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Testing for chloride solder-flux with a portable test kit recently designed by the Microchemical Laboratory (*see page 282*)

The Philosophy of Toll-Test Boards

By A. J. PASCARELLA
Toll Maintenance Engineering

ALWAYS a vital element in maintaining high-grade toll service, the toll-test board assumes particular importance under present wartime conditions when an unprecedented load on the toll plant demands the maximum possible use of all existing circuits. Toll testing, and the facilities provided for it, have undergone many changes over the past years, but certain principles and methods, learned early and confirmed by long experience, provide a basic technique that may be discerned in the wide variety of arrangements and uses of equipment that local conditions have shown to be desirable.

In terms of this broad underlying philosophy, two general types of testing are performed at toll-test boards. One of them verifies that trouble is present on the circuit, and determines its general nature and approximate location. The other, which is required only when it has been determined that the fault is on the outside line, locates this fault with precise measuring apparatus. Another function is performed at the toll-test boards, which is a necessary corollary of the presence of trouble. It consists of rearranging the lines and office equipment so that channels are made available to take the place of those put out of service by the trouble. In

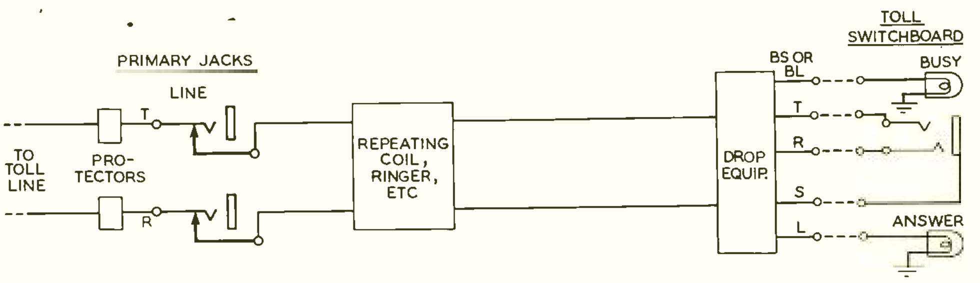

Fig. 1—In their simplest form, primary toll-test jacks merely disconnect the office equipment and give direct access to the line

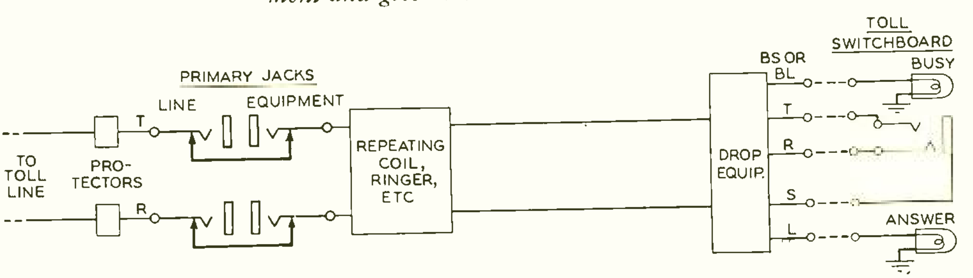

Fig. 2—When lines are to be "patched" as well as tested, double primary jacks are provided: one pair giving access to the line, and the other, to the office equipment

addition temporary regrouping of circuits can be easily taken care of.

As a result of there being two types of tests, there are functionally two types of test boards, or testing positions. These are called the primary and secondary toll-test boards. Rearrangement of circuits may be done at either or both of the boards. In the smaller offices, combined primary and secondary boards are used. At repeater stations, the secondary testing functions can be performed at the jack panels in the repeater bays, and so only primary boards need be provided. The size of the office, its location, and the type of toll lines largely determine the choice of testing facilities used.

The presence of trouble on toll lines may be discovered during routine tests, or by an operator, or it may be reported by a subscriber. A calling subscriber, for example, having had a toll connection completed, may find difficulty in hearing, and will "flash" the operator and report the condition to her. The operator may listen on the circuit to make sure the trouble is on the line, and if it is, she reports the condition to the attendant at the test board.

The test board attendant calls the test board at the distant office and tests the line reported in trouble, using apparatus available at his position. If the line proves satisfactory, which it sometimes does, he marks his trouble card "OK on test," and places the channel back in service. If, on the other hand, there is a high loss in the circuit, he will have the circuit sectionalized, and local transmission tests made from various points to locate the section of high loss. As a result of these, he may have the repeaters tested in one or more intermediate offices, and adjustments made as needed. Should the fault be determined to be on the outside line, he will test from the primary jacks where there is direct access to the lines themselves. Here voltmeter measurements will be made to determine whether the fault is a ground, an open, or a short circuit; and Wheatstone bridge measurements to locate it in distance from the near-

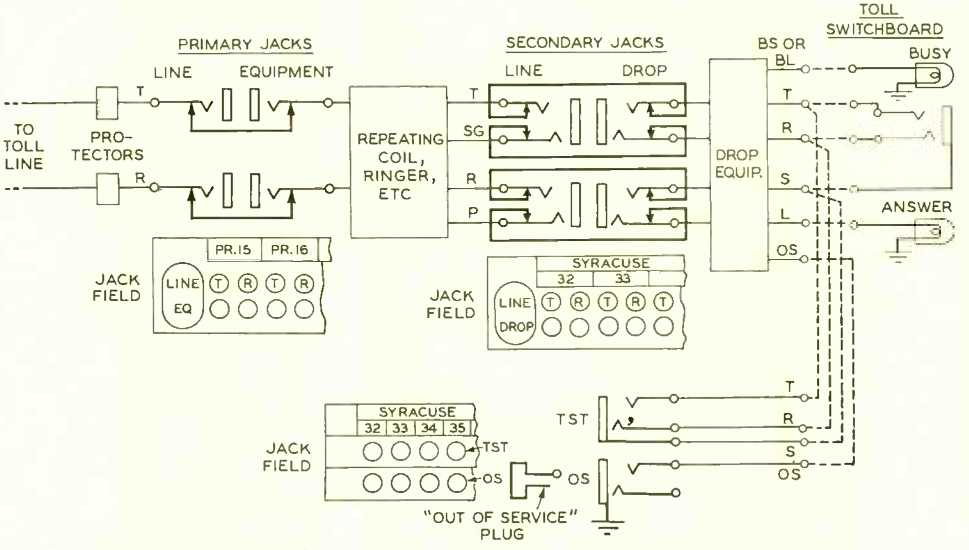

Fig. 3—At larger offices, both primary and secondary jacks are provided

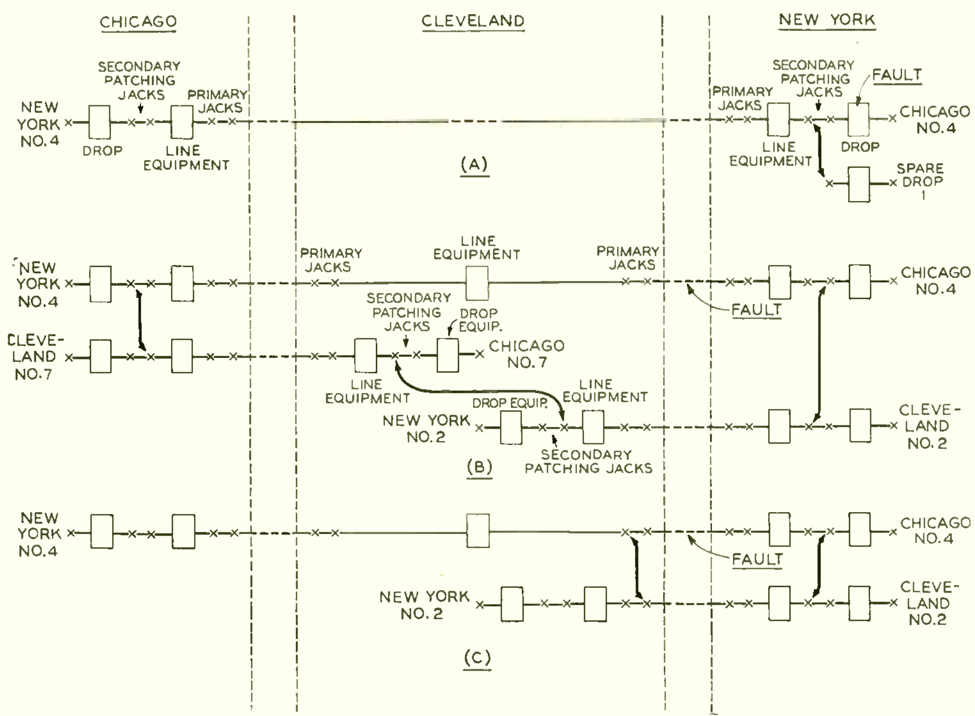

Fig. 4—Typical patches that may be made at the secondary jacks

est office so that a lineman can be dispatched to repair the trouble.

Separate secondary toll-test boards are usually located only at the larger offices. At all offices regardless of size, however, there will be primary toll-test jacks so that the section of line between that office and the next adjacent may be tested.

The simplest arrangement of primary jacks is shown in Figure 1. The line runs to these jacks immediately after leaving the protectors, and there is a pair of jacks for each line entering the office. It will be noticed that each conductor of the line is brought to a separate jack, instead of the two conductors being brought to a single jack as is done at the toll switchboard. This is the general practice in primary toll-test boards in the Bell System, and facilitates many types of tests where a connection is wanted to only one conductor of the circuit. The jacks are arranged so that when the test plug is inserted, the line is opened at that point, and connected only to the test equipment.

Figure 1 represents the arrangement for a terminal circuit, and thus shows a toll switchboard at the right. Had it been a "through" circuit, there would have been another pair of jacks at the right instead of the toll switchboard. Jacks of this type are frequently mounted at the central-office distributing frames or on relay racks with the office equipment, and if testing is needed, portable testing equipment will be used.

Another arrangement of primary test jacks is shown in Figure 2. This provides two pairs of jacks for each line: one pair is like that of Figure 1, and the other gives access to the office equipment. This permits a test to be made toward the office equipment as well as toward the line but, of more importance, it permits substituting one line for another by means of patching cords. If trouble is found on a line that is a link in an important circuit, some other line may be substituted for it by patching at both ends of the section. This permits an equivalent channel to remain in service, while the fault on the original circuit is being found and repaired.

At large toll offices, the arrangement of jacks is as shown in Figure 3. Here the primary jacks are the same as in Figure 2, but, in addition, secondary jacks are provided. In general the secondary patching jacks resemble the primary jacks, except that two additional leads are brought through them: a signaling lead through the tip jack, and a pad-control lead through the ring jack. These secondary positions are also equipped with "test" and "out-of-service" jacks. The former are multiple appearances of the jacks in front of the operator, and permit a line to be seized and made busy without her assistance. If test and out-of-service jacks were not provided, it would be necessary to have the line made busy at the toll switchboard before it was "taken up" for test. These jacks, together with the secondary test cord circuit, are used for making overall tests and provide for simulating all the functions of the operator. The attendants usually ring over the lines and converse with distant attendants to determine the nature of the trouble before making transmission or other more extensive tests. The "OS" jacks are used to make a line out of service while test or repair work is in progress.

One of the most important functions of the secondary patching jacks is to permit rearrangements of the circuits. This is because they are at a point of the circuit where transmission and signaling are the same for all terminal circuits. A few of the types of patches that may be made are indicated in Figure 4. At A, a spare drop is substituted for a faulty one assigned to Chicago No. 4 circuit. C shows a New York-Cleveland circuit being employed temporarily to replace a faulty link in a New York-Chicago circuit. These examples indicate a few of the great variety of patches that may be made. Under stress of circumstances traffic may be diverted over very roundabout paths: a direct New York to Miami channel, for example, may be replaced by one running by

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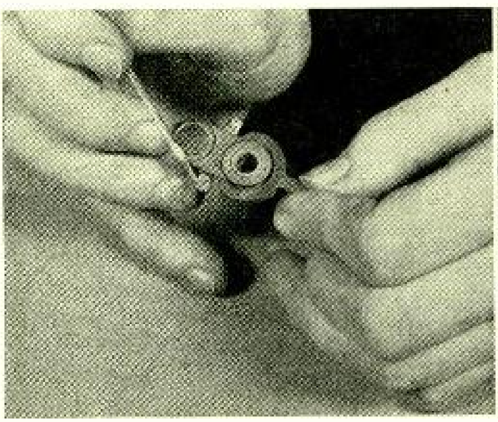
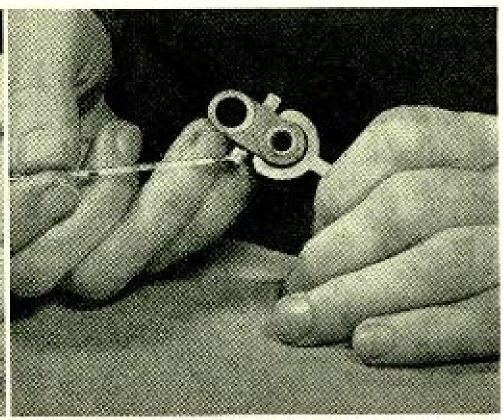
After graduating from Columbia University in 1916 with the degree of E.E., A. J. Pascarella entered the General Electric Company at Schenectady. Then, for two years during World War I, he was in charge of the electrical laboratory of the U. S. Navy Gas Engine School at Columbia. In 1921 he joined the Laboratories where he has since been concerned with the development of toll testboards, toll signaling, telegraph, carrier, and miscellaneous testing equipment. Recently, his work has consisted of formulating maintenance requirements for the overall testing of toll lines and the detecting and location of faults on toll cables. Also, he has contributed much to the design of the new toll-test boards including those for the No. 4 toll crossbar system. He is now concerned with war projects.

way of St. Louis. This procedure does not affect the operator's work, since she continues to make connections to the same jacks as before the patch was made.

Testing other than ringing and talking is done principally with voltmeters, Wheatstone bridges and transmission measuring equipment. At the primary test boards of all important toll centers voltmeters and bridges are available. They are connected to the lines by cords and plugs, and the various tests are carried out by keys at the test positions.* At the secondary boards† transmission measuring equipment is usually terminated on jacks as a matter of convenience. As already noted, however, the testing equipment is available in a number of forms, and at some of the smaller offices portable equipment may be used. All of these equipments are used to insure continuity of toll service which is so highly important now in the war effort.

*Record, *Dec.*, 1928, *p.* 168; *Feb.*, 1933, *p.* 163.
†Record, *July*, 1934, *p.* 337; *Aug.*, 1934, *p.* 367.



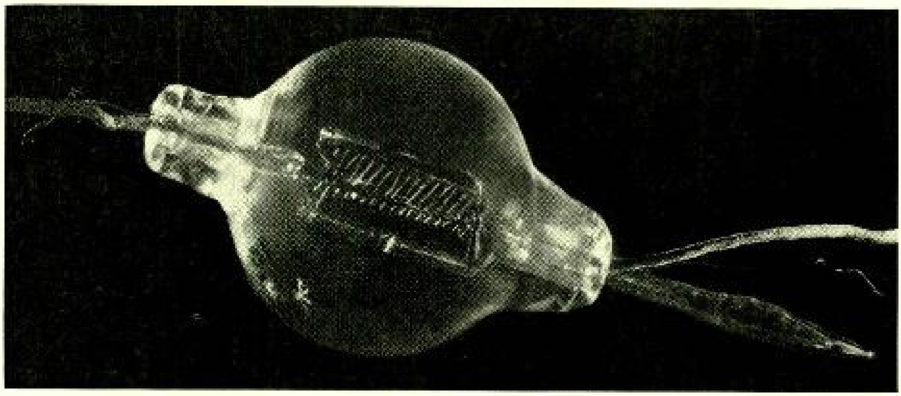


In making soldered joints a flux is commonly employed to clean the surface and thus secure better adhesion. Some fluxes contain chlorides that, while harmless for some applications, may prove a source of trouble when used on fine wires which may be exposed to moisture. It is important, therefore, to insure that no chloride flux is used on apparatus supplied to our armed forces. Although no such flux is used by the Western Electric Company, some of the apparatus incorporated in their equipment is obtained from outside suppliers. To find out whether chloride flux is present, the test set shown on page 277 was designed in the Microchemical Laboratory. With it, as little as one millionth of a gram may be detected.

A hundredth of a cubic centimeter of chloride-free distilled water is transferred, as shown at the left above, to the soldered joint to be tested. After one minute, the liquid is recovered by the pipette, as shown at the right, and the extract is allowed to flow into filter paper that has been impregnated with silver chromate. This reagent paper has a maroon color but in the presence of chloride ions is bleached white due to the formation of the more insoluble, white silver chloride. The quantity of chloride may be estimated from the amount of bleaching.

Historic Firsts

The High-Vacuum Electronic Tube



Arnold's high-vacuum tube used as a telephone repeater at Philadelphia on a New York-Washington cable circuit in October, 1913. *Other, later, models were used on the transcontinental circuit as opened for commercial service in* 1915

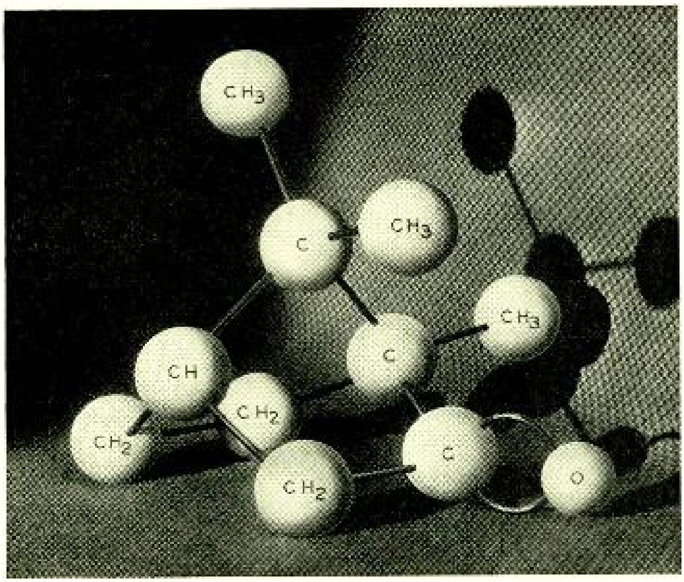
In millions of vacuum tubes today electrons are precisely controlled to perform crucial operations of electrical communication. As amplifiers and oscillators, as modulators and detectors these tubes play a necessary part in wire and radio communication, telephony and telegraphy, picture transmission and television, phonograph recording and sound pictures, and vitally important military services.

The first high-vacuum tube was the research development of Harold D. Arnold in Bell Telephone Laboratories, then, 1912, the Engineering Department of Western Electric Co.

On its engineering side this electron tube of Arnold's derived from the audion—an invention of Lee DeForest in 1906 which has proved to be one of the most important if not the most important invention of the first quarter of this century.

On its scientific side it derived from the researches of university scientists, like Thomson and Millikan who proved the existence of electrons, Richardson who studied thermionic emission and those who investigated conduction through gases.

Although the audion had many uses and was particularly competent as a radio detector it was not, in its original form, suitable for use as a power amplifier. Its electronic possibilities were first recognized by Arnold, who appreciated the necessity of a high vacuum if the tube's operation was to be due to the controlled motions of electrons freed from its heated filament. He developed methods for obtaining such high vacua, calculated and predicted the behavior of the freed electrons, and developed on that basis vacuum tubes suitable for amplifiers of telephone and radio frequency currents.



Influence of Physics on Chemistry

By K. K. DARROW
Physical Research

ONE of the most futile and at the same time most instructive of enterprises is that of making a reasonable distinction between chemistry and physics. The progress of the years makes it steadily clearer that no distinction at all should ever have been made; but since "chemists" form one large class of scientists and "physicists" another, since all institutions of higher learning have separate departments of "chemistry" and "physics," since students are trained with textbooks implying by their names that they deal with one of the subjects and not with the other, the distinction does exist and cannot be ignored. Its fluctuations with the lapse of time, and the steady growth of intermediate subjects bearing such ambiguous names as "chemical physics" and "physical chemistry," form a queer and rather deplorable part of recent scientific history. I call this a deplorable part, because it is all too evident that the boundary between chemistry and physics has been as variable, artificial and harmful as the worst of the old-fashioned boundaries of Europe, cutting across the natural lines of intercourse and trade and debarring many a specialist on either side from knowledge of many subjects that is most pertinent to his own.

As a college student long ago, I had the fortune of listening to the elementary lectures of no less a chemist than the famous Alexander Smith. It was his deep conviction that most people were prone to form much too definite a notion of the atom and the molecule, and some of his time was spent in advising his pupils not to take these concepts too literally, but rather to regard them as handy though perilous aids for remembering the laws of combining weights and multiple proportions. Now it is allowable to claim that one of the greatest contributions made by physics to chemistry lies precisely in this, that no such admonition need be given any more. It is rare indeed, though not impossible, to visualize the atom and the molecule more definitely than modern physics now allows us. Mass, size, shape, rotation are all of them determined for these tiny particles by the methods of physics.

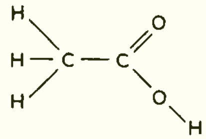
Let us begin with mass. The chemists ascertained the relative weights or masses of atoms and molecules, but their actual weights in grams were established by physicists Sir William and Sir Lawrence Bragg and their successors who by diffraction of X-rays measured with ever-increasing accuracy the spacings of the atoms in crystals, and Millikan, who determined the charge of the electron. It is obvious how the spacings of the atoms led to the desired result, for knowledge of these enables us to tell how many atoms go into any piece of a crystal large enough for its weight and its dimensions to be measured, and the result follows by simple division. As for the electron charge, one divides it into the "Faraday"—the amount of electric charge carried through a solution of (for example) a silver salt during the electrolysis of one gram-molecule thereof—and the quotient is the number of atoms in the gram-molecule, since one electron is carried across for every atom of silver deposited. Faraday, who measured the latter amount and in whose honor it is named, is one of the few great scientists whom chemists and physicists may claim with equal justice as one of their own.

The spacings of crystals, as discovered by diffraction of X-rays and lately by diffraction of electrons, indicate also to us the sizes of atoms and molecules; but as my examples of the encroachment of physics on chemistry I should rather take first the gaseous molecules, and of these the simplest of all, the diatomic—of which hydrogen and nitrogen and oxygen furnish us with examples. Chemists derived the diatomic nature of these gases from their densities and the combining weights of the elements. Statistical physics, that deep

Karl K. Darrow was graduated from the University of Chicago in 1911 with the degree of Bachelor of Science. During 1911 and 1912 he studied at the Universities of Paris and Berlin. Returning to Chicago, he received his degree of Ph.D. there in 1917, having specialized in physics and mathematics. He then came to West Street. Here his work has included the study, correlation, and representation of scientific information for his colleagues to keep them informed of current advances made by workers in fields related to their own activities. As a corollary to this work, Dr. Darrow appears before audiences to lecture on current topics in physics and the related sciences. He is the author of *Introduction of Contemporary Physics*, *The Renaissance of Physics* and *Electrical Phenomena in Gases*.

and difficult theory of which Maxwell and Boltzmann and Gibbs were the founders, showed that the specific heats of these gases admit of this and only this interpretation. The spectra of these gases, which are of the beautiful intricate kind known as band-spectra, yielded numerical values for the moments of inertia of these molecules—that is to say, for the product of atomic mass by the squared distance between the atoms of these miniature dumb-bells. Electron diffraction, having been developed out of the experiments of Davisson and Germer and of Thomson, supplied the values of these interatomic distances directly. Mass being determined in one way and distance in another and the product of mass by distance squared in yet another, the whole edifice of theoretical physics could have toppled if the three had been discordant. But they were not discordant, and the structure is assured.

Hardly ten years ago, anyone drawing his knowledge of molecules from physicists and their writings could scarcely avoid the conclusion that the diatomic molecules are the only ones which really count. But many molecules and in particular all of the "organic" molecules are polyatomic, and if they have only half a dozen atoms to the molecule they are likely to be regarded as simple by the organic chemists, those remarkable people whose memories for the formulae, the structures and the names of their compounds are a source of perennial awe to the physicist. I could easily find a diagram for a molecule which if printed here on a reasonable scale would cover a whole page; but I need not be so extravagant of paper to exhibit one which is simple to the organic chemist, bewildering to the physicist and hopelessly complex for the mathematical theorist:



This seems to be a geometrical model of the molecule, for here stand the symbols of the atoms in definite places on the page. To some extent it *is* a geometrical model, and I shall later be claiming for the physicist some of the credit—though by no means all of the credit—for establishing this fact. This is, however, not the only feature of the "structure-diagram," for the lines are as significant as the atom-symbols. Four of them radiate from every carbon atom (or rather from the symbol thereof); two from every oxygen atom and one from every hydrogen atom. No line ends out in the air; each extends from atom to atom. This is almost the same as saying that each carbon atom is connected to four other atoms, each

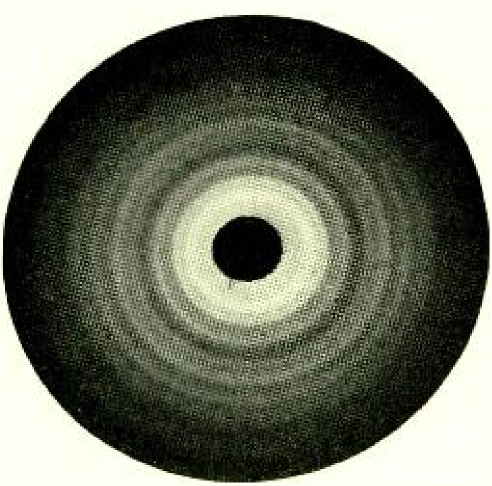


Fig. 1—The X-ray diffraction-pattern of a cellulose plastic, giving information about the structure of the plastic and the spacing of its atoms

oxygen atom to two others and each hydrogen atom to one other. It is not quite the same, for two parallel lines are seen to extend from one and the same carbon atom to one and the same oxygen atom. The lines are said to stand for "bonds"; and this particular molecule exhibits examples of C-H bonds, of O-H bonds, of C-C bonds and of two kinds of C-O bonds of which the one is drawn somewhat differently from the other.

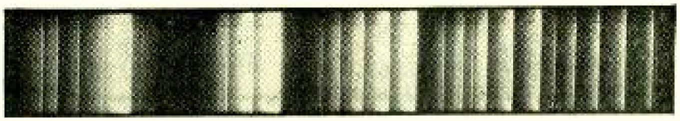


Fig. 2—Part of the band-spectrum of nitrogen. From this spectrum the moment of inertia of the nitrogen molecule has been accurately determined and the obedience of this molecule to the laws of wave-mechanics attested

What is signified by this webwork of lines? First of all, one is meant to infer that the molecule is held together not by some sort of force which like gravity draws every atom to every other, but rather by short-range forces which act only between immediate neighbors. Then, one is to infer that the number of neighbors to any atom is limited strictly: not more than one to any hydrogen atom, not more than two to any oxygen atom, not more than four to any carbon atom. One could not deduce so much from this particular diagram only; the point is that for the great majority of organic molecules, the diagrams can be so drawn that when all of the atoms are linked, there are four lines and two lines and one line springing from each carbon and oxygen and hydrogen atom respectively, and there are no loose ends anywhere. Then—and so far as this article will go, lastly—one is meant to infer that to tear any one of the atoms loose from its neighbors a certain amount of work must be done, a certain amount of energy spent, in loosing or breaking the bonds. This stands forth most clearly from such diatomic molecules as those of hydrogen and oxygen, for which the structure-diagrams are H-H and O=O respectively. The "unbinding-energies" required to dissociate these molecules into separate atoms are known, and quite exactly (with an uncertainty of 1 per cent or so). They are called the "bond-strengths" of the H-H single bond and the O=O double bond respectively. The single dash which unites the letters H and the double dash which unites the letters O should be taken as saying not merely that these molecules hold together, but that the energy required to take them apart is definitely fixed, definitely knowable and in these cases definitely known.

By the art of electron-diffraction (and X-ray diffraction also, but to a lesser degree) the arrangement of the atoms in some of these polyatomic molecules has been found directly. An example of this is the model of the camphor molecule, shown in the headpiece on page 284. This is the type of model which has been confirmed as to shape and fixed as to scale by the arts of electron-diffraction and X-ray diffraction for many molecules.

Generally, this art confirms the structure-diagram of the chemist, or rather, that generalization thereof which arises from the fact that many molecules are three-dimensional while most of the diagrams are printed on two-dimensional paper. Diffraction tells us that some triatomic molecules, CO_2 for instance, are linear, while others, H_2O for instance, are

Fig. 3—The electron-diffraction pattern of gutta-percha, a source of information about the structure of this complicated molecule

v-shaped, and it tells us the angle of the v where there is one. Diffraction tells us that in many compounds the four neighbors of a carbon atom stand remarkably close to the four corners of a regular tetrahedron; and many other things as well, which there is not room to recount.

By the arts of electron-diffraction and X-ray diffraction, the scale of the molecule has been found; that is to say, the actual distance in centimeters from atom to atom. The concept of "bond-length" now is added to that of bond-strength, and the lines of a structure-diagram stand for distances actually known, as well as for unbinding-energies actually known. Pauling has listed, from his own measurements mainly, the distance between carbon atoms linked by a c-c bond, in diamond and in seventeen organic molecules. All of the eighteen values lie between 1.52 and 1.55×10^{-8} cm, the greatest uncertainty of any not surpassing 2 per cent. There are other molecules in which the structure-diagram demands that carbon atoms be joined by a double dash c=c, as in ethylene; or even by a triple dash c≡c, as in acetylene. Electron-diffraction testifies that for these the bond-length is different and smaller, 1.34 for the double bond and 1.20 for the triple. By this testimony it confirms that the linking of atom-symbols in the structure-diagram by two or three lines is not merely a specious device for covering up a flaw in the general rule that four lines should be drawn from every carbon atom and two from every oxygen atom. There is a palpable difference in bond-length between c-c and c=c and c≡c, in addition to the difference in bond-strengths, a fact which also has been proved.

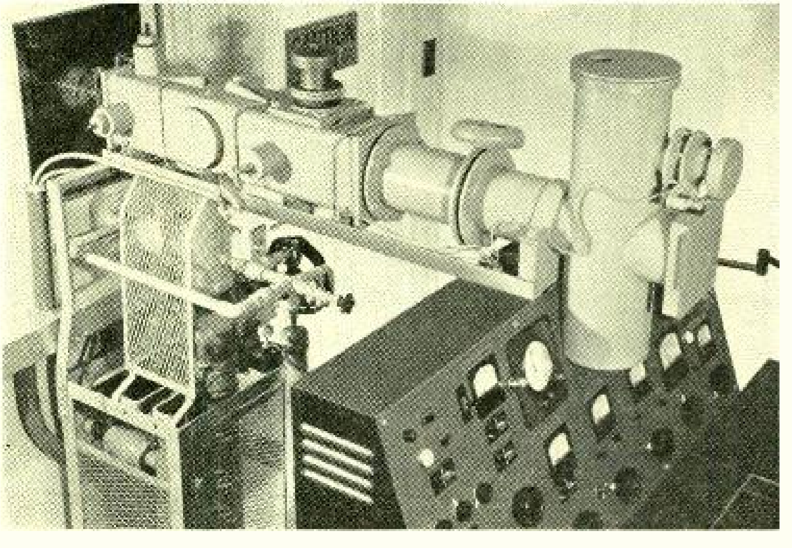
Bond-strengths at first were derived mainly from thermochemistry; but the art of the spectroscopist has provided not one but several new ways to determine them. Of these I can mention the basis of only one: the wavelengths of light most strongly absorbed by organic molecules are those for which the energy of the corpuscles of light is just right for breaking one or another bond.

The study of molecules in electric and in magnetic fields supplies the values of their electric and magnetic moments respectively — quantities which have bearing on many questions, including the fundamental one of the nature of the forces which hold the molecule together. This question of the nature of the "chemical" forces is the ultimate one which is posed for chemistry and physics both.

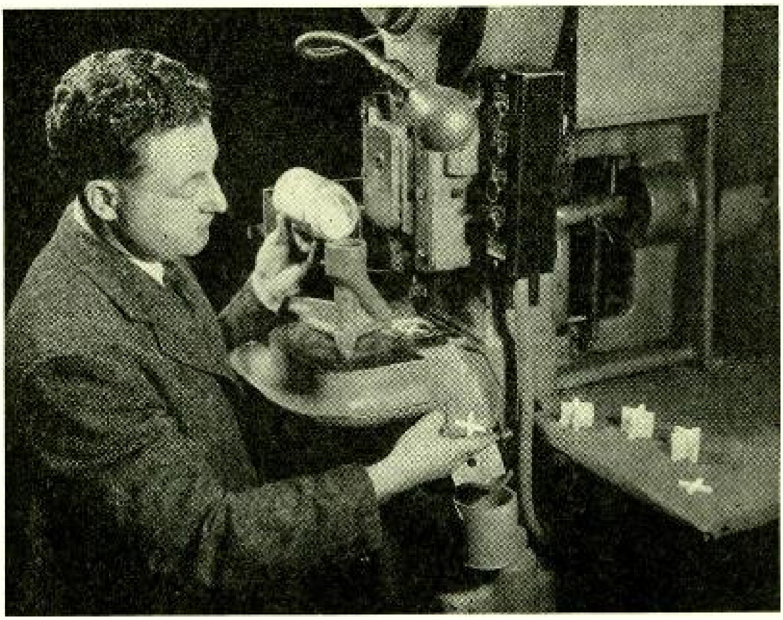
Gravitational they cannot be. Electromagnetic forces are the only others known to the physicist from his studies of elementary particles, apart from the nuclear forces which do not enter here. The physicist would very much like to believe the chemical forces to be electromagnetic entirely;

and after many years during which the arguments against that belief seemed stronger than the arguments for it, the doctrine of wave-mechanics has come to fulfill his hopes. Wave-mechanics, alas! is a doctrine which is expressed in truly formidable mathematics, and there are only two molecules to which it has been perfectly applied. These are of course the two simplest: the diatomic molecule H-H, and the still simpler system to which H-H is reduced when one of its two electrons is taken away from it, leaving it a positive ion composed of two nuclei and a single electron. Wave-mechanics gives values for the unbinding-energies of these, it being assumed that the only forces are the electrical. The theoretical value lies in each case within the limits of uncertainty of the experimental value; and these limits are narrow. This emboldens us to believe that in all of the countless cases of molecules too complex for our mathematical powers, the forces are likewise purely electromagnetic. If anyone says that we have not actually proved this, we will have to concede the point.

I close this article by mentioning the contributions which the physical art of transmutation has made to the list of the chemical elements. The procession of the elements as it was known before this art was invented ran from atomic number 1 (it was the physicist Rutherford who more than anyone else explained the meaning of "atomic numbers," but on this I cannot dwell) to atomic number 92. Interrupting this procession there were four vacant places, 43 and 61, 85 and 87. Two of these, the first and the third, have now been filled; and the procession has been extended by number 93, while for 94 we have indirect but convincing evidence.



Electron-diffraction camera at Murray Hill for investigating the crystal structure of surface films. A beam of high-speed electrons, scattered from the surface of the material, records its diffraction-pattern on a photographic plate. Apparatus designed by L. H. Germer



Ceramics for High-Frequency Insulation

By M. D. RIGTERINK
Chemical Laboratories

TRENDS toward the use of higher frequencies in the radio and communications industries have been furthered by the development and use of improved insulating materials to keep the losses of electrical energy down to reasonable values. Some of the electrical energy is transformed into heat in any material that is used to insulate against an alternating potential. This is the dielectric loss and it is proportional to the square of the applied voltage, to the frequency of the alternating field, and to the dielectric constant and power factor of the insulator. The voltage and the frequency are determined by the use to which the insulator is put but the dielectric constant and power factor are properties of the insulating materials and, within limits, are subject to control.

Electrical porcelains, which are quite similar in composition to dinnerware, are satisfactory and very useful insulating materials for low-frequency currents. At high frequencies, however, they have been replaced by new ceramic materials which have far smaller power factors. This replacement, desirable for high-frequency insulation even at room temperature, becomes absolutely essential at elevated temperatures such as are encountered in power vacuum tubes in which the insulator operates almost red hot. The power factor of most ceramic insulating materials increases very markedly with increase in temperature. This causes more conversion of electrical energy into heat and results in a cumulative effect which may lead to a breakdown in any but the very best of materials.

The most important and the most widely used of the improved ceramic materials are the steatites. This name derives from the mineral steatite which is essentially a massive form of talc, the same material which has found extensive use in the cosmetic industry. Known also as soapstone in its more impure forms and as Lavite, after firing to a high temperature, it is a good electrical insulator. The name steatite is now applied to all synthetic ceramic materials which are prepared with talc as the principal raw material and which have magnesium metasilicate as the principal crystalline phase.

Steatite bodies are prepared from mixtures of 60 per cent or more of talc, 30 per cent or less of clay or kaolin, and the remainder usually of alkali or alkaline earth oxides or compounds that will decompose to furnish these fluxing oxides. Temporary organic binders and plasticizing agents are often added to aid in the forming processes of pressing, casting, extruding or jiggering. These do not affect the composition of the products, however, because they burn out during the subsequent firing in which the formed ware is heated from 1,200 to 1,400 degrees C. on a controlled heating and cooling cycle. During this heat treatment the fluxing oxides combine with part of the magnesia, alumina, and silica furnished by the talc and the clays to form glasses which in turn dissolve more of these constituents as the temperature rises. In addition to glass formation there are chemical reactions between the solids and between the solids and liquid glasses; also crystallizations as the temperature is lowered, and finally crystalline transformations. These complex changes make the mixture shrink and become the hard, dense material that is known as a steatite ceramic.

Steatite ceramics differ from the electrical porcelains in their crystalline and glass phases. A typical porcelain is prepared from approximately 50 per cent of clays and kaolins, 35 per cent of flint and 15 per cent of soda feldspar or potash feldspar. After firing such a mixture to a hard, dense material, it consists principally of crystalline mullite and quartz em-

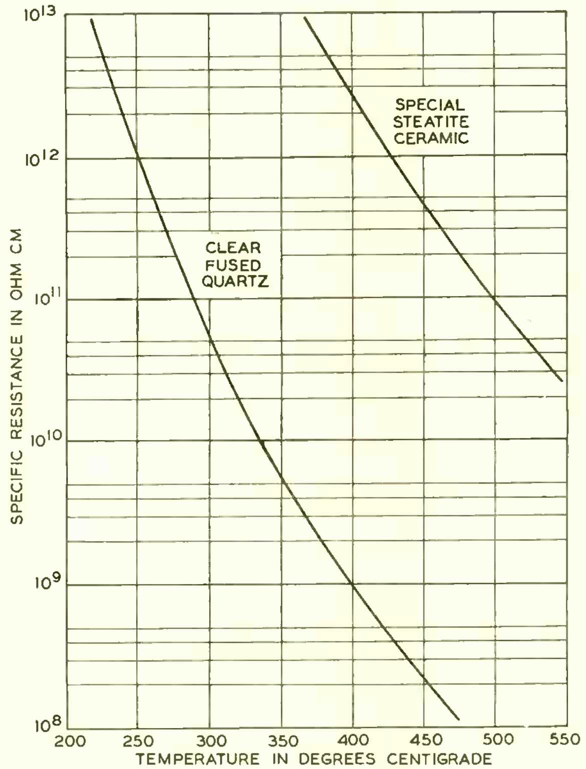


Fig. 1—Variations of the specific resistances of clear fused quartz and a special steatite ceramic with changes in temperature

bedded in an alkali glass matrix. This combination does not possess as good dielectric properties as the steatite ceramics, due largely to the appreciable quantities of sodium and potassium ions that are present in the glass phases of the porcelains.

Dielectric properties of the steatite ceramics vary considerably depending on the amount, kind and proportions of fluxing oxides that are used in their preparation. The alkalies are particularly detrimental, and the alkaline earth oxides appear to be especially beneficial. Other variations are caused by the grinding and mixing of the raw materials, the firing cycles, and the nature and the amount of impurities present. An automatic press used in preparing experimental steatite ceramics at the Laboratories is shown in the headpiece. The ceramic is mixed with a temporary binder which disappears on firing.

Of greater interest to the designer are the properties of the finished products. All of the steatites have unusually high transverse, tensile, and compressive strengths. In fact, these values are frequently as much as three times as high as the corresponding values for electrical porcelains. In common with most ceramics they also possess resistance to cold flow, ability to withstand high temperatures, resistance to all common chemical agents except hydrofluoric acid, and low porosities.

One of the disadvantages of these materials from the standpoint of the ceramic manufacturer is the extremely short firing range over which the bodies may be heated to obtain hard, dense substances of the proper dimensions without warping and overfiring. This has necessitated a closer control of the raw materials and the firings which in turn has contributed toward an improved product.

Steatites have replaced porcelains for some uses solely because of their greater mechanical strength but more frequently on account of their improved dielectric properties. The useful range of dielectric constant for steatite ceramics varies only from five to eight. Loss of electrical energy in these insulators depends more on the power factor than on the dielectric constant.

Some of the insulating materials of the steatite group are such good dielectrics that measurements at room temperature indicate the amount of water absorbed from the atmosphere rather than the dielectric properties

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M. D. Rigterink received an A.B. degree from Hope College in 1933. The following four years he attended Ohio State University where he held a graduate assistantship in Chemistry. The Ph.D. degree was granted to him there in 1937 immediately after which he joined the Laboratories. Dr. Rigterink has been concerned principally with the development and improvement of ceramics for telephone uses. The solution of miscellaneous problems in the inorganic chemistry of non-metallics has been a natural outgrowth of this work.

of the material itself. This is especially true at lower frequencies but is not so important at the higher ones where these ceramics are most valuable. For this reason the dielectric properties have to be measured over a range of temperatures to obtain a true comparison of different insulating materials. This serves also to emphasize the importance of making the electrical measurements of the insulators under conditions closely simulating those encountered in their use.

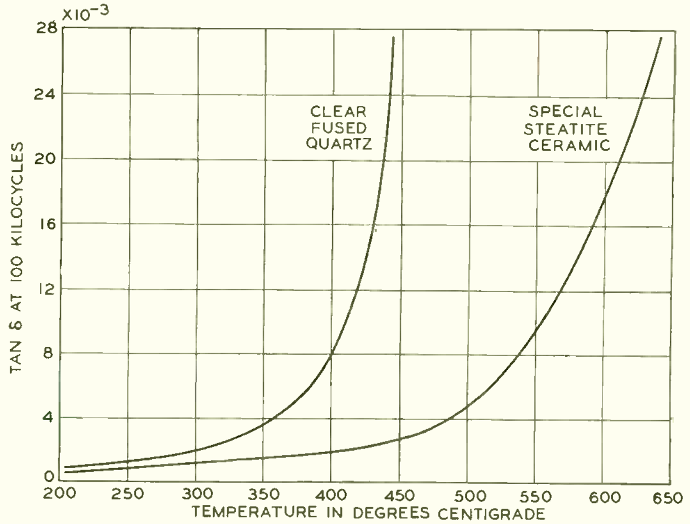


Fig. 2—Variations with temperature of the dielectric losses at 100 kilocycles of clear fused quartz and a steatite ceramic

Improved electrical characteristics obtainable with the steatite type of ceramic are illustrated by comparing the properties of one of them with those of clear fused quartz. Fused quartz has long been considered the ideal inorganic dielectric, and at room temperature it does possess an unusually high d-c resistance and a low, almost vanishingly small, dielectric loss. The d-c resistance decreases very rapidly, however, with an increase in temperature—from over 1×10^{14} ohm-cm at room temperatures to approximately 1×10^{9} ohm-cm at 400 degrees C. This change in resistance as a function of temperature is illustrated in Figure 1, along with a similar plot for a steatite ceramic developed at the Laboratories. The specific resistance of the steatite ceramic is more than a thousand times larger than that of fused quartz at 400 degrees C.

When the dielectric loss factors are compared, the special steatite ceramic again shows its superiority. The values of power factor, expressed as tan δ, measured at 100 kc are plotted as functions of temperature in Figure 2. At room temperature the loss of both materials is very small. At about 300 degrees C., however, there is a noticeable increase for fused quartz and it becomes progressively worse until at 450 degrees C. it is a comparatively poor insulator. In contrast, the value for the steatite ceramic does not increase very rapidly until 450 degrees C. is reached. Then it still is equivalent at 650 degrees C. to fused quartz at 450 degrees C.

Another interesting and important property of these steatite ceramics observed during the development of this special ceramic was that those which have good insulating properties for direct current may not be as satisfactory for alternating current. For example, ceramic bodies with the same direct current resistances were prepared whose values for tan δ at 100 kc varied by a factor of over twenty-five. Thus, where a-c and d-c voltages are superimposed the dielectric properties for both have to be considered in comparing different materials.

Lightning Protection of Buried Cable

By E. D. SUNDE
Protection Development

FOR the new toll facilities now being installed, much of the cable is being buried in the ground to secure greater immunity from the effects of sleet, snow, and storms of all sorts. It might seem that buried cable would also be free from the effects of lightning damage, but burying alone is not necessarily sufficient. Moreover, when damage by lightning does occur, such as fusing of cable pairs or holes in the sheath, it is not so easy to locate and repair as on aerial cables, since excavations may have to be made at a number of points. As a result of this situation, studies have been made of the factors affecting damage of buried cables by lightning, and remedial measures have been devised which are expected to provide substantial protection in most cases that are encountered.

When lightning strikes, the current spreads in all directions from the point where it enters the ground. If a cable is in the vicinity, it will provide a low resistance path, so that much of the current will flow to the cable and in both directions along its sheath to remote points. The flow of current in the ground between the lightning channel and the cable may give rise to such a large voltage drop that the breakdown voltage of the soil is exceeded, particularly when the earth resistivity is high. The lightning stroke will then arc directly to the cable from the point where it enters the ground, often at the base of a tree. When this happens practically all the current reaches the cable sheath. Furrows as long as 100 feet have been found in the ground along the path of such arcs.

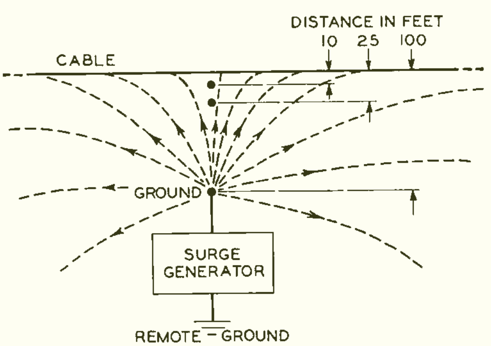


Fig. 1 — Relative positions of various grounds and cable for surge tests

The current entering the sheath near the stroke point is attenuated as it flows toward remote points. The current leaving the sheath must flow through the adjacent soil, and the amount of this leakage current per unit length of cable is therefore smaller if the soil resistivity is high than if it is low. Thus the current will travel farther the larger the earth resistivity. The flow of current along the sheath produces a voltage between the sheath and the core conductors, which is largest at the stroke point. This voltage is substantially equal to the resistance drop in the sheath between the stroke point and a point which is sufficiently remote so that the current in the sheath is negligible. Since the higher the earth resistivity, the farther will the current travel, this resistance drop will also increase with the earth resistivity. The maximum voltage between sheath and core is thus proportional to the sheath resistance and, as it turns out, to the square root of the earth resistivity. Carrier cables now being used are of smaller size and have a higher sheath resistance than full-size voice-frequency cables, and for this reason they are more subject to lightning damage, particularly when the earth resistivity is high.

To secure experimental verification of the theory outlined above, tests were made on the Stevens Point-Minneapolis cable, using a surge generator, which generates a short-time surge of current similar to that of a lightning discharge but of much smaller magnitude. A ground was established remote from the cable, and the surge generator was connected between this ground and the cable sheath, and between the remote ground and grounds at distances of 10, 25, and 100 feet from the cable, as indicated in Figure 1. The voltage between conductors and sheath was then measured for various conditions. The results obtained with the surge generator connected between sheath and remote ground are shown in Figure 2, which gives both the current flowing into the sheath and the voltage between conductors and sheath as they vary with time. Allowing for the difference in the magnitude of the current, such a test would represent an arcing of the lightning directly to the cable. Voltages between conductors and sheath when the surge generator was connected between the remote ground and grounds near the cable are given in Figure 3. These voltages are plotted as percentages of the maximum voltage shown in Figure 2. Tests such as these are comparable to lightning strokes to ground at various distances from the cable when arcing to the cable does not occur. The observed voltages are in good agreement with those calculated for a cable of the size used in the tests on the basis of the earth resistivity measured at the various test locations.

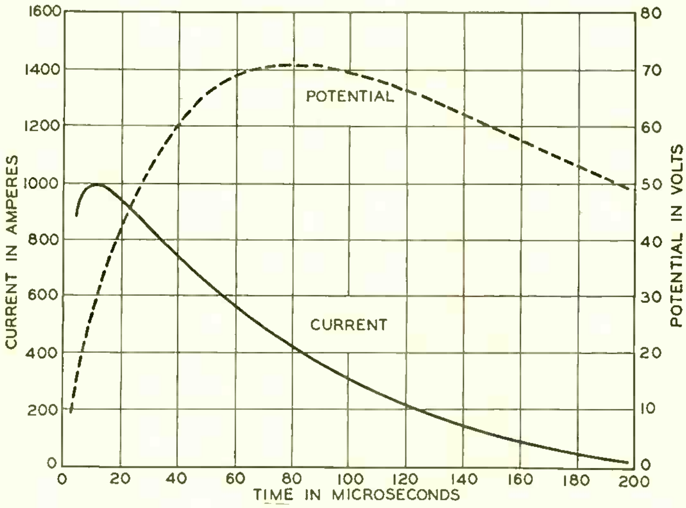


Fig. 2—Surge current and voltage between sheath and conductors during surge test on cable between Stevens Point and Minneapolis

The voltages of Figure 2 were those observed at the point where the current entered the sheath. As the current flows along the sheath it is attenuated, however, with the result that the voltage decreases. The rate of decrease as obtained in the tests is indicated by the upper curve of Figure 4, where the voltage is plotted as a percentage of the maximum voltage of Figure 2. There is some un-

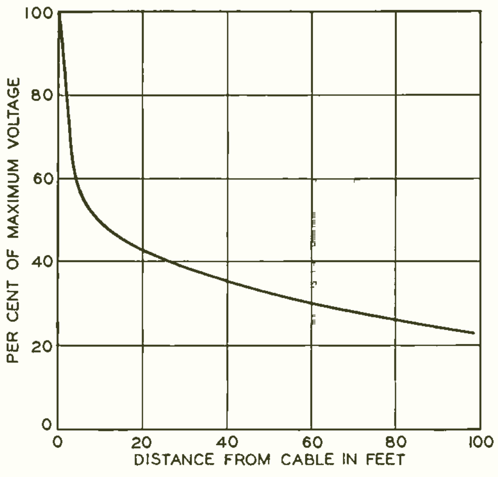


Fig. 3—Reduction in voltage between sheath and conductors as the ground representing the point of lightning stroke is moved farther from the cable

avoidable variation in the dielectric strength of the core insulation, and thus although the voltage decreases rapidly with distance, actual failure may not occur at the point where the current enters the sheath but at some distance away where the dielectric strength of the insulation may happen to be less.

When the voltage at the point where current enters the sheath is great enough to break down the insulation, the conductors and sheath are brought to essentially the same potential by the arcing. Under these conditions, the voltage between conductors and sheath will increase with distance along the cable as shown by the lower curve of Figure 4. A maximum is reached at some distance from the original fault, and beyond this point the voltage slowly decreases. After a puncture of the insulation where the current enters the sheath, other failures may therefore occur at some distance from this point in either or both directions. A single lightning stroke may thus cause insulation failures over a considerable distance along the cable.

The crest value of the current in a lightning discharge varies over wide limits. Measurements made largely with magnetic links* by engineers of the power industry have indicated that a relationship somewhat like that shown in Figure 5 exists between various values of crest current and the percentage of the total flashes in which they occur. Although measurements of wave shape are not extensive, they indicate that the current reaches its crest value in from 5 to 10 micro-

*Record, *December*, 1942, *p.* 86.

E. D. Sunde came here from Norway in 1927, after having received an E.E. degree in Darmstadt, Germany, the preceding year. After some months with the Brooklyn Edison Company, he joined the Department of Development and Research of the American Telephone and Telegraph Company, and was transferred with this department to the Laboratories in 1934. Since then he has worked mainly on inductive interference, particularly from the standpoint of electrified railways. More recently Mr. Sunde has been associated with the protection of the telephone plant against lightning damage.

seconds, and it decays to half its maximum in from 25 to 100 microseconds —the average being about fifty microseconds. This type of wave shape was simulated by the surge generator used in the tests shown in Figure 1.

For voltages of short duration, such as those arising from lightning strokes, the dielectric strength of normal core insulation is about 2,000 volts. Based on the data of Figure 2, this voltage would be reached for a lightning current of some 28,000 amperes for a cable of the particular size and construction tested, and—as shown in Figure 5—a surge of this magnitude occurs in about 50 per cent of the strokes. If the stroke reached the ground 100 feet from the cable, instead of arcing directly to it, the lightning current would have to be of the order of 127,000 amperes to cause a breakdown potential between conductor and sheath, and currents of this magnitude, estimated from Figure 5, occur in less than 5 per cent of the strokes.

One method of reducing failures caused by lightning strokes to buried cables is to increase the core insulation. This has been done for most new installations of buried cable. The cable itself, and such accessories as cable terminals and stubs, loading pots, and gas-alarm contactors are all provided with sufficient extra insulation to double the dielectric strength between cable conductors and sheath. For a cable like that on which the measurements were made, such increased insulation would reduce the number of lightning strokes that could cause failure by direct arcing to the sheath to about 15 per cent of the total instead of 50 per cent, and would almost entirely eliminate the danger of breakdown when lightning strikes the ground as much as one hundred feet from the cable.

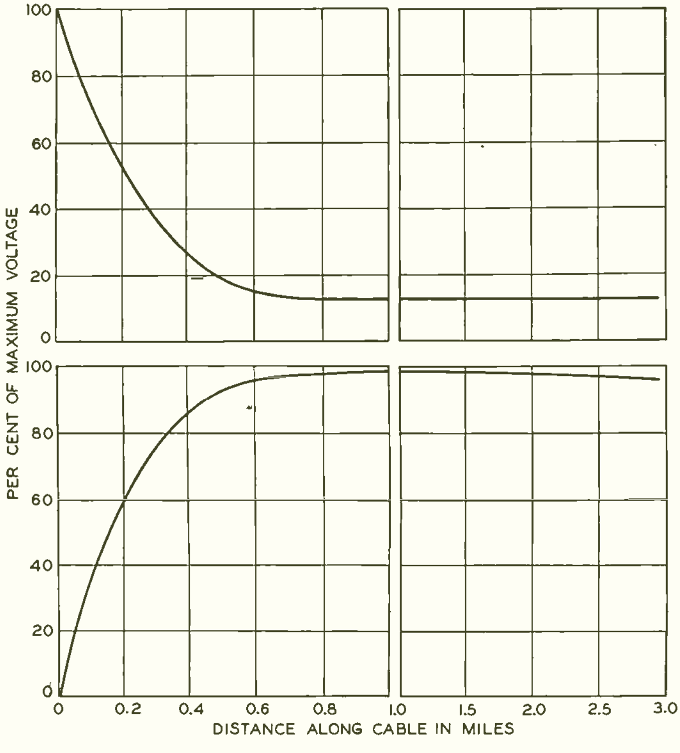


Fig. 4—Variation in voltage between sheath and conductors with distance along the cable. Above, when no breakdown occurs; below, when insulation breakdown occurs at points of lightning stroke

Another method, which may be employed in addition to the extra insulation where excessive lightning damage would otherwise be expected, is to bury shield wires over the cable.

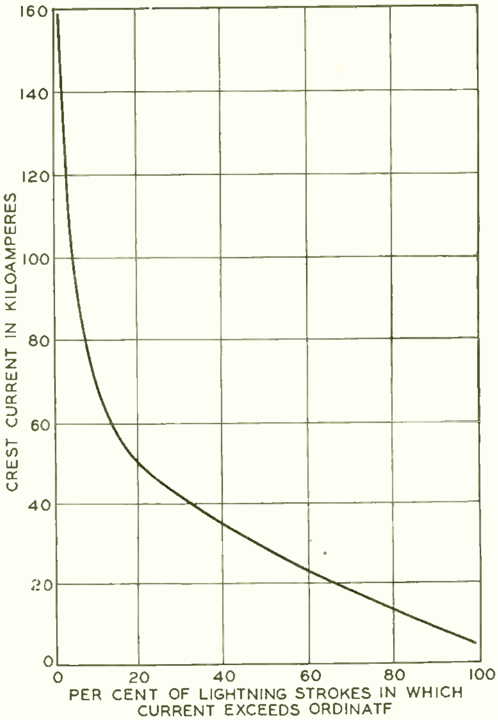


Fig. 5—Percentage of lightning strokes in which current exceeds the ordinate

These conduct away part of the lightning current and thus reduce the amount that flows along the sheath. These wires may be plowed in with the cable, or they may be installed afterward. When wires and cable are plowed in together, one of the practicable arrangements is that of Figure 6. The percentage of the current carried by the wires depends to a greater extent on their inductance relative to that of the sheath than on their resistance. Two wires are employed, rather than a single wire of smaller resistance, in order to obtain a lower inductance than would be possible with a single wire.

On the route between Stevens Point and Minneapolis, where the shield wires were installed after the cable was in place, two 165-mil copper wires about twelve inches apart were plowed in some ten inches above the cable for a distance of eighty miles. Surge measurements made after these wires were installed indicated that the wires reduced the voltage between sheath and core conductors about 60 per cent, in substantial agreement with theoretical expectations. The shield wires should thus reduce the number of direct lightning strokes that would be expected to cause failure to about 10 per cent instead of 50 per cent without shield wires.

In estimating in advance the need for specific remedial measures, the probable incidence of lightning strokes to the cable and to ground near the cable is of course an important consideration, in addition to the factors discussed above. The incidence of lightning varies considerably over the country, and to take account of this factor, use has been made of data collected by the U. S. Weather Bureau over a period of 30 years. According to these data, the average number of thunderstorm days per year is as low as 5 in some parts of the country and as high as 90 in other parts. The expected rate of cable failures is taken proportional to the number of such days for the locality in question. The theoretical curves of

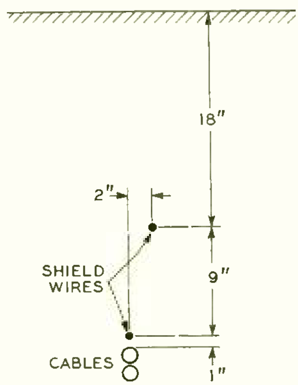


Fig. 6—Position of shield wires when they are plowed in with the cable

"lightning trouble expectancy" for buried cables shown in Figure 7 are for convenience referred to ten thunderstorm days per year. They are based on normal core insulation, on a current wave-shape similar to that of Figure 2, and on the crest current distribution shown in Figure 5.

From Figure 7 it is evident that the rate of cable failures to be expected, and hence the need for remedial measures, depends greatly on the earth resistivity. Of particular importance in the majority of cases is the resistivity up to a depth of ten feet or so. With low resistivity to this or greater depths, the danger of a direct stroke to the cable is small, and if the resistivity is low to considerable depths — a few hundred feet—strokes other than direct strokes are not usually of importance. When, however, the resistivity at depths beyond ten feet or so is very high and the cables are of small size, strokes to ground may cause insulation failures, and this is also true of discharges between clouds. Earth resistivity measurements* along new cable routes are now regularly made as a guide in applying protective measures.

*Record, *February*, 1941, *p.* 185.

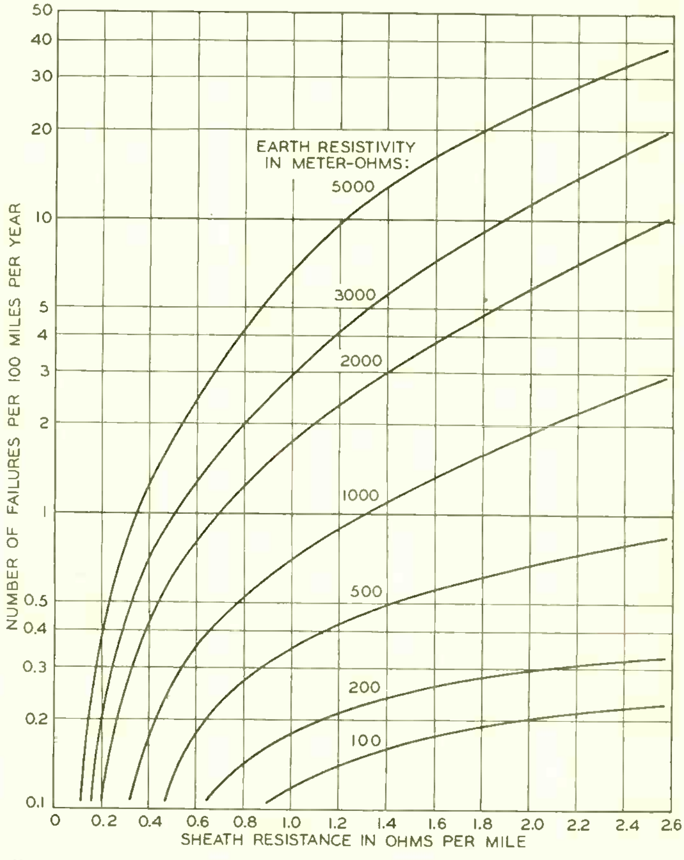
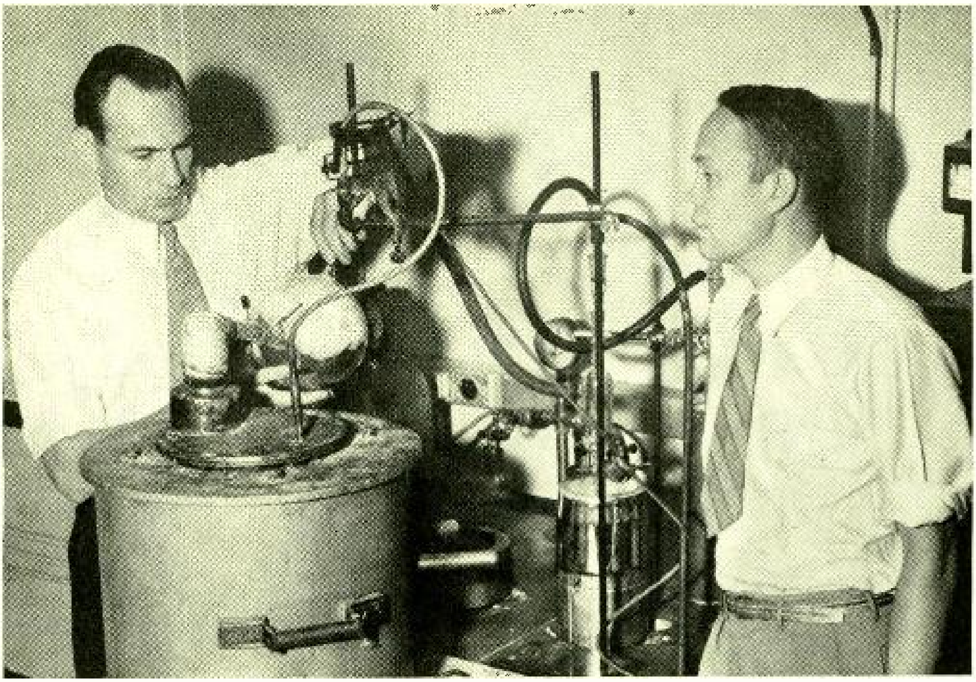


Fig. 7—Calculated expectancy of cable failures with normal insulation between core and sheath for a lightning incidence of ten thunderstorm days per year. Resistance of the sheath of a full-size cable is about 0.60 *ohm per mile, and of the Stevens Point-Minneapolis cable, is about* 1.5 *ohms per mile*



New Synthetic Rubber Developed

A NEW specialty rubber which will help meet essential war needs has been developed by the Laboratories as a by-product of research in insulating materials. This new material, known as Paracon, looks and feels like ordinary rubber, resembles it fairly closely in mechanical properties, and has important advantages for certain purposes. It has a high resistance to damage by oil or gasoline. It is also better than natural rubber in resistance to heat, light and oxidation although inferior to natural rubber in resistance to steam, alkalies and acids. Paracon can be worked with ordinary rubber machinery. In its raw state it is highly plastic and unusually well adapted to molding into intricate shapes and to use in producing rubberized fabrics. Paracon might be used for making inner tubes but its special fitness for other applications and its present limited production rule that possibility out of immediate consideration.

Paracon can alleviate the rubber shortage in those lines of manufacture where its peculiar properties give it an advantage over natural rubber. In helping to meet the present difficulty Paracon is useful not only as a replacement for rubber but more particularly as a material for special applications where, as in the aircraft field, its combination of unique properties is required. An important advantage of Paracon is that it will not compete with other synthetic rubbers for its basic raw materials since the chemical intermediates required for its production are derived by other trains of chemical processes. For its synthesis it uses two major types of intermediate material. These can be derived from agricultural products and coal products; or from coal and petroleum sources; and in each case by a variety of different chemical processes. Although the equipment for manufacturing Paracon is highly specialized it differs from that required for synthetic rubber production; and, consequently, Paracon can add to the present supply of rubber substitutes without interfering with the production of those already under way.

The synthesis of Paracon was accomplished by Drs. C. S. Fuller and B. S. Biggs of the Laboratories and their associates.

Some months ago, at a time when their experiments had demonstrated the practicability of Paracon, information as to it was made available to the Baruch Rubber Committee and to the War Production Board. To carry the development from the laboratory scale to that of quantity manufacture, the Laboratories turned over to some chemical manufacturing companies full information as to the processes involved. One of these companies, The Resinous Products and Chemical Company, is now producing Paracon on a semi-commercial scale.

Dr. Fuller is now on leave of absence while attached to the office of the Rubber Director in Washington.

Increased Personnel

By G. B. THOMAS
Personnel Director

One out of four of those now working in the Laboratories has been hired since the war began. Whereas at the end of 1939, as shown in Figure 1, the Laboratories had 4,612 members and at the end of 1940, 4,638, the personnel grew to 4,953 at the end of December 1941, to 6,186 a year later, and to 6,472 at the end of March, 1943. During this time a transformation from peacetime activities to wartime was accomplished. Today only about 20 per cent of the total effort of the Laboratories is expended on projects other than those required by the Army, Navy and National Defense Research Committee. This almost irreducible minimum of other effort is, however, essentially war work since it is directed toward the expansions and changes in Bell System plant which are made necessary by Army and Navy camps and stations and by the rapid growth of war industries.

The number of new employees that has had to be recruited to bring about this increase in manpower is even more than these figures of growth indicate, since during the same time about 10 per cent of the Laboratories' force left for service in the armed forces or with other Government agencies engaged in war work. In addition, the turnover (Figure 2) has been higher than usual, as would be expected when the family arrangements of so many persons are altered

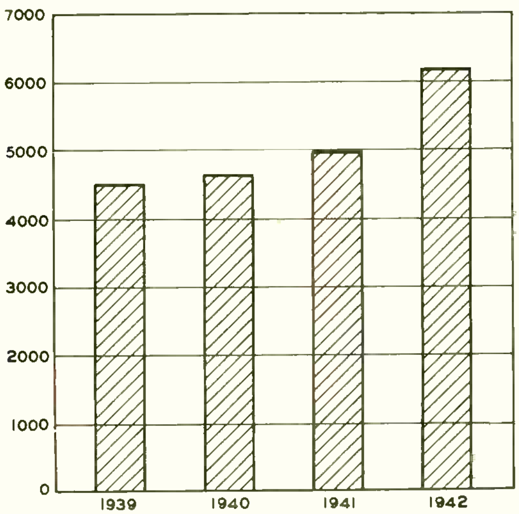


Fig. 1—Number of employees at end of year

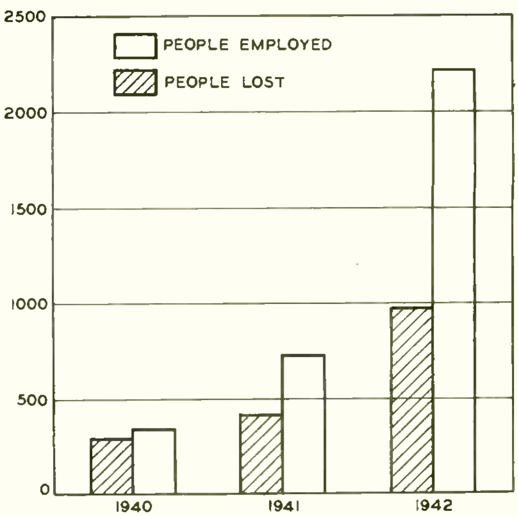


Fig. 2—Turnover during year

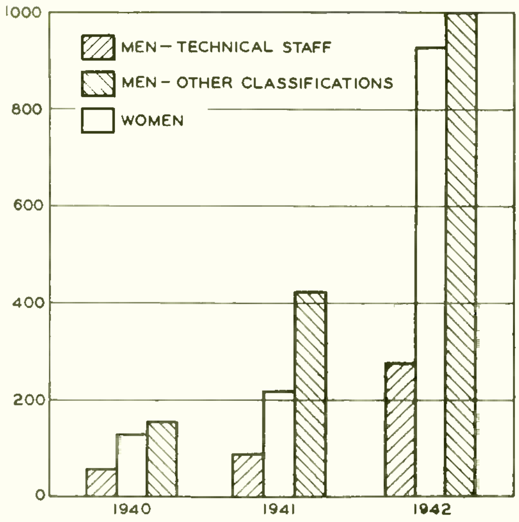


Fig. 3—Applicants interviewed—men versus women

drastically by wartime demands. Many younger members of the Laboratories have resigned because their families have moved from this section of the country or for other similar reasons.

The work of the employment groups in the Personnel Department has consequently been increasing and has grown rapidly in the last year and a half. The demand which the war has brought about for scientifically trained personnel and skilled technicians has made it harder and harder to find suitable candidates for employment in the Laboratories' work. During 1940, for example, the Personnel Department, as shown in Figure 3, interviewed 9,600 applicants for employment and selected 345. In 1942, the corresponding figures were 26,000 and 2,211. Under wartime conditions, sources of manpower which formerly proved prolific no longer yield the increased personnel the Laboratories needs, and the growing deficit has had to be made up by drawing more and more heavily on other resources.

Whereas, for example, prior to 1940 the Laboratories was taking many of its new members directly from the schools and colleges, these sources supply only a small portion of its present employment. The next most prolific source for applicants for employment was acquaintanceship with persons already members of the Laboratories. Advertisements were relied upon only to a small extent although a considerable number of skilled workers, particularly clerical and stenographic, came to the Laboratories through employment agencies. The changed picture of the employment situation for work in the Laboratories is shown in Figure 4.

Of particular interest is the increase in per cent of new people who come to the Laboratories from the Associated Operating Companies of the Bell System. Because of restrictions on the manufacture and installation of telephone equipment, these companies are not carrying on their usual amount of plant expansion. Through their coöperation, by arrangements made by the Personnel Department of the Laboratories, over 340 engineers and other workers have been transferred to the Laboratories for the duration. In addition, but not counted in

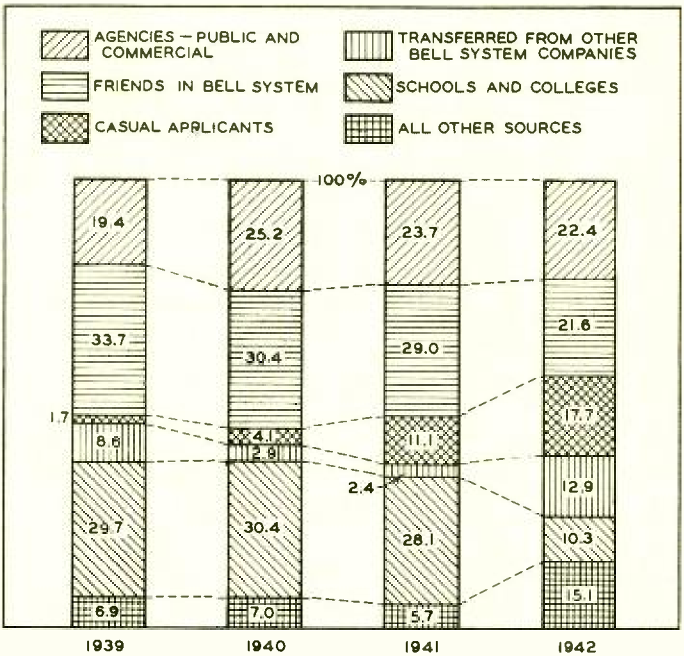


Fig. 4—Sources of new employees as percentages of total input

the total employment of the Laboratories, over 300 skilled members of the Installation Department of the Western Electric Company, where work has fallen off, have been assigned to the Laboratories where they work like other members but they are paid by their own company and the Laboratories is billed accordingly. This coöperation of Bell System companies has just about saved the day for the Laboratories in its struggle to obtain properly qualified members for its technical staff. There are also a few instances where other public utility companies, whose expansion is at present restricted, have allowed the Laboratories to hire members of their technical staffs, to be released back to their original companies at the end of the war.

Although the number of members of the technical staff of the Laboratories has increased appreciably, the large increase has been in other groups. To get work out—to reduce to models and specifications in drafting form the developments of the technical staff—has required a large increase in draftsmen of all grades, skilled mechanics of all types, and typists and other clerical workers. There has also been necessarily a large increase in the accounting activities of the Laboratories. This is due in part to the larger total number of employees but very largely to the added accounting duties occasioned by state and national taxation and payroll allotments for war bonds.

The most pronounced change in the character of employment has been the increase in the number of women workers employed for the Laboratories, shown in Figure 5. Whereas, for example, before the war our messengers and mail clerks were youths just out of high school, many of whom were taking their college work at night, these services are now carried on by girls. There have been corresponding increases, although not so large, in employment of women for shop work and for other tasks such as operating elevators or any work where the physical effort required would be easily within their capabilities. Light mechanical operations and the assembly of experimental apparatus models have engaged a relatively large number of women—the number increasing during 1942 alone nearly 800 per cent of the 1940 figure.

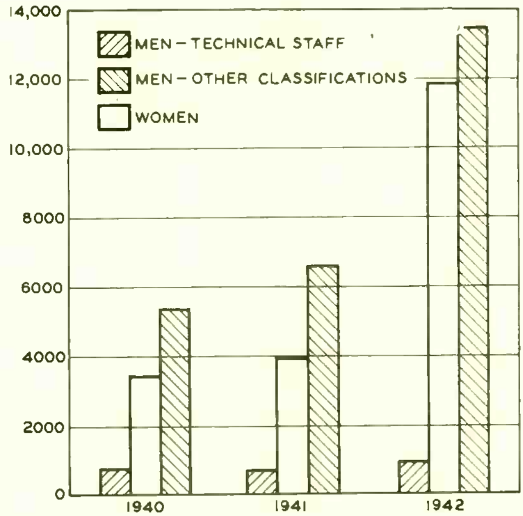


Fig. 5—Number of new people employed—men verus women

All the new workers, both men and women, whether in the technical groups or staff and service groups, have been selected with fully as great care for proper qualities as in ordinary peacetimes although, naturally, some concessions have had to be made in experience requirements. The work of the Laboratories, which is practically all undertaken on behalf of our armed forces, warrants the best capabilities of workers, the utmost loyalty and the greatest energy and initiative.

Blood Donors at Murray Hill

These members of the Laboratories recently donated blood through the mobile unit of the New York Chapter of the American Red Cross:

V. J. Albano	J. B. Howard
B. S. Biggs	Elizabeth Hyde
Jean Brewer	D. M. Jones
W. E. Campbell	F. C. Koch
J. B. DeCoste	W. H. Lockwood
F. E. Dorlon	Marie Marti
L. Dorrance	W. McMahon
Mary Duffy	W. J. Myles
R. H. Erickson	A. Ortiz
Amanda Force	Jane Otto
C. J. Frosch	N. R. Pape
Emma Graetz	F. J. Saxton
A. H. Hearn	Charlotte Schandolph
June Houghtaling	G. H. Williams

W. H. Matthies Retires

In 1896, the rate of growth of the Bell System began a new trend: the curve of increase, instead of remaining roughly horizontal as it had for the preceding fifteen years, took a sudden and sharp turn upward. It was also in 1896 that W. H. (Bill) Matthies — then a young man of seventeen summers but with the vitality that has distinguished him ever since—made his first connection with the Bell System. Whether there is any close connection between these two events cannot be said with certainty, but those who know Bill well could readily believe there was. After some forty-three years of colorful and productive service in the Bell System, Mr. Matthies is now retiring—a little ahead of schedule as usual, since he still lacks some months until the retiring age.

Bill completed his junior year in high school in the spring of 1896, but the urge to get out and do something more interesting than school was strong within him, and on June 8 he got a job as office boy with the Western Electric Company in their eastern factory at the corner of Thames and Greenwich Streets. His first job was cleaning inkwells, copying letters on one of the old hand presses, and answering buzzer calls. He was later transferred to the stockroom and would carry brief cases full of orders between the Thames Street building and the stockroom some blocks away. Between trips he would fill bags with salamoniac for use in the batteries of subscriber sets since this was before the time that common battery systems were used.

After two years of this work, he sensed the importance of technical education to the rapidly growing Bell System and returned to his studies. He went to the Dwight School to prepare for college, and by working six days a week and all the following summer, taking certain additional courses at the New York Preparatory School to overflow an already full schedule, he was able to enter Cornell in the fall of 1898. The following year he transferred to M.I.T., where he felt he could get into Electrical Engineering work more quickly, and graduated in 1902 with a B.S. degree in Electrical Engineering.

He then returned to the Western Electric Company which by this time had moved to its new building on Bethune Street near Washington. After taking the student training course, he first worked as an equipment engineer and then engaged in special studies with J. L. McQuarrie. About this time the Bell System was installing its first dial system in Queens, and Mr. Matthies undertook development work to correct some of the weaknesses that were developing in service. An extensive redesign was made, and he supervised the installation of the improved system in Queens in 1903. Further development made this system available for 10, 20, or 100 lines, and during the next few years he installed a number of these systems for Western Electric in various parts of the country.

In December, 1905, he was sent by the Western Electric Company to supervise the installation of one of these systems in Berlin and to train personnel in its operation and maintenance. Returning to this country a few months later he was sent again to Berlin, this time as Chief Engineer of the Berlin plant of the Western Electric Company. Except for brief periods home, he remained in Europe for the next ten years and become conversant with European telephone practice in both the manual and dial fields.

At this time the Berlin plant was building manual switchboards and manual telephone equipment of all kinds, and was selling either directly or through associated houses in

Vienna, Budapest, and St. Petersburg. As Chief Engineer, Mr. Matthies not only supervised the engineering, testing, and many phases of manufacturing, but was closely connected as well with the patent and selling situations. He traveled extensively in central and eastern Europe in pursuit of his various activities.

In 1910 he transferred to Antwerp as Assistant Chief Engineer for the Western Electric European organization. The following year he returned to Berlin to assist F. R. McBerty—now President of the North Electric Company—in the development of dial switching, which was rapidly coming into use. He took an active part in this work and to the present day, European machine switching systems carry many evidences of his ingenuity. This development work was transferred to Antwerp in 1912 and Mr. Matthies remained here until he was driven out by the German advance in 1914.

Escaping from Antwerp, he went to London and for the next two years he was associated with the London office of the Western Electric Company. During this period he traveled in Scandinavia, installing dial systems in both Norway and Sweden.

On May 1, 1916, Mr. Matthies returned to New York, and worked as circuit designer on the panel system. In 1918 his supervisory functions were widened, and he organized our present machine switching laboratory. During the following decade, the scope of his work continually increased. In 1920 he was placed in charge of the circuit group working on panel machine switching, and in 1921 he was placed in charge of all local central-office circuit design. In 1927 he was made Local Systems Engineer, having supervision over all circuit design as well as laboratory work. In 1935 he became Switching Development Director, the position he holds to the present time. In 1930 he again made a trip to Europe to study current European practices.

For over twenty-five years he has been actively directing circuit development for the Bell System. During this period both the panel and crossbar systems have been developed, and most of the larger cities of the country have changed over from manual to dial operation. In spite of a heavy supervisory load, he has found time to take an active part in development, chiefly in the form of suggesting new and better ways of doing things. It is largely as a result of his suggestions that the sender links were developed to replace the former sender selectors of the panel system. This improvement permitted senders to be used in larger groups, and resulted in very appreciable economies. The panel decoder is also attributable to his keen insight into essential needs and his ability to simplify. It was also largely as a result of his suggestions that the crossbar development was undertaken. He has some thirty-two patents to his credit, as a record of his many contributions.

Mr. Matthies was married during a trip to this country in 1907, and besides two sons born in Berlin, and a daughter born in London, now has two grandchildren.

Frequency Analyzer Used by an Explosive Manufacturer

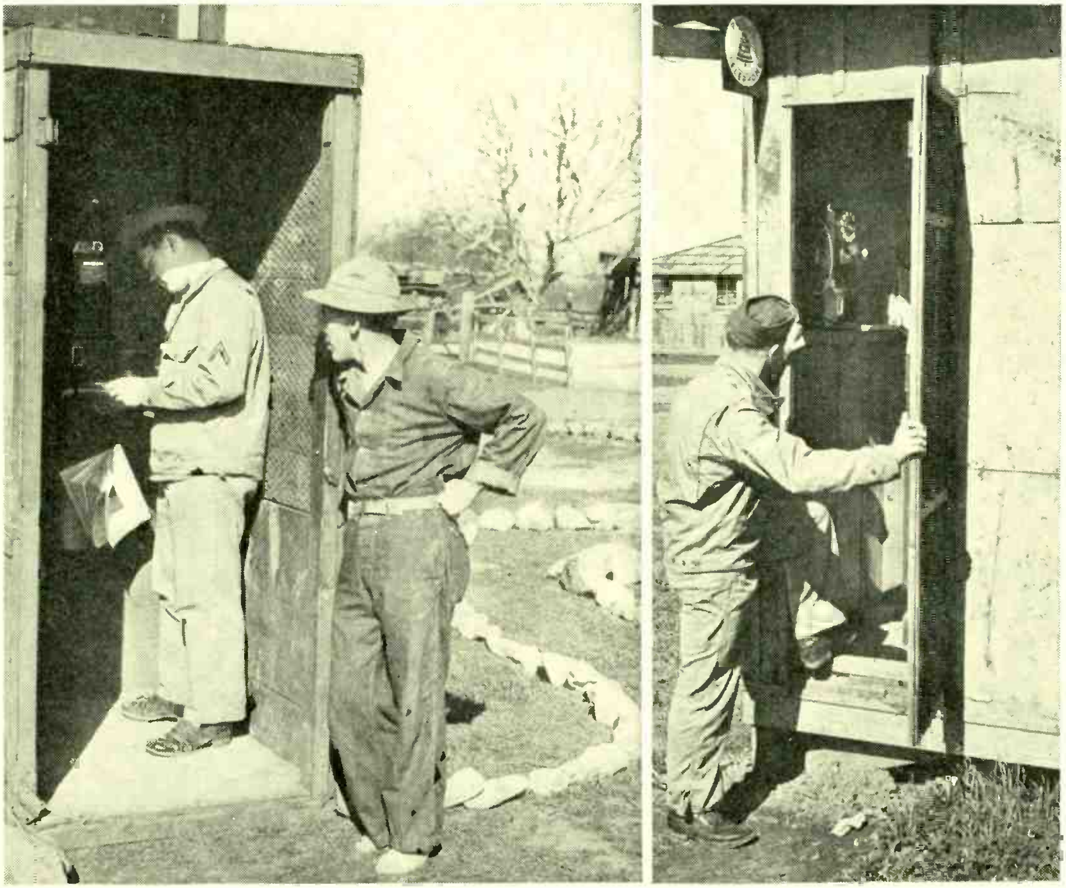
One of the largest manufacturers of explosives has recently found a novel use for the Western Electric RA-281 sound frequency analyzer. This recording analyzer was primarily intended to help in decreasing noise in automobiles, refrigerators, and other mechanical apparatus by revealing the magnitude and frequency of any vibration present. In its new use it is applied to the human heart.

The analyzer picks up frequencies from 10 to 10,000 cycles, modulates them with an adjustable frequency oscillator, selects a 5-cycle band with a quartz crystal filter, and records the amplitude of this band on a chart. The oscillator frequency may be adjusted either by hand to allow any five-cycle band to be selected at will, or by a motor drive that sweeps the oscillator frequency over the entire range in about two minutes—thus giving a complete analysis of the sound picked up.

In the plant referred to above, it was found that certain chemical fumes to which employees might by unavoidably exposed, resulted, over a period of time, in a fatigue of the heart muscles that induced fainting if it became great enough. If an employee fainted while handling certain chemicals, a dangerous explosion might follow, and thus it was important to devise some method of detecting heart fatigue before the critical stage was reached. Efforts to discover it by the stethoscope proved unreliable because of the very small differences in the sound of the heart under normal and fatigued conditions. It was found, however, that the RA-281 analyzer would reveal fatigue before the critical point was reached. By making a record of the heart vibrations of employees who had not been exposed to the fumes, and also of those who had fainted as a result of them, the distinguishing features of the heart fatigue were discovered. It was then possible by making periodic analyses of the heart sounds of employees subjected to the fumes to discover the fatigue before it became serious. The employee could then be transferred to some other department in the company.

Telephone Service for Small Army Detachments

For obvious reasons, the Pacific Coast is a "hot" defense area, with troops stationed not only in large camps but in small detachments in out-of-the-way places. The soldiers have come from training camps where excellent public telephone facilities—both coin boxes and attended stations—have been available. But wherever they are, they want to telephone, and in the small tactical units the telephone is even more of a morale builder. The Pacific Telephone and Telegraph Company has had real difficulties in rendering adequate telephone service in many isolated spots, and has succeeded only by the hearty coöperation of the Signal Officers concerned.



Left—Make-shift booth protects the public telephone installed on the outside wall of recreation hall. This "booth" serves the officers and men of an isolated ordnance unit. Right—Space partitioned off in the rear of a tool house serves as a public telephone booth for soldiers of an ordnance detachment

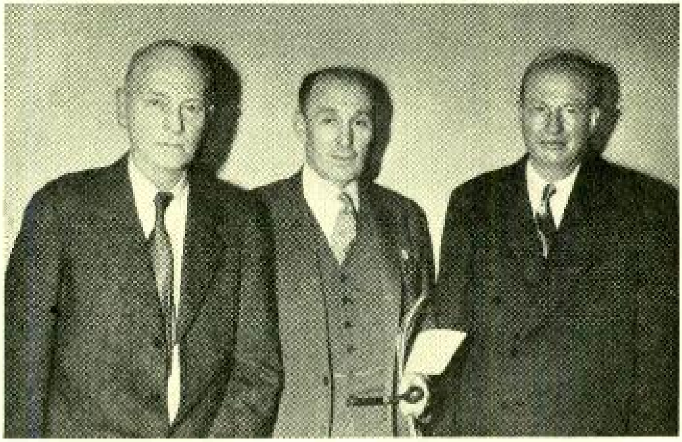
When a unit takes up a new location, some public telephone facilities are usually available, but not in a convenient location. The survey will show that some stations can be discontinued, others moved, and often many more installed.

Invariably, soldiers will give out the number of a public telephone as a number over which they can be reached. A tacit agreement exists among the men that whoever is nearest the telephone when it rings will answer it and either summon the called party or take a message. For convenience in handling "incoming" calls, orderlies' tents, canteens and recreation halls are preferred public telephone locations. For example, two outdoor booths were installed about 25 feet from the canteen to serve an infantry battalion on the outskirts of a country town. The canteen attendants answer incoming calls and take down messages.

Another group of men was located in a ball park about 300 yards from an outdoor public telephone at the gate. This station was too far away to be convenient for answering and making change, and the boys ignored it. Arrangements were made to move the station over to the orderly's tent.

In one locality small groups of men are scattered in gun nests and observation stations. When the men are brought in to eat, some distance from their posts, they are allowed to stop at one of the stores or cafés along the road if they have any telephoning that they want to do.

A neighbor opened her heart to a small detachment of troops adjoining her property. She gave them a standing invitation to drop in for coffee and sandwiches, etc., and to use the telephone whenever they wished. In a short time she was keeping the Telephone Business Office busy tracing calls. Anticipating the difficulties that might arise from this neighbor's generosity, it was considered wise to install a public station, so an outdoor booth was installed next to the orderly's tent and the boys were well pleased.



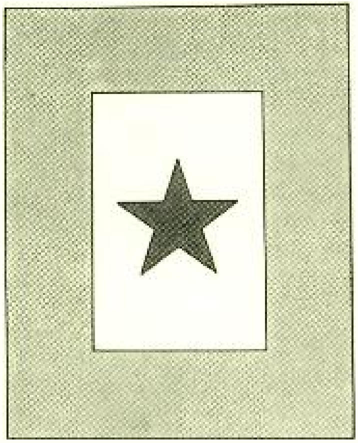
John Mills, A. W. Page and O. E. Buckley *were photographed after a meeting of department heads at which Mr. Page, who is a vice-president of the A T & T, told of the Laboratories' part in building good will for the Bell System*

Purchase of Keystone System Authorized by F.C.C.

Acquisition by the Bell System of the Keystone System in Philadelphia has been authorized by the Federal Communications Commission. The Commission has given its approval to the purchase by the Pennsylvania and New Jersey Bell Companies of the Keystone telephone system. As the next step, the proposal will be submitted to the New Jersey and Pennsylvania State Commissions for their approval.

The Keystone System serves a few counties in southern New Jersey but has most of its subscribers in the business and industrial sections of Philadelphia, where it furnished about 13,800 customers flat-rate local business service; 86 per cent of these customers are also subscribers to the Bell of Pennsylvania. Keystone has virtually no residence subscribers in Philadelphia.

The Commission found that disadvantages, if any, to particular users which might result from the consolidation are outweighed by the benefits to the general public and the advantages of "increased efficiency, convenience and comprehensiveness of service." In petitioning for permission to acquire the Keystone system, the Bell brief pointed to the advantages of more convenient, economical and wider telephone service.



In Uncle Sam's Service

As of March 31 there were 460 members of the Laboratories on military leaves of absence. These men and women are divided among the various services as follows:

Navy, Marines and Coast Guard 127

Army 320 Waves 10 Waacs 3

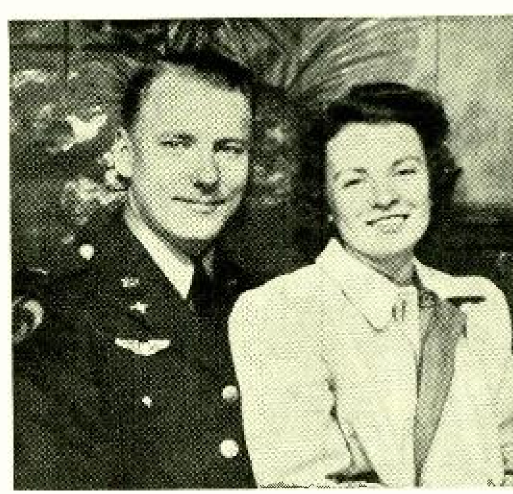
Lieut. Bertram M. Froehly

Bertram Froehly of the Laboratories made front page news in New York evening papers recently. An Army pilot in North Africa, he is our first known hero, our first member wounded in action. There's a storybook angle to his life, too, but first let's recall more about Bert. He was a circuit draftsman in our Systems Development Department until, in 1941, he enlisted for three years as an aviation cadet. In 1942 he was commissioned at Turner Field, Georgia, where a few months earlier he had fallen in love with a pretty Army nurse, Lieutenant Elaine Bost. He was then given sailing orders to England, and later to Africa.

Early in January, 1943, Bert was injured in action. On February 6 Elaine, who had also been shipped to the African front, came "a day's march" from her battle station to the hospital where he was recuperating. For them it was no ordinary day! It was the first anniversary of their meeting. There wasn't too much they could do except possibly to reminisce about the things they said that day a year ago . . . the things they did . . . the birdmen they knew. . . . They recalled the red clay of Georgia . . . blossoms in an orchard. . . .

The hours snatched from war were nearly over. It was eight o'clock at night, when a dispatcher handed Bert the War Department's permission to marry Elaine. Unbelievable, it was, but true! Time was priceless; they decided that the wedding would take place at nine that night, and they sent for their friend, Chaplain McCarthy. Word flashed through the camp, "Froehly's marrying Lieut. Bost in an hour!" Sagely, he invited all the French officers. Incidentally, he borrowed their chef to prepare a roast chicken for the wedding supper which was complete, even to the champagne. For Elaine, the daughter of a doctor and sister of an Army nurse who was in the bombing of Pearl Harbor, there was a candlelight ceremony as lovely as she had dreamed about as a child in Vandalia, Illinois.

Since then Bert has seen more action. In a delayed dispatch from the Tunisian front, dated April 3, the Associated Press related his exploits when, with several other American bombers, he attacked a German fighter base at La Fauconnerie, southeast of Faid. After dumping their bombs on runways and dispersal areas and turning for home, the U. S. planes were intercepted by swarms of



N. Y. World-Telegram

Lieuts. Bertram and Elaine Froehly

Messerschmitts. For nearly the entire way back 15 to 20 of the Nazi fighters "kept pecking away all the time."

The ship Bert piloted was badly mauled by airplane cannon fire. The oil line was knocked out, stopping one motor. Another shell tore away a large portion of the rudder, while a third shot ripped a big hole in the wing. A fourth shot entered a rear bomb bay, narrowly missing a 100-pound bomb, jammed when the release mechanism failed. Machine-gun bullets ripped many holes in the wings and body; the hydraulic mechanism was damaged. Froehly was barely able to manipulate the rudder and spent ten minutes with a hand pump lowering the landing gear. His men said he did a wonderful job in bringing them home.

Joseph Delano of the Murray Hill Restaurant poses in a Jeep

George Eltz

"Avast Greasy Elbow (*J. J. Shindle*) and Ex-Fellow Workers!

"From the serenity of his humble Sanctum Sanctorum, Eltz the great lays aside his Bible and Superman Comics to write to you honorable defense workers. Again I packed my duds and left the land of Mint Juleps and proceeded N-NW to St. Vincent's College in an up-and-coming metropolis known as Latrobe, Pa. The populace and band were there to greet us. (They got wind of us because we stuck our feet out of the window.) We put on a parade through town to the campus which is two miles away. Upon arrival each man was assigned a fine room all

Members of the Laboratories Granted Leaves of Absence to Enter Military Service Since the Last Issue of the Record

United States Army

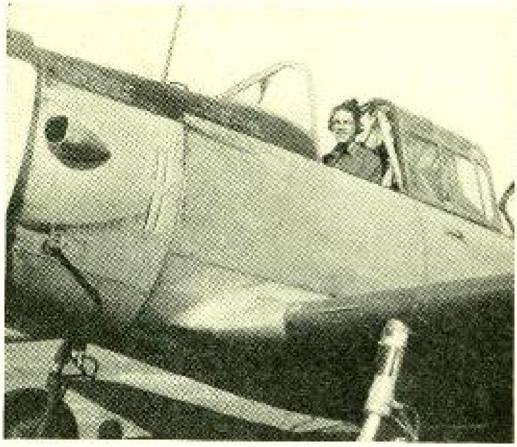
Robert B. Burns
Lawson F. Cooper
William F. Edwards, Jr.
Helen A. Elberson
Lt. Robert J. Fluskey
Grace M. Goodall
Merle I. Hampton
Ward C. Heaton
Peter L. Hollod
LeRoy A. Hopper
Arthur Jackson, Jr.
Charles E. Kempf
Charles E. Klein
Robert Klem
Anne L. Kos
John A. Lasco
Alois H. Lobisser
Robert W. Mann
John M. Marko
Francis R. Meehan
Frank R. Monforte
Charles W. Muccio
Andrew Olsen
John H. Phillips
Martin E. Poulsen
Nicholas Sfougaras
Walter Sokolosky
Norman A. Sorger
Frederick B. Vreeland
Julian M. Wiener

United States Navy

Ensign Maywood K. Asdal
Ensign William B. Callaway
James S. Devanney
Robert E. Filler
Spencer N. Foster
William H. Gray
Joseph Kelly
Edward J. R. Lang
Joseph F. Mallon
Clara E. Muller
John E. Sienko
Daniel Spicciati

United States Marines

William M. Ehler
Ellis Gilliam
Raymond S. Yerden



William B. Schellerup
Electronics Research

to himself. It is swell with a closet, bed, desk, chair, sink and cabinet. The lawns and grounds are adorned with religious statues and shrines, really beautiful.

"Here's a bit of news for any self-centered slackers. Down here we all allotted money for defense bonds and the per cent was 38½ of the pay given out. Along with that, 12 per cent is taken out for insurance and about 15 more for laundry and cleaning, so you see that out of our $50.00 per month we get about $18.00 per month to spend on amusement, special necessities and such."

Michael Collins

"I have had an overseas trip and am stationed in Northern Ireland. I can't say much about this place except that there are some beautiful sights here. I've visited Belfast, the one big city, and it's a bit of all right although you can't compare it with some of the little big cities back home. The most popular, or should I say about the only, drink you can get out here is the old Irish whiskey, of which you'd swear you wouldn't touch another drop the morning after. We spend the first two weeks of any month having a heck of a time.

"The Red Cross is doing a grand job trying to make us boys comfortable. Recently some alterations to their building were made and now we have access to a large hallroom, game room and library. That is where you are sure to find us, playing cards or ping pong, or writing letters home."

Edward M. Kennaugh

"This has been my first chance to take the potato-peeler out of my hand and use a pen. To tell the truth, it looks as though I am still handling a potato-peeler. I have the 'K.P. Shakes.' I spent ten glorious days at Fort Dix—the Sergeant and I and the Cook had long discussions. Then they sent me here to Texas—about as far away as they could—by a cattle train. It seems that I can see clearly with only one eye, and you need only one eye to look down the barrel of a gun. But seriously, this is a fine outfit, and a swell part of the country. Don't believe all that propaganda about the Army waking you up in the morning by a bugle. They have the personal touch, now. They walk by every cot and blow a whistle in your ear. They do everything by whistles. After the war I will qualify as a seeing-eye dog. By the way, how has the draft been doing at the Labs? The way the new men came into Fort Dix every day, they must be using a fine tooth comb in New York. The only physical requirements for a Grade A yard-bird these days are a right hand to salute with and a loud voice to complain with."

Lieutenant Margaret Gray

Lieut. Margaret Gray, now attached to the Radio and Electrical section of the Bureau of Aeronautics, says that she is unable to discuss the work she is doing but her experience in the Laboratories has been of assistance to her in Washington.

John Houlihan

He was a Laboratories man, attending church services at the African front. The soldiers' choir, the hymns and the familiar service brought back memories of his boyhood. Perhaps, too, in that crude chapel he remembered the many slow Sundays he had spent as a doorman at West Street, checking in and out the few engineers who came to do special tests or to tinker with a brain child,

Please send letters of interest and pictures of Laboratories' members in service to the Record, Room 1103, at West Street. We will return them to you within a week.

as well as the little band of power plant men and the watchmen who went about the building to see that nothing was amiss. Strange, how he had spent so much time guarding indirectly the inventions that were now preserving his very life! Perhaps he wondered when he would see his friends in the Plant Department again . . . how the war was affecting the Laboratories. . . .

The service over, JOHN HOULIHAN rose and turned to leave. He fell back a bit. That husky soldier facing him in the pew opposite was JOHN O'SHEA, also of Department 7520. They had been camped near each other, but neither knew the other was in Africa; they're buddies now, fighting at the front for us.

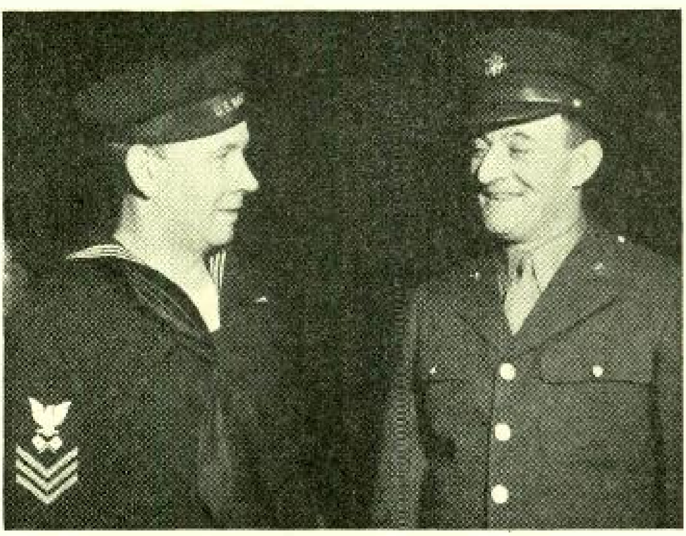
LIEUT. MARGARET GRAY

William Schellerup

"We have to exercise some when we first get up at 5:45 A.M.—just enough to make us feel like going back to bed again when we're through—then one-half a day is spent in ground school and the other half out at the airport, flying. (*He is with the U. S. Navy Air Corps at Denton, Texas.*) Nights are taken up by more classes, studies, or a little extra sleep. It's swell in Texas this time of year, warm and always clear. We've had ½ day rain since I was here; I wish I could stay longer. I am sending two pictures, one of me in the Cubs we train in, and another in an Army B.T. (basic trainer)."

Robert A. Dryden

"They have decided to make us all hard fighting soldiers now. From their training they want us to be commandos, because the fighting that is being done now is mainly of commando tactics. We all have to be able to repair radios, fight like the infantry, ride like the cavalry, fly over the enemy lines and fix the radios of the troops behind their lines. They are making us able to take care of ourselves and also take command of any troops if the occasion should arise."



The cameraman caught Carl E. Stone and Andrew Hannan visiting in the Chemical Department. Mr. Hannan has recently returned to West Street, having been released from the Army because of the age limit

Charles T. Bolger

"I thought that perhaps my friends at the Laboratories would like to know that I am overseas. At this writing I am somewhere in the southwest Pacific theater of war. It's a nice tropical island. There is a breeze blowing, this makes it comfortable nearly all of the time. I am well and feel fine and I hope everyone is the same in the Laboratories."

Marcelle Lesire

"When we were in Madison, Wisconsin, we didn't have much time for anything but study, but now we have more liberty than we need. We work for nine days in a row, and then we are off for three days. We have to work eight hours a day and are allowed to go ashore (outside the base) any time we are not on watch. It is quite a privilege and it is only granted to watch-standers (those in radio work). So far so good down here. I feel right at home, except that I miss New York City, the Labs and everyone there. I hope to see you all when I get a leave."

Marcelle Lesire
Transcription

* * * * *

Graham R. Freer and Clifford J. Lundquist have been given personal leaves of absence and have entered the Merchant Marine.

Edward J. Hughes has graduated from Aviation Mechanics school and is stationed in Kansas at a basic training school field. "Our work is quite interesting. We are applying the theory we learned at school. I expect to be made crew chief soon."

Major W. J. Galbraith successfully completed a course at the Command and General Staff School at Fort Leavenworth, Kansas. He is now in the Department of Training Literature and on the Faculty Board of the Staff and Faculty, Signal Corps School, at Fort Monmouth, N. J.

Herbert J. Braun and Harry Reimels are at Bradley Field, Conn. "Our duty is to supply an air field with ammunition, machine guns and bombs. We will probably be ready to go overseas in about six months. Our training should be quite extensive but how much we get depends upon conditions much beyond our control. Since we cannot write to all the fellows personally, Herbie and I want you to give them our best regards."

Kay Parsons, WAAC, writes from Kansas City, Mo.: "Greetings to my fellow workers! I have finished my basic training and am now attending Midland Radio School. This is a 13-week course; it's rather difficult, but I'll be the best darned operator in the service when they're finished with me! Thanks for the Record."

"I completed the one-month Pre-Radio course and was then retained here as a member of the instructor staff. I am at present teaching mathematics, electricity, and electrical laboratory courses. I will be

Edward Burns
Commercial Relations

William Schneider
Plant Operation

John Galbraith
Club Store

transferred to the Naval Research Labs in Washington, D. C., soon for further training." This note was received from CHARLES E. GREENE, Naval Armory, Michigan City, Indiana.

JOHN E. GALBRAITH of the Club Store is taking the Air Corps' course to become a high-speed radio operator in a Signal Corps detachment.

FROM THE Radio Matériel School of the Naval Research Laboratory BILL CONNER sends this message: "I am still plugging along trying to learn a little of the great field of radio and perhaps be able to serve with the Navy's proudest group, the Radio Men."

C. A. Parker, right, is an Operations Analyst attached to the Fighter Command in Panama in a civilian capacity

IN A LETTER to his old gang, SPENCER N. FOSTER wrote: "We just got back from the drill hall where we had to exercise for an hour and then practice dirty fighting again—Time out for mess—Back again, this being Friday we had filet of sole, which wasn't half bad. We get the best of food here but once they get it in the kitchen, the Lord only knows what they do to it."

WILLIAM J. SCHNEIDER has been attending aviation machinist mate school at the Naval Base, Jacksonville. "If everything continues smoothly I'll graduate towards the end of June. I am anxious to leave this station because I prefer a Marine Base to anything the Navy has to offer."

WILBUR SAUER is in the Parachute Infantry, Fort Benning. "The RECORD sure is a welcome article down here. It's nice to keep up on Company affairs. This is the outfit to be in, never a dull moment. This week we are making parachute jumps from a 250-foot tower. Next week we will complete our training by making five jumps from an airplane. So until I receive my next issue, Diablo!"

"HELLO, BELL LABS! Here I am in sunny Florida in the Medical Corps attached to the Army Air Force. I am just waiting to be sent to a hospital in some air base to start my medical work." This greeting came from DAVID WEBSTER, formerly photostat assistant in the Photocopy Department.

W. C. HICKMAN, formerly of Building R, is stationed at Atlantic City.

ROGER WALTER at Haverford College, says: "I am now stationed about 8 miles out of Philadelphia and am a pre-meteorology cadet. It's quite a change—we (200 of us) go to classes seven hours a day, drill two hours and study two or more. We eat in the College dining hall, have waiters and table cloths and everything, just like humans."

G. WARREN WHEELER sent this message from Fort Knox, Ky. "I have just qualified for rifle 'Marksman' with 151 points out of a possible 200. On the range I operated a Western Electric field telephone set. Words came very clear despite the noise of the guns. Give my regards to all members of the Purchasing Department."

JOHN G. PHILLIPS is at Syracuse University for five months studying to become an Air Cadet. The whole course takes 15½ months instead of the 9 months it used to. From there, he will be going to pre-flight school down south somewhere.

JOSEPH J. ROSATO, a Murray Hill watchman, sends this message: "I'm out in 'sunny' California. It has rained here almost every day I've been here. I'm with the Coast Artillery Anti-Aircraft, a swell outfit. If we're not riding to go to eat we're on guard duty. We travel over 90 miles a day in the back of a truck to eat. Some rough riding! I hope to see you all in the near future."

Transportation for How Long?

I. W. Whiteside

Coördinator of Transportation

All of us know we, as war workers, must get to our jobs to win this war. At two recent national conventions held in New York, leading transportation authorities agreed that our transportation system is a "one hoss shay" which must be handled with the utmost care so that it will hold together until the war is won. Tires and gasoline are now the critical elements of transportation. Even though these are granted in abundance within the next two years, how useful will they be for cars and buses that are in need of major repairs which can't be made because mechanics and spare parts are not available? As any further restrictions on the use of cars mean a decided inconvenience to many of us, the question logically arises as to what our Transportation Plan has accomplished on the job of making available transportation equipment last as long as it possibly can.

Transportation Committees at all work locations have been busy on this problem. At Whippany alone "planned overtime" and the full coöperation of all concerned have effected a yearly saving in the order of four million passenger miles in getting employees to work; and further plans are now in progress which will effect another yearly saving of one to three hundred thousand passenger miles.

At Murray Hill the number of passengers per car has been increased in the order of 40 per cent, thus also effecting a sizable saving in automobile miles. Efforts of the Committee at this location are now being directed toward more uniformly planned overtime which will permit further group commuting efficiency.

At the Holmdel and Deal work locations where the total personnel is relatively small, the necessity for well-planned overtime to promote efficient commuting was recognized before rationing was started. As a result no major changes have been made in commuting plans at these points. Tire and gasoline rationing routines have therefore constituted the major part of the transportation job at these locations.

At New York work locations the commuting problem is entirely different. Practically all of the necessary car driving is done by employees going to the station. A few employees working odd hours on night shifts are about the only drivers traveling all the way to the office by car. Irregular over-

Car Sharing Demands Courtesy and Good Manners

Good Manners for Riders

1. Be on time.
2. Don't be a grouch; let others enjoy the ride.
3. Don't be a chatterbox; let others set the mood, too.
4. Don't rehash your personal life.
5. Use the ash trays; not floor or upholstery.
6. Don't smoke constantly, particularly in the winter when windows can't be opened wide.
7. Don't finish dressing in the car each morning.
8. Don't read your newspaper all over the seat.

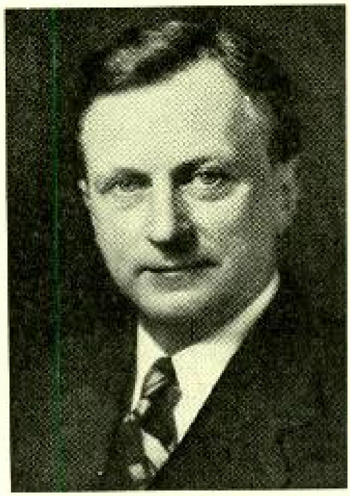
Good Manners for Drivers

1. Be on time.
2. Have your car ready to go; taxis and buses don't refuel on customers' time.
3. Keep your car clean.
4. Do your personal errands on your own time.
5. If you don't come to work, arrange to have your riders use your car or ride with someone else.
6. Be sure your open front windows are not chilling the back seat riders.
7. Don't be dictatorial to your passengers.
8. Don't overcrowd your car.

Courtesy of Lowell Ordnance News

time and the recent reduction in "A" gasoline rations have increased greatly the tire and gasoline requests at these locations. Through supervisory channels attempts are being made to have overtime hours planned where possible to permit commuting connections at stations close to home. This point is being stressed at the present time because many car miles can be saved daily when this plan is used.

As more efficient commuting results are obtained, more of the efforts of the various Transportation Committees will be directed toward the saving of time and miles of driving that is required to obtain rationed automobile equipment.



HAROLD S. OSBORNE *recently appointed Chief Engineer of the American Telephone & Telegraph Company*

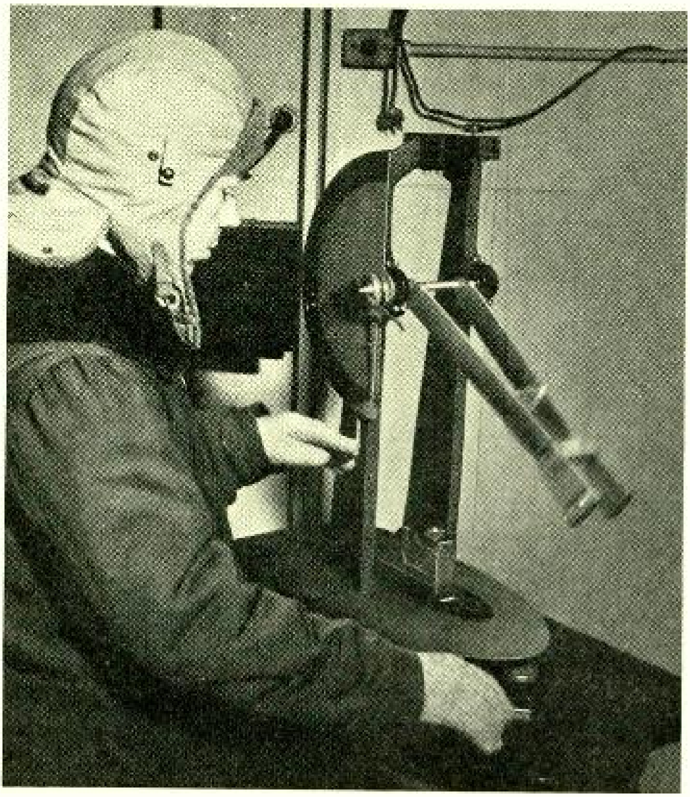
LAURANCE G. WOODFORD *recently appointed General Manager of the Long Lines Department, A T & T*

Since each work location presents a different problem on the question of trouble preventive car maintenance, tire inspections, obtaining of car and driver licenses, etc., these points will require further attention at various periods. As an example of the possibilities along this line, through the efforts of respective committees arrangements were made whereby 1,129 car and drivers' licenses were obtained for Murray Hill and Whippany employees on the job, thus saving considerable time, tires and gasoline. In the meantime, hundreds of requests for tires and gasoline are being handled during each renewal period by your Transportation Committees. Therefore, if your gas application is a bit complicated by varying hours of work, optional transportation routes, and a request for two trips a day to the station you will appreciate that your Committee may not be able to give it the rush service that nearly everyone expects.

In a few words: the transportation advice from your Committee is to save your car by taking public transportation if it is available; travel in groups wherever and whenever possible; have the car serviced regularly; observe the rules of courtesy and good manners for riders and drivers given on the preceding page; and last but not least drive carefully and safely.

MEMBERS OF THE LABORATORIES TO WHOM PATENTS WERE ISSUED DURING THE MONTH OF MARCH

H. H. Abbott
H. W. Bode
R. Bown
J. R. C. Brown, Jr.
W. W. Brown (2)
A. M. Curtis
W. H. Doherty
F. Gray
C. A. Hallam
H. Hansen
J. R. Haynes
C. N. Hickman
R. G. Humphrey
W. A. Knoop (2)
E. Lakatos
F. A. Leibe (2)
F. B. Llewellyn
M. A. Logan
G. R. Lum
A. A. Lundstrom (2)
R. F. Mallina
C. F. Mattke (2)
J. W. McRae
L. E. Milarta
F. R. Norton
H. Nyquist
W. A. Phelps
C. E. Pollard, Jr.
C. D. Richard
M. D. Rigterink
J. G. Roberts
K. F. Rodgers
G. Sandalls, Jr.
L. G. Schimpf
W. G. Shepherd
A. M. Skellett
H. Walther
G. W. Willard
S. B. Williams
L. A. Wooten
S. B. Wright



Materials used in aircraft equipment have to withstand the extremely low temperatures reached at high altitudes. I. L. Hopkins is shown here measuring the brittleness of hard rubber and organic plastics on an Izod testing machine in a cold chamber which is cooled to 35° F. below zero. A sample of the material, 2½ inches long and about ½ inch square, is mounted on the base of the instrument and broken as the pendulum swings past it. The angle through which the pendulum swings after breaking the sample measures the resistance of the material to fracture

Your Victory Garden

By this time in May, the experienced gardener has had his seed in the ground long enough to begin looking for the faint green haze that means some of the plants have come up. If cold weather, overtime, or something else has prevented your getting started, it still is not too late to begin. Prepare the soil as outlined in the April Record. If the area has been covered with sod, a good method is to take up the sod in a strip, dig a trench eight inches deep and lay the sod, roots up, at the bottom. Then remove the next strip of sod, and throw the dirt beneath it into the adjoining trench, breaking up the clods. At the end of the job, the dirt from the first trench goes into the last trench. In any case, a finely pulverized ground surface is a *must* for good growth.

A number of interesting and practical garden layouts may be found in the pamphlets "Victory Garden Manual" and "Victory Gardens" available from the Library at West Street and at Murray Hill. Mark the ends of each row with a substantial stake, on which you write with lead pencil the name of the vegetable and the date sown. A string between the stakes helps you plant the rows in a straight line—a great help in cultivation. Halfway between each row make a shallow trench with the corner of your hoe; in it put fertilizer at the rate of 1 lb. per 30 feet of trench, and rake the dirt over it.

Cultivation means the removal of weeds so that the useful crop can get a good start. After that, cultivation is a waste of effort; the vegetables have sent their roots far below the weed roots, and their tops well above the weeds. Retard the weeds by cutting their roots with a sharp hoe as soon as you see their stems out of the ground. Don't go down more than an inch. An hour's work when the weeds are small will accomplish more than ten hours when they have gotten a good start. Keep your hoe sharp and clean.

Especially if you have made a late start, you can save time by setting out plants bought from a professional gardener. When you lift the plant from its shipping-tray, keep a ball of earth intact around its roots. Make a hole in the soil, pour a cupful of water in it, set in the plant and firm the soil around the plant. A newspaper to keep off the sun's rays for a day or two will help. Water the plants daily for several days.

Unless you have sown with great restraint, plants will come up too thickly for their own good. They must then be thinned as specified in your Victory Garden pamphlet. Beets and the like should not be thinned until their leaves can be used for food. All but one or two shoots from each tomato plant should be removed.

News Notes

Frank B. Jewett recently delivered an address at Rockford College, Rockford, Illinois. In 1939, at its Charter Day exercises, he had been awarded an honorary degree of LL.D. His wife, a graduate of this College, is a member of its board of trustees.

C. J. Christensen visited the Wheaton Glass Company, Milltown, N. J., to discuss glass molding problems.

Beverly L. Clarke addressed the regular meeting of the New York Section of the American Chemical Society at the Hotel Pennsylvania on March 30.

Walter A. Shewhart presented a brief outline of the value of statistics in war production when he spoke to a group of engineers and industrialists at Brown University, Providence. Following the address Dr. Shewhart was the guest of the University at a dinner.

Attending the Annual Dinner of the Fourteenth Greater New York Safety Council Convention at the Hotel Pennsylvania were L. E. Coon, H. E. Crosby, J. S. Edwards, R. W. Gast, L. S. Hulin, E. D. Jones, F. D. Leamer, Dr. C. E. Martin, C. Erwin Nelson, J. W. Tengstrom, G. B. Thomas, G. B. Timm, R. L. Towne, and Claire E. Holmes.

"The Telephone Hour"

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

MAY 10, 1943

A la Bien Aimée — *Schütt*
Orchestra
Musette and Tambourin — *Rameau*
José Iturbi at the Harpsichord
El Pelele from "Goyescas" — *Granados*
Minute Waltz — *Chopin*
José Iturbi at the Piano
At an Old Trysting Place from "Woodland Sketches" — *MacDowell*
Orchestra
Concerto in B Flat Minor—First Movement — *Tschaikowsky*
José Iturbi and Orchestra

MAY 17, 1943

Life — *Curran*
All Through the Night (with Chorus) — *Traditional*
Swing Low, Sweet Chariot — *Spiritual*
Helen Traubel
Polovetzian Dances from "Prince Igor" — *Borodin*
Orchestra and Chorus
Suicidio from "La Gioconda" — *Ponchielli*
Helen Traubel
Scherzo Tarantelle — *Wieniawski*
Orchestra
O Master, Let Me Walk With Thee — *Smith*
Helen Traubel and Chorus

MAY 24, 1943

Water Boy — *Traditional-arr. Robinson*
James Melton
Oh, What a Beautiful Mornin' from "Oklahoma" — *Rodgers*
Orchestra
O Cease Thy Singing Maiden Fair — *Rachmaninoff*
The Flowers That Bloom in the Spring — *Gilbert & Sullivan*
James Melton
The Moldau from "My Country" — *Smetana*
Orchestra
Cielo e Mar from "La Gioconda" — *Ponchielli*
James Melton

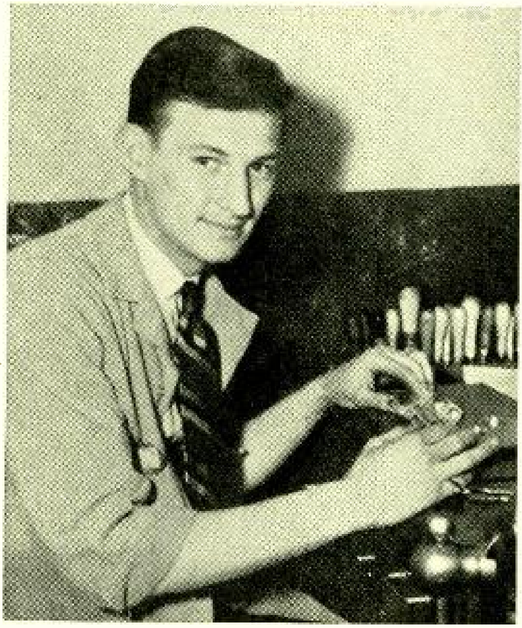
MAY 31, 1943

Prelude from "Carmen" — *Bizet*
Orchestra
I'll Take Romance — *Oakland*
Grace Moore
Toccata — *Bach-arr. Seiniger*
Orchestra
Home, Sweet Home — *Bishop*
Grace Moore
Poet and Peasant Overture — *Von Suppé*
Orchestra
Ballatella from "Pagliacci" — *Leoncavallo*
Grace Moore

Men of the Laboratories

(Chosen by Lot)

INSTRUMENT MAKER at Whippany, FRED H. ENGELMAN has seen the place grow nearly ten-fold since he went there in December of 1940. Only six months had then passed since he finished his three-year course as apprentice, having come to the Laboratories in July of 1937.



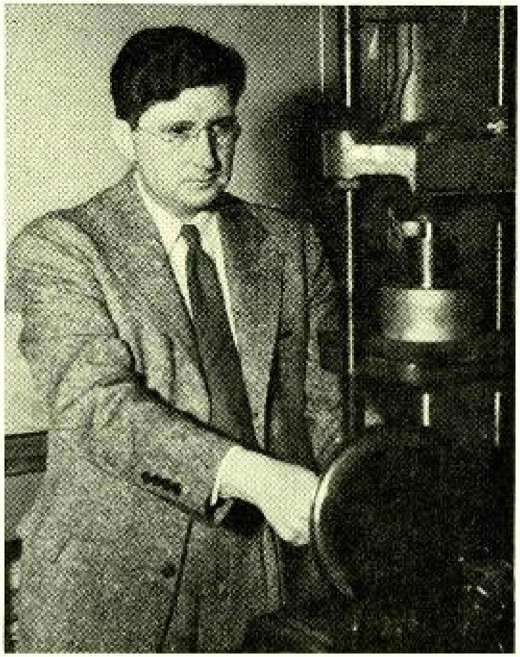
FRED H. ENGELMAN

Fred lives with his parents in West New York. There, he enjoys his hobbies of basketball, athletic leadership among the boys of his community, and young people's work in his church. He is a Sunday School teacher and an officer in the Walther League, state-wide organization of young people. His vacations have been spent at Camp Beaverbrook where he has enjoyed and benefited from the summer sports. Another hobby is carving miniatures from plastics—small animals being his specialty.

At Whippany, he captains the Gremlins, softball team that hopes to blow the fuses for the other four teams in that brief noon-time sport. Already he is well along with his own spring practice—knocking grounders expertly pitched by his pal and fellow-commuter, Elizabeth Meyers.

* * * * *

WHILE ALEX SOUDEN was still getting long summer vacations, he used to work in the quarries and shipyards of his home town, Quincy, Massachusetts. Now he recalls with interest that he was at the Fore River shipyard as a ship fitter's helper when the first aircraft carrier *Lexington* was being fitted out for service. He graduated from the local high school and attended M.I.T., where he received his S.B. degree in Electrochemical Engineering in 1929 and an S.M. in 1930. Alex joined the metallurgical group at the Laboratories that summer and for several years had an active part in non-ferrous alloy developments. He was later concerned with investigations of special conductors and magnetic cores, and for the past few years has been working on metallurgical



ALEX SOUDEN

problems connected with the war effort.

Alex is married and lives in Summit. His sixteen-month-old son now claims much of his spare time, but he maintains an interest in most sports with a preference for baseball, football and hockey. Reading has always been a favorite form of relaxation and here his tastes are varied, ranging from detective mysteries to historical literature.

* * * * *

When Gordon De Sato was halfway through high school, his father's death put him in charge of an automobile service station. He managed this station until graduation in 1928, then sold it and got a job as a draftsman for a manufacturer of lighting fixtures in New York. During the next dozen years he worked for two other concerns in the same line, and took evening courses in radio and electronics; so when war clouds began to gather, he was well prepared for his entrance into the Laboratories in October, 1940, as a draftsman in Research Drafting. Now he is doing just what he enjoys—making drawings of Army and Navy devices.

In peacetime, Mr. and Mrs. De Sato shared many of the usual recreations, such as swimming, skating and golf. Most of those are out for the duration, so when Mr. De Sato has the time he returns to one of his old hobbies—the building of ship models.

* * * * *

In March K. K. Darrow attended a meeting of the New England Section of the American Physical Society at Wellesley where he gave a paper *Entropy and Probability*. He also delivered a course of five lectures on *Nuclear Physics* before the Communications Group of the New York section of the A.I.E.E. during March and April.

L. H. Germer has been elected vice-chairman of the Metropolitan Section of the American Physical Society. On April 9 he gave two lectures at Western Reserve University on *Electron Diffraction and Its Applications to the Examination of Surfaces Including Catalysts*. These were part of a series of lectures on *Frontiers in Chemistry* presented by prominent scientists.

On two trips to Hawthorne during March, C. H. Sample discussed finishing and corrosion problems.

Gordon De Sato

F. F. Lucas presented a motion picture study of *Balata and Hevea Latices with Some Observations on Buna S and Neoprene Latices* at the Western Connecticut section of the American Chemical Society at Stamford, Conn.

R. M. Burns spoke on "Corrosion and War" at the Walker Laboratory, Rensselaer Polytechnic Institute, on March 16. Dr. Burns also gave a lecture before the Technology Club of Syracuse in the Museum of Fine Arts at which he told how American chemists had made great reduction in the world's bill for losses by corrosion. This was three and a half billion dollars annually up to fifteen years ago. At the Rochester section of the American Chemical Society he discussed the corrosion of metals and its relation to the war effort.

J. H. Ingmanson visited Point Breeze to discuss problems on the development of rubber-covered wire. He and V. T. Wallder attended the spring meeting of the A.S.T.M. in Buffalo on March 3.

P. B. Findley has been elected president of the Princeton Engineering Society.

Trial installations of communications lines by a Field Signal Battalion in Florida in February and March were attended by A. L. Fox, J. H. Gray and D. C. Smith.

A NEW A.S.A. STANDARD for *Engineering and Scientific Graphs for Publications* has just been issued. W. A. SHEWHART is Chairman of the Subcommittee in charge of this work. H. F. DODGE was Chairman and C. D. HANSCOM a member of the special subgroup which prepared the Standard. The line drawings in the RECORD for several years have been made in close accordance with the recommendations now incorporated in this new A.S.A. Standard.

S. A. SCHELKUNOFF, in the March issue of the Proceedings of the I.R.E., reviews the book *Fundamentals of Electric Waves* (John Wiley) by Hugh Hildreth Skilling; and S. D. ROBERTSON, the book *Microwave Transmission* (McGraw-Hill) by J. C. Slater.

* * * * *

T. C. ROGERS, 1896-1943

THEODORE C. ROGERS of the Transmission Engineering Department died on March 23. Mr. Rogers, who was graduated by Cornell University in 1916 with the degree of Civil Engineer, entered the Traffic Department of Long Lines. Two years later, in 1918, he joined the Army, was commissioned a Second Lieutenant of Field Artillery, and went to France with the 117th Field Artillery, 31st Division. After demobilization he returned to the A T & T, but into the Department of Development and Research which had just been organized. With that Department he became a member of the Laboratories in 1934.

Following the war Mr. Rogers spent three years at the Phoenixville test station where he made studies of carrier transposition and crosstalk on open-wire lines. Since then, he had been engaged on economic studies of new and proposed toll systems, determined their fields of use and relative economies, and thus helped to draw conclusions as to the desirable course of development.

For many years Mr. Rogers had been a prominent member of the Bell Laboratories Bridge Club and its chairman last year. He was also a member of the Club team in the Metropolitan Commercial Bridge League. He is survived by his wife, Beatrice Roberts Rogers; a daughter, Mrs. Katharine Rogers Randall who is a technical assistant in the Switching Apparatus Development Department; and a son, John Barker Rogers, a student at Cornell.

* * *

GEORGE C. SOUTHWORTH was the speaker at the graduation exercises of the University of Chicago's twenty-week course in advanced radio, electronics and microwaves given by the Army Signal Corps.

S. B. INGRAM has been elected chairman of the new committee on electronics of the A.I.E.E.

WILLIAM FONDILLER was chairman of the presentation ceremonies for an Army-Navy "E" Award to the Silent Hoist Winch and Crane Company in Brooklyn on March 20. Aside from some appropriate preliminary remarks, Mr. Fondiller's duties were the introduction of the speakers on the program. He also spoke briefly at the dinner which followed the presentation ceremonies.

R. W. DEMONTE made trips to Illinois and to Ohio during March. With members of the Western Electric Company he visited the Thordarson Electrical and Manufacturing Company in Chicago and the Jefferson Electrical Company in Bellwood, and the Line Material Company, Zanesville, on power transformers and choke coils.

P. S. DARNELL spent a week at Hawthorne in connection with carbon and wire-wound resistors.

C. A. WEBBER was in Chicago on wire and cable problems; D. R. BROBST and W. R. LUNDRY on new developments.

H. H. STAEBNER went to Baltimore to check on cord developments.

N. Y. PRIESSMAN has been appointed a member of the subcommittee of the Electrochemistry and Electrometallurgy Committee of the A.I.E.E. The duties of this subcommittee will be to survey the field of the dry-type rectifier.

J. R. TOWNSEND has been nominated for the vice-presidency of the A.S.T.M.

Members of Bell System Companies Transferred to the Laboratories to Aid in War Work—Dec. 1, 1942, to April 1, 1943

A. T. & T.

Margaret E. Jaeger.........2600
F. E. Young...............3600

Bell of Pa.

James Campbell, Jr.........3600
J. R. A. Mulligan..........2200

Mulligan

Harden

Indiana Bell

J. G. Harden..............3500

Michigan Bell

J. H. Butcher..............3200

New Jersey Bell

G. W. Bodine..............2100
T. M. Bryda...............3200
J. K. Lantz................2100
Doris E. Law..............3200
A. F. Miller...............7400
Edward Praizner...........3100
A. P. Robertson............2100
J. J. Smith................2100
T. N. Von Wallmenich......3200

New York Tel.

T. C. Bassett.............3600
B. E. Beyer...............7400
W. G. Bowie...............2100
R. H. Brashear............3200
C. E. Brooks..............3400
Marie A. Cote.............7300
J. L. Cyester..............3200
B. J. Edwards.............7400
E. L. Fletcher.............3200
C. S. Gardner..............3200

Von Wallmenich

Norton

N. J. Glock................7400
J. G. Havens..............3200
F. W. Hold, Jr.............7400
J. M. Horne, Jr............3100
R. H. Humer..............3200
G. L. Johnson.............2100
H. M. Lahm...............7400
Nicholas Lazo.............2100
A. G. Marz................3200
J. J. McCormick...........7400
P. P. Nichols..............3200
S. E. Norton..............7400
L. H. Peterson.............3600
A. E. Petzold..............2100
J. P. Rulison..............2100
G. W. Schaible.............2200
C. G. Smith...............7400
W. A. Thomas.............7400
G. B. Timm...............2600
Elias Toy.................3200
M. S. Tubbs...............1700

Miss Jaeger

Miss Jacobs

W. B. Vollmer.............7500
H. G. Wisker..............3200
W. J. Wood...............3200
R. L. Wotton..............7100
G. E. Yeaton..............7400
T. C. Zwang...............3200

Northwestern Bell

C. E. DuBois..............3200
F. S. Hird, Jr.............3400
C. J. Johnston.............2400
S. J. McDermott...........1600
L. E. Peterson.............3600
M. I. Risley...............3400
W. H. Shad...............1700
A. L. Untinen.............3400
F. E. Wherland............1700
C. H. Will................2200

Ohio Bell

H. C. Bonacker............6000
J. H. Jaeger...............3400
G. R. Leach...............1700
A. E. Schwindig............2100
C. L. Sedam...............2400
A. J. Toth................2100
W. L. Walter, Jr............1700

Hird

Walter

Southwestern Bell

L. W. Cloyd...............3400
C. F. Crandell.............1400
M. C. Francis..............3400
R. F. Glore................2200
G. K. Shirling.............1700

Western Electric

L. W. Bellevue.............2100
L. I. Broughton............2100
James Denardo............2100
Ellsworth Hollopeter........1700
Edith E. Jacobs............1700
L. R. Kalmbach............2200
O. L. Kip.................7500
Anne F. Kopacka..........1700
Paul Kraeutter.............2100
N. C. Loper...............2100
F. B. Lozier, Jr............2100
Kathryn M. McMahon.....2600
Edward Migdal............2100
H. L. Miller...............2100

Shirling

Williamson

P. S. Nelson...............1700
A. W. Oliver..............2100
Eleanor M. Paredes........3200
L. R. Paul................2100
C. R. Post................2200
H. E. Rogers..............3200
A. M. Shemet.............2100
L. J. Smith...............1700
Furth Ullman.............3200
K. A. Williams............3200
F. N. Williamson...........2200
D. C. Wills...............1700
E. S. Wolek...............3200

1400	Electronics Research (J. R. Wilson)
1600	Radio Research (R. Bown)
1700	Commercial Products (O. M. Glunt)
2100	Transmission Apparatus (W. Fondiller)
2200	Switching Apparatus (H. A. Frederick)
2400	Station Apparatus (W. H. Martin)
2600	Apparatus Staff (H. S. Sheppard)
3100	Switching Engineering Dept. (H. M. Bascom)
3200	Equipment Development (H. H. Lowry)
3400	Transmission Engineering (R. G. McCurdy)
3500	Transmission Development (D. A. Quarles)
3600	Systems Administration (M. Sultzer)*
6000	Personnel (G. B. Thomas)
7100	General Accounting Department (A. O. Jehle)
7300	General Service Department (R. H. Wilson)
7400	Commercial Relations (B. B. Webb)
7500	Plant (S. H. Willard)

*On Military Leave of Absence.

Women of the Laboratories

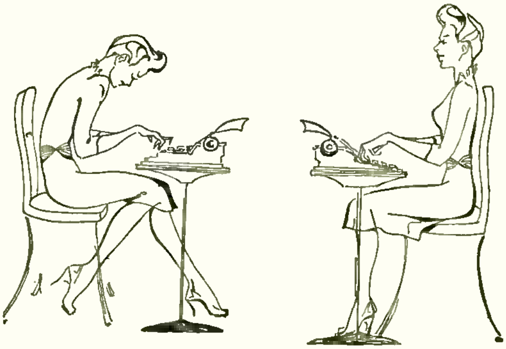
MARIAN HATCH is an electrical engineer with a degree from the University of Toledo in 1939. A girl in this field is a rarity, even in the Laboratories; girls seem to study all

MARIAN M. HATCH

branches of engineering, except electrical. In Transmission Apparatus Development, Marian works on resistors, making many kinds of tests to see how they will stand up in the field. Creating artificially the temperatures under which the resistors are to be used, whether it is 130 degrees for the tropics or minus 50 for the wastes of the North, she studies and helps to decide what changes will be necessary before the device reaches the manufacturing stage. She is shown making precision measurements on resistors assembled in networks.

A native of Toledo, Marian is the daughter and the sister of an engineer. After attending the University of Tennessee she returned to her home town to finish and take her degree. She worked for the Toledo Edison Company as a sales engineer before coming to the Laboratories. Having been here nearly a year she feels like a pioneer when she meets the many new girl recruits in laboratory work. Marian keeps the Library busy between finding and sending her books and, it must be admitted, following her for their return. Her only hobby, besides technical reading, is golfing.

However, she does have an unusual Sunday avocation. From the Sloane House she takes a group of soldiers or sailors on trips around New York, under U.S.O. auspices. As a rule the group and the tour vary according to the boys and the weather. Sometimes she has 40 or 50 soldiers, as she has now from Fort Hancock, who are sent for several successive Sundays. Once these men have toured the city, it is also Marian's job to find tickets and to escort them to such places as Radio City radio broadcasts, a hockey game, or the theater. "It's surprising," she says, "how many people are anxious to help the boys." When she has a different group each Sunday she has a definite tour lined up—usually it's downtown Manhattan, the municipal buildings, lower Broadway, Wall Street and the Battery. The boys go off to fight remembering a girl guide on Manhattan, little realizing that her efforts at the Laboratories help to provide the equipment which will enable them to wage this war successfully.



Drawn by Peggy Ann Lightfoot

A straight spine is essential to good posture. Carry your head high and avoid a double chin

KATHRYN REGAN's girlhood was spent in Bridgeport and in New York. Now as a bride, she spends much of her time commuting between these same points because her husband, Gilbert, a fingerprint expert at Remington Arms, divides his working time between these cities. She worked in the Equipment Development drawings and specifications group before moving into a special defense room. There she keeps records for Army and Navy projects, does typing and acts as "housekeeper" for a group of engineers.

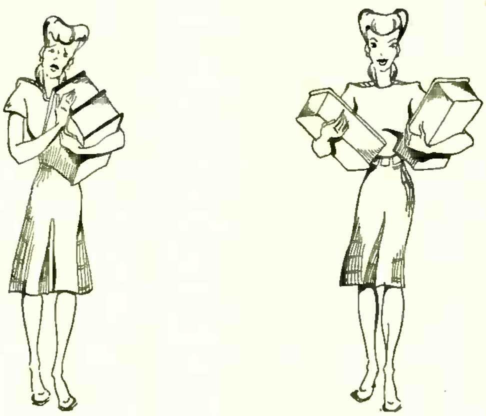
Before long hours of overtime were the rule at West Street, Mrs. Regan did settlement work at the Madonna House where she also belonged to a choral group. In those days she had time to do fancy sewing too. Now she enjoys dancing when her husband is in town. She and Gilbert read a great deal; she prefers current literature and belongs to a Reading Club. Any spare time Mrs. Regan can find she uses to advantage writing to her brother, a Navy man. She is known to her friends as "Kathleen," the Gaelic of "Little Kathryn," a name given to her as a child to distinguish her from her Aunt Katie in Bridgeport who brought her up after her parents died when Mrs. Regan and her brother were very little children.

KATHRYN REGAN

MARY MORRIS

As MARY MORRIS puts together vacuum tubes in Electronics Research, she thinks of her husband, a corporal of Infantry stationed in Hawaii, and she's glad she's a war worker and a ten percenter in War Bonds. Married in 1941, she followed her husband's regiment from Alabama to San Francisco, saw him sail, and then came back to her home on Staten Island. Last fall she took up her present work in Building R—quite a change from her six years of office work but just what she wanted, a job directly in the war effort.

A native of West Virginia, Mary has lived most of her life on Staten Island where she



At home or on the job equalize the load you're carrying

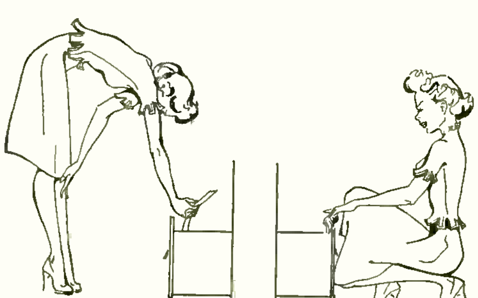
MARIE BUSHE

graduated from Curtis High School. She works on the four-to-twelve shift and likes it because, with her husband away, leisure is much more useful in the daytime than it is in the evening.

* * * * *

MARIE BUSHE, unlike her more dressy sisters the Waacs and Waves, needs no snappy uniform to serve her country. In a flowered smock she is taking the place of a man who has gone off to fight. She is learning to read the micrometer and blueprints, to run a drill press as she is doing in this picture, and to build parts of experimental models as required by the engineers. She has other plans for after the war but now she is proud to do her share to bring home safely her only brother, a Warrant Officer in the Marines, stationed in Newfoundland.

Marie lives in the Bushwick section of Brooklyn where she graduated from Franklin K. Lane High School. She reads a good deal and likes to see a show or a good movie each week. An all-round athlete, her favorite sport is swimming, with rowing, skating, hiking and badminton close follow-ups. Such sports help her to keep healthy and happy after long hours of machine or bench work in the Development Shop.



Keep your spine straight and sit on your heels when using low files. You'll avoid needless strain

NEWS NOTES

FORTY-SEVEN MEN AND WOMEN of the Plant Shops Department held a get-together dinner in the service dining room at Murray Hill, Tuesday evening, March 16. Those present were members of the Plant Shops Department from West Street, Whippany, Deal and Murray Hill who are engaged in analyzing assignments, schedule control and outside shop service. Prior to the meeting, the group visited the Auditorium and other parts of the new buildings. After the dinner, brief talks on the function and work of the Shop Staff as part of the Laboratories war effort were given by S. H. WILLARD, H. C. ATKINSON, D. P. BARRY, A. F. GILSON, GEORGE DOBSON, EDNA AAMODT and HELEN ASHER. Miss Asher, MARY FRANCIS and MATILDA MANDELL acted as hostesses for the group.

D. BARNES has been appointed Rationing Supervisor. At all locations of the Laboratories he will supervise relations with Ration Boards covering automotive supplies and equipment for Laboratories owned or leased cars, trucks and tractors, and for Restaurant food supplies. He will also prepare all inventories and other reports on these commodities as they are affected by Company purchases. Mr. Barnes reports to E. G. CONOVER, Merchandise Manager.

ON MARCH 24 A. R. KEMP lectured on the *Significance of Viscosity Measurements in the Chemistry of Organic High Polymers* to graduate students at Brooklyn Poly.

R. H. COLLEY, in St. Paul, discussed the development of northern pine crossarms. He also visited the Forest Products Laboratory at Madison, in connection with the substitution of wood and wood products for metal.

W. W. Brown visited Hawthorne to discuss the manufacture of new wooden chairs for operators.

J. W. Corwin is in Philadelphia for the installation of the new toll-crossbar office.

E. L. Rudd made a trip to Philadelphia to discuss power problems.

V. T. Callahan visited the U. S. Motors Corporation, Oshkosh, and D. W. Onan & Sons, Minneapolis, in connection with gasoline engine problems. He also went to Denver and Salt Lake City to discuss Diesel engine problems.

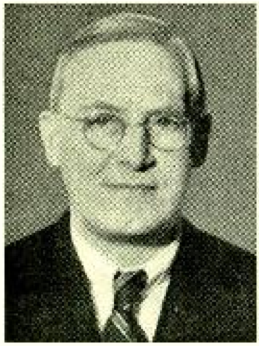
E. F. Helbing was at Wright Field and at the Leland Electric Company, Dayton, on power problems.

C. W. Van Duyne and R. H. Ross were at Wright Field, Dayton, discussing power problems with Signal Corps representatives.

Edward Alenius spoke February 24 in The Franklin Institute, Philadelphia, at a joint meeting with the Miniature Camera Club of Philadelphia on *Color Harmony and Composition*. Mr. Alenius is chairman of the Metropolitan Camera Club Council's Advisory Board.

At the end of the 1943 *Red Cross War Fund Campaign, which was sponsored by Bell Laboratories Club, this Citation was awarded by the American Red Cross. D. D. Haggerty, secretary of the Club and in charge of the campaign, has announced that* 3,069 *members of the Laboratories subscribed a total of* $15,443; *that sum is* 61% *more than we raised in* 1942. *Local chapters other than New York received* $7,552 *of the total.*

Launched on March first by letters from Dr. Buckley and E. C. Wente, president of the Club, the campaign was without personal solicitation in view of the intensive house-to-house campaigns carried on by local Chapters. On two occasions the Club's portable sound system was operated by H. L. Bowman and J. R. Hefele to bring to cafeteria patrons at West Street transcribed messages from Red Cross workers in the South Seas



H. T. Reeve — W. A. Shewhart

Twenty-Five-Year Service Anniversaries

Howard T. Reeve, Member of Technical Staff. Birmingham University (England), B.S. in Metallurgy, 1909. National Physical Laboratory, Metallurgical Department with Rosenhain, Teddington, England, 1909-12; American Optical Company, Southbridge, Mass., 1912-18; Bell Laboratories, 1918. mem. Am. Chem. Soc. m. Violet Millar; ch. Eric Millar, now in U. S. Army; r. Millburn, N. J.

As a Research Metallurgist, Mr. Reeve has made many important contributions in the technique for handling and processing precious and base metals for contact purposes, vacuum-tube filaments, light-valve ribbons and magnetic tapes. Of particular importance has been his work in the drawing of fine wire and in "duplexing" precious metals to base metals for central-office switching apparatus and other equipment by the inlay, overlay and edgelay processes to get the most use out of the precious metal at a minimum cost. He has also been responsible for designing special equipment for doing this work among which are rolling mills, wire-drawing machines, slitting machines and vacuum pouring apparatus for melting contact and filament materials.

Walter A. Shewhart, Research Statistician. U. of Illinois, A.B. 1913, A.M. 1914; U. of California, Whiting Fellow 1915-16, Ph.D. 1917. Bell Laboratories, 1918. Lecturer on applied statistics, Stevens Inst., 1930, U. of London, 1932, and Grad. Sch. U. S. Dept. of Agr., 1938. Chairman of Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing, 1929-. Consultant on ammunition specifications, War Dept., 1935-. Member of Advisory Council, Dept. of Math., Princeton, 1942-. Member of Committee on Applied Math. Statistics, National Research Council, 1942-. Fel. Inst. Math. Statis. (v.p. 1935-36, pres. 1937), A.A.A.S. (mem. of Council, 1941-), Am. Statis. Assn. (v.p. 1934 and member of Board of Directors 1942-). mem. Econometric Soc., Am. Math. Soc., Math. Assn. of Am., Am. Phys. Soc., A.S.T.M., Philosophy of Science Assn., Assn. for Symbolic Logic, Sigma Xi, Kappa Delta Pi, Sigma Phi Epsilon. Author: *Economic Control of Quality of Manufactured Product,* 1931; *Statistical Method from the Viewpoint of Quality Control,* 1939; and of numerous scientific and technical articles. m. Edna Hart; r. Mountain Lakes, N. J.

Even in Dr. Shewhart's earliest experience in the Laboratories matters of statistical interest arose, including the determination of head sizes for aviation helmets and the application of statistics in studies of the carbon microphone. In 1924, when the Inspection Engineering Department was formed, he was assigned to develop the theory of the statistical control of manufactured products. In this work he invented the control chart and developed sampling methods which are now used in much of industry. He is now a recognized international authority on this subject. Since 1938, in the Mathematical Research Department, he has developed the statistical run chart that contributes to the early stages of research and development in much the same way as the control chart aids in production and inspection.

Victor Subrizi, Member of Technical Staff. Cooper Union, B.S. in E.E., 1924. Bell Laboratories, 1918. mem. Telephone Pioneers. m. Sylvia Carraro; ch. Carl; r. Greenwich Village.

In the early twenties Mr. Subrizi spent several years in the Research Department on the development of carrier systems, picture transmission and television. In 1929 he transferred to the Commercial Products Development Department where he worked on the so-called "flutter" circuit for sound reproducers and recorders; in this connection he was co-author with T. E. Shea and W. A. MacNair of a paper on this subject presented before the S.M.P.E. Later he was

Victor Subrizi — A. R. Saunders

associated with the development of magnetic tape recorders and reproducers, notably the Mirrophone. Since 1940 Mr. Subrizi has been on war projects.

Arthur R. Saunders, Member of Technical Staff. Chamberlain and Hookem, Birmingham, England, 1916; Westinghouse, 1917; Bell Laboratories, 1918. mem. Telephone Pioneers. m. Dorothy Koonce; ch. Paul Leeds, Daisy Cook, Marcia Eloise; r. Chatham, New Jersey.

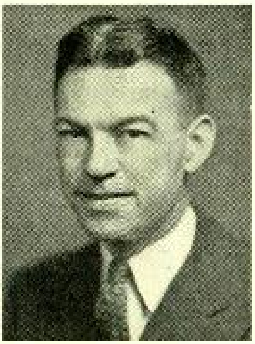
For many years Mr. Saunders was in the machine switching group of the Apparatus Development Department where he was concerned with the mechanical design of central-office equipment and later with the development of maintenance tools for manual and dial systems. In 1941 he transferred to the Chemical Laboratories where he has since been engaged in experimental work in varistors and ceramics.

Charles D. Hartman, Member of Technical Staff. Bell Laboratories, 1918. mem. Phys. Soc., I.R.E., Telephone Pioneers. m. Helen von Lintig; ch. Robert Raymond, Janice Myra; r. Summit, N. J.

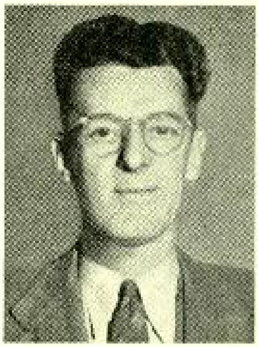
For most of the time until 1938, Mr. Hartman was concerned with the development of vacuum tubes with emphasis on exhaust techniques, filament activation and electrical characteristics. In 1938 he transferred to the Physical Research Department where he has since been engaged in fundamental studies of secondary electron emission and on war projects.

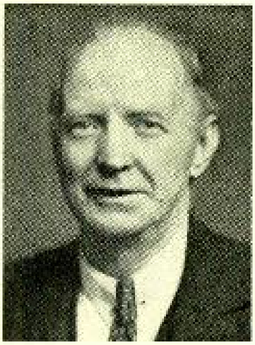
William F. Vieth, Member of Technical Staff. Cooper Union, B.S. in E.E. 1924. Electrical Testing Laboratories, 1917-18; Bell Laboratories, 1918. m. Estelle Schiehser; ch. Carol Ann; r. Munsey Park, L. I.

From 1918 to 1926 Mr. Vieth was in the Research Department engaged in work on Rochelle salt crystals, vacuum-tube repeaters and broadcasting over wire lines. He



C. D. Hartman W. F. Vieth





A. G. Eckerson James McInerney

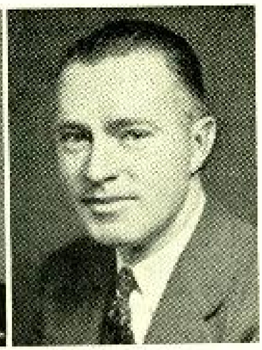
then transferred to the Complaint Bureau of what is now the Quality Assurance Department. Since then he has been primarily concerned with complaint investigations and with quality surveys. This work involves the investigation of instances where unsatisfactory performance is reported and the guidance of steps taken to prevent recurrences of such cases. Quality surveys ascertain the clarity and completeness of the engineering requirements and the adequacy of the manufacturing and inspection procedures to insure satisfactory quality. In this Mr. Vieth has been concerned with vacuum tubes, coin collectors, dials, special products, and teletypewriter apparatus.

Abram G. Eckerson, Service Clerk. Erie R.R., 1913-17; D. L. & W. R. R., 1917-1918; Bell Laboratories, 1918. mem. Telephone Pioneers. Deputy Air Warden, Summit. m. Lily Roeder; ch. Eva Blanche and Raymond Walter; r. Summit, N. J.

Mr. Eckerson is in charge of the Central Instrument Bureau at Murray Hill. He expedites the work of the technical departments there by making available on a short-term loan basis standard types of testing and measuring instruments and maintaining files to assist in locating specialized instruments required for short periods.

James McInerney, Night Watchman. With Patrick Connolly, Jersey City, 1911-18; Bell Laboratories, 1918. m. Rose Donohue; ch. Mary, James, Thomas, Henry (U. S. Army), Rose Ann, Kathleen; r. Astoria, Long Island.

For sixteen years Mr. McInerney was an electrician's helper in the Plant Shop. Then, during the depression, he was transferred to the Plant Operation Department as a night watchman. One of his daughters, Kathleen, works in the blueprint group of the General Service Department.

R. J. RILEY　　　WM. MULDOON, JR.

Robert J. Riley, Laboratory Mechanic. 9th U. S. Infantry, 1907; 7th U. S. Cavalry, 1908-11; Stephan Ransom Company, 1911-18; Bell Laboratories, 1918. m. Mary Dingle; ch. Francis, Robert, Thomas, Alice, Mary, Patricia, Agnes; r. New York City.

Following two years in the Receiving Department, Mr. Riley transferred to the Chemical Laboratories where he has since become an expert roller in the Metallurgical Shop, now located at Murray Hill. He does all the rolling on the Laboratories 6-inch and 10-inch mills.

William Muldoon, Jr., Project Expediter. Neuss, Hefflin Co., 1908-09; Lord & Taylor, 1911-16 and 1917-18; Sterns Bros., 1916-17; Bell Laboratories, 1918. mem. Telephone Pioneers. m. Alice Spanier; ch. Eileen; r. Forest Hills, L. I.

After several years in the Development Shop on production work and in obtaining materials for the work being done, Mr. Muldoon transferred to the Commercial Relations Department where he has since been concerned with expediting model production on commercial projects. This work involves translation of engineering requirements into requisitions for purchases, fabrication and assembly, subsequently maintaining contacts necessary for insuring job progress. More recently most of his work has been on various war projects.

NEWS NOTES

M. M. JONES spent several days in Baltimore making low-temperature measurements, during a cold spell, on the trial installation of the 0.8 megacycle coaxial system.

ROBERT POPE visited Oklahoma City, Dallas, Denver and Milwaukee with E. B. King of the A T & T to discuss cable sheath corrosion. At St. Louis they attended the National Bureau of Standards Soil Corrosion Conference where Mr. Pope presented a paper entitled *Coöperation Among Utilities on Corrosion Problems to Minimize Interference.*

TELEPHONES in service during 1942 exceeded 1,100,000, compared with 1,360,000 in 1941. The number of Bell telephones in service has now passed twenty million. The number of individual line residence telephones in service showed a substantial decline, while the proportion of party line

APRIL SERVICE ANNIVERSARIES OF MEMBERS OF THE LABORATORIES

Research Department

R. E. Coram—30
A. B. Crawford—15
Clara L. Froelich—25
E. J. Howard—20
Herbert Hoyle—25
W. C. Jordan—20
Bernard Leuvelink—25
L. M. Ludlam—20
Anna K. Marshall—25
A. R. Saunders—25

Apparatus Development Department

D. T. Sharpe—15
J. C. Vogel—20
F. S. Wolpert—15

Systems Development Department

A. E. Bachelet—20
Grace M. Fismer—15
S. J. Fulton—25
W. J. Gordon—20
Philip Husta—25
Pierre Mertz—20
Helen C. Mockler—25
S. C. Smithers—15

Patent

O. E. Rasmussen—30

Personnel

H. P. Smith—15

Publication

Ethel B. Rispin—20

Financial

H. J. Stewart—20

General Accounting Department

Laura Arata—25
Louise B. Muller—25

General Service Department

Albert Ebinger—20
T. H. Metzger—20
L. R. Shropshire—20
Mildred H. Suits—15

Commercial Relations Department

H. S. Enger—25
E. J. Sause—25

Plant Department

R. C. Ennis—20
Josephine A. Kirby—20
Henry Kords—20
A. B. Wylie—15

residence stations increased, reflecting measures taken to conserve facilities. The average daily number of telephone conversations handled by the System in 1942 was estimated at 87,400,000, a record high and about 2,700,000 a day more than in 1941. This figure includes both local and toll conversations. Toll conversations in 1942 were 3,406,000 a day, or about 9 per cent above 1941. Calls over the longer distances, however, showed a much greater relative increase.

FIRE DRILL OF THE VOLUNTEER SQUAD AT MURRAY HILL

A—C. F. Larkin is making a bowline knot for R. Ortega and W. A. Yager. J. H. Heiss is tying a square knot. These hitches are used in lifting hose and in rescue work

B—Demonstrating clove and half hitches to hoist a fire extinguisher. W. A. Yager is showing J. H. Heiss how it is done. The onlookers from left to right are C. F. Larkin, J. Griffin, R. Ortega and J. McDonald

C—Attaching a rubber-lined hose to a standpipe for the gas mask drill. R. Ortega is connecting the hose while J. Griffin stands by to turn on the water

D—Gas mask drill with hose. The miner's safety lamp is to detect the presence of toxic gases or a deficiency of oxygen. W. A. Yager and J. McDonald are directing a stream of water. J. H. Heiss holds the safety lamp

Signal Corps Seeks to Purchase Radio Equipment

Radio amateurs have been requested to sell their short-wave equipment to the Signal Corps. The equipment needed consists of transmitters, ranging from 25 watts to 450 watts, receivers and such radio components as capacitors, resistors, and installation material. Especially desired are audio-frequency and radio-frequency signal generators and oscilloscopes, precision a-c and d-c voltmeters, ammeter and miliammeters, and other measuring equipment.

Owners of such equipment who wish to sell for Army use are invited to send a brief description to Captain James C. Short at the Philadelphia Signal Corps Procurement District, 5000 Wissahickon Avenue, Philadelphia.

Eleven members of the Laboratories attended the conference *Security of War Plants* of the Metropoiltan Military District, Second Service Command, at the Hotel Commodore on March 11. Delegates from the Laboratories were:

G. H. Bogart	C. W. Green
L. E. Coon	M. B. Long
H. E. Crosby	E. V. Mace
J. W. Farrell	L. Montamat
G. F. Fowler	L. S. O'Roark

S. H. Willard

J. S. Edwards and L. E. Coon acted as hosts at luncheon to Donald W. McLeod, Director, and Grant McCubbin, Assistant Director, of the North Atlantic Area of the American Red Cross, who visited the Laboratories to attend a showing of the sound picture *First Steps in First Aid* released by the Bureau of Mines on March 31. After a discussion of the picture with Dr. C. E. Martin and a representative group of Laboratories' First Aid Instructors, the Red Cross officials talked informally about contemplated revisions of the First Aid Textbook and of the Instructor's Outline.

C. R. Burrows has been appointed chairman of the I.R.E. Technical Committee on Radio Wave Propagation. J. L. Barnes is also serving on this committee.

R. C. Jones of Kearny was in Hawthorne on the design of cable stubs for loading coils.

We See by the Papers, that

Victory gardens of poles are being planted at the Bell Telephone Laboratories. These miniature telephone poles, however, are not expected to grow, but are being used for experimental purposes to select substitute materials for war-scarce preservatives.—*Post, Birmingham, Ala., March* 29, 1943.

Production for Army use of a new type portable cable that will carry seven telephone and telegraph messages simultaneously—and yet offer the enemy nothing but squeaks and squeals if he succeeds in tapping the line—was announced today by Western Electric Kearny Works. The cable was developed by Bell Telephone Laboratories and Western Electric.—*News, Newark, N. J., April* 2, 1943.

The residence at 15 Sherman Drive, Morristown, N. J., has been sold to J. Sheldon Parsons of Morristown, associated with the Bell Telephone Laboratories. —*N. Y. Times, March* 14, 1943.

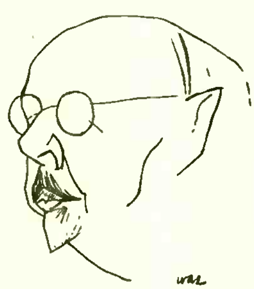
I favour, then, the freest basic research in the closest contact with practice, but I often meet with the view that free research aimed at the discovery of new laws and principles is incompatible with practice; that it is impracticable in war-time; that research and practice cannot run in double harness, and that their aims are totally different. That their aims may be different I do not for a moment deny, but that they are incompatible is demonstrably untrue.—*J. W. Munro, Nature, February* 6, 1943.

In an article entitled "A Spread-Scale Recorder" (Bell Lab. Record, 21, No. 3; November, 1942), O. D. Engstrom points out that the transmission tolerances of telephone circuits have become more severe, requiring a corresponding improvement in measuring technique and equipment. . . . More accurate and faster operating testing equipment has been required, and a recording transmission-measuring set was developed that covers the voice-frequency spectrum in a few minutes.—*Nature, February* 27, 1943.

Captain Howard B. Larlee, of the Army Air Forces, lost his life in an airplane crash, March 4, while engaged in maneuvers near Needles, California, it was announced by the War Department. He is survived by his widow, Mrs. Vivian Larlee, and his parents, MR. AND MRS. H. A. LARLEE, of Mountain Lakes, New Jersey. Captain Larlee's father is a member of the Bell Telephone Laboratories.—*The Telephone News, March*, 1943.

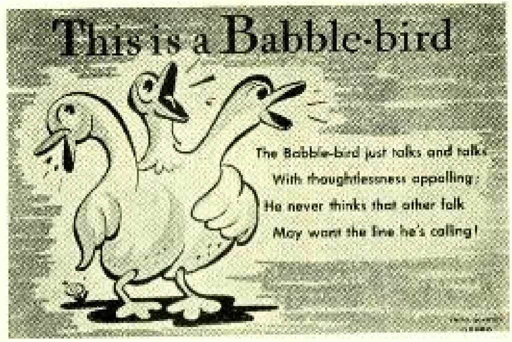
The American Telephone and Telegraph Co. was given permission by the FCC, March 16, to engage in overseas radio telephone tests with Kabul, Afghanistan. If these tests are successful the circuit would be the longest haul channel operated from this country. The A T & T will utilize its Lawrenceville, N. J., stations for the tests with Kabul. The Afghan Ministry of Posts and Telegraphs will operate their end of the service.—*Telegraph & Telephone Age, April.*

Granting that a long-distance telephone will be forthcoming, it will require an absolutely perfect condition of the elements along the route over which the wire runs; there must be no rain, no fog, no sleet, nor mist; no moisture in the atmosphere, no electrical storms. . . . After all these difficulties have been overcome there still remain many reasons why it will not be a success . . . No, sir . . . the coming long-distance telephone will be a plaything, nothing more. Put a mark on the assertion.—*Cincinnati correspondence in the Syracuse, N. Y., Sunday Times, February* 22, 1885.



This impression of H. E. Ives appeared in the March issue of "Salmagundi," organ of that club of writers and artists

The thousands of company house organs going to soldiers overseas led the Post Office Dept. last January, at War Dept. inspiration, to ban shipment of any of these magazines weighing over two ounces. Hundreds of protests, both from men in the service and from house organ editors, have recently led to new interpretations of the original order so that now an eight-ounce publication sent first-class mail is acceptable. In the meantime, however, in order to keep circulation abroad uninterrupted, a number of companies created special overseas editions for their magazines. Among the special editions are the . . . . Bell Laboratories Record—*Business Week, April* 3, 1943.



This booth card used by the New England Telephone and Telegraph Company conveys a timely tip to all telephone users

[*The overseas edition, which is printed on so-called "bible" paper, weighs, with its envelope, just under two ounces. It goes to all members of the Laboratories in service overseas and all others on the mailing list outside the North American continent.*]

Since mercury finds many applications in industry, particularly in the telephone industry, its effect on other metals used in contact with it is of importance. The solubility of metals in mercury is generally slight. Bell Telephone Laboratories have a new method using a circulating still.—*Metal and Alloys, March*, 1943.

Secretary Morgenthau can take considerable satisfaction in the progress of voluntary bond purchases. More than 25 million people buy through payroll deductions. The amount of war savings bonds outstanding climbed \$1,635 million in February and March when income taxes were being paid. Redemptions rose but were amazingly low—.39 of 1 per cent of the total outstanding in January, .73 of 1 per cent in March.—*Wall Street Journal, April* 21, 1943.

Design for Using—*an editorial by* John Mills

The first automobile I ever owned was a second-hand car which needed constant repair. After a time I came to wish it had been designed like the wonderful one-hoss shay to fall in pieces all at once, and once and for all. Its most irritating feature was the inaccessibility of its short-lived parts. When something went bad one had to remove most of the still good parts to get at the defect. I gave up before it did and sent it to the scrap pile.

It emphasized the difference between *designing for sale* – hereinafter referred to as S – and *designing for use* – hereinafter referred to as U. The difference is not simply a matter of honesty: S will differ from U no matter how honest and well intentioned the designer.

S considers the competitive market. Improvements in a product must not increase price more than the market will stand. For certain products design should not be for too long life since styles or technical advances may soon make it obsolete. In other cases where quantity production is involved too durable a product, by restricting sales of succeeding models, might even delay future economies. The designer cannot be expected to know the dollar value which the user assigns to reliability of operation since that varies with individuals. Also there are commercial limits beyond which hidden weaknesses of design may not be corrected with corresponding increase of price: the user must bear part of the risk.

U requires full appreciation of the needs and habits of the user. His necessities must dominate production from the first pencil mark of designer to the last inspection check of installer. For use, reliability is the prime requirement. First cost must not be cheapened at the expense of reliability and of economy in maintenance. Parts most subject to replacement should be conveniently accessible. Accelerated life tests and field trials of preliminary designs must eliminate bugs before manufacture.

The reliability of Bell System service largely results from the U characteristic of its equipment and from the determination of its operating forces. Their determination that "the message must go through" speeds ordinary repairs; and drives to supreme efforts in times of flood or hurricane.

In the functional organization which the Bell System has evolved, user and designer, manufacturer and inspector have coordinate responsibilities and a common purpose. Intensely modern in its research methods, manufacturing processes and operating procedures, the System still preserves homespun virtues of pioneer days when people designed and made what they used – and had to live with it.

Primarily responsible for studying the operating needs of the user – that is, the telephone companies – is the Department of Operation and Engineering in the American Company. For meeting the equipment part of these needs, and for anticipating others, new instrumentalities are produced by the Laboratories. After field-test and specification they go to the Western Electric Company, whose engineers develop and carry out the manufacturing processes. And then the Laboratories comes in again through the contacts of its Quality Assurance group to tie together user, maker and designer in a continuing check on the quality and conveniences of the equipment.

"Bell System equipment" as President Walter S. Gifford said in his annual report for 1942, "has always been designed – and manufactured – with emphasis upon its use and reliability. This System policy works to the country's advantage in our war contributions just as it has in the past to that of the telephone user."

The Laboratories did not have to change its methods or its attitudes in order to work for our military forces. It was accustomed to thinking first of the needs of the user and of the importance to him of reliability and ease of maintenance. This has enhanced the military value of its products since, to the best of its ability, they are designed to stand up under adverse conditions and to deliver the blows for which they are intended. And the Laboratories has received specific commendations "for the measures taken to insure trouble-free operation." Bell Laboratories designs for use!