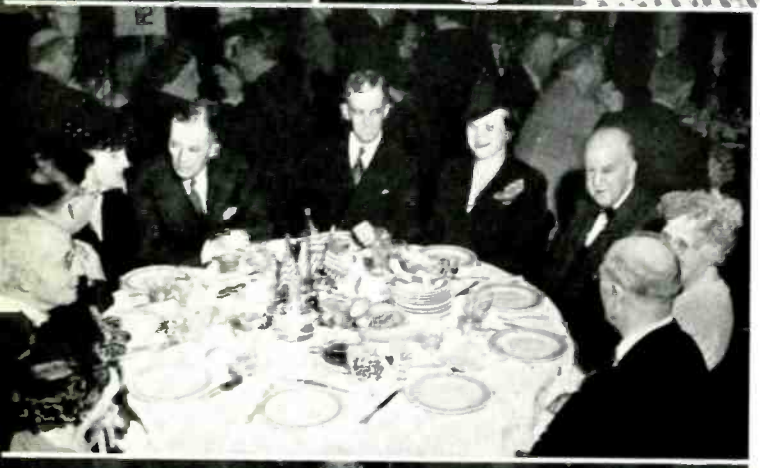
Joseph Berka is stationed in Hawaii, "maintaining and servicing 'our' electrical director"; Robert Klem is in the Pacific theater.

Private Jean Sanderson, U. S. Marine Corps, is now attending the Training School for Aviation Machinists Mates at Norman, Oklahoma. Jean was a Laboratory Assistant at Murray Hill when she joined the Marines last April.



Caught by the camera at the Pioneers' party on September 30 were Dr. Jewett, Mr. Gifford, Mrs. Jewett, Mrs. Buckley, Dr. Buckley; the Chapter's new banner; H. H. Lowry; John Mills; several retired members of the Laboratories: J. G. Roberts, H. S. Warren, Morton Sultzer (on military leave), E. H. Colpitts, A. F. Dixon, and Mrs. Dixon





Telephone Pio

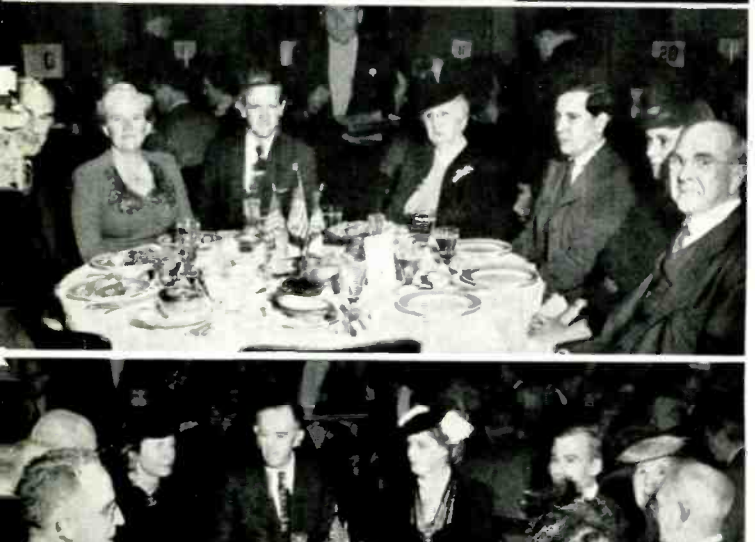
CLIMAXED by the renaming of th Chapter, the meeting of the Pioneers a dinner in the Hotel Commodore on Septembe 30 was a tribute to the Laboratories' Chai man, Frank Baldwin Jewett. The meetin was attended by nine hundred members an guests and was honored by the presence o President Gifford of A T & T.

Soon after six o'clock the Pioneers and the guests began to gather, and at seven the rose to sing the National Anthem. Dinne over, R. K. Honaman as Chairman of th Program Committee introduced "The Chant cleers"—a male quartet, and a dance tear "The Stars."

With greetings to his fellow Pioneer President Buckley then took the chair, an introduced Mr. Mills. Following in general h appreciation of Dr. Jewett in the RECORD fo October, Mr. Mills spoke in lighter vein an showed many pictures of Dr. Jewett fro infancy through college, courtship, your manhood and maturity.

A dramatic number, "A Day in the Life o a Pioneer, or, A Pioneer in a Daze," the presented Dr. Jewett's last day at 195 Broad way as some of his intimates imagined might have been. The cast: "Dr. Jewett, H. D. Peckham; his Secretary, Margare Glander; Messenger, Vivian Driscoll; "D A. B. Dark," C. R. Sawyer; "Dr. S. I Light," S. B. Wright.

Returning to the rostrum, Dr. Buckle paid a personal tribute to Dr. Jewett, wh





rs of America

d been his inspiration for all the thirty ars of his service. For the Laboratories as a ıcle, he said that Dr. Jewett's personality penetrated the organization that it was ised at all levels, and that in molding the rit of the Laboratories Dr. Jewett had in-enced the character of its members. He en presented a certificate of life member-p in the Pioneers.

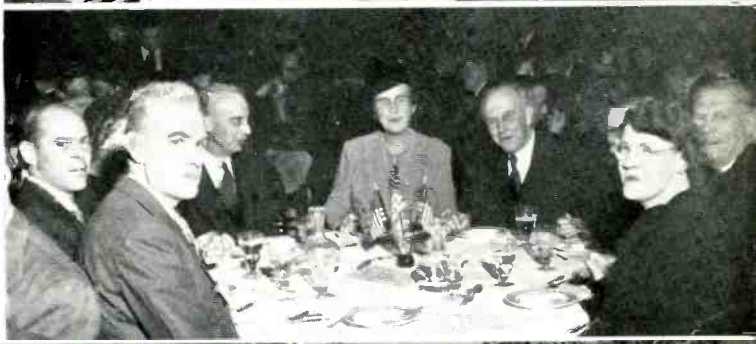
Acknowledging the certificate and Dr. ickley's tribute, Dr. Jewett outlined the ad trends in Bell System technology dur-g his forty years of service. He entered when ephoning across the continent was no more an a dream. Success in that project was lowed by telephone transmission across the lantic, by ship-to-shore radio, airplane io, and broadcasting. Looking back over years, he was proud to have played a rt in it all, and to have been associated th the group who were there assembled bid him good-bye.

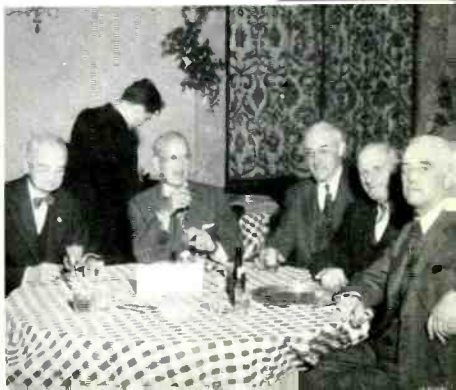
Asked to address the meeting, Mr. Gifford pressed his pleasure at being included in s group of Telephone Pioneers, and his isfaction in having known and worked h Dr. Jewett for many years.

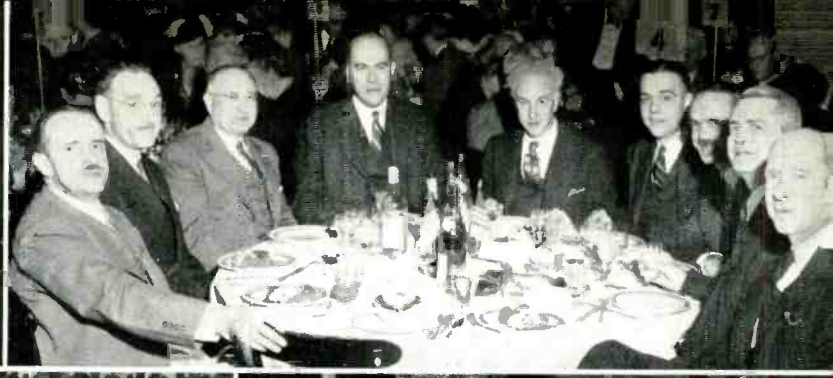
A resolution proposed by H. H. Lowry and onded from the floor was enthusiastically opted. It changed the name of the organi-ion to "Frank B. Jewett Chapter No. 54, lephone Pioneers of America."

After adjournment, many of the members nained for dancing and cards.







At the Dinner of the Telephone Pioneers

Electron Ballistics Symposium

The Basic Science Group of the New York Section, A.I.E.E., is sponsoring an *Electron Ballistics Symposium* that will be held during the next six months. J. R. PIERCE and A. L. SAMUEL of the Laboratories will give two of the lectures. The program follows:

Kinematics of Charged Particles in Electric and Magnetic Fields, by Prof. C. W. van der Merwe, Chairman, Department of Physics, Washington Square College, New York University, November 15.

Electron Beam Formation, by Prof. Ernst Weber, Head, Department of Graduate Electrical Engineering, Polytechnic Institute of Brooklyn, December 20.

Electron Optics, by Dr. D. W. Epstein, Research Engineer, RCA Laboratories, Princeton, January 10.

Solution of Electron Ballistic Problems by Analogues, by Dr. J. A. Rajchman, Research Physicist, RCA Laboratories, Princeton, February 21.

Physical Limitations in Electron Ballistics, by J. R. PIERCE, Bell Telephone Laboratories, March 21.

Electron Ballistics in High-Frequency Fields, by A. L. SAMUEL, Bell Telephone Laboratories, April 11.

National Service Life Insurance Payroll Deduction Plan

The Laboratories has adopted a plan whereby members who are veterans of the present war and who carry National Service Life Insurance may authorize the Laboratories to deduct from their salaries the amount of the monthly premiums on their insurance and remit such premiums to the Veterans Administration. The details of this plan are included in a pamphlet entitled *Payroll Deduction Plan for National Service Life Insurance Premiums*. Copies of this pamphlet are being distributed to those members who, according to the records of the Laboratories, have been in active military or naval service.

Murray Hill-Whippany Tennis Tournament

The first inter-laboratory tennis match between Murray Hill and Whippany was held on September 24, and was won by the Murray Hill team, five matches to two. In the singles, V. T. WALLDER, Murray Hill, defeated F. E. DEMOTTE, 5-7, 7-5, 6-4; R. N. LARSON, Murray Hill, defeated J. C. CROWLEY, 6-0, 6-1; JEANNE LEVER, Murray Hill, defeated ELIZABETH MEYERS, 6-0, 6-4; and ELEANOR GORMAN, Whippany, defeated LOUISE YAWGER, 7-5, 4-6, 6-1.

In the double matches, R. C. CARLTON and S. E. HARDAWAY, Whippany, defeated J. H. HAM and J. J. FRY, 6-3, 6-2; ELSIE SWEITZER and MILDRED HOOGSTRAAT, Murray Hill, defeated GERTRUDE SCHWARZ and MARIANNA WHALEY, 6-2, 6-3; and PHYLLIS TAYLOR and W. G. PFANN, Murray Hill, defeated GWEN ROWE and G. E. HADLEY, 4-6, 6-3, 6-3.

News Notes

O. E. BUCKLEY attended the inauguration of Dr. Homer L. Dodge as President of Norwich University, Northfield, Vermont, on October 9. He also attended a meeting of the Policy Committee of the American Institute of Physics held at Norwich University on October 7.

DR. BUCKLEY and R. J. HEFFNER attended a regional conference of the Presidents and Secretaries of New York and New Jersey chapters of the Telephone Pioneers of America held in New York City.

A. B. CLARK spoke on his experiences during his recent trip to the European war fronts at a meeting held in Nutley, New Jersey, on September 15, that was sponsored by the New Jersey Activities Committee, New York Section, A.I.E.E.

WILLIAM FONDILLER, on September 21, spoke at a luncheon meeting held in New York City under the auspices of the Radio and Allied Industries Committee of the Kisch Memorial Laboratories of which F. B. JEWETT is honorary chairman. This project is designed to establish laboratories for electrical and industrial engineering at the Hebrew Institute of Technology in Haifa, Palestine. Mr. Fondiller explained the aims and objectives of the project and the work of the Institute in

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expanding its program into the fields of electronic broadcasting and electrical industrial engineering. FCC Commissioner J. L. Fly also spoke.

A. F. DIXON, who retired from the Laboratories in 1940, was chairman of the Sussex County, New Jersey, Committee of the National War Fund.

MEMBERS OF THE LABORATORIES presenting papers at the National Electronics Conference, held in Chicago, were: F. B. LLEWELLYN and L. C. PETERSON, *Interpretation of Ultra-High Frequency Tube Performance in Terms of Equivalent Networks;* A. L. SAMUEL, *Some Notes on the Design of Electron Guns;* S. B. INGRAM, *Recent Electron Tube Developments in Telephone Systems;* and G. C. SOUTHWORTH, *Recent Researches and Post-War Radio;* F. A. Cowan of the A T & T presented a paper, *Broad-Band Carrier and Coaxial Cable Networks.* K. K. DARROW and S. A. SCHELKUNOFF also attended the Conference.

MISS ELLA A. WEBSTER, formerly secretary to R. L. JONES, transferred to the American Telephone and Telegraph Company on October 1.

S. A. SCHELKUNOFF, in the September issue of the *Proceedings of the I.R.E.*, reviewed the book *Fields and Waves in Modern Radio* by Simon Ramo and J. R. Whinnery.

MARION C. GRAY reviews the book *Erzwungene elektrische Schwingungen an rotations—symmetrischen Leitern bei zonaler Anregung*, by Ernst Metzler, in the August issue of *Proceedings of the I.R.E.*

PAPERS by R. M. BURNS, *Laboratory Corrosion Tests*, and by W. O. BAKER, *Inter-Chain Order and Orientation in Cellulose Esters*, were presented before the fall meeting of the American Chemical Society held in New York City from September 11 to 15. Others attending were MISS TOSCA JANK, C. H. SAMPLE, C. C. HIPKINS, W. J. KIERNAN, J. C. OSTEN and W. L. HAWKINS.

B. L. CLARKE has been reëlected a member of the Advisory Board of the Analytical edition of Industrial and Engineering Chemistry for the term from Jan. 1, 1945, to Jan. 1, 1948.

DR. CLARKE attended the Silver Anniversary Forum on *Future of Industrial Research* sponsored by the Standard Oil Development Company.

J. LEUTRITZ and W. J. KIERNAN were consultants on moisture and fungus-proofing problems at a meeting of the Signal Corps Tropicalization Committee at Bradley Beach, N. J., on September 11.

R. L. SLOBOD, E. A. THURBER and A. H. WHITE visited the Kolmar Avenue Plant of the Western Electric Company. While in Chicago, Mr. White attended the National Electronics Conference.

F. B. LLEWELLYN reviews the book *Klystron Technical Manual*, by the Sperry Gyroscope Company, in the August issue of *Proceedings of the I.R.E.*

M. WHITEHEAD visited the Sprague Electric Company, North Adams, Mass., on September 6 and 15, and the Aerovox Corporation, New Bedford, Mass., on September 27, on matters pertaining to electrolytic capacitors.

October Service Anniversaries of Members of the Laboratories

10 *years*

Thomas Bateman
J. F. Brennan
H. E. Kern
Christine Scanlan
W. A. Waechtler

15 *years*

W. O. Braatz
H. D. Breiner
Louise Butler
C. E. Clutts
C. J. Custer
Lynn Degen
Margaret Denio
Olga Gramm
C. M. Hill
T. S. Huxham
H. C. Jonas
John Kalbskopf
Thomas Keegan
C. C. Lawson
Nicholas Lazo
Catherine Lertolar
James McGovern
Michael McMahon
H. J. Michael
J. E. Reade
L. R. Schreiner
Christine Stephan
H. L. Thal
W. A. Thomas
Margaret Wardlaw

20 *years*

A. D. Benning
G. F. Doppel
J. F. Hargreaves
R. J. Lewis
J. E. Ottman
Ann Reilly
George Sawyer
J. H. Shepard, Jr.
M. T. Slacum
H. V. Wadlow

25 *years*

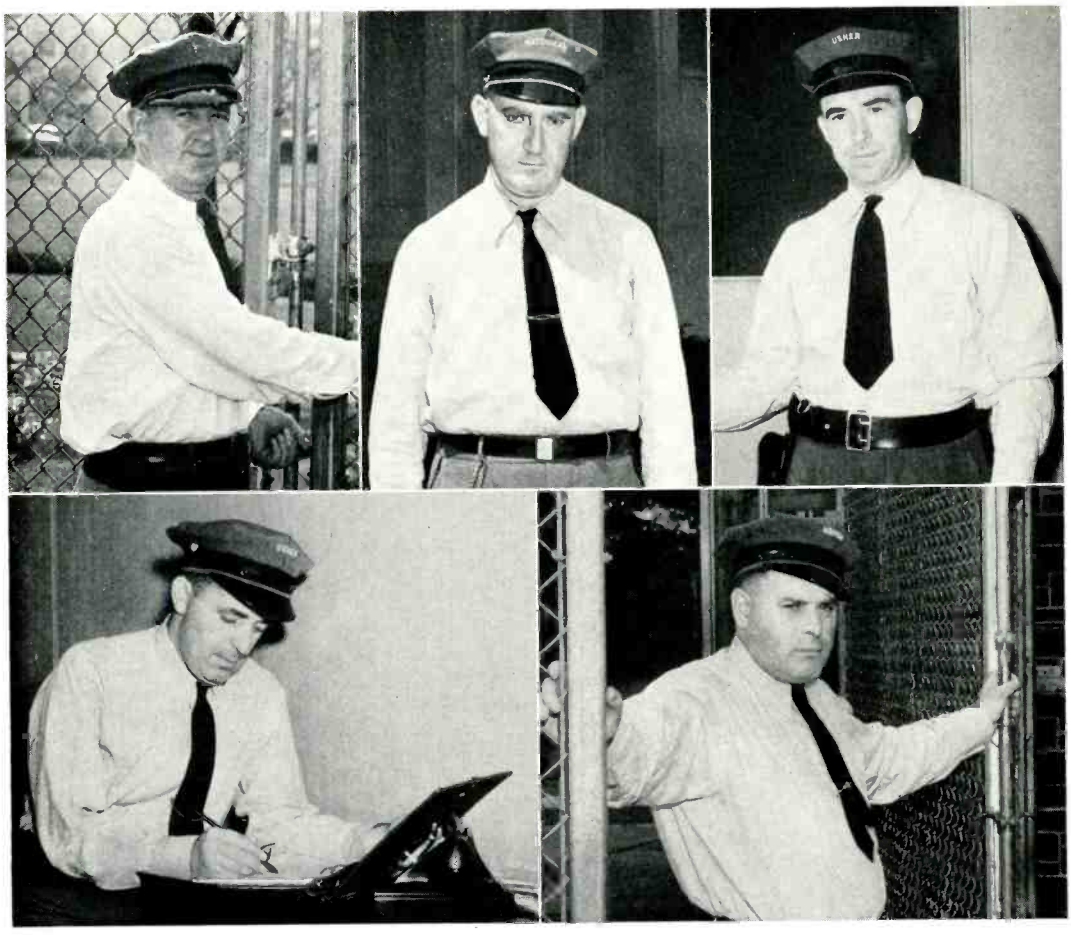
G. W. Ames
G. B. Baker
W. H. Berthold
Walter Connick
J. W. Dehn
Frank Gray
Elith Hansen
F. A. Hubbard
G. T. Morris
E. B. Payne
J. M. Peabody
R. P. L. Piltan
D. A. Quarles
P. C. Smith
C. R. Taft
C. C. Taylor
J. R. Townsend
Louise Van Bergen

30 *years*

R. C. Fisher
N. Y. Priessman

35 *years*

D. D. Miller
M. P. Sherwood



GUARDS AT THE MURRAY HILL LABORATORY

Above, left to right, Thomas Corcoran of the automobile gate, John Lavelle outside the main entrance and Daniel Breen outside one of the side entrances. Below, John Bowens inside the main entrance of the building and John Griffin outside the main entrance to the grounds

C. A. WEBBER went to the Hawthorne plant of the Western Electric Company on the manufacture of high-voltage cables.

H. H. GLENN, at the Bureau of Ships, Navy Department, Washington, and R. T. STAPLES, at the Boston Insulated Wire and Cable Company, discussed cable design.

H. H. STAEBNER and E. B. WOOD visited the Point Breeze plant to discuss cord development problems.

A. G. GANZ, at the M.I.T. Radiation Laboratory in Boston, attended a conference on special apparatus used for war projects.

A. B. HAINES visited the Bureau of Ships and the Naval Research Laboratory at Washington on transformer problems.

J. A. KATER was at Hawthorne in connection with silvering of mica and miscellaneous condenser problems.

H. A. STONE spent one week at Hawthorne to discuss network design.

A. D. HASLEY was at Hawthorne and at M.I.T. Radiation Laboratories on transformer problems.

C. B. GREEN and J. R. FLEGAL visited the General Electric Company at Schenectady to discuss thermistors.

LUDWIG PEDERSEN, who has been on a special assignment with the Western Electric Company since last May, completed 25 years of service on September 25.

A. J. WIER was in Watertown and Haverhill, Massachusetts, to discuss manufacturing problems on carrier equipment.

F. W. Mayo made a trip to Grand Rapids, Mich., in reference to the status of power equipment for radio systems.

A. S. King and G. J. Maggi assisted in the installation of equipment at Princeton for the trial of coaxial cable.

W. E. Mougey, J. W. Kennard and C. Kreisher, accompanied by members of the O & E, Long Lines and Western Electric Company, spent several days at Greenville, Ill., attending field trials of a new type of protection for buried cables.

J. W. Kittner was in St. Louis in connection with electrical testing problems on the St. Louis-Terre Haute coaxial cable.

J. H. Gray visited Pittsburgh to discuss with manufacturers prefabricated houses for auxiliary repeaters on coaxial cable routes.

C. H. Amadon was in Toronto, Canada, to observe the annual inspection of poles to which protective ground line treatment had been applied.

G. Q. Lumsden visited Trenton, Ontario, in connection with studies being made regarding the air-seasoning of red pine poles, and to examine pentachlorphenol-treated northern pine crossarms installed in the lines near Tillsonburg, Ontario. Mr. Lumsden was also in Reading, Pa., where, with representatives of the Metropolitan Edison Company and the Osmose Wood Preserving Company, he examined poles given a ground-line treatment.

M. T. Dow's article, *Magneto-Striction Noise from Telephone Wires*, published in the June issue of the Record, was abstracted in the September 16 issue of *Nature* (London).

J. A. Hall and H. S. Wertz were at the Patent Office in Richmond relative to patent matters during September.

William J. Conroy, 1917-1944

William J. Conroy, a storeroom attendant in the General Service Department, died on October 8. Mr. Conroy had been with the Laboratories since May, 1943.

"The Telephone Hour"

(NBC, Monday Nights, 9:00 P.M., Eastern War Time)

NOVEMBER 6, 1944

Hora Staccato — *Dinicu-Heifetz*
Orchestra

Liebestraum (No. 3 "O Lieb") — *Liszt*
Spanish Dance in G Major — *Granados*
José Iturbi

Love Scene from "Romeo and Juliet" — *Berlioz*
Orchestra

Concerto No. 1 in B Flat Minor—Finale — *Tschaikowsky*
José Iturbi and Orchestra

NOVEMBER 13, 1944

March from "The Love for Three Oranges" — *Prokofieff*
Orchestra

Creation's Hymn — *Beethoven*
I Love You — *Beethoven*
Helen Traubel

Valse Lente from "Sylvia" — *Delibes*
Orchestra

All the Things You Are — *Kern*
from "Very Warm for May"
Helen Traubel

Finlandia — *Sibelius*
Orchestra and Chorus

The Battle Hymn of the Republic — *Traditional*
Helen Traubel and Chorus

NOVEMBER 20, 1944

My Heart Stood Still — *Rodgers*
from the "Connecticut Yankee"
James Melton

Autumn — *Chaminade*
Orchestra

Do Not Go, My Love — *Hageman*
Don Juan Gomez — *Hageman*
James Melton

Carnival Overture — *Glazounoff*
Orchestra

The Lord's Prayer — *Malotte*
James Melton

NOVEMBER 27, 1944

Turkey on the Block — *Traditional*
Orchestra

Ave Maria — *Bach-Gounod*
Lily Pons

Poor Pierrot from "The Cat and the Fiddle" — *Kern*
Orchestra

Chitarra e Cuore — *Gaudiosi*
Lily Pons

Overture to Le Roi D'ys — *Lalo*
Orchestra

O luce di quest' anima — *Donizetti*
from "Linda di Chamounix"
Lily Pons

Bell Laboratories' Club has no more tickets for these programs because its limited supply has already been distributed to applicants.

Distaff

"Symbolically, the work or activities of women, or woman's authority or domain"—Webster

VIRGINIA MERRILL is using her talents doing patent drafting in the Laboratories' Patent Department in the Davis building. Evidence of her success in this field is the fact that a design for a telecommunications set was thought sufficiently novel to warrant the filing of an application for a design patent in the name of Virginia Merrill and Stanly Terry of the Patent Department.

VIRGINIA MERRILL

Miss Merrill started working as an artist. With four years of fine arts at the Boston University Art School and one year of fashion training as a background, she began free-lancing in Boston. Later she came to New York with another girl to break into the art field here. She worked for five years in a buying office, doing free-lance art work in her free time.

When war came she went to Manhattan College to enroll in one of the Government drafting courses. She took a three-month evening course. When she finished she came to the Laboratories where she took a six-week drafting course at West Street and then continued her studies while working. She was one of the first girls in the patent drafting department.

During her free time Virginia sketches and does oil paintings. She took a course in portrait painting recently. She lives in Manhattan, likes bridge, and belongs to the Laboratories Bowling Club.

* * * * *

EDITH KECK is the "lead girl" in the shop at Whippany. That is, she assists the supervisor in distributing the various jobs among the girls in the shop. She advises them on these jobs, sees that they are completed, and she also watches out for accident hazards.

She first became interested in this line of work by helping her brother-in-law who

EDITH KECK

has a workshop of his own in his home. Edith prepared for machine shop work at a vocational school where she learned blueprint reading and the use of the lathe, drilling machine and milling machine.

Miss Keck rolls bandages for the Red Cross two evenings a week, enjoys sports—especially baseball—and belongs to the Book-of-the-Month Club.

* * * * *

LITTLE wonder that the engineers at the Graybar-Varick building like to give dictation when the girl that is taking it is ETHEL GERE. She has done stenographic work at Graybar-Varick for two and one-half years. She started working at West Street, and before coming to the Laboratories she was secretary to a lawyer.

ETHEL GERE

After hours Ethel likes to dance, swim, ice skate and cook. She is interested in photography, collecting records and in interior decorating—she studied it once. She is starting her own library and this takes up much of her time. But even with all of these outside interests, Ethel now devotes many of her evenings to writing to the boys overseas and to those in the service who are still in this country.

CARMELA D'ANDRIA

BEING a wife, mother of four, and grandmother of five doesn't prevent MRS. CARMELA D'ANDRIA from doing a vital war job. She is an inspector in the shop at Chambers Street, where she examines for defects all types of equipment made in the Preproduction Shop at this location.

Her interest in this type work started twenty-five years ago when her husband owned an electrical supply shop. He taught her a great deal about the business, and when women were needed for war work, Mrs. D'Andria went to Brewster Aircraft. There she learned assembling of airplane

BILLIE HAY

parts, and later became a group leader. When she came to the Laboratories she first did wiring in the shop at Chambers Street, next she did repairing, and now she has become an inspector.

Mrs. D'Andria was born in New York, and has always lived here. She has a son who is a bombardier with the United States Air Forces in Africa. Taking care of her home and family claims most of her free time.

* * * * *

BILLIE HAY was the first girl to become a Technical Assistant in the crystal unit development group of the Laboratories. Here she helps to make experimental models of quartz crystal units. As our "cover girl" on the RECORD this month, she is shown heading wires—"like putting a head on a pin," she explains.

Billie got her first taste of laboratory work in the production development department of an electrical products company. Later she worked in the office there. Three years ago she came to the Laboratories where she was trained in the work she is now doing.

A West Virginian by birth, she has lived in Pennsylvania, New Jersey, and now New York. She now lives with her mother and her sister in their Manhattan apartment near Central Park.

The Wounded Man's First Telephone Call Home

Sometimes even harder for our wounded veterans than meeting the Japs on the beaches of Pacific islands or the Nazis in the mountains of Italy is the task of facing loved ones at home. In her article *The Wounded Man's First Call Home*, Joan Younger, a United Press Correspondent, cites several incidents which emphasize this fact. There is no way to prepare the families but for the boy himself to give them the details of his injuries. The War Department in its message merely states that he has been wounded.

The boys are a great deal more worried about the effects of their injuries on their mothers or wives than on themselves. As soon as they arrive here, almost without exception, those who can, call their mothers first. They don't talk about their wounds—they console their mothers.

When they are critically wounded—with an arm or leg gone, or both—they try to break off their engagements, although the nurses try to induce them to wait and talk it over with their girls.

Doll and Toy Committee

Again this Christmas, for the fifth year, the Doll and Toy Committee is working to provide dolls and toys for sick and underprivileged children. Fifty-four charitable institutions in the metropolitan area are to receive contributions. Under the chairmanship of Annette Richter, the representatives have collected money to buy the gifts and have distributed dolls to those who wish to dress them. Mrs. M. G. Wright is chairman of the committee at Murray Hill which is working separately to provide for nearby New Jersey institutions. This year there were only six dozen of the usual thirty dozen dolls available, so the committee has found a pattern for a rag doll which can be easily made by those who wish to dress the dolls. Members of the Laboratories who are dressing or making dolls should turn them in not later than November 27.

Doll and Toy Committee at Murray Hill

Marie G. Wright ..... *Chairman*
Dorothy Storm ..... *Secretary*
Agnes Connors ..... *Acting Secretary*

Ruth Bowerman	Joan Grenier
Betty Buser	Betty Hyde
Jenny D'Ambrosio	Mary Elizabeth King
Mary Duffy	Jane Melroy
Rose Ellis	Phyllis Nimmo
Ruth Finn	Jane Otto
Frances Galbavy	Carmel Rillo
Mary Gargiulo	Gladys Sanderson

Dorothy Thom

Engagements and Marriages

Since the RECORD began announcing engagements and marriages of members of the Laboratories in August, 1943, there have been a total of 97 engagements listed and 107 marriages.

Engagements announced this month were Samuel Gassy, U. S. Army, to Muriel Wagge and Warren D. Kitchell to Marilyn Trevorrow; marriages were Ensign Donald W. Mack, U. S. Navy, to Doris Lutz and C. L. Thrall to Edith W. Hayford.

The Specification Writer as Seen by His Typist

Oh! for the life of an Engineer
He orders a change as he'd order a beer.

He specified paint—a certain rare hue.
He can't get the stuff—so we have issue two.

He drills a few holes where none 'er should be
Then cancels them all with a "hot" issue three.

A note from the shop brings a practical tip
That a quick issue four might cover a "slip."

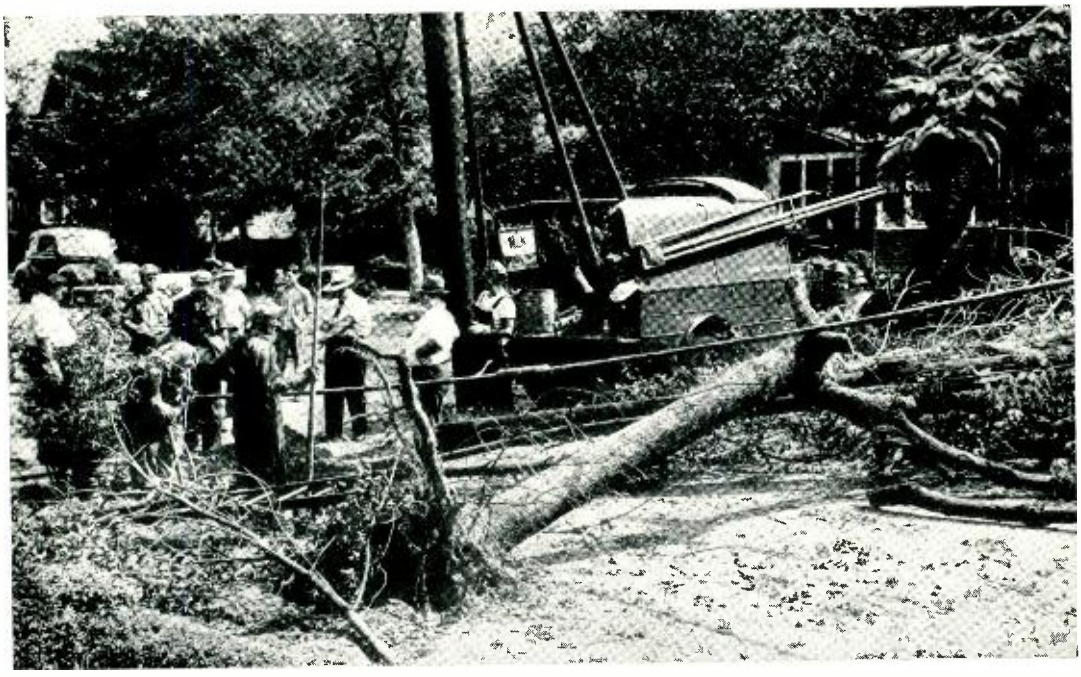
Then the sad engineer finds the parts just don't jive
So he covers his "bones" with an issue called five.

We think he's all finished but we're still in a fix
Cause his boss sends a memo which wants issue six.

The issues reach ten and then twenty-five
Now he's changing the changes, Oh gosh! sakes alive!

Representatives on the New York Doll and Toy Committee

Annette Richter ..... *Chairman*		Anna O'Connor 3400	
Mary Reddington ..... *Treasurer*		Constance D. Roke, Irene Longley	6000
Winifred Meszaros ..... *Display*		Petrina Ribis	7000
Charlotte Bortzfield 110		Molly Radtke	14th Street
Nellie Schofield 1000		Elizabeth Doyle	Graybar-Varick
Margaret Schiehser 2500		Ada I. Van Riper	Davis Bldg.
Grace Haas, Bernice J. Potwin, Henrietta M. Purkrabek	2600	Alice King	Chambers Street
Emily Seifert, Catherine Mills	2100, 2200, 2300, 2400		
Helen C. Mockler	3100, 3300, 3500, 3600		
Mildred M. Ralph	3200		
Helen Finley	3200 Files		
Hilma Edin, Catherine Cronin, Margaret Remmelman	3200 Drafting		



From the Diary of a Telephone Tradition

TELEPHONE people along the Atlantic Coast are still talking about the September hurricane and of the warm, human chapter it added to the diary of the Bell System tradition of service.

During the days immediately following the storm, all thought and effort were directed at getting 414,000 telephones back in service as soon as possible. After that tremendous job was finished, there was time to examine the personal side of those exciting days and nights when the emergency required "that extra something" from the men and women to whom the word *service* means much more than seven letters.

In each of the affected operating territories, each district and town, there were memorable incidents of individual performance, initiative, unselfishness, teamwork. The stories of some of them are put down here:

* * *

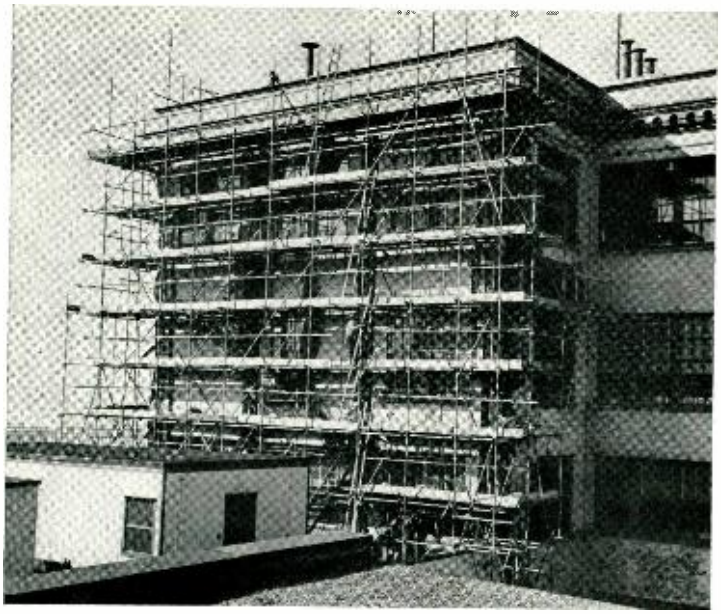
An operator, on military leave from the Southern New England Company and now a Spar stationed at Chatham, Mass., went immediately to her superior officer when the hurricane neared Cape Cod. It was her night off duty and she asked if she might help out the New England Telephone Company. She could and she did, by taking a switchboard position in the Chatham office where she worked until late in the night.

* * *

The proprietor of a summer hotel on Long Island was willing to open the place to accommodate some of the imported telephone crews, but the basement held four feet of water. The place was damp, cold, and there was no hot water. The newly arrived telephone men got busy with three pumps. Soon the water was out and the coal furnace was heating the water tank, so 150 men moved in. The hotel switchboard was connected up and a New York Company operator came in to run it. She worked until midnight, went to bed and slept until 4 A.M., then returned to the switchboard and got everyone up. This done, she donned an apron and helped serve breakfast to the 150.

* * *

Three telephone women, an operator from New York City and two chief operators from Pittsburgh and Norristown, Penna., were spending their vacations in Atlantic City.



This photograph shows major repairs being made on Section A—required by the corrosion of steel which was caused by leakage of moisture through the brickwork over a period of forty-five years. Pointing up the masonry and other methods used in the past had retarded but not prevented this corrosion

Before the hurricane struck, they walked into the office there. "We knew you would need us, so here we are," they explained, and their offer was gratefully accepted.

* * *

A business office representative, about to be inducted into the Waves, had left her job 10 days before to say good-bye to friends and relatives and attend to other personal affairs. Came the storm and she went back to the telephone office, spending the last three days of her civilian life on the telephone job, because she knew she was needed.

* * *

An information operator, arriving at the central office soaked to the skin, apologized for being late. As she kicked off wet shoes and donned a dry cafeteria uniform she explained why: "I had to walk and it was dark; the water in the streets is pretty deep; it took me an hour and a half to get here. The rugs were floating in the living room when I left. I don't know what I'll find when I get home." And she didn't find out until next day. She and 50 other weary girls from that office stayed in quarters at a nearby hotel which had been reserved for them.

* * *

Fifty-six plant men of the Chesapeake and Potomac Company left Washington at 3:30 P.M., Saturday, bound for New York to help restore service in the hard-hit Long Island area. There were 33 automobiles in their caravan. Minor troubles included eight flat tires before they had covered 70 miles. Efforts of New York Company people to persuade them to stop for rest fell on deaf ears. They kept moving and arrived in Manhattan at 5 A.M. Sunday. Most of them were on the job that afternoon.

* * *

One hundred thirty operators were working at top speed in the Atlantic City central office. Suddenly, one of them began to sob. By a strange coincidence, it was she who had been given a flash: "The Brigantine Bridge has been washed away." Her father was the bridge tender. The bridge house was in the middle of the bridge and undoubtedly her mother was there with him, as she so often was, their home being nearby. Taken from the switchboard, the operator was made comfortable while information was sought from the Coast Guard about the fate of her parents. In a very short time both parents were reported safe and the operator insisted on going back to the switchboard.

* * *

An evening chief operator had timed her vacation to be with her soldier-son during his week's leave. She hadn't seen him in nine months. While the storm lashed the Jersey Coast, she telephoned the office, not once but several times: "Hadn't I better come in?

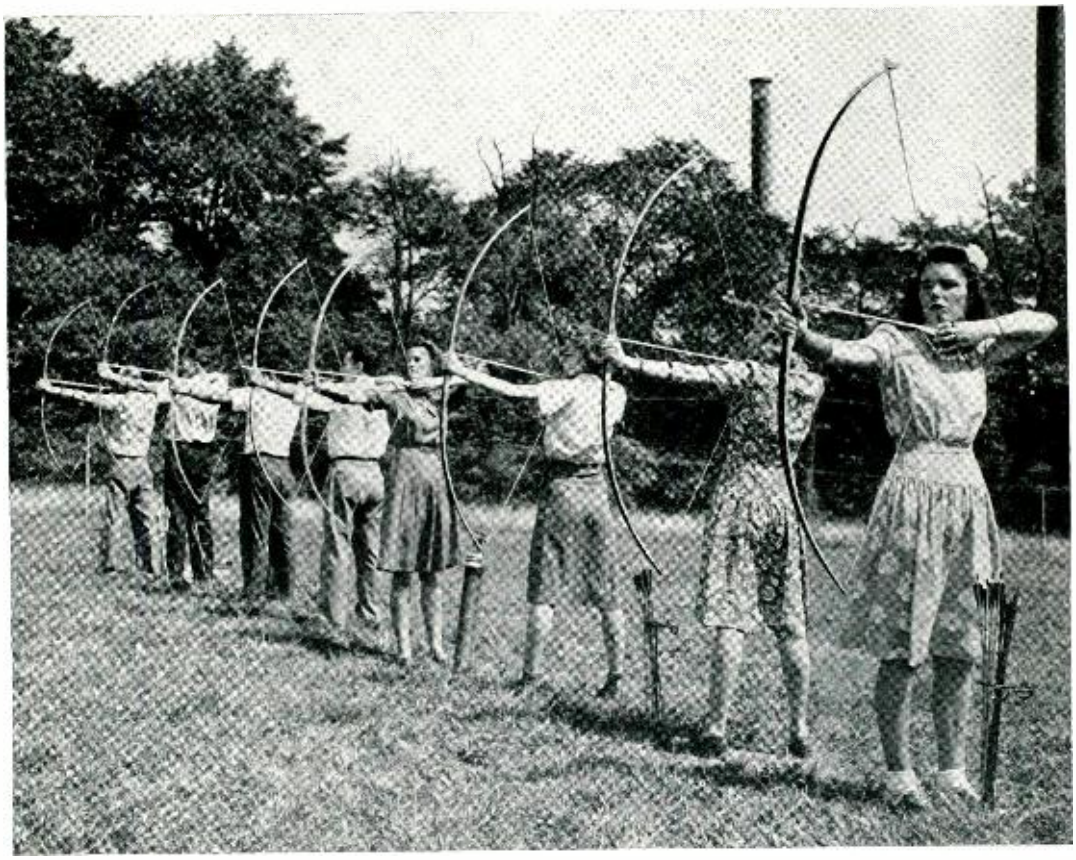
I know you need me." Urged by her associates to be with her son as much as possible and assured that they would make out, she kept insisting and finally reported for duty with the explanation that her son "had a few things to look after."

* * *

On Sunday, following the Thursday night storm, telephone repair crews were moving in on Wareham, Mass., a small community serving a sizable shore resort area. Most of the telephones served by the Wareham exchange were still out of service. The young lady in charge of the business office, a senior commercial representative, went to all of the ministers of the town and asked them to announce from their pulpits that the telephone business office would remain open that day to permit townsfolk and summer residents to make long distance calls to reassure distant families and friends. Toll trunks connecting the Wareham office with the outside world were still in service. That her initiative was appreciated by the community is demonstrated by the fact that booths in the business office stayed busy until 7 o'clock Sunday night. More than a hundred people came in to call.

* * *

In numerous places along the coast, many of the men and women usually found in telephone business offices or behind desks popped up in strange places during and after the storm. Accounting and commercial girls with switchboard experience donned headsets again. Some commercial men served as helpers to repairmen and others teamed up with engineers patrolling lines to report damage. A number of accounting men shared the patrol duties while others moved into special accounting tasks in the field. All pitched in to help with the big storm job.



One of the recreational activities at Whippany

Electron Diffraction Patterns of Copper-Gold Alloy

By F. E. HAWORTH
Physical Research

BY HEATING metallic alloys under controlled conditions their properties can often be improved. One of the many structural changes which may be made is a rearrangement of the atoms in which those of a given kind choose special positions in the crystal lattice of the alloy instead of being arranged at random. This special arrangement is often called an ordered lattice. Heat treatments, which cause this change, have been used extensively in recent years for magnetic alloys, but they are also applicable to others as, for example, those from which electrical contacts are made. Studies of this change in structure, which have been made by several methods, are extended to smaller crystal regions in the present investigation by the use of electron diffraction patterns.

An alloy of copper and gold, of composition Cu_3Au, was chosen for examination because it had been studied by other methods and because changes in arrangement of the copper and gold atoms in it can be detected easily by their widely different scattering power for electrons. Films of this alloy about 4×10^{-5} mm thick were prepared by vaporizing the metal onto sheets of lucite and subsequently dissolving the plastic with ethylene dichloride. The films that remained were supported across narrow molybdenum slits. These films were at first heat treated in high vacuum in a glass or copper tube which was attached to a diffusion pump. After exhausting the tube, an electrically heated furnace was placed around it. When rapid cooling was required

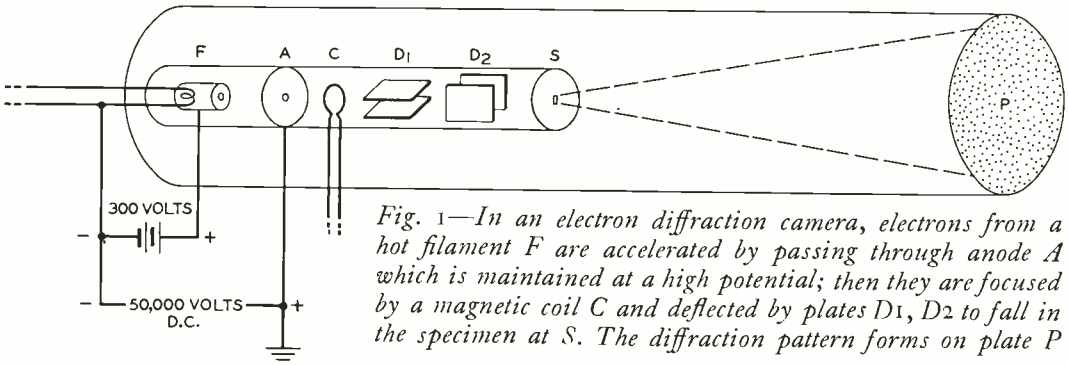


Fig. 1—In an electron diffraction camera, electrons from a hot filament F are accelerated by passing through anode A which is maintained at a high potential; then they are focused by a magnetic coil C and deflected by plates D1, D2 to fall in the specimen at S. The diffraction pattern forms on plate P

Fig. 2 (left)—Diffraction pattern from an unordered film of Cu_3Au alloy before heat treatment
Fig. 3 (right)—Diffraction pattern of a Cu_3Au alloy film which had been heated in vacuum to 450 degrees C. and quenched. The diffuse ring next to the central spot indicates that the atoms of the alloy were partly aligned in ordered arrangement

the copper tube was used and it was cooled with a stream of water immediately after withdrawal from the furnace. To increase the rate of cooling, the slit was pressed against a copper block which was in close contact with the inner wall of the tube.

After heat treatment, the films, while still mounted on the slits, were put into a diffraction camera, Figure 1, where a fine stream of electrons was shot through them onto photographic plates. Some of the electrons are diffracted by the specimen and these form, on the photographic plate, a pattern of rings characteristic of the crystal structure of the specimen. The effect of heat treatment on the crystal structure of the alloy can be seen by comparing Figures 2 and 3. The former was obtained from a film

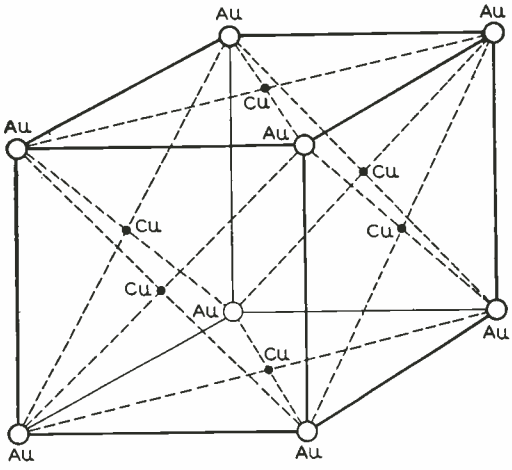


Fig. 4—Face-centered cubic structure, showing the position of the gold and copper atoms in the alloy crystals when ordered. The gold atoms are at the corners of the cube and those of copper in the center of the faces

which had not been heated; it is made up of broad bands with sharp inner and outer edges that correspond, respectively, to the unit cells of gold and copper. These broad bands show that the alloy consisted of randomly oriented crystals of gold and copper and of alloys of intermediate composition. The pattern of Figure 3 was made from a film that had been heated to 450 degrees C. and quenched at this temperature. Present are all of the sharp rings that correspond to a face-centered cubic structure, Figure 4, of composition Cu_3Au, but with

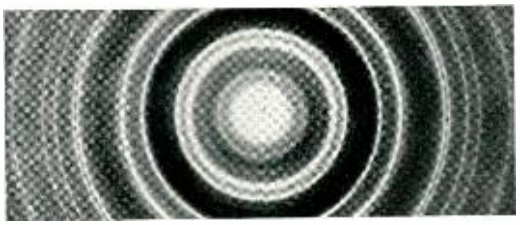


Fig. 5—Diffraction pattern of a Cu_3Au alloy film after it had been heated for sixteen hours at 194 degrees C. The two diffuse rings next to the central spot indicate that annealing had caused partial ordering of the atoms

gold and copper atoms arranged at random on the corners of the cubes and at the centers of the faces. There is also a diffuse ring next to the central spot made by reflections from Cu_3Au crystals which had been partly changed to an ordered arrangement at 450 degrees C. or in the very short time afterward while the alloy was cooling from this temperature. The ordered arrangement in this alloy had gold atoms at the corners of the cubes and copper atoms at the centers of the faces, as in Figure 4. That the quenching rate was sufficient to maintain the state which existed before quenching was indicated by patterns from films quenched at different rates from temperatures between 425 degrees and 450 degrees C., all of which showed the diffuse ring. This was confirmed also by patterns made at high temperatures, as described below.

To study the effect of annealing, a film was heated for sixteen hours at 135 degrees C. and then for the same time at 194 degrees. After the first test the pattern appeared as before but, after heating at 194 degrees, there were two diffuse inner rings, shown in Figure 5. They indicate that the higher temperature had ordered some of the alloy atoms.

A higher degree of order, as evidenced by narrow inner rings, Figure 6, was produced by heating a similar film for sixteen hours at 270 degrees C. The temperature at which ordering began was determined by heating, for sixteen hours at temperatures from 127 to 169 degrees, newly prepared films that had not been previously ordered. The appearance of diffuse inner rings, indicating ordering, was first observable after heating the film at 169 degrees, but they were weaker

Fig. 6—Atoms of Cu_3Au alloy become completely ordered when heated for sixteen hours at 270 degrees C. This is shown by the two sharp rings next to the central spot

than the rings that are shown in Figure 5.

To avoid uncertainties introduced by quenching, an electrically heated furnace was constructed which was small enough to be operated within the diffraction camera, thus permitting patterns to be photographed at high temperatures. The furnace was a copper cylinder, two centimeters in diameter, Figure 7, that had been bored out to receive the molybdenum slits on which were mounted the films under test. Copper discs with holes to let the electron beams pass covered the ends of the furnace. The heating element was nichrome wire wound on mica over the outside of the copper cylinder. An aluminum shield with holes in its ends surrounded the furnace to decrease the heat lost by radiation. The temperatures of the films were measured with an iron-constantan thermocouple.

Representative diffraction patterns made from films at temperatures between 215 and 490 degrees C. are shown in Figure 9. Pattern A was obtained by heating a film to 490 degrees and then cooling it in 55 minutes to 215 degrees. The four marked rings indicate that the crystals in the film were ordered, but not as perfectly as that shown in Figure 6, since the rings in Figure 9A are not quite so sharp. Another film which had been ordered like that of Figure 9A was heated to 490 degrees, and patterns, of which three are shown in Figures 9B, C and D, were photographed at several temperatures on the way up. Pattern B is similar to pattern A, which indicates that

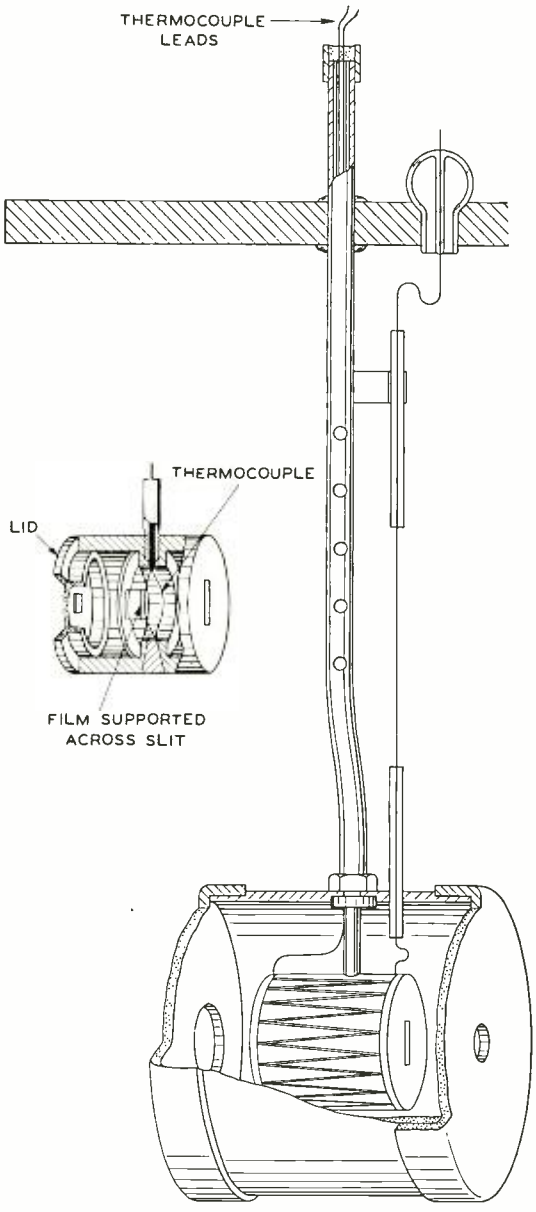


Fig. 7—Electric furnace in which alloy films were heat treated inside the diffraction camera. A heating element of nichrome wire was wound on a copper cylinder within which the film was supported on its molybdenum slit. Temperatures were measured with an iron-constantan thermocouple

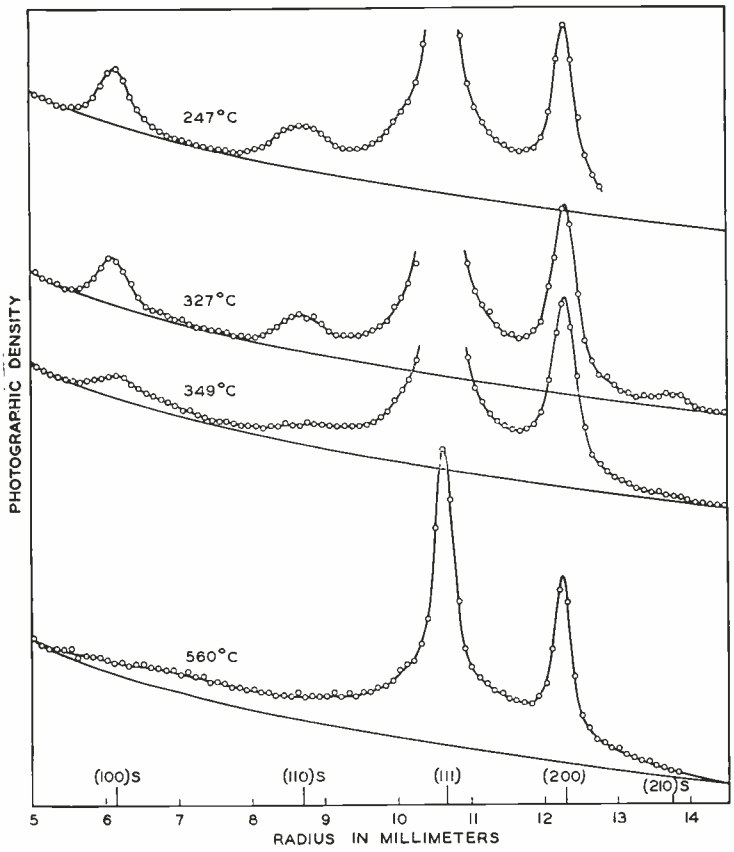


Fig. 8—Microphotometer curves show the gradual change from sharp rings to diffuse bands when an ordered film is heated. Up to 327 degrees C. there is no marked difference in the shape of the peaks but at 349 degrees considerable broadening has occurred

thermal agitation of the atoms at 308 degrees had not been sufficient to destroy appreciably the ordering in the sample. In pattern C, however, which was taken at 363 degrees, the inner rings are broader and less intense, indicating a decrease of order in the specimen. This effect is still more noticeable in pattern D, obtained at 490 degrees; in this pattern the rings indicating order are almost gone. From the examination of several hundred patterns it was concluded that broadening of these rings first appeared between 325 and 350 degrees. On further heating this effect increased, but above 370 degrees the change was slight and very gradual up to 560 degrees, which was the highest temperature at which tests were made.

Patterns obtained from films at the high temperatures, which are above the critical temperature for order, always had a fuzzy band within the 110 ring of Figure 9. Sometimes it appeared to be resolved into the 100 and 110 bands, and other photographs seemed to have bands in the 210 and 211 positions. These have not been previously observed. There is no indication of them in copper-gold alloy of composition CuAu, which can also be ordered at low temperatures. It is thought that these rings are caused by local ordering of small groups of atoms that are not extensive enough to give sharp rings.

The microphotometer curves of Figure 8 show the gradual change from sharp rings to diffuse bands when an ordered film is heated. Up to 327 degrees C. there are no marked differences in the shape of the peaks, but at 349 degrees considerable broadening has occurred. Above 371 degrees the 100 and 110 rings merge and

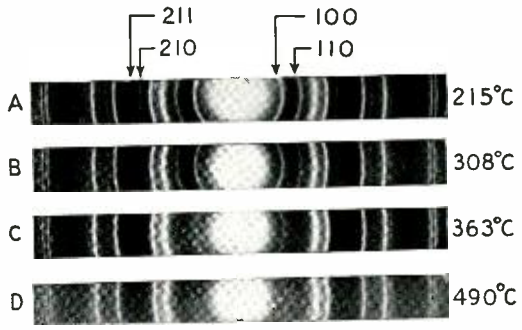
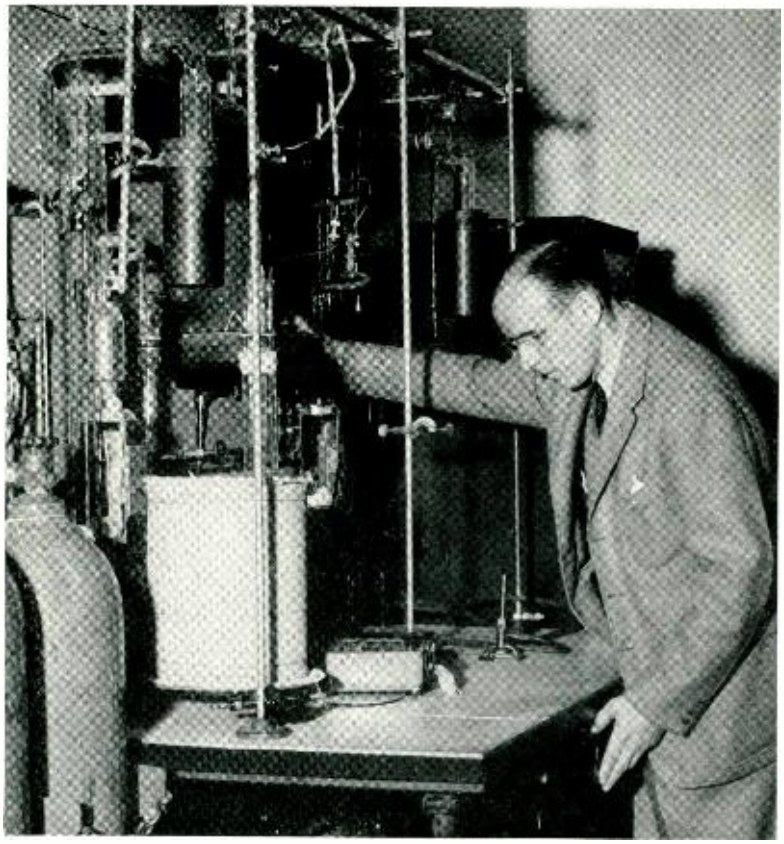


Fig. 9—Diffraction patterns from Cu_3Au films heated to different temperatures in the electric furnace. Patterns A and B have the diffuse bands which indicate that the imperfect ordering had not been appreciably affected by heating to 300 degrees C. In patterns C and D, taken at higher temperatures, broadening of these bands shows that ordering had decreased

at 560 degrees the photographic density becomes nearly uniform where the 100 and 110 rings had been. The size of the ordered regions can be calculated from the width of the rings. They decrease from about 40×10^{-7} to 10×10^{-7} mm when the temperature rises from approximately 300 to 560 degrees. From these curves it appears that there is no large change in order within the Cu_3Au alloy at any critical temperature such as the alleged Curie point.

This investigation shows that atoms of Cu_3Au order when heated above 169 degrees, becoming maximum between 270 and 325 degrees and decreasing at higher temperatures. Ordering is characteristic of other alloys also and affects their performance by changing their physical properties.

THE AUTHOR: After graduating from the University of Oregon in 1924, F. E. HAWORTH spent a year as Graduate Assistant in Physics at Columbia University. He joined the Laboratories in 1925 where he has been engaged since that time in experimental work on magnetic materials and crystal structure by the use of X-rays. More recently he has also done work on electron diffraction problems. In 1929 Mr. Haworth received the A.M. degree from Columbia University. His entire time is now devoted to work on war projects.



Laboratory at Murray Hill for research work on high-frequency electronic devices. C. A. Bieling of the Radio Research Department is shown operating the pumping equipment

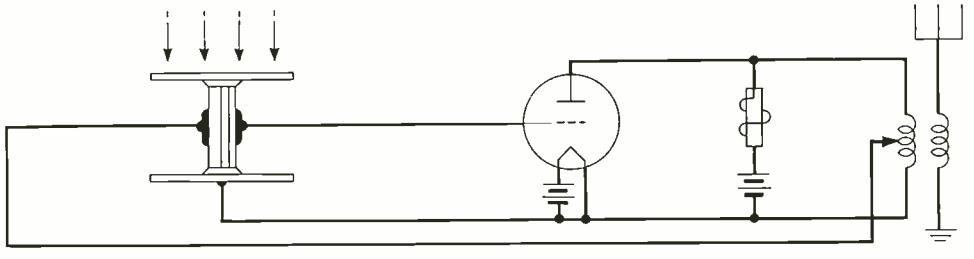
Historic Firsts: Piezo-Electric Oscillator

WHEN pressure is exerted on certain crystalline substances, a difference in electric potential appears across them. This is the piezo-electric effect, the discovery of which has generally been credited to the Curie brothers in 1880. For nearly thirty-five years it remained chiefly an interesting phenomenon. During World War I, however, the French Government requested Professor Langevin to devise methods of submarine detection, and one of his most promising devices employed a piezo-electric crystal which, responding to sound waves in the water, would reproduce them as electric waves. About this same time the Research Laboratory of the Western Electric Company—now Bell Telephone Laboratories—independently began an investigation of the piezo-electric effect. A. M. Nicolson successfully used such crystals as loudspeakers, microphones, and phonograph pick-ups, and suggested other uses. Piezo electricity is characteristic of a large variety of crystals—of 20 of the total of 32 classes, as a matter of fact—and by far the largest effect at room temperatures is obtained from crystals of Rochelle salt. Because of this fact Nicolson carried on most of his studies with this material.

The piezo-electric effect as originally observed was the appearance of a charge when the crystal was compressed, and again when the compression was relaxed, and this is the characteristic that is involved in using the crystals as detectors of audio waves. There is also an inverse effect: when a charge is applied across it a crystal will expand or contract, depending on the polarity of the charge. This inverse piezo-electric effect is employed when the crystal is used as a loudspeaker.

When a charge is applied to a crystal that compresses it by the inverse piezo-electric effect, the charge, and hence the compressive force, is opposed both by the charge resulting from the direct piezo-electric effect, and by the elastic force of the crystal. If the charge is now removed, the elastic force will rapidly reverse the direction of deformation, and the momentum gained in reforming will result in an expansion with accompanying piezo-electric charge. The crystal thus tends to oscillate under the action of these electric and elastic forces, but internal friction gradually dissipates the original energy, and the oscillations die down. If energy were periodically applied to the crystal in step with its natural period of oscillation, however, sustained oscillations could be obtained.

Realizing the significance of these various interactions, Nicolson saw the possibility of using piezo-electric crystals as a source of sustained oscillations. He therefore associated a piezo-electric crystal with a vacuum-tube circuit in such a way that the charges appearing on the crystal as a result of its oscillations would be amplified and returned to it in the proper phase to sustain the oscillation. As a result of this work, he applied for a patent on a piezo-electric oscillator on April 10, 1918. The immediately following years were very active in radio development, and before a patent could be



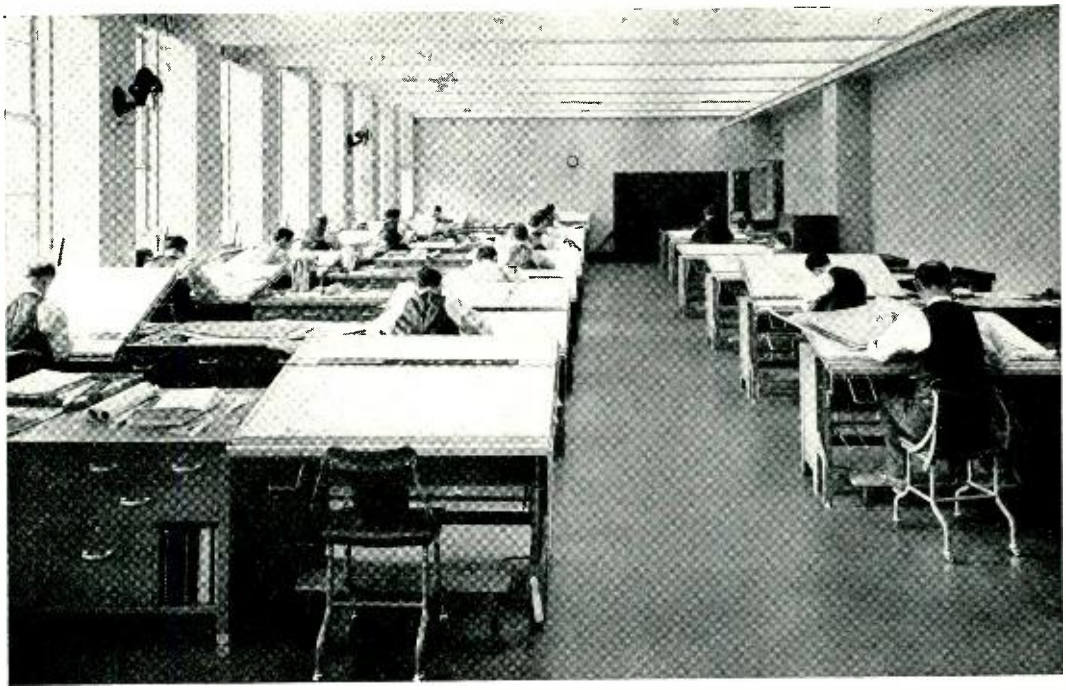
Piezo-electric oscillator circuit shown in Nicolson's patent

granted to Nicolson, many claims had been made by others to inventions allied to his original work. A protracted period was required to investigate all these claims and to establish priorities, and as a result it was not until August 27, 1940, that Patent No. 2212845 was granted to Nicolson for a basic piezo-electric oscillator.

The first piezo-electric oscillators were used chiefly to control the carrier of radio transmitters, but more recently they have been applied to carrier-telephone systems, and also to radio receivers, where, by merely switching in a different crystal for each change in transmitted frequency, the slower tuning process is eliminated. Nicolson used Rochelle salt for most of his experiments but he carried on some studies with quartz; and quartz is the material now almost universally used. Although quartz has a piezo-electric constant less than a hundredth of that of Rochelle salt, its stability, chemical inertness and other desirable characteristics more than compensate for its lower activity.

The Adolph Lomb Medal

for noteworthy accomplishment in the field of optics has been awarded to Dr. Robert Clark Jones for his development of a new calculus for optical systems involving polarizing, double-refracting and optically active elements. Dr. Jones thus makes applicable to the field of polarized light the convenience of matrix algebra now widely known to physicists through its use in quantum mechanics. This accomplishment was completed three years ago while he was a member of the Polaroid Corporation prior to his connection with the Laboratories



Drafting Facilities at Murray Hill

By F. M. COSTELLO
Development Shops

THAT draftsman's equipment can still be improved has been shown by the added convenience and adjustability which has been incorporated in the new drafting room furniture at Murray Hill. Each worker there has a table that can be tilted from horizontal to vertical about the transverse axis of the board. It can also be set at any desired elevation from desk level to a height convenient for the draftsman to work while standing. A hand lever releases the table top to change its slope and a foot lever is pressed to change its height. To reduce to a minimum the physical effort required to make these adjustments, a spring counterbalances the weight of the movable section. These adjustments are easily made from any position at the board. There is also a counterbalanced attachment to hold the straight edge in position regardless of the board's slope. This table is essentially of commercial design but it was modified to meet the needs of apparatus drafting.

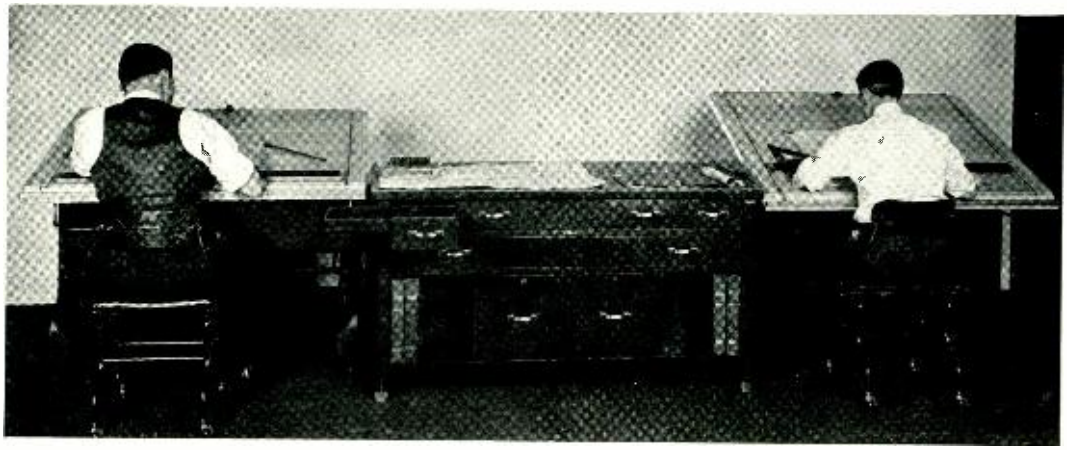
The new tables are usually arranged in pairs, one on each side of a steel reference cabinet, of Laboratories design, intended for the use of two draftsmen. This cabinet is at desk height and its top, on which reference drawings can be placed, has a linoleum cover. The uppermost section has two instrument drawers, each equipped with a sliding tray for ease of access. Between these two drawers there is one for storing drawings of ordinary size. A full-size drawer below provides space for the storage of larger drawings. This drawer and the one above it are used jointly by both draftsmen. The bottom section has two letter-size file drawers between two recesses which are used for reference books and catalogs. Directly behind this bottom section and opening to the rear there is a recess the full width of the table for the use of the draftsmen in the row ahead. These facilities provide the convenience of a table top and storage space. They also promote orderliness in the arrangement of the ma-

terials with which the draftsman works and reduce the time required to lay hands on the tool or the information wanted.

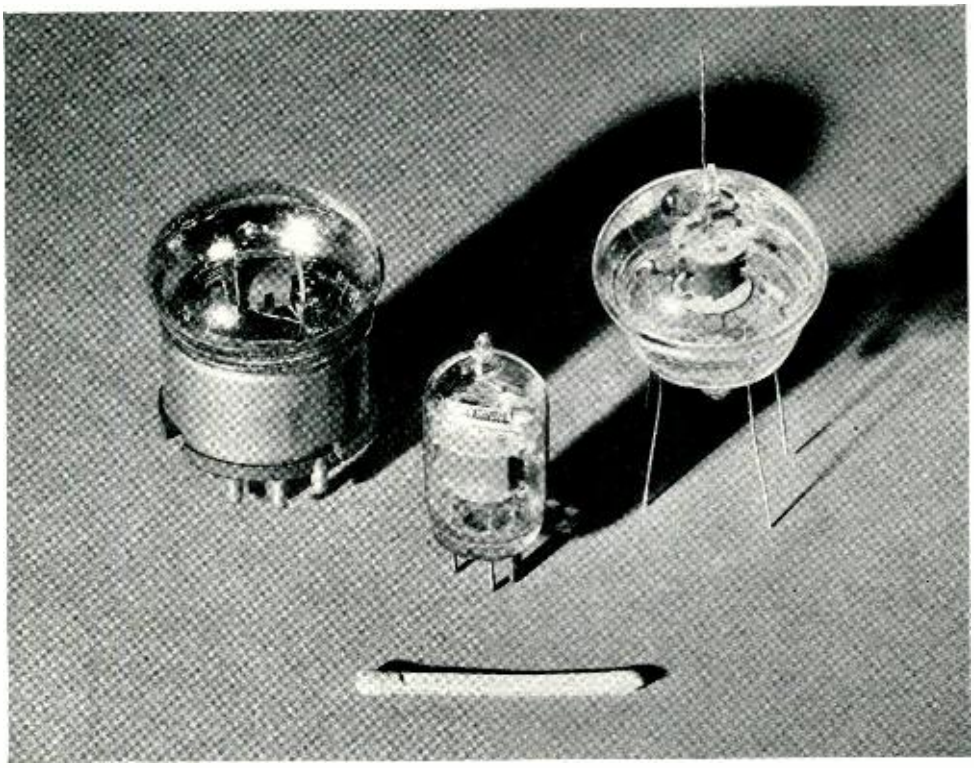
A new drafting chair is shown in accompanying illustrations. Although used at normal desk height, it has a back. When the board is set at a higher level, the draftsman usually prefers to stand. He finds the change from sitting to standing, and vice versa, restful when the board can be adjusted easily for height and slope.

Exceptionally uniform illumination has been provided in the drafting room at Murray Hill. It is lighted indirectly by rows of 300-watt lamps which are spaced three feet apart near the ceiling. Each lamp has three concentric metal reflectors and its bottom is silvered to prevent direct light from reaching the drafting boards. A beamed ceiling, which is decorated with paint of exceptionally high reflectivity, increases the illumination. This averages about forty footcandles at the tables. Adequate lighting compares in importance with good equipment in promoting drafting efficiency. Both have been given up-to-date consideration in furnishing the new drafting room at Murray Hill.

THE AUTHOR: F. M. COSTELLO received his degree of B.S. in Civil Engineering from Cooper Union in 1911. He joined the Apparatus Development Department of the Laboratories in 1917 as a draftsman to work on submarine devices. From 1922 until the present war Mr. Costello was a drafting supervisor. Recently he has been with the Development Shops supervising work in outside shops. Music is one of Mr. Costello's avocations. He conducted the Laboratories Choral Society for two seasons and has sung for many years in church choirs and on sustaining programs of the major radio networks.



Between each two drafting boards there is a storage cabinet for drafting tools, drawings and reference books. The boards, themselves, are adjustable from horizontal to vertical and also for height by easily operated levers. They can be set at any desired elevation from desk level to a height convenient for the draftsmen to work while standing



Midget Tubes for High Frequencies

By G. T. FORD
Electronics Research

WHEN Bell Telephone Laboratories became involved in the defense program, effort which had previously been directed toward improved tubes for new broad-band carrier systems was turned toward the adaptation of such tubes to use in high-frequency circuits for the Armed Services. The requirements are almost identical. The most important are high transconductance, low capacitances, low noise, and high input resistance. Since these are of importance in all broad-band high-frequency applications, whether military or telephone, the development of tubes for war use was a natural consequence of development work done during the last few years on tubes for use in broad-band telephone systems. Two of the high-frequency tubes developed—the 6AK5 and the 6AJ5—are pentode tubes with indirectly heated cathodes, and have the suppressor grid tied internally to the cathode. Both are direct descendants of the 386A tube, which was developed for coaxial cable carrier systems.

One step in adapting the 386A tube to war use resulted in the 717A (left), which is shown in the headpiece with the 386A (right) and the 6AK5 (center). The 717A and the 6AK5 are capable of providing better than twice the signal-to-noise ratio that could be realized with any tubes previously available for use at frequencies of the order of 50 megacycles. Lower power consumption and a smaller physical size, particularly in the case of the 6AK5, are additional advantages. The saving in chassis space in going from the octal base construction of the 717A to the midget glassware of the 6AK5 is illustrated in Figure 1. The smaller socket used for the

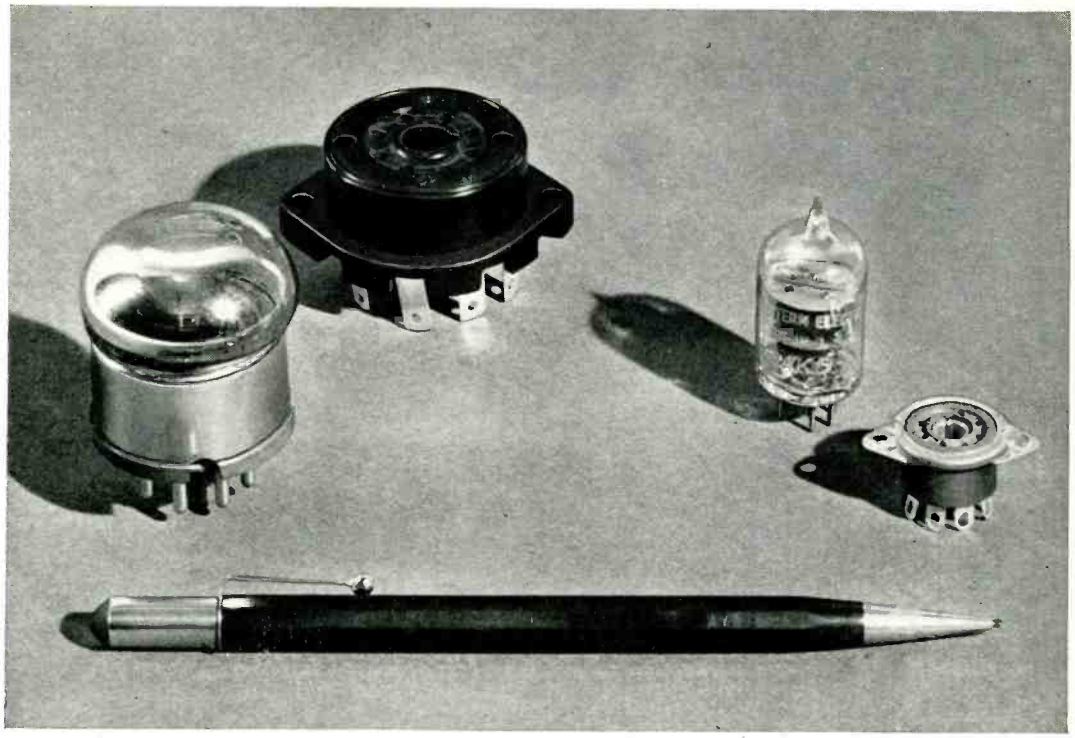


Fig. 1—Much of the saving in space made possible by the 6AK5 *tube, compared to the* 717A *tube, is due to the difference in size of the sockets required for the two tubes. The* 717A *is shown at the left and the* 6AK5 *at the right*

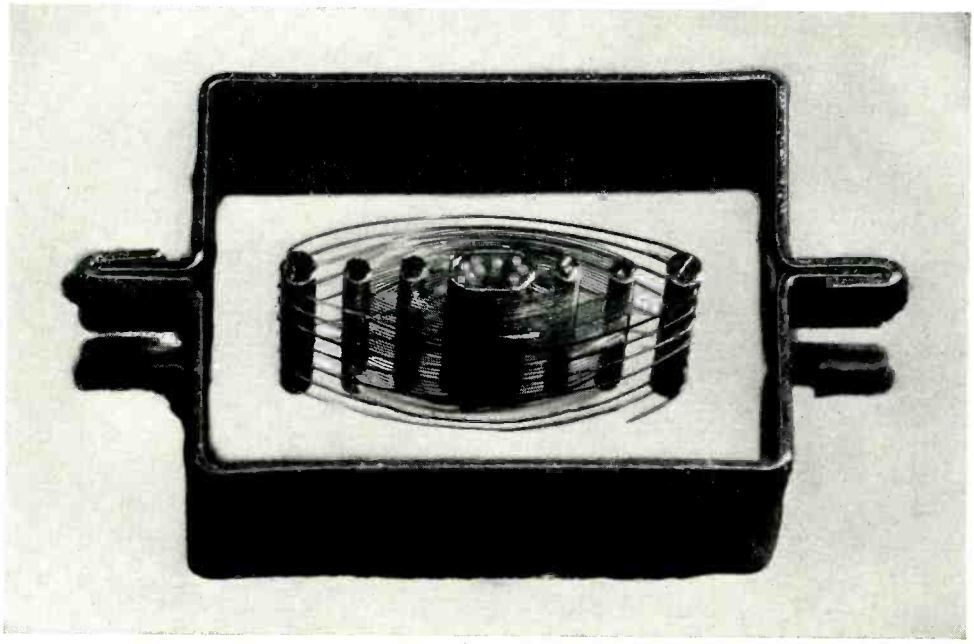


Fig. 2—A cross-section of the 6AK5, *shown about ten times actual size, reveals the small size and close spacing of the elements that have made it possible to secure the desired characteristics*

6AK5 saves considerable mounting space.

High transconductance, low noise, and high input resistance at the higher frequencies are fundamentally dependent upon the spacing between the cathode and the control grid. In the 6AK5 tube the nominal spacing is 0.0035 in. The spacings between the elements are shown in Figure 2, magnified about ten times. The mechanical difficulties associated with assembling the parts and maintaining the necessary tolerances are obviously very great. Low capacitances

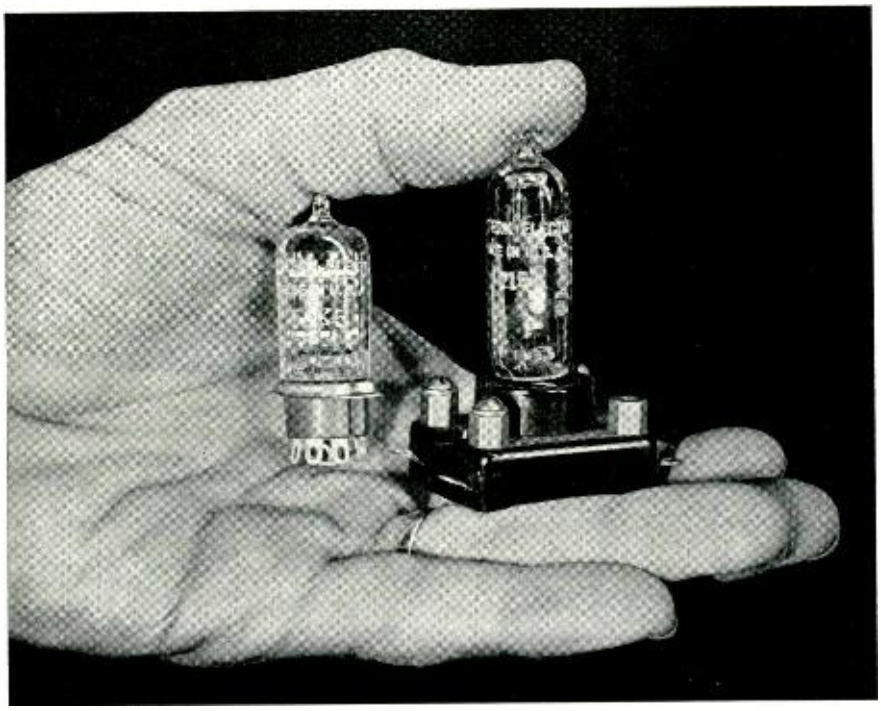


Fig. 3—The 6AK5 *tube (left) is distinctly smaller than the* 215A *peanut tube developed during World War I and has approximately twelve times the transconductance. Their characteristics follow:*

	215A *Vacuum Tube*	6AK5 *Vacuum Tube*
Maximum Diameter	$\frac{11}{16}$ in.	$\frac{3}{4}$ in.
Maximum Overall Height	$2\frac{11}{16}$ in.	$1\frac{3}{4}$ in.
Classification	Triode	Pentode
Type of Cathode	Filament	Indirectly Heated
Filament or Heater Voltage	1.0 volt	6.3 volts
Filament or Heater Current	0.250 amp.	0.175 amp.
Normal Plate Voltage	60 volts	120 volts
Normal Screen Voltage	.....	120 volts
Normal Grid Voltage	−3 volts	−2 volts
Normal Plate Current	2.0 ma	7.5 ma
Normal Screen Current	.....	2.5 ma
Normal Transconductance	420 μ mhos	5000 μ mhos
Input Capacitance	1.6 $\mu\mu$f	4.0 $\mu\mu$f
Output Capacitance	1.2 $\mu\mu$f	2.0 $\mu\mu$f
Plate-grid Capacitance	2.6 $\mu\mu$f	0.01 $\mu\mu$f

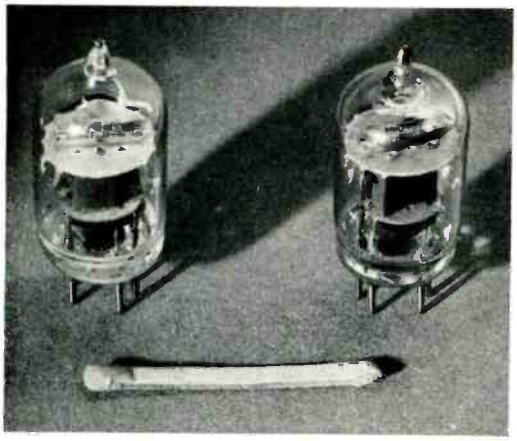


Fig. 4—The 6AJ5 tube (left) is similar in construction to the 6AK5, but is designed particularly for low-power applications in communications equipment for aircraft. The characteristics of the 6AJ5 tube follow:

Heater Voltage	6.3 volts
Heater Current	0.175 ampere
Plate Voltage	28 volts
Screen Voltage	28 volts
Cathode Resistor	200 ohms
Plate Current	3.0 milliamperes
Screen Current	1.2 milliamperes
Transconductance	2,750 micromhos
Input Capacitance	4.1 $\mu\mu f$
Output Capacitance	2.0 $\mu\mu f$
Plate-grid Capacitance	0.01 $\mu\mu f$

are the result of using the smallest possible elements and of eliminating unnecessary metal parts in the tube. Close mounting of the structure on the seven-pin button stem provides very short leads so that the lead inductances are kept at a minimum.

During World War I, development work resulted in the Western Electric 215A tube, widely known as the peanut tube. The size and appearance of this tube as compared with the 6AK5 tube may be seen in Figure 3, and their characteristics are given in the table below the illustration.

The 6AJ5 tube, shown at the left of the 6AK5 in Figure 4, is similar in construction to the 6AK5. It is designed particularly for low-power applications in communications equipment for aircraft where the maximum potential available is 28 volts. Typical operating conditions and characteristics are given in the table below the illustration.

It may be seen from the table (see Figure 4) that while the plate and screen power required for the 6AJ5 is only one-tenth that required for the 6AK5, the transconductance has been reduced only from 5,000 micromhos to 2,750 micromhos. The total power consumption has been reduced by 47 per cent.

The 6AK5 tube is manufactured by the Western Electric Company and a number of other companies, and is being widely used in air-borne and other mobile equipment where its characteristics provide performance advantages, and where its small size saves space and weight. It is expected that the 6AJ5 tube will find wide application in equipment of similar type, but where in addition the maximum potential available is 28 volts.

C. Depew and W. Gronros have been responsible for the mechanical design of both of these small tubes as well as of the 717A.

THE AUTHOR: G. T. FORD received the B.S. degree from Michigan State College in 1929, and at once joined the Technical Staff of the Laboratories. He first spent two years with the Personnel Department as an instructor in student assistant courses, and then joined the physical Research Department where he worked on gas tubes and thermistors. Transferring to the Electronics Research Department in 1934, he has since been engaged in vacuum tube development. In recent years, his work has been concerned almost exclusively with developments for the Army and Navy. In 1936 he received the M.A. degree from Columbia University.